Personas as drivers

An alternative approach for creating scenarios for ADAS evaluation

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Abstract

Research and development on vehicle safety has lately started to direct its focus towards how to actively support the driver and make it easier for her to drive safely through letting Advanced Driver Assistance Systems (ADAS) have effect on how the driver interacts with the vehicle and the surrounding traffic. This requires research on both how the driver and vehicle perform in different situations, in terms of psychology, cognition and individual differences. In addition, physical limitations and requirements of the driver and the vehicle must be taken into account. Therefore scenarios for evaluation of these systems are required. In the area of user-centered design a rather new method, Personas, is being adopted. This thesis tries to explore if the Persona method is a viable tool for creating scenarios for such evaluations. Experiences after completing this work imply that personas indeed is a viable way to include aspects and raise issues concerning individual variability and situational context in ADAS scenarios.

Keywords: User-centered Design, Scenarios, Personas, ADAS, Ecologic validity, evaluation, personal needs and goals, individual differences, situational context, secondary tasks, qualitative method.

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Summary

A literature study was conducted along with a study of statistical customer data. The information from the studies was used as a foundation for 14 semi structured deep interviews. The material gathered from the interviews was then analysed in affinity diagrams to extract essential information from the respondents to use when creating the personas and scenarios. Creating the scenarios included the creation of a scenario template where outer- and inner variables were separated. The inner variables were dependent on each one of the created personas. The scenarios together with the personas functioned as a starting point for the creation of the final narrative scenario descriptions.

From our 14 interviews we were able to create four personas with different personalities that did not overlap. We were also able to identify tasks and distractors in the driver environment found in earlier studies. These findings were also accompanied by information about how, when and where the tasks were carried out and the drivers' attitudes towards different tasks. Moreover we were also able to extract the drivers' experienced perception of distractors and their willingness or aversion to engage in different tasks.

From the personas we were then able to make assumptions about their behaviour and possible in-vehicle environment in two specific road situations. As all of the four personas were exposed to both situations eight narrative scenarios could be formed.

The purpose of this thesis was to explore how pre-studies for designing evaluations and experiments for Advanced Driver Assistance Systems can be carried through to include individual factors and differences. Our assessment in trying to achieve this was to use Personas as a foundation for developing in-vehicle scenarios for driving cars. The problem statement that has been guiding us through the work was stipulated as follows:

Can personas be a possible tool for extracting the individual context inside a vehicle in everyday situations?

Is involving personas in the creation of ADAS scenarios a viable way to establish/stipulate user-specific information?

Explore whether personas can contribute to ADAS scenario creation? What is that contribution?

We believe that our results show clear examples of personal and contextual variability in everyday in-vehicle situations that the ADAS are thought to function in and are of the opinion that personas and the methods used to create them may indeed be a feasible way to extract user-specific information to include in the ADAS scenarios.

By using personas we believe that we have been able to capture some of the qualitative aspects that are brought up in the discussion about the introduction of ADAS and their effects that was mentioned earlier in this report.

We also believe that we through the interviews have gained information about user/driver behaviour, their habits and attitudes towards technology and situations in traffic which was useful to the process of scenario creation.

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1 Introduction

Vehicle safety researchers have lately started to direct their focus on how to actively support the driver and make it easier for her to drive safely by using active safety systems support the drivers interaction with the vehicle and the surrounding traffic. This demands research on both how the driver and vehicle perform in different situations, in terms of psychology and cognition, as well as taking physical limitations and requirements of the driver and vehicle into account. Until today researchers has been focusing on how to avoid accidents and incidents through analysing earlier cases and trying to establish their causes. Within the automotive industry there is a recent trend to develop Advanced Driver Assistance Systems (ADAS) that are supposed to assist the driver in avoiding accidents before they occur. There are at present two directions in the research and development of these systems; 1) development of systems that intervenes when incidents occur to assist or make the driver attentive on presumptuous accident situations, 2) development of systems that intervene when the driver is assumed to have lost control over the driving situation and an accident is a fact/unavoidable. An example of the latter is an anti-collision system that actively brakes immediately before a crash if the driver for some reason has not.

The early development and testing of these systems often focuses more on technical aspects concerning the implementation of the systems in the vehicles. Questions like when, where, how and why one should present warnings to the driver of the vehicle are often left to be considered at a later stage. One big issue that arises when considering how warnings are best presented to the driver in a given situation is which modality or which combination of modalities to use. The modalities in focus of today's experiments are visual warnings, auditive warnings, haptic warnings and different combinations of them. The outlines for the test scenarios are often narrowed down to measure system performance in aspects of the drivers' cognitive capabilities concerning the drivers' perception of system presentation and the drivers' response. The test environments hence often lack the naturally rich context and individual variability of the driver.

In their article "An Overview of Advanced Driver Assistance Systems (ADAS) and Possible Human Factor Issues" Lindgren and Chen (2006) present several systems, some of which is already on the market, and the modalities that they use to warn the driver in a given situation. The research concerning which modalities are best suited for specific situations is still ongoing by both the commercial and academic worlds of research, even though early versions of some of the systems already exist on the market. The results seem ambiguous since different results are obtained depending on how the experiments are set up. Variables such as which distractors that are used during the experiment have great impact on the results. Different solutions implemented by different manufacturers could be a cause of differing results from the experimental stage of the development process. Citroën has chosen haptics to make the driver attentive on crossing the lane markings by letting the side of the seat closest to the crossed lane marking vibrate. BMW also uses a haptic warning but gives the driver a warning by adding resistance in the steering wheel. Here the system also takes an active role in a possible risk situation by trying to get the car on the right path by slightly steering the car back to the correct lateral position on the road. This solution lets the driver override the system at will by simply continuing to turn despite the resistance in the steering wheel. The overall purpose of these so called Lane Departure Warning systems is to avoid dangerous situations from occurring due to loss of attention or distractors such as mobile phones or fatigue (Lindgren & Chen, 2006)

When it comes to adapting ADAS to different driver behaviours Lindgren & Chen mention that there are several approaches that focus on different aspects and types of problems. Some research shows that Adaptive Cruise Control (ACC) can increase the performance of secondary tasks in the vehicle. The same study showed that the reaction time to discover dangerous situations increased when drivers used ACC (Rudin-Brown and Parker, 2004, in Lindgren & Chen, 2006). In order to handle problems like these, solutions are proposed where the ADAS are dynamically adjusted to the drivers behaviour and by that trying to hide the vehicles improved behaviour from the driver, hence forcing the driver to subconsciously adapt to the actual results in different situations, rather than the expected (Kovordányi et al. ,2005, in Lindgren & Chen, 2006).

Young, Reagan and Hammer have done an overview of the state of the vehicle safety research in their article "Driver Distraction: A Review of the Literature" (2003). In the article they present the distractors that have been identified so far (until 2003), how they have been identified and different methodological procedures to measure the impact these distractors have on driving. The National Highway Traffic Safety Administration (NHTSA) has identified four overall categories of driver distractions; Visual-, Auditive-, Bio-mechanical- and cognitive distractions. In their report, Young et al. (2003) chose to divide the sources of distraction in technology-based (i.e. mobile phones, stereo etc) and none technology-based distractors (i.e. conversations with passengers, eating, drinking and smoking etc).

In the article Young et al. brings forth that a lot of today's research is focusing on the technology based distractors since there is a consensus that they are likely to be the underlying reason for many of the incidents that occurs on the road. The increasing number of technology based distractors inside the vehicle has also gotten a lot of attention in the research on none-technology based distractors. Controversially enough the new active safety systems can also be categorized as technology based distractors due to their features and warnings. Lindgren and Chen (2006) present possible human factor concerns for ADAS and puts forth the importance of designing the systems in a way that is as suitable for humans as possible in order to not counteract its own purpose through increasing the cognitive and mental workload and/or lessen situation awareness. Other aspects they bring about are the importance of noticing how the driver behaviour is affected by the ADAS. Exaggerated or nonexistent trust or faith in the system for example, can have large effects in critical situations. They also point out the importance of approaching questions concerning the driver's behaviour in combination with ADAS. These aspects stretch from the drivers specific attitude towards leaving certain functions in the hands of the system, or adapting to the system carrying out some tasks, to more personal and individual factors of the driver such as stress and the drivers expectations and attitudes towards the system. The individual context in different situations, and the non-technology based distractors included in it, can also affect the driver behaviour and thereby also the total performance (Vlassenroot et. al, 2006; Harbluk & Noy, 2002).

A deduction made from above paragraphs is that issues as driver in-vehicle behaviour, trust, attitudes, secondary tasks, driver variability and context, may have influence on the driving situation and therefore needs to be thoroughly established and described in order to certify that the ADAS achieve the intended effect.

1.1 State of the art in ADAS evaluation

Active Safety Systems is a fast growing area of interest in the automobile industry. Systems to make the driver situation safer are developed in a fast rate. Examples are Adaptive Cruise Control (ACC), Forward Collision Warning (FCW) and Lane Departure Warning (LDW). In order to implement these new systems in cars they have to be thoroughly tested so that they bring about the intended effects. Experiments are often carried out through studies in simulated environments and these test situations often differ from real life situations in a way that makes it difficult to generalize the results to real driver situations. This because experiments often push the driver to his/hers limits in one way or another in order to find out how the system or the driver performs under the given circumstances. These laboratory experiments provides measures of performance in terms of hard facts that are comparable to data from other studies such as reaction time, different kinds of distance measures, incident/accident frequencies, speed or other technical aspects of the system/human performance. A known obstacle for laboratory experimental testing is the ecological validity of the experimental environment.

A low level of ecological validity makes it difficult to generalize the result of the studies to real world situations. This makes trying to make the experimental test situation resemble the real world as much as possible an obvious area of interest. The striving towards a higher level of ecological validity has lead to adding distraction tasks into the driver environment. To this day the added distractors are often purely designed for the experiment in order to maintain constant variables and making the experiment easy to replicable. Apparently the ecological aspect of the experiment has been a concern for the designers of the experiments since they are letting test drivers of driving simulator tests sit in real car or replicas of real cars and spend a lot of money creating virtual environments simulating g-forces and adding dynamic 3D-graphics. Put aside is the dynamics of the individual driver and his/hers dynamic in-vehicle context with all its variables that most certainly will affect the behaviour of the driver and thereby also the outcome of the experiment. Indeed those issues are taken into account in methods and disciplines related to user-centered design. A possible reason for not including these aspects could be that there is no out spoken method of gathering and presenting the issues of individual differences among drivers and their environments for the domain of experimental evaluations of ADAS.

1.1.1 Stakeholder routines

After reviewing the literature on how current practices in ADAS development are dealing with the individual variability in users/drivers without having any success in finding relevant documentation we talked to people involved in design, branding, market intelligence and system development at the stakeholders. All gave the same impression. None of the departments seemed to have any established method for paying attention to individual differences in drivers. Indeed, the market intelligence department regularly makes extensive customer inquiries investigating customer demographics and other particulars. The information gathering procedure is focused on getting to know as much as possible about the individuals as possible members of a customer group. The gathered information is used to some extent by several instances. At product planning for example, the information is sometimes used in focus groups where experts from different disciplines are creating target customers who are detailed descriptions of fictive buyers of cars that are yet to be designed. The use of the target customers often ends in a phase where a conceptual design of the product is achieved and does not seem to be used or considered when designing or evaluating separate functions and systems of the car very often. In the cases where the information is used in system or function design the original purpose of the target customers as potential buyers, not users, makes them inapplicable due to lack of aspects of relevance concerning important user perspectives and dimensions tied to the specific system or function.

A problem for the vehicle industry, as well as for other domains, is their strive to satisfy a large target group. In their strive for customer satisfaction they often tend to make their product as broad as possible by adding functionality to suit as many users as possible. According to Cooper & Reimann (2003) there are always risks when adding too many constituents to a product. It will probably increase the users workload, cognitively or/and physically, and increases the risk of ending up with a product that does not make anybody satisfied (Ibid.).

No matter how much demographic data one collects from the customers it is difficult to make statements about the user in the usage situation. The demographic data is very useful when trying to define markets and establish if and why people will buy a product but it is not as useful when trying to say how it will work, how it will be used or look and feel (Cooper & Reimann, 2003). There are several reasons for this; the customer may not be the same as the user (Pruitt & Adlin, 2006), demographic data does not reflect situations of use nor does it reflect user needs or user goals in relation to the use of the product or the situation the product are meant for (Cooper & Reimann, 2003). The demographic data may reflect purchasing power, purchasing habits and purchasing behaviour and sometimes also lifestyles but may be less useful for making statements and assumptions about user behaviour in relation to the product. The demographic data may indeed be used to inform the design process but it is a necessity that it is accompanied and or complemented by qualitative user data (Ibid.).

At the stakeholders they are running thoroughly experimental testing on how systems are perceived and received by test persons. This stage of the development process, when the systems are almost ready to be implemented, seems to be the first time in the design process that respect is taken to presumptive end users. In the software industry the trend is lately to engage in a more user-centred way of research and development. The underlying reason for this approach is the belief that an early focus on the user will lead to earlier detection of problems in the design and at the end also lead to products that are more satisfactory and more usable for the end users.

1.2 Personas in short

Since quantitative data is easier to grasp and convey, methods that gives quantitative results is often preferred not only at the stakeholders but in most other industries as well. Submitting to the view that 'numbers don't lie' could sometimes be deceiving. Cooper & Reimann stresses that when trying to reduce human behaviour into statistics one are likely to overlook important nuances that may not directly affect the business plan but may have an enormous effect on the product design.

In the area of user-centred design in software development Alan Cooper introduced a new design tool in 1999 in his book '*The Inmates Are Running the Asylum'* called *personas*. The basic idea behind this design tool is to develop a precise description of the users of the product in focus of the design and what the user wishes to accomplish. (Cooper, 2004)

Cooper advocates that instead of using the uninformative and imprecise word 'user' to describe a person who is to use a system one should talk about a specific user by name in order for the discussion to be fruitful. The term 'user' gives room for diverging conceptions of the user. Instead he proposes a description of a person that one can get to know and get a feeling for. A persona is a hypothetical archetype of real users described in great detail and defined by their goals and needs, rather than just demographics. The persona description always includes a name, a picture and a description of the persona as a person, not solely in the context of the system you are designing but also in the personas everyday life. In order to be able to accomplish such a detailed user description one have to gather qualitative data about actual or presumptive users. The persona method suggests qualitative information gathering methods such as interviews and observations. The methods can be used standalone or complemented by more quantitative research methods.

Quesenbery (2006) stresses that Personas help you to understand the user. Not as a part of a group or a demographic but as a person, an individual with goals, a history, interests and a relation to the product.

1.3 Purpose

The purpose of this thesis is to explore how pre-studies for designing evaluations and experiments for Advanced Driver Assistance Systems can be carried through to include individual differences and individual factors. The approach is trying to achieve this through using Personas as a foundation for developing in-vehicle scenarios for driving cars. The problem statement that has guided the work has been stipulated as follows:

Can personas be a possible tool for extracting the individual inner context inside a vehicle in everyday situations?

Is involving personas in the creation of ADAS scenarios a viable way to establish/stipulate user-specific information?

Explore whether personas can contribute to ADAS scenario creation? What is that contribution?

1.4 Targeted readers

This thesis is primarily written for students and professionals with in the areas of interaction design and cognitive systems engineering with interests in methodological aspects of evaluation of complex cognitive systems.

1.5 Disposition of this report

Apart from the introduction, this report is divided into five major parts. First, a theoretical framework is presented including theories that are directly or indirectly related to this thesis work. Part two and three are sections that sequentially deal with theory, methods and the results of creating the personas and the scenarios. Part four deals with the response we have got when presenting our work at our stakeholders. Part five is a discussion of the results and the methods used to achieve them. It also includes a discussion with more general reflections on the problem area per se.

As the underlying reason for this thesis is the fast paced development of the new active safety systems in cars, we start off by giving a brief introduction to the systems that we chose to keep in mind during throughout this thesis.

1.6 The ADAS

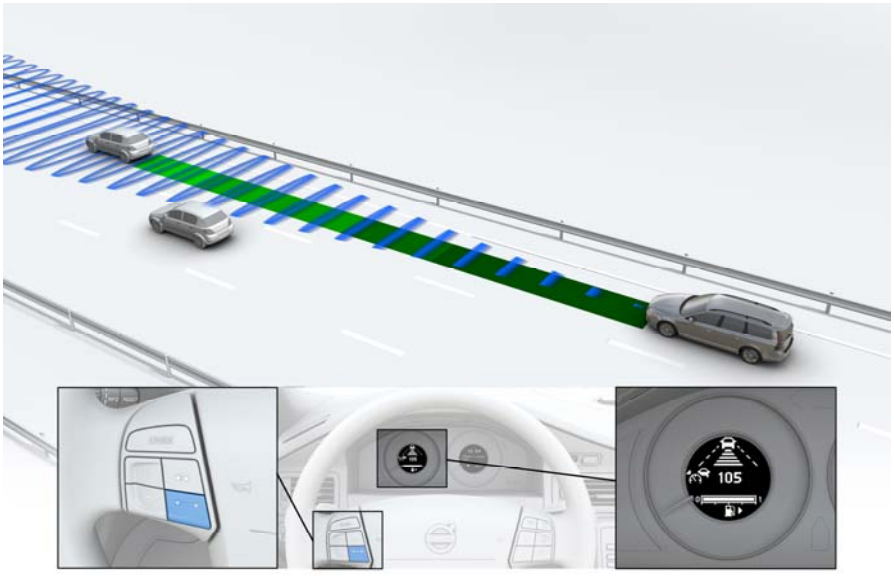
There are several ways of categorising the different safety systems. One way is to divide them into longitudinal and lateral safety system. The longitudinal systems assist the driver concerning obstacles in front or behind the car. An example of a longitudinal system is the Forward Collision Warning (FCW) that warns the driver if he or she is about to collide with the vehicle in front. The lateral systems assist the driver concerning potential risks or danger in the lateral direction of the car. Lane Departure Warning is an example of a lateral system. It gives the driver a warning if it interprets a movement of the car as unintentional wandering sideways. Put together all these systems goes under the name Advanced Driver Assistance Systems, also known as ADAS.

