SERVICE PROPOSAL FOR THE FUTURE EXPERIENCE OF DRIVING

"Vorsprung durch Mobilität Erfahrungen"

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The Car as service platform with main identity “the experience”
Introduction
This thesis is the result of the challenging assignment: “design a product service system which creates value for the user in the future context of automated driving”. The goal was to find out from the user perspective what would create value for them in 2020. The Service Innovation Team (SIT), part of the Research group of Volkswagen AG, initiated this assignment as a part of the research program “automated driving”.

Analyses
Chapter 4 describes the analyses phase. It gives holistic overview of the ecosystem around automated driving. The insights form the input for the design process in chapter 6.

Technology
• Understanding the state of the art of the technology automated driving.
• Trends and related technologies are analyzed to get a broad understanding of the technical possibilities in 2020.
• In 2020 high automated driving is expected to function well at highways with minimal take over requests.

Context:
• The obstacles of automated driving are establishing C2X but also to resolve the issues around laws and liability.
• Volkswagen AG works together with many stakeholders to solve these obstacles.

User research
Chapter 6 deals with the user research. This is done in order to collect qualitative descriptions of the driving experiences, these insights create an understanding in the behavior and emotions of the driver. This knowledge is used in the design phase in order to come up with concepts. In order to collect this qualitative data the participants were carefully selected to represent the group of people who love to drive. Those participants were asked to participate in the cultural probe and workshop. The result is the co-created experience for driving in 2030: “the car as butler” and “the car as first class airplane seat”

The behaviors identified
• “Introvert” were the car was a place to think and plan the day and to regain energy.
• “Extrovert” behavior was including experiences of social networking, having a good conversation with close family on the phone or making jokes with other drivers on the highway.

Design approach
Chapter 5 is arguing that using the technology of automated driving will only make sense to users when this technology can support the new driving experience of 2020. The experience is the story of the product in the context which is created by both rational and emotional aspects of the design. Collecting driving experiences of today’s drivers will help in designing tailored experience for future drivers.

User
• Current research in the behavior of drivers, acceptance studies and the cognitive abilities of users are shortly discussed.
• Behavioral studies showed that people are already involved in many side tasks while driving.
• Redesign of the HMI of the car is needed because high automated driving asks for new interactions which fit into the future of being connected

Competitors such as Google and BMW, seem to be interested in using the time in the car rather than selling the technology. Volkswagen needs to make strategic decision: provide Google or Siemens their automated car and become a hardware supplier or profit by becoming the mobility service provider themselves.

• The premium customers of Audi are willing to invest in extra time.

Ideation
Chapter 7 deals with the ideation phase. The VIP methodology is used to create a “future experience” design statement. This by making use of the analyzed behaviors and placing them in the future context. The future context was created by the trends already analyzed in chapter 4.2.6.

Two statements were created for both VW and Audi to showcase the opportunity to manifest the brand identity in mobility experiences. These statements led to concept
proposals were a scenario helped in showcasing the concept. The Audi concept was chosen in consultation with the main initiators of this thesis. The main argument to continue with the Audi concept was the interest of the premium Audi customers in the extra time and the willingness to invest in advanced technologies.

Service concept
Chapter 8 describes the proposal for a product service system “the Basic Experience Package”. The car is the platform of this product service system and Volkswagen AG is the mobility experience provider. The design statement “offering people a cocoon in which they can make the transition from work to leisure in order to regain energy for daily life” is specifically tailored for the premium Audi customers to provide quality time during their daily commute. The “Basic Experience Package” consists of the high automated driving hardware and multi-touch OLED display in combination with service offerings such as internet and other forms of infotainment. The most important service offer is the “Balancing Life Application” which launches the appropriate applications and service offerings at the right time of the journey, supporting the driver. This by going through the phases “family table mood”, “balancing life mood” and the “personal growth mood” to support the driver making the transition from work to leisure and back. The “balancing life mood” is activated while driving high automated driving on the highway. In this part of the journey the driver can go out of the driving loop and start planning the day or finish to do’s by interacting with the large scale multi-touch OLED display.

The premium Audi customer is extra supported by “the premium service offerings”. These premium service offerings are additions to the monthly subscription on the “Basic Experience Package” and are communicated through the OLED Display. This idea was derived out of the user co-creation workshop “the car as butler”. Examples of additional services include: reservation of parking spots or managing home devices. In order to tailor those services specifically to the customer the online user profiles which are generated during the automated commute, are used as input. The brand Audi benefits from this direct link between them and the customer which improves the customer loyalty.

Conclusion
High automated driving technology turns out to be an enabler of the car as service platform. This basic experience package enables the car and the driver to become connected. This results in private quality time for the driver and the possibility for Audi to increase customer loyalty and create extra revenue because of the new business opportunities generated by the Volkswagen application store. (Business model chapter 8.3.6)

The prototype was tested by the same people who participated in the user research from whom the behavior was used to create the Audi experience. Although the user group loves driving, they felt that the “Basic Experience Package” including the high automated driving functionality would create private quality time and therefore improves the driving experience of their daily commutes of today.

Recommendations
1. Continue the development of automated driving technology; there is growing acceptance towards automotive driving.
2. Use the new ideas of the car as platform taken into account the requirements for designing the interior concepts and the hmi as mentioned (chapter 8.3.4).
3. Showcase prototypes to policy makers in order to speed up the process around the laws and liability issues.
4. The SIT team should start building the business case and create a service lobby to show the possibilities of a car as service platform
5. Establishing the “Premium service platform” department. This department becomes responsible for improving the customer relation and handle the big data which come from the online user profiles and the car performance.
6. A new strategic organization needs to be build around the application store of Volkswagen AG. This to set up a system which will work for all brands within the portfolio of Volkswagen AG.

Audi should take the first step in talking their customers along in the future mobility dream and there for need to reconsider “Vorsprung durch Technik”. I would like to recommend selling Audi’s by “Vorsprung durch Mobilität Erfahrung”
This graphic illustrates the added value for the customer and the company in terms of quality time, revenue, and data. N.B. The online behavior of the user during the high automated commute generates valuable user data.
The design process of this thesis. The numbers in the picture correspond with the chapters in the index.
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3. ASSIGNMENT
Design a product service system that provides value for the driver in a high automated car.
The starting point of this thesis was defining the assignment. This chapter gives a short introduction and description of the assignment and the expected results. The Service Innovation team (SIT), part of the Research group of Volkswagen AG, initiated this research of service possibilities in a future scenario of automated driving.

Introduction

Since 2005, when Volkswagen AG participated with Stanford University in the DARPA Grand Challenge, the topic automated driving is of growing interest. Within the Research group of Volkswagen AG multiple teams research the automated driving technology. The Service innovation team is new in this play field and wants to approach automated driving from the user perspective in order to create value for user and the business.

The Service innovation team (SIT) started in 2009 as part of the research group of Volkswagen AG. SIT is seen as an internal consultant. They design mobility services and want to push Volkswagen AG to innovate and reinvent their business. From classic car manufacturer to a mobility provider for people.

Current topics are for example car sharing, parking, fluctuating oil costs etc. The topic of automated driving is on the contrary to most other projects of SIT closer related to the product “the car”.

The Research group of Volkswagen AG does research for all the Brands within Volkswagen AG. These brands include VW, Skoda, SEAT, Audi, Porsche, Bentley, Ducati, Bugatti, Lamborghini, Skania, Mann, Volkswagen Commercial Vehicles. The Research Department focuses on trend and technology scouting. This because they want to anticipate on future needs of customers so they can be converted into innovative technologies.

Problem definition

In the field of personal mobility the responsibilities of a driver in the car are changing. It is expected that cars will become more autonomous. The effect of this development leads to a different driving experience. The main challenge for car manufactures becomes to create a driving experience that makes sense to the user and improves the driving experience rather than make it more complicated. This technological innovation will be very beneficial especially to prevent shock wave traffic jams and also lower the amount of accidents. Not only will the traffic flow be more fluent, the cars will drive more energy efficient, which results in less emissions.

Instead of putting the user in a supervisor role Volkswagen Research want to offer their users time for other activities in the car. They struggle on how to couple the technical innovation with the user needs. If the experience with the first automated cars are not satisfying for the user, the user might reject this innovation. It will be therefore important to understand the user and to find out what the user expects.

Assignment

Design a product service system that creates value for the user when driving a highly automated car. This by first exploring the research area “automated driving” from different research angles. These research angles will include Technical feasibility, Usability and Context. In this project it is important to find out the real user needs and expectations when driving highly automated. The user research will be leading in designing a new product service system. In order to see if the designed service product system creates the value for the customer as expected, the service will be made tangible in order to verify the design among the users.

Results

The end result will be a visualized product service concept. Including the following end products for this thesis:

- visualization/ demonstrator of the final design
- service blueprint
- oral presentation
- written research report
- poster
4. ANALYSES
Introduction

This part of the report will generate insights into automated driving and the ecosystem around this technology. These insights are used to determine which opportunities, of future services in the context of automated driving, will be interesting for Volkswagen AG.

Structure of analyses report:
The Analyses report is divided into the three parts: Technology, Context and User. The technology part will help in understanding the possibilities of the technology and will generate design guidelines for the service scenario. In the part Context both the strategy of Volkswagen is analyzed as the other players in the field of automated driving. In the User part it was explored what kind of user research exists concerning automated driving. These 3 different parts create a holistic overview of the ecosystem around automated driving and will help establishing the design scope of this project.

For a quick update of this part of the thesis I recommend reading the summaries on page 29, 40 and 45.
The technology chapter will explain some common used jargon, related technologies, the past, present and future of automated driving. And the future scenario as described by Research group of Volkswagen AG.

### 4.1.1 Understanding technological context

The technical development around in-vehicle robotics, smart transportation is interesting for many different businesses. Smart transportation, also referred to as connected driving, is expected to create higher safety and efficiency in logistics.

The foreseen advantages include:

- Less pollution, without the human actuating the car driving becomes more efficient.
- Less failures, the systems are expected to act safer than humans in traffic.
- Higher efficiency, because of optimized traffic flow. Less traffic jams and slow traffic.
- Lower fuel consumption, because of efficient actuating and smooth traffic flow.

These are the reasons many different companies and research institutes are involved in the play field of smart transportation. This part is to clear some of the language confusion between those research areas and to give an understanding of the context of the technology.

#### Autonomous, Automated or Automatic?

In the field of automotive the terms autonomous, automated and automatic are all used to describe the technology of a car driving by itself. The Cars become robots with artificial intelligence. Within Volkswagen AG they use the term Automated as the translation of the German word “Automatisch”. In this report Automated is used when talking about the technology in cars. In a bigger context which is not car related often the word Autonomous is used.

![Picture 4.1.1.2 Automated driving car of the Research group of Volkswagen AG](image)

#### Degree of Automation

BAST\(^2\) is an the federal highway research institute in Germany. They research the battlefields between traffic, humans and environment. The division of automation within the car was the result of a project in collaboration with the German car manufacturers. These standards are now common jargon within car companies.

### Autonomous, Automated or Automatic?

- **Driver only**
  - Human driver executes manual driving task

- **Driver Assistance**
  - The driver is permanently controls either longitudinal or lateral control. The other task can be automated to a certain extent by the assistant systems.
  
  Example: adaptive cruise control, where the driver is assisted in the longitudinal direction when driving up to other cars.

- **Partial Automation**
  - The system takes over longitudinal and lateral control, the driver shall permanently monitor the system and shall be prepared to take over control at any time.
  
  Example: adaptive cruise control + lane assistant

- **High Automation**
  - The system takes over longitudinal and lateral control; the driver must no longer permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.

- **Full Automation**
  - The system takes over longitudinal and lateral control completely and permanently. In case of a take-over request that is not carried out, the system will return to the minimal risk condition by itself.

2. www.bast.de
4.1.2 Working principle Automated driving

Products around us become more smart. This means systems are embedded with sensors, and get connected. In order for a car to drive automated it needs a lot of information from the surrounding and the parameters of the car itself.

This information is collected by the sensors (pic. 4.1.2.2). The input of the control system is data from the sensors. The output of the system are the signals which need to actuate the steering wheel, the motor, the brake etc. A feedback loop is then made to control if the output is indeed the desired output of the system.

The programming of automated cars is done by control engineers, who design the algorithms which determine with what input which output of the system is generated. (Appendix page 5)

In order to drive full automated it is expected that the car needs both input of the sensors and the data from the Car to X communication to make the system redundant.

4.1.2.1 Example of simple Control system

4.1.2.2 Visualization of sensor reach.
4.1 TECHNOLOGY

4.1.3 Related Technologies

Wireless Ad hoc network
A random network independent on wired routers or other access points. Every node in the network functions as a router and forwards data to others.

Car to car communication (C2C)
Communication between cars which is not via satellite, but direct. The cars can form a mobile ad hoc network to communicate data about traffic conditions. To be able to forward data from one car to another it is important to make the high automated driving system more redundant. The prediction is that the amount of data shared might overload the normal communication via satellite. This would cause delays which will be a disaster for the safety. That is why a lot of projects focus on establishing wireless ad hoc networks to enable C2C communication. Example of those projects are:
- The cooperative driving project of AutomotiveNL in Helmond, the Netherlands and the SIM td project in Germany.

Within cooperative driving project in Helmond the goal was to prevent ghost traffic jams and optimize traffic flow. The communication is important to establish the traffic flow. In the SIM td project the possible traffic scenario’s were tested with different communication scenario’s. For example: what happens when the distance between cars becomes too big for WLAN connection.

The C2C communication is needed to complement the data of the sensors which only have a limited range (max 200 m).

Car to Infrastructure communication (C2I)
C2I mean Communication between car and the infrastructure. The traffic control centres can change speed limits or control traffic lights by information they get from the cars. This to optimize the safety and efficiency of the traffic flow. The traffic control centers can also communicate real time data to the cars about road condition.

Automated Guided Vehicles (AGV)
These AGV systems are robots used for tasks in factories, mostly for handling heavy loads. These vehicles make processes more efficient and reduce the amount of failures. The AGV orientate themselves with set points which are either markers or wires. In combination with sensors the device checks if there are no objects on the planned route. These kind of AGV’s are already widely implemented, because the technology compared to automated driving is easier. The technology is easier because they use the marker system to orientate and they don’t need so much sensors and difficult algorithms because factories are clinical environments with only a few parameters to take into account.

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1. www.automotivenl.com
2. www.simtd.de
pic 4.1.3.1: Rendering of Pod cars in Masdar city.

pic 4.1.3.2: Automated guided vehicles used to move pallets back and forth in a factory.

pic 4.1.3.3: Platoon of trucks.

pic 4.1.3.4: C2X communication
Personal Rapid transit (PRT)/ Podcars/ Group Rapid transport (GRT)

Personal Rapid transit also called Podcars are small public means of transportation which are guided by a rail or a certain route. The bigger version is the Group Rapid transport. They are driverless vehicles. Successful projects such as the one realized in Masdar city and London Heathrow push acceptance of this technologies to a wide public. They use the same guidance systems as known from the AGV systems. In the Netherlands examples at Schiphol airport and Revium show failed projects of GRTs.

