Master Thesis

Project OnDeskTacho

A comparison between activity-centered design and human-centered design.

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ABSTRACT

Purpose: The goal of this study is to find the requirements for the new web-portal of the Inspection of Living environment and Transportation (ILT). The web-portal will enable the ILT to collect data regarding the driving and resting times of the freight carriers. The ILT would like to analyze these data and examine which companies or which market sector need more surveillance. This will allow them to plan and perform their inspections more efficiently. As a result, they will be able to decrease driver's fatigue, unfair competition and increase road safety.

Method: Two different design methods were used in order to retrieve the requirements for the ILT's future web-portal. The first list of requirements was formulated during the human-centered design process (HCD), in which the freight carriers were asked to give their opinions and ideas regarding a concept of the ILT's web-portal. The second list of requirements was based on the downloading process of the tachograph, which derived from the activity-centered design process (ACD). Finally, the two lists of requirements were compared in order to study what the differences were between the results of ACD and HCD.

Findings: The requirements that derived from the ACD and HCD procedure were related to the variables of the Unified Theory of Technology Acceptance and Use (UTAUT). It appeared that the variables of UTAUT played a role in the adoption of the ILT's web-portal. Furthermore, a comparison was made between the ILT's web-portal and the web-portal of the Dutch tax authorities. Since this comparison and the variables of UTAUT were used in both the ACD method and HCD method, the lists of requirements were similar. The main difference was the reasoning behind the requirements, as HCD focused more on user-experience and ACD focused more on the usability and the development process.

Conclusion: In the end, ACD seemed sufficient in order to design the web-portal. The list of requirement included the wishes of the ILT, the wishes of the future users and the limitations within the development process of the web-portal. However, it should be taken into account that these results might be different when the technology and its development process are more complex.

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1. INTRODUCTION

Since the rise of the internet, people are more and more online. Within the Netherlands, 97 percent of people above the age of twelve are connected to the internet. They are using the internet for all kinds of activities, such as checking email, finding information, shopping online and gaming (CBS, 2019). Due to the rise of the internet and the changes in the behavior of humans regarding technologies, human-computer interaction (HCI) is getting more important (Grudin, 2013). In addition, the methods to design HCI applications are used and developed increasingly. What started as a paper and pencil drawing grew into design methods that include multiple fields, such as communication, psychology and requirement engineering. After the 1980's, the opinions of the future user became more important and the designers started to incorporate the users' ideas and additions into their designs. As a result, the context and the experience of users regarding the product became more valuable within product design (Aguiar, de Lacerda, & Van der Linden, 2011; Birkhofer, 2011).

Nowadays, there are many different user-centered design methods and each method includes the users in their own way. This had an impact on the decision making process of designers, since it became more difficult to choose a method that fits the product's development process. The differences between the user-centered methods are difficult to specify, since the methods are quite alike. Especially, since most design methods seemed to be based on the same theoretical approach and are built upon each other (Abras, Maloney-Krichmar, Preece, 2004).

A user-centered method can be distinguished from other methods by their characteristics, which are 1) the focus on the user and their tasks, 2) empirical measures and 3) an iterative design (Gould and Lewis, 1985). Moreover, the different user-centered design methods can be identified based on the level of involvement of the users during the design process. In some design methods the users are co-creators and on the same level as the designer. Whereas in other design methods, only the opinions or the context of the user is incorporated in the process (Preece, Rogers & Sharp, 2015). This study investigates and compares human-centered design with activity-centered design.

Human-centered design (HCD) is a design method with a high level of user involvement. During this process, the users are asked what requirements they would like to see in a product. HCD is a method that contains several steps and has roots in requirement testing. Therefore, it is a design method that is known and used within the development of HCI and various technologies (Baker, Harte, Glynn, ÓLaighin, Quinlan, Rodríguez-Molinero, & Scharf, 2007; Dell'Era, & Landoni, 2014; Lowdermilk, 2013; Maguire, 2001)

In contrast to HCD, activity-centered design (ACD) includes their users on a lower level. Instead of asking the users what they want to include in a product, this method focuses on the users' context. During an ACD process, the environment and the activities of the users are examined in order to make a product that is in line with their activities (Norman, 2005; 2006).

Multiple researchers argued that ACD would be more efficient than HCD (Constantine, 2004; Gay & Hembrooke, 2004; Kaptelinin 2014; Norman, 2005; 2006). They state that people are able to use technologies more easily than they did 30 years ago. Therefore, the context of the users will result in a sufficient amount of information in order to enable the designer to create a usable and user-friendly product (Gay & Hembrooke, 2004; Norman, 2005; 2006). Even though several researchers seem to be convinced about the benefits of ACD, the method is barely tested in practice. In addition, the differences in results between HCD and ACD are not entirely clear (Constantine, 2004; Gay & Hembrooke, 2004; Kaptelinin 2014; Norman, 2005; 2006).

As an addition to the existing literature and in order to fill this gap of information, this study is concentrated on the differences between the results of HCD and ACD. The methods are tested during a case study in the form of a requirement analysis. This requirement analysis is focused on the establishment of a web-portal for the Inspection of Living environment and Transport (ILT).

1.1 The ILT and project OnDeskTacho

The ILT supervises the transport sector, infrastructure, environment and living environment (Inspection of Living environment and Transport, n.d.). They make sure that all organizations live up to the regulations within the Netherlands. This is done through licensing, enforcements and specific studies (Inspection of Living environment and Transport, n.d.). Project OnDeskTacho focuses on whether the freight carriers live up to the regulations regarding the driving and resting times.

At this moment, the ILT either select trucks on the street or visit the freight carrier at the companies address in order to do an inspection. However, with more than 130.000 trucks to check every year and the limited amount of inspectors, it is almost impossible to supervise the entire market. This is why the ILT wants to start with digital inspections based on the data of the tachograph and drivers' cards.

A tachograph is a small device, which is placed within trucks that weigh more than 3500 kilograms, see figure 1. By placing a company card in the digital tachograph, the device registers the truck to the company. By placing a driver's card in the digital tachograph, the devise registers that this driver belongs to the truck. When these two cards are put into the tachograph, the device is able to register who is driving the truck and when he or she is driving or standing still. Depending on the type of tachograph, the data can be downloaded from the device with a 'download key' or through satellite. A 'download key' is a device that looks like an usb-stick. With this key, a driver can retrieve the data from the tachograph and upload the data to a computer. The 'raw' files retrieved from the tachograph are useless, since they are encrypted. However, multiple software suppliers offer software programs that can retrieve the

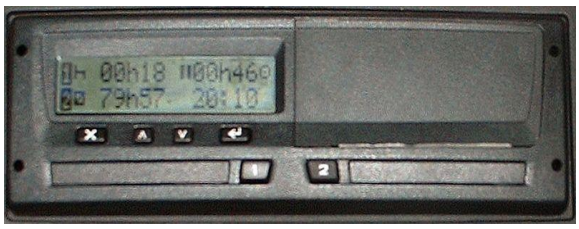

Figure 1. Digital Tachograph (Wikipedia, 2008)

information regarding the driving and resting times.

The ILT wants to collect the data from the tachographs via the web-portal. This way, the data can be collected more secure and at one location. The next step would be to analyze this data and retrieve information regarding the driving and resting times.

In the best-case scenario, the freight carriers will send in their data on a yearly basis and the analysis would proceed automatically. This way, the ILT and the freight carriers would receive feedback right away. However, freight carriers often send the wrong data or no data at all. They are either too busy to send the data or do not know how to send it. Because of this issue, the ILT needs the web-portal to guide and motivate the freight carriers in order to get the required data. Therefore, the ILT would like to know which requirements are needed in order to make the web-portal usable and user-friendly for all the freight carriers.

1.2 The comparison between HCD and ACD

In order to find the requirements for the web-portal, a qualitative study was executed in the form of a requirement analysis. This analysis consisted out of two parts, namely a HCD and an ACD procedure. In total, 31 interviews were conducted with various freight carriers. During the HCD procedure, the respondents were asked their opinions and ideas regarding a concept of the ILT's web-portal. Based on these results, a list of requirements was formulated. For the ACD procedure, the respondents explained and showed how they downloaded and stored their data. These actions were visualized in a process scheme, see appendix 6. This process scheme was used to formulate the second list of requirements. Finally, the two list of requirements were compared in order to examine the differences between the results of ACD and HCD.

The requirements derived from this study serve as input for the web-portal of the ILT. If the freight carriers are able and willing to deliver their data, the ILT could increase their information position. As a result, the inspections can be planned and performed more efficiently. This could lead to less unfair competition, less cases of drivers' fatigue and safer roads.

1.3 Preview

This paper discusses different theories and models regarding the adoption and the design of technologies. Based on these theories and models, the research question is formulated. Next, the method is described, including an elaboration of the research design, the procedure, the participants and how the data was analyzed. Further, the results of HCD and ACD are elaborated and discussed in order to answer the research question. Also, the limitations and implications of the study are elaborated. In the end a conclusion is drawn.

2. LITERATURE REVIEW

The ILT would like to take in account the future users within the design of the web-portal. Therefore, this chapter sheds a light upon the variables that are necessary in order for a user to adopt a technology. Furthermore, this chapter elaborates upon the different user-centered

design methods in order to find a method that fits the ILT's project.

2.1 Adoption of technology

Whether people decide to adopt a new product depends on multiple factors. There are different theories that explain why people will or will not adopt a certain product. Since this study focuses on the adoption of a web-portal, the Unified Theory of Acceptance and Use of Technology (UTAUT) is used. This theory is specifically focused on the use of technologies and includes the variables of other adoption theories. The theory of planned behavior and the technology acceptance model are examples of previous theories that played a significant role in the development of UTAUT. These theories are elaborated in the next paragraphs in order to paint a clear picture of UTAUT.

2.1.1 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) explains how certain behavior is established. According to this theory, behavior is influenced by certain behavioral intentions. These behavioral intentions are attitude, subjective norm and perceived behavioral control (Dainton & Zelley, 2015).

Attitude refers to whether a person approves of a certain behavior, which is determined by two factors. The first factor is called 'the observation of an object', which clarifies whether a person finds the object important. The second factor is 'belief strength', which indicates whether a person thinks the behavioral intention has a positive or negative influence on his/her life (Dainton, & Zelley, 2015). According to Chervany, Karahanna and Straub (1999), attitude played an important role in the adoption and continuance of use of a technology. However, they found that 'subjective norm' was a more significant factor regarding the adoption of a technology. Subjective norm refers to whether people feel social pressure to behave in a required way (Ajzen, 1991; Dainton & Zelley, 2015). The last variable is 'perceived behavioral control', which refers to the feeling of control in a certain situation or whether it is easy to behave in a certain way. Several studies show that when people feel in control of the situation, they are more risk taking or more likely to act in a required way (Ajzen, 1991; Greenslade, McKimmie, Smith, Terry & White, 2009).

The TPB is often included within other adoption theory, because it is a general theory concerning humans' adoption behavior. The technology acceptance model is an example of a model that elaborates upon the TPB. This model is explained in the following paragraph.