Our assignment at Volvo was to create everyday scenarios for Advanced Drivers Assistance Systems, consequently a choice of systems to have in focus had to be made. The following section covers the ADA-Systems in focus throughout the report. The systems are presented with their intended functions and are examples taken from the categories longitudinal and lateral systems.

1.6.1 Adaptive Cruise Control

Adaptive Cruise Control (ACC) is a sensor (laser or radar) based system that monitors the traffic and adapts the speed of the vehicle to the traffic flow longitudinally. If the system is on and it detects a slower moving vehicle in the same lane it decelerates the speed of the car to ensure that the pre-set safety distance is ensured. When the system no longer can detect a vehicle ahead in the same lane it accelerates to the pre-defined speed again. (BMW, 2005)

The driver has to activate the system every time he/she wants the ACC to take over the speed control. The driver chooses the preferred maximum speed through activating the ACC when the car reaches that speed and at the same time he/she has to make a choice of minimal distance to a vehicle in front. (Volvo, 2005)



The pictures shows samples of system functionality and graphical interface of the Adaptive Cruise Control (www.media.volvocars.com)

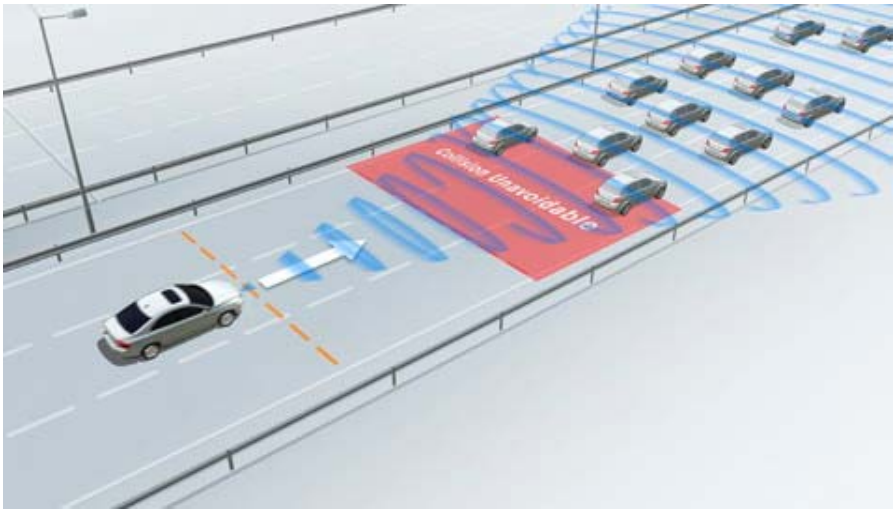
1.6.2 Blind spot Information System

The Blind Spot Information System (BLIS) helps the driver to detect vehicles in the critical area on the side just behind the car, also known as the Blind spot. Cameras in the lateral rear view mirrors detects objects, i.e. vehicles or pedestrians, coming up from behind and the system then alerts the driver by giving him/her a visual warning signal. (Volvo, 2005; Siemens VDO, 2005)

The pictures shows samples of functionality and signal design of The Blind spot Information System (www.media.volvocars.com)

1.6.3 Forward Collision Warning

Forward Collision Warning (FCW) is a longitudinal warning system that warns the driver of obstacles ahead of the vehicle. Its sensors are either based on radar or laser and measures the distance, the angle and relative speed of the obstacle ahead. The system constantly scans the road ahead and decides whether or not the vehicle is in imminent danger of collision. If there is a vehicle or an object in the same lane and inside the pre-defined closing time threshold and hence risk for a collision, the system gives the driver both an audible and visual warning. These time thresholds are set by the systems manufacturer. (Federal Motor Safety Carrier Administration, 2005)



The picture shows the system functionality of the Forward Collision Warning system. (www.media.volvocars.com)

1.6.4 Lane Departure Warning

Lane Departure Warning (LDW) detects unintentional lane departures and is triggered automatically when the driver lets the car wander out of its current lane without using the turning signals. Sensors or cameras keep track of the road markings and when the car crosses the markings without its indicators being used the system gives the driver a warning through a buzzer sound (Volvo LDW). Different manufacturers have different opinions on what warning modality to use. The system is only active during high speed driving, i.e. speeds over 60 kph. (Citroën, 2006; Volvo, 2005; Federal Motor Safety Carrier Administration, 2005)

1.6.5 Driver Alert System

Driver Alert system is a future system that consists of cameras to measure if the car is following a reasonable path relative to the road markings. The system senses if the driver is alert by calculating if the driver keeps a steady course. When the system detects unstable/unsafe driving, an auditive signal sounds and a message is shown on the display and then it is up to the driver to take a decision about whether or not to continue driving. (Volvo, 2006)

2 Theoretical framework

In the area of human machine interaction, scientists and researchers are trying to establish what factors/variables may have an impact on human performance or behaviour in cognitive systems interacting or using technology. This is also the case for the automotive industries. The theories are often grounded on cognitive theories about human mental and physical capabilities. From these theories, researchers have brought up many related issues and factors. Some of them thought to affect human in cognitively complex and demanding situations.

In vehicle industries researchers are trying to reduce the factors having a negative impact on human performance and driver behaviour and trying to compensate gaps in human capabilities by means of new technology and new design solutions. The following chapter will give a brief reminder on relevant theories of cognition and behaviour along with an introduction to concerned areas of interest of this report. Besides being relevant areas of interest for our work the matters below has also served as input when generating questions for our interview series.

2.1 Human factor implications

When it comes to the new ADAS systems there are many factors to be considered, especially the factors concerning the driver i.e. the user of the system. Introducing the ADAS systems into the cockpit in cars will inevitably lead to an introduction of new, or at least altered, information to the driver. Looking into when, how and if to present this information is of obvious importance. According to Iqbal et.al (2005) users performs tasks slower, commits more errors, makes worse decisions and experience more frustration, annoyance and feel more anxious when applications interrupt at an, for the user, inopportune moment during task execution. For further information on mental workload see appendix 1.

In order to lessen the level of mental workload on human operators many solutions are presented. One of the solutions to be considered is automation. Automation can be defined as a machine, in most cases a computer, carrying out a function that earlier has been carried out by humans (Parasuraman, 2000). The improvement of computers and technology concerning speed, capacity and “intelligence” has lead to that more and more tasks that formerly were carried out by humans now, to a larger extent, are assigned to computers, in recent time also complex cognitive tasks as decision making and planning. As the possibilities for automation has increased and the range of what can be automated have become larger there is also an increasing need to look further into what, how, if, in what way and on what grounds one chooses to automate ones systems or processes. (More on automation in appendix 2)

Although automation can be a viable answer to lessen the drivers workload there are still some implications about its effects on the drivers situation awareness which is the drivers awareness and conception of the current situation in terms of having the right perception of the surrounding elements, comprehending and correctly interpreting those elements to project possible future or upcoming events in those surroundings (Endsley, 1988 in Endsley, 2001).

The ability to project the near future of one’s surroundings is something a automobile driver uses continuously in order to choose the most favourable action to meet his/her objectives. The complexity of the environment inside and outside the car imply that several factors have impact on how good or bad a person’s situation awareness is/get. Factors as how easy it is for that person to perceive the situational cues, how complex the situation is and how high the

degree of mental workload is all affect one's ability to form a correct awareness in a specific situation and are important areas to be considered when developing the new ADAS systems (For more information on SA see appendix 3). Accordingly, automation may lead to better situational awareness through reducing the mental workload by relieving the driver from complex tasks. On the other hand it could lull the driver into a sense of security that reduces the driver's over all attention and thereby also the driver's situational awareness (more on attention in appendix 4). Therefore it is of importance to carry through thorough investigations when automation is considered as a solution in a critical and complex system.

2.1.1 Driver distractions and secondary tasks

According to Ranney et al. in the paper *NHTSA driver distraction research: Past, present, and future* (2000) a "Driver distraction may be characterized as any activity that takes a driver's attention away from the task of driving" (Ranney et al., 2000, p. 1). Ranney et al. categorizes the distractions in four categories; "visual distraction (e.g., looking away from the roadway), auditory distraction (e.g., responding to a ringing cell phone), biomechanical distraction (e.g., manually adjusting the radio volume), and cognitive distraction (e.g., being lost in thought). Many distracting activities that drivers engage in can involve more than one of these components (e.g., visually searching for a control to manipulate)." (Ranney et al., 2000, p. 1). However a more recent and more comprehensive definition is proposed by Pettitt et al. (2005) in *Defining driver distraction* the authors in addition to dividing the distractions in previous four types of categories also stress the importance of dividing them further into internal and external distractions to the vehicle. Internal distractions are accordingly the distractions that "can be categorised as both driver initiated, e.g. making a mobile phone call, or non-driver initiated, e.g. the unpredictable actions of a passenger." (Pettitt et al., 2005, p. 6). Regarding the external distractions Pettitt et al. makes it clear that it is suggested that "all forms of external distraction could be said to belong to be non driver initiated, e.g. the unpredictable behaviour of a drunk pedestrian" (Ibid.) In their proposed definition of driver distraction they propose a four component model and argue that it should be discussed in terms of: "the difference between distraction and inattention; the recognition that distraction can be internal and external to the vehicle; that distraction can be categorised into four types; and, the effect of distraction on the driving task." (Pettitt et al., 2005, p. 11). The four key components that constitute the definition are; impact, agent, mechanism and type and the proposed definition is that:

"Driver distraction occurs when:

- A driver is delayed in the recognition of information necessary to safely maintain the lateral and longitudinal control of the vehicle (the driving task) **(Impact)**
- Due to some event, activity, object or person, within or outside the vehicle **(Agent)**
- That compels or tends to induce the driver's shifting attention away from fundamental driving tasks **(Mechanism)**
- By compromising the driver's auditory, biomechanical, cognitive or visual faculties, or combinations thereof **(Type)**."

(Pettitt et al., 2005, p. 11)

Pettitt et al. states that their definition primarily is based on what is provided in Young et al. (2003) where the authors present a compilation of current research in driver distraction,

identified sources of driver distractions and different methodological approaches for measuring their impact on driving. Some of the identified sources of distractors listed in Young et al. (2003) is recognized by the National Highway Traffic Safety Administration (NHTSA) (Ranney et. al, 2000) and provided by (Stutts et al., 2001) as:

- eating or drinking;
- outside person, object or event;
- adjusting radio, cassette, or CD;
- other occupants in vehicle;
- moving object in vehicle;
- smoking related;
- talking or listening on mobile phone;
- dialling mobile phone;
- using device/object brought into vehicle;
- using device/controls integral to vehicle;
- adjusting climate controls;
- other distraction; and
- unknown distraction.

(Stutts et al., 2001, p. 8)

Young et al. (2003) have chosen to further divide the different sources of distraction into the categories technology based distractions (cell phones, infotainment, etc.) and non-technology based distraction (i.e. conversations with passengers, food and beverages and smoking)

In the article it becomes clear that much of today's research is directing its focus towards the technology based distractors since there is a consensus that many causes that contributes to the incidents that occurs on the roads can be found therein. What also comes in to the light is that there has been very little research on the non-technology based distractors in combination with the increasing manifold of technology based distractors.

2.1.2 Trust

In the article ”Product liability for ADAS; legal and human factors perspectives” Kiliaan van Wees and Karel Brookhuis (2005) brings up trust among other perspectives for ADAS. Trust is certainly an issue when it comes to certain kinds of ADAS systems especially the kinds that brings automation to the vehicle and that takes some of the control away from the driver i.e. Adaptive Cruise Control. Wees and Brookhuis claims that it is of great importance whether a driver have any trust in automated vehicles or not. They raise questions like: Will the driver reclaim control of the vehicle when required, and which driving mode will the driver prefer, and will the driver accept supervision over an automated vehicle instead of driving themselves? They refer to studies that show that drivers does not always reclaim control over the vehicle in critical situations or if they do it is often to late. Hollnagel and Woods (2005) draws similar conclusions about automation where they stress that automation may bring the operator out of the loop i.e. in a supervisory mode of control the operator sometimes loose some situation awareness in situations where decisions are critically relying on it. This could be from overtrust in the system or the system reacting faster than the operator/driver leaving them out of the loop.

Itoh, Abe and Tanaka (1999) have shown that the level of operator trust in a system is heavily dependent on the system performing correct. The trust is significantly reduced if continuous malfunctions occur and eventually lost if the malfunction is repeatedly occurring. Interestingly they also found that discrete malfunctioning did not cause significant reduction of the trust in the system. Although they found that trust quickly returns under normal operating conditions and also that if the operator gradually experience more individual malfunctions, they become less susceptible for them. (Ibid.) The latter findings implicates that trust indeed is an issue to take into consideration when designing systems containing some sort of automation. The systems performance and function may have an impact on how the system is perceived by the user in forms of trust.

2.1.3 Attitudes and acceptance

A relative big concern for people adopting and accept a new system is the attitudes towards it. These matters have been brought up by several researchers. In his prize winning Masters Dissertation and student essay Ashley Curtis (2004) brings up concerns about some of the barriers in the individual and public adoption of ADAS. He claims that: “Attitudes are favourable towards such systems providing they can be switched off by the driver and negative when they cannot. There is, however, a general willingness to accept systems that remove some form of control from the driver, with 54% of respondents believing they should assist or take over from the driver.” (Curtis, 2004, p. 42) He also brings forth and refers to expert opinions such as Bachman et. al that suggests that:

> “if authority and responsibility are taken away from the driver and are delegated to a technical system . . . the driver tends to rely on these systems in all circumstances (“this is what the system is there for”)’. He therefore suggests that ‘The main key for enhancing road safety . . . is to direct responsibility to the driver, not to take it away from him’. “
>
> (Bachman et. al, 2000, in Curtis, 2004, p. 43)

Although above statement Curtis contends that attitudes are not one of the greatest barriers for introducing ADAS systems but rather responsibility and liability issues if the systems should

fail. Noticeable is that Curtis statement only brings up barriers for introduction and adoption of ADAS, not how adoption and attitudes may come into consideration over time after the introduction of the system.

In another article '*User Attitudes to automated highway systems*' Chalmers (2001) reports on research conducted in focus groups concerning user attitudes and acceptance on Intelligent Vehicle and Highway systems he concludes that: "attitudes are favourable towards systems which aids the drivers, but are less favourable towards more automated systems" and that "in-vehicle systems have more influence on driver behaviour than fixed information systems. Attitudes were most favourable towards those systems where the automatic driving mode is activated only in emergency situations where the driver has not responded to a warning." (Chalmers, 2001, p. 1) Chalmers also notice that previous research shows that drivers are individuals that may respond differently to the various components of an automated highway system. An interesting finding in Chalmers report is that "males, and drivers aged between 30 to 59 years were most enthusiastic about using the fully automated highway" (Chalmers, 2001, p. 5) and that car drivers 18-29 years became salient as a group that showed resistance and scepticism towards all automated highway systems. Noticeable also for this study is that the user groups were only presented concepts of the systems not yet in production.

As mentioned above research in above reports relied mostly on explorative studies on pre-production systems based on focus groups and interviews. In a combined study by Hoedemaeker (2000) involving both questionnaires and experiments in driving simulator testing the ADA-system Adaptive Cruise Control (ACC), he tries to answer questions concerning effects on driver support systems on behaviour and how the systems will be accepted by the individual drivers and also to what extent the driving behaviour and acceptance will be determined by individual differences. One of the conclusions for the ACC was that "The distinction in driving style between high and low speed drivers was found to be important in the acceptances of ACC. Both driver groups like driving with an ACC, but for different reasons. High speed drivers like the comfort of the system, whereas low speed drivers like the system's usefulness. This finding could be used in marketing strategies. In order to get both driver groups into ACC-cars they should be addressed differently. Most popular in this respect is the ACC where drivers can change their headway setting during driving, i.e. switch between short and longer headways depending on their personal preferences and the current situation." (Hoedemaeker 2000, p. 508)

Other conclusions suggest that high speed drivers increase their driving speed when driving with ACC which in turn may lower the overall traffic safety. Hoedemaeker also concludes that:

> "Dangerous overtaking behaviour and delayed reactions to traffic from the right were found in combination with an elevated heart rate. This clearly indicates that these traffic scenarios get more difficult when driving with ACC, whereas ACC facilitates driving in traffic conditions that were already not too complicated: motorway driving and car following-situations where ACC was originally designed to be used."
>
> (Hoedemaeker 2000, p. 508)

Findings mentioned above suggests that factors like acceptance of different ADAS and attitudes may have an impact on driving behaviour hence it should be taken into consideration when evaluating ADAS systems.