Podcars and GRT’s push the acceptance of driver less vehicles but can also block acceptance due to failed projects of the past.

Platooning
Platooning is the clustering of vehicles into a platoon. The idea of a platoon is that vehicles could join a cluster of vehicles moving in the same direction. The first vehicle in the platoon sets out the route while the other vehicles follow the lead. In a platooning situation the car might need less sensors and complicated algorithms to be able to follow the car in front of him. However the system highly depends on the communication lines between cars. Access and exit strategies need to be designed for cars to be able to hop on and hop off the platoon. The difficulty is to establish an high enough percentage of cars with C2C communication functionality in order for the system to function. This requires a high level of cooperation between car manufactures and other stakeholders involved and the question remaining is who earns money from those investments.

For Truck companies platooning scenario’s might be more interesting. Especially because of the many hours they can stay in a platoon which will lead to sufficient fuel savings.

Cooperative driving
In a cooperative driving scenario, drivers are given a real time speed advice which is based on traffic conditions, traffic around the car and wetter conditions. This data is communicated to the drivers by C2X communication. When drivers follow the speed advice the result is a smoother traffic flow with less traffic jams.

Electric driving
Electric cars are gradually entering the market. For an automated driving car it is not relevant if it has an electric, hybrid or combustion engine in the power train.

(Appendix page 5)
4.1.4 History of Automated driving

Automated driving is a technology in long development phase. Important developments over the last century have been GPS, Miniaturizing of Sensors and Computers, drive by wire and internet. In 1937 Norman Bel Geddes already predicted automated cars. In the 60th GM motors have been experimenting with automated cars. In the 80th also Volkswagen envisioned an automated driving scenario. After a successful project of Mercedes in the 80th the European government funded 7 years research programme. This to give the technology of automated driving an extra push, DARPA organized the DARPA challenge in 2005. Car manufacturers and knowledge institutes where challenged to maneuver a car autonomously through the dessert. This first Challenge was won by Stanley, the car designed by Volkswagen’s American research satellite ERL in collaboration with the Stanford university.

The second competition from DARPA was the Urban Challenge in 2007 where the car had to maneuver in traffic situations and comes closer to a realistic situation. All the developments and the competition of who will be the first to succeed, contributed to the status of current projects within Volkswagen. (Appendix page 6)

The information from the workshop in Helmond (Appendix page 55) in combination with the experts interviews (Appendix page 50) show a step by step technology push of automated driving into the market based on the evolution of safety systems.

pic 4.1.4.1: envisioning the future
pic 4.1.4.2: envisioning the future by VW
pic 4.1.4.3: Fahrrobotor of 2001 by VW. This project resulted in further development of the ACC system.
Picture taken in Volkswagen museum Wolfsburg

Stanley VW, Fully automated car which won the first DARPA Challenge.
4.1 TECHNOLOGY

4.1.5 Current Automated technologies

The Research project: Fahrrobotor of VW from 2001 (see picture 4.1.4.3) was the beginning of a development of many assistant systems within VW. Assistant systems are the collective name for all systems providing the driver extra safety and comfort. The degree of automation for assistant systems currently on the market is the "driver assist" mode. Those systems are believed to be the predecessors of further automation in cars. Most advanced this moment is the stop and go dynamic cruise control of Audi. This system is able to follow the cars in front by breaking and accelerating also in a traffic jam.

All brands give different names to their systems, in this report the terminology of NCAP (European organization which ranks the safety of new cars) is used. In this paragraph the important assistant systems are discussed. This to get an understanding of the current products and terminology. (Appendix page 8)

When a driver buys a car boxes are checked to add these kind of features. No information was intern accessible on how many cars are sold with assistant systems and how people use them.

The following categories of systems are assisting to avoid accidents.

Autonomous emergency Breaking
These autonomous emergency breaking systems are mend to do an emergency stop when the driver is not responding in time to avoid the crash. In cities those system typically use LIDAR (light detection and ranging sensor) to detect objects in a 6-8 m range from the car. For sensing pedestrians, cyclists or animals data from radar and camera are added. On higher speeds long range radars are used to detect other cars.

Lane Support Systems
Lane support systems help the driver to keep in lane. The system recognizes the road markings and gives correcting pulses in the steering wheel to avoid unwanted lane departure. These systems vary from giving steering wheel corrections to only warnings.

DAF committed a test with a Lane Support System (Appendix page 55). Most truck drivers rejected the warnings after a while because they were to frequent. This system failed in supporting the user.

Other safety assist systems include blind spot monitor, speed alert control system, pre-crash systems. (Appendix page 5)

1. www.darpa.mil
2. www.nl.euroncap.com
The following assistant systems are increasing the comfort of driving.

**Adaptive Cruise Control**
Adaptive Cruise Control is a system to control the speed of the car considering the distance of the car in front. This system takes control of the speed and acceleration of the car when activated. ACC controls the speed in only in longitudinal direction. The term *dynamic cruise control* is used when the cruise control is not only slowing down when driving up to another car but when the car is able to speed up as well and there for can follow in traffic.

**Parking assistant systems**
The parking assistant systems in the car are varying from visual help to actual help in steering skills. There are some park assists on the market were the driver only needs to control the gas. The system can easily identify the parking spot. The unexpected circumstances such as bicyclist, pedestrians and animals are still over watched by the user.

**Car infotainment**
Car infotainment include all information and entertainment offered in the car. Navigation, phone book and radio are typical features in any car at this moment. Many car manufactures are researching the possibilities of open platforms such as Linux. This to be able to deliver all kind of new applications to the users. BMW already offers users the possibility to use applications while driving. More specific knowledge about car infotainment might be needed in the ideation phase.
4.1.6 Trends in technology

Ubiquitous displays

This trend is the shift in future use of the displays. People are not longer around the display but displays surround people. Techniques such as OLED allows displays to be ubiquitous and morphed into all kind of products around us in order to serve as interface whenever we ask for it.

OLED (Organic Light Emitting Diode) is a nanotechnology where on contrary of LED the material itself emits light. Because of that many products can turn into devices. This allows screens to be transparent and flexible in combination with multi touch it opens a lot of possibility for services and other functions. For example augmented reality on windows which shows an extra layer of information about the world around us.

For cars this combination of techniques will change the way displays are currently arranged. So where and how information or entertainment is provided can become more applied to certain driving situations. Current examples include the head up display of BMW 3 series. A head up display is right in front of somebody which allows a person to pursue an activity while being able to see the display without turning the head. In the 3 series they project the speed and navigation in the front window.

The way ubiquitous displays are arranged around us in the car will influence the timing and form in which services can be offered while driving.
Cloud computing

Cloud computing enables people to access the programs and data from any device whenever there is a connection with the internet. It allows people to rent software and use it as a web-based application.

The individual cloud enables people to be more flexible in their lives without having to move data between devices. Examples of companies providing this service are Apple with the I-Cloud and newly on the market also Windows 8. Older examples are a Gmail account, Dropbox etc.

Access to your data and programs in the car becomes more important especially with the development of automated cars. Projects such as “4G venture Forum for Connected Cars” are set up to find out how to deliver connectivity to vehicles of all types with open standards. With the 4G internet technology within cars they try to enable cloud access for users but also to support the establishment of car to car communication.

The connectivity of cars therefore is an important development which allow cars to become more and more a platform for services.

Ubiquitous Services

Providing prefiltered knowledge, data, product offerings etc. at the moment that a consumer needs it. Smart filters combine data and pre-filter it in a way that it is tailored for the user. The input for those filters consist of a lot of different data. This data can be obtained by sensors sensing for example the mood of a user. In this case sensors measure facial expressions by either measuring muscle contractions, blood pressure, or transpiration of the skin.

This mood data can be combined with the history of data stored in the personal cloud and internet search profiles of this person. Combining this data can lead to an accurate service offerering. This kind of ubiquity is based on constant monitoring of persons and their behavior. This addresses the moral question of privacy and how to protect this personal data.²

The car when driving high automated is a good platform for creating experiences and offer people services. Especially when data from drivers mood and health are used as input for smart filters to see what services to offer at what time.

2. www.Corning.com
4.1 TECHNOLOGY

4.1.7 Development of technology within Research group of Volkswagen AG

Successful projects of Volkswagen concerning high automated driving for production cars:

HAVE-IT\(^1\)
The have-it project is one of the European funded projects in which many partners come together to combine knowledge. In this particular project Volkswagen developed the TAP system. This stands for Temporary Auto Pilot. They used a car with production level sensors. The Tap system is a combination of systems such as Lane assist, ACC, Emergency brake and speed control. They managed to build a safe system were the car could drive partial automated and the driver was able to take the hands of the steering wheel on the high way.

Volkswagen Et
The Volkswagen Et project is a research project in collaboration with Deutsche Post and the Technical University in Braunschweig. The Volkswagen Et is the future vision on delivering mail. It is an Electronic driving vehicle, which follows the mail man when he delivers the mail. At very low speed the car the car is able to drive fully automated.

Next to projects concerning high and full automated driving Volkswagen AG is also involved in monitoring the drivers health and wellbeing in the car.

Challenges include

Senors need to be improved to see further ahead. Especially important with high speeds. Pedestrians and Animal recognition, they are mend to blend into nature and are therefor hard to recognize. Ghost targets and miss measurements form obstacles in the reliability of the sensed date.

\(^1\) www.haveit-eu.org
4.1.8 Scenario 2020

In the research group two scenarios are used in the communication of the concepts. Those two are the 2020 and 2030 scenario. The technology and the responsibilities of the driver are elaborately described in these two scenario’s. For this thesis a simplification of the scenario 2020 is used. (Appendix page 9)

In the 2020 scenario of Volkswagen the car drives high automated on the highway. The driver can take the hands of the wheel and do other activities. At country roads where speeds can go up to 100 km/h the car could sometimes drive highly automated. However it will mostly drive partially automated which means that the car asks permission for some maneuvers and that the driver needs to supervise the system at all times. In the city the car will only be able to drive partially automated.

In the final concept (page 83) a simplification of the scenario 2020 is used. This because the partial automation mode as described in the scenario by Volkswagen AG seems no addition to the value of having extra time and only makes the situations more complicated. The following arguments were taken in to consideration to change the partial automation mode to driver assist mode in the vision of 2020:

Rejection of lane departure warning by truck drivers due to high frequency of warnings. (Appendix page 55)

When the system drives partial automated and the driver gets to many warnings there is a high change that they will reject the system.

Supervising state of the driver might lead to under load of work which is according to L. Hackenberg² (HMI team, Volkswagen Research group) not the best state. Test persons who love to drive love driving especially on country roads.

The new scenario can be seen on the right page. The partial automation mode in the city and on the country side is changed to a driver assistance mode.

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1. Hoellerman, J (2012): personal communication with project leder lebenswelt automatisches fahren
It can be concluded that Volkswagen AG and other car manufacturers are focused to push the technical development of Assistant systems further into highly automated driving systems.

### 4.1.1 Understanding technological context

**High automate driving**, car can take over all driving tasks. In case of a take-over request, the driver must take-over control with a certain time buffer.

Foreseen advantages of the high automated technology:
- Eco efficiency due to smoother actuation compared with human.
- Less accidents due to human failure
- Time efficiency due to time gain.

### 4.1.2 Working principle automated driving

The working principle behind automated technologies are control systems. Where the input is generated by sensors and the on board computer determines what actuation needs to be done in order to manoeuvre in traffic.

### 4.1.3 Related Technologies

Development of C2C communication is important to stretch the time limit to get back into the loop. C2C communication in combination with C2I will also improve the traffic flow.

### 4.1.4 History of Automated driving

The technical evolutions past century in the field of communication, robotics, internet, nanotechnology etc. lead inevitably to autonomous vehicles. Current achievements of participants in the DARPA project and the Have-it project show the result of 100 years of development.

### 4.1.4 Current Automated technologies

Evolution of safety assistant systems lead to partial automated, highly automated and in the end fully automated cars. The have-it project proved the partially automated system TAP. Since it is fore seen that with the stop and go of Audi more and more advanced partially automated system enter the market.

### 4.1.6 Trends in technology

Trends important within the context of automated driving are:
- **Ubiquitous displays:**
  Everyday products are embedded with smart technologies. This will shift the use of displays, people will be surrounded by displays instead of the other way around. Related technologies to make this possible are OLED and augmented reality.

### Cloud computing:

The access to personal data and programs from every connected device becomes more obvious. This means that accessibility to the cloud becomes of more importance in cars.

### Ubiquitous services:

Ubiquitous Services are tailored to support daily life of users. Services can be offered through the connected products around us. Data from users, about their internet behavior and personal wellbeing and mood, are used.

### Obstacles within development:

High speeds, miss measurements, ghost objects, animals, venerable road users still form challenges.

### 4.1.7 Development of technology within the Research group of Volkswagen AG.

High automated driving: high ways
Driver assistance: city traffic and country road
4.2.1.1 Strategic choice become the future hardware supplier or provide mobility services?
In this chapter the context around automated driving is discussed, this to get an overview of the development and the parties involved. This chapter starts with finding the status quo of the project intern of Volkswagen AG. Then the ecosystem around Volkswagen is discussed in order to understand which stakeholders are crucial in the success of automated driving. This success is highly depending on agreements on regulation and liability issues. The last part will discuss the competition and who is investing in potential market share and why.

4.2.1 Automated driving a Research topic

Automated driving is a research topic, some of the outcomes are shared with the research and development of the brands to improve the safety assistant systems on the market. A successful transfer was the knowledge gained within the Have-it project where the Volkswagen Research group worked on the TAP (temporary autopilot) system. This TAP system has been the bases for Audi’s ACC with stop and go function. Audi not only seems interested in improving their safety assistant systems but also in actual develop automated driving. They foresee that the premium customers are willing to invest in the comfort of extra time during the boring commute on the highway.\(^1\)

Within the Research group of Volkswagen bits and pieces of different research areas concerning Automated driving start to come together. The main focus is the development of the technology. New investments in this development show the involvement of top level management, creating an inevitable technological push. A smaller group focuses on implementing this technology in future car concepts. Research areas include human machine interface, interior design, multimedia design and business design. A list of technological and ergonomic requirements are leading in the designs. The presence of SIT in the projects should change the focus to a more user centered approach.

Potential markets for Automated technology

Both B2C (business to consumer) and B2B (business to business) are considered within the projects of the research group. The initial focus was the development of sensor platforms on luxury and economy car platforms. It is expected that fleet owners and transportation companies benefit from higher fuel efficiency and the reduction of accidents.