2.1.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) is based on the TPB and stated that the key points of the adoption of technology are perceived ease of use and perceived usefulness. Perceived ease of use indicates the amount of effort a user has to spend on the technology. Perceived usefulness indicates to which degree the user feels that the technology is enhancing his/her life or work performance (Davis, 1989). The findings of Chervany, Karahanna and Straub (1999) were in line with this theory and they found that perceived usefulness is a key factor in the continuance of use of a technology. Furthermore, they stated that the factor 'ease of use' is

important for both the adoption and the continuance of use of a technology. Hertzum and Hornbaek (2017) agree with this statement and mentioned that there is a connection between the variables of TAM and the user experience regarding a design.

Several researches tried to enhance TAM by including more variables that could influence the adoption and use of a technology, for example the Unified Theory of Acceptance and Use of Technology (UTAUT). This theory is discussed in the next paragraph.

2.1.3 Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) combined multiple theories, such as the TPB and TAM. According to UTAUT, there are four key factors regarding the acceptance and use of technology, namely performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy and effort expectancy are similar to the variables of TAM and relate to the perceived usefulness and the perceived ease of use of a technology. Social influence is similar to the variable 'subjective norm' of the TPB. It indicates whether the users of a technology can push other people into using the technology. Lastly, facilitating conditions are the conditions that make a technology easier to use, for example a helpdesk (Larsen, 2003; Thong, Venkatesh & Xu, 2012; 2016)

Furthermore, this theory includes four moderators that could influence these key factors. The moderators are age, gender, experience and voluntariness (Chervany, Karahanna & Straub, 1999; Larsen, 2003; Thong, Venkatesh & Xu, 2016).

UTAUT used to focus on the adoption of technologies on a professional or corporate level. Later, the model was extended in order to replicate consumers' needs as well. The model is called UTAUT II and it included the factors hedonic motivation or enjoyment, price value and habit. Hedonic motivation represents the extent the user wants or likes to use the technology. Price value is described as the price of the technology or the profit a user can earn by using the technology. Last, habit is the feeling that a technology is part of a routine within a person's life (Chang, 2012; Larsen, 2003; Thong, Venkatesh & Xu, 2012; 2016). The variables of UTAUT could increase or decrease the user experience and adoption rate regarding a technology. Therefore, these variables should be taken into account when designing a technology.

2.2 User-centered design

User-centered design methods became more important during the industrial revolution around 1980. Before the 1980's, design methods were focused on the objective functions of the tools that were made. After the 1980's, the role of the user became more significant within the development process of a product. As a result, other disciplines were added to the design methods, such as requirement engineering, psychology and communication (Aguiar, de Lacerda & Van der Linden, 2011; Birkhofer, 2011). The rise of the internet also played a role in the changes of the design methods. People started using computers for work and within their private life to create, manage and use information

more often. Since computers became available to both professionals and consumers, the devices needed to become usable and user-friendly for both types of users. As a result, the users of the technology started to play a significant role in the design of human-computer-interaction devices (Grudin, 2013).

The term 'user-centered design' is used within different contexts. In this paper, 'user-centered design' is used as an umbrella term for all the different kinds of design methods that are user-centered. The definition is related to the definition of Baker, et al. (2017), who stated that user-centered design is a design approach in which multiple stakeholders are taken into account when designing an interactive system. Note that the stakeholders do not have to be future users. However, some papers use the term to indicate a method. Usually, to indicate the human-centered design method. But in this paper the definitions of Baker, et all. (2017) are used and HCD is seen as a design method that is user-centered.

Gould and Lewis (1985) stated that there are three main characteristics of user-centered design, which are: 1) the focus on the user and their tasks, 2) empirical measures and 3) an iterative design. These characteristics consist out of multiple tasks and goals, which are required in order to proceed with the user-centered design method. First, the focus on the user and their tasks is meant to understand the users and their attitude regarding the tasks they perform, for example the working area or context of work of a user is evaluated. Next, the reactions and performance are evaluated when using the product or a prototype, for example the user receives a prototype of a product and is asked to use it and give their opinion. Based on this process, it becomes clear whether the attitude regarding the product is positive or negative. Based on this evaluation, problems are located and the product is redesigned until it is ready to use (Abras, Maloney-Krichmar, Preece, 2004).

Since there are many different user-centered design methods, it is difficult to choose a method that fits the development process of a product. In the following paragraphs, different user-centered design approaches are discussed and compared in order to choose a design approach that would fit the development process of a web-portal.

2.2.1 Design methods with high user involvement

When the future users and the designers are equal partners during the development process of a product, they are classified as co-creators. As a result, the users would feel a sense of ownership. In this case, the user involvement is perceived as high. High user involvement methods could lead to a useful source of information, particularly when the users are free and willing to participate. However, the information of the users could be constrained by a lack of knowledge, which might work counter-productive (Preece, Rogers, & Sharp, 2015). Examples of high user involvement designs are participatory design and human-centered design. These methods are discussed in the following paragraphs.

Participatory Design

Participatory design was founded in Scandinavia during the early 1970's when the need for communication was high. Due to the complex

political systems and the labor union who wanted to be more democratic, people from different backgrounds were brought together during a development process. Nowadays, participatory design includes multiple fields, such as software engineering, graphic design, psychology, communication studies and political science (Druin, & Muller, 2002; Preece, Rogers, & Sharp, 2015). Later, the method became popular within application development, as it took in account both the interest of the designer and future users. Within this design method, the future users are co-creators of the product and take part in every step of the development process (Dell'Era & Landoni, 2014).

The goal of this method is to create products that are in line with the users' needs in order to increase the adoption rate and continuance of use of those products (Floyd, Mehl, Reisen, Schmidt & Wolf, 1989). However, some researchers are worried that the user aspect would not be represented enough due to the designers' inability to select useful respondents and their lack of appreciation regarding the users' opinions (Cavaye, 1995; Howcroft & Wilson, 2003). Furthermore, the users may not have any influence at all due to lack of knowledge regarding the product or lack of a hierarchical or political power to speak (Howcroft & Wilson, 2003; Kirsch & Beath, 1996; Markus & Bjorn-Andersen, 1987). Gasson (1999) and Nelson (1993) add that there will always be a wedge between the so-called 'irrational' user and 'rational' designers.

Human-centered design (HCD)

Another high user involvement design method is human-centered design (HCD). This method is similar to participatory design, since it also includes future users in the development process in order to create a usable and user-friendly product. However, in HCD the users are not part of the entire development process. The actual development of the product remains the task of the designer, but the users' ideas, wishes and demands are taken into account. Usually, by executing interviews with individuals or during focus group sessions (Dell'Era & Landoni, 2014; Lowdermilk, 2013; Maguire, 2001). Similar to the characteristics and tasks of the general user-centered design, the HCD procedure contains four steps, namely: 1) identifying the future users and their context of use, 2) making a list of requirements based on the users' ideas, wishes and demands, 3) create a prototype based on these requirements and 4) evaluate the design.

In contrast to participatory design, HCD has its roots in requirements analysis. The goal of this method is to create a usable product, while also paying attention to user-satisfaction and safety performance (Baker, Harte, Glynn, et al., 2007). According to Boy (2013), HCD is the perfect method to integrate humans, organizations and technology. Stephane (2009) agreed to this statement and adds that HCD is able to cover both the emotional and cognitive aspects of the design of a product.

Even though HCD includes the users in a different way, researchers argued about the uncertainties of HCD. Gasson (1999; 2003) stated that, similar to participatory design, technical issues could occur due to the different

nature of the HCD process in comparison to the development process. She explained that the nature of the development process is much more technical than the nature of HCD. Gay and Hembrooke (2004) add that due to a shift in the use of technology, the focus should be on the users' context of use instead of on their ideas, wishes and demands. Other researchers argued that, within technologies, the context of the users is much more important than the actual opinions of the users. They stated that the future users would be able to adapt to the technology if it was based upon their activities (Constantine, 2004; Gay & Hembrooke, 2004; Norman 2005; 2006). Therefore, they pledge for a low user involvement design that is based on the users' context.

2.2.2 Design methods with low user involvement

Low user involvement methods prefer to look at the context in which a product is used, rather than to include the ideas, wishes and demands a user might have. These methods usually consist out of the following steps: 1) understanding the context of the user, 2) create a process scheme of their tasks, 3) designing and redesigning a product which fits to the context of use and the users' environments, 4) testing the product with the customers and 5) launching the product (Preece, Rogers & Sharp, 2015). Two examples of methods that are based on the context of the user are interaction design and activity-centered design. These methods are discussed in the following paragraphs.

Interaction design

Interaction design is a method in which the context of use is examined. The context of use is described by the ways people use and work with a certain product and the environment in which the product is used. The method includes other design methods, such as the ethnography and coherence method (Preece, Rogers & Sharp, 2015). An ethnographic study is used to understand an individual or a group of individuals within their own environment, for example within a business. Usually, the participants are observed in order to identify and understand their daily activities. Even though the ethnographic study is a useful method to collect information, it usually takes up a lot of time and requires a certain amount of expertise. In addition, the findings are difficult to translate into requirements. Nevertheless, this study serves as input for multiple other low involvement design methods, for example the coherence method (Preece, Rogers & Sharp, 2015; Sommerville & Viller, 1998).

The coherence method tries to resolve the translation issue that was mentioned in the ethnographic study, by combining the ethnographic study with requirements engineering. By identifying the ethnographies, this method creates a set of viewpoints and concerns for a product (Preece, Rogers & Sharp, 2015; Sommerville & Viller, 1998). Even though this method makes it possible to include ethnographic aspects within the development process of a product, the user-centeredness of this method is not sufficient to create a usable and user-friendly design (Preece, Rogers & Sharp, 2015).

In order to integrate the context of use within a development process, there should be a more user-centered focus. The interaction design captures this user-centered focus, because it combines the previous methods with a requirement analysis (Gasson, 2003; Winograd, 1996). Cooper (1999) added that this design is goal-oriented and should be able to include the users' contexts of use. However, this method can only be used if the goals are defined beforehand, which is often not the case (Checkland, 1981; Checkland and Holwell, 1998; Preece, Rogers & Sharp, 2002). Furthermore, Gasson (2003) stated that the design method is often focused on a task or problem of a single user, by which it isolates itself from its surroundings. As a result, the interactivity of the design is reduced.

Activity-centered design

Similar to human-centered design, the focus should be on multiple future users in order to create a product that takes in account the context of use (Gasson, 2003). Activity-centered design (ACD) could be the solution, since it integrates the approaches of HCD with the focus on the context of use (Norman 2005; 2006).

ACD elaborates upon HCD and is originated from the activity theory. According to the activity theory, an 'activity' can be described as an interaction between a subject and an object. For example, a subject could be a human or animal and an object could be certain skills or the access to food (Engestrom, 1987; Kaptelinin, 2014). An activity is different from other types of interactions, since the subject which performs the activity has certain needs. Furthermore, the activity will both transform the subject and the object. As a result, the subject has to reveal the objective meaning of an object in order to fulfill its needs. For example, the willingness to study a language depends on the difficulty of the language, as well as the person's ability to learn a language. Yet, the difficulty of a language also influences the ability to learn the language (Kaptelinin, 2014). Furthermore, Engestrom (1987) argued that this process could be influenced by a set of other variables, such as the tools that are available, the community of the subject, the rules and rituals within that community and the amount of effort that is required. Taking these variables into account, as well as the ability of the activity to transform the subject and object, the outcome of an activity could either be planned or unplanned (Engestrom, 1987; Kaptelinin, 2014). This process is visualized on the following page in figure 2.