2.1.4 Variability in user characteristics

In the article *Search History for User Support in Information-seeking Interfaces*, Komlódi (2002, p. 54) states that "User profiles contain information about the user and his information needs, user characteristics and contexts." Komlódi call attention to taking user characteristics and context into account when designing systems for information seeking tasks where the design of the system can support the specific user's needs and tasks according to the context they use it in. As an example she mentions the task of information-seeking among legal practitioners. She states that this task is of great importance in this occupation and demands that they apply specific tactics to finding and using the information. (ibid.)
She further stresses that:

> "Information system designers and information intermediaries have long known and emphasized the importance of user characteristics in different information intermediation processes. Domain, system, and searching knowledge define user types and have effect on users' information- seeking skills and techniques."
>
> (Komlódi, 2002, p. 65)

When it comes to vehicle safety and driver characteristics Smith and Stevens at Transport Research Laboratory (TRL) (reviewed in *Identification of drivers needs and functional abilities in relation to new ITS systems and services*, 2006) covers and reviews what they consider to be three main driver characteristics in their report; demographics, personality and situation. They stress that:

> "To facilitate comparisons between studies, there is a need for automotive human factors researchers to better define, understand and manage driver characteristics. Appropriate identification of key driver characteristics is critical to helping researchers select representative samples, control data variability within a similar group, interpret results (make comparisons across groups), and generalize the findings."
>
> (Smith & Stevens 2006, p. 9)

Smith and Stevens (2006) categorizes:

- Sex differences, age, driving experience and driving habits as demographic characteristics
- Perceived risk i.e. sensation seeking, risk takers, risk aversive, aberrant driving behaviour as personality characteristics
- Fatigue and license status as situational characteristics.

However when describing characteristics they also mention the capabilities required to drive a vehicle as including: "threshold levels of motor response, attitude, sight, and hearing." (Smith & Stevens 2006, p. 9) but also: "In addition, drivers acquire habits, skills, and conditioned responses. Social and contextual factors also affect driving behaviour. It is hard to find examples of driver behaviour that are entirely free from social influences (i.e., social customs, habits, values and expectations)." (Ibid.)

2.1.5 Driver behaviour

In the areas of vehicle safety many researchers mentions driver behaviour as a major factor influencing the area. Albeit there are many more or less accepted definitions and models of driver behaviour ranging from different approaches of risk factors and task difficulty involving variables of biological characteristics, procedural knowledge and experience to the more classic human factor variables as; attitude, motivation, effort, fatigue, drowsiness, time-of-the-day, drugs, distraction, emotion and stress and motivational variables contributing to the drivers resource allocation (Fuller 2004). According to Vaa (2001, p 48) there is no "Great Unified Theory" neither is there a consensus about the underlying reasons of the different proposed driver behaviour models. In spite the lack of consensus there are some more or less used or adopted methods of accessing driver behaviour. One of the adopted methods of accessing and measuring of driver behaviour is the Driver Behaviour Questionnaire (DBQ) initially developed by J.T. Reason in the early nineties. The DBQ has since been revised by many and exists in many shapes and designs. The DBQ in general takes into respect driver errors and violations in traffic. The main assumption is that they have different psychological origins and demands different modes of remediation as they assume that errors are result from cognitive processing and violations includes motivational components and contextual demands (Özkan et al. 2006).

Another method of accessing behaviour is the Theory of Planned Behaviour Questionnaire (TpBq) which is based on the Theory of planned behaviour, which has its roots in social psychology. According to Ajzen (2006) this theory assumes that there is a connection between attitudes and behaviour and tries to predict the user's behaviour by getting to know their attitudes. Theory of planned behaviour has previously been used in vehicle research for trying to predict aggressive driving behaviour and speeding behaviour (Parker, 1998).

Above mentioned methods involves the use of surveys. A third more quantitative method is Galvanic Skin Response (GSR) which measures the subjects electrical resistance of the skin, has according to Vaa (2001) evident congruency with achievements in modern neurobiology. Where according to Vaa, "GSR rate is an appropriate variable of subjective risk as it is also analogous to a tension or anxiety level." (Vaa, 2001, p. 56). GSR is amongst others adopted in simulator studies in vehicle and aviation industries.

All in all, the models and methods used to model vehicle behaviour strives to accomplish valid ways to accommodate for measuring or bringing up the concerned factors in vehicle safety areas. The surveys try to get hold of the different hard to grasp factors and the GSR tries to measure and quantify them in a more technical approach.

There are numerous of other models of driver behaviour that insist on its important contribution to vehicle safety. Regardless of the way of modelling the driver behaviour, it is important to keep the concerns and issues it brings about in mind while developing ADAS. Some aspects of driver behaviour may not be easy to measure in quantifiable ways, such as certain aspects of attitudes, emotions and motivational variables et cetera, but nonetheless these are areas that should not be neglected.

2.2 User-centered approach

A user-centered approach to design basically involves finding out as much as you can about the targeted users and then using this information to inform design. The approach is rather to be seen as a philosophy than a technique. The best way to make sure that the user's activities are taken into account is keeping them involved throughout the whole process of development. By doing this it is easier for the designers to gain a better understanding of the users goals and needs, which hopefully leads to a more appropriate and usable product. The drive behind this approach is that the real users and their goals should be the driving force behind the development of a product, not the technology. A well designed system should support rather than constrain the user, make the most of the human skill and be directly relevant to the work at hand. (Preece et. al, 2002)

Preece et. al (2002) has pinpointed five essentials that should be paid attention to when submitting to a user-centered approach to design. First, as already mentioned, the user's tasks and goals should be the driving force behind the design. Second, the user's context and behaviour should be studied and the system has to be designed to support them. Third, the user characteristics have to be captured and designed for. Fourth, the users should be consulted throughout the development, from the earliest stage to the latest, and input from them has to be taken seriously into account. Fifth, all the design decisions should be taken within the context of the users, their work, and their environment.

In user-centered design there are different methods used to extract and communicate useful information and data about the users. A method that have been gaining ground lately is the Persona method which simplified is a enriched and communicative way of establishing and communicating data from the information gathered using various already established methods.

2.2.1 Issues and intentions revisited

As described earlier a big concern in the evaluation process of new features and signals in cars has been the ecological validity of the experiment settings. The critical situations like those who lead to involvement of the new ADAS (i.e. the drivers attention directed of the road for and extensive time) are hopefully occurring more seldom than often and are therefore not to be considered as normal conditions. These critical situations lie as a starting point for the design of most of today's experiment environments. What about all everyday situations not included? How will the systems affect the driver in those situations? What about the personal differences of the persons that drive the car, will they cause responses that differ from the thought? Do different people carry out different secondary tasks during driving? These are examples of questions raised in today's research that question the ecological validity of the results of the ongoing evaluation process.

We intend to explore if scenarios based on the Persona method can be created to include and communicate the driver's individual context and stipulate specific information about presumptuous users.

The following two chapters are going through the theory, the process and the results of the method which we used to create a description of everyday in-vehicle situations that the new ADAS are thought to function in. Even though there are a strong coupling between Personas and Scenarios they are divided into two separate chapters.

3 Persona development

The following section is an introduction to personas. It covers a brief review over its history, its purpose and the methods used when creating them, followed by our creation process and its final result.

3.1 Personas

In 1999 Alan Cooper introduced a new design tool called Personas in his book '*The Inmates Are Running the Asylum'*. The idea that lies behind this design tool is very simple:

> "Develop a precise description of our user and what he wishes to accomplish"
> (Cooper, 2004, p. 123)

Cooper thinks that the use of the word 'users' is to uninformative and imprecise to use when talking about those who are supposed to use a product, feature or whatever it is you are designing. Instead he proposes a description of a person that you get to know and get a feeling for. A persona is a hypothetical archetype of real users described in great detail and defined by their goals and needs, rather than just demographics. The persona description always includes a name, a picture and a description of the persona as a person, not solely in the context of the system you are designing but also in the personas everyday life.

The personas are involved through the whole design process and the focus of the design team lies in helping the personas to fulfil their goals. Helping the design team to keep focus on the users goals are one of the biggest benefits of personas along with being a tool for enhanced and improved communication. (Blomquist & Arvola, 2002).

3.1.1 Goals

As user goals in an essential constituent of the personas, it is important to understand the meaning/concepts of the term and its usage in the forum of interaction design.

Goals vs. tasks
Goals are not the same as tasks. A goal is an end state/condition whilst tasks are steps on the way to reach the goals. The goals are what motivate people to perform tasks. Goals are what drives people to do things and are driven by human motivation which according to Cooper & Reimann (2003) changes very slowly (if they change at all) over time. Tasks on the other hand are transient and rely on the technology at hand to a great extent. Looking at goals can help designers to eliminate tasks that technology renders unnecessary for humans to perform. (Cooper & Reimann, 2003)

Goals vs. features (& facts)
Many companies put value in adding features to their products. But according to Cooper (2004) users are not compelled by features. They simply wants their things to work, they only care about achieving their goals. The case could be that some features are needed to reach the goals but often additional features only lead to confusion amongst the users and hinders them from doing their work. This inefficiency leads to users feeling stupid and that stand in direct contradiction with one of humans highest prioritised goals, to not feel stupid. (Cooper, 2004)

3.1.2 The benefits of using Personas

When designers try to reach a broad audience, logic often tells them to make their product as broad as possible in terms of functionality. Doing so increases the risk of including too many constituents to the product and thereby enlarges the cognitive load on the users. Not knowing who you design for increases the risk of ending up with a product that does not make anybody sufficiently satisfied. (Cooper & Reimann, 2003)

According to Cooper (2004) you will have far greater success if choosing to design for just one specific person, a persona. The key is to choose the right individuals to design for, whose needs are representative for the needs of a specific set of constituents and knowing how to prioritize needs to address without significantly conflicting with the needs of the secondary users (Cooper & Reimann, 2003).

When a design team talks about users in general there is a big possibility that each team member's ideas of the user's needs and goals are quite different. The detailed description of a persona helps to prevent this. The personas being so specific and detailed are probably what make them powerful as design and communication tools. In order for the personas to have the right effect on the process and engage the team members in the personas and their goals it is important that they come to life. The embodiment of the user needs and goals through personas makes it easier for the design team to know what they are designing for and gives them a common understanding of the users that is easier to talk about and remember than a list of features and vague descriptions of the users. (Blomquist & Arvola, 2002)

Personas help you to understand the user. Not as a part of a group or a demographic but as a person, an individual with goals, a history, interests and a relation to the product. (Quesenbery 2006)

From the beginning personas were met with scepticism because of its 'soft', and thereby perhaps hard to grasp, way of adding value to the design process. Now the attitude towards it has changed and personas as a method, to complement other methods, is starting to get more widely used in several design areas in software and system development among others.

3.1.3 Knowing your users

The importance of knowing the users of a product and how your decisions are affected by this information are perhaps best shown in an illustrating common example:

> First imagine that you are a newly hired clerk working in a store for consumer electronics.
> A customer is on the phone and tells you that she is interested in buying one of those new digital cameras. The customer tells you that she wants the best digital camera she can get for her money. As you have quite a lot of different models with different features you decide to offer the customer a professional system camera with a lot of built in features. Since the customer wanted the best she could get, and this model is made for professionals this had to be the choice. The customer takes the offer and you order the quite expensive camera model from your head supplier. One week later the customer, a nice lady in her mid fifties comes to your store to pick it up and pay for it. After she had paid she asks you to show her how the camera works. You say to her that your really don't know cause this camera is for professional photographers, but tells her that the camera comes with a thick and comprehensive manual for all its features. The lady seems satisfied with the answer and leaves with the camera.
>
> After a week she returns with the camera and tells you that the camera didn't live up to her expectations. She tells you that she wanted to use the camera for taking pictures on a birthday party for one of her grand children but the pictures was all blurry and out of focus. She argues that she suspects there is something wrong with the camera.
>
> You have a look at the camera and its display and then look into the manual. You then find out that the camera is in its default manual mode and not in its optional automatic mode. You find out that when the camera is in manual mode the photographer has to manually adjust the focus and the shutter time of the camera. You now realize that this camera model is quite complicated to handle with all its features and optional adjustments for taking the perfect picture and that it is probably not a camera suited for the lady you now come to know as the distinguished grandma who just want to use the camera for taking pictures of her family and then store and view the pictures on her new computer she got from her children and maybe sometimes e-mail the pictures to other relatives. You tell her that she probably will get better pictures with a fully automatic digital pocket camera with a descent resolution. You buy the professional camera back, exchanging it for an in-stock nice priced digital pocket camera that is easy to use with the press of a button. The lady returns home with the new camera, calling you back in a week pre-ordering a second one for her husband.
>
> The lesson you learned from your experience with the lady was that you from now on is going to ask questions about the expected use of the gadgets you sell, and also try to get some of the context surrounding the customer, to try finding out and imagining the expected use of the gadget from the consumers' point of view. That is, if the lady customer was your mother you most certainly would now what type of camera would fit her needs and personal prerequisites.

The example above, although primarily based on fiction and related to the selling of consumer electronics, shows some issues related to concerns also central for a designer, i.e. it is of utter importance for the designer to know their users and who you are designing for as it is for the clerk to know his customers. Even though this is not an example of a design situation it illustrates how information about the users and the picture a designer has of the users can affect the design choices the designer makes.

3.1.4 Persona development process

Even though personas are fictional users of the system in focus of the design they are based on facts and data from real people that are presumed to be possible users of the product. There are numerous methods that can be used to collect the information needed for the persona creation, both quantitative and qualitative. Every method has its down sides and up sides so the choice of method has to be made with accuracy and with the system and its context taken into consideration.

As a design tool Alan Cooper (1999) says that it is more important for the persona to be precise than accurate, this to make it easier to know exactly what to design. Coopers advocates ethnographic interviews, observations and contextual inquiry as methods for collecting data to base your personas on (Cooper & Reimann, 2003). This of course presumes that you already identified who to observe and interview.

In comparison to Cooper, Grudin and Pruitt (2002) use a slightly different approach to gather information about the users. In order to enhance the accuracy in their personas without loosing any of the precision their approach includes a mixture of both the qualitative methods mentioned above and more quantitative methods and market research such as questionnaires and structured interviews. By combining qualitative and quantitative methods their aim is to ensure the accuracy of the outcome.

There are several methods to choose from when it comes to gathering information needed to create personas. A choice of method is not to be decided as applicable in every individual case and has to be fitted to the context, situations and the system in mind.

In the next step several personas are created based on behaviours and their associated goals found in the preceding studies. A distinct number of personas should be created to cover the whole range of behaviours. Ideally they should be created so that there is no overlap between them in order to keep the number of personas to a minimum. (Blomquist, 2002)

When a cast of personas are created a choice has to be made, who is the main target for your design? This persona is called the *primary persona* and he or she can not be satisfied by a system or an interface that has been developed with any of the other personas as primary. There are also other types of personas. *Secondary personas* for example, who are fully satisfied by the system developed for the primary persona with one or two additional needs that has to be addressed. When addressing these you have to be sure that they are not in the primary personas way. *Supplemental personas* are neither primary nor secondary but they are completely satisfied with one of the primary personas interfaces. *Served personas* do not use the product at all but they are affected by the use of it. Cooper & Reimann (2003) uses the illustrating example of a patient being treated with a radiation therapy machine, the patient is not the user of the machine but is served by a good interface. *Negative personas* are not users of the product and their purpose is purely rhetorical. They help to communicate who you are definitely not designing for. (Cooper & Reimann 2003)

For the personas to have the best effect the design team has to get to know them well. This makes a third person narrative a good choice for conveying the needs, attitudes and problems to the other team members. The typical length of a persona narrative is no longer than one or two pages and contains some fictional events and reactions. Despite this the narrative should not be seen as a short story. It should give the readers a fast introduction of the persona in

terms of job or lifestyle and put through a brief sketch of a typical day in the personas life including peeves, interests and concerns that concerns the product. “The narrative should express what the persona is looking for in the product by way of a conclusion” (Cooper & Reimann, 2003, p. 71). Giving the personas detailed descriptions is very important in order to make them come to life for the team members, but it is important that the level of detail in a persona description not exceeds the level depth of the research. (Ibid.)

Cooper & Reimann (2003) point out the importance of giving your personas a lively description and an easy to grasp detail. A detail that can have great impact on how realistic the personas come to feel for the team members is the photo. The photos make the personas feel more alive when you are creating the narrative and it makes them more alive and engaging for others when you are done. Therefore great care should be taken in choosing the persona photograph. The best photographs mediates demographic information, hints about the environment and the personas general attitudes. (Ibid.)

