Appendix

Design for Calibrated Trust for Acceptance of Autonomous Vehicles

Table of Content

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	Valentine
initials	given name David Callisto
student number	4752090
street & no.	
zipcode & city	
country	
phone	
email	

Your master programme (only select the options that apply to you):

IDE master(s): ☐ IPD ☐ DfI ★ SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ☐ Honours Programme Master

specialisation / annotation: ☐ Medisign ☐ Tech. in Sustainable Design ☐ Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	Dr. Kim, E.Y	dept. / section:	DOS
** mentor	Ir. Smit, I.R.	dept. / section:	HICD
2nd mentor			
organisation:			
city:		country:	
comments (optional)			

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Dr. Kim, E.Y date 16 - 03 - 2020 signature E.Y. Kim

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: — EC

Of which, taking the conditional requirements into account, can be part of the exam programme — EC

List of electives obtained before the third semester without approval of the BoE

☑ YES all 1st year master courses passed

☐ NO missing 1st year master courses are:

name date 23-3-2020 signature CB

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ☑ APPROVED ☐ NOT APPROVED

Procedure: ☑ APPROVED ☐ NOT APPROVED

comments

name Monique von Morgen date 30-3-2020 signature MvM

Initials & Name Valentine Student number 4752090

Title of Project Designing for Calibrated Trust for Acceptance of Autonomous Vehicles

Personal Project Brief - IDE Master Graduation

TU Delft

Designing for Calibrated Trust for Acceptance of Autonomous Vehicles — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 16 - 03 - 2020 — 28 - 08 - 2020 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

In the past decade has seen car manufactures pour nearly 4 billion USD into the development and deployment of autonomous vehicles. This money was seen as an investment into the future of mobility with an optimistic release of fully automated vehicles in the early 2020's. However, the development of autonomous vehicles has seen two prominent road blocks. The first is with regard to consumer acceptance (Bienzeisler, 2017) and the latter regarding regulations (Fagnant and Kockelman, 2015). The current project focuses on the aspect of consumer acceptance, more specifically building trust for increased acceptance. Below, barriers faced by the acceptance of autonomous vehicles have been highlighted:

1. Over reliance on machines (Mistrust) (Trimble, 2008)
2. Lack of trust in the capabilities of autonomous vehicles (Distrust) (Fraedrich and Lenz, 2014)
3. Specific risk of crashing (Daziano et al.,2016)
4. Non-autonomous vehicles traffic participants (Bazilinskyy et al., 2015)
5. System failure (Fagnant and Kockelman, 2015)
6. Breach of information and personal data (Fagnant and Kockelman, 2015)
7. Deprived from joy of driving (Fagnant and Kockelman, 2015)

The first two challenges to the acceptance of autonomous vehicles can be considered the two extremes of trust. Over reliance on machines (mistrust) can be seen as placing more trust as compared to the capabilities of the automated system. An example of this is people falling asleep at the wheel of autonomous vehicles Level-2 vehicles when driving on highways. On the other extreme lack of trust in the capabilities of autonomous vehicles or distrust is when people refuse to acknowledge the capabilities of the autonomous system. For example, user's not trusting/using lane assistance or reverse assistance systems present in vehicles.

We can see that the other obstacles to autonomous vehicles (3-7) have an influence on the user trusting autonomous vehicles, leading to either mistrust or distrust depending on the outcome. However, it is important for trust between autonomous vehicles and user not be at either extremes (distrust or mistrust). There is a need for calibrating trust. Calibrated trust can be defined as "The process of adjusting trust to correspond to an objective measure of trustworthiness". In simpler terms it is the ability to balance the capabilities of the autonomous system with the expectations of the end user. Research shows that calibrated trust allows for better implementation and acceptance of new technologies.

The project is in association with the "Cities of Things Lab" and "People in Transit" . The Cities of Things Lab, works on in the field of smart cities and the role autonomous artefacts play in this future. Whereas, People in Transit focuses on addressing the changing landscape of mobility.

References:
Bazilinskyy, P., Kyriakidis, M., de Winter, J., (2015). An international crowdsourcing study into people's statements on fully automated driving. Procedia Manufact. 3,2534–2542.
Bienzeisler, L. (2017). Impacts of an Autonomous Carsharing Fleet on Traffic Flow. ATZ worldwide, 119(7-8), 60-63.
Daziano, R.A., Sarrias, M., Leard, B., 2016. Are consumers willing to pay to let cars drive for them. Analyzing Response to Autonomous Vehicles
Fagnant, D.J., Kockelman, K., (2015). Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. Transp. Res. Part A: Policy Pract. 77, 167–181.
Fraedrich, E., Lenz, B., 2014. Automated driving: individual and societal aspects. Transport. Res. Rec.: J. Transport. Res. Board 2416, 64–72
Fagnant, D. J., & Kockelman, K. (2015). Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. Transportation Research Part A: Policy and Practice, 77, 167-181.

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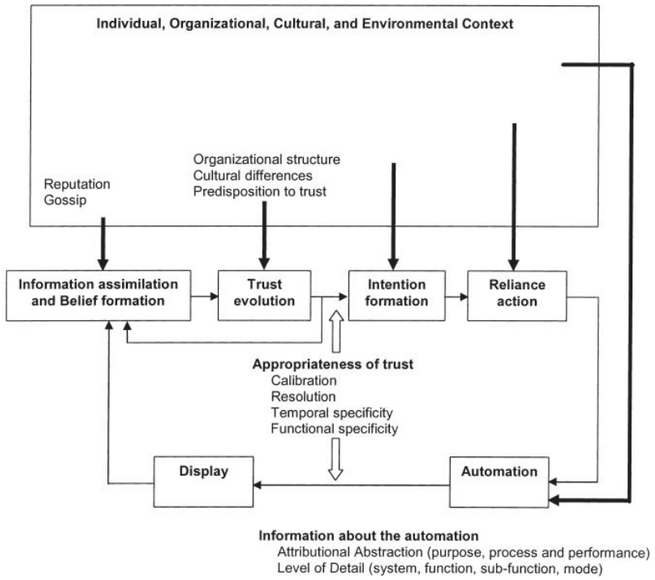
Initials & Name Valentine Student number 4752090

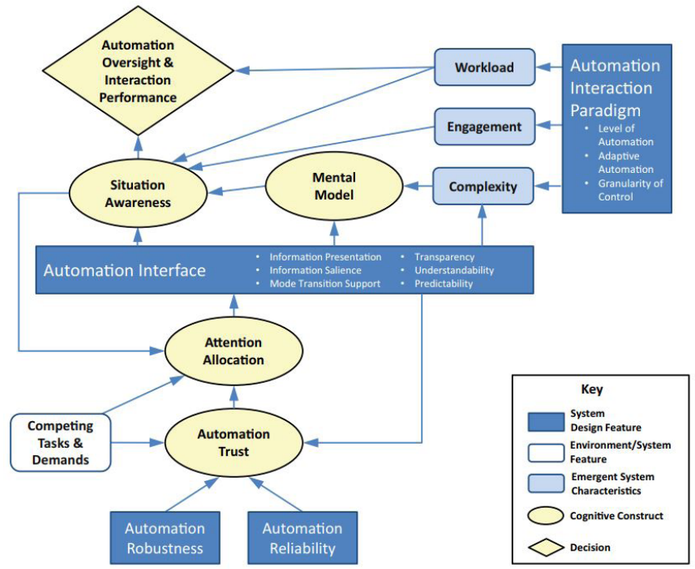
Title of Project Designing for Calibrated Trust for Acceptance of Autonomous Vehicles

Appendix-B | Trust Models

The first model of trust to represent calibrate trust was presented by Lee & See (2004). Within the model we see that trust depends on the dynamic interaction between the operator, automation ,context and interface. It is also seen that trust formation is a closed loop which refers to the fact that favourable outcomes boost trust and vice versa.



The HASO model presented by Endsley (2017) is designed to understand situational awareness. Situational awareness is seen as one of the prominent research areas with designing for HMI systems and trust in automation. This model does not directly correlate to a trust model but highlights important insights and relations between trust and situational awareness. As seen from the model, automation trust is based on automation robustness and reliability. In addition the automation interface has an influence on the trust. This correlates to the Hoff & Bashir (2015) model in which we see dynamic learnt trust being influenced by the design of the HMI system.



Appendix-C | Calibrated Trust Frameworks

The first framework presented is by de Visser et al.,(2015). This was one of the first frameworks designed for calibration of trust and focused towards designing better HMI systems. Along the x axis is the information processing stages and along the y-axisis the trust evidence levels.