For the B2C market it is expected that the first focus will be the premium customers of Audi and not the VW, SEAT or Skoda customers. Audi is also the first to offer “Audi connect” a service of Audi which includes internet in the car with up to date news, wetter and traffic information. The target group taken into consideration for Audi connect is the premium target group who according to Audi want to be more online and have the opportunity to be in touch with family life, friends and work, while driving.\(^2\)

Business Model automated driving

The classical business model for the safety assistant systems is to sell those as add-on to the car. In the future where high automated cars are connected to the internet many services and features become interesting for the user. The service offerings might become a more interesting business than the feature as add-on. New opportunities arise and Volkswagen AG needs to decide whether they are going to become a supplier of hardware or if they want to become the mobility provider who offers the services themselves.

Market introduction

Traditionally assistant systems are marketed and placed with a top down approach. This top down approach will mean that the high automated driving will be sold as a feature first available for premium cars in the brand portfolio. This top down approach is visible for Audi’s cruise control with stop and go function which is not jett available in VW cars. Volkswagen wants to offer the features throughout their whole brand portfolio quicker. However they have been introducing assistant systems also with a top down approach. Starting with the Phaeton and the Passat CC towards Golf and Polo.

\(^1\) B. Meuller-Bessler (coordinator Driver-Assistance-Predevelopment) & T. Petregger (produktmarketing ausstattungen Faherassistenzsysteme & sicherheit) (2012): interview Audi in Ingolstadt

\(^2\) A. Strotbek. (Finanz & Organisations vorstand Audi AG) (2012); movie over Chancen der Automobilindustrie durch die IT 2020,
IEEE Institute for electrical & electronics engineers
ISO, international standards
European Committee of Standardization
BMW AG
Ford
Audi AG
Daimler AG
Opel
Mann
Fiat
Renault
PSA Peugeot Citroën
Car2Car communication consortium
AKTIV
development of high automated driving by Volkswagen AG
UR-BAN
COMeSafety
E.U 7th framework
Bundesministerium für Wirtschaft und Technologie
Bundesministerium für Bildung und Forschung
Bundesministerium für Verkehr, Bau und Stadtentwicklung
VDA
Vodafone
Governments
Research Institutes
Car manufacturers
Suppliers
Bosch
Continental
Bundesministerium für Wirtschaft und Technologie
Bundesministerium für Bildung und Forschung
Bundesministerium für Verkehr, Bau und Stadtentwicklung
SIT
HMI
Infotainment, media & entertainment
Future Interior Function architecture
project Chauffeur
lebenswelt automatisch fahren
project piloted commute
management VW AG
konzernforschung VW AG
Design
R&D
Marketing
Design
R&D
Marketing
ERL, Electronic Research lab
VW
Audi
VW AG
konzernforschung VW AG
As mentioned before the development of automated driving is closely related to the development of C2X communication. This is the reason that car companies such as Volkswagen AG need to collaborate with partners. Volkswagen AG is involved in many projects and platforms. This ecosystem analyses is done to get an understanding of the different stakeholders involved in the projects.

The main question in the stakeholder analyses: Who influences the development of this technology? The Volkswagen world is represented on the right page. It is shown how the projects internally are connected with the departments. The system around the Volkswagen world represents the platforms Volkswagen AG is involved in. Within Volkswagen world the research is mainly focused on designing the technology independent of C2C communication. The projects and platforms in which they participate focus on establishing Intelligent transport systems enabled by C2X communication.

In the C2X projects the main challenge is to find a common communication strategy to establish C2X. The COMeSafety platform is an European funded platform where international standardization institutes and governments join the OEMS to establish agreements and standards for intelligent transport systems. Connected to this platform is the C2C communication consortium, where all European car manufactures join to collaborate. The main goal of this consortium is to standardize Important norms for the C2C communication by 2013.

Another Research focus in European funded projects has been the integration of real time traffic data with in-car safety assistant systems. Volkswagen Research is now involved in the UR:BAN project where they cooperate with 30 partners together to develop driver assistant systems in combination with traffic management systems for urban areas. Past projects have been the aktiv and the have-it projects. Both of those projects had similar goals.

Stakeholders categories involved in platforms and projects are car manufacturers, governments, suppliers of electronics, communication and IT companies, research institutes and universities.

Car manufacturers,
Goal: They want to enter the new business, offer people high automated driving. It is foreseen that this brings possibilities for the business to business market and the business to consumer markets.
In order to offer the high automated feature they will benefit in establishing agreements on the C2X communication and the real time traffic data integration. For the latter two topics they have to collaborate with competitors and governments. Important for the car manufactures:
- New market opportunities for automated driving.
- Improve safety of the car

Obstacles for car manufacturers
- Offering users the possibility of a better traffic flow: C2X becomes effective for optimizing traffic flow with enough cars using the same communication system.
- Offering value for customers by offering not only active safety but also time for the driver. However legislation at this moment in Europe needs to be changed in order for users to benefit from the extra time. The role of car manufactures in those projects is sharing knowledge of safety systems and behavior of drivers. They also deliver the cars for the Field operation tests.
Suppliers of Electronics, Communication and Software industry:
Goal: Benefit from business opportunities in the new field of automotive. Use the connected car as platform to offer services. The role of these companies is to research integration of communication systems with the IT.

Government, policy makers:
Goal: Optimize traffic flow, especially in congested areas around cities. An optimized traffic flow results in lower emissions and optimize logistics and thus efficiency for businesses. This is connected to easy multi-modal travelling (using more ways of transport to get to the destination) and providing reliable ways of transportation. They also want to improve the overall traffic safety and security. The European commission communication “sustainable future for transport” (eu com 279) goes one step further and funds projects concerning connected cars and intelligent transport systems with the future of the internet and cloud computing.

Obstacles:
- Changing the regulations around automated driving concerning hands free driving are potential blocking market introduction.
- Deciding on which infrastructure investments need to be made. What is done by public companies and what is done by private companies. Who is responsible for what?

Research institutes and Universities
The Research institutes and Universities seem to be either focusing on improving the safety or in developing the technology of automated driving. They are independent of competition and are able to work in depth to solve technical questions.

1. www.comesafety.org
2. www.car-to-car.org
3. www.sintd.de
4. www.urban-online.org
5. www.aktiv-online.org
4.2.3 Laws and liability

Laws concerning the registering of Cars:
In order to license a car it should meet the regulations for motor vehicles. Every country has its own institute in order to decide which cars are allowed to participate in traffic and there for are registered. In the Netherlands this is for example the RDW (Rijks Dienst Wegverkeer) and in Germany this is done by StVZO (Strassenverkehrs-Zulassungs-Ordnung).

Both International and European agreements determine which regulations car manufactures have to take into account when designing cars for the street. At this moment high automated cars will not be able to get a license in most countries. An acceptance is the state of Nevada, in the United States, who licensed the first high/full automated cars in 2012.

Laws concerning behavior in traffic:
There are also laws describing how the human should behave in a car in order to safely take part in traffic. Main traffic agreements internationally were made in 1968 on the road traffic convention in Vienna:

“A driver of a vehicle shall at all times minimize any activity other than driving. Domestic legislation should lay down rules on the use of phones by drivers of vehicles. In any case, legislation shall prohibit the use by a driver of a motor vehicle or moped of a hand-held phone while the vehicle is in motion.”

This agreement will need to change along with the corresponding laws nationwide to be able to allow drivers to drive without hands.

The advantages for the user of automated driving will decrease if the person is by law prohibited to take hands of the wheel and get out of the concentration loop. If regulations and laws will not be changed the car stays an environment where safety features dominate. If so the only option for better traffic flow is cooperative driving and a mandatory C2X feature in every car (as once the safety belt got mandatory). Car manufactures will not be able to sell their customers extra time, only safety.

Product liability laws:
Producers liability for damage caused by malfunctioning products. Laws concerning liability get more complicated concerning automated cars. “When is it the fault of the driver?” and “When is it the fault of the IT of the car?” Are car manufactures able to take that responsibility of being liable in situations of full automated driving or was the data from the infrastructure delayed and is there for the traffic controller responsible? Since many more parties are involved the question of who is responsible becomes more and more complex. There for insurances concerning liability and cover damages need to be adjusted for these new situations with all these stakeholders involved.

Regulations and Laws need to be pushed in order for high and full automated cars to function for which they are designed. The status of negotiations in Europe about these issues is not clear. According to Volkswagen, governments could be more involved in solving liability and regulation issues. The task for car companies is to get governments more involved by continuously showing the sophisticated state of the technology in order to convince them of the necessary changes.

2. Weiser, M (former boss of Driver Information Systems department) (2012)
4.2.4 Competitors in the field of automated driving

Best practice: BMW:

BMW focuses on the future of driving. They show the future driving experience and involve people in new ideas. They use platforms such as Facebook and their BMW i site to show connected drive and electric mobility of the future. Their slogan of connected drive is “in touch with your world”. What BMW smartly does is introducing “the new way of driving” through movies. They take their customers along in their future dream. They leave the story about safety and comfortable drive behind and focus on possibilities of a connected car.

Next to their marketing there are reasons to believe that BMW is a front runner in the technological field. Successful projects of BMW and the many platforms in which BMW (see stakeholders map) is involved show their know-how within the field of automated driving. BMW is currently hiring 70 more employees for software development of driver assistant systems. This shows serious investments in further development of the automated driving technologies.

New player in the car market: Google

A new thread in the automotive world seems to be Google with their self driving car. They hired all the engineers participating in the DARPA challenge in 2005. The recently released YouTube movie is showing the Google car driving a blind man autonomously to a fast-food chain. This in combination with the autonomous cars they got registered in the state of Nevada (U.S.) led to panic within car companies.

What can traditional OEMS expect from Google entering the automated driving market?

It is expected that Google is interested in offering their services to users in a car when they don’t have to be involved in driving anymore. Google looks for collaboration and there for new business opportunities. With this video they push the car industry. Volkswagen experts claim that the technology Google uses is mainly based on Google maps and not so advanced when interacting in traffic situations.

Daimler AG, Cadillac (General motors), Toyota, Volvo

All car manufactures need to update the safety systems to the current standards in cars. However some car manufactures seem to buy the systems from companies such as Bosch instead of building up the know-how themselves. The question who develops what and where is difficult to answer since this knowledge is something car companies keep to themselves.

The companies clustered above are known for projects in the past and shared successful research projects on YouTube. Many other car manufactures join the platforms as can be seen on the map. However it seems they are not the frontrunners in developing in house technology, this conclusion is drawn because data and showcases are lacking.

GM, Daimler and Toyota have a long history in developing automated cars (see chapter 4.1.4). These 4 companies seem to have a more similar approach to Volkswagen AG then BMW. When they communicate the future of driving and automated driving technologies they talk about safety and the comfort of driving.

Cadillac for example refers to improving safety as their main goal when they showcased their super cruise concept (automated driving of GM). Toyota focus is assistant systems for elderly people. Important in this research domain is the monitoring of the wellbeing of the driver. They also recently announced the development of their “car social network”.

Volvo is known for their safety, and there mission is to have accident free cars. They focus on making safety assistant system that will correct all human mistakes which might lead to accidents. Currently they have a strong focus on animal detection to avoid collisions with for example dear (of course a big problem in Scandinavia) which is often both fatale for the animal and the drivers. Mercedes is updating their assistant systems according to their finding is the development of automated driving. Their aim for future automation is to look for a point where pleasure driving is important and automated driving helps excluding the situations where driving feels uncomfortable.
Network, technology and communication Companies: Siemens, Bosch, and Verizon.
Siemens announced to develop the car of the feature. They will use their knowledge of IT to design a connected car. Bosch currently designs smart assistant system such as the driver drowsiness detector etc. Verizon is joining the 4G venture forum to establish the internet for within cars.

Why are IT companies such as Siemens suddenly involved?
These companies are involved because of the interesting markets appearing within their knowledge domain. In the B2B case they could provide communication networks or sell the car companies software for their connected cars. In the B2C case the car could become the platform for the IT companies. They could use this platform to offer services to end consumers while they are moving.

What if…..
In the future consumers buy a monthly package XL which includes x amount of electricity and connectivity and the car comes for free with a 5 year contract. The IT companies will become the connected mobility providers and the car companies will only provide the hardware.

Autonomous labs
Autonomous labs is a group of researchers and students of the Freie Universität Berlin who are funded by BMBF (the Ministry of Education and Research) and showcase fully automated cars and concepts related to this technology. They showcase concepts in a way which triggers the imagination. For example the project “autonomous taxi” The cab is able to drive autonomously to the person requesting it per iphone or ipad. Another project is their “Brain Driver” concept which uses the brain as direct input to control the car.

This group of researchers is important for the whole car industry because they create the bridge for people to understand these technologies. They showcase the possibilities of future technologies in an exciting way.

1. www.bmw-i.nl
2. BMW highly automated driving mode (2012): A movie about concept high automated driving bmw
4. The Future of Mercedes - Frankfurt Auto Show (2011): movie about interview with director advanced design about the future concept of mercedes
5. www.autonomos.inf.fu-berlin.de
4.2.5 Trends & Developments

This chapter will state the trends which can be important to the VIP design process as described in chapter 7.

Demographic

- Aging society, the same development can be seen in many countries in Europe and also in China and Japan. Keeping mobile is for many older people a problem. Full automated driving might be a solution to many of them.  

- People move more and more to the cities. (Urbanization) This can mean that cities become even more congested and more and more people are depending on public transport. Smart mobility services are the solutions for these places, for example autonomous car sharing etc.

Economical

- China and Brazil are most important market for cars sails this will continue being so in the future. Services tailored for European markets cannot be transferred 1:1 to Chinese or Brazilian market. Cultural differences need to be taken into account when designing services for specific geographical areas.

- In the future people will tend to rent or share products rather than owning products. Car manufacturers are aware of this shift and start to design mobility services along with their cars. The car manufactures provide platforms in cities for sharing cars. Examples of platforms: Greenwheels, BMW and Drive now, Daimler and Car 2 Go, Volkswagen and Qui-car

Social

- More flex workers

- The strict division between work and leisure time disappears.  

- Individualism own identity is important. People like to differentiate themselves. This own identity can be created with many personalized services. How much are people willing to share their identity in order to gain personalized services?  

- Social online networks will become of even bigger important. According to fjord (service design consultant) people will combine more and more the social with time and place in order to create a more special experiences. Fjord believe this is the next stage of the experience economy as conceptualized by Joseph Pine.

- State: People need social interactions and true friendships to emotionally connect.

1. CBS (2012): Leeflijst opbouw Nederland 2025  
2. www.sustainablelifestyles.eu  
3. KEFZ (2012): mobility report 2030 (internal documentation)  
4.2 CONTEXT

4.2.6 Insights Context

4.2.1 Automated driving a Research topic
Automated driving is a Research topic from which parts of the knowledge are transferred to the research and development of the brands in order to improve safety assistant systems. Audi however is also interested in Automated driving for their customers and collaborates with the Research group. They think that their premium customers are willing to invest money in order to gain time. The potential markets include the premium commuters (B2C) and the fleet owners and transportation companies (B2B).