In order to conduct an ACD process, specific knowledge regarding the activities of the stakeholders is essential. By taking the activities of the stakeholders into account, the design is focused on user performance instead of the opinions of the user (Constantine, 2004; Norman, 2005; 2006). According to Gay and Hembrooke (2004), the flexibility of ACD will contribute to a better adaption of the actual experiences of the users. As a result, an effective and feasible set of requirements will derive from performing an ACD procedure.

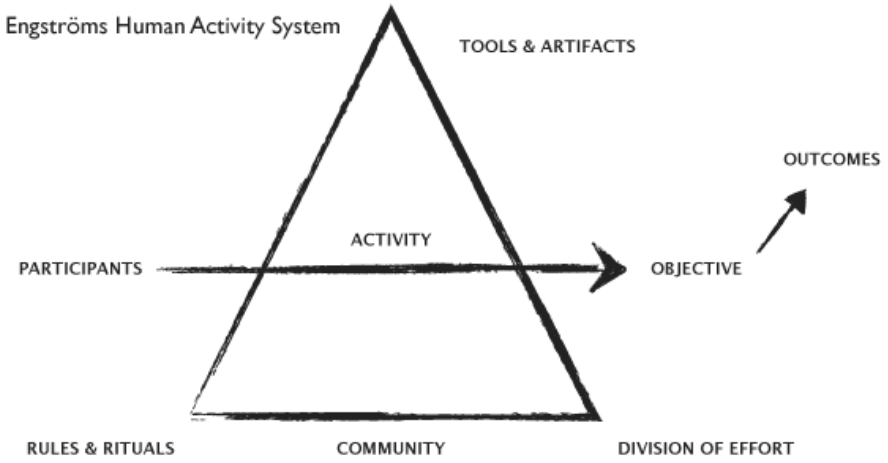

Figure 2. Activity theory (Engestrom, 1987)

2.3 HCD vs ACD

During this case study, a requirement analysis is performed in order to create a web-portal for the ILT. The HCD method is chosen for this research, since it has roots in requirement analysis. In addition, it does not include the users within the entire process. This is more suitable for this particular project, because the web-portal includes the input of the ILT as well. In addition, this might overcome the wedge between the users and designers, as both the opinions of the users and the technical procedures are taken into account.

However, multiple researchers prefer a low user involvement design method. According to the literature, ACD seems to tackle most design related issues. It takes the users into account, but still focuses on the context of use. Gay and Hembrooke (2004) pledge for ACD over HCD. They stated that technology is becoming a part of humans' life and that the actions of a user are presenting a designer with enough information in order to design a usable and user-friendly product. According to Constantine (2004), ACD should provide a more feasible and executable list of requirements than HCD. Constantine (2004) argued that by putting the focus on the users' needs, the list of requirement would be too extensive and unrealistic to execute. Whereas ACD is much more goal-oriented. However, Gasson (2003) does not entirely agree with this statement. She mentioned that, due to the goal-driven nature of ACD, ACD cannot promote human interests as well as HCD.

Besides Gasson's attempt to compare the two different design methods, there is little known about the differences between the results of ACD and HCD. During this research, both design methods are used to retrieve the requirements for the web-portal of the ILT. In the end, the results were compared in order to see what the differences were between the two design methods. Therefore, the following question is asked:

To what extent do the results of an activity-centered design process differ from the results of a human-centered design process when conducting a requirement analysis for a web-portal?

3. METHODOLOGY

In this chapter, the method of this study is clarified. Starting with the research design, which includes the model that is used during the study. Next, the used materials and the procedure are explained. Further, the participants and their characteristics are elaborated upon. Last, the method of analysis is elaborated.

3.1 Research Design

As was mentioned in the previous chapters, a case study is performed in the form of a requirement analysis, in which the differences between HCD and ACD are examined. HCD is tested through interviews with freight carriers, which is added in appendix 1A. The interview resulted in a list of requirements for the ILT's web-portal, which is added in appendix 5A. ACD was tested by observing the process of downloading the data of the tachograph. The checklist for the observations is added in appendix 1B. Based on the observations, a process scheme was made in order to visualize the downloading process. This scheme is added in appendix 6. Based on this process scheme, the second list of requirements was formulated and added in appendix 5B. These two lists of requirements were compared in order to examine the differences between de results of ACD and HCD. The research design is visualized in figure 3.

In order to get as much data as possible, the respondents participated in both HCD and ACD. In order to increase the liability of the research, it was tested whether HCD and ACD influenced each other. Therefore, the respondents were separated into two groups. The first group started with the HCD procedure followed by the ADC procedure and the second group started with the ACD procedure followed by the HCD procedure. The group of respondents were randomly separated into two equal groups, see appendix 1C. This way, it was also tested whether the sequence of questions or methods would have any influence on the results.

Before the interviews started, the research was approved by the ethical commission of the faculty Behavioral, Management and Social Sciences of the University of Twente.

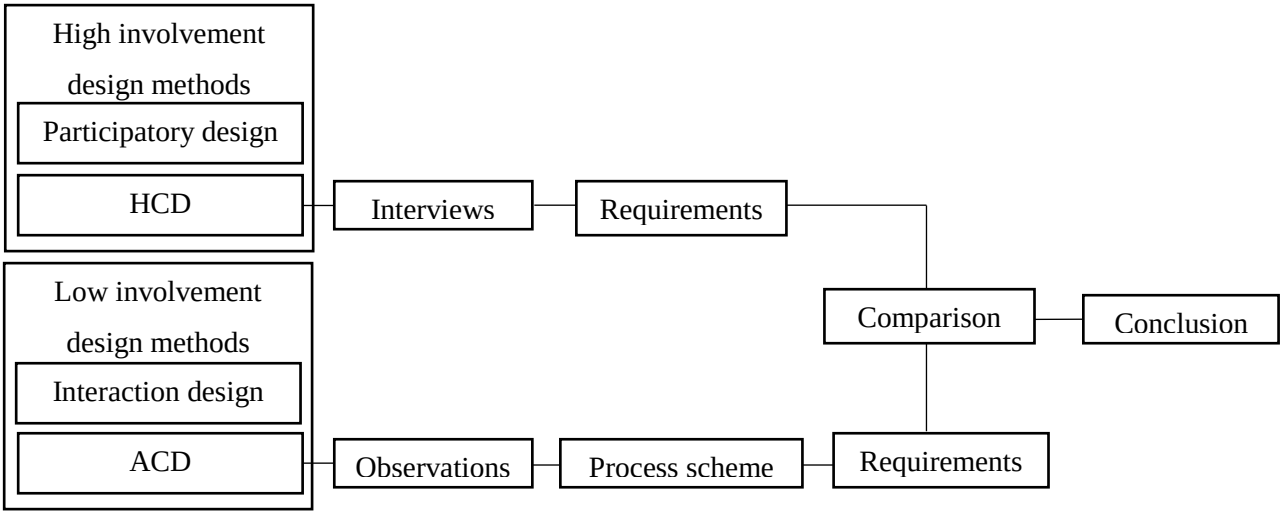

Figure 3. Research Design

3.2 Materials

During the interviews, the researcher brought the list with the interview questions and the list of action points for the observation on paper. All the interviews started with questions regarding their business, for example 'can you tell us something about the company?' and 'how many trucks does the company own?' These questions were meant to get basic information from the company, such as the demographics. The interview questions regarding the HCD, see appendix 1A, were separated in several subjects. First the opinions regarding the web-portal and the login method were asked, such as 'would the web-portal motivate you to deliver the files?' and 'what do you think about e-recognition?' These questions already made clear whether the respondents had a positive or negative attitude towards the web-portal. Next, several questions regarding the design of the web-portal were asked, for example 'how should the design look like?', 'which support would you need?' and 'what kind of feedback would you like to receive?' These questions in particular contributed to the first list of requirements.

During the ACD procedure, the download process of the tachograph was observed. These observations were based on a list of action points, which are added in appendix 1B. The first action points were related to the actual downloading process, for example who downloaded the data and whether all steps were proceeded. Next, it was examined how the data was stored, for example whether the original data files were saved and analyzed. Lastly, the use of the data was examined, for example if they were compliant to the law or used the data for other activities such as planning and administration. The process of downloading varied per freight carrier, but all the actions needed to be taken into account within ACD. Therefore, the observations were translated into a list of actions that is visualized in a process scheme. See appendix 6. Based on this process scheme, the second list of requirements was formulated.

3.3 Procedure

In order to ensure that the interview questions were clear, they were piloted at three different companies.

The sessions started with an introduction of the ILT, followed by an introduction of the study. The researcher explained the procedure of the study, which either started with questions about the use of the tachograph or their opinion regarding the web-portal. Next, the researcher handed them an informed consent form to sign, see appendix 3. After the participant agreed to join, the voice recorder started and the interviews began.

The interview consisted of several questions regarding their company and the future web-portal. As an introduction, the respondent told something about the company and their activities. This was followed by either the observation (ACD) or the interview questions (HCD). If the interview started with the HCD procedure, the participants received an example of the ILT's web-portal, see appendix 2. The respondents could use the example in order to give feedback on how to improve this web-portal. For example, which method of registration they found useful, which user

support to include and how the design of the web-portal should look like. The interviews took about 30 minutes. The interview was followed by the ACD procedure.

If the interview started with the ACD procedure, an observation was conducted first. This observation took about 30 minutes, but varied per respondent due to the differences between the downloading devices. The respondents showed how their data was collected and stored. This observation was based on a list of action points, which is added in appendix 1B. The interview was followed with the HCD procedure, as described above. In total, the interview took one hour per respondent. At the end of the interview, the respondents received a small present for their participation.

The transcripts of the interviews were written out in Word and coded with the software 'Atlas.ti'. Before the transcripts were coded, they were sent to the respondent in order for them to check and make additions if necessary. Their additions were taken in account before the data was analyzed.

3.4 Participants

The participants of the study were freight carriers. They were selected based on two factors, namely 1) they owned at least one truck with a digital tachograph and 2) their companies were located within the Netherlands. The participants were either called or emailed whether they would like to join the interview. This resulted in 31 freight carriers who participated in the study. The respondents were visited by the researcher and one of the inspectors at their company address.

They varied a lot in size and type of transport. In table 1 the demographic information is showed. In total, there were fourteen small companies that had less than ten trucks and twelve companies in the middle segment that owned up to 50 trucks. The other five companies owned more than 50 trucks. Moreover, from the 31 companies, 22 performed transportation for other companies and eight companies performed transportation of their own goods. One of them did both. Further, the type of products they transported varied, for

Table 1. Demographics

	Amount of trucks			
	< 10	**11 till 50**	**51 till 100**	**> 101**
	Number of freight carriers			
	14	12	2	3
	Transport area			
Delivery in NL	7	6	0	0
Delivery international	1	2	0	0
NL and International	6	4	2	3
	Responsible			
Planner/administrator	4	4	0	1
Logistics	3	3	1	0
Owner	4	2	0	0
Chauffeur	2	3	1	1
Extern	1	0	0	1
	Method of download			
By hand	10	7	0	0
Automatically	4	6	2	3
	Downloading time			
Real time (0min)	3	4	1	1
1-5 min	4	3	0	0
6-15 min	3	4	1	2
>15 min	4	1	0	0
	Data storage			
Intern	10	8	1	0
Extern	4	4	1	3
	Use of data			
Checking driving times	2	0	2	3
Checking working hours	2	3	1	2
Salary administration	1	0	1	1

example food, bulk, window frames or exceptional transport.