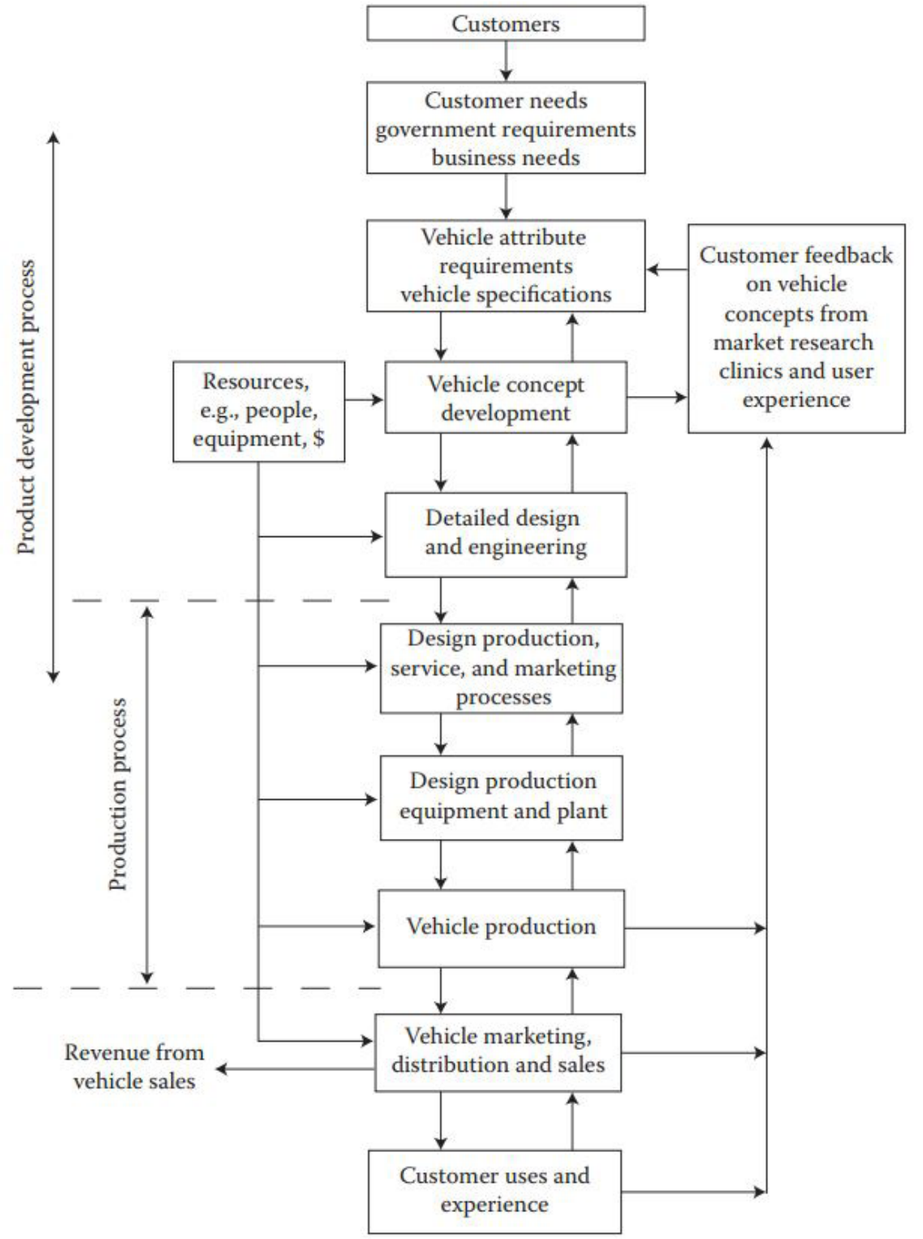
Trust Cue Taxonomy		Information Processing Stages				
Trust Evidence Levels		perception	comprehension	projection	decision	execution
	Intent	perceptual intent & goals	comprehension intent & goals	projection intent & goals	decision intent & goals	execution intent & goals
	Performance	perceptual errors	classification errors	prediction errors	decision-making errors	execution errors
	Process	perceptual steps	comprehension steps	projection steps	decision steps	execution steps
	Expressiveness	perceptual indicators	comprehension indicators	projection indicators	decision indicator s	execution indicators
	Origin	design of perceptual capability	design of comprehension capability	design of projection capability	design of decision capability	design of execution capability

The second framework was presented by Mirning et al., (2016). While de Visser et al. framework focused purely on the trust level. Mirning et al., framework looked at the task performance levels which can be seen along the y-axis. This allowed for investigating the driving task not only from an operational level but also a strategic level.

OVERTAKING	Perceive	Understand	Predict	Adapt
Operational	▪ Deviations of other vehicle in either speed or lane position (yes/no + values) ▪ Presence of oncoming traffic (yes/no)	▪ Overtaking maneuver is being initiated (yes/no)	▪ Pulling out will be completed in x time units ▪ Pulling back in will initiate in y and be completed in z time units	▪ Further pull out if lateral lane position of the to-be-passed vehicle changes (distance units) ▪ Adjust speed if speed of the to-be-passed vehicle changes (speed units)
Tactical	▪ Observe speed limit (speed units) ▪ Distance to and velocity of oncoming traffic if oncoming traffic = yes on operational level (distance and speed units)	▪ The conditions are suitable for initiating the overtaking maneuver (yes/no)	▪ It is possible to finish the overtaking maneuver successfully (yes/no)	▪ Continue executing overtaking maneuver *or* ▪ Abort overtaking maneuver
Strategic	▪ Road and lane widths (distance units) ▪ "No Overtaking" sign present (yes/no)	▪ This is a suitable road segment for overtaking (yes/no)	▪ Next suitable road segment for overtaking approaches in x distance units / y time units	▪ Decision: overtaking maneuver begins in x distance units / y time units.

Appendix-D | Product Development Process for Automobiles

The product development process for an automobile as presented by Bhise (2017). When compared initially there exist certain differences in the title of the of the different stages. But one closer inspection we see that stages presented by Bhise (2017) correlate quite closely with Ulrick et al., (2019). The one prominent difference is the inclusion of the service design along with the product design. The reason for excluding this part is because the scope of the project would become much bigger having to design for the product and service. Thus a decision was made to neglect the service component of the design and purely focus on the design of the product.



Appendix-E | Design Recommendations from literature

Design Recommendation	Explanation	Source
Automate only if necessary—avoid out-of-the-loop problems if possible	As autonomy can lead to such significant difficulties in lack of understanding, system complexity, decision biasing, and out-of-the-loop performance problems, it should be avoided except in those situations where it's assistance is really needed	Endsley (2017)
Use automated assistance for carrying out routine tasks rather than higher-level cognitive functions	Reliable autonomy that carries out the action portion of routine tasks is highly beneficial for reducing manual workload and error. Autonomy that carries out the decision portion of tasks should be avoided, unless highly reliable due to decision biasing problems and OOTL.	Endsley (2017)
Provide SA support rather than decisions	Significant performance improvements and more robust decision making can be found with systems that enhance SA through improved information presentation to operators, integration, and projections.	Endsley (2017)
Keep the operator in control and in the loop	To minimize the out-of-the-loop effect, increase operator involvement and control, improving engagement in task performance. Ensure that the operator maintains control over the automation and devise strategies that incorporate the human decision maker as an active ongoing participant, such as lower levels of automation and periods of manual control via adaptive automation	Endsley (2017)
Avoid the proliferation of automated modes	Autonomy modes increase system complexity and the ability of operators to develop a good mental model of how the system works. They also make it harder to keep up with which mode the automation is in at the present time, increasing SA errors and increasing training requirements.	Endsley (2017)
Make modes and system states salient	When modes are present, the current mode should be made highly salient to the operator (including mode transitions back to manual operations). The current state of the system autonomy should be salient so that any violations of operator expectations will be readily apparent	Endsley (2017)
Enforce automation consistency	Consistency in the terminology, information placement, and functionality of the system between modes should be enforced to minimize errors in working with system autonomy.	Endsley (2017)
Avoid advanced queuing of tasks	Systems that allow the operator to set up in advance a number of different tasks for the autonomy to perform are most likely to leave that operator slow to realize there is a problem that needs intervention. Approaches that maintain operator involvement in the decisions associated with execution of tasks should be considered.	Endsley (2017)
Avoid the use of information cuing	Unless there is very high reliability, information cuing (automatic highlighting of information) should be avoided in favor of approaches that allow people to use their own senses more effectively. For example, systems for systematically decluttering unwanted information or improving picture clarity are preferable.	Endsley (2017)
Use methods of decision support that create human/system symbiosis, such as contingency planning and critiquing systems	Decision support systems that avoid decision biasing include "what-if" analysis, encouraging people to consider multiple possibilities and perform contingency planning that can help people formulate Level 3 SA, as well as systems that help people consider alternate interpretations of data, helping to avoid representational errors in their SA.	Endsley (2017)
Provide automation transparency	A high degree of transparency and observability of system behavior and functioning is needed, making it clearly apparent not only what the system is currently doing but also why it is doing it and what it will do next.	Endsley (2017)

Ensure logical consistency across features and modes	Inconsistencies in the logical functioning of the system dramatically increase complexity. Differences in operational logic, display of information, and different sequences of inputs that are not directly necessary for the operation of that mode or feature should be reduced or eliminated	Endsley (2017)
Minimize logic branches	Minimize complexity by reducing the linkages and conditional operations contained in the autonomy, avoiding modes with their multiple-branch logic as much as possible.	Endsley (2017)
Map system functions to the goals and mental models of users	A clear mapping between user goals and system functions should be present, minimizing the degree to which operators need to understand the underlying software or hardware linkages in order to operate or oversee the autonomy	Endsley (2017)
Minimize task complexity	Task complexity (the number of actions needed to perform desired tasks and the complexity of those actions) should be minimized, reducing sequence errors and cognitive load in interacting with the autonomy	Endsley (2017)
Integrate information to support comprehension of information (Level 2 SA)	As attention and working memory are limited, autonomy that displays information that is processed and integrated to support operator understanding of data in relation to key goals will be beneficial	Endsley (2017)
Provide assistance for SA projections (Level 3 SA)	Autonomy support for projecting possible and likely future events and states of the system should directly benefit SA, particularly for less experienced operators.	Endsley (2017)
Use information filtering carefully	While extraneous information should not be shown to operators, autonomy should refrain from filtering information needed for prioritizing across operator goals or for forming projections of possible upcoming events or problems.	Endsley (2017)
Support assessments of confidence in composite data	Autonomy should explicitly represent its confidence level when data are fused to form higher levels of SA or decisions to include the effects of underlying data and fusion algorithms.	Endsley (2017)
Support system reliability assessments	In that trust and effective judgments on when to intervene in the performance of system autonomy depend on an accurate assessment of its reliability for performing the task at hand, interfaces should make explicit how well the autonomy is currently performing and its ability to handle upcoming or contemplated tasks.	Endsley (2017)
Appearance/anthropomorphism	Increase the anthropomorphism of automation in order to promote greater trust Consider the expected age, gender, culture, and personality of potential users because anthropomorphic design features may impact trust differently for diverse individuals	Hoff & Bashir (2015)
Ease of use	Simplify interfaces and make automation easy to use to promote greater trust Consider increasing the saliency of automation feedback to promote greater trust	Hoff & Bashir (2015)
Communication style	Consider the gender, eye movements, normality of form, and chin shape of embodied computer agents to ensure an appearance of trustworthiness. Increase the politeness of an automated system's communication style to promote greater trust	Hoff & Bashir (2015)
Transparency/feedback	Provide users with accurate, ongoing feedback concerning the reliability of automation and the situational factors that can affect its reliability in order to promote appropriate trust and improve task performance. Evaluate tendencies in how users interpret system reliability information displayed in different formats.	Hoff & Bashir (2015)