A top down approach have been common for the market introduction of safety assistant systems. These systems have been sold as add on feature. The service offerings might become a more interesting business than the feature as add-on. New opportunities arise and Volkswagen AG needs to decide whether they are going to become a supplier of hardware or if they want to become the mobility provider who offers the services them self.

4.2.2 Ecosystem
Developing C2X is connected with the success of automated driving. There for Volkswagen collaborates in many platforms and projects with other stakeholders such as UR:BAN and the SIM td project. Players involved in establishing C2X are: Car companies/ Governments/ Suppliers in electronics/ IT / communication. Establishing standards and assigning responsibilities to stakeholders are obstacles which needs to be solved.

4.2.3 laws and liability
Laws need to be pushed in order for high and full automated cars to function for which they are designed. The laws concerning registering of cars and concerning behavior in traffic need to be adjusted in order for the car to legally drive on the roads and for the driver to take the hands of the wheel. Appointing the liable stakeholder becomes complex, agreements need to be made among stakeholders and insurance companies.

The status of negotiations in Europe about these issues is not clear. According to Volkswagen, governments could be more involved in solving liability and regulation. For Car companies the task to get governments more involved by continuously showing the sophisticated state of the projects.

4.2.4 Competitors in the field of automated driving
It is hard to understand what car companies really do because they protect a lot of their research projects. They see the technology and the new arising markets around automated driving as sensitive data which needs to be highly protected to competitors. However companies such as Google and research institutes like Autonomous labs push acceptance among government and the public for future technologies. This in contrast with what Cadillac, Daimler, Toyota, Volvo and Volkswagen AG show online, they emphasize the functionalities which improve the safety. BMW seems, at this moment, most advanced in both development of the technology and presenting feature possibilities to their users.

4.2.5 Trends & developments in Europe
An important trends for automated driving is the increasing need for social networks in combination with spatial information. Also important is the disappearing line between work and leisure because this might influences the daily commute.
In this part an analyses has been done to find out what user aspects are being researched in the context of automated driving. Talking to experts from the HMI team of Volkswagen AG and to research institutes such as TNO generated a general understanding of these aspects. For this research it was also important to find the gaps in the already existing research, to be able to add to the knowledge instead of repeating already existing insights.

4.3.1 Cognitive ergonomic

Cognitive ergonomics is the ability of the brain to understand user product interaction in a certain context. The brain should be able to understand the situation and knows how to react. The HMI lab of VW is researching what different requirements the human interface interactions need to fulfill, in order for safe use of high automated and full automated cars. The high automated driving scenario requires attention from the driver to be able to take over at any time.

An important measurement in cognitive ergonomics is the work load. In overload situations the driver has to deal with too many tasks which lead to a higher risk of accidents. In an under load situation the driver is losing attention because the lack of task. This under load situation can also enlarge the risk of accidents. An under load situation is when the driver supervises the driving task. That is why HMI team does not recommend this mode.

Another research question is how the driver can get back in the concentration loop. Out of the loop means not focused on the driving task, in the loop means concentrating on the driving task. Getting back to the driving task can be compared with pilots talking over of the autopilot in planes. Most accidents occur at that moment of mode transition. Knowledge from cognitive ergonomics in airplanes complements the HMI research of automated driving. When designing for drivers of automated cars one should take in consideration that unlike pilots they are not trained professionals.

In order for people to get back into the loop HMI team states that the system should at least be able to warn the persons in between 5-10 seconds before the driver is really needed. This time is needed to both switch mentally from task x back to driving and switch physically by taking over the steering wheel and understand the mode in which the car is. This mode awareness needs to be communicated to the driver. The driver needs to immediately understand in which direction the steering wheel is directed. In the 2020 scenario all kinds of tasks except for sleeping can be done in the car but people have to get back within 5-10 seconds.

The mode transition and mode awareness will determine the reaction time of the driver getting back into the loop. To effectively alarm the driver of an upcoming situation the driver needs to understand the feedback. Tests are done with speech, sound, light and brake shocks. At this moment calling the name of the person seems to be most effective.

Requirements for the Human machine interface design:
- For automated driving a 5-10 seconds time buffer is needed for drivers to get back into the loop.
- Feedback about mode transition needs to be understood by the driver. An effective way seems alarming the person by saying his/her name.
- To understand the mode in which the car is smart interface design will support the user in getting back in the loop.
- Supervising state is not recommended because of under load of work.
- This 5-10 second range should be enough for all possible side tasks to get back in the loop, accept for sleeping.
4.3.2 Human Product Interaction

Current interactions: intuitive, simple
Tablets such as the I-Pad are designed to be intuitive. Those devices are so intuitive that it invites young children and even cats to interact with them. In general the personal devices around us are getting easy to interact with. The information on the displays is carefully designed for use efficiency. Most first screens provide the often used applications and information.
Windows recently made a shift to windows 8 system, where using and choosing applications become primary focus. Concerns about system management and protection or other options are not complicating the first screen anymore.

NS (Dutch Railway Company) uses touch and simple design for their tickets machine. Not all information is displayed at the same time. But by choosing out limited amount of options it supports the user fast through the system.
All these new interactions with touch in combination with interface design leads to faster interactions and easier multitasking.

Interactions in cars: interaction within cars can be compared with a television control from the 90th
If we compare the design of personal computing devices and simple tickets machines with the car interior design there is a big difference see the pictures. Although all processes in the car are electronically controlled in the interaction design they are controlled from different places on the dashboard and middle console as if they are not using the same processing unit. All the possible functionalities and controls for driving (climate control, safety & assistant systems, Navigation, Car maintenance, control of windows) and Infotainment (radio, phone, and movies) have different buttons to adjust settings and preferences. This results in an overload on functionalities and buttons which can be adjusted from the driver’s seat.

The handle and buttons to activate the ACC systems can be found in the pictures on the right. It shows a lot of functionalities and options. Using it first time is confusing especially because there is no time while driving to read and understand the use cues. There is the option to start the ACC, enlarge the distance between cars and adjust the speed. A lot of options all combined with different interactions.

Future interactions
Technical developments of for example smart glass and merging personal computing devices with interfaces are enabling even smoother transitions and easy/ intuitive interactions.
4.3.3 Acceptance of Technology

The HMI team of Volkswagen Research group has done an acceptance study in their test car. They monitored the reaction of users while driving automatically and they asked the users how they experienced that. In this study according to the test persons easily adapted to the technology of automated driving. (Appendix page 55)

TNO had done similar testing with automated driving according to M. Marthens [TNO]. During the workshop Driver Experiences in Helmond she concluded that their test drivers didn’t accept the technology. More research and details were not shared concerning the research methodologies. Understanding the different outcomes is there for difficult.

Other research, to the acceptance of the technology, was done by J.D Powers1 in America. They asked the subjects if they would want to invest in an automated driving feature. More premium vehicle owners where interested than non premium vehicle owners.2

Research institutes and OEMs are apparently concerned to answer the question if users accept the technology. However the Service Innovation Team and the Industrial design approach is different. This approach is to start with the need of the user instead of pushing a technology and then asking if the user would want it. First we look if there is a need in the future. Then we look at how we could fulfill this need, and maybe this feature can support that need.

4.3.4 Behavioral Studies & Safety

Behavioral studies are done by many Research institutes. One of them is SWOV3 (National Dutch Research Institute for traffic safety). The main focus in these studies is to find out what drivers do when they are driving and see if these activities are jeopardizing the safety. A common research technique is shadowing people. In the project PROLOGUE people were asked to have a camera installed in their car to monitor their behavior for a certain period of time. The first outcomes were shared in the driver behavior workshop. [See appendix chapter X]. According to this research people call a lot in the car without using hand free. Also when interacting with the phone or navigation people reduce their speed without meaning to.

The HMI team of Volkswagen Research also conducted these kinds of behavioral studies first in America. The result was a list of side tasks including: calling, eating, doing make up and groom.

They expect the results to differ a little from Europe because of the smaller distances people travel and the higher amount of traffic on the road. However the results of the research seem the same: people do many side tasks in the car already so people can benefit from a system which will support drivers and their behavior on boring commutes.

1. www.jdpower.com
3. www.swov.nl
4.3 USER

4.3.5 Insights User

4.3.2 Cognitive Ergonomics
Requirements for systems

- For automated driving a 5-10 seconds time buffer is needed for drivers to get back into the loop.
- Feedback concerning mode switches need to be understood by the driver. An effective way is alarming the person by saying his/her name.
- The driver needs to understand the condition of the car in order to take over, smart design needs to support the driver getting back in the loop.
- The supervising state (partial automation) is not recommended because of the under load of work.
- The 5-10 second time range should be enough for drivers to return in to the loop from all possible side tasks, accept for sleeping.

4.3.3 Acceptance of technology
Research institutes and the OEM’S are apparently concerned to answer the question if user accept the technology and what they will pay for such a feature in the car. However the Service Innovation Team and the Industrial design approach is different. This approach is to start with the need of the user instead of pushing a technology and then asking if the user would want it. First we look if there is a need in the future. Then we look at how we could fulfill this need, and maybe this feature can support that need.

4.3.4 Behavioral Studies & Safety
Currently people do many side tasks while driving. Automated driving might be a solution to support this driving behavior better on boring commutes.

4.3.2 Human Product Interaction
If car manufactures want to sell customers automated driving they will miss opportunities if they keep on offering the functionalities in the same way as ACC and other assistant systems. This because high automated driving asks for a new way of driving and there for also interactions which are intuitive and fit more into the future of being connected. The HMI team within Volkswagen Research is currently working on concepts with head-up displays and augmented reality in front screen. Looking to smart products around us the car instrument panel and consoles can be approved by:

- They should integrate functionalities to central display point.
- Adjusting and fine tuning settings should not be shown at first and could easily be linked to user preferences.
5. DESIGN SCOPE
When designing a product service system for automated driving, we should first design the new driving experience for 2020.

“The sum of the whole is greater than it’s parts”
(Bauhaus)
Scope thesis:
This thesis focuses on the value of high automated driving for the end consumer in the luxury and economy car segments.

This was determined in the beginning of this project when the research department was developing the technology on existing sensor platforms of those car segments. The end user is taken into consideration because of the interesting tension field between "the fun of driving yourself" and "the comfort of automated driving during boring commutes".

In the Analyses phase we concluded that rational arguments to buy a feature such as automated driving will create value for B2B (business to business).

Rational arguments for automated driving:

- Fuel efficiency, increases due to smoother actuation.
- Time efficiency, on the highway the driver can do other activities, while driving high automated.
- Increased safety, in overload and under load situations the driver is supported by the systems.

These arguments are expected to be important for example for transport companies and fleet owners. Their trucks spend many km's on the highway. Higher fuel efficiency due to the feature will save money. End consumers who use their cars for example to commute (B2C) spend less time on the highway, the impact of fuel saving will there for be less visible.

For the end consumer not only those rational arguments are important. Since "The car is all about emotion" [W. Busser former import director of Kia and Ssang Young in the Netherlands] the emotional value is very important.

Add emotion to rational German mobility
To compete in the current car industry the quality of emotion in design becomes more important. German car manufacturers have a long tradition to design for the rational part of the brain. Quality and technical ingenuity have been most important however according to Luca De Meo (Director of Marketing, VW Group) it starts to become more important to design also for the emotional side of the brain.

If high automated driving is introduced as an evolution of the existing hardware (ACC) from which the interaction design is not adapted to current or even future standards (see chapter 4.3.4) then the brands from Volkswagen will miss the big opportunity to come up with something revolutionary.

Start by designing the experience
In order to come up with something revolutionary they should focus on selling future driving experiences. The experience is the story of the product in the context which is created by both rational and emotional aspects of the design.

“People will buy experiences rather than products” (M. Hassenzahl)²

“We are shifting to an experience economy where experiences become the predominant economic offering” (J. Pine)³

Automated driving should be one of the technical features which support the driving experience. Other components which support this experience when driving are the interior & exterior, the human machine interaction and the offered services. See picture on the right.

To create this new experience of driving in 2020 it is important to understand the experience of driving from people nowadays. The experiences of the users in 2012 will lead to insights of behaviors, need and emotions which serve as inspiration for the 2020 scenario.

6. USER RESEARCH
Dear Sophie,

A very nice surprise! I would never imagine that you would go this far! Well done! As you can imagine, this does not go unnoticed. The photo of you is great and really speaks for itself. I can only say that a big hand goes to my parents. We are so proud of you! They bought a car for you! Can't wait to see the final product! Enjoy it! I am really looking forward to the next letter. Can you address it to the post office? Liked it and will definitely pass it on. Love, [Name]
User Research is done to in order to inspire and validate the design process as described in chapter 7. In order to design the experience of driving in 2020 we first collect experiences of drivers in 2012. This chapter will validate how the research is set up and states the outcomes.

**Goal of User Research**
The goal of this research is to collect experiences of drivers, who love to drive.

- Understand the experiences and behaviors of drivers nowadays and translate these in persona’s which will inspire the ideation process.
- Finding qualities in the driving experience which are independent of time.

Why researching the experience of driving?
In order to create this new experience of driving in 2020 it is important to understand the experience of driving from people nowadays. The experiences of the users in 2012 will lead to insights of behaviors, need and emotions which serve as inspiration for the 2020 scenario.

Why people who love to drive?
According to findings of the J.D power studies, people who love to drive will be less likely to buy automated driving as a feature. This research supports that people who love to drive will be late adopters of this feature, the so called extreme users. The hypothesis for the user research was that these extreme users can help identifying the qualities of the driving experience best. They turned out to be true experts in talking about their driving experiences. The commitment of the user group resulted in a rich quality of data.

Selecting the participants:
To collect different driving experiences selecting the right participants was important. There for participants in different phases of life where chosen.

What is meant by experience?
To be able to translate the main question into sub questions, the word experience need to be unraveled in measurable units. Literature study revealed many existing frameworks defining product experience. For this research the framework of T. Mattelmäki and V. Jääskö was used. (Further details about researching different frameworks can be found in Appendix chapter 2). In the article Observing and Probing, T. Mattelmäki and V. Jääskö, provide a framework on the qualities of user experience which have an impact on the human-product relationship. The human-product relationship framework breaks down the experiences in 6 qualities. Which helped in prioritizing and making sub questions. This guided the process of designing the assignments within the probe kit.

### Framework of Tuuli Mattelmäki and Vesa Jääskö:

<table>
<thead>
<tr>
<th>Qualities of the user experience framework</th>
<th>scale of importance for this research: experience of driving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product look &amp; feel</td>
<td>Appearance 0</td>
</tr>
<tr>
<td>Socio-cultural context</td>
<td>User Interface 0</td>
</tr>
<tr>
<td>Time/historical context</td>
<td>User personality ++</td>
</tr>
<tr>
<td>Physical context</td>
<td>Product meaning ++</td>
</tr>
<tr>
<td>Use Context</td>
<td>Environment ++</td>
</tr>
<tr>
<td>Market context</td>
<td>Interaction ++</td>
</tr>
<tr>
<td></td>
<td>Product novelty 0</td>
</tr>
</tbody>
</table>

This scale on the right states the importance of the qualities for this user research. Where ++ is most important and 0 not important. On the basis of this framework sub questions are formulated for this research.