25 of the 31 respondents downloaded the data within 30 days. However, the download process differed per freight carrier. There are different devices and software that could be used for downloading the tachograph. The download keys differed from each other, both in looks and downloading time. The older versions took more than fifteen minutes to download the data of one truck. Whereas automatic systems could retrieve the data within ten minutes or real time through a satellite.

Especially the smaller companies downloaded the data by hand and stored it on an internal server, whereas the bigger companies invested in an automatic downloading system and stored the data on an external server, for example at the software supplier. As a result, the freight carriers that invested in an automatic system usually did not have any problems with downloading their data. In addition, the bigger and more experienced companies seemed to be able to receive and analyze data on a professional level. They often used the data for planning and administration purposes. The freight carriers that used a downloading key were more likely to forget to download the data. They also did not analyze the data, due to lack of time or the lack of equipment. Therefore, most of the flaws and insecurities regarding the process of downloading the data of the tachograph was detected at companies with less than five trucks. This group is most likely to send the wrong data period or the wrong file.

Furthermore, the responsible person for downloading the data of the tachograph varied per company. However, within the smaller companies the owner of the company was often responsible for this task. Whereas bigger, more experienced companies tend to have a special logistics or administration department who collected and analyzed their data.

3.5 Analysis

The results of the HCD procedure were based on the interviews with the freight carriers. Their voice recordings were written out. However, unclear, personal or irrelevant information was left out and highlighted by putting: (…). In order to code the transcripts, a codebook was used. See appendix 4. The codebook was tested on inter-rater reliability. The researcher and the second reader both coded four interviews, which resulted in a kappa of .61. The low score was a result of a repeating disagreement on one of the codes. Therefore, the codebook was adjusted and the same piece of text was coded again. The second try resulted in a kappa of .89. In order to make sure that the codebook was clear enough, four other interviews were coded as well. This coded piece of the interviews reached a kappa of .92. Since these scores are sufficient, the codebook was approved.

The codebook is separated in codes regarding the download process of the tachograph and the web-portal. The codes are separated in four categories, namely: design, support, feedback and expectations regarding the ILT. ‘Design’ refers to the esthetics, texts and used language within the web-portal. ‘Support’ refers to the understandability of the web-portal. ‘Feedback’ refers to the feedback the participant would receive from the ILT. And ‘the expectations of

the ILT' are the expectations the participants had regarding the ILT. Based on these codes, the transcripts were coded with the software Atlas.ti. The requirements of the ACD procedure were based on the observations regarding the process of downloading the data from the tachograph. As was mentioned in the previous paragraph, the data of the observations were translated into actions and visualized in a process scheme. This process scheme explained the steps that were taken by the freight carriers in order to collect the data from the tachograph. The scheme is added in appendix 6.

Usually, the researcher or designer should use this scheme in order to create a list of requirements that is in line with the activities of the future users. However, in this case the researcher also knew the requirements of the HCD procedure, which could lead to a conformation bias when formulating the requirements of the ACD procedure. In order to reduce conformation bias, six other people were included during the development process of the second list of requirements. These people received the process scheme in order to keep the actions of the respondents in account while discussing the requirements.

The six people were asked based on their affinity with the project. Four of the people were spoken to individually and two preferred to work together. The first person was an ICT specialist at a company that transported their own goods. He was asked because of his technical knowledge and his insights regarding common ICT related issues at the transport company. The other people were employees of the ILT. One of them was a behavioral scientist, who was asked with regard to nudging and communication. The second employee worked on the functional designs of other relatable portals and would be included in this project. The third employee was an inspector, who just started to work within the project. She already had some knowledge about the project, but was not involved for a long period of time in order to exclude conformation bias. Furthermore, she was working on a similar project and knew a lot about the future users and their most common offenses. The last two people preferred to answer the questions together. They were both team leaders and were chosen because of their knowledge regarding the organization and the departments who might be included within this project.

Based on the input of these six people, the second list of requirements was formulated. The two lists of requirements were compared in order to examine the differences between the results of the two design methods. In the end, the ILT received an advisory report including the lists of requirements.

4. RESULTS

As was mentioned in the method section, the respondents were separated into two groups in order to examine whether the ACD and HCD procedure influenced each other. After comparing the results of the respondents, there were no differences detected based on the sequence in which the questions were asked. The respondents always included their method of downloading within their answers, even when the interview started with the interview questions from the HCD procedure. It is concluded that the methods have not influenced each other.

Although it would be easier to start with the ACD procedure, since the respondents included their actions within the answers anyway.
During the study, two list of requirements were formulated, one for ACD and one for HCD. As mentioned before, the requirements of HCD were based on the interviews with the respondents and the requirements of ACD were based on the activities of the respondents and the additions of the six selected people. These lists are added in appendix 5A and 5B. The technology would probably be adopted when these requirements are present in the web-portal. The requirements related to the variables of the adoption theory 'Unified Theory of the Use and Acceptance of Technology (UTAUT)'. Since there is a connection between the results and UTAUT, this theory is used to structure and explain the results.

4.1 Expected effort

This variable refers to the amount of time and effort a user has to spend on the web-portal and whether the web-portal is easy to use.

HCD | Ease of use

All the respondents mentioned the code 'ease of use'. In total, the code was mentioned 82 times with regard to the design and 67 times with regard to support. The respondents made clear that using this web-portal should take as less effort as possible.

'I want to spend as less effort as possible in this web-portal.' - Respondent with 10 till 50 trucks.

In addition, the respondents expected a web-portal that is easy to use and has a simple design. Especially, since they do not benefit from using the web-portal.

'You want me to use this portal. I do not benefit from it. If you want me to use it, you have to make it as easy as possible and quick to fill out.' - Respondent with 50 till 100 trucks.

Furthermore, the respondents stated that the amount of steps should be limited. They also preferred the questions to be multiple choice.
Moreover, they mentioned multiple types of support, such as a manual or a video. The type of support depended on the personal liking of the respondent. However, almost all the respondents agreed on adding pop-ups to the web-portal. These pop-ups were meant to present the information directly, without having to search through a manual. These pop-ups could contain information, such as explanations of abbreviations or terms. According to the respondents, these pop-ups could increase the flow of the process.

'The web-portal should be, let us say, intuitive. You should not have to think about what step to take, but it should guide you in the right direction.' - Respondent with less than ten trucks.

In addition to this quote, the respondents stated that the issues regarding uploading the wrong data file could simply be solved by only admitting one type of file.

HCD | Time indication

To give an indication of the effort that the users have to put into this web-portal, four respondents argued about adding a progress bar to the web-portal. This would give them a better indication of the number of steps they have to fulfill.

'A progress bar would be useful. Then you would know how many steps to take.' - Respondent with 10 till 50 trucks.

HCD | Accessibility

Another important factor was accessibility. All the respondents mentioned this factor and it was coded 35 times. The idea was to log in with e-recognition, which is similar to the login method called 'digid'. E-recognition is becoming the standard login method for businesses who want to contact the government, because of its high level of security. E-recognition makes it possible to transfer personal data in a secure way and it is in line with the rules and regulations of the GDPR (E-recognition, n.d.). The overall attitude regarding e-recognition was positive, because it would be easier to use one login method for multiple web-portals. However, e-recognition was not accessible to all of the respondents due to the costs. It was mentioned that:

'*Registering to use e-recognition would be one step to much for me.'* - Respondent with less than ten trucks.

'*E-recognition is usable for the bigger companies, but we only have one car. It would just be another source of unnecessary costs.'* - Respondent with less than ten trucks.

Especially smaller companies would prefer another way to login, since they do not want or cannot make the costs for e-recognition. In contrary to bigger, more experienced companies, who often purchased e-recognition already and used it for multiple purposes. They mentioned that:

'*E-recognition is used more and more often. I think it is even obligated for some governmental task. You might as well register for e-recognition, since you are going to need it in the future*.' - Respondent with 50 till 100 trucks.

Furthermore, twelve freight carriers stored their tachograph data at a third party. This third party saved the data and, in some cases, presented the freight carriers with information regarding their driving times. Because a third party stored all the data for them, they would prefer to create a link with these parties.

'*If I would get this request, I would send it right to my supplier. They store all our data and know exactly what to send in.'* - Respondent with 10 till 50 trucks.

'I do not even use the data! It would be much easier if our supplier could provide you with the information. It would safe us and you a lot of time.' - Respondent with 50 till 100 trucks.

In addition, three freight carriers preferred to store all the data of the tachograph at the ILT, since it would lower their costs.

'You know what would be nice, if we could store the data at the ILT. As I said before, we do not even use the data. Storing the data at the ILT would be good for both of us, since you get the required data and we safe some costs for storing the data.' - Respondent with 50 till 100 trucks.

ACD | Ease of use

'Ease of use' was also the most mentioned code within the ACD procedure. It was taken in account that:

'The freight carriers do not get any profit from this, it is just for the benefit of us. So, the web-portal should be as simple as possible.' - Team leaders.

With this in mind, it was proposed to include only several tasks and mainly multiple-choice questions. The tasks should be in a logical and chronological order. Furthermore, the idea of only admitting one type of file was also indicated by the six people within the ACD procedure.

'If you do not want people to send in other files, you should not let them. You should mention that you need that specific type of file and make it impossible to submit any other type of file. This would also be safer, since you cannot adjust the ddd-files.' - ICT specialist.

Finally, the six people argued that there should be support options to guide the user through the system.

ACD | Use of language

Another important factor within ACD was the use of language. The ILT has a standard to communicate and to write pieces of text. They are also familiar with nudging within text.

'*By using the right words, you might be able to influence the users. This might help to get the required data. For example, using a simple text that everyone could understand.*' - Behavioral Scientist.

ACD | Accessibility

The last code, which is related to the effort expectancy, is the accessibility to the web-portal. E-recognition was preferred by the people in the ACD procedure, because it is already used among other government agencies and offers a secure method to login. Next to the benefits with regard to security, e-recognition could reduce the amount of tasks in the web-portal. According to the functional designer, e-recognition adds all personal data, such as company names and addresses. Using this data is more reliable and increases the web-portal's ease of use.

'E-recognition works as a digital signature. This is very beneficial, because you can easily retrieve some basic data in a secure way. For example, some personal data such as the name and company name.' - Functional designer

4.2 Expected performance and facilitating conditions

Expected performance refers to the usefulness of the web-portal. According to the results, the performance was related to the access to the web-portal and the availability of user support.

HCD | Expected performance

One of the respondents had a very clear opinion regarding the performance of the web-portal and stated:

'The web-portal should just work at any time. If it works, there should not be a need for a lot of support and I would never have to call anyone.' - Respondent with 10 till 50 trucks.

Even though most people preferred to have various support options, they all agreed to the statement that the web-portal should function at any time.

'I expect the web-portal to function. If it does not function, I am not going to make an effort to fill in the questions' - Respondent with 10 till 50 trucks.

Based on this remark, there seemed to be a link between the expected performance and the expected effort. Furthermore, three respondents worried about their results if a system did not work or if questions were missing. They expected the web-portal to take several things in account, such as an exclusion from downloading the data.

'But what happens if the system does not work? I think that I should be able to tell you that the system does not work and that I have tried to fill it in.' - Respondent with less than ten trucks.