Level of control	Consider increasing the transparency of high-level automation to promote greater trust . Evaluate user preferences for levels of control based on psychological characteristics	Hoff & Bashir (2015)
Shared Autonomy	Keep the human in the loop, the human machine team must jointly maintain sufficient situational awareness to maintain control of the vehicle	Fridman(2018)
Learn from Data	The process of continuous data collection and improvement. Focused towards collecting edge cases	Fridman(2018)
Human Sensing	Understand the state of the driver using face detection, cognitive overload	Fridman(2018)
Shared Perception Control	Communicate the limitations and capabilities of the vehicle, we are not trying to create a perfect black box safe	Fridman(2018)
Deep Personalization	The vehicle must adopt to the needs and habits of the user	Fridman(2018)
Imperfect by Design	Focus on communicating limitations on how the system sees the world instead of focusing on removing limitations	Fridman(2018)
System-Level Experience	Optimize both the safety and enjoyability of the system	Fridman(2018)

Insight	Explanation	Source
Hold Steering Wheel	During the use of autonomous modes in SAE Lv 2 and 3 drivers are required to keep their hands on the steering wheel. This is not always adhered as drivers indulge in secondary activities	Banks et al (2018)
Mode Confusion	Instances when the driver is unsure about the mode the vehicle is, thus causing a delay in responding to road conditions	Banks et al (2018)
Testing the limits	Significant performance improvements and more robust decision making can be found with systems that enhance SA through improved information presentation to operators, integration, and projections.	Banks et al (2018)
Keep the operator in control and in the loop	Tendency to test the limit of automation despite strict instructions to remain in control of the vehicles	Banks et al (2018)
Startle effect	Driver is startled when the AV sends out an alarm, resulting in the driver taking time to regain control of the vehicle.	Lin, Ma & Zhang (2018)
Initial Information is important	Initial information about the autonomous modes of SAE Lv 2 and 3 aid greatly in forming the correct mental models of the autonomous system	Lin, Ma & Zhang (2018)
Trial and error driving method	Most drivers seem to use the trial and error method to understand how automation works. This works well for regular conditions but in case of novel cases they pose challenges	Lin, Ma & Zhang (2018)
Low risk use	The autonomy modes were engaged in familiar and low risk areas which had no pedestrian and cyclists	Lin, Ma & Zhang (2018)
Knowing limitations is good	Users that were aware of the limitations of the autonomous vehicles were seen to be more tolerant towards the limitations.	Lin, Ma & Zhang (2018)
User manual and sales men	The information provided while purchasing AV and the user manual are usually neglected by the user. As they prefer the trial and error method of driving	Lin, Ma & Zhang (2018)
Brands play a role	The brand of the vehicle has a role in how users perceive the trust they have in the autonomous vehicle	Lin, Ma & Zhang (2018)
Software Updates	Regular software updates require a continuous modification of the mental model drivers have of the AV	Endsley(2017)
Engaging wrong mode	The compactness of the drivers control lead to engaging the wrong mode in SAE Lv 2 and 3 vehicles	Endsley(2017)

Design Recommendation	Explanation	Source
Show when a vehicle is in automated driving mode	Pedestrians should be able to easily distinguish if a vehicle is manual or automated driving models.	Habibovic et al (2018), Rasouli & Tsotsos (2019)
Show future state of the AV	Pedestrians need to obtain information about the AV's future state	Habibovic et al (2018), Rasouli & Tsotsos (2019)
Replace eye contact	Pedestrians should be provided with information that eliminates the need of seeking eye contact in encountering AV's.	Habibovic et al (2018), Rasouli & Tsotsos (2019)
Not urge pedestrians when/where to cross	Pedestrians should not be told explicitly when/where to cross the street in encounters with AV.	Habibovic et al (2018)
Enable a calm interaction	Pedestrians should experience encounters with AV's	Habibovic et al (2018), Rasouli & Tsotsos (2019)
Harmonize/Standardise external communication principles	Set a standard interaction principles that can be communicated to pedestrians and is standard across all vehicles	Habibovic et al (2018), Rasouli & Tsotsos (2019)
Consider the speed of the vehicle	Vehicle speed plays an important role in the TTA and pedestrian interaction with vehicles	Terwilinger et al (2019)
Minimise explicit communication	Explicit communication can add confusion to an already confusing traffic scenario	Ackermann et al (2019)
Unambiguousness	The cues must not elicit multiple meanings and confuse pedestrians	Ackermann et al (2019)
Intuitive Comprehensibility	Easy to understand communication mechanism	Ackermann et al (2019)
Recognisability	Easily recognisable as a communication cue	Ackermann et al (2019)
Highlight pedestrian advice	The information provided must be informative so that pedestrians can make their own judgment	Ackermann et al (2019)
There is no best modality	Communication needs to be a mixture of multiple cues such as audio, visual etc	Rasouli & Tsotsos (2019)
Information should be informative rather than advisory	The information provided must be informative so that pedestrians can make their own judgment	Rasouli & Tsotsos (2019)

Appendix-F | Research in Human Values

In this part we explore considerations of human values in designing for autonomous vehicles. Friedman & Henry (2019) propose a collection of 13 values that are most prominently considered in system design. Considering the context of the project, the subsequent human values play a major role: privacy, universal usability, trust, autonomy, courtesy and calmness.

Privacy: Refers to a claim, entitlement, or a right of an individual to determine what information about himself or herself can be communicated to others.

Universal usability: Refers to making all people successful users of information technology

Trust: Refers to expectations that exist between people who can experience goodwill, extend goodwill towards others, feel vulnerable, experience betrayal

Autonomy: Refers to people's ability to decide, plan and act in the way that they believe will help them to achieve their goal

Courtesy: Refers to treating people with politeness and consideration

Calmness: Refers to peaceful and composed psychological state

Considering the context of the project, the most prominent human values to be considered are privacy and universal usability. We will also consider cyber security as a sub part of privacy, as it does not feature in the list of human values but is an important aspect of privacy. Courtesy and calmness have already been highlighted in the design recommendations and thus will not be considered in this section. Moreover in this section we will look at how these various human values relate to each other and the influence they have on Trust.

Privacy and Cybersecurity

Privacy can be defined as "The protection of a person and his/her behavior" such that the individual is "able to control the risks for his or her right to privacy, freedom, or equality caused by the processing of data related to him or her", according to the information privacy/data privacy (Lim & Taeihagh, 2018).

The challenges of privacy in AV are related to "*no explicit rules to consider certain data special and have special hindrance for their usage*" (Lim & Taeihagh, 2018). This can lead to the use of personal data by insurance companies and credit rating agencies. In extreme cases the use of highly sensitive data like geographical location could lead to dataset biases against people of certain ethnicity or sexuality. Other misuses of data form AV can lead to: Harassment through tailored advertisements and marketing strategies, disparity in power of organisations controlling this information and individuals and re-identification by aid of side information (Lim & Taeihagh, 2018). It should be noted at this stage tvhat all these misuses of data of AV is speculative and based on past experiences with other technologies. However, it is important to incorporate privacy into the designing of AV to not just build but also calibrate trust in users.

One way of building privacy is through the process of creating transparency in the process of data collection, the use of data and in-depth disclosure about potential security vulnerabilities (Pype et al., 2017). While the idea of transparency makes sense theoretically, creating a truly transparent system is a challenging task. One possible solution of addressing this challenge is Privacy by Design which provides principles to address the challenge of privacy by incorporating it into the design process.

Privacy by design does not promise or aim for complete security or total privacy. What it can achieve is in preventing unwanted accidents and building trust between users and the company (Langheinrich, 2001). The principles of privacy by design are as follows:

Notice: Also known as the principle of openness, it means making it known to the user what data is being recorded at what time and place.

Choice and Consent: This principle takes the next step from notice by not just informing the user what data is being collected but also requesting their consent to collect data. We should note however that there is a need to distinguish between consent and blackmailing i.e. not just providing one option to the user and demanding them to agree or not receive the service (take it or leave it dualism).

Anonymity and Pseudonymity: Anonymity can be defined as "the state of being not identified within a set of subjects". While pseudonymity refers to assigning a certain ID to a certain individual, and this person is identified by this ID.

Proximity and Locality: This principle focuses on the idea that data recording must take place when the owner or the designated users is within proximity of the device. Further locality refers to the idea that instead of continuously asking permission or recognising the owner, the data recording feature is activated by a geographical location or any other anchor point.