Socio cultural context:
What is the personality of my users?

Time/historical context:
What does the car mean for my users and why does it have that meaning?

Physical context:
What are the traffic situations the users dislikes and likes?

Use context:
How do the users use the car in daily life? What are the interactions the user has in the car with passengers and with other road users? What is their mood of my drivers during their daily use of the car?
Method

It is hard to catch experiences by questionnaires or observing. A common used method to do this is called context mapping. This is a combination of tools and techniques to get qualitative user insights about experiences of the user. This method will help generating rich qualitative data from the drivers.

This user research will consist of two phases. In the first phase the participants will be asked to do self documentation which help of a probe kit. The participants are asked to think about his/her driving experiences. During the self documentation period the users will be trained in translating their tacit experience into explicit knowledge. They will get a book with daily assignments in order to guide them writing down their experiences. This skill of self reporting will help them also during the workshop. The trained participants will be more comfortable when talking about these experiences which will contribute to rich insides.

This workshop will consist of two parts. In the first part we will continue to go more in depth in the driving experience of the user. To prepare questions and interesting topics for discussion the books with assignments will be returned before the workshop starts.

In the second part of the workshop we will co-create future experiences which will enhance the quality of the extra time when driving. This helps in understanding what they expect from driving experiences of automated driving cars in the future.

Probe kit

The probe kit will consist of assignments which are filled out by the participants. The participants need to self report during 4 days. Every day the participants need to fill in 2 assignments one of them is a diary assignment the other differs every day and will focus on researching other qualities from the used framework. The assignments are building up towards a final statement concerning their driving motto. This motto will be the starting point in the workshop. The outcomes of the books are analyzed to provide answers on the sub questions.

Workshop

Goals of the workshop in the first part:
- Set a good atmosphere among participant so they feel safe to share all their thoughts and experiences.
- Enrich the knowledge gained from the cultural probes
- Train the participants for the co-creation part

Goal of the second part of the workshop:
- Understand how they think of automated driving in future scenario’s.
- Co-create new driving experiences.

3. Sleeswijk de Visser, F (2009): Bringing the everyday life of people into design, Delft Technical University
Finding a way to analyze the data. First translate the Dutch cultural probe and video. Then organise the data per research question.
6.2 SUMMERY OF DATA

The important qualities concerning the driving experience are listed per person. All data can be found in chapter 2 page 11 of the appendix.

Sophia 26,
Lives alone, just started working

Personality:
Nostalgia and Control
Time = scares and shared with loved ones

Driving Experience:
- Reliable Buddy,
- Driving is fun in free time, cruising
- Catching up with family while driving to share daily emotions and to truly connect.
- Being in control provides security
- Emotions while driving are influenced by others.
- Negative emotions are influenced by uncertainties in traffic caused by behavior of other road users.

Simon 31,
Young family with baby,

Personality:
Energetic, creative, social
Time = making time to spend as much of it with close people or at least surrounded by people.

Driving Experience:
- Experience of product as hobby object however starts to develop into a safe place for family.
- Fun way to be mobile especially when those moments are shared together.
- Especially fun when together.
- Use in daily life, family mobility and driving together.
- Emotions got influenced by other road users, annoyance solved by jokes. Influence on positive emotions, share funny moments with passengers.

Bouke 32,
Lives alone,

Personality:
Trendy, focused, sportive
Time = carefully divided between private and work. He uses this time efficient both in his private and work life.

Driving Experience:
- Car is mainly a reflective product for him, showing his personality.
- Driving = a skill and a relaxing activity.
- The time while driving can be efficiently used for social networking.
- Driving is not work time but already leisure
- Emotions are not so much
- Influenced, but mainly with traffic annoyances.
Joan 48,
Family with young kids,

**Personality:**
Straight forward, enjoys life (Burgundian)
Time for him is efficient when working, free time means intensely experiencing family and fun.

**Driving Experience:**
- The car is a functional object which brings him from a to b.
- Driving as an activity is comfortable transport, efficient and fun when speeding.
- Hurrying around
- Not many emotions during driving, only some negative emotions from other road users and his own reaction on that.

Wim 52,
Family with teenagers,

**Personality:**
Down to earth, small joys in life
Time= carefully divided between private & work

**Driving Experience:**
- His car is a personal bubble.
- Commuting is good for thinking, finishing to do’s. Driving in his free time is playing with the elements. (either on motor or in convertible)
- Commuting = transformation from mind-set. Warming up and cooling down for the day by planning and finishing to do’s and thoughts.
- Emotions get influenced when thinking bubble is interrupted by disturbances coming from outside the car or by unsolved = problems from work.

Bep 58,
Family of grown-ups, retirement phase.

**Personality:**
- Positive and communicative
- Time = a flow, well balanced and overlap between private and work.

**Driving Experience:**
- The car is providing her a window to the world
- Driving is involving activity because of seeing and experiencing people, nature, buildings.
- Driving is relaxing
- Emotions are positively influenced by environment.
- Road conditions, lots of traffic leads to negative emotions.
In the co-creation session the participants came up with two concepts based on different experiences.

The car as butler
One experience was “the car as butler” providing the driver with a cozy atmosphere. Where the driver can enjoy close contact with friends/ family or look to the world outside from a lazy chair.

Important features:
- Zoom in movement on windows, to show the driver an augmented zoomed in representation of the world around. This to see for example birds more close.
- Offer games, for when people travel together.
- Prepare home on the arrival of the driver, by sending notification for example that the coffee can be switched on.

The car as a business class flight
The other experience was “the car experience as a first class seat in an airplane” the car as a place to relax, while continue work.

Important features:
- Offer work possibility,
- Having massage chair, possible sleeping position.
- Glasses you can put on to see augmented world around you, to do work.
- Light adapts to activity and mood.

Conclusion of two concepts
A central theme can be found in both concepts. This theme was delivering comfort by offering the user many possibilities. However too many possibilities doesn’t directly mean that the users experience this comfort. These two concepts show that the participants want to direct their time and space according to their needs. Although they don’t drive themselves they still create an experiences in the car where they will feel in control and autonomous.
6.3 CONCLUSIONS USER RESEARCH

This research delivered qualitative descriptions of the driving experience of the six participants. Those experiences will be used in the ideation phase as inspiration. Later on the persona’s can be used in evaluation of the concept. The workshop outcomes serve as inspiration as well.

Insights from research questions

- A trend could be found in what influences the emotions of the participant. The positive emotions were mostly related to nice interactions with family or passengers when driving. The negative emotions where mostly related to annoyances with other road users.

- Other positive emotions were for example: Enjoy sun, beautiful landscape, listening music, an empty road, driving home or to leisure activity, playing fuel efficiency “games” and drift in the snow. (pic 6.3.1)

- Other negative emotions were for example: Inefficient use of time, such as standing in a traffic jam or waiting for others, bad weather conditions which course longer travel times and boredom when commuting (pic 6.3.1)

- When the participants reflected on their cultural probes they all agreed that the activity “driving” seem to disappear to the background. During their daily commute they used the time in the car almost as if they already drove highly automated.

- Although the meaning of the product and the experience of driving is different for all the participants, two behaviors could be identified:

  Introvert
  Wim:  “A place to think and plan my day”
  Bep:  “A place to regain energy by watching the rest of the world”

  Extrovert
  Bouke:  “Time to plan my social agenda”
  Sophia: “Having good conversation with close family members”
  Simon:  “Making jokes of white vans that drive dangerous”

Workshop insights

The participants valued the high flexibility of the time spend when driving. They want to direct their time and space according to their needs.

In the workshop the emotion of cars was discussed. The participants stated that in the future the interior will become more important than the outside of the car. They concluded that the skill of driving is no longer important but the experience in the car becomes leading. They also agreed that the relation with the car will change. Simon stated: “It will not be your buddy anymore”
7. IDEATION
Using the VIP design methodology to design the future driving experience of 2020
In this chapter the ideation process is explained. On the picture on the left of this page the design process is visualized. The input from the user research is used to create the future users under influence of the future trends. The future users are coupled to the brand identity and placed in the future context. This served as inspiration for the two future experience statements for both Audi and VW.

How to design an experience for the user in 2020?
Designing appropriate services for users is important in order to create value for both user and business. Service design projects strongly focus on current interaction and context, often pain points and user needs serve as design criteria for new services. When designing appropriate services for 2020 current constrains should not be leading in the design because context and interactions might have changed over time. However the knowledge generated in both the analyses phase and the user research will inspire the design process.

Therefore the focus will not be on what could be a service in 2020, but first on what should be the experience of driving in 2020. The Vision in Product design (VIP)
methodology of M. van Dijk en P. Hekkert will serve as framework in this process to design the future experience. This methodology helps designers in pushing their creativity by focusing on future contexts and not on current constraints. The goal is to come up with a design statement which can summarize this future experience. This design statement will be constructed by 3 building blocks.

3 Building blocks

- **Future world**
  Envision the context of driving in 2020 according to the VIP methodology

- **Future user behaviors**
  See how the trends will influence the behaviors analyzed in the user research. What will that mean for the qualities of driving in 2020?

- **Brand identity**
  The products in a portfolio need to be able to express the identity of the brand. When moving to an experience economy, brands need to reflect their identity in the experiences they sell.

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7.2 FUTURE WORLD

The first step in the VIP methodology is envisioning a future world. This future world can be constructed out of developments, trends and states combined into vision for 2020.

In the chapter 7.3 the future world is used to see how this will influence the behavior of the users from 2012.

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The unstructured world of activities in 2020

Development: leisure and work time will overlap more, this results in flexible work times and flexible work spaces. (chapter 4.2.5)
State: people need daily routines
Role of the car: quality time in between activities

The social connected world in 2020

Development: online social networks continue to become more important in everyday life, the spatial aspect of interacting in online networks becomes more important (chapter 4.2.5).
In car trend: E-learning becomes more important¹.
State: true friendships and family become more important to emotionally connect.
Role of the car: the communication hub to connect and learn from others

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¹ Fliegner, J (2012), personal communication, appendix page 50.
7.3 FUTURE USER BEHAVIOR

Analyzed behavior

Introvert behavior (chapter 6.3),
Wim: “A place to think and plan my day”
Bep: “A place to regain energy by watching the rest of the world”

Extrovert behavior (chapter 6.3),
Bouke: “Time to plan my social agenda”
Sophia: “Having good conversation with close family members”
Simon: “Making jokes of white vans who drive dangerous”

The socially connected world
In the future people will participate more and more in social online network activities. Being connected while driving becomes more important. In this world “online learning communities” become important.

The car can support new behavior:
• To support the behavior of Bouke, Sophia and Simon in the future better, the car should support them so they can connect on different emotional levels with friends, family or social networks.
• Plan the social agenda.
• The road can function as a market place to share knowledge and support positive road interactions.

The unstructured world of work/leisure activities
Leisure and work time will overlap more and people are on the look for new routines in a chaotic life. In this world, the car as a place to think and regain energy for daily life, becomes more important. The introvert behavior of Wim and Bep therefore needs to be supported in future cars.

The car can support new behavior:
• Warming up for activity at destination.
• Cooling down from activities where one commutes to.
• Being in a bubble concentrated on organizing life and there for regain energy.

Future user behavior
When moving to an experience economy, brands need to reflect their identity in the experiences they sell. The brand which is most likely to adopt this technology for the B2C market first is Audi. Volkswagen is also interested in this technology. Both brands are analyzed to be able to showcase how different brands in the portfolio of Volkswagen AG could design this future experience of driving.

Brand identity VW
The UP, the new Beetle and the concept Bulli are all designed with a specific character. Which is showing, according to Walter de Silva: “honesty, simplicity and it is meant to make the customers smile”.

According to dr. Martin Winterkorn, chairman of the Board Volkswagen AG, all the cars of Volkswagen Brand are meant to symbolize a positive approach to life.

The future vision of the brand is to bring more emotion into the design of the car. Because according to Klaus Bischoff, Head design VW Brand, the current product portfolio is too functional.

Concluding, VW is intending to move from the rational more to the emotional. The UP and the New Beetle are good examples of that. The new emotion they want to sell: a positive approach to life with a car that makes you smile. They want people to fall in love with the product.

The experience should contain the following qualities:

- Make people smile
- Honest and simple
- Understandable for everybody
- Functional
Identity Audi,
Audi has always been about high precision in technology; “Vorsprung durch technique”. They are focused on optimizing performance. This love for the technology and precision is what Audi tries to communicate by rigorous and pure styling⁴. They perform with their cars in the “Le Mans” race. They couple their brand name also to other individual sports where high performance equipment such as skiing and sailing. It seems that Audi wants their drivers to feel like “a skilled pilot which controls a high performance machine”. While in reality Audi offers a comfortably drive from A to B.

In their commercials they often use grey industrial landscapes which shows that their target segment is the business commuter with money. They want to offer those people a premium commute.

The experience should contain the following qualities:
Sportive skilled pilot.
• Premium commute
• “Swiss watch feel” of high craftsmanship and luxurious material use
• Comfort of a private space

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2. Cinti, F(2010): Strong design strong brand, Auto & Design supplement al nr 190 September/October 2010
IDEATION: CONNECTING THE BUILDING BLOCKS

INDIVIDUAL COMFORT

UNSTRUCTURED ACTIVITIES

SOCIALLY CONNECTED

FUN TOGETHER

INTROVERT BEHAVIOR

EXTROVERT BEHAVIOR

2020
Connecting the building blocks
On the left side of the page the blocks from chapter 7.2, 7.3 and 7.4 are visualized this in order to understand the design step from the building blocks to the design statement which should describe the experience. For this design process the combinations of introvert behavior and the unstructured world of activities combined well with the brand identity of Audi. So did the extrovert behavior together with the socially connected world and the brand identity of VW.

From building block to design statement
The combinations of building blocks are used as input for the design statement. On the following 4 pages the ideas are documented. It consists of the design statement describing the future experience and how this abstract phrase can be translated into functionalities and service offerings. A short scenario is added to visualize the idea.
OFFER PEOPLE A COCOON IN WHICH THEY CAN MAKE THE TRANSITION FROM WORK TO LEISURE IN ORDER TO REGAIN ENERGY FOR DAILY LIFE

Vision:
Offer quality time to the driver when driving as an activity isn’t fun. This quality time for this specific use group is tailored by offering them an experience consisting of the following elements:

How:
Offer the right infotainment of the car in the right form and time which supports the user making the transition from leisure to work and back.