'Is it possible to add any comments? For example, my drivers prefer to leave earlier from home to avoid traffic. Officially, they would work one hour in overtime, but they chose this themselves. Can I add this in the comments?' - Respondent with 10 till 50 trucks.

'We have certain agreements regarding the use of the tachograph. So, we do not have to download all the data. Can we add this anywhere in the web-portal?' - Respondent with 10 till 50 trucks.

HCD | Facilitating conditions

Related to these concerns, the respondents argued about the importance of a helpdesk. The access to a helpdesk or any other form of support, relates to UTAUT's variable 'facilitating conditions'. The importance of facilitating conditions refers to the availability of conditions that make the web-portal easier to use.

Within HCD, all possible methods of support were named due to the differences in the companies' needs. Experienced companies knew more about the files and often already analyzed the files themselves. Uploading the files would not be a problem for them. A lot of them stored the data at another company, therefore they could ask for the required data more easily. Less experienced companies could use some more support with downloading the data. Especially smaller companies with less than ten trucks that

used a download key to collect the data, since they have to take more steps during their downloading process. For example, they could use more information about the download period in order to keep them for uploading the wrong period.

'*I did not even know that I had to download the data of the tachograph. I was already wondering why the light kept flickering. Fortunately, I know what to do now. But it would be nice if the ILT could offer more information about this process*.' - Respondent with less than 10 trucks.

Fourteen respondents argued about adding a helpdesk with a telephone number or email address. Whereas eleven respondents preferred a faster type of support, such as a chat function or WhatsApp. Even though the differences between the ages of the respondents was not examined, age seemed to be a moderator when it comes to the type of support. It seemed that the older generation preferred more personal contact, whereas the younger generation preferred fast support. The older generation preferred to have a helpdesk in which they could call an experienced worker.

'I think it would be much faster to just call a helpdesk, because I can explain my problem so that they can solve it right away.' - Respondent with 10 till 50 trucks.

However, the older generation also stated that:

'Calling a helpdesk can be tedious, because you have to wait so long.' - Respondent with 10 till 50 trucks.

'Please do add a helpdesk which you can call. Except when you have to wait forever to get an answer. Then an email address or something would still be nice.' - Respondent with 10 till 50 trucks.

Similar to the younger generation, they would prefer another option if it would be faster and offers the same solution.

'I used to call a helpdesk, but I always had to wait for so long. Some time ago, I tried to use a chatbot and it solved the problem very fast. I would rather use a chatbot if it is faster.' - Respondent with 10 till 50 trucks.

The younger generation seemed to be more willing to work with different support systems, such as chatbots and a FAQ. But they also stated that it depends on how fast they would get a respond.

During following researches, it might be useful and interesting to take in account the age of the respondents. But also the level of experience of the respondents and the companies. Experience also seemed to influence the choice of the type of support. More experienced and/or high-tech companies promoted the use of videos and chatbots.

'*We use videos all the time. It is very useful, because our drivers can actually see what they have to do. This helps them to learn much better*

and quicker than when they have to read a manual.' – Respondent with more than 100 trucks.

However, these companies also acknowledged the issues that might occur when using a chatbot.

'You can use chatbots, if they are solving the problem faster than when you would make a phone call. Then again, you will need the capacity for that. Another solution would be a robotic chatbot which can answer basic questions, but this is less personal of course and it does not always work.' - Respondent with more than 100 trucks.

ACD | Expected performance

Within ACD, the performance was taken in account as well. With regard to the accessibility of the web-portal, it was stated that:

'*You should take in account that these people might not know anything about computers or computer systems. Therefore, you should make the system 'dummy proof' and basically unbreakable*.' - ICT expert.

According to this statement, the web-portal should be simple and 'unbreakable'. In other words, both small and big defects should be prevented. Noticeable is that, similar to this statement, ACD is more focused on technical enhancements, issues or difficulties.

'We have to make sure that the analytic software can handle this much amount of requests' - Team leader.

'*Before this web-portal can even be rolled out, it has to be tested. For example, with a group of future users.'* - Team leader.

'It would be nice if we can use the web-portal for related issues as well, such as licenses' - Team leader.

ACD | Efficiency

These statements were specifically focused on the efficiency of the web-portal, such as the capacity or adding and combining tasks. The issue related to capacity is also mentioned with regard to support.

'A chat function is not feasible, because we have a limited amount of staff to take care of that. And the helpdesk would be the same as the helpdesk for other web-portals. I think this web-portal should be simple and obvious enough to not raise too many questions.' - Inspector.

As a result, it was intended to re-use the facilitating conditions of existing web-portals of other parties. For example, by using the same helpdesk or a similar design for the web-portal. In order to create a proper user experience, it was suggested to combine some basic support options.

'We do have a general helpdesk. Maybe we can use that helpdesk for this web-portal as well.'
- Inspector.

'You can start with an introduction video and then add some pop-ups within the portal. Lastly,

people could go to a Q&A list in which you could include a general phone number in the end.'
- Team leader.

4.3 Motivation, price value and social influence

Price value refers to the price to use the technology and whether the users can earn something by using the web-portal. In this case, the web-portal is free to use and it is not possible to gain money from it. Therefore, the ILT preferred to focus on intrinsic motivation instead of extrinsic motivation. For example, by using social influences, which refers to whether the freight carriers can motivate each other into using the web-portal.

HCD | Motivation

The respondents made clear that working with the web-portal is something 'they must do' and that it is not fun to use. There is no price value or other kind of reward involved, therefore they mainly care about having a web-portal that is easy to use. Moreover, the code 'positive feedback' was mentioned by almost all the respondents and was coded 40 times. This indicated that all the respondents preferred to receive feedback in a positive form. The respondents argued about getting the results of the analysis with some advices of the ILT. Especially less experienced companies were interested in the results, because they cannot or do not have enough time to download the results themselves.

'I would like to know what went wrong and how I can improve the company to avoid these mistakes in the future.' - Respondent with 10 till 50 trucks.

Whereas more experienced companies analyzed the data more often or got a report from a third party. Therefore, more experienced companies were not interested in these results. This group of respondents literally asked:

'How does filling in these questions benefit me?'
- Respondent with 50 till 100 trucks.

'I analyze the data myself, so I do not need a report. How could the web-portal benefit me?'
- Respondent with 50 till 100 trucks.

HCD | Benchmark

Related to this remark, twenty respondents mentioned their interest in a score or benchmark with regard to their performance. According to the respondents, a benchmark could help motivate the drivers or the management team to make changes regarding the driving and resting times. Furthermore, they mentioned that it might be possible to compete on the compliance regarding the driving and resting times, if the score would be important for shareholders.

'A benchmark can be used to show my employees whether they do well' - Respondent with 10 till 50 trucks.

'I can show a benchmark to my bosses. If it is too low, the chances are bigger that I get the possibility to make a change in our processes'
- Respondent with 10 till 50 trucks.

Especially bigger companies with a lot of experience argued about adding a benchmark to the report. Nevertheless, most respondents were in favor of receiving a benchmark to indicate their position with regard to the rest of the sector. However, some respondents did not like to compare themselves with other companies.

'I need to know my business and what I am doing. I am not interested in what my neighbor is doing' - Respondent with 10 till 50 trucks.

Still, both parties preferred to get positive feedback instead of negative feedback, for example when they score high in a benchmark or an advice on how to improve their processes instead of receiving a fine when they made a mistake.

'*If I would get a fine, I will pay it and move on. But If I would get an advice on how to improve my business, I would be put to action more easily'* - Respondent with 10 till 50 trucks.

ACD | Motivation & feedback

Within ACD, the use of positive feedback was mentioned as a requirement as well. One of the differences is that ACD focused more on the use of language. They stated that they want to give feedback in a

'*Positive, critical manner.'* - Team leader

and to

'Highlight what the company has done well'.
- Behavioral scientist

Using a benchmark to rate the companies based on their behavior, seemed as an interesting option as well. However, it was questioned whether it would actually make a difference.

'A benchmark would only work if the companies see it as something to compete on.' - Behavioral scientist

'It is possible to motivate the users with a benchmark, but only if they want to compete on compliance or safety.' - Functional designer

Therefore, it was proposed to rank the companies in order to use the benchmark as a motivational tool.

'Make and publish a list of the best and the worst scoring companies.' - Behavioral scientist

'Maybe if you would post the most compliant companies, this would trigger them into taking their driving times in account.' - Team leader

4.4 Habit

The goal of the requirement analysis was to examine which features could make the web-portal more usable, user-friendly and persuasive. In the best-case scenario, the users would provide the ILT with the files of the tachograph on a yearly basis.

HCD | Link with existing web-portals

Related to the variable 'habit', 21 respondents mentioned the web-portal of the Dutch tax authorities as an information source.

'The web-portal of the tax authorities is very easy to use. I think the idea of your portal is similar to that, so you might want to make it similar.' - Respondent with 10 till 50 trucks.

According to the respondents, the web-portal of the tax authorities is easy to use. Making a similar web-portal could increase their motivation and turn the task into a habit, similar to filling out the taxes.

ACD | Link with existing web-portals

Also within ACD, the comparison between the ILT's web-portal and the web-portal of the Dutch tax authorities was mentioned.

'The web-portal of the tax authorities is used every year to fill in the taxes. And it is true that the actions are similar to the actions regarding uploading the data of the tachograph. By looking at this web-portal, the ILT's web-portal might become easier to understand and to use. And it might become a habit to fill in this data, similar to filling in the taxes' - Inspector

4.5 Practical implications

Two lists of requirements derived from this study. For the ILT, the two list were merged into one list that included all the requirements from ACD and HCD. See appendix 5C. The list was ranked based on the MOSKOW method. This method separates the requirements into three categories, namely should, could and would. Requirements that have the biggest priority to be implemented in the web-portal are listed under the category 'should'. The other requirements that have a significant value, but are not the highest priority, are listed under the category 'could'. Lastly, the requirements that would be nice to have, but do not have any priority are listed under the category 'would' (Van Vliet, 2008).

In order to reduce the effort that people have to spend on the web-portal, it is suggested to keep the design simple and clean. It would be preferred if the questions were multiple choice and a time indicator was added to indicate the number of steps the user has to take in order to fulfill the task. Further, it is suggested to add various ways of support as a facilitating condition. For example, an introduction text or video, pop-ups with additional information in the web-portal, a helpdesk including a FAQ and a general phone number in the end of the FAQ.

Since the web-portal does not have a price value, the motivation could be increased if the web-portal provides the necessary feedback and is easy to use. For example, an overview of violations, advise to overcome the violations and a benchmark to indicate the score of a company with regard to the rest of the sector. In addition, the benchmark can play a role as social influencer in order to motivate the freight carriers to compete on compliance. However, this is only possible if the freight carriers want to compete on compliance. If they choose not to compete, the score would still serve as an information source, but it might have a smaller effect on their motivation.

This combination of requirements should increase the usability, the chance of adoption and the continuance of use of the web-portal. In the best-case scenario, the use of the web-portal and

the delivery of the data becomes a yearly habit for all freight carriers. Resulting in a better information position of the ILT and a higher level of compliance with the law regarding driving and resting times.