Adequate Security: Privacy is seen as a by-product of security. The principle highlights the need to understand not just data security but in large product or service security. In the case of AV we can see security as cybersecurity and will discuss this in a later part.

Access and Recourse: This principle is focused towards the legal aspect of privacy by design as it highlights who can access the collected data and what would be the consequences if there is unacceptable behaviour when dealing with the collected data. In essence the principle can be seen as following three steps:

Only collect data for a well-defined purpose
Only collect data relevant for the purpose
Only keep data as long as it is necessary for the purpose.

Privacy by design principles are not universal and can be seen to vary from author to author, for example Wicker & Schrader (2011) have five principles instead of six whereas Everson (2017) considers seven principles. Although, there is a discrepancy in the number of principles the underlying idea remains the same in all cases. For this project we will use the six principles as proposed by Langheinrich (2001) as discussed above, incorporating insights from Wicker & Schrader (2011) and Everson (2017) wherever necessary.

Having acquired a working understanding of privacy, we now move on to cybersecurity. As highlighted in the principles of privacy by design, adequate security is considered as one of the major factors that allows for creating privacy. If we were to extrapolate the idea of security to AV, we will not only need to focus on the cyber world but also the physical safety of the vehicle. Since the physical safety of the vehicle goes beyond the scope of the project we will be focussing on cybersecurity.

Cybersecurity can be defined as "the organisation and collection of resources, processes and structures used to protect cyberspace and cyberspace enabled systems for occurrences that misalign de jure from de facto property rights". Considering the effects of cybersecurity in the case of autonomous vehicles, research by Noy et al (2018) has shown that risky cybersecurity behavior is associated with over-trust of automated technologies. Further it is seen that people do not have an understanding of cybersecurity and the use of metaphors does not make the process any simpler. However, the challenge of cybersecurity in AV is not grounded in the understanding of the concept but the ability to react appropriately to a cyberattack, especially in a transition period, when drivers are not yet used to AV and cognitive overload (Linkov, 2019). The concern is further deepened because cyber attacks are more abstract as compared to real-environment problems. Linkov (2019) highlights the impact of cyber security on AV through table , we see that as we move into the transition period (level-2 and level-3), the cyber risks increase from small/medium to high.

There is limited research in the area of cybersecurity and AV makes answering certain questions very tough and thus only further research or naturalistic studies can aid in answering the questions (Linkov, 2019):

What are the characteristics of people vulnerable to AV cyberattacks and in which scenarios do these take place?

Ways to effectively educate people to improve AV cybersecurity skills?

Will the reduction in the skill set of drivers, influence their ability to respond to cyber attacks?

Only with more research can we develop a better understanding of cybersecurity for AV. Till then we will need to rely on learning from other fields where cybersecurity has been deployed.

Insight	Explanation	Source
Explain the risks of cybersecurity to users	An understanding of cybersecurity allows for safer use of technology	Fagan & Khan (2018)
Minimise multitasking and distractions	Multitasking makes people prone to risky cybersecurity behavior	Hadlington & Murphy (2018)
Authentication of user	Authentication steps must be used in interaction with AV as seen with other technologies	Juang & Greenstein (2018)
Communicating during a cyber attack	Cyberattacks make users stressed and erratic. There is a need to look at the correct method of communication by the AV	Parkinson et al.(2017)
Selecting the right team	The back end team must be selected with care and deliberation. They should be able to meet the demands of a job in cybersecurity	Dawson & Thomson (2018)
Specialization within teams	Certain specialization is required in teams to develop a secure system	Buchler et al. (2018)
Trust within organisation	OEM must trust their employees and use strict monitoring to maintain a secure system	Henshel et al. (2015)
Understand the risk	The risk of a cyber attack on an AV can lead to not just damage but loss of life, is important to communicate within the organisation	Dreibelbis et al. (2018)

Universal Usability

Universal usability looks at the idea that a technology should be used by nearly every person or majority of people. The idea of universal usability closely links with an existing design approach of universal design. Universal design became prominent in the 20th century due to the major social and civil right changes that took place in the world during that period.

The Disability Act 2005 (Preiser & Smit, 2011) defines Universal Design as:

To design and composition of an environment so that it may be accessed, understood and used
To the greatest possible extent
In the most independent and natural manner possible
In the widest possible range of situations
Without the need for adaptation, modification, assistive devices or specialised solutions, by any person of any age or size or having any particular physical, sensory, mental health or intellectual ability or disability, and

Means in relation to electronic systems, an electronics-based process of creating products, services or systems so that they may be used by any person.

Through research between 1994 and 1997, the Center of Universal Design was able to create seven principles that allow for the designing of products/services that can be used universally (Preiser & Smith, 2001). The principles are as follows:

1. Equitable Use: The design is useful and marketable to people with diverse abilities
a. Provide the same means of use for all users
b. Avoid segregation or stigmatizing any users
c. Make provisions for privacy, security and safety equally available to all users
d. Make the design appealing to all users

2. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities
a. Provide choice in method of use
b. Accommodate right-or-left handed access and use
c. Facilitate the users accuracy and precision
d. Provide adaptability to the users pace

3. Simple and Intuitive Use: Use of the design is easy to understand, regardless of the users experience, knowledge, language skills, or current concentration level
a. Eliminate unnecessary complexity
b. Be consistent with user expectations and intuitions
c. Accommodate a wide range of literacy and language skills
d. Arrange information consistent with its importance
e. Provide effective promoting and feedback during and after task completion

4. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the users sensory abilities.
a. Use different modes for redundant presentation of essential information
b. Maximize “legibility” of essential information
c. Differentiate elements in ways that can be described
d. Provide compatibility with a variety of techniques or devices used by people with sensory limitations

5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidents or unintended actions
a. Arrange elements to minimize hazards and errors
b. Provide warning of hazards and errors
c. Provide fail safe features
d. Discourage unconscious action in tasks that require vigilance

6. Low Physical Effort: The design can be used effectively and comfortably and with a minimum of fatigue
a. Allow user to maintain a neutral body position
b. User reasonable operating forces
c. Minimize repetitive actions
d. Minimize sustained physical effort

7. Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation and use regardless of users body size, posture or mobility
a. Provide a clear line of sight to important elements for any seated or standing user
b. Make reach to all components comfortable for any seated or standing user
c. Accommodate variations in hand and grip size
d. Provide adequate space for the use of assistive devices or personal assistance.

The seven principles and the subsequent guidelines were created from a product design perspective and thus might not fully translate to HCI. But the fundamental principles create an important base to understand the idea of universal usability of technology.

Appendix-G | Interview Guide

Introduction

The interviewees have been divided into 4 parts depending on the area of expertise. This include:

Autonomous vehicles: Research into the field of autonomous vehicles, cognitive design and automation in general

Vulnerable road users: Research in the field of pedestrian and cyclist behavior

Responsible Innovation: Focused towards developing the field of responsible innovation and value centered design

Trust: Research that have focused on trust as a factor of acceptance of technology/automation in their work

The interview questions have thus been segregated into four formats to have effective interviews. The core of all the interviews is the influence of trust in the respective domains. The interviews are in the form of semi-structured interviews that will last between 45 minutes to 60 minutes.

Interview Guide-Autonomous Vehicles

The interview is being conducted as part of a graduation thesis at TU Delft, on the topic of building trust in autonomous vehicles. More specifically the role of designers play in this process. All information form the interview has been anonymized and the interview itself will not be shared beyond the scope of the project. I would like to ask you permission to record the interview for further analysis.

Introduction (5 minutes)
1. Could you briefly highlight the focus area of your research/area of interest?
1. Additional probe questions to understand the research better?

Design Approach (15 minutes)
1. What is your approach to designing a system for autonomous vehicles (such as adaptive cruise control or lane assistance)?
1. What kind of stakeholders do you consider during this process?
2. How long does this process take?
2. Do you think there are areas of expertise missing that can aid in this process?
1. If yes, can you elaborate why?
2. If no, why?

Autonomous Vehicles (15 minutes)
1. What would you consider as the challenges to autonomous vehicles?
1. How would you see them differ between semi-autonomous vehicles and fully autonomous vehicles?
2. Out of the above stated challenges, which one would be considered the most detrimental to the acceptance of autonomous vehicles? Could you explain why?
2. What role does human values (privacy/security) play in these barriers to autonomous vehicles?
1. Can you elaborate more on your answer?
2. How do you consider these factors in you design
3. What would you consider factors that would influence the end user trusting an autonomous vehicle?
1. Could you elaborate your answer?

The Manufacturers Challenge (5minutes)
1. Would there exist any additional challenges that manufacturers face as compared to the ones we discussed earlier?
2. What changes are required in the current way of manufacturing vehicles to transition to AV?

Ending
1. I think I have got all the information that I require for the project. Are there any points you would like to add to the subject?

Interview Guide-Vulnerable Road Users

Introduction (5 minutes)
1. Could you briefly highlight the focus area of your research/area of interest?
1. Additional probe questions to understand the research better?
2. How would you define vulnerable road users?

Vulnerable Road Users (15 minutes)
1. What do you consider as a challenge for autonomous vehicles with regard to vulnerable road users?
1. Would you consider these challenges different for semi-autonomous vehicles to fully autonomous vehicles?
2. Out of the above challenges which one do you consider the most detrimental to vulnerable road users?
2. Are the challenges similar for both pedestrians and cyclists or do they exist any differences?
1. If yes, could you elaborate?
2. If no, why?
3. What factors do you consider vital for vulnerable trusting autonomous vehicles?
1. Do you think there are cases where VRU *can misuse or abuse AV?*
4. What kind of data is recorded and how do you work with privacy laws?