Special attention to applications offered in the part of high automated commute. Here the system should offer the balancing life application. The balancing life application offers a spacial interaction with the dashboard in order to physically interact with thoughts, activities and to does.

Functionalities of the service includes:
• Ordering thoughts
• Order activities, to do’s and thoughts in the daily time line
• The ability to finish work or other to do’s
• Work on life goals
In control, because of setting the alarm clock and time and destination of his first appointment. Part of evening ritual.

Finishing morning ritual, stress to go because multi-task attention between family and concentrating on departure. Comfort of the car supporting in leaving the time.

Slowly leaving stress behind, last thoughts about family and about his warm bed. Because of nice music, and sweet message of daughter.

No stress in comfortable own space. Supported in actively ordering thoughts and planning. Starting to make the transition to more work related thoughts.

Driver is enthusiastic about interesting topics. He can use during his day. He thinks about the first to do’s. He enjoys the last km’s in his cocoon.

Energized because of his commute, which was a good place to think. Kick start for the day when he got the reminder of his last thought.
OFFER PEOPLE A HUB IN WHICH THE FEEL AS IF WEEKEND HAS BEGUN WHILE THEY ARE CHALLENGED INTO SURPRISING INTERACTIONS.

Vision:
Offer quality time to the driver when driving as an activity isn’t fun. This quality time for this specific use group is tailored by offering them an experience consisting of the following elements:

How:
Setting up a road community where drivers take part in and belong to. This for exchanging information and knowledge. The road becomes a new marketplace to exchange knowledge.

Special attention to high automated commute, where the car offers many interaction possibilities. Smart systems and mood detectors need to pick up the energy level of the driver and use this as input to offer the right music to energize the driver.

Functionalities of the service includes:
- Taking part in discussions or sharing information in road community
- Actively plan leisure agenda, because of proposed activities or events which are within the interest bubble of the driver
- Connect with friends to plan dinners and parties with multiple people
Set alarm clock and destination to automatically log-in into the road community of 7 o’clock Den Haag-Amsterdam.

Feeling excitement for the next day because of interesting people on the road community network.

Think of interesting question and how to connect people.
Preparation to join interesting information exchange

Surprising new thoughts on problems with scholars in class, because of good advice or interesting point of views of road community.
Proud to have connected a friend with that interesting person driving a red Polo.

Show the driver events and people who belong in his interest bubble. To not miss out.
Option to plan date with group of friends.
Provide optimal support in call or video call family/friends.
Ability to easily exchange data with each other.

Say goodbye to road community
Play Music adapted to mood and general taste user.
Play the best/favorite just before driver gets out of the car.

Planning activities. Update social agenda.
Feeling that the weekend has began (although it is Monday). Energized because of all the exiting activities and dates planned.

Music accelerates excitement of leisure activities to come.
7.6 CHOOSING THE CONCEPT

AUDI EXPERIENCE

+ Audi is expected to be implementing high automated features first. (Chapter 4.2) Therefore it is more interesting for Research group to come up with concepts for Audi first.

+ In this concept the classical business driver is taken into consideration. It fits into the already existing idea of Research: to sell extra time to people who are willing to pay for that.

+ The target market of Audi will be between 35-55 who have the money to invest in this experience.

- It fits in the already existing mind-set of the Research group.

VW EXPERIENCE

+ Showing that extra time in the car does not automatically mean time for extra work.

+ Addressing to an interesting future. Where social connecting on the road is evenly important as with family and friends.

+ Creating a new story for Research department. Automated driving does not only support introvert behavior of business commuters but also extravert social behavior of commuters.

- New expertise needed to create road community.

- Business model should result in a low entrance barrier for customers by low hardware costs. This because the first adopters of this experience are probably young people typical students and starters who have a high exception for new technologies however have not so much money to invest.

The Audi concept was chosen in consultation with the main initiators of this thesis. The most important argument was the interest of the premium Audi customers in the extra time and the willingness to invest in advanced technologies.
8. PRODUCT SERVICE CONCEPT
Dream: The car as platform for mobility experiences

Tangible: Visualization of the product service system in the car
In this chapter the outcomes of this thesis are described. It starts with strategic advice concerning the design process of “mobility experiences” in order for Volkswagen AG to become a mobility experience provider. The second level is providing an example of what experience Audi should sell according to my research. The third level describes the product-service system which should create the experience. This product-service system is called the basic experience package. Within this package the balancing life application makes sure that the right services and applications are offered tailored to the driver. The visualization of this application can be found in the last part of this chapter.

The concept “basic experience package”
The final outcome of this thesis is a proposal of a product service system for the car as a service platform. In this case the product service system is called the “basic experience package” it is mend to create value for the customer by offering tailored experiences which provide private quality time for the daily commute of the premium Audi customers.

The basic experience package is a monthly subscription offered as a combination of hardware, connectivity and services offerings:

- The connection package provides internet and C2X communication to connect the car.
- The hardware package provides the multi touch OLED display and the automated driving technology to ensure the driver can use the time during the daily commute.
- In the service package the most important for the user is the balancing life application which launches the appropriate applications and service offerings at the right time of the journey. This by going through the phases family table mood, balancing life mood and the personal growth mood to ensure that the driver can be supported in making the transition from work to leisure in order to regain energy for daily life.

Premium services
Premium services are extra service offered next to the services included in the basic experience package. These premium services are specifically tailored to support the driver even better. These premium services are important to Audi whom suddenly have the opportunity to create more touch points with the user during the use phase of the car. The online data profile of the user is important input for these service offerings. This can create a better customer relationship because of the direct link created between the Audi brand and the customer. When drivers spend more time driving highly automated the better this is for collecting their online behavior. This results in even better tailored services and in a reduction of market research costs.
8.2 STRATEGIC ADVICE

This thesis started with the assignment: Design a product service system which creates value for the user when driving a high automated car.

The amount of cars per person is expected to stop increasing in Europe. Owning cars becomes less popular by younger generations. (Page 39)

These expected effects will have an influence on the car market in Europe. Innovations and new mobility concepts are needed to keep the brands of Volkswagen in a competitive position.

Technical trends in “automated driving”, “cloud computing”, “umbuiquitous displays”, “umbuiquitous services” and “Intelligent transport systems” open opportunities for Volkswagen AG to make a statement on what mobility in the future will mean for car owners. (Page 81)

In the past, technologies were pushed to the market. (Example of Audi Quattro). However if Volkswagen introduces automated driving as an extra safety technology, as they are claiming on the official website, they will continue the technology push and therefore miss an opportunity to address future mobility needs of drivers and therefore potentially become the hardware provider to Google or Siemens. (Page 36)

In the analyses we found out that opportunities lie in offering the driver quality time. The Audi concept was about giving users the luxury of a private space in which they can use the quality time to balance life.

Audi will therefore be a great showcase for selling the experience of extra time. The early adopters to this new experience are the ones who are willing to invest in new technologies and have the money for that. Most likely these are the business commuters who spend much time in the car and for whom time is valuable. These are considered already as the target group of Audi. (Page 31)

Furthermore Volkswagen AG can still use the top down approach which they are used to. However new business models will help in faster market penetration of the “experience” cars which is needed to get a more redundant car 2 car communication network.

1. Selling driving experiences rather than technologies and cars.

This because an experience is the story which creates both emotional and rational value. People will buy experiences rather than products. (Page 53)

2. The car should be a platform for mobility services, applications and features with main identity; the experience.

When a car is used for everyday life (not for cruising or racing) technologies allow us to use it as part of our connected world. In this case the behavioral qualities of the mechanics of the car becomes less important than the online possibilities and the service offers which come along with it. The car as a platform enables therefore many business opportunities. (Page 40)

3. The experience should be a mixture of user needs projected into a future world in combination with the brand DNA.

Starting from the user needs it will be necessary to create tailored experiences which will make sense to drivers. To think ahead and project those needs into a possible future helps in thinking about future use scenario’s. (Page 36)

4. Audi should showcase the future mobility experience of all the brands within Volkswagen AG first.
For Audi a new driving experience is designed to provide the customers with an exiting story about future mobility. The new driving experience of Audi will be about offering the driver quality time. This by:

OFFERING A COCOON IN WHICH PEOPLE CAN MAKE THE TRANSITION FROM WORK TO LEISURE IN ORDER TO REGAIN ENERGY FOR DAILY LIFE.

Offer the right infotainment of the car in the right form and time which supports the user making the transition from leisure to work and back. The balancing life application launches the right functionalities and moods at the right time during the commute. The scenario on the right visualizes how the experience is created.

The Experience is visualized on the right side of the page.

COMMUTE SCENARIO:
To visualize the experience in the car a part of journey was chosen. This scenario is of a typical morning commute. Where rural and city traffic have the same effect on the automated commute.

EXPERIENCE USER:
This visualizes per phase of the journey what the mood and experience for the user should be.

MIND-SET
How the overall mind-set of the driver should change during the drive.

FUNCTIONALITIES
This sums up the functions which are needed to support the experience created as visualized above.

IN VolvEMENT IN DRIVING TASK
This is when the driver is in the loop or out the loop of driving. In this concept the system only drives high automated on the highway to limit the amount of mode switches and therefore confusion and possible rejection of the system. Supervising state is only an option when parking.

TECHNOLOGY
The technology which support the phases of the journey
The technology which supports the phases of the journey experience:

**EXPERIENCE USER:**
- **Home departure:** Set alarm clock and leaving clock. Visualization of pictures family or display there goodbye texts.
- **City or rural traffic:** News and Radio on demand. Partial automated drive. In car media focused on Audio and Images.
- **Highway:** Visualization of daily activities. Physical interaction with balancing daily to do’s. Both work and leisure oriented. High Automated drive. All applications are unlocked. In car media focused on Audio and Images.
- **City or rural traffic:** Visualization of daily activities. Smart filters offer focused knowledge or applications which support preparation of activities to come.
- **Parking:** Message to user to repeat important thought for the first meeting. Full automated parking, however user should override situation either from inside or outside the car.

**FUNCTIONALITIES:**
- **Set alarm clock and leaving clock:**
- **Visualization of pictures family or display there goodbye texts:**
- **News and Radio on demand:**
- **Partial automated drive:**
- **In car media focused on Audio and Images:**
- **High Automated drive:**
- **All applications are unlocked:**
- **In car media focused on Audio and Images:**
- **Message to user to repeat important thought for the first meeting:**
- **Full automated parking:**
- **However user should override situation either from inside or outside the car:**

**TECHNOLOGY:**
- **Light:**
- **In the driving loop:**
- **Out the driving loop:**

**IN Volvement DRIVING TASK:**
- **In the driving loop:**
- **Out the driving loop:**

**MIND SET:**
- **in the driving loop:**
- **Out the driving loop:**

**FUNCTIONALITIES:**
- **Set alarm clock and leaving clock:**
- **Visualization of pictures family or display there goodbye texts:**
- **News and Radio on demand:**
- **Partial automated drive:**
- **In car media focused on Audio and Images:**
- **High Automated drive:**
- **All applications are unlocked:**
- **In car media focused on Audio and Images:**
- **Message to user to repeat important thought for the first meeting:**
- **Full automated parking:**
- **However user should override situation either from inside or outside the car:**
8.3 PRODUCT SERVICE SYSTEM: “THE BASIC EXPERIENCE”

SERVICE

• Balancing application
• Premium services
• Application store Volkswagen AG
• Update and maintenance of in car software
• Real time traffic data

TECHNICAL FEATURES:

• Automated driving
• OLED dashboard
• C2X Communication

HUMAN INTERACTION DESIGN REQUIREMENTS
(Chapter 4.3.5 page 41)

• Integrate functionalities to central display point
• Settings don’t need to be displayed all the time
• 5-10 seconds time buffer for takeover request, all activities except for sleeping are accepted
• Supervising state is not recommended because of under load of work

INTERIOR & EXTERIOR DESIGN REQUIREMENTS
(Chapter 7.4, page 67)

• Comfort of a private space to think and plan the day. Feeling of cocooning.
• Sportive skilled pilot
• Premium commute
• Swiss watch feel of high craftsmanship and luxurious material use

pic 8.3.1: Showing how the features, services together with the requirements for the interior and hmi form the experience.
8.3.1 Introduction Basic Experience package

This chapter will describe how this experience and the corresponding functionalities will be unified in a product service system which can be sold to the customers.

When the car is seen as a platform, the experience and its identity form the basis for service offerings. The functionalities and technologies from the experience journey diagram are summarized in picture 8.3.1, just as the requirements from chapter 4.3 User and Chapter 7.4 Brand Identity.

As described in chapter 5 the experience is created when the hardware, software, service offerings and design are communicating the same message. So the sum of all the elements should create the Audi experience of: offer a cocoon in which people can make the transition from work to leisure in order to regain energy for daily life.

The basic experience package is a result of translating the functionalities and requirements in combination with the idea that the car should be platform of mobility services.

The basic experience package as product service system is visualized on page 89.

The basic experience package will be a monthly subscription which offers the driver the hardware, the connectivity and the services as discussed in the experience journey. Premium service offerings are an addition to this monthly package and form new possibilities for improving customer relation and extra revenue stream.

The basic experience package consists of three components: the connection package, the service package and the hardware package.

8.3.2 Connection package

Internet connection,
Providing internet connection is essential for offering the driver the connectivity needed when using the car to plan the day and to finish to do’s. How the internet and applications are used in the car is valuable data. This is data which Audi should not give away for free to third parties. This data should be used as input for the premium services. Recent demonstration of 4G internet within cars already show examples of this kind of application based infotainment.

Car to X communication
The C2X communication is needed to improve the traffic flow and the redundancy of the automated driving system. In the beginning when market penetration of this feature within cars is low, it will not have the effect as described above. However implementation in cars is needed to start growing the float of cars with the feature in order to improve safety, fuel efficiency, traffic flow, redundancy of automated driving cars.

Real time traffic data,
Real time traffic data is the information the automated driving system needs to make better assumptions on travel times and warn the driver when travel time overlaps with for example appointments due to delays. Especially in the morning the real time traffic data can help the driver in deciding to leave earlier because of a traffic jam.1

8.3.3 Hardware package

Control system sensor platform for high automated driving and on-board computers,
In contradiction to most features in the basic experience box the hardware of the control system is something which can not be removed when a customer stops the subscription on the basic experience package. The sensors and control unit are installed in the assemblage process of the car. The hard and software needs to direct all the processes of driving, automated driving, other onboard tasks and the infotainment computer. This essential control system and the on board computers are the basic for offering the customer extra time.

OLED displays
In order to provide infotainment and service offerings the OLED multi-touch screens are the interfaces for the driver to interact with the 7.3.3

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1 DigitalAgendeEurope (2012); Internet of things Europe teaser n. 3: Traffic, online movie about the connected future.
8.3.4 Services package

Balancing Application
The Balancing Application is an application which needs to offer the right infotainment in the right time of the journey. Depending on the automation modus and the routine of the daily commute. In this driving routine three stages are defined:

- Visualization of the audio applications of the user in the car focused on entertaining and leisure activities.
- Visualization of the appointments, thoughts, to-do's of the user with the possibility to change, finish or plan these.
- Visualization of the audio application of the user in the car focuses on interesting topics, to be inspired and educated.