5. DISCUSSION AND CONCLUSION

Within this chapter, the main findings of the study are summed up and discussed. Since this study existed out of two parts, the chapters are separated into paragraphs that either discuss the requirement analysis or the comparison of the design methods. Next, the implications and limitations of the study are discussed. In the end, the research questions are answered and a conclusion is drawn.

5.1 Main findings

During this study, the activity-centered design method and the human-centered design method were tested in the form of a requirement analysis. First, the main results of the requirements analysis are elaborated. Followed by the main findings regarding the differences between the two design methods.

5.1.1 Main findings regarding the requirement analysis

In order for the future users to adopt the web-portal, the respondents listed a set of requirements that were in line with the variables of UTAUT. Effort expectancy and expected performance were the most important variables, since ‘ease of use’ has been mentioned the most times within both design methods. The results indicate that the design has to be simple and has to contain several support options. The required support options seemed to be influenced by the experience of the company and the age of the respondent.

Since there is no actual price value to this web-portal, the motivation can only be triggered by providing information, such as results, advice or a benchmark. Within both design methods, people referred to the web-portal of the Dutch tax authorities. The respondents argued that this web-portal is ‘similar to what the ILT is making’ and ‘easy to work with’. They stated that ‘the web-portal should be similar to the one of the Dutch tax authorities’.

5.1.2 Main findings regarding the design methods

The results of HCD and ACD were similar. Nevertheless, the way of reasoning was different. The respondents based their requirements on their daily life. For example, they evaluated web-portals they had used before and the issues that occur when using these web-portals. Because of this and the differences in experience and age, the requirements list of the HCD was very extensive. In the end, the requirements of HCD were mainly based on user experiences.

In contrast with HCD, the requirements of ACD were focused on the usability of the web-portal. Within the ACD procedure, the requirements were based on the technical possibilities of the web-portal and the features the ILT already had to offer. Also the feasibility to produce the web-portal, the rules and regulations, and possible technical, financial or legal restrictions were taken into account. This resulted in a list of

requirements that was shorter than the one from HCD and more feasible to execute.

The similarity in results are most likely caused by the possibility to compare the web-portal with existing web-portals. In this case, the people within the ACD and HCD compared the ILT's web portal with the web-portal of the Dutch tax authorities. Nevertheless, ACD included the same requirements as HCD, but is also focused on the technical development process. Furthermore, ACD is usually faster and cheaper to execute than HCD, because ACD usually does not need six more people to define the requirements. The designer defines the requirements based on the user's activities. As a conclusion, it can be stated that ACD would be sufficient in order to create a web-portal.

5.2 Discussion

Within this chapter, the results are discussed. The chapter is separated into a discussion of the requirements analysis and its relation to UTAUT, and the comparison of the ACD and HCD.

5.2.1 Discussion of the requirements analysis

As described earlier in this paper, the variables regarding the adoption of a technology were related to the requirements that were mentioned during the HCD and ACD procedure. The variable 'ease of use' was a red line through all the results, since this variable could influence the amount of effort that people were willing to spend on the web-portal. Therefore, the 'ease of use' could increase the users' motivation to work with the web-portal.

Chervany, Karahanna and Straub (1999) also mentioned the importance of 'ease of use' within their paper. Related to this paper, they mentioned that this factor has a big influence on both the adaption and the continuance of use of a technology. Therefore, the 'ease of use' might be a persuading factor within the web-portal. For example, by placing support options in order to guide people into a proper use of the web-portal. This is in line with Fogg's theory regarding the importance of creating a simple design. According to Fogg (2003), increasing the knowledge and ability of the user to complete the list of questions should also increase their motivation to finish those questions.

Within the 'ease of use', the factor 'time' seems to be captured as well. The respondents mentioned that the use of this web-portal is a 'must do' and should be 'finished as fast as possible', therefore time seems to be an important factor. Moreover, the importance of a time indication was argued during both the ACD and HCD procedure. The users preferred to have an indication of the number of steps they have to fulfill in order to finish the task. Since there are only four steps to complete, an indicator of time could result in a calming and motivating effect on the user (Conrad, Couper, Peytchev, & Tourangeau, 2010; Myers, 1985; Van Dijk & Van der Sluis, 1998).

The last factor that could increase motivation is social pressure, which was mentioned within the TPB and UTAUT as well. Since the transport sector is highly competitive, their need to compete with each other can be used as a way to motivate the freight carriers into using the web-

portal and increase their performance regarding the driving and resting times.

By increasing the motivation to use the web-portal, the goal of collecting the data every year might become more feasible. In this case, the web-portal should include the requirements that were mentioned during this study. Especially, the ones regarding the 'ease of use'. In addition, the features of the web-portal of the Dutch tax authorities can be used, since the respondents rated this web-portal as 'positive' and found it relatable to the ILT's web-portal. During following researches on this topic, it might be interesting to include the variables 'age' and 'experience'. It might also be interesting to investigate the influence of adding features from existing web-portals to new web-portals, and whether the benefits of this can be explained by existing behavioral theories.

5.2.2 Discussion of the design methods

The ACD and HCD did not influence each other, but the respondents did include their activities during the HCD procedure. Therefore, it would be easier to start with the ACD method.

Returning to which differences there were between HCD and ACD, the answer would be that the methods delivered similar results and both took in account the future user. However, the list of requirements of HCD was more extensive than the list of ACD. In addition, the list of requirements of ACD contained the most important requirements that were mentioned in the HCD procedure. Furthermore, ACD is more focused on what the company can build and which information they actually need to obtain from the respondents. In comparison to HCD, the concept of the web-portal was more comprehensive and feasible to execute. This result is in line with the arguments of Constantine (2004) and Norman (2005).

Since the study was focused on creating a web-portal, the respondents were able to relate this design to other designs they already knew. For example, the design of the web-portal of the Dutch tax authorities. The respondents already knew this technology and how it should or could work. Therefore, the argument of Gay and Hembrooke (2004) makes sense. They argued that ACD would be more efficient due to the shift of the relationship between people and technology. In the case of this web-portal, this seems to be true. ACD seems to be able to promote the interests of the future users and is in line with the development process.

However, it should be taken into account that this theory was tested for the development of a web-portal. Many requirements were based on known web-portals, such as the web-portal of the tax authorities. Within both the ACD and HCD procedure this comparison was used, which could be a reason for the similarity in requirement. The question remains whether these results would be similar when creating an innovative technology. Gasson (2003) already stated that once a technology becomes more complex and is not comparable with other technologies, ACD might not be able to promote human interests as well as HCD. In another context HCD might be more efficient than ACD, but Gasson also mentioned the weaknesses of HCD. Especially when the development process is very technical and complex, HCD will not be in line with the development process.

The results of the study of Gasson (2003) were similar to this study, since it became clear that ACD focused more on usability and the technical development procedure and HCD focused more on user-experience. As a solution, Gasson proposes a dual-cycle model in which both methods take part. With this model both the technical issues and human interest are taken in account, which would make the model very effective for complex designs. Future research could test the ACD and HCD within a more complex and innovative design method in order to see whether the design methods are able to include both the human and technical aspects. In addition, Gasson's dual-cycle model could be tested in order to reveal the true value of this design model.

5.3 Implications

The results of this case study will be used to create a web-portal for the ILT, which will be based on the requirements that were listed during the ACD and HCD procedure. The requirements should increase the usability and user-experience of the web-portal. In the best-case scenario, the freight carriers will use the web-portal every year to upload their data. This gives the ILT the possibility to increase their information position. With this information, the inspectors are able to plan and perform the inspections more efficiently, and focus on high-risk companies or high-risk sectors. As a result, it could stimulate the freight carriers to increase their performance regarding the driving and resting times. Which could reduce unfair competition and drivers' fatigue and increase road safety.

Furthermore, the results of this study can be used for similar web-portals. For example, the requirements can be used for similar web-portals or applications for the government. Also, this study may serve as a reference for other researchers or designers and help them to use or choose one of these design methods.

Furthermore, this study serves as an addition to existing papers regarding the design and the adoption of technologies. First, this study has shown that the variables of UTAUT are needed in order to increase the possibility of adoption of the web-portal. Moreover, this paper is an addition to the theory regarding ACD and HCD. Most papers argue about the benefits of ACD in comparison to HCD, but these papers are limited to theoretical statements. Whereas in this study, ACD was tested and compared to HCD in a practical setting. Therefore, this paper fills a gap between the knowledge regarding the execution of ACD and the differences between the results of ACD and HCD.

5.4 Limitations

One of the limitations of this study is that the participants chose to either join the interviews or not. As a result, the companies that perform poorly regarding the driving and resting times were most likely less involved in this study. This could have influenced both the results of HCD and ACD, since the attitude and downloading process would most likely be different from companies that are compliant with the law. Nevertheless, there were still some companies involved who were not compliant to the law.

Furthermore, one can never be sure whether the respondents spoke the truth, which could also

have ended in different or false results. Nevertheless, it is assumed that the respondents spoke honestly about their download procedure and their actions. They seemed to be transparent about their processes, since they showed all the systems and equipment they used. In addition, they participated voluntarily and took the time to answer the questions. Further, they told information about the company and the processes that were rather personal and sometimes even out of the interview's scope. They seemed to feel confident during the interview and asked questions if they felt this was needed. Lastly, some participants asked if they could be informed more about the project and wanted to take part in future researches.

Another limitation is that the study is focused on the requirement analysis and not on the entire design process, which might have had an influence on the results. Since the web-portal is not actually made and tested, it remains the question whether the list of requirements has been sufficient to make a usable and user-friendly web-portal. The last limitation is that this study is focused on a web-portal, which is not an innovative product. The results regarding an innovative product might be different, due to its complex technical process and the chance that it cannot be compared with other products as easily as a web-portal.

5.5 Conclusion

In conclusion, the results of HCD and ACD seemed to be similar. However, ACD focused more on usability and the technical implications of the web-portal and HCD focused more on the user-experience. In the end, ACD seemed to be sufficient to cover the requirements for the web-portal. However, this is most likely due to the comparison of this web-portal with the web-portal of the Dutch tax authorities. It remains a question whether the result would be the same when designing an innovative product, which has a more complex technical process and is less easy to compare to another product.

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APPENDIX

Appendix 1A. Interview (HCD)

INTRODUCTIE

De ILT is bezig met de ontwikkeling van een nieuwe werkwijze met betrekking tot de naleving van de wet rondom rij- en rusttijden. Volgens deze wet, dienen werkgevers de rij- en rusttijden van hun chauffeurs in de gaten te houden door de data van de tachograaf te uploaden. Om de naleving van deze wet te onderzoeken, analyseert de ILT de tachograafgegevens van bedrijven. Dit interview is bedoeld om inzicht te krijgen in het proces met betrekking tot het uploaden van de data naar de ILT. Het uiteindelijke doel van dit onderzoek is om mensen op een juiste manier te begeleiden en/of informeren, zodat het gemakkelijker wordt om aan deze taak te voldoen. Daarnaast wil de ILT het controleproces automatiseren door middel van een web-portaal. Omdat u hoogstwaarschijnlijk een toekomstige gebruiker bent van dit web-portaal, willen we u laten meedenken over hoe dit portaal kan worden ingericht. Hierbij zijn we vooral benieuwd naar uw eigen mening en eigen ideeën.