Design Approach (15 minutes)
1. What is your approach to designing a system for vulnerable road users?
1. What kind of stakeholders do you consider in this process?
2. How long does the design process take before testing?

2. *Do you think there are any areas of expertise that you feel are missing in this process?*
    1. *If yes, can you elaborate why?*
    2. *If no, why?*

Manufacturers Challenge (5 minutes)

1. *Would there be any other challenges that manufacturers face in addition to the ones we have discussed already?*
    1. *If yes, could you elaborate why?*
    2. *If no, why?*
2. *What decisions must manufacturers make in AV for considering VRU*

Ending

1. *I think I have got all the information that I require for the project. Are there any points you would like to add to the subject?*

Interview Guide-Responsible Innovation

Introduction (5 minutes)

1. *Could you briefly highlight the focus area of your research/area of interest?*
    1. *Additional probe questions to understand the research better?*
2. *How would you define responsible innovation (RI)?*

Responsible Innovation (15 minutes)

1. *What would you consider as responsible innovation (RI)?(wording the questions)*
    1. *Could you elaborate it with an example?*
    2. *What factors do you think make it a responsible innovation (RI)?*
2. *Are they any other factors that govern responsible innovation (RI)?*
3. *What role do you think human values play in RI?*
    1. *I would like to drill a little deeper and understand the role trust plays in the acceptance of responsible innovation?*
    2. *Could you elaborate on the concept of transparency?*
4. *Does responsible innovation always lead to consumer acceptance?*
5. *What role does the end user play in the acceptance of a responsible innovation?*

Designing for RI (15 minutes)

1. *What would you consider as the basic design process for RI?*
2. *How can designers make users aware of responsible use of technology?*
3. *How can designers identify their own biases in case of design processes?*
4. *What recommendations would you give to people engaging in RI for the first time?*

Ending

1. *I think I have got all the information that I require for the project. Are there any points you would like to add to the subject?*

Interview Guide-Trust in Automation

Introduction (5 minutes)

1. *Could you briefly highlight the focus area of your research/PhD/work?*
    1. *Additional probes to understand the research better?*
2. *How would you describe trust?*

Trust (15 minutes)

1. *What is the predominant difference between interpersonal trust and human automation trust?*
    1. *How do you think these differences affect trust building within human automation trust?*
2. *What do you think are the important factors that influence trust in the case of human automation trust?*
    1. *What role do human values play in this?*
3. *What do you think is the role of appropriate trust/ calibrated trust of the use of autonomy?*
    1. *What would you prefer mistrust or distrust in automated technology?*
4. *What would you consider an appropriate method to measure trust?*

Autonomous Vehicles and Trust

1. *What do you think is the role of trust in acceptance of autonomous vehicles?*
    1. *Is there a difference between semi-autonomous and fully autonomous vehicles?*
2. *How do we address the idea of edge cases and their influence on trust?*
3. *What instances do you believe trust can be damaged the most in av interaction?*

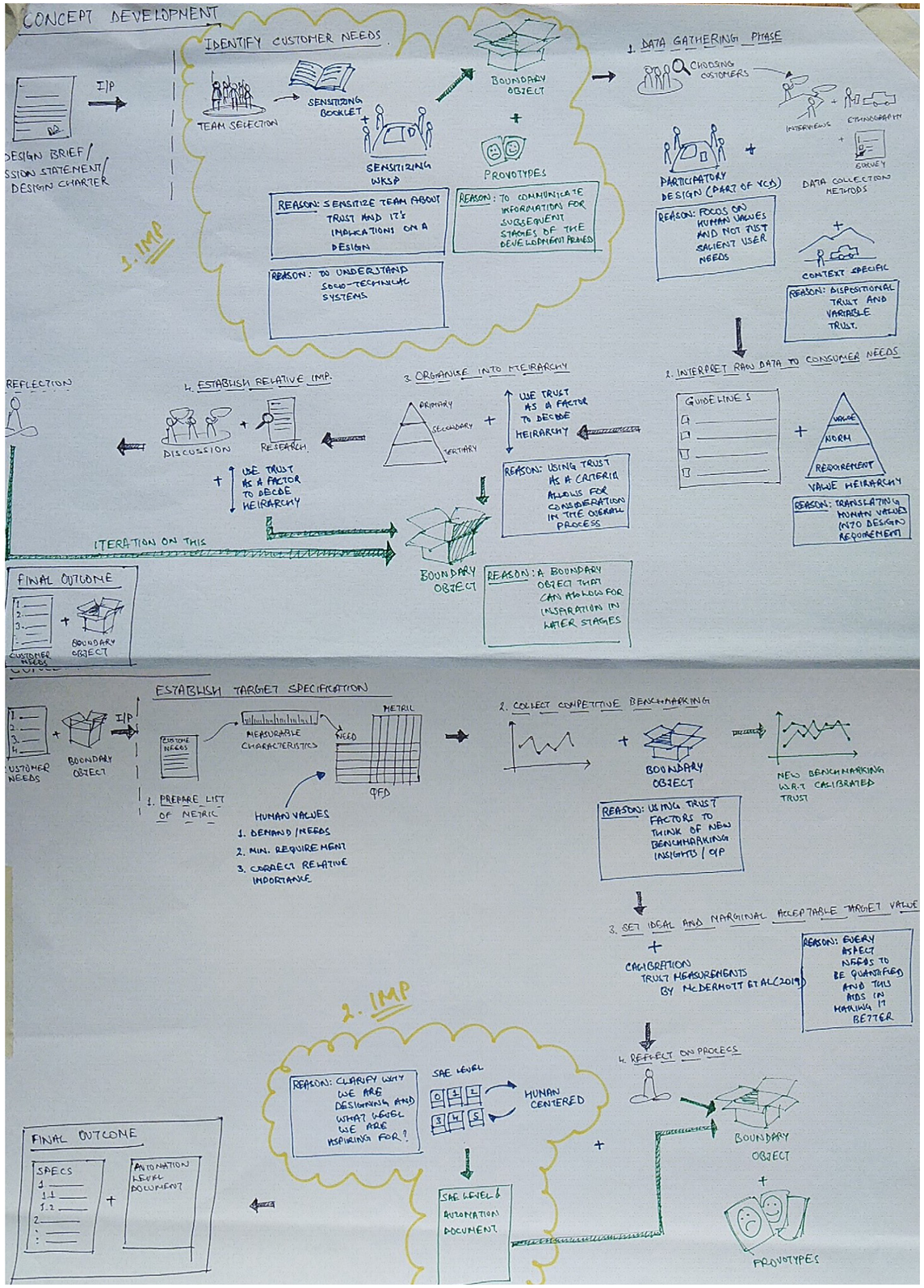
Designing for Trust (15 minutes)

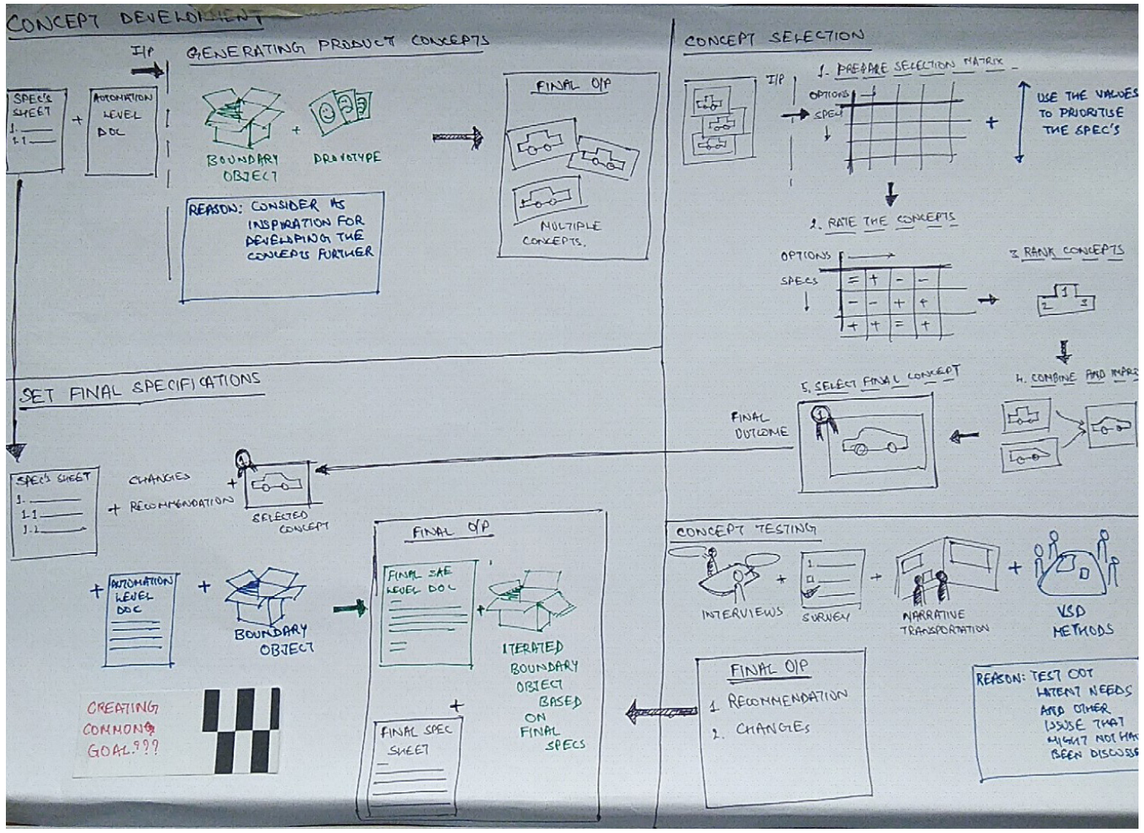
1. *What approach do you use when designing for trust?*
    1. *How can this be integrated within the conventional design process?*
2. *What do you think are misconceptions when designing for trust?*
    1. *Could you elaborate your answer?*
3. *What recommendations would you have for designing with trust for novice designers?*