3.1.5 Personas and scenarios

In their article ‘Personas, Participatory Design and Product Development: An Infrastructure for Engagement’ (Grudin & Pruitt, 2002) bring up the issues on why scenarios formerly rarely were used in design because of them not always being empirically grounded. They suggest grounding them in ethnographic studies, contextual inquiry, demographic data or other information directly gathered from the participant users in order to certify a sufficient level of realism. Scenarios often are used *in place of* real data. The main issue is hence not the method per se, but how people have chosen to create and apply it. They also refer to findings by S. Bødker (2000) that it is important to use more than one scenario and that it is important that the scenarios are anchored to reality. Grudin & Pruitt (2002) further claim that personas; “is a foundation on which to build scenarios and data collection. It is an infrastructure for engagement. It is a means for communicating data that is collected using other user research methods.” (Grudin & Pruitt, 2002, p. 8) If used in this way it enhances the reality of the scenarios and makes them easier to relate to. Finally they also stress that the scenarios should be constructed around the personas and not the other way around as they are supposed to be considered and assumed as real people and not actors in a script.

Arvola & Blomkvist (2002) conclude that:

> “The scenarios developed from the personas can function very well in usability evaluations, where they can be used for writing test cases.” (Arvola & Blomkvist, 2002, p. 200)

Pruitt and Adlin (2006) also propose the usage of personas and scenarios together to inform test cases, they imply that used in the right way, they can provide “testers with a mechanism for pairing test cases down to a reasonable number” (Pruitt & Adlin, 2006, p. 413) They suggest that the personas in this approach can be used in ad hoc tests or ´bug bashes’ [sic!] in search for code bugs, user experience issues, performance issues et cetera. This is proposed to be done by loosely formed teams consisting of developers, designers, domain specialists among others.

The recommended way of approach in short, according to Pruitt & Adlin is;

> "To involve the personas, simply divide the bug bash participants into teams, one team per persona. Each team then reviews the persona descriptions and related scenarios and attempts to 'use' the product as if they where that persona, reporting bugs as they come across them. After some period of time has elapsed (e.g., four hours on a Friday afternoon), the bugs are counted and evaluated, removing duplicates and non reproducible issues. The results are then communicated back to the team per persona… Our experience in doing this has been quite positive. The bash participants enjoyed the challenge of trying to use the product as someone else and felt that the quality and types of bugs uncovered were good."
>
> (Pruitt & Adlin, 2006 p. 414)

3.1.6 Others experiences of using personas

Jonathan Grudin and John Pruitt at Microsoft talk of the benefits and pitfalls of personas in their article *Personas: Theory and Practice* (2003). They talk out of own experience since they used, and still use, personas in their design work on MSN Explorer and Windows. Their experience are that Personas alone can aid design, but they are more powerful when complementing other quantitative and qualitative methods rather than totally replacing them.

According to Grudin and Pruitt (2003) the greatest benefit of using personas are that they give the design team a common ground for communication and helps them keeping focus on users. From their experience they give examples on how designers, programmers and even Vice Presidents are using their personas as tools for persuasion. Expressions like –Alan won't like that… or –Alan will find that difficult… (with Alan being a persona) are examples they give from meetings and focus groups. In these cases the persona also works as an evaluation tool. Another benefit they found in using personas were that it help them keeping focus on a target audience. Personas can not cover all users at the same time but they can help you to concentrate sequentially on different kind of users by for example in one evaluation focus on Alan's scenarios and Kate's in another.

Although Grudin and Pruitt are mostly positive about using personas, they point out some possible pitfalls/downsides with them. As many are overwhelmed by the effects of using personas they tend to use them everywhere. Grudin and Pruitt explicitly point out the danger in reusing personas from one project to another without revising them since the target audience in different projects seldom has the exact same goals. They also give a warning hint that personas should not be overused. They should augment already existing design processes and increase user focus through enhancing user testing, field research, scenario generation, design exploration and solution brainstorming.

Many practitioners have tried to apply Coopers popular design method with differing results. The most common reasons for not reaching expected results are that the method only has been implemented partially, the personas are not communicated well enough and lack of understanding how to use them in a beneficial way. (Grudin & Pruitt, 2003)

3.2 Our Procedure

Below you will find a description of the method chosen to create our personas. The procedure included both quantitative and qualitative research methods.

3.2.1 Use and analysis of earlier quantitative studies

Every other year a pool of car manufacturers (of the same type of cars as Volvo) perform a customer survey in order to map out their customers and users. The information from this survey is very valuable to them in design, marketing and branding. Earlier customer surveys have resulted in a large database in which a lot of demographic information about the costumers is stored, i.e. hobbies, where they live, age, gender, income etc. This information was used to delimit the group on which the study was going to be conducted on. The information was also used in a later stage of the persona development process when adding demographic information to the characters that was created.

The assumption that Volvo is not only interested in the people that already drive their cars but in all possible future drivers, our focus was on the total result of the survey and not only on Volvos part of the survey. Therefore the only variable that came to function as criterion for the group to interview was age since that was the only variable where distinct demographic clusters could be identified. People that were to be included in the series of interviews had to meet the criteria of being in the age between 35 – 65 years old and have a driving license.

3.2.2 Main series of interviews

A series of 14 semi-structured deep interviews was conducted on participants that matched the criteria chosen from the quantitative data. The respondent group of the interview series finally consisted of 9 men and 5 women with an equable distribution of education level and size of town in which they lived.

From the interviews we wanted information on the drivers' attitudes, goals, needs and behaviour. Additionally we wanted information on user situations and distraction. In order to get as much personal information as possible about the respondents, one goal during the interviews was to let the interviewees tell as much as possible about themselves, both as drivers and as persons in general. Despite this, an extensive list of clarifying questions was prepared as backup if further information on certain topics was needed (see appendix 5).
The questions were organised in four main groups:

- Questions in relation to the car
- Questions on distractions and secondary tasks
- Questions concerning themselves as drivers
- Questions about themselves as persons in general

The questions were inspired by considerations and results from earlier studies made by others, such as Lajunen et. al (2004), Özkan (2006), Westerman & Haigney (2000) who used a variant of the Driver Behaviour Questionnaire originally developed by Reason et. al in the early nineties. Other questions were inspired by Stutts et. al (2003), Tijerina (1999), Ma & Kaber (2005), but were also based on topics and areas that we found relevant according to theories of cognition and design to show who the interviewees are as persons, as drivers and what their goals and needs are from different perspectives.

The interview series were carried through by two interviewers and each interview had length of approximately one hour. The two interviewers were present at the same time in one pilot interview and two of the 14 interviews in order to get a shared view on how the interviews should be carried out. All interviews were audio recorded with the interviewees' approval. There was no fixed amount of interviews set in advance, instead the interview series ended when the information from the interviews were found redundant.

All interviews were listened to by both interviewers and interesting parts (expressing goals, attitudes, needs, behaviour, personality or possible scenario situations) were transcribed on a phrase level which focuses on what principally has been said rather than on exact how the respondents said it (Linell, 1994). This resulted in an extensive list of expressions in a chronological order. The expressions in the list were later revised and expressions on similar topics were sorted under significant categories in a first version of a so called *Affinity Diagram*.

Affinity diagramming is a simple technique that can be used to understand and group large amounts of data and basically involves placing related information together. As a method Affinity Diagramming is mostly used in workshops where several participants work together to identify and discuss different issues. Still, affinity diagrams also function well when large amounts of data needs to be handled, for example when sorting information from contextual inquiry. (Gaffney, 1999)

Categories of the affinity diagram (translated from Swedish by the authors):

Safety	Car-dependency	Easily influenced
Economy	Sense of freedom	Trust
Environment	Hobby mechanic	Attentive
Performance	Sensation seeking	Quick-witted
Comfort	Sense of control	Purposeful
Quality minded	Altruistic	In need for affirmation
Practically minded	Aware of technology	Fatalist
Space favouring	Technology hostile	Analytic
Looks/Appearance	Adaptability	Anxious
Practical usage	Self-conscious	Educating
Joy rider	Absent driver	Self-confident
Frequent driver	Egoistic	Restless
Confident driver	Foreseeing	Preventive
Easy annoyed driver	Competitive	Considerate
Calm driver	The active driver	Personal particulars
Driver alone	Fawner	
Takes care of the car	Patience	
Like the car	Independent	
Likes driving the car	Impatience	

Below are some sample excerpts from the affinity diagram that shows expressions that were sorted under the categories Safety, Car-dependency and Trust.

Safety
Person 2
- I'm a typical caller… I know it's dangerous. I often call people from the car. I consider the time in the car as idiot-time and therefore try to make the most of it.

Person 3
- I don't like talking on the mobile phone while driving. If I must make or take a phone call, I drive to the side of the road.

Car-dependency
Person 6
- As I live on the country side I wouldn't get by without my car. I have to drive 15 km to work everyday. And on the weekends I visit my old mother who lives 50 km away.

Person 13
- The car is very convenient to have, but I believe that I would do rather good without it. The car is not that important to me.

Trust
Person 6
- I don't trust other drivers in traffic. That's one of the reasons I don't like having my grandchildren in the car.

Person 8
- I believe I subconsciously trust other drivers. Maybe I shouldn't, but I do.

Person 10
- I believe I'm calm in the car. I'm more worried about my fellow road-users. I have the idea that if I'm left alone I'm probably able to keep the car on the road. That may be an illusion but I would like to believe it's true. (said with irony)

The sample expressions above are only intended to give the reader of this report a formal hint on how the affinity diagramming was carried through. Subsequently the above categories contain further more aspects of the category. For instance, the category on safety also contains aspects other than mobile telephony, such as passive safety and distractors etc.

3.2.3 Using the information

The categories of the affinity diagram where then used as starting points for developing our first set of personas. Each category served as attributes to the different members of our persona cast. The categories were to express certain personality properties that became salient, such as issues concerning needs, goals, trust, attitudes, behaviour and other personal characteristics. Several rough personas were created, each description was based on expressions made by the interview participants. During the refinement of the personas several overlapping attributes were found and in such cases elimination of members of the persona cast was needed. Attributes we found important to emphasize were added to other members of the cast. We had no specific goal when it came to number of personas to create. Our goal was to create a persona cast that reflected the collected data in a natural way with minimal overlap. The expressions under each category in the affinity diagram functioned as the foundation for the narrative description of the personas. As soon as a clear picture of the persona at hand had emerged, a photo was chosen and added to the document. The photo made the refinement and polishing of the personas easier, as the persona we were about to describe got more tangible. The statistical information in the quantitative study, both from our own interviews and from the earlier study made by the car manufacturers, was used to give the personas demographic attributes in accordance to real facts.

The end result of the procedure above was four different personas. As the personas are going to be exposed to more than one system interface we deliberately chose not to order them in primary persona, secondary persona etc. The ordering of the different members of our persona cast is something that has to be done in direct correspondence to the system one chooses to evaluate or elaborate on.

3.2.4 Validating the personas

Personas are intended to serve as a tool for communication and a common understanding. To make sure that the created personas were understood in the intended way we had them red through by four different persons, two from the interview group and two persons that had not been involved in our work before. We needed confirmation on if the personas were comprehensible, if they were easy to relate to and if they had any correspondence to the acquaintances of the person asked.

The personas were met with positive critique and comments like “I have several people that directly come to my mind” and “feels like someone I know” came from several of the persons asked. Some sentences in the persona presentation needed explanation. These were revised, and some further elaborated, to minimise the risk of misunderstanding.

3.3 Personas created

The persona creation process resulted in a final persona cast of four members; Claes, Kristina, Mats and Camilla who are presented underneath.

3.3.1 Claes Bergström 64 (the experienced, practical, self confident)

Claes is a retired industrial engineer who is happily married to his wife Agneta. Together they live in a rather large house in a suburb to a larger town in Sweden. They have three grown up children and are proud grandparents to two girls and a boy.

Claes is a practical man who likes to take on small and larger projects at home, such as repairing his house or building other things they need in the garden. Along his side is always his dog Nic who Claes always makes sure gets the attention he needs. Since the retirement Nic is only alone when Claes leaves him in the car when he goes shopping.

When he is not involved in his projects he loves being outdoors taking walks in the forest with Nic or going fishing with his boat. This is something he enjoys more now that he is retired.

His long experience and broad knowledge form working in the same domain his entire working career makes him still attractive at his old company where he now and then takes on selective assignments as a senior consultant. This often involves on-site inspections to which he most often takes his car.

His long driving experience makes him consider himself as a good driver. He is a confident driver and believes he is foreseeing and has full control at all times. The only times he can feel less comfortable driving is when he is tired and the drowsiness and fatigue may jeopardize safety of him and his passengers. Although he enjoys driving, he nowadays mainly regards the car as a means for transportation and primarily uses it for practical reasons.

He travels to his summer cottage regularly which is located about 400 km from home. Since he often has to bring a lot of tools, equipment and other luggage with him he often brings his trailer. During his longer trips he has had time to get familiar with the cruise control function of his car and he has started to like it. The constant turning it on and of in heavy traffic annoys him so therefore he avoids using it in such situations.

He easily gets annoyed when other drivers take stupid actions, when so, he often expresses his annoyance through honking the horn or signalling with the headlights.

The last couple of years his hearing has gotten a little impaired and he has been wearing spectacles since he was 45. The radio is mostly turned off when he is driving to try to keep the sources of distractions to a minimum. When it is on the volume is almost at its maximum level due to his bad hearing.

He finds the new technical features and inventions interesting and engaging but finds them more and more difficult to access.

3.3.2 Kristina Alperud 62 (“nonchalant”, “oops”, whatever, calm)

Kristina is a 62 year old hospital Departmental manager in a smaller town in Sweden. She has been married to her husband Kurt since she was 25 and has two daughters, Monica and Mikaela, who are 22 and 24 years old. She and Kurt live in a condominium alone, except from when their daughters are at home visiting from college.

Kristina has a very close relationship to her family and they try to go on a vacation trip abroad together at least once a year. Last year they went to explore Asia and covered China, Japan and Malaysia in three weeks.

The hospital Kristina works at is located just outside town which makes her more or less dependent on a car since she does not like to be subordinated to the schedules of public transportation. Driving doesn’t bother her, but she sees it as a means for transportation and something that gives her a sense of freedom.

She always has a lot of things occupying her mind regarding her two daughters and her quite demanding work. This can make her friends regard her as quite absent-minded in certain situations. This is also reflected in her driving where she often “wakes up” at her arriving destination.

She changes car every second or third year to minimise the chances of problems occurring. Even though she changes car rather often she doesn’t bother to learn the new high-tech features that comes with it since she thinks the threshold for learning how to use them is too large in comparison to what they contribute to her driving. When a new signal/warning is displayed in the car she asks someone else to check why “some light is blinking” when she comes home. If something happens to the car, i.e. if some malfunction occurs, she lets somebody else take care of the problem for her, either her husband, one of her daughter’s boyfriends or a mechanic.

As a driver she is mostly calm and does not let other drivers or driving situations get to her. The thing she finds most annoying is when passengers in the car make comments about her driving. Kurt, for instance thinks that she should change gear more thoughtfully and pay more attention to the surrounding traffic. Her daughters think that she drives too jerky.

She doesn’t avoid taking the car because of bad weather conditions. If she does, it has to be something really extreme. She beliefs that “bad weather only makes the drive take a little longer…”.

Kristina sees the time in the car as a waste of time and when she is alone she frequently uses her mobile phone, both for family and work matters. She avoids using the phone in situations that are unfamiliar to her. But she mostly drives on roads that she knows well and hence feels comfortable on. Due to this, she often drives a little bit above the speed limit and neglects the blinkers every now and then.

3.3.3 Mats Nygård 44 (early adopter of new technology, entrepreneur, on the run)

Mats is an owner of a small construction company. He is divorced since four years and his two kids, 11 and 14 years old, stay with him every other week.

Mats could be described as a hard worker or a busy bee. Except for the book-keeping, Mats takes care of all of the company's customer relations and administrative work by himself. He makes sure he is updated when it comes to new technology, not only because he likes new things but also if it in any way can get his daily life easier both for his spare time and for work, for instance the kind that makes the administrative tasks easier.

The customer relations demand quite a lot of phone calls and meetings which result in Mats spending a lot of time in the car driving from place to place. The introduction of new navigation aids such as GPS-navigators early caught Mats attention. He thinks that the navigation system he has installed in his car takes a lot of the stress out of finding the right and fastest way to a certain location without the hassle of trying to read paper maps while driving. The system just guides him to the right spot using vocal and visual instructions. Another positive side effect to the navigation system is that he now thinks it is less stressful to talk to customers on the mobile phone while driving even though he sometimes misses certain instructions from the navigation system. Before he got the system he sometimes stopped at the side of the road when making a phone call or taking one. He likes his navigating system a lot and has even managed to set it up in a way that it warns him in advance for speeding cameras along the road with the sound of his choice.

He thinks that the Air Condition takes effect from the engine and tries to use it as scarcely as he can. This causes him to turn it on and off when overtaking and driving in hilly environments.