Voorafgaand wil ik u graag vragen om dit formulier door te nemen en ondertekenen indien u het eens bent met de procedure. In dit formulier staat onder andere dat u er altijd voor mag kiezen een vraag niet te beantwoorden. Daarnaast kunt u ook altijd stoppen als u zich niet prettig voelt bij het onderzoek. Verder blijven de resultaten van dit onderzoek anoniem en worden niet voor andere doeleinden gebruikt. Als u wilt kan ik u de uitwerking van dit onderzoek toesturen, zodat u deze nog kan teruglezen.

ALGEMENE VRAGEN

1. Kunt u allereerst iets vertellen over uw bedrijf?
   - Bent u beroepsvervoerder of eigen vervoerder?
   - Wat is de grootte van het bedrijf (personeel en vrachtwagens) ?
   - Welke producten vervoert u?
   - Betreft het nationaal of internationaal vervoer?
   - Op welke manier worden de gegevens gedownload (HANDMATIG, LUCHT, ETC)

2. Na aanleiding van het onderzoek van de ILT , ontvangen bedrijven op dit moment deze brief met de vraag om de m- en c- bestanden aan te leveren.
   - Heeft u verbeterpunten voor de brief?

VRAGENLIJST (HDC)

De ILT houdt zich bezig met de naleving van de wet op rij- en rusttijden, en voert daarom controles uit waarbij er gevraagd wordt om de tachograafgegevens en bijbehorende bestuurdersgegevens van een bepaalde periode naar hen op te sturen. Op dit moment gaat dit via de mail, maar ze willen in de toekomst de gegevens gaan opvragen via een web-portaal.
In het ideale geval betekent dit dat ondernemers eenmaal per jaar worden gevraagd om de gegevens te uploaden via dat portaal, zodat zij dit kunnen controleren en feedback kunnen geven aan het bedrijf.

3. Wat vindt u van het idee om een web-portaal op te zetten?
   - Hoe kan dit portaal voor u een meerwaarde zijn?
   - Denkt u dat een dergelijk web portaal u en anderen motiveert om de gegevens aan te leveren, waarom?
   - Zou het portaal u en anderen motiveren om de zorgplicht na te leven?

4. Om het portaal te beveiligen en het gebruik te vergemakkelijken wil het ILT gebruik maken van E-herkenning.
   - Bent u bekent met E-herkenning?
   - Wat vindt u van E-herkenning?
   - Gebruikt u al E-herkenning? Zo ja, waarvoor?
   - Waar heeft u het aangevraagd?
   - Wilt u E-herkenning gebruiken voor de communicatie met de ILT?

5. Als u wordt gevraagd om dit web-portaal te ontwerpen, hoe zou het er volgens u uit moeten zien?
   - Hoe zou het design eruitzien volgens u?
   - Zou u het web-portaal voor meer activiteiten willen gebruiken, bijvoorbeeld als standaard opslag van de tachograafgegevens of gelinkt aan met meerdere (overheids)taken?
   - Welke informatie zou er volgens u opgevraagd moeten worden van de gebruiker?

6. Welke vorm van uitleg denkt u nodig te hebben om met het web-portaal te kunnen werken?
   - In welke vorm zou u graag uitleg willen ontvangen (video, handleiding, etc.) ?
   - Wie zou u contacteren indien u vragen heeft?

7. Ten slotte is het ook de bedoeling dat mensen een rapport terugkrijgen van ons. Wat zou voor u interessante informatie zijn om terug te krijgen met betrekking tot rij- en rusttijden?
   - Zou u het handig vinden om een score te ontvangen?

8. Heeft u verder nog vragen of toevoegingen?

Appendix 1B. Checklist (ACD)

PROCEDURE ACD (Observaties)

A. Proces van het downloaden

- Wie is degene die de gegevens download en verwerkt: NAAM / FUNCTIE / EXTERN
- De gegevens op vaste momenten gedownload: JA/NEE
- Gegevens van gehuurde vrachtwagens of uitzendkrachten worden ook verwerkt: JA/NEE
- Stappen die de verantwoordelijke persoon uitvoert (handmatig):

Tachograaf:

1. De bedrijfskaart wordt in de digitale tachograaf geplaatst (rechts).
2. Het klepje wordt geopend en de key wordt in het apparaat geplaatst.
3. De key en de kaart worden verwijderd zodra de gegevens zijn gedownload.
4. De gegevens worden geüpload op een pc.

Bestuurderskaart:

1. De bedrijfskaart wordt in de digitale tachograaf geplaatst (links).
2. De chauffeurskaart wordt in het apparaat geplaatst (rechts).
3. Er wordt op ▼ en 'ok' geklikt.
4. Het klepje wordt geopend en de key wordt in het apparaat geplaatst.
5. Na het downloaden worden de key en de kaarten verwijderd (▲).
6. Bestuurderskaart wordt gedownload met speciale apparatuur.
7. De gegevens worden geüpload op een pc.

- De hoeveelheid tijd die de stappen in beslag nemen: MINUTEN
- Stappen worden als gemakkelijk ervaren: JA/NEE

B. Bewaring van gegevens

- De originele bestanden worden bewaard: JA/NEE
- De bestanden worden ingelezen: JA/NEE
- Bewaartijd van de bestanden: MAANDEN

C. Gebruik van de gegevens

- Gegevens worden gebruikt om de zorgplicht uit te oefenen: JA/NEE
- De gegevens worden gebruikt voor andere doeleinden: JA/NEE

Indien ja, namelijk ….

Dit is het einde van het onderzoek. Bedankt voor uw deelname.

Appendix 1C. Schedule companies

BedrijfNR.	RandomNR	VragenLijst	Methode
1	0,066214125	B	HCD-ACD
2	0,33788545	B	HCD-ACD
3	0,171612611	B	HCD-ACD
4	0,413999764	B	HCD-ACD
5	0,47315409	B	HCD-ACD
6	0,251248575	B	HCD-ACD
7	0,546735562	A	ACD-HCD
8	0,66391168	A	ACD-HCD
9	0,559186219	A	ACD-HCD
10	0,03615438	B	HCD-ACD
11	0,916438434	A	ACD-HCD
12	0,575160533	A	ACD-HCD
13	0,200257788	B	HCD-ACD
14	0,626335572	A	ACD-HCD
15	0,502012696	A	ACD-HCD
16	0,65995758	A	ACD-HCD

BedrijfNR.	RandomNR	VragenLijst	Methode
17	0,707145764	A	ACD-HCD
18	0,390184516	B	HCD-ACD
19	0,840606012	A	ACD-HCD
20	0,158809843	B	HCD-ACD
21	0,704496385	A	ACD-HCD
22	0,498939808	B	HCD-ACD
23	0,848873623	A	ACD-HCD
24	0,30123182	B	HCD-ACD
25	0,095476763	B	HCD-ACD
26	0,710006456	A	ACD-HCD
27	0,775220787	A	ACD-HCD

28	0,011306862	B	HCD-ACD
29	0,800605755	A	ACD-HCD
30	0,345704824	B	HCD-ACD
31	0,357894734	B	HCD-ACD

Appendix 2. Example web-portal

Appendix 3. Letter of consent

Informatieblad 'Project OnDeskTacho'

Doel van het onderzoek

Dit onderzoek wordt geleid door Daniëlle Jongman, student aan de Universiteit Twente. Door middel van dit onderzoek willen wij inzicht krijgen in het proces en de bijbehorende moeilijkheden die zich voordoen wanneer ondernemers wordt gevraagd om tachograafgegevens aan te leveren. Daarnaast vragen wij naar de meningen en ideeën omtrent het gebruik van een web-portaal voor het aanleveren van gegevens.

Hoe gaan we te werk?

Tijdens dit onderzoek willen wij informatie vergaren door het proces van het aanleveren van tachograafdata te observeren. Daarnaast willen we u graag interviewen met betrekking tot het gebruik van het web-portaal. Het interview wordt genoteerd of opgenomen via een audio-opname en uitgewerkt in een transcript. Indien gewenst, kunt u het transcript van het interview terugontvangen. Daarnaast is het mogelijk om uw transcripten aan te passen, te wijzigen of te verwijderen.

Risico's en vrijwilligheid

Er zijn geen fysieke, juridische of economische risico's verbonden aan uw deelname aan dit onderzoek. De deelname aan dit onderzoek is vrijwillig en u kunt op elk gewenst moment ervoor kiezen om vragen niet te beantwoorden of uw deelname te stoppen. Als u tijdens het onderzoek besluit om uw medewerking te stoppen, zullen de gegevens die u reeds hebt verstrekt tot het moment van intrekking van de toestemming in het onderzoek worden gebruikt.

Vertrouwelijkheid

Wij doen er alles aan uw privacy zo goed mogelijk te beschermen, daarom worden uw resultaten uitsluitend gebruikt voor dit onderzoek en niet gedeeld met derden. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u naar buiten gebracht, waardoor iemand u zal kunnen herkennen. Voordat onze onderzoeksgegevens naar buiten worden gebracht, worden uw gegevens zoveel mogelijk geanonimiseerd. Dit houdt in dat namen, bedrijfsnamen, en dergelijke worden verwijderd of hernoemd.

De audio-opnamen, transcripten en formulieren worden door de onderzoeker op een beveiligde locatie bewaard. De audio-opnamen worden aan het eind van dit onderzoek verwijderd. Tot slot is dit onderzoek beoordeeld en goedgekeurd door de ethische commissie van de faculteit BMS van de Universiteit Twente.

Contactgegevens

Indien u naderhand vragen of klachten heeft met betrekking tot dit onderzoek, kunt u contact opnemen met de onderzoeker.

Daniëlle Jongman

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Voor bezwaren met betrekking tot de opzet en of uitvoering van het onderzoek kunt u zich ook wenden tot de Secretaris van de Ethische Commissie van de faculteit Behavioural, Management and Social Sciences op de Universiteit Twente via ethicscommittee-bms@utwente.nl. Dit onderzoek wordt uitgevoerd vanuit de Universiteit Twente, faculteit Behavioural, Management and Social Sciences. Indien u specifieke vragen hebt over de omgang met persoonsgegevens kun u deze ook richten aan de Functionaris Gegevensbescherming van de UT door een mail te sturen naar dpo@utwente.nl.