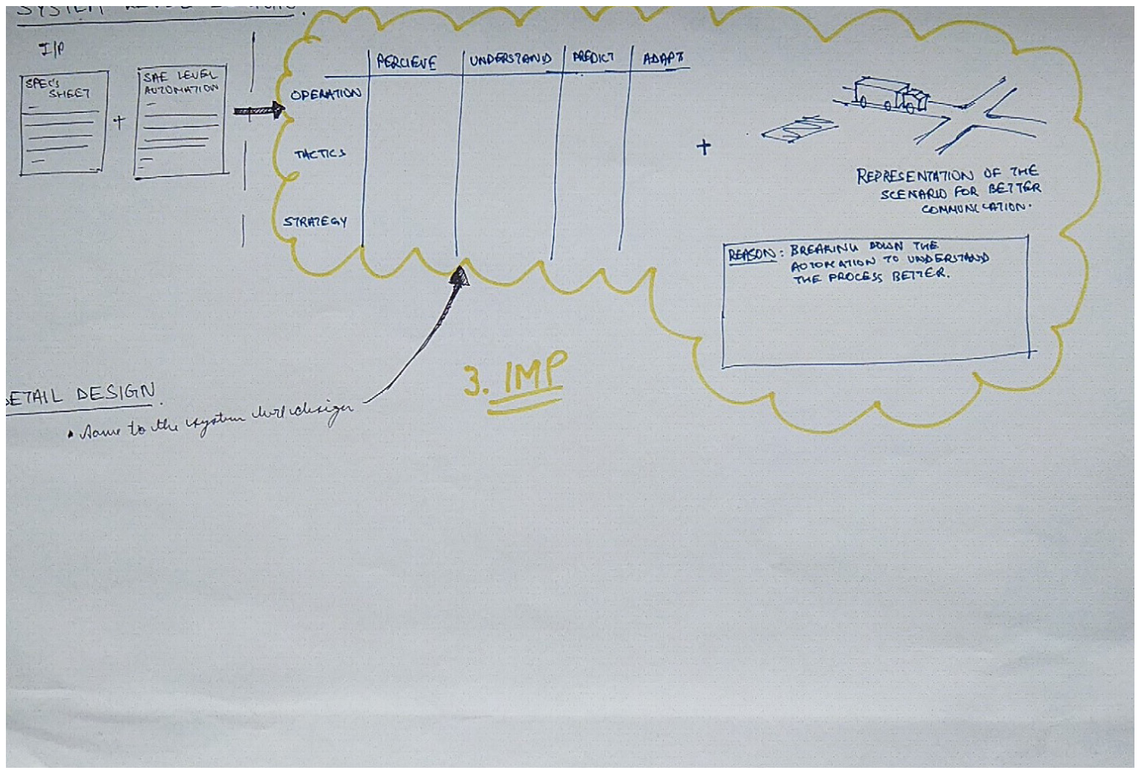
Ending

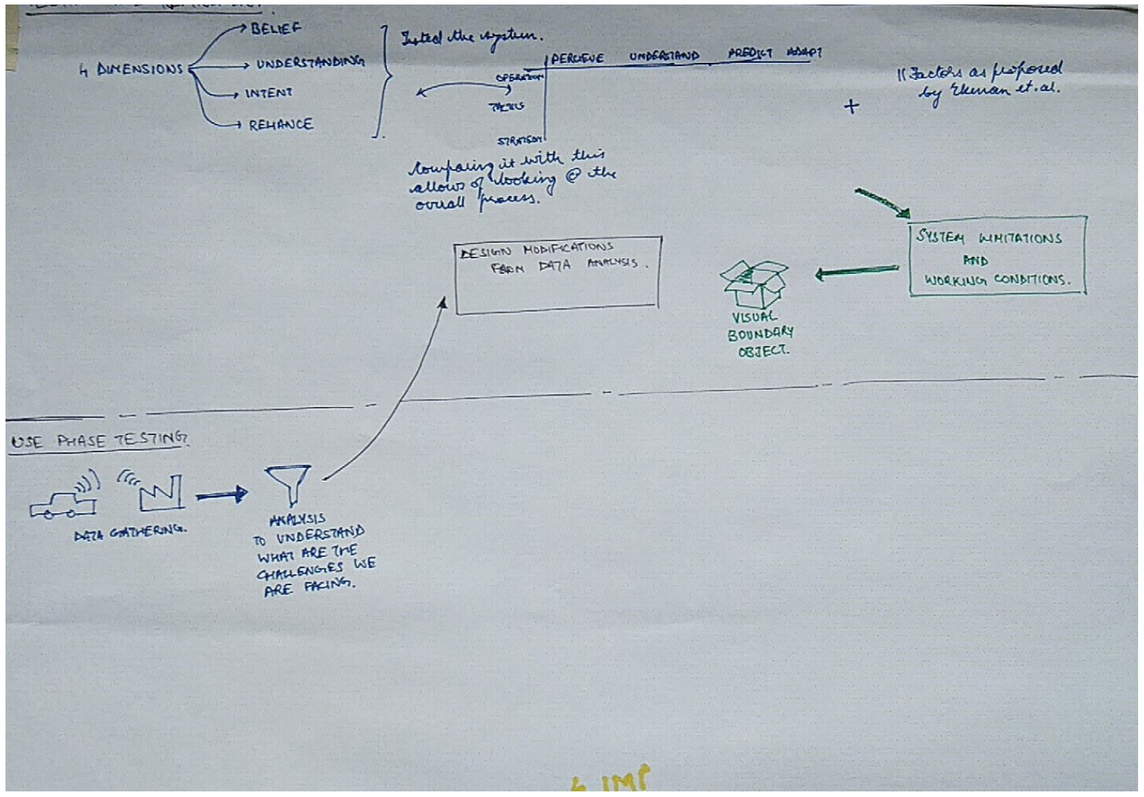
1. *I think I have got all the information that I require for the project. Are there any points you would like to add to the subject?*

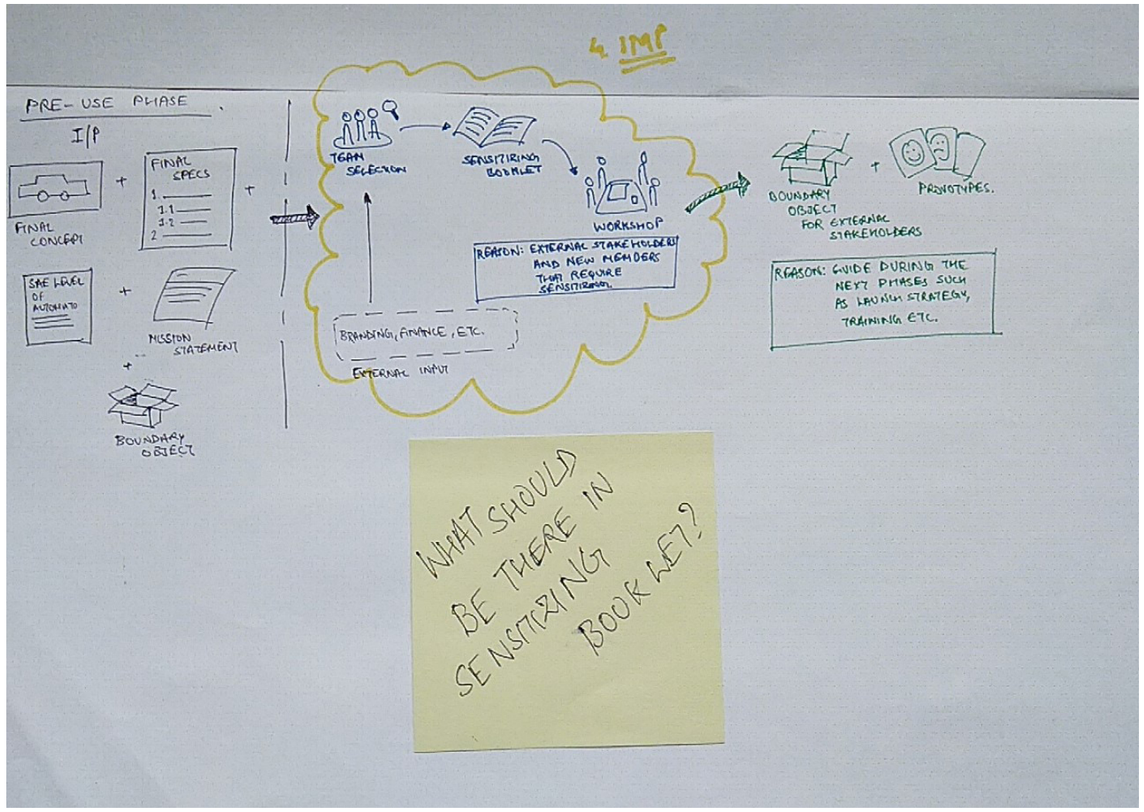
Appendix-H | Ideation Process & Concepts