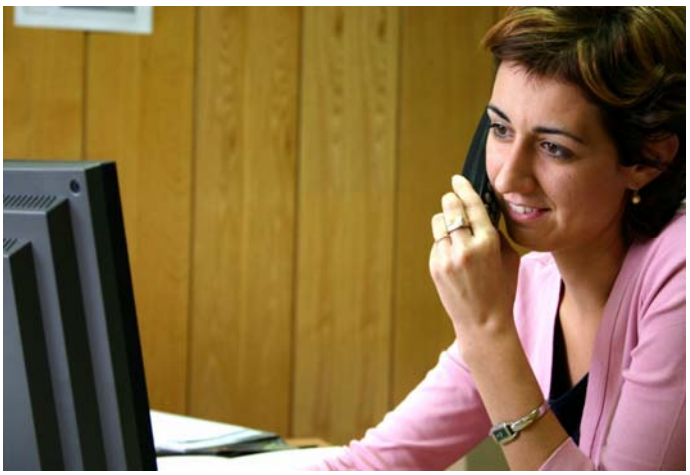
Because of the frequent and sometimes long trips Mats has developed some bad habits. The worst one is that he sometimes smokes in the car when he is really stressed. Another one is eating fast food on the run. He occasionally even eats burger meals while driving which he enjoys for the moment he eats it but gives him a bit bad conscience as his trips to the gym has become less frequent due to his busy schedule at work.

Mats truly likes driving but occasionally when the roads are boring he tends to make it a game to keep the gas consumption at a low level. Not primarily for economical reasons but he sees it as a sport and it also keeps him occupied and alert when he feels tired while driving.
Tiredness and fatigue is generally not an issue for Mats when he is driving his car as he feels comfortable not only behind the steering wheel but in the car overall. This makes him go for trips just to relax sometimes. The only thing that really can make Mats upset is when other drivers don't behave as expected on the road, for example when someone is driving really close up behind him. When that happens he tends to signal the pursuer with the brake light or

if he is in a bad mood he may also step on the breaks to force the tailgater to back off. He really thinks that far too many drivers should get back to driving school and also learn some manors in the traffic. In some situations other driver's bad driving manors can sometimes cause him to get quite emotional and upset.

The only thing that competes with Mats dedication to his work is his children, which he tries to spend time with every other week and also give them rides to their sports training or friends. Another thing of great importance in Mats life is his boat of which he takes good care, and in which he loves to take trips alone or with his children on those rare free weekends.

3.3.4 Camilla Johansson 38 (Late driving license, uncertain, environmental aspects, in need of being in control)



Camilla is a 38 year old Project manager at a rather big It-service company. She enjoys her work where she gets to meet new people and as a project manager help a group to reach its goals. Her colleagues see her as a fair and intriguing person that fills her project and their members with enthusiasms and also as a person that doesn't think there is any loss of prestige in asking stupid questions.

She has been married to her husband Tomas since the age of 31 and together they have a son Anton who is seven years old. She has a big passion for nature, not only does she like spending time in it but also like to contribute to preserving it in any way she find reasonable. This includes recycling household waste, buying ecologically produced food and trying to keep her energy consumption down, but the latter is for economical reasons as well.

Camilla got her drivers license quite late in life, at the age of 33, because both her education and raising her son and later also her career has taken up the majority of her spare time. The main reason for getting a car was the fact that it was the easiest solution for relieving her from combining her quite demanding working career and family life with the bus and commuter train time tables. Just knowing that she is able to go wherever she wants whenever she needs to gives her a sense of freedom. As she is quite concerned about the environment (and of course about her private economy) she tries to use the car only when necessary and if she is going somewhere that is in the range of a 20 minute walk she leaves the car at home. That is if she is not too tired.

Her five years behind the steering wheel has not been enough to make her feel confident as a driver. She can often feel a bit uncertain in some situations, not always because she has doubts about her own ability but in others. Her desire of being in total control makes her avoid driving in situations with heavy traffic when she can. She thinks this involves too many situations that make her feel a bit anxious, like overtaking, being close to trucks and having a car close behind at high speed.

Her dislike of not feeling totally in control made her put good vision and an easy to understand interior and displays besides the common safety aspects at the top of her list when she and Tomas bought their new car.

As she is still rather inexperienced as a driver she is rather tense in new driving situations and reacts strongly to different buzzer sounds. Her son Anton turned seven a couple of weeks ago and got a Sony PlayStation Portable as a birthday present which he brings wherever he goes, especially in the car. Camilla can get a bit annoyed at times because the sounds it makes stresses her and occasionally scares her if they are loud and sudden.

Despite her anxiousness behind the steering wheel she thinks it is exciting to drive and if she is going somewhere with close friends she often volunteers to be the chauffeur. That is if it's not raining or snowing outside, in that case she rather lets someone more experienced drive the car.

4 Developing scenarios

The following section consists of a brief introduction to scenarios followed by a description of our procedures during the scenario creation process.

4.1 Scenario-based design

Scenario based design is an essential part of the methodology of Goal Directed Design (Cooper & Reimann, 2003). The basic idea behind scenario-based design is to give a concrete description of the use of a future system early in the development process. This could be done by using various techniques that result in a narrative description of different envisioned usage situations/episodes. Scenario-based design takes focus away from system operations and instead turns it towards how people will use a system to achieve their goals by complete/accomplish tasks at work or in other situations. (Rosson & Carrol, 2002, Cooper & Reimann, 2003)

4.1.1 Scenarios

A user interaction scenario can be seen as a sketch of use that has the intention of capturing the essence of an interaction design. Rosson & Carrol (2002) compares it to the use of paper and pencil sketches for envisioning the essence of a physical design. Scenarios can be used in multiple ways. They can serve as starting points for group brainstorming to raise questions about which assumptions that can be made. They can also be used for requirement analysis for software, as partial specification of functionality, to guide design and to identify and plan evaluation tasks that can be further elaborated in a usability test etc. (Rosson & Carrol, 2002)

Scenarios enable rapid communication about usability concerns and possibilities among different stakeholders. It also provides the designers with a fast tool for sharing their ideas so that they can get feedback and continue refining them. (Ibid.)

In a situation that is ambiguous and dynamic you are often helped by design representations that are both concrete and flexible. Concreteness is needed to avoid indeterminacy and the flexibility to not being too vulnerable to false steps. (Ibid.)

“Scenarios of use help us to reconcile concreteness and flexibility” ((Rosson & Carrol, 2002, p. 49) since they envision concrete design solutions but still allow deviations on different levels of detail. Scenarios describes possible design solutions by specifying what tasks are going to be performed without going into exactly how the task is being carried out. The scenarios being work-oriented helps the designer to keep his/her focus on the users needs and concerns instead of on detailed functionality of the system. (Ibid.)

One way of describing a scenario is to use narratives in order to give them a more lively and easier to relate to presentation. Pruit and Adlin (2006) explain the importance of a narrative scenario as:

> “As the design is developed, these stories present an entire task in a narrative format. The story format carries context and other environmental information to help make sure the proposed design, flow, or use case makes sense when seen from the point of view of a persona. These stories are usually longer than more evocative types of stories because they need to follow a task or a scenario from beginning to end.”
>
> (Pruit and Adlin, 2006, p 539)

4.1.2 Scenarios versus use cases

In the domains of system development there is often a confusion of ideas between the meaning of the terms scenarios and use case. A use case is a very detailed sequenced system oriented description of a system interacting with a user described as an actor/s. The description in general involves writing the use case in Unified Modelling Language (UML) and consists of a brief definition of the actor/s, a brief description and pre-conditions of the different use cases. Every case consists of a preferred path of the system but also any exceptions i.e. alternate paths. A use case also describes the state of the system throughout the whole use case. (Asplund & Ranta, 2003)

A scenario accompanied with a persona is on the other hand a more narrative description of a specific user interacting with the system. As a persona incorporates individual user characteristics and behaviours they too could affect the interaction with the system. According to Grudin (2005) qualitative approaches and methods, such as persona development, "can provide deeper understanding of user behaviors" (Grudin, 2005, p. 55). Although use cases and scenarios are slightly different describing the user interactions with the system, they could work together very well in system or software development, as shown in the article '*How use cases are defined from scenarios in development of mobile services'* (Asplund & Ranta, 2003) where the authors used both methods in the development of a mobile music player and a music listening service. They created three music listening scenarios where they later found and created use cases for the actual implementation. Yet in their conclusions they emphasize that new use cases may be generated every day but some scenarios may become out dated due to development of new technology. But as they mean that the scenarios life-cycles can vary and are not bound to each other they suggest that "This independency makes it possible to focus on the components of the design that are currently interesting and reuse old information when needed." (Asplund & Ranta, 2003, p. 8). They further stress that "The methods are found to complement each other and it can be seen that using both is actually necessary in the pre-product development phase. These two methods allow also the valuable possibility to reuse information and the analysis of old designs into reusable components.". (Asplund & Ranta, 2003, p. 1)

4.2 Procedure of creating scenarios

As mentioned earlier the intention was to use personas as a starting point and fundament for creating scenarios. In order to do this we used the information from the personas and the interviews on which they are founded. The information was structured in a template which is described below both in terms of structure and the way of filling in its different parts. The explanation of each section of the scenario template is followed by the actual scenarios which is a result of filling in the template.

4.2.1 Scenario template

When extracting the scenario-information from the personas and the interviews there was a growing need for some way to structure the information in order to certify a minimal level of detail and included attributes and variable/variable categories. This need lead to creation of a scenario template to use as a foundation for the narratives. The template included the necessary parameters to take into account when developing the narrative descriptions of the scenarios. The template is divided into three different parts where the first part, Outer variables, is a revision of traditional road scenarios which often are used when setting technical specifications of requirements on automotive systems. In the second part we have tried to create a possible way to add information about the drivers given the prior knowledge about the users through personas.

The ADAS has not been taken into explicit consideration when creating the scenarios other than that the situation in focus are ones in which the systems are possibly active. The reason for this is that the systems are thought to aid in already existing situations, not create new ones.

Descriptions and the results of the two different template parts, Outer- and Inner variables follow below followed by a description and the results of the creation process of the narratives.

4.2.2 Outer variables

The first part of the template is called *outer variables*. It consists of the same kind of variables that today's practice (for example the Federal Highway Administration, 1995) traditionally has directed almost all its attention to. It includes information on road structure, road environment, road- and weather conditions and traffic situation. It also includes a simple illustration/sketch of the traffic situation. This kind of information is very useful when setting up experiments for establishing system requirements and specifications. This first part served as a starting point during the scenario development.

Defining the road situations
The first thing to do in order to be able to fill in the template was to choose situations to describe. As been said earlier the chosen situations had to meet up with two main criteria. They had to be normal situations, i.e. situations without any incidents or accidents, and they had to be situations where the systems can come into play. Some of the systems had thresholds to exceed before they start to function. For example the vehicle had to exceed a speed limit of 60 kph in order for Adaptive Cruise Control (ACC) and Lane Departure Warning (LDW) to start functioning.

Finally two situations were chosen. The two situations are both situations on roads with a high speed limit and the main difference is how heavy the traffic is. The two situations, Highway driving and Heavy traffic highway driving are presented underneath.

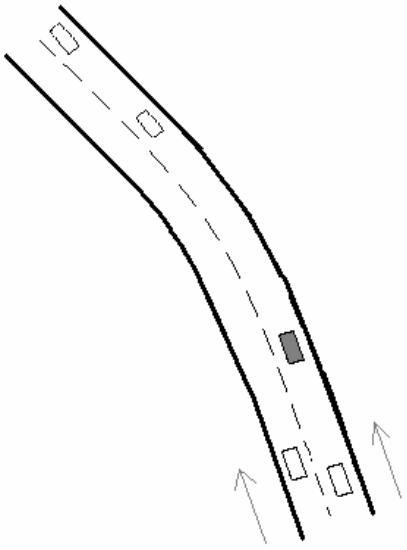
Outer variables Situation 1: Highway driving

Traffic situation (nearby cars, rush hour, traffic jam):
- Light traffic
- two cars about 200 m ahead
- 3 cars in the range of 1 km behind in the same lane
- 2 cars in adjacent lane closing in.
- Speed limit 110 kph

Road structure (highway, intersection, urban,)
- Highway

Road environment (gravel, snow covered, wet surface, daylight, sun, darkness, fog etc.)
- Good weather conditions
- spring
- partly sunny
- dry road surface
- Early afternoon

Main task (overall)
- Highway driving



The grey car is the main object of the sketch

Outer variables situation 2: Heavy traffic highway driving

Traffic situation (nearby cars, rush hour, traffic jam, speed limit etc)

- Heavy traffic
- Cars longitudinal / Cars on both sides (sketch)
- 3 lanes
- 90 kph

Road structure (highway, intersection, city traffic, urban etc)

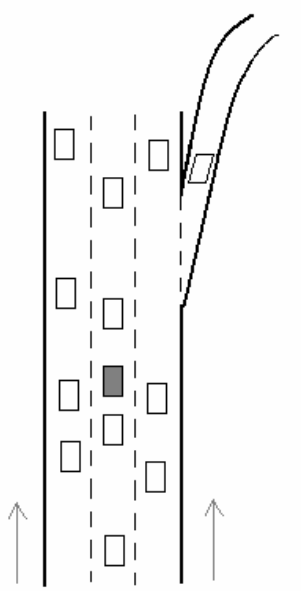
- Urban highway

Road environment (gravel, snow covered, wet surface, daylight, sun, darkness, fog etc)

- Rain
- Wet road surface
- Autumn
- Evening (dusk)

Main task (overall)

- Highway driving



The grey car is the main object of the sketch

4.2.3 Inner variables

The information from the interviews and the personas were now combined with the scenarios described from an outer variable point of view. Previous to this step, the scenarios so far consisted of 'universal' facts that are the same no matter who is driving the car. Working with the next part of the template includes taking the personal information from the personas into account. Each persona created in the previous step was exposed to each situation and the different characteristics of the personas were taken in consideration when refining the scenarios and used to make sure that the claims made about the situations had correspondence in the earlier interviews and matched the contents therein.

The result of adding the personas to the road situations gave an enhanced picture of what the situations looked like, not only from an outer perspective but also from an in-vehicle perspective which, from our perspective, is heavily dependent on who is sitting behind the steering wheel. This part of the scenario description added information about the personas goals, its characteristics, its intentions and the secondary tasks that were carried out by the personas in their personal environments.

The variables and categories we chose to include were:

Driver context (passengers, auditory environment sounds, visual environment etc)
Here we try to add information about the drivers' personal context inside the vehicle. The things to choose to include are parameters that are important for describing the situation.

Driver secondary tasks (conversation (phone, passenger), eating/drinking, nomad devices)
This category describes the secondary tasks performed or engaged in by the driver.

Driver objective/s (on time, safety, comfort, enjoyment etc)
This category brings about the drivers objectives on a general level and may also reflect some of the drivers' personality. Driver objectives as being on time, going for a joy ride or if safety is a big concern may be added in this section.

Driver condition and status (stress, fatigue, boredom, experience, self confident etc)
This part of the template states the psychological and sociological condition of the driver. Parameters as the drivers' feelings like anxiety, self esteem, boredom, levels of stress and fatigue are things to add under this category

Driver primary goals (momentary)
This category should describe the drivers' momentary goal of the driving task in the situation at hand. This could be over taking another vehicle, making it through a heavy traffic crossing, keeping distance to the car in front or keeping the gas consumption down.

The descriptions of the scenarios inner variables are described hereafter.

4.2.4 Filled in template of inner variables

Inner variables Situation 1: Claes

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - One passenger next to him
- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - Conversation with his passenger
  - Eating snacks
- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Arrive at destination before dusk
  - Nice comfortable drive
- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Relaxed
  - A routine drive
- **Driver primary goal** (momentary)
  - Keep consistent speed/distance to car in front and stay inside lane

Inner variables Situation 1: Kristina

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - Alone in the car
  - Radio on
- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - phone conversation (family matters)
  - taking/reading notes
- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Getting home as soon as possible
- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Wearied but relaxed
  - A routine drive
- **Driver primary goal** (momentary)
  - Keep consistent speed/distance to car in front and stay inside lane. Speed just above the speed of the surrounding traffic.

Inner variables Situation 1: Mats

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - No passenger
  - The radio is on
  - Navigator instructions (auditory and visually)

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - Eating/drinking

- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Get to next location on time
  - Waste as little time as possible driving

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident)
  - Stressed/Rushed

- **Driver primary goal** (momentary)
  - Follow directions from the navigation system
  - Stay inside lane markings
  - Keep safe distance from other vehicles

Inner variables Situation 1: Camilla

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - 2 passengers (her son and husband)
  - The radio is on
  - The passenger is playing with a portable video game. The video game makes some digital sounds irregularly.