Toestemming

	JA	NEE
Ik ben voldoende geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Deze vragen zijn voldoende beantwoord.	☐	☐
Ik neem vrijwillig deel aan dit onderzoek. Er is geen expliciete of impliciete dwang voor mij om aan dit onderzoek deel te nemen. Het is mij duidelijk dat ik deelname aan het onderzoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil.	☐	☐
Ik geef toestemming om tijdens het interview opnames (geluid / beeld) te maken en mijn antwoorden uit te werken in een transcript	☐	☐
Ik wil naderhand het transcript van mijn interview ontvangen. Indien JA, noteer emailadres:	☐	☐

Naam deelnemer:

Naam Onderzoeker:
Daniëlle Jongman

Handtekening:

Handtekening:

Datum:

Datum:

Appendix 4. Codingscheme

Informatie ondernemer

- Werkgebied
- Werkzaamheden
- Grootte van het bedrijf

Downloadproces

- Methode van download
  - Door de lucht
  - Handmatig
- Frequentie van het downloaden
  - Binnen de wettelijke termijn (C-bestanden binnen 30 dagen en M-bestanden binnen 90 dagen)
  - Buiten de wettelijke termijn
- Downloadtijd
  - Kort (tot 10 minuten)
  - Lang (Meer dan 10 minuten)
- Data opslag
  - Interne opslag
  - Externe opslag
- Gebruik van de data
  - Voor de planning
  - Voor salarisadministratie
  - Nakijken van rij- en rusttijden
- Vooraf verkregen informatie

Brief

- Taalgebruik
  - Onduidelijke terminologie
  - Onvriendelijk
  - Woordgebruik is niet passend
- Onduidelijkheden

Portaal

- Design
  - Taalgebruik
    - Onduidelijke terminologie

        - Woordgebruik is niet passend
    - Toegankelijkheid
    - Gebruiksgemak
    - Onduidelijkheden
    - Veiligheid
- Support
    - Taalgebruik
        - Onduidelijke terminologie
        - Woordgebruik is niet passend
    - Gebruiksgemak
    - Personalisatie
- Feedback
    - Taalgebruik
        - Onduidelijke terminologie
        - Woordgebruik is niet passend
    - Gebruiksgemak
    - Motivator
        - Positief
        - Negatief
        - Neutraal
- Verwachting ILT
    - Controlerend
    - Handhavend
    - Adviserend
    - Beoordelend

Requirement (NAAM)

Appendix 5A. Requirements HCD

Brief	Portaal	Design	Support	Feedback
Periode van aanleveren aangeven	**Introductie**	Simpel	Chatfunctie	Score / benchmark per sector
Extensie bestand aangeven (ddd)	Algemene informatie	Zakelijk	Whatsapp	Foutmeldingen
Uitleg over de analyse	Periode van aanleveren aangeven	Efectief	FAQ	Pushbericht bij ged aanleveren/goed ontvangen
Contactgegevens toevoegen	Extensie bestand aangeven	Stapsgewijs	Filmpje	Tijdspad om te verbeteren
		Gebruik van indicatoren (? Of I)	Handleiding	Vanuit score verder klikken naar overtredingen
	Inloggen	Gebruik van kleur ter indificatie (groen, oranje, rood)	Helpdesk	
	E-herkenning		Indicatoren	
	Mogelijkheid om e-herkenning aan te maken		Email	
	Benodigde leven van e-herkenning aangeven		Contact met ILT / 3e	
	Inloggen via de mobiel			
	Derde partij laten inloggen			
	Inloggegeven onthouden			
	Vragenlijst			
	Meerkeuzevragen			
	Keuze uit branche			
	Keuze tussen eigen vervoer en bedrijfsvervoer			
	Gegevens van tevoren geven (personalia)			
	Kentekens weergeven			
	Mogelijkheid om vrijstellingen aan te geven			
	Mogelijkhedid om een opmerking toe te voegen			
	Voorbeeld (I) geven van briefhoofd nummer			
	Data uploaden			
	Periode van aanleveren aangeven			
	Maximaal één extensie toelaten			
	C en M bestanden apart anleveren			
	Bestanden inslepen			
	Rechtstreeks de bestanden uploaden (automatisch of via link)			

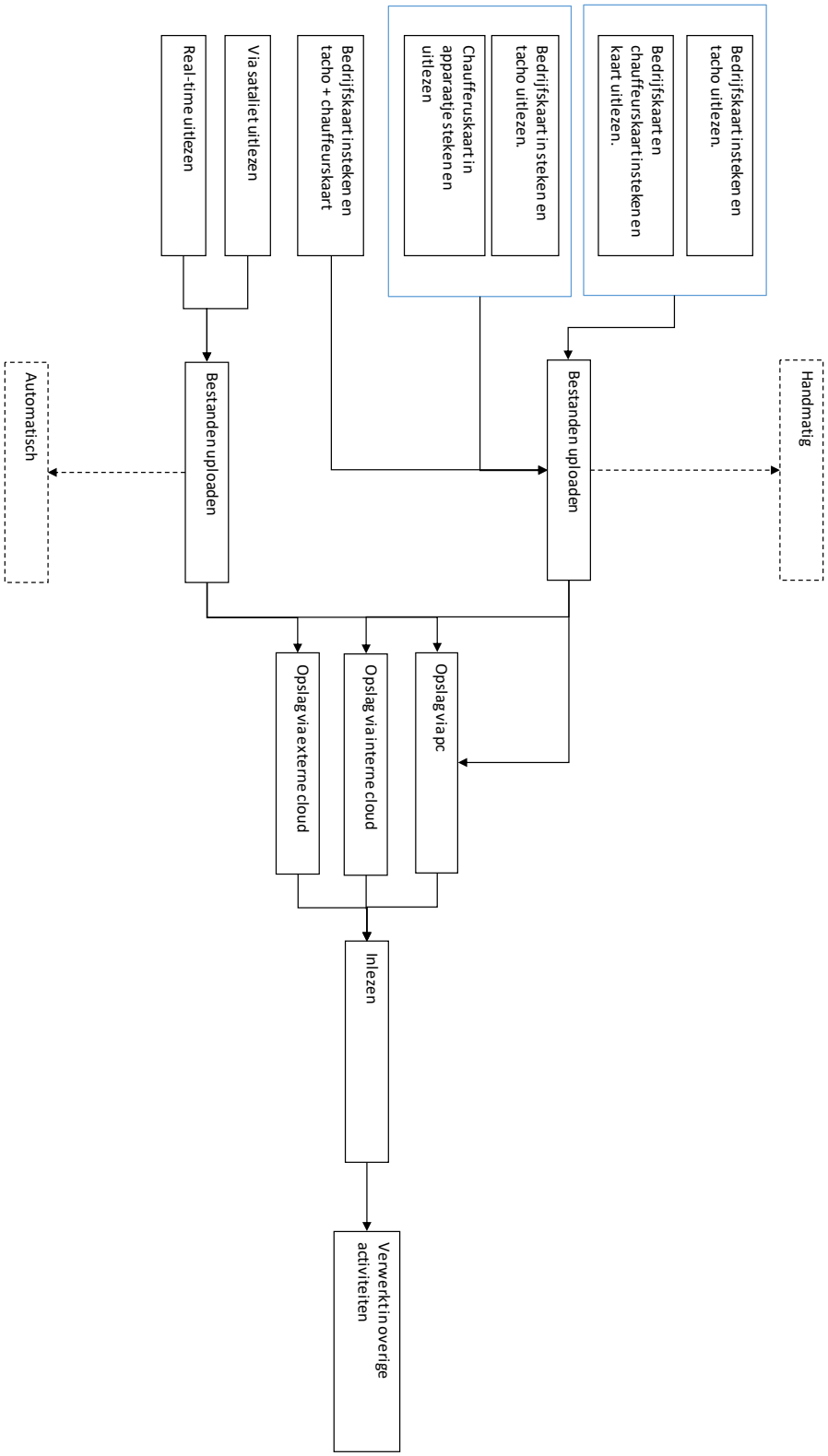
Appendix 5B. Requirements ACD

Portaal	Design	Support	Feedback
Introductie	Stappen indicator	Drie lagen support	Gebruik van positieve feedback
Introducerend filmpje (animatie)	Kleurgebruik (groen, rood, oranje)	Filmpje	Positief kritische opmerkingen
Aangeven wat de gevolgen zijn	Simpel en motiverend taalgebruik	Chatfunctie	Directe feedback
Privacy statement	Rolmenu, beperkte keuze	Telefoonnummer	Historie inzien
Uitnodigend (taalgebruik)	Uniform taalgebruik	Handleiding	Score/Benchmark
	B1 taalgebruik	Pop-up	Indicatie van ontvangst
Inloggen	Stylesheet	Q&A	Advies geven
Inloggen voor gemachtigen	Feedback aannemen van gebruiker	Voorlichting	Feedbakc naar ILT
Automatisch invullen bij handmatig invullen (dmv KVK)	Versie laten zien		Begeleidende tekst bij score
E-herkenning verplichten	Proces op elk moment stoppen en oppakken		Wanneer iets terug ontvangen
Vragenlijst			
Kentekens weergeven			
Filter op categorie			
Filter op grootte bedrijf			
Aangeven als geen vervoer is verricht			
Grootte aangeven (wagens/chauffeurs)			
Koppeling NIWO			
Data uploaden			
Maximaal één extensie toelaten			
Is multi-upload mogelijk (capaciteit)			
Automatisch gegevens ophalen			

Appendix 5C. List of requirements for ILT.

Portaal		Design		Support		Feedback	
Introductie		Simpel en motiverend taalgebruik	**should**	Meerdere lagen support	**should**	Foutmeldingen	**should**
Uitnodigend (taalgebruik)	**should**	B1 taalgebruik	**could**	Filmpje	**could**	Indicatie van ontvangst	**should**
Algemene informatie	**should**	Stylesheet	**could**	Handleiding	**could**	Wanneer ze iets terugontvangen	**should**
Introducerend filmpje (animatie)	**could**	Stappen indicator	**should**	Q&A	**should**	Score / benchmark per sector	**should**
Periode van aanleveren aangeven	**should**	Gebruik van kleur ter indificatie (groen, oranje, rood)	**could**	Pop-up	**should**	Vanuit score verder klikken naar overtredingen	**would**
Extensie bestand aangeven	**should**	Meerkeuzevragen	**should**	Chatfunctie	**would**	Positief kritische opmerkingen	**should**
Aangeven wat de gevolgen zijn	**should**	Stapsgewijs	**should**	Helpdesk (telefoon/email)	**could**	Begeleidende tekst bij score	**should**
Privacy statement	**should**	Proces op elk moment stoppen en oppakken	**should**	Whatsapp	**would**	Advies om te verbeteren	**should**
		Versie laten zien	**would**	Voorlichting	**would**	Tijdspad om te verbeteren	**should**
Inloggen		Simpel, zakelijk, effecitef design	**should**			Directe feedback	**could**
Inloggen met e-herkenning	**should**					Historie inzien	**would**
Mogelijkheid om e-herkennng aan te maken	**could**					Feedback naar ILT	**could**
Aangeven welk level van e-herkenning nodig is	**could**						
Derde partij of gemachtigde laten inloggen	**should**						
Inloggegeven onthouden	**would**						
Automatisch invullen bij handmatig invullen (dmv KVK)	**could**						
Inloggen via de mobiel	**would**						
Vragenlijst							
Meerkeuzevragen	**should**						
Gegevens van tevoren weergeven (personalia & kentekens)	**could**						
Keuze uit branche	**could**						
Keuze tussen eigen vervoer en bedrijfsvervoer	**could**						
Aangeven wat de grootte van een bedrijf is	**could**						
Mogelijkheid om een opmerking toe te voegen (vrijstellingen, geen vervoer & uitleg)	**could**						
Koppeling NIWO nummer	**could**						
Voorbeeld (I) geven van briefhoofd nummer	**could**						
Data uploaden							
Periode van aanleveren aangeven	**should**						
Maximaal één extensie toelaten	**should**						
Is multi-upload mogelijk (capaciteit)	**should**						
Rechtstreeks de bestanden uploaden (automatisch of via link)	**would**						
C en M bestanden apart anleveren	**could**						
Bestanden inslepen	**would**						

Appendix 6. Process scheme



Appendix 7. List of abbreviations

ILT: Inspection of Living environment and Transport

HCI: Human-computer interaction

ACD: Activity-centered design

HCD: Human-centered design

TPB: Theory of planned behavior

TAM: Technology acceptance model

UTAUT: Unified theory of acceptance and use of technology