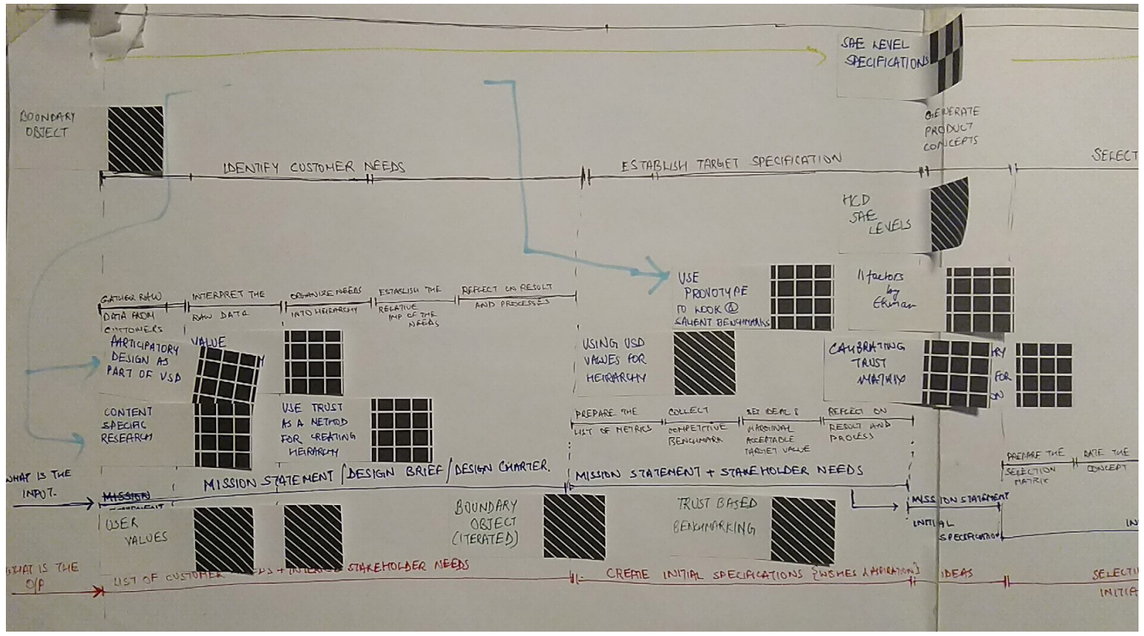

CONCEPT DEVELOPMENT
I/P
GENERATING PRODUCT CONCEPTS
SPEC'S SHEET
AUTOMATION LEVEL DOC
BOUNDARY OBJECT
PROTOTYPE
FINAL O/P
MULTIPLE CONCEPTS.
REASON: CONSIDER AS INSPIRATION FOR DEVELOPING THE CONCEPTS FURTHER
CONCEPT SELECTION
1. PREPARE SELECTION MATRIX
I/P
OPTIONS
SPECS
USE THE VALUES TO PRIORITISE THE SPEC'S
2. RATE THE CONCEPTS
OPTIONS
SPECS
3. RANK CONCEPTS
4. COMBINE AND
5. SELECT FINAL CONCEPT
FINAL OUTCOME
SET FINAL SPECIFICATIONS
SPEC'S SHEET
CHANGES
RECOMMENDATIONS
SELECTED CONCEPT
AUTOMATION LEVEL DOC
BOUNDARY OBJECT
FINAL O/P
FINAL SAE LEVEL DOC
ITERATED BOUNDARY OBJECT BASED ON FINAL SPECS
FINAL SPEC SHEET
CREATING COMMON GOAL???
CONCEPT TESTING
INTERVIEWS
SURVEY
NARRATIVE TRANSPORTATION
VSD METHODS
FINAL O/P
1. RECOMMENDATION
2. CHANGES
REASON: TEST OUT LATENT NEEDS AND OTHER ISSUE THAT MIGHT NOT HA BEEN DISCUSS

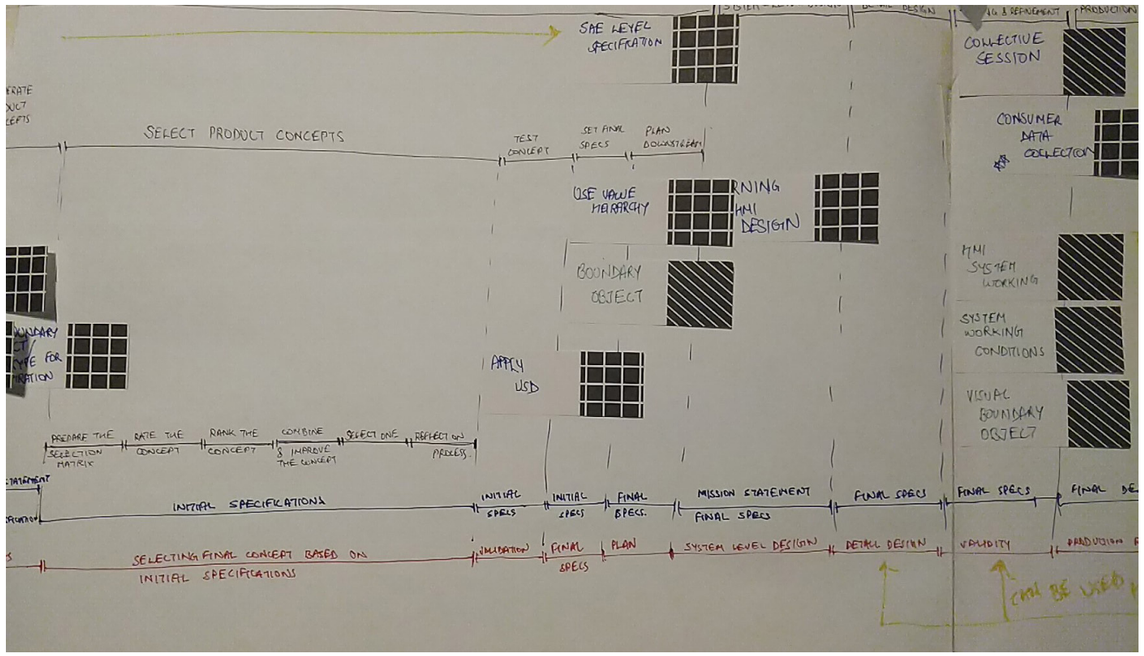

I/P
SPEC'S SHEET
SAE LEVEL AUTOMATION
OPERATION
TACTICS
STRATEGY
PERCIEVE
UNDERSTAND
PREDICT
ADAPT
REPRESENTATION OF THE SCENARIO FOR BETTER COMMUNICATION.
REASON: BREAKING DOWN THE AUTOMATION TO UNDERSTAND THE PROCESS BETTER.
3. IMP
ETAIL DESIGN
Zoom to the system and redesign

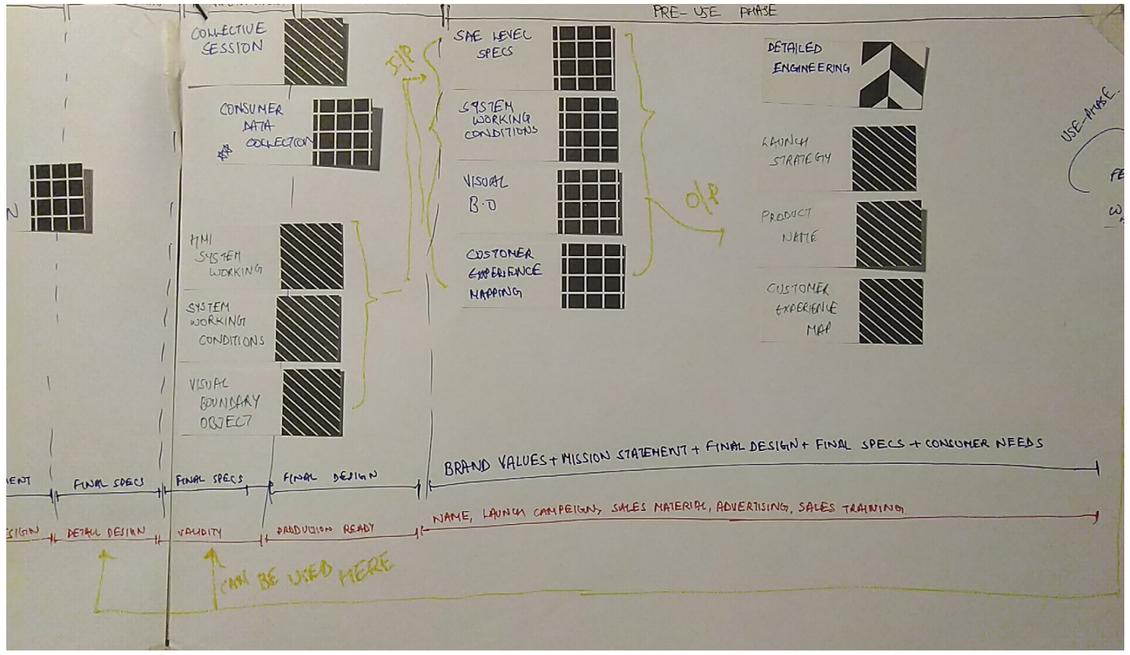

4 DIMENSIONS
BELIEF
UNDERSTANDING
INTENT
RELIANCE
Intel the system.
PERCEIVE
UNDERSTAND
PREDICT
ADAPT
OPERATION
TACTICS
STRATEGY
If factors as proposed by Ekman et.al.
Confusing it with this allows of looking @ the overall process.
DESIGN MODIFICATIONS FROM DATA ANALYSIS.
VISUAL BOUNDARY OBJECT.
SYSTEM LIMITATIONS AND WORKING CONDITIONS.
USE PHASE TESTING
DATA GATHERING.
ANALYSIS TO UNDERSTAND WHAT ARE THE CHALLENGES WE ARE FACING.