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - Talking with passenger in front seat

- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Get to their camping site before dusk
  - Have a pleasant drive with spontaneous stops along the road

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident)
  - Relaxed but alert

- **Driver primary goal** (momentary)
  - Stay inside lane markings
  - Keep safe distance from other vehicles

Inner variables Situation 2: Claes

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - Alone in the car
  - Radio on, very loud

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - (Perhaps trying to understand some new technical feature)

- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - To not arrive at his next location too late

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Tired
  - Irritated on other drivers
  - Stressed

- **Driver primary goals** (momentary)
  - Trying to drive as correct and predictable as possible

Inner variables Situation 2: Kristina

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - One passenger (her husband Kurt)
  - Radio turned on

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - (occupied mind)
  - (discussion with her passenger)

- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Getting home

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Calm (concerning the traffic situation)
  - Annoyed (husband intervening with her driving)

- **Driver primary goals** (momentary)
  - Keep track of other vehicles behaviour to be able to keep safe distance
  - Follow the traffic flow

Inner variables Situation 2: Mats

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - One passenger (His son Kristofer, 14)
  - Radio turned on
  - Navigation system turned on and in use

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices etc)
  - Conversation with Kristofer

- **Driver objective/s** (on time, safety, comfort, enjoyment)
  - Getting in time for Kristofers football training.

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Irritation (caused by the car tailgating him)

- **Driver primary goals** (momentary)
  - Keep track of other vehicles behaviour to be able to keep safe distance
  - Follow the traffic flow
  - Follow the instructions from the navigation system

Inner variables Situation 2: Camilla

- **Driver context** (passengers, auditory environment sounds, visual environment etc)
  - One passenger (Her son Anton, 7)
  - Radio off

- **Driver secondary tasks** (conversation (phone, passenger), eating/drinking, nomad devices)
  - Concentrating on driver task

- **Driver objective/s** (on time, safety, comfort, enjoyment etc)
  - Getting to her location safely

- **Driver condition and status** (stress, fatigue, boredom, experience, self confident etc)
  - Anxious
  - Stressed

- **Driver primary goals** (momentary)
  - Keep track of other vehicles behaviour to be able to keep safe distance
  - Follow the traffic flow

4.2.5 Narratives

Filling in the first two parts of the template resulted in a list of facts in a structured order without a lively description. Without a lively description it is hard for the designers and other specialist involved getting the right picture of the design situation.

In order to give the scenarios the detailed level of description needed to emphasize the persona context the information from the scenario template was used to describe each situation in a narrative way.

During the creation of the narratives information from both the interviews and the personas were used. The information from the interviews structured in the affinity diagrams contributed by making feasible in-vehicle situations and contexts visible. The information from the personas was very useful when making the scenarios more colourful and lively with a richer context.

In order to fully comprehend the information given in the narratives it needs to be accompanied by the persona description and the data from the scenario template.

The narratives were read through and commented by four persons from both the earlier interview group and people that had not earlier been involved. These four persons were not the same as those who participated in the persona validation. This was made in order to ensure that the narratives were easy to understand and easy to relate to. Final adjustments were made according to relevant critique and the final narratives are presented underneath. As the scenarios are dependent on which of the personas who is sitting in the car the presentation of the narratives on the following pages is divided into *situation one* and *situation two* and each narrative in each situation is marked with the personas name.

4.2.6 Narratives created

Situation 1: highway driving

Claes

Claes and his wife are on their way to their summer cottage 410 km north of their home town. They left after having lunch with their eldest son in town. They have driven about half the distance and are having a long conversation about their eldest grandson who just learned how to swim. The weather is nice, even though Claes sometimes finds the sun a bit annoying when it impairs his vision when coming in through the windscreen. Claes has brought a lot of gardening equipment with him since this is the first time they are visiting the cottage since the snow melted. He is really curious to see what the garden and the house looks like after the winter season and therefore wants to get there before it gets dark. Apart from the occasionally irritating sun he thinks that the road conditions are perfect with light traffic and dry roads. Claes is completely relaxed and has turned on the cruise control function slightly above the legal speed limit and Agneta is giving him pieces of chocolate during their conversation.

Kristina

Kristina is on her way home from work. It is Friday afternoon and she is really eager to get home since her two daughters are on their way home from college to visit over the weekend. Kristina feels a bit absent minded after a busy week at work and now thinking on how she wish to welcome her daughters home by having the food on the table when they arrive. The radio is on at a low volume since she turned it down when she picked up the cell phone to call her husband Kurt to read him the list of groceries that she wrote down for him to pick up at the store on his way home.

As Kristina is in a hurry she drives a little faster than the surrounding traffic. She is gaining on the car in front and starting to prepare to overtake. The two cars in the adjacent lane are approaching from behind.

Mats

Mats has been spending all morning in a meeting with an important client and the meeting took much longer than expected. Mats has just got back on the highway after picking up a burger and a cup of coffee at a fast food restaurant. He has to hurry to make his afternoon construction site inspection on time. He has never been to the site before and has therefore put in the address of the site location in his navigation system. Mats is now cruising the highway following the general traffic speed, sipping coffee, eating his burger, listening to the radio and glancing at the navigation system waiting for it to tell him when it is time to choose the next exit from the highway.

Camilla

Camilla have had a busy week at work but was able to leave a little earlier so she and her family could avoid the heavy weekend traffic out of town when going camping. They are now on their way and she and Tomas are sitting in the front seats and talking about impressions they get from outside the vehicle. Anton is sitting in the back seat playing with his new Sony PSP which hasn't left his hands since he got it as a birthday gift a week ago. The thought of leaving the city behind in favour of the country side and outdoor activities makes Camilla excited and the weather seems to be perfect for hiking.

Camilla really enjoys driving under calm circumstances like these when she doesn't have to worry about other vehicles as much as she does when she drives to and fro work. The only thing that she finds a bit annoying in this situation is the intermittent sounds Antons Sony PSP is making. But she lets him play, she knows how boring he finds longer periods in the car and how happy he is about his new toy.

Situation 2: heavy traffic highway driving

Claes

Claes is on his way to his daughter Christine to meet his wife and have dinner together with the rest of his family. He is tired but pleased with himself after completing his assignment as a consultant for his former employer. He is listening to the radio. The volume is turned up quite high due to his bad hearing.

The time is 17.35 and he promised to be at Christine's at 17.45 and he still got 30 km left to go. At current pace he won't be there until 17.55 at earliest. Even though he is a calm person in general he is starting to feel more and more irritated at the other drivers. They drive too slowly, don't give way and neglect using the turning signals when changing lanes, forcing him to sudden breakings and slowdowns. He finds reading other cars body language quite difficult when they are not signalling as they should, especially under these harsh weather conditions.

Kristina

Kristina and Kurt are on their way home from a visit to their daughters at a College 300 km south of their home town. The radio is on since Kurt wants to listen to the broadcast from an Ice hockey game. After making a food stop they changed seats and Kristina has been driving for the last 100 km and the traffic is building up as they are getting closer and closer to town.

Kristina thinks she has full control over the situation, Kurt is of another opinion and he thinks she should be more stabile in her lane and keep more distance to the car in front. Even though Kurt knows Kristina hates when he intervenes in her driving, he can't help giving her a few comments every now and then. Kurt's complaining really starts to get on her nerves.

Mats

Mats is driving his son Kristofer to an away game in soccer. Kristofers team is playing a team they never played against before so Mats isn't sure about the way. He has entered the location into his navigation system and it is guiding him on his way using auditive and visual instructions. Mats is a bit tired from a long working day but happy for getting to spend some time with his son driving him to his game.

Mats just noticed that he has a car tailgating him and is starting to get irritated. He touches the brakes to show his dislike and looks in the rear view mirror to see if he is backing of. The car behind doesn't increase his distance so Mats decides to overtake the car in front in order to get away from the tailgating car.

Camilla

Camilla is on her way from work to her mother. She picked up Anton on her way and he is telling her about the "excursion" they made in school and how his back pack broke when they were running for the bus. The heavy traffic makes her feel uncomfortable and the car tailgating her makes her feel uneasy and making her to constantly glance at the rear view mirror. Her uneasy feeling makes her turn off the radio and ask Anton to tell her about his day when they arrive at grandmas instead because she has to concentrate on driving the car. Anton then picks up his Sony PSP and starts playing a game.

5 Seminars, presentations and Stakeholder response

This section covers the midway presentation and the final presentation of our work that we held at our stakeholders in Gothenburg. It also covers a brief description of how the stakeholders made use of our work in a workshop. The purpose of this section is to present comments and feedback on our work from professionals within the domain in which we carried out our thesis work.

5.1 Persona seminar

Midway through our work at Volvo we held a seminar on the persona method. Participants during the seminar were human factors experts and interaction design experts both from the stakeholders (Volvo and OPTIVe-project) and Chalmers University of Technology, 9 persons in all. We tried to show the basic concept of the persona method and its possible benefits. During the seminar we used our own creation process as an example of how to collect data and how to create personas. None of the participants had any experience from using personas in their work and only a few had briefly heard about the method before.

After a brief presentation of the method we used two early versions of our personas and let the whole group make use of them by making assumptions about the personas in different driving scenarios. We let the participants give examples of relevant situations to expose the personas to. Our apprehension was that the participants all seemed very committed to trying to estimate the personas behaviour in the specific situations and that the whole group was surprised by the big differences in the scenario outcome due to the differences between the two personas. Another significant point was that the participants talked about the personas as real persons and mentioned them by name rather than ‘the driver’ or ‘the user’. This led us to believe that they could envision the personas as real persons that were possible to relate to.

At the end of the seminar we asked the participants what they thought about personas both as a method and what possible benefits they found during the seminar. The comments were solely positive and the questions raised were of the more methodological kind like how much time to spend on creating the personas and how to know when their quality are sufficient.

Examples of comments were (translated from Swedish by the authors):

“It would be very interesting to see if the persona method is possible to combine with my accident analysis research”

“You get to know more about the users, you get a clearer picture of who they are, that makes it easier to make more qualified assumptions…”

“This is very interesting. I’m sitting here trying to figure out how I can use personas in my work”

5.2 Final presentation at the Stakeholders

After the completion of our work of creating the scenarios proceeded by personas, a presentation was held at the stakeholders. Present at the presentation were representatives from the stakeholders (OPTIVe and Volvo), experts from the disciplines of Human Factors, Driver Information & Interaction Design, ergonomics, industrial design, HMI/HCI students and technical specialists and specialists from accident research, all in all 14 attendees.

The presentation was held orally with visual aid through Microsoft PowerPoint and a projector. At this presentation we presented the project in its whole. This included:

- A going through of the thesis background and our main task of assignment
- A brief theoretical introduction to Personas and Scenarios
- A description of the work methodology
- Illustrating excerpts that showed some of our work procedures and their results
- Proposals on how to proceed from the point where we ended our work and the use of our results as starting points.
- A joint discussion and evaluation on our work.

All points except the last two has been dealt with earlier in this report. The former of the two will be discussed later in the discussion section, therefore the last point is the only one that will be elaborated in this section.

The outcome of the joint discussion is best summarized in a list of concluding points:

- During the discussion there was a consensus on the difficulties in generalising results from laboratory experiments.
- The general impression was also that personas very well may serve as a tool for extracting and presenting individual differences and other important user aspects that earlier have been difficult to convey and concretize in a way that is understandable for people from different disciplines and backgrounds, involved in the same system development project.
- A person involved in system design expressed that he thought that we had brought to the surface several aspects that he and his colleagues had overlooked but now realizes to be of obvious importance when concretized and pointed out in our work.
- Another person, involved in research on vehicle safety at Chalmers University of Technology, pointed out that our scenarios very well could be used to identify possible tasks of driver distraction. These could later be used when trying to design more realistic experiments and thereby contribute to an enhanced ecological validity and more generalizable results.
- We put forth a suggestion that scenarios of the kind we have created also may function as a tool for early theoretical evaluations of the systems in order to identify issues for further elaboration. This suggestion was supported by the audience.
- The scenario template we created was positively received. The audience seemed to favour its way of structuring the scenario and still being flexible enough to be fitted to the purpose of its usage.

The presentation at the stakeholders was received with positive response. Questions that occurred during the presentation mostly concerned methodology and practical issues such as,

how many personas should one create? Can the personas be reused? Is it possible to create them in a more 'quick and dirty' way? etc.

The conclusion of the presentation was that our work was appreciated by the stakeholders and that they planned to use our work in a, at that point, near future work shop. The work shop and its outcome are briefly covered below.

5.3 Workshop on Active safety systems

After the completion of our work inside the OPTIVe-project the personas and the scenarios have been used in a workshop on active safety systems held by an employee at the stakeholders. The aim of the workshop was to try to establish the needs of different system both from the different views of the personas and from the personas put into the scenarios. A subsequent aim was also to discuss how the information from the system should be designed in order to suit the personas in the best way possible in the specific scenarios.

During the workshop the participant was initially introduced to the four personas we had created. Paying respect to the personas personal particulars the participants chose systems from a list of about 20 ADAS that they though to be relevant for the persona at hand. When this was completed for all four personas the participants were assigned to imagine the personas in our narratives, this in order to certify the personas needs for the chosen ADAS but first and foremost to give suggestions on how to design the system signals in order to suit the specific persona.

The opinions from the workshop participants about possible designs of the information coming from the system were afterwards used to create driver interface design proposals.

After the workshop the person that was responsible for it mentioned several positive experiences from using the personas and the narratives that we created. One big perceived benefit of the usage of the personas was that it helped the participants, which usually think from a system point of view, to change perspective and look at the systems and the situation from a specific user's perspective. Other benefits were that the use of the personas served as fuel to the discussions making them fruitful and the narratives helped to air opinions.

6 Discussion

We have created and gotten to know four different persons with different personalities, goals, needs, attitudes, life contexts, backgrounds and values. We have gotten to know them so well that we believe that we are able to make reasonable assumptions on how they would behave in specific situations. With the personas as starting points we have tried to describe their contextual environmental variables in an easy and accessible way. We believe that we have brought issues of the individual driver to the surface.

After working with the method we are of the opinion that personas are a viable way to achieve a common understanding across disciplinary borders and functions well as starting point for building scenarios. Latter use of the personas and the scenarios we created also gave such implications. This will be further elaborated later on in this discussion.

6.1 Personas

When discussing personas with uninitiated persons one question almost always occurs, how much time and effort does one have to spend on creating them?

As with many other things in life the quality of the personas is linear to the time and effort invested in them. The correctness and detail of the persona stands in direct proportion to how well you later are able to fit the product to the presumed user. Another fact that goes in real life as well as for personas is that they their use and level of description detail have to be suited to their purpose. In our case we had to adjust our personas to a rather specific use where the situations they were to be exposed for are dynamic and very dependent on its actors. Therefore we had to give the personas a description with a sufficient level of detail to make reasonable assumptions about their behaviour in the context surrounding them in different situations.

We feel satisfied with the outcome of our persona development process. We have created four different personas with personalities and peculiarities with minimal overlap. We also believe that the way we described them makes it possible for us (or others) to come to reasonable conclusions about them in different situations.

The four personas in short (for a full description of the personas see chapter 3.3):
Claes is an elderly man (64 years old) who puts great value in his family. He is experienced both from life and as a driver. Other people see him as a rational, practical and self confident man with authority.

Kristina is an elderly woman (62 years old) with a calm laid back attitude. She thinks that most situations are their own problem solvers. She is often perceived as a person with a laisser-faire attitude and sometimes even a bit nonchalant.

Mats is a middle aged man (44 years old) that is an early adopter of new technology. He is an entrepreneur who always is on the run and a self confident driver that often mistrusts others in traffic.

Camilla is a woman in her younger middle age (38 years old). She got her drivers licence rather late in life and therefore does not yet feel fully comfortable behind the steering wheel.

Other persons describe her as a caring person that cares for the environment and has a need of being in control.

One of the goals of the persona method is to achieve a common understanding for the target group, this through getting to know the individuals in the persona cast. In order for the personas to be useful they need to mediate the information necessary for the practitioners to make reasonable assumptions about them in relevant and intended situations. This means that the information they convey has to be suited to the situation of interest.

In our case the overall interest was to create scenarios for ADAS evaluations. Consequently we had to include information that met various needs regarding ADAS evaluation issues such as attitudes, needs, goals and the drivers' situational context of which the systems are thought to function. The conducted interview series proved to be a very good tool for extracting this kind of information. One reason for the beneficial outcome of the interview series was the well prepared interview basis which was grounded on earlier research and studies, and gave us a clear direction on what kind of answers we wanted.

Findings from the interviews were individual motivations or aversions towards engaging in different secondary tasks or certain driving strategies. Different driver behaviours were also salient.

Below are examples of expressions that show attitudes and personality along with individual motivations or aversions towards engaging in different secondary tasks or certain driving strategies. Different driver behaviours were also salient in some of the excerpts from the interviews beneath. (The expressions are roughly translated from Swedish by the authors):

- "I never use my Cruise control. I want to be in control…"
  "I use my Cruise Control a lot, I think it is relaxing."

- "I never trust other drivers"
  "I always trust other drivers, what other choice do I have…?"