This application needs to have access to other applications in the car to launch them in the right time. But also supports in visualizing those functionalities and data on a bigger and different screen namely the dashboard.

Premium services
A premium service can be thought of as a service which is specially tailored for the individual customer during his daily commute. One must think of a personal assistant within the car. (This idea is derived out of the user-co-creation workshop.)

An example can be reserving parking spots. The premium service offers are meant to create an extra value for the customer of Audi. This extra service level should help Audi in maintaining a good customer relationship throughout the use phase and creates brand loyalty.

To be able to offer those premium services, data is needed concerning online behavior. The user data needs to be protected, stored and analyzed in order for Audi to offer appropriate services customized to their user.

In order for Audi to manage this new business it needs to establish a new department which concentrates on offering customized premium services. This new department can be called the “Audi service platform” and is later discussed in the business model.

Application Store Volkswagen AG
Volkswagen AG needs to develop an application platform which is able to function in the car environment with regard to passenger safety. This enables a new platform for developers and the possibility for users to use their applications in the car as well.

Update and maintenance of in car software
The update and maintenance of the software in the car concerning automated driving is important for Audi. Depending on liability agreements Audi might be held more often responsible for accidents instead of the driver. To avoid claims and accidents Audi will benefit from offering updates and maintenance service to their customers.
PRODUCT-SERVICE SYSTEM

- Internet connection
- C2X
- Real time traffic data
- Control system sensor platform high automated driving + board computers
- Display dashboard
- The Audi balancing life app
- Access to Application store
- Update and maintenance
- Premium service offerings
8.3.4 Redesign

In order to create a space where drivers are able to plan the day and finish to do’s an interface is needed which creates more advantages than tablets and smart phones.

The requirements taken into consideration:

- No mechanical interior changes should occur in case of a mode switch. This due to a short time frame (5-10 seconds) in which the driver need to switch back form activity x to the driving task. This means the driver should remain in safe driving position also during the high automated commute. The interface should support the driver in making the transition between driving and high automated drive. The hmi of takeover requests is not within the scope of this thesis.

- As concluded in the analyses the future interface of cars should be simplified and more similar to smart devices around. In order for drivers to accept that the future car is no longer a mechanical device but a smart, connected platform the interaction needs to be adjusted in order to fulfill that role.

- To be able to offer the functionalities such as: displaying pictures, radio and news on demand, planning application etc. an interface is needed which gives the freedom and space for interaction during the high automated and manual mode of driving.

These requirements lead to the following proposal of using the dashboard as a big multi touch OLED screen. Inspiration derived from chapter 4.1.6 and from the movie “a day made out of glass”.

A distinction is made between the manual and high automated mode. Where in the manual mode the interface can be used to display audio based applications and in the high automated mode all kinds of applications can be used. The advantage of a big screen is that it allows multitasking and a big workspace to physically interact with by gestures.

To validate the ergonomics of the OLED touch screen a quick analyses was done on the reach envelopes. Reach Envelopes help in determining if people can reach the dashboard for interaction. Because of the different dimensions and ratio of human bodies the position of x, y and angle alpha from the h-point in combination with the length of the arms result in a wide variety of reach envelopes. Looking at the dynamic situation this becomes even more complex. To reduce complexity, the average h-point position and average arm length of Dutch people (man and woman) is considered for the first estimation. Further research is needed to also investigate the comfort of the interaction with the screen in a dynamic situation.

This estimation determined the size of the active workspace of the OLED screen dashboard. In picture 8.3.4.2 this is indicated by the blue area on the dashboard and middle console.

The second proposal is to move all information and settings which concern driving and comfort from the center stack and center console to the steering wheel and transform earlier shifts, buttons etc into applications visible on the steering wheel. The idea is that settings such as heating, seat position will smartly adjust and therefor don’t need to be controllable from the “start” screen. Resulting in the organization of the hmi as shown in picture 8.3.4.2. The dashboard and the center console can be completely used for the infotainment.

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2. Dirken, H (2004), Product Ergonomie ontwerpen voor gebruikers; DUB blue Print
3. Macey, S & Wardle, G; H-point the fundamentals of car design & packaging; Design studio press
Head-up display for navigation.

From the OLED display multi-touch dashboard screen the blue area is the area used for interaction. The rest of the screen enhances the mood and can be functional when another passenger is on board.

OLED Display on the middle console for application library. To open applications they can be swiped on towards the dashboard. Part of this smaller display on the middle console can be used as keyboard.

OLED screen on the steering wheel. The settings integrated in the steering wheel include:

- The manual drive functions (shift gears, mirror settings, blinker, lighting)
- The automated drive function (settings)
- Seating position
- Windows cleaning and Health of Car
- HVAC (heating, ventilation, air conditioning control)

The h-point, the length of the arm and shoulder height determine the reach envelopes. The h-point is determined by x, y and α.

Pic 8.3.4.3: side and top view of reach envelopes

Width car interior medium coupe

Green line: Arm length P 50 (Dutch female and male 30-60): 719 mm
Red line: H-point to steering wheel: 300 mm
Black line: Shoulder width P 50 (Dutch female and male 30-60): 443 mm

Pic 8.3.4.2
**Service Blueprint**

**Frontstage**
- **Experience store** online (app or website)
- **Experience popup** store at car dealer or congresses

**Backstage**
- Communication to customers to involve them in the dream
- Provide cars with the Audi experience to the dealers for test drives.
- Communication between the dealer and Audi Service platform
- Create plan to involve target group in future mobility experience of Audi
- Product registration system. Installation of "Basic experience" package.
- Data collection of user when driving automated mode
- Filter and store data

**User Action**
- Orientate on buying a new car
- Buy monthly "Basic experience" package and the hardware (the car)

**Physical Evidence**
- One day trial of "experience car". Ex: test drive during annual check old car or at

**Backstage**
- Bought premium Audi service. Ex: Park in Excellence Parking at Schiphol airport

**Communication to customers to involve them in the dream**
- NEW Premium Audi Service offers while driving on dashboard
  - Service touch points created due to user data.
  - Audi is able to offer premium services which creates new possibilities in customer relation during the use phase of the car.

**User Action**
- **FRONTSTAGE**
  - **BACKSTAGE**
    - **PHYSICAL EVIDENCE**
8.3.6 Service Blueprint

In order to better explain the product service system a service blueprint is used to schedule it and explain why those Premium service offerings for Audi are so important. Also, what needs to change in marketing of the product in order for the customer to understand the values of buying this experience.

The user action describes the customer journey from “orientate on buying a new car” to “using the product service system”. This remains the same although the focus needs to shift from buying a car to buying a platform with a monthly package of the basic experience.

The physical evidence row describes the evidence for the customer in every step of the customer journey. In this case the evidence when orientating on buying a car should be a test drive. It is important that the potential customer is able to undergo the new experience of driving and has time to test all the possibilities of the “Basic experience package”. In order to create this service of providing “Experience test” cars, the brand Audi needs to make a marketing plan and early communicate the future dream to their customers and the dealerships. An online experience store and pop up experience stores at dealerships allow Audi to create touch points for this new product. The pop up experience store at the dealership is the touch point where the customer for an annual check can swap there own car to test the “experience test” car for a day or more.

The value for Audi and the customer is created in the use phase of the product service system. Nowadays therefore little touch points between Audi and the customer and there for little evidence for the customer. This means that in the current situation the customer relationship for Audi is a hard one to maintain also because the dealers are a third party in this relation.

Automated driving brings a new possibility for the customer relation for Audi. When drivers are driving highly automated it is expected they will go online and by doing so create a use profile. This use profile is valuable data which Audi can use to offer extra services. In the high automated commute the car supports the customer to create a atmosphere where they can use there time valuable. The car become a personal assistant for the driver. The premium service offerings are an addition to that service.

These Premium Service offerings form the new touch points between Audi and the customer in order to improve the customer relationship. The Audi Service platform needs to conduct this data and provide the customers with the appropriate service offers.

The frontstage row shows where and how the customer interacts with the product service offering. The backstage row shows what needs to be arranged backstage in order to accomplish the touch points and the physical evidence.

Important points blue print

- The customer should be able to understand the new mobility experience. New touch points in the “orientation on buying” phase should show the possibilities of the new driving experience. These touch points are important in marketing the product and are therefor important for the success.
- The “online behavior” data of the customer is collected in the user phase of the product. This data will create the opportunity to improve the customer relation ship.

1. Stickdorn, M & Schneider, J (2011); This is service design thinking, basics-tools-cases, Bis publishers
**BUSINESS MODEL**

<table>
<thead>
<tr>
<th>KEY PARTNERS</th>
<th>KEY ACTIVITIES</th>
<th>VALUE PROPOSITION</th>
<th>CUSTOMER RELATIONS</th>
<th>CUSTOMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application developers</td>
<td>Design premium services</td>
<td>Offer a private place where tailored experiences provide quality time during daily commute.</td>
<td>Tailored premium services.</td>
<td>B2C, mass market</td>
</tr>
<tr>
<td>Network provider</td>
<td>Data collection car and driver.</td>
<td></td>
<td></td>
<td>First adapters:</td>
</tr>
<tr>
<td>Content providers</td>
<td>Internet service provider</td>
<td></td>
<td></td>
<td>Premium Audi customers</td>
</tr>
<tr>
<td>Real time traffic data provider</td>
<td>Maintenance system</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEY RESOURCES**

- People
- Smart filters for data
- Automated driving technology.
- Applications and content

**CHANNELS**

- Audi Dealer with experience pop up store
- Application store Volkswagen AG
- OLED Dashboard displays premium service offers.

**VALUE PROPOSITION**

- Tailored premium services.

**CUSTOMER RELATIONS**

**COSTS**

- Maintenance system
- Network costs and costs of real time traffic data
- Offer premium services
- Operational costs data logistics and storage

**REVENUE STREAM**

- Monthly subscription on “Basic experience” package
- Premium Services
- Rental of space in application store for sponsored content and application
- Production costs hardware
8.3.7 Business Model of the basic experience package

In order to get better insights in the product and how it can create value, not only for the customer, but also for Audi the business model canvas tool is used. The business model canvas helps in visualizing the business model (left page).

Reason for Audi to offer this product: value Proposition
The design of the product service system “the basic experience package” started with creating a future experience tailored for the Audi customer. This was done by both co-creation and an analyses of the cultural probes (chapter 6). The conclusion was that it is important to offer the customers a private place where tailored experiences provide quality time during the daily commute. The reason for Audi to sell the basic experience and the premium services is to create that value for their customers.

Customers, Customer Relations and Channels
The customer who wants a private space and quality time and is willing to invest in that are the business commuters. This target group travels a lot for their work. They have high acceptance to new technologies and have the money to invest in that. (Chapter 4.2.1)
In order to reach these customer the dealerships are important marketing and sales points. The application store in the car is another channel were the customer can buy addition applications or content. Another channel is the dashboard display which communicates the premium services offers which come from the Audi’s premium service platform.

Key activities, key Resources, Key partners
The important activity which Audi needs to do is to design the premium services for their customers. Audi’s service platform needs to collect the data and use smart filters to select the data they need, they also need to distribute this data from the car and driving behavior to the marketing and the research and development departments. The network is provided by a third party, however Audi is responsible for delivering the internet service themselves. Because this allows Audi to freely collect the data of the online user profiles of their customers.

In order for Audi to offer the basic experience safely to their customers they need to do maintenance and provide updates for the automated driving system.

The content and application in the Application store will come both from Audi and from content providers and application developers. These form the key resources in the basic experience package.

Costs
- People working for the new department “Audi’s service platform”. They are responsible for the premium service offers and the data logistics. Their main goal is to maintain the customer relationship and provide the R&D and marketing departments with the appropriate data.
- Costs of People who need to update and do maintenance of the system. This is a continuous task and is ensuring safety of the high automated driving cars.
• The operational costs which are created because of the data storage and logistics.
• Key partners such as the network providers and the “real time traffic data” providers need to be paid for their services.
• The main investment costs include further research and development of automated driving, building the Application store and setting up the new “Audi service platform” department.

Revenue

In this business model the user generates an online user profile when driving high automated. This information is very valuable for Audi. This improves there customer relation because the data will help them in offering tailored premium services to the customer. This data is also very valuable for marketing and will reduce the costs of other market research.

Another advantage of the data structure is not only collect data from the user but also from the car. The advantage of a connected car is that data about the performance can be used to improve and optimize production processes. This real time monitoring of the performance of the car will allow a reduction in costs for research and development. This two have an effect on the efficiency within the marketing and the R&D department. The money saved because of this might cover a large extend of the investment costs of Audi.

N. B. Customer data is a very sensitive topic and there should be a balance between extra services and privacy protection. Many business opportunities arise for Audi when they invite third parties to make service offerings based on their acquired data. However with regard to the value proposition, in the initial phase of sales the data should only be used by Audi to improve the quality time in the car and provide the premium feel. It is important to not abuse the customer relation and therefore have a good strategy concerning this data when eventually third parties get involved.

The costs including; maintenance system, network costs and costs of real time traffic data, offer premium services, operational costs data logistics and storage, need to be covered by the monthly subscription which is paid by the costumer. The monthly subscription will be around 100 euro’s. This doesn’t include the hardware costs. The hardware and software cost will be covered by the initial amount the customer pays to have this feature. This is estimated on 2000 euro (only including the production costs without making revenue).

Important value for Audi summarized

• The most important value for Audi is offering a new product which keeps Audi in leading position regarding “Vorsprung durch Mobilität Erfahrungen”. Setting up a Service platform around automated driving can create many more business opportunities.
• In this model the premium service offers will be very valuable to improve the customer relationship, which in the current situation goes via dealers. It is therefore that the OLED display will only give pop-up messages generated by the “Audi Service Platform” and not by other third parties using the data. This customer relationship is direct between the Audi brand and the driver also when the car is sold to fleet owners or other third parties. Another advantage is the possibility of building customer relationship with the 2nd or 3rd owners from the car. In the future when car sharing becomes more common brand loyalty will be important in selling the additional mobility services.
• The basic experience package, the premium service offerings and the sales of applications and content are not mend to generate the biggest revenue. The rental of space in the application store for sponsored application and content will create the most revenue. These third parties are interested to make sponsored applications available in order for them to reach a specific target audience.
8.4 BALANCING LIFE APPLICATION

8.4.1 Goal application

Support the driver in changing the mind-set form leisure time to work time and back.

Functionalities:

- Offer the driver the full possibilities of the onboard infotainment when driving high automated.
- Offer the right infotainment at the right time of the commute
- Visualize application on the dashboard
- Download of the balancing application on personal computing devices to keep the user up to date on real-time traffic data when not in the car.