- "I like driving a car"
  "I see driving as a waste of time, therefore I try to occupy myself with tasks I find necessary, like phone calls and eating"
  "I purely see driving as a means to get where I'm going"

- "I always know exactly what's going on in the traffic"
  "I can often get the feeling that – puh, I managed through again"

- "I drive in the exact same way whether or not I have passengers in the car"
  "I believe I drive more calmly, being more careful, when I have someone in my car"

These are some examples of expressions we believe illustrates that there are individual differences in the drivers' attitudes and personality when it comes to the need of being in control, attitudes towards other drivers and the general task of driving. This includes issues in trust, faith, self esteem behind the steering wheel and willingness to engage in different secondary tasks. We believe that we have been able to accommodate and express these differences in our four different personas.

Other things we found during the interviews were the different secondary tasks the drivers carried out while driving, details about their personal context inside the vehicle and things that the respondents found distractive. Some had been identified in earlier studies but we also found sources of distractions that we had not come across during our literature study. Examples of this are two anecdotes related to the on- and off switching of the air conditioner in the car. This was done from two different reasons. One person turned it off when he needed more engine power, e.g. in long uphill slopes or when overtaking another car, and another person kept adjusting it because of the absence of automatic temperature control.

In the validation process we got positive response from the people who read the personas through, both specialists and laymen. Comments like “I know a person just like that” and “that could be me” are according to us a satisfactory result, meaning that the persons who read our personas through got an immediate relationship to the personas and could envision them in different situations. This is according to persona theory one of the main aims, and if achieved also gain, of the persona method (chapter 3.1.2).

Our view is that personas merely is a very communicative and useful way to collect and present hard to grasp factors and variables into an easy to grasp concept that communicates through several disciplines and work practises. Applied in a right way personas may bring up “soft” issues to the surface that hard facts and numbers have difficulties to convey. If it is the case that personas are a way to achieve synergy effects across discipline borders then it should be a strong argument for an extended use in system development were respect has to be taken to both human and technical aspects.

6.2 Scenarios

The use of scenarios in system development is widespread. They are used to show the thought functionality of the system or as a tool for creating test cases. In the pursuit system justification scenarios often tend to turn towards resembling use cases more and more and are often created to show the systems functionality in a way that suits the purpose. Unless a scenario is strongly based on real data it can be created to promote any feature and any position (utopian or dystopian) and can be difficult to engage with (Grudin and Pruitt, 2003).

When focusing on the system, the description of the user tends to falter. The user is often referred to as simply "the user". Often, little or no regard is taken to the users' individual differences and variability. In order to give the user its deserved room in our scenarios we chose to focus on the personas in our descriptions of the situations in which the systems are thought to function. We used the personas as a starting point and as lodestars during the scenario creation process taking into account their individual goals, needs and other personal differences, thereby trying to submit to the user-centered approach towards the system through the persona perspective.

We chose to describe the situations without including the different ADAS and instead focusing on the user and situations in which we know the system are going to be active. By not including the systems in our scenarios we avoid describing them as dream scenarios where the systems are depicted as problem solvers. Our intention was to create scenarios of real situations as they are today and thereby hopefully creating a more solid ground to use when envisioning the systems thought effects in that environment.

This approach led us to create a scenario template in which we could include both the road environment and the personas situational and personal context. The scenario template functioned as a useful tool to structure adequate and important information needed for further construction of the scenarios' end goal, the narratives. In our template we have included variables that we found important for the purpose of our scenarios, after going through earlier studies, findings and proposals for future work, i.e. the driver context, secondary tasks, objectives, condition and status and primary goal. These variables were added to the more conventional variables (e.g. what we call outer variables) used to describe road scenarios which our first part of our template consists of. The variables one chooses to include may be altered and chosen based on relevance and importance for the situation. In other words, one should add stuff that one think, or according to theory, has impact on the situation and finds relevant for later use of the specific case, for example in an experimental evaluation. It simply depends on the intended use.

The variables we chose to include functioned as an aid and checklist when adding information to the narratives. For sure, one can probably create the narratives just having the information from the persona and the road information, but in order to be sure to include all relevant aspects of the scenario we believe some kind of specification has to be used as a starting point. Having the information from the personas and the information about the road situation may function very well as a staring point for focus groups and brainstorming sessions which we experienced when we held a seminar for human factor specialists and traffic safety experts within the OPTIVe project (see chapter 5.1). The subsequent discussion showed great variability in made assumptions in the same situations depending on the persona taking part in it. This gives a first indication of one of the positive contributions personas can deliver. It points out that there are several different angles to consider in situations as complex as driving

a car. When designing systems that are to function in such environments one has to pay attention to the great variability in the group of users that are of concern for the design, not to a single user stereotype.

After completing the process of filling in the scenario templates we started to create narratives that merely are assumptions about the personas in the situations filled into the templates conveyed in an easy and understandable way. By doing this our aim was to give the former hard facts in our template a more engaging and easy to relate to description by specifying and bringing latent or partly concealed information in the scenario to the surface. By making the information easier to assess one opens up the possibility for people from other disciplines to understand the information that otherwise can consist of rather domain specific terminology and thereby minimizing sources of misconceptions.

Since our scenarios have their origin in our personas the quality of our scenarios are dependent on the quality of the personas. If the personas are developed using scientific methods and includes sufficient and valid information, thence the probability of valid and qualitative scenarios and narratives should be high.

The narratives that we created have to be accompanied by the persona serving as the main actor and the filled in scenario template to be fully understood. It is true that one can read and understand the narratives alone, but then you would be back to just see Claes, Kristina, Mats and Camilla as some random general user. Hence one can see the personas and the filled in scenario template as pre-requisites for a sufficient understanding of the narratives. Our belief is that if all the parts, the persona, the filled in scenario template and the narrative, has been read through one ought to have a specific understanding that should be common for most readers and thereby a good starting point for discussions and workshops.

Many scenarios that are created today are based on brainstorming sessions with experts were conceptions and ideas about certain areas or topics are being aired. We believe that the more information you have access to when making these assumptions the stronger the coupling to reality. After going through the process of creating personas, scenarios and the narratives we believe that our scenarios strives towards getting far more inclusive concerning relevant aspects of human individual variability in testing ADAS systems that today's research claims is a missing factor in prior scenarios that mainly focus on road- and traffic situations. We are of the opinion that we have been able to show differences both within a single personas behaviour in different situations and between the personas in the same type of situations. We hope that our work may also facilitate an all-embracing understanding of the problem domain through describing every situation from different angles and thereby rely on synergy effects to provide this comprehensive picture of the problem domain in its entirety. This means that after going through this process one will have not just a description of the situation from a system point of view but also from the individual users, and his/hers context in that situation. By creating a big picture and combine the different parts of our work into a whole, we believe that aspects of more than just the drivers' main tasks and events have been included in our scenarios.

6.3 Further reflections

> "For 25 years, psychologists have been exploring our ability to predict another persons behaviour by understanding their mental state. Theory of Mind first asked whether primates share this ability and then explored its development in children. Every day of our lives, starting very young, we use partial knowledge to draw inferences, make predictions, and form expectations about the people around us. We are not always right, but we learn from experience. Whenever we say or do something, we anticipate the reactions of other people. Misjudgements stand out in memory, but we usually get it right." (Grudin & Pruitt, 2003, p. 11)

The above quote comes from Grudin and Pruitts article *Personas: Practice and theory* in which they brings up our natural ability to trying to predict the future behaviour of people and creatures around us. We have tried to make use of this ability and describe the environment in which the future ADAS are thought to work with starting point in the four personalities we have gotten to know through our personas.

We used interviews as our main tool for extracting information from Volvo's possible user group. We feel that it was a suitable method since other methods used for extracting need goal, motivations and attitudes such as observations and questionnaires not are as applicable in this case due to reasons concerning first and foremost resources but also levels of appropriateness. After having conducted the work we feel that we during the interview series developed a deep understanding and feeling for the respondent's way of reasoning and behaviour that would have been hard to retrieve using observations and questionnaires. On the other hand both observations and questionnaires could complement the interviews, but not function as stand alone substitutes. When it is possible we believe that it would be of great benefit to conduct observations prior to interviews where one could elaborate on the users or respondents actual behaviour and motivations in different situations.

The target group of our study was rather voluminous, approximately at least 3 million in Sweden. How was it possible for us to create our persona cast from just 14 interviews? We never had the intention to say that these and only these types of drivers are the drivers of the cars that Volvo manufactures. We conducted 14 interviews in which we found obvious patterns and dissimilarities which we expressed in form of our personas. Most certainly we would have found more details and attributes to include if our sample would have been larger. We had no preset number of interviewees. In par with the persona method, we chose to end our interview series when we felt that the curve of new incoming information started to stagnate. It is possible that the stagnation could derive from our preparation and carrying through of the interviews. The methods that followed the interview also need to be commented on, i.e. the transcription of the recorded interviews followed by the affinity diagramming. Even though the transcription meant a whole lot of work, it afterwards stood out as one of the biggest contributors to the overall understanding of the material. Another positive experience was the creation, refinement and usage of the affinity diagram. The understanding achieved during the transcription phase made the sorting of the information into categories in the affinity diagrams a quite simple task after coming up with the categories. Within the categories of the affinity diagrams there were emergent differences that were rather easily translated into salient personal characteristics.

Anyhow, our persona cast may not be all inclusive but it does reflect many of the actual factors that may influence the members in the driver group in a way that the designers has to pay attention to when designing the ADAS systems.

The way that we made benefit of the personas was that we got a good feeling for the main actors making it easy for us to imagine them in different situations and make qualified assumptions about their contexts and peculiarities, thence simplifying the process of enriching the scenarios and describing them in a narrative way. We recommend that the involved designers should be included in the creation of personas to get a better understanding for the users of the system they are designing. We believe that this would be the most optimal way of getting to know the population you are designing for, even though it may not be the most practical and time efficient.

The scenarios that were generated around our personas include the individual factors that have been mentioned throughout this report and raised in the research around ADAS. Our belief is that they would function as good starting points and fuel for dialogues concerning the ADAS issues of use, design and existence. Such dialogues could have the form of focus groups where the participants could engage in heuristical evaluations, state hypotheses for further testing through experiments, or designing such experiments.

The result of our work is obviously not of the kind you receive from quasi experiments or simulator studies, but they can serve as input and foundations for forming hypotheses to test in such experiments. The result can also be used as input to the design process of such experiments by providing information to add as variables in the experiment and possibly increasing the ecological validity. The narratives and the scenarios may serve slightly different purposes even though there are close couplings between them. The narratives may serve well as a foundation for discussions whilst the scenarios may function better as a specification for designing experiments.

Our task/aim at Volvo has been to develop scenarios for ADAS evaluation. Coming from the perspective of cognitive science and CSE we are of the belief that before one is to insert new or altered information in to a complex environment as the cockpit of a car one has to be sure that the added information gets the intended effect. The introduction of the Advanced Driver Assistance Systems in vehicles could be seen as an automation of some of the tasks that earlier solely has been carried out by the human driver. It must be of the automotive industries best interest that the systems are supportive rather than distractive. This goes for critical situations as well as for normal situations when nothing extraordinary is happening. If the systems distracts rather than supports the driver, the systems will counteract their own purposes and should thence be re-designed and re-evaluated or perhaps not be introduced into such environment at all. Even though the systems may lessen the stress and workload of the driver, distraction can be an implicit effect of setting resources free for engaging in secondary tasks that has negative effects on driving performance. Dealing with cognitive systems, which the man-car system can be seen as, one has to be aware that most or all factors may have an effect on the systems total performance. It is not for certain that that if you improve one part of the system, the system as a whole will perform better. One should examine the effect of the "improvement" of a specific part of the system from more than one perspective, including the perspective of the whole system. One of the perspectives that so far have not gotten sufficient attention is the perspective of the individual user. During our work our aim has been to grasp aspects from this point of view and consolidate them and make them salient in personas and scenarios.

Our understanding is that one major concern of today's ADAS research is the systems intended effects on different users. Within the discipline of automotive industry it is of our

understanding that they have often tried to show the envisioned use/effects of the system through illustrating scenarios. By creating a big picture and combine the different parts of our work into a whole, we believe that aspects of more than just the main tasks and events has been included in our scenarios. These aspects could very well have impact on the users' attention, stress and total situation awareness and therefore also the total performance of the tasks of driving. We do not claim to have found every aspect of individual driver differences but we are of the belief that we at least brought the importance of the individual aspects to the surface.

When creating a scenario one has the possibility to add information and create them in any way. It is up to the creator of the scenario to create the scenarios so that they include the variables considered relevant and important for the situation at hand. Building scenarios around personas are according to us a feasible way to create a scenario and describe the situation in terms of variables that are important for that specific individual in a specific situation. During our work we have understood that a well developed persona can be a very good starting point for making assumptions about its behaviour in specific situations. Assuming the foundation of the persona is well anchored in reality and that it has a strong correspondence to the targeted user group, the assumptions one makes about the specific persona should be possible to generalize out to the targeted user group without too prominent deviations.

In the beginning of this section of further reflections we chose to cite Grudin and Pruitts reflections about the human natural and powerful capability of adapting to the environment by trying to predict what response a certain behaviour will get from people around us. Most people would agree that the better you know a person the more likely it is that your predictions about that person's behaviour will be correct. Grudin and Pruitt also wrote about their reflections on the benefits of personas and made conclusions that we agree with. They wrote that personas invoke the powerful capability of anticipating another person's behaviour and bring it to the design process. Therefore we end this section with another quotation from them about personas that we certainly agree with:

> "Well-crafted Personas are generative: Once fully engaged with them, you can almost effortlessly project them into new situations."
>
> (Grudin & Pruitt, 2003, p. 12)

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Appendix – Table of contents

Appendix A - Mental workload

Introducing the ADAS systems into the cockpit in cars will inevitably lead to an introduction of new, or at leased altered, information to the driver. Looking into when, how and if to present this information is of obvious importance. According to Iqbal et.al (2005) users performs tasks slower, commits more errors, makes worse decisions and experience more frustration, annoyance and feel more anxious when applications interrupt at an, for the user, inopportune moment during task execution.

Patten et. al (2006) puts forth Wickens & Hollands definition of mental workload and explains it as the amount of information-processing resources used per time unit, for task performance. Alison Smiley (1989) explains it in a more practical way, being associated with a task, mental workload can be described as; the rate at which information (regardless of modality used to retrieve it) is being processed by an operator, the rate at which decisions are being made and the difficulty of the decisions. In her article she brings about an example that is highly topical today at the present introduction of the new lateral ADAS as LDW. She tries to explain it in both product- and process oriented ways. The product oriented example is that trying to maintain a lane position while driving with a lateral variability of 25cm will demand a higher level of mental workload than trying to keep the position variation at 50cm. For her process oriented example she uses the controlling task of keeping ones lane position by using either lateral cues or heading angle cues, the latter demands less mental workload than the former and sets recourses free to distribute to other tasks included in driving.

Many of the tasks performed in complex environments as a cockpit inside a car or and airplane are of the kind that demands a high level of mental workload. As earlier mentioned, adding additional tasks in these environments can lead to a workload overload which can have devastating consequences. An increase in workload can occur from different reasons, for example if a user performs a very demanding task, but also if several tasks have to be performed simultaneously or if the time to perform a task is too short (Smiley, 1989). In order to lessen the workload on users in critical situations, automation of some of the processes that are included in the situation is often seen as a solution. The new systems that are introduced into these environments intended to reduce workload often mean that new information is added and could lead to a further increase in workload and in that case counteracts its own purpose (Parasuraman, Sheridan, Wickens, 2000).

Appendix B - Automation

Automation can be defined as a machine, in most cases a computer, carrying out a function that earlier has been carried out by humans (Parasuraman, 2000). The improvement of computers and technology concerning speed, capacity and "intelligence" has lead to that more and more tasks that formerly were carried out by humans now, to a larger extent, are assigned to computers, in recent time also complex cognitive tasks as decision making and planning.

There are different reasons for automation and these reasons are often divided into two different categories, *evolutionary* and *reactive* automation. In the evolutionary automation approach, automation is driven by the purpose of increasing the precision and economical exchange in certain operations, as well as lowering the demands on operator learning and workload (Sarter et. al, 1997). This type of automation is often based on statements/questions as when do we have the technology to accomplish it and when are the cost to do so low enough to for it to be beneficial in terms of efficiency. This is a common attitude within high technology industries where being in the front line of technology is seen as a way of attracting customers.

The second category, reactive automation, takes place as a reaction to an event or an accident and are driven by the opinion that automation of a process or task previously carried out by a human can accomplish a decrease in earlier failures and accidents. Even though a decrease in accidents and failures can be economical beneficial this is not the main reason for this automation approach. (Ibid.) An example of an automated process where safety aspects are the reason for its development is Anti-locking Braking System, a.k.a. ABS, which helps the driver to maintain the steering possibility while braking maximally.

There are different levels of automation and common for them all is that the one of the reasons behind the automation is to reduce the extent of human involvement and by that also reduce that opportunities for human mistakes. (Ibid.)

As the possibilities for automation has increased and the range of what can be automated have become larger there is also an increasing need to look further into what, how, if, in what way and on what grounds one chooses to automate ones systems or processes. In her article *Ironies of Automation* Lisanne Bainbridge, (1980), point out that the more advanced and complex a system gets the more important is the contribution from the human operator. She further points out that if the developed by the approach that one should automate all parts of a process that are possible, the tasks that are left for human operators to carry out are often the ones that the system designers could not solve. Since the tasks the machine/computers take over are the ones it can carry out faster and more effectively than the human, the role of the human will only be supervisory. Here Bainbridge stresses that the human only will be able to supervise the system on a meta-level since it would be impossible to control if the system has carried out each step in real time, hence will the operator lose some of his/her situation awareness.

Appendix C - Situation awareness

Situation Awareness (SA) is a term often used in domains of complex environments. Situation awareness is the operators, in our case a drivers, internalized mental model of the current state of the environment (Endsley, 2001). This mental model is built up by all the incoming information from systems, passengers and other variables inside the vehicle, as well as information from the out side environment. The integrated picture formed by all this information is central to all the decisions and actions that take place by the operator (Ibid.). Personal factors as stress, fatigue, boredom, fear, anxiety among others are parameters that may have an impact on SA (Endsley, 1999).

Situation Awareness is formally defined by Mica R. Endsley as:

> "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future".
>
> (Endsley, 1988 in Endsley, 2001, p. 2)

This definition divides Situation Awareness into three levels:

- Level one, *perception of the elements in the environment* is about perceiving the status, attributes and dynamics of relevant elements in the environment.

- Level two, *comprehension of the current situation*, goes beyond just perceiving and being aware of the elements in level one. It includes interpreting them and understanding their significance, as parts and as a whole, to ones goals.

- Level three, *projection of future status*, is the ability to project the future of the elements in the environment, at least in a very short term, based on the knowledge from level one and two.

(Endsley, 2001)

The ability to project the near future of ones surroundings is something a automobile driver uses continuously in order to choose the most favourable action to meet his/her objectives. The complexity of the environment inside and outside the car imply that several factors have impact on how good or bad a persons situation awareness is/get. Factors as how easy it is for that person to perceive the situational cues, how complex the situation is and how high the degree of mental workload is all affect ones ability to form a correct awareness in a specific situation and are important areas to be considered when developing the new ADAS systems.

Appendix D - Attention

Sternberg (2003) divides human conscious attention in to three main functions. These are signal detection, selective attention and divided attention.

Signal detection

Signal detection includes two different "strategies", *Vigilance* and *Search*. The first one, Vigilance, refers to a person's ability to pay attention to a field of stimulation over a prolonged time, during which the person seeks to detect the appearance of a specific target stimulus. Being vigilant the individual watchfully waits passively for a target stimulus to appear at any time and is typically needed in environments where stimulus appear rarely but needs immediate action when they do. (Sternberg, 2003)

In contrast to vigilance, Search involves actively seeking out a target. It refers to scanning an environment for something particular, an active seeking for something specific without knowing exactly where it is supposed to appear.

Selective attention

As the processing capacity of the human brain is limited and our surroundings consists of an almost endless amount of information we need to filter the incoming stimuli in order of relevance. The choice of information to process can be made with different degrees of conscience. For example, when you go to a party and are having a conversation with someone and suddenly hear your name mentioned in a conversation nearby you notice your name as salient even though you can't recall any other parts of that conversation. This phenomenon is known as the cocktail effect (Cherry, 1953 in Sternberg, 2003). An example of a more conscious use of focusing attention is one of a traffic situation where a driver is at a junction with traffic lights. He or she is then able to focus attention on the red light to see when it switches to green, even though there are lots of other stimuli surrounding the driver, perhaps both outside and within the car. The human mechanism in charge of this selection is called selective attention. (Cohen, 2003)

Divided attention

To alter focus between several tasks simultaneously demands a lot of energy and concentration. Humans have a well developed ability to let our attention delimit our cognitive activities in order to focus on one specific task (Sternberg, 2003). Unfortunately we have certain limitations when it comes to handling several tasks at the same time and therefore often have to set cognitive resources free in order to handle the situation. Some of the difficulty lies in that our attention is rather easily diverted. The reasons for this lies in matters as fatigue, interests, the complexity and difficulty of a task, the amount of training on a certain task and the amount of attention it demands (Ibid). Many studies has been conducted on the issue and several models try to explain the difficulties that lies in keeping focus at two tasks at the same time. Some, as Neisser & Becklen (1976) in Sternberg (2003), are of the opinion that the ability of dividing our attention only is dependent on the amount of training we have gone through, others claim that it is all about the human ability to filter information since we only can let signals from one of our sensory input channels reach our conscience at a time (Sternberg, 2003). However, most researchers agree that humans have certain difficulties when it comes to dividing her attention to several tasks at the same time.

Appendix E - Interview questions in Swedish

Underlag för intervjuer

(Frågeområden, beteenden och vanor under bilkörning, attityder och avsikter. Gärna med inriktning på motorvägs/landsvägs/motortrafikledskörning)
(Finns det skillnader i förarnas beteenden i dessa fall gentemot körning i statstrafik?)
Frågorna i dokumentet är strukturerade under övergripande kategorier. De fetstilta frågorna under varje kategori är huvudfrågorna de andra är mer av följdfrågekaraktär. Alla frågor kommer nödvändigtvis inte att ställas, detta underlag kommer att användas som ett stöd för intervjuledaren under intervjun.

Glöm ej att ställa ytterligare följdfrågor där det känns relevant för att ytterligare utreda personella egenskaper och faktorer i kontexten.

Bilrelaterat

Frågor som anknyter till inställningen till sin bil

1. **Hur mycket använder du din bil?**
2. **Vad använder du din bil till mest?** (tänk på att rikta intervjun (baserat på deras svar här) mot normalfallet i deras körning kontra vad som kan vara intressant ur systemhänseende) (Uppdelning av typ av körning, motorväg/stadstrafik/landsväg?)
3. **Vad har du för relation till din bil?**
4. **Vad tittar du på när du köper bil.**
5. **Hur viktig är din bil för dig i vardagen/arbetet?**
6. Hur långt har du till arbetet? Vilken typ av väg är det mest under den sträckan?
7. Hur långt har du till din fritidsbostad?
8. **Hur sköter du om din bil?**
9. Hur ofta tvättar du din bil? Själv, automattvätt, med eller utan borstar?
10. Hur ofta byter du vindrutetorkare?
11. Hur ofta kollar du nivåerna på motorojla, däcktryck och spolarvätska?
12. **Om det uppstår ngt smärre fel på din bil som inte påverkar bilens övergripande funktion,** (ex. ngn trasig lampa, eller vinande generator/fläktrem etc.) **brukar du då se till att fixa felet direkt eller vänta med det till dess att du har tid/pengar/ork att fixa det?**
13. **Hur ofta servar du din bil?**

Distraktorer

Vad gör de i bilen under bilkörning förutom att köra bil (secondary tasks)

1. Mat och dryck:

14. **Brukar du äta eller i bilen när du kör? (Ex. mat, glass, godis, kaffe etc).**
15. **Om ja vad?_____**
16. **Händer det ofta att du spiller/tappar mat i bilen? Om ja, rättar du då till det under färden eller stannar du till för att ställa saker till rätta?**
17. **Stannar ni och äter? Varför?**

2. Justering av radio, kassettradio, eller CD:

18. **Lyssnar du på bilstereon under tiden du kör?**
19. **Vilken typ av program lyssnar du på? tal eller musik?**
20. CD, radio, kassett eller mp3?
21. **Byter du ofta mellan låtar/kanaler/skivor/kassetter?**
22. Var förvarar du CD-skivor och kassetter?
23. **Är kanalerna förinställda?**
24. **Är din radio lättanvänd?**
25. **Hur manövrerar du din musikanläggning? Via ratten eller på center-stacken (mittkonsolen)?**
26. Om rattreglage, vad kan och kan du inte styra från ratten?
27. **Hur högt brukar du lyssna på stereon?**
28. Ökar du volymen när du kör fortare?
29. Högre volym vid vissa tillfällen?

3. Andra passagerare i fordonet:

30. **Åker du mest själv i bilen eller har du oftast passagerare?**
31. Vilken typ av passagerare brukar du ha med dig? (kollegor, barn, familj)
32. Var åker ni då? Och vad gör ni då?
33. **Är din körstil olika beroende på om du har passagerare i bilen eller inte?**
34. **Barn i bilen?** (sitter de i bilbarnstol? Fram eller bak? Hur mycket och på vilket sätt kräver de uppmärksamhet?)
35. Husdjur? (Löst i bilen, bur i bagageutrymmet etc.)
36. **Finns det situationer då du tycker att det är jobbigt att ha passagerare i bilen?** Om ja, vilka?
37. Hur mycket uppmärksamhet kräver passagerarna?

4. Lösa objekt i fordonet:

38. **Vad brukar du oftast ha med dig i bilen? (handväska, mobiltelefon och dylikt)**
39. **Var i bilen brukar du ha/lägga det?**
40. **Händer det ofta att du behöver/använder något av detta under tiden du kör?**

5. Rökning:

41. **Röker du i bilen?** Om nej, varför inte?
42. Om ja, hur tänder du cigaretten? (gaständare, tändstickor, bilens tändare)
43. Öppnar du fönster/taklucka när du röker i bilen?
44. var askar/fimpar du? I askkoppen eller ut genomfönstret?

6. Mobiltelefoni:

45. **Använder du mobiltelefonen i bilen?**

Om nej, varför?
Om ja;

46. **Ringer du eller tar du bara emot samtal?**
47. Av vilken karaktär är samtalen vanligtvis? (jobb, familj, vänner, köranvisningar etc)
48. **Skickar/läser du SMS?**
49. **Använder du handsfree i bilen**? Om ja, vilken typ? Snäcka eller integrerad?
50. **Avslutar du samtalen vid mer krävande körning?** Om ja, vid vilka tillfällen?
51. Stannar bilen du för att prata i mobiltelefonen?

7. Andra medtagna artefakter/anordningar i bilen (mp3, navigator, handdator, DVD etc.)

52. **Vilka använder du/dina passagerare sig av?**
53. **Hur ofta och vid vilka tillfällen?**
54. Hur är dessa ordnade i bilen? Placering? Fästanordning? (ställning, knä, etc)

8. Andra artefakter/anordningar/kontrollpaneler integrerade i bilen (nav, färddator, DVD, infotainment, klimatanläggning, stolar, speglar etc)

55. **Vilka använder du/dina passagerare?**
56. Var sitter reglagen? (ratt, center-stack etc.)
57. **Ställer du in dessa under körning?**
58. Hur ofta och vid vilka tillfällen?
59. **Undviker du att använda någon av dem? Om ja, varför och vid vilka tillfällen?**

Annat

60. **Vad upplever du som mest störande i bilen under körning**?
61. **Vad upplever du som mest störande under en körning motortrafikled/motorväg/landsväg/stadstrafik?**
62. **Vad gör du när körningen blir tråkig?**
63. Vilka faktorer utanför bilen fångar din uppmärksamhet?
64. **Fixar du ofta håret eller sminkar dig under tiden du kör?**
65. **Vad gör du när du blir trött under tiden du kör bil?**
66. **Skiljer ditt beteende i bilen med avseende på distraktorer beroende på om du kör på motorväg/motortrafikled/landsväg?** (tar du fler risker etc.)
67. **Är det något i bilen som du tycker är krångligt att ställa in under färden?**

Vidare intressanta frågor

(hur förarna uppfattar sig själva som bilförare inom olika områden kan vara intressant för att se vilken typ av förare de är)

68. **Hur uppfattar du dig själv som förare?** (Beskriv dig själv som förare)
69. **Vad betyder din bil för dig?** (Ge ingen vidare förklaring i fall de undrar vad vi menar, vi vill åt det som först kommer till dem)
70. **Använder du ofta bilen under semestern? Bilsemester?**
71. **Gillar du att köra bil?**
72. **Finns det tillfällen då du ogillar att köra bil?**
73. Känner du dig nervös när du kör? Vid vilka tillfällen? (skillnad mellan stadstrafik m/mtl/l)
74. Känner du dig pressad/trängd/oroad när du kör? Vid vilka tillfällen?
75. **Gillar du att köra fort?**
76. **Vet du hur din bil uppträder i olika situationer?**
77. **Känner du till din bils begränsningar? Har du testat?**
78. **Har din bil farthållare? Använder du den?**
79. **Hur brukar du reagera då en varningslampa tänds i bilen?** (Ignorerar/ kollar upp/ förstår eller upptäcker inte etc.)
80. Brukar du ha bråttom till ditt resmål?
81. **Anser du att du kör försiktigt?**
82. Vad tycker du om att ligga i en bilkö?
83. **Vad tycker du om att ha bilar framför dig?**

84. Brukar du köra om bilarna framför dig eller låter du andra kör om dig?
85. (Vad är din inställning till avstånd till framförvarande/bakomliggande bil i bilköer?)
86. **Brukar du ofta byta fil vid motorvägskörning eller brukar du följa med det övriga trafiktempot?**
87. **Om det växlar om till gult vid ett trafikljus, försöker du hinna fram innan det slår om eller stannar du direkt?**
88. **Hur noga är du med att använda blinkers.**
89. **Brukar du i en omkörningssituation lägga dig nära bilen framför innan du kör om?**
90. **Om vägen framför dig är helt fri från andra bilar brukar du då köra lite snabbare/långsammare/håller du samma fart?**
91. **Om du sitter i en bilkö och filen bredvid börjar röra på sig, brukar du då försöka byta fil så fort du kan eller ligger du kvar där du är?**
92. **Om en bil framför dig vid ett trafikljus inte startar med en gång när det har blivit grönt, sitter du lugnt kvar och väntar eller försöker du få honom att köra (tuta)?**
93. Om någon försöker tränga sig in framför dig på vägen, försöker du då förhindra detta? (bilkö)
94. **Händer det ofta att du är upptagen med något när du plötsligt upptäcker att bilen framför dig bromsar och du blir tvungen att göra en häftig inbromsning?**
95. **Känner du dig orolig/osäker i din körning när det är dåligt väder?**

Frågor från artikeln individual differences in driver stress, error and violations
(Översatta från originalet)

96. **Blir du frustrerad när du försöker men misslyckas med en omkörning?**
97. **Blir du irriterad av att köra bakom fordon som kör långsamt?**
98. **Kör du aggressivt när du är irriterad?**
99. Hur upplever du ett trafikljus som slår om till rött när du närmar dig det?
100. **Hur påverkas ditt humör när du ser någon annan förare göra något dumt?**
101. **Blir du ofta irriterad på dina medtrafikanter?** Vid vilka tillfällen?
102. Ogillar du att bli omkörd generellt sett?
103. **Hur är din känsla när du sätter dig bakom ratten? (kontroll, makt etc…)**
104. **Känner du dig nöjd när du har kört om en bil?**
105. **Känner du att det är värt att ta risker på vägen?**
106. Blir du otålig under rusningstrafik?
107. Anser du att du anstränger dig för att hitta potentiella faror i trafiken?
108. Är du mer alert på en besvärlig väg?
109. Anser du att du alltid är redo att reagera på andra förares oväntade manövrar?
110. Anser du dig säker på din förmåga att undvika en olycka?
111. Känner du dig mindre bekväm bakom ratten när det är mycket trafik på vägarna?
112. Kör du annorlunda när du kör på nya vägar jämfört med när du kör på familjära?
113. **Känner du dig mer spänd när du kör om andra fordon än annars?**
114. **Kör du försiktigare när du kör på en motortrafikled än på en motorväg?** (Förklara skillnaden vid behov)
115. **Finns det tillfällen då du känner dig mindre uppmärksam på dina medtrafikanter än annars?**

Generellt

Frågor som vi vill ha svar på utan att ställa dem specifikt

116. **Berätta lite om dig själv (obs ställ inte denna fråga specifikt)**
117. **Vilka är dina styrkor respektive svagheter?**
118. **Hur tror du andra människor uppfattar dig?**
119. **Var ser du dig själv om fem år?**
120. **Vad är det bästa du har åstadkommit hittills?**

För att få fram vad personerna har för övergripande mål

Mål

Life goals: helps explain *why* the user tries to accomplish something
Experience goals: express how someone wants to feel while using a product
End goals: what the user wishes to accomplish, like: find the best price, make this overtake etc. ma

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Title
Personas as Drivers - An alternative approach for creating scenarios for ADAS evaluation

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Abstract
Research and development on vehicle safety has lately started to direct its focus towards how to actively support the driver and make it easier for her to drive safely through letting Advanced Driver Assistance Systems (ADAS) have effect on how the driver interacts with the vehicle and the surrounding traffic. This requires research on both how the driver and vehicle perform in different situations, in terms of psychology, cognition and individual differences. In addition, physical limitations and requirements of the driver and the vehicle must be taken into account. Therefore scenarios for evaluation of these systems are required. In the area of user-centered design a rather new method, Personas, is being adopted. This thesis tries to explore if the Persona method is a viable tool for creating scenarios for such evaluations. Experiences after completing this work imply that personas indeed is a viable way to include aspects and raise issues concerning individual variability and situational context in ADAS scenarios.

Keywords
User-centered Design, Scenarios, Personas, ADAS, evaluation, personal needs and goals, individual differences, situational context, secondary tasks, qualitative method.