The underlying system of the application and the precise task flow of the application are not necessary in this conceptual form of this design. In order to showcase the concept a scenario sketch was made. A first draft of the scenario in picture 8.5.2.

A scenario was made in the form of a stop motion video to test if the application and the functionalities of the basic experience package give the support the target group of Audi would expect. The test results can be found in the chapter...In the final concept some changes were made with regard to the customer feedback.

The following remarks are taken in consideration in the new scenario (The complete report about prototype and testing can be found in appendix page 64):

- The ergonomics of interacting with the screen. The interactive application are always displayed on the middle console and the center stack confirm the conclusion of chapter... The rest of the screen can be used to enhance the mood and possibly for a passenger.

- The flexibility of the routine was remark of Simon and Bep. The automation of the car decides which application can be used with regards to safety. In the manual drive mode only audio applications are displayed. The flexibility depends on how much applications the user buys. The balancing life application is initially showing the opportunities and a natural flow. However the pilot stays in control and therefor it is easy to swipe another application on the dashboard screen.
8.4.2 balancing life application time line

Family table mood:
Visualization of the audio application on dashboard, applications opened are focused on entertainment and free time. Examples are audio news on demand visualized as newspapers. Pictures from phone and messages from phone are displayed on dashboard. The dashboard is like an extension of the breakfast table or dinner table.

Balancing life Mood:
Visualization of the appointments, to do’s of the user (Works the same as a smart phone calendar which is able to use all different calendars of outlook, Gmail etc and combine them). In this part of the commute the driver can use all applications. When the drivers wants to plan his day she/he can interact with the displayed agenda. If the driver wants to finish to do’s it can be done by pushing on the to do/appointment and the appropriate applications are opened. The mood changes to planning and balancing life.

Personal Growth Mood:
Visualization of the audio application of the user in the car focuses on interesting topics, to be inspired and educated. The balancing life application looks for interesting online links to topics in the calendar of the driver. The mood is about personal growth and looks like a library.

---

**Premium offer**
- extra subscription to audio newspapers
- Conference call application
- online audio courses.

**Standard**
- audio
- office
- conference call
- TED
- spotify
- up
- online audio courses.
Monday 16-3-2020

Tuesday 17-3-2020

19:00 22:00

prepare dinner 19:00

9:00 11:30 13:00 15:30

prepare presentation 9:00

Time line showing: to do's, thoughts, appointments

Work

Leisure

Multi-task display area

Applications displayed

Projection of keyboard

Swipe through time line

Swipe application to workspace

Type
Interaction during the high automated commute:

In the top picture it can be seen that the driver has chosen to “prepare presentation” to do. In the bigger blue circle on the center stack the applications are opened which are needed to prepare the presentation. Because the driver downloaded the premium office application Powerpoint the balancing life application is able to open it.

In the second picture the driver is on the way back home and selects “the prepare dinner to do”. Automatically the digital cook book which the driver downloaded opens. As well as the supermarket website and the phone contact of his friend with whom the driver has the appointment.

When the driver wants to quite being productive any other application can be swiped into the main screen.

When the driver is online the profile of the user is carefully analyzed to offer the appropriate premium services.

Take over request. Either on the highway or when leaving the highway.

!!! ending auto pilot !!!

5 sec.

Shall I book a premium parking spot at the airport for your recently booked flight?
9. CONCLUSIONS
The added value for the premium customer of Audi is created by the private quality time which can be used to balance life. The basic experience is the product service system which creates quality time by offering a package of services, hard and software.

The concept was based on the insights gathered during the cultural probes. After testing the prototype with the same user group it can be concluded that the basic experience package generates the experience in the car the subjects would expect. Although they love driving they would like to use their time efficiently during their daily commute and therefore use high automated driving which enables the support generated by the “Basic experience package.”

The added value for the premium customer of Audi is created by the private quality time which can be used to balance life. The basic experience is the product service system which creates quality time by offering a package of services, hard and software.

The concept was based on the insights gathered during the cultural probes. After testing the prototype with the same user group it can be concluded that the basic experience package generates the experience in the car the subjects would expect. Although they love driving they would like to use their time efficiently during their daily commute and therefore use high automated driving which enables the support generated by the “Basic experience package.”

Driving automated brings value for both the customer and the business by:

**The Customer**

The Value for the company when they offer the basic experience package are the many business opportunities which arise when the car is connected platform. Monitoring the car performance and the behavior of the driver improves the production process. Even more important is the data generation of the drivers online behavior. This latter is very useful to set up “Audi Premium Service” offerings department which can sell extra tailored services to support the driver with the main goal to improve the customer relationship. This direct link created between the brand Audi and the customer is valuable and creates brand loyalty. This is especially valuable for Audi when third parties, such as fleet owners, are involved and in the future where car sharing becomes more common.

Another value for Audi is the recurrent revenue stream which can be created by renting space in the “Application store” to third parties. Interesting for those third parties is to provide sponsored content and applications specially targeted at the premium customer.

**The Business**

This service proposal is the result of a challenging assignment: “Design a product service system which creates value for the user in the future context of automated driving” The outcomes of the user research resulted in this design proposal of the “Basic Experience Package”. The value for the customer is created by hardware, connectivity and services which combined create the experience: “Cocooning while making the transition from work to leisure in order to regain energy for daily life”.

This graphic on the right site of the page illustrates the added value for the customer and the company in terms of quality time, revenue and data. N. B. The online behavior of the user during the high automated commute generates valuable user data.
Recurrent revenue from third parties who sponsor applications and content, to reach the "premium Audi customer".

The premium services give the driver extra support. The online user profile is used to generated these tailored premium services. This creates extra touch points between Audi and the customer and therefore improves the customer relation. Which leads to brand loyalty of the customer.
9. RECOMMENDATIONS
1. Continue the development of automated driving technology; there is growing acceptance towards automated driving.

The further development of the automated driving technology is important to be able to deliver the platform for these new service possibilities. Important is that legislation and liability issues need to be clarified as discussed in chapter 3.2. The key resources is the knowledge of the ERL team and the project Chauffeur of Volkswagen. Other knowledge comes from European funded projects where collaborative solutions are created for Intelligent Infrastructure with help C2X communication technology.

2. Use the new ideas of the car as platform taken into account the requirements for designing the interior concepts and the hmi as mentioned.

Research need to be done to the hmi within the car. In this thesis it is recommended to free the center stock from all the mechanical features and move everything to the steering wheel. This to make free space for the OLED screen displaying the infotainment. However the whole interior and HMI needs to be reconsidered. In this thesis the standard architecture of the interior was used, however for these new functionalities a redesign of interior and hmi will help to build a concept which supports the new usability. One important aspect is the design of take over requests. The remark of one of the test persons during user testing phase was that the moving car would create too much of an distraction for him to focus on the infotainment. One could think of blinding glass or other architectural changes to make a clear distinction between the manual driving focus and automated driving focus.

3. Showcase prototypes to policy makers in order to speed up the process around the laws and liability issues.

4. The SIT team should start building the business case and create a service lobby to show the possibilities of a car as platform.

For SIT it will be important to build a business case. The primary goal is to investigate the feasibility of the business model and therefore determining the possible revenue and the complementary pricing strategies.

In order to do so they need to collect quantitative data about the premium Audi customers providing a solid argument. Further research is necessary to understand what amount of costs can be reduced with the permanent collection of car and user data. Research also needs to include other business model opportunities including the rental of space in the application store.

Furthermore SIT should create a lobby within Volkswagen AG to use the car as platform for experiences. “Forschungstag” will be a good opportunity to showcase a concept. In order to make a concept the software needs to be designed for the balancing life application.
5. Establishing the “Premium service department”.
Meanwhile research can be done in order to design the new “Audi Service Platform” department. Their main goal should be to deliver premium services to customer. There resources are the online user profiles generated during the high automated commute. This new department is not only improving customer relationship of the new car owners but also for future car owners who bought a second hand Audi which contains the required hardware for the basic experience package. They can also subscribe to a monthly package to use the full potential of this hardware. This is therefore creating a new but direct link between the 2nd hand owners and the brand Audi. This also create a direct link from Audi with those who rent or lease their cars.

The Audi service platform need to think of premium services creating extra value for the customer. Examples can be an advanced conference call function with background information popping up about customer or clients, reserving parking spots, support shopping, connect to home devices etc.

6. A new strategic organization needs to be build around the application store of Volkswagen AG.
To create this store a new organization needs to provide the backbone. The platform can be standardized for all the cars from Volkswagen AG. The platform needs to interact with the automated driving hardware, the display and the service departments such as “the premium service” department of Audi. The main tasks of this organization is not only building a standardized platform but also direct the new business around the application store. This includes major changes in current organization, there for it is recommended that Volkswagen AG buys an IT company who can establish this new organization within Volkswagen AG.

Audi will take the first step in talking their customers along in the future mobility dream and there for need to reconsider their slogan “Vorsprung durch Technik”. As a conclusion of this thesis I would like to recommend selling Audi’s by

“VORSPRUNG DURCH MOBILITÄT ERFAHRUNGEN”
9. REFLECTION
Reflecting on the outcome “the product service system the basic experience package”

+ The argumentation formed a close loop, creating both value for the customer and the business, I’m glad with that result and I believe in this concept. The detail of the visualization could have been better, I wanted to learn a little bit more about good automotive visualization and what tools and techniques could be of use.
- Writing down my story has been an enormous challenge. The challenge of writing this thesis is the duality of the story. On one hand writing about my design process and on the other selling my ideas. After so many years of practice I feel it’s time that I need to establish a way that works for me. In the future when there is no academic purpose I would like to tell the story more through pictures.

Reflection on the overall Design approach

It has been a struggle in finding the right approach. I learned a lot of service design from the SIT team which helped in understanding tools and techniques which could help. The product design way of thinking blocked me in the beginning to see the many possibilities of automated driving and service design.

The time management of this project has been difficult. I want to give my best for my last project therefore many things took so much longer than expected. Writing the report and detailing the idea has been most time consuming. On forehand I could have set more boundaries to the design proposal. However I feel that I have learned a lot.

The analyses phase could have been more efficient. I wanted to have a complete overview of automated driving context which was not necessary for the end goal. Next time I should stick more to the initial time frame.

It was interesting to learn more about business models. I didn’t expect that I was going to also dive into the business model of the product service system, but it makes the story stronger. Certainly because the whole idea concerns a future concept.

During this thesis I was afraid to move a way to much from my master program IPD. However evidencing my final concept with a paper prototype and working on the visualizations gave me enough opportunity to make the idea more tangible.

Deciding how to prototype the experience and using the right approach took me a lot of time. I have talked to many people and looked in so many design books to find a way. Then I decided to just make a paper prototype scenario. It turned out to be a super fast method to showcase the concept to my test persons. They reacted positive and understood the story line and more important were able to give good feedback.

Designing for 2020 while using today’s drivers behaviors was a challenge. I used the VIP methodology in a way that it worked for this specific thesis. This way of ideation with the building blocks as described in chapter 6 helped me very much explaining my thought process. It was effective. Communicating this process to my mentors at VW was more difficult. This because they felt I made assumptions which were not based on qualitative data. It is therefore that I spend some extra pages in this report explaining the process with deliberately naming my sources.

Reflection on User Research

Cultural probes:
Balance between strict assignment & freedom to write down thoughts. It was hard to determine were to give more direction in the assignments and were to let the participant free. In the diary assignment I gave a lot of freedom, however in this case the participants put a lot of effort in filling them in. Next time it will be easier to determine that due to experience out of this research. Interaction assignment was understood differently than I expected. I tested the assignments on fore hand on how
people would interpreted this. The mistake made was that I should have asked people with less experience in cultural probes. Easy to change for next time.

Workshop:
The workshop worked really good to get a more in depth understanding of the filled in cultural probes. The people participating where really enthusiastic about the methods. I received a lot of positive feedback. This reassured the feeling that I was able to facilitate the session in order for them to be creative and open to share their own experiences.

The co-creation part of the workshop ended up focused more on products than services. It was hard to facilitate it more towards service design, so I let it slip to my own area of expertise on products. In that way I was able to guide them better. Next time I will design the session differently and get more expertise in from service designers. However the outcomes from the workshop and cultural probe turned out to be inspiring for the design process.

Analyses of data:
The data analyses took very long because of the translation of Dutch into English. And because of the many steps which it took me to converse the data into inspiring design statements. To improve the speed of that process it might be good to be less precise in the translation but maybe also to schedule more time in for analyses of the data. I was glad that I used the framework of Tulli Mattelmaki to unravel the experience because in that way I could also easily get the outcomes together from the cultural probes and answer the defined research questions. However after the research questions where answered I still had to converge and select in what was interesting. I hadn’t foreseen this extra step. So I struggled to find a good approach in finding how to converge and highlight the interesting outcomes. In the end I described the experiences in keywords per person and drew the most significant factor in their driving behavior. This was successful.

Reflection on being intern at Volkswagen.
The team
+ The people in the team were open and very enthusiastic full of energy. From the first day I felt at home. It was nice to be part of it, and many of them helped somewhere in the process.
- In the beginning me and Gisa (my buddy intern) were in a project of the research group without a supervisor from our team. The communication was very difficult and it was hard to acquire data because the sensitivity of the topic “automated driving”, apparently data which was not meant to be shared with interns. It was hard to manage the resources and build bridges to other people doing the same research. For some reason we didn’t manage to get through this barrier. After the summer many new colleagues joined the team, this was when the boss decided to get somebody into the project “autopilot” to supervise us. This helped in the process.

- It took a while before I got the hang of adjusting to the system. German outlook accounts, letters and hundreds of passwords were confusing. There were a lot of new rules in regard to protection of data and entrance to buildings. However I think after 2 month I started to understand how it works. Filling in permission forms to enter buildings, take home my own data etc. Although rules kept surprising me until the end of my internship.
+ Every Tuesday there was the team meeting, it was a good moment to get people updated and to learn from other projects. The meetings were in German and by the end of the time I could better understand the meaning behind the Njeins…ja und nein answers. Building up “fingerspitzengefühl” for the German language
- If I would fill in the scale of Hofstede I would end up saying that Volkswagen culture typically has a high power distance and is more masculine then at the TU Delft! Being used to low power distance and more feminist environments this has been quite a cultural shock if one considers to only have crossed one border.

Conclusion…. Learnt a lot about the culture in the company, the culture in Berlin, team beginnings (as observer), Management of contacts and resources.
10. RESOURCES

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2. Google continues Autonomous car tests (2012): Movie on cardesignnews.com
6. Internet of things (2012): Internet of things Europe teaser n. 3: Traffic, online movie about the connected future
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9. BMW highly automated driving mode (2012): A movie about concept high automated driving bmw
11. The Future of Mercedes - Frankfurt Auto Show (2011): movie about interview with director advanced design about the future concept of mercedes

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