4 IMP
PRE-USE PHASE
I/P
FINAL CONCEPT
FINAL SPECS
1.
1.1
1.2
2
SAE LEVEL OF AUTOMATION
MISSION STATEMENT
BOUNDARY OBJECT
TEAM SELECTION
SENSITIZING BOOKLET
WORKSHOP
BRANDING, FINANCE, ETC.
EXTERNAL INPUT
REASON: EXTERNAL STAKEHOLDERS AND NEW MEMBERS THAT REQUIRE SENSITIZING.
BOUNDARY OBJECT FOR EXTERNAL STAKEHOLDERS
PROTOTYPES.
REASON: GUIDE DURING THE NEXT PHASES SUCH AS LAUNCH STRATEGY, TRAINING ETC.
WHAT SHOULD BE THERE IN SENSITIZING BOOKLET?

The image above shows the first part of the concept development process, the post its represent possible design interventions that can be used within the process, the bule marker lies represent the commections between the various concepts and the interrelation between the design interventions. The bottom red line represent the output of the particular phase and the blue line above it represents the input to each phase.







Appendix-II Autonomous function visualization Canvas Iteration and Testing

Autonomous Function Description for Testing

Introduction

The document is an excerpt for the Owners Manual from the Tesla Model S. All information contained within the document is part of the owners manual and has not been altered or modified. The current document has been developed for the testing of the design intervention and by no means should be considered as an alternative to the actual Tesla Model S owner's manual.

The document consists of one autonomous function which is used in the Tesla Model S. As a participant you are kindly requested to read through the document before attending the online session. The document is 5 pages long and should take around 10-15 minutes to complete reading. You are not required to memorize any details as the document will be available during the session. However, please feel free to highlight any information that might seem important to you for the online session.

For further clarifications, queries or questions feel free to contact on the email id d.c.valentine@student.tudelft.nl

Tesla Model S

The Model S is an autonomous vehicle developed and marketed by Tesla. Its autonomous function is termed as Autopilot that actively monitors the surrounding roadways, through an array of sensors:

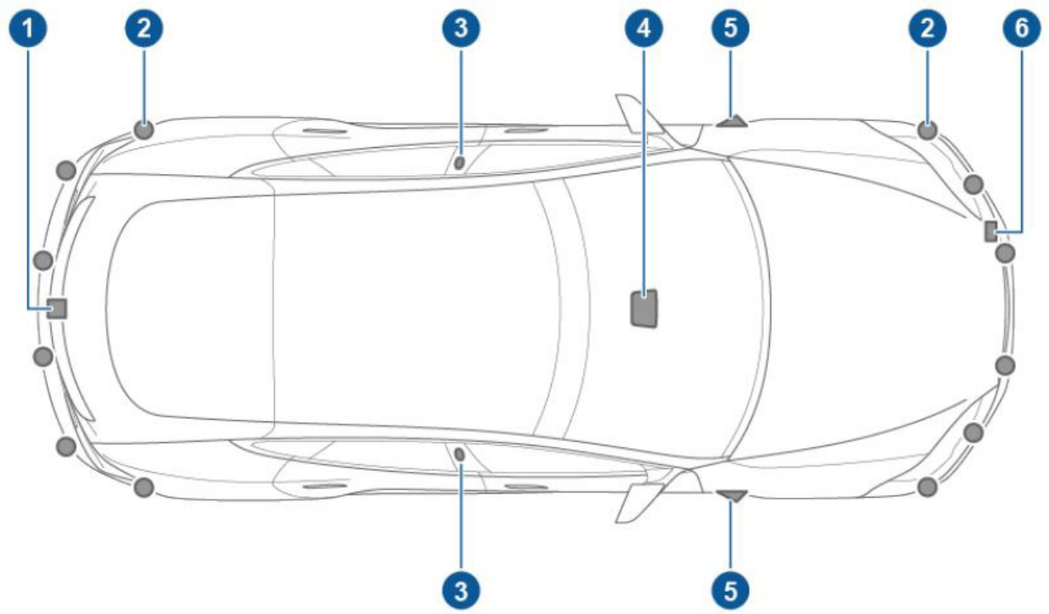
A camera is mounted above the rear license plate.

Ultrasonic sensors are located in the front and rear bumpers
A camera is mounted in each door pillar

Three cameras are mounted to the windshield above the rear view mirror

A camera is mounted to each front fender

Radar is mounted behind the front bumper



Lane Assistance

The Autopilot cameras and ultrasonic sensors monitor the markers on the lane you are driving in as well as the areas surrounding Model S for the presence of vehicles or other objects. When an object is detected in your blind spot or close to the side of Model S (such as a vehicle, guard rail, etc.), colored lines radiate from the image of your vehicle on the instrument panel. The location of the lines correspond to the location of the detected object. The color of the lines (white, yellow, orange, or red) represent the object's proximity to your vehicle, with white being the farthest and red being very close, requiring your immediate attention. These colored lines only display when driving between approximately 7 and 85 mph (12 and 140 km/h). When Autosteer is active, these colored lines also display if driving slower than 7 mph (12 km/h). However, the colored lines do not display if Model S is at a standstill (for example, in heavy traffic).

Lane Assist also warns you when a desired lane departure is not appropriate. When you engage the turn signal and a vehicle or object is detected in the adjacent lane you are planning to move into, the instrument panel displays a red lane line to indicate that a vehicle or object is detected. When the vehicle or object is no longer detected, the lane line returns to normal.

CAUTION: Ensure all cameras and sensors are clean. Unclean cameras and sensors, as well as environmental conditions such as rain and faded lane markings, can affect Autopilot performance.

WARNING: Lane Assist features are for guidance purposes only and are not intended to replace your own direct visual checks. Before changing lanes, always visually check the lane you are moving into by using side mirrors and performing the appropriate shoulder checks.

WARNING: Never depend on Lane Assist to inform you of unintentionally driving outside of the driving lane, or informing you that a vehicle is in your blind spot or close to the side of your vehicle. Several external factors can reduce the performance of Lane Assist such as a lack of lane markings or curbs. This may result in false, or lack of, warnings. It is the driver's responsibility to stay alert, pay attention to the driving lane and always be aware of other road users. Failure to do so can result in serious injury or death. Lane Assist also consists of the following features to assist you in staying safe in the driving lanes:

Lane Departure Avoidance
Emergency Lane Departure Avoidance
Blind Spot Collision Warning Chime

Lane Departure Avoidance

Lane Departure Avoidance provides steering interventions if Model S drifts into (or close to) an adjacent lane when driving between 40 and 90 mph (64 and 145 km/h) on major roadways with clearly visible lane markings.

OFF: You are not warned of lane departures or potential collisions with a vehicle in an adjacent lane.

WARNING: The steering wheel vibrates if a front wheel passes over a lane marking while the associated turn signal is off. A visual warning on the instrument panel is also displayed

ASSIST: In addition to the steering wheel vibration and a visual warning, Model S attempts to steer to a safer position in its driving lane if the vehicle detects drifting or a potential collision while the associated turn signal is off.

Your setting is retained until you manually change it. When Lane Departure Avoidance detects drifting and applies a steering intervention, the designated lane line is highlighted in blue on the instrument panel.

NOTE: Lane Departure Avoidance is intended to help keep you safe, but it does not work in every situation and does not replace the need to remain attentive and in control. WARNING: Keep your hands on the steering wheel at all times. If the vehicle senses your hands are not on the steering wheel, Model S sounds a chime and the hazard warning lights flash. WARNING: Steering interventions are minimal and are not designed to move Model S out of its driving lane. Do not rely on steering interventions to avoid side collisions.

Limitations and Inaccuracies

Lane Assist cannot always clearly detect lane markings and you may experience unnecessary or invalid warnings in these situations:

Visibility is poor and lane markings are not clearly visible (due to heavy rain, snow, fog, etc.). The exact detection zone of the ultrasonic sensors varies depending on environmental conditions.

Bright light (such as from oncoming headlights or direct sunlight) is interfering with the view of the camera(s).

A vehicle in front of Model S is blocking the view of the camera(s). Lane Assist Autopilot 125

The windshield is obstructing the view of the camera(s) (fogged over, dirty, covered by a sticker, etc.).

Lane markings are excessively worn, have visible previous markings, have been adjusted due to road construction, or are changing quickly (for example, lanes branching off, crossing over, or merging).

The road is narrow or winding.

Objects or landscape features are casting strong shadows on lane markers.

Lane Assist may not provide warnings, or may apply inappropriate warnings, in these situations:

One or more of the ultrasonic sensors is damaged, dirty, or obstructed (such as by mud, ice, or snow).

Weather conditions (heavy rain, snow, fog, or extremely hot or cold temperatures) are interfering with sensor operation.

The sensors are affected by other electrical equipment or devices that generate ultrasonic waves.

An object that is mounted to Model S is interfering with and/or obstructing a sensor (such as a bike rack or a bumper sticker).

In addition, Lane Assist may not steer Model S away from an adjacent vehicle, or may apply unnecessary or inappropriate steering, in these situations:

You are driving Model S on sharp corners or on a curve at a relatively high speed.

Bright light (such as from oncoming headlights or direct sunlight) is interfering with the view of the camera(s).

You are drifting into another lane but an object (such as a vehicle) is not present.

A vehicle in another lane cuts in front of you or drifts into your driving lane.

Model S is traveling slower than 40 mph (64 km/h) or faster than 90 mph (145 km/h).

One or more of the ultrasonic sensors is damaged, dirty, or obstructed (such as by mud, ice, or snow).

Weather conditions (heavy rain, snow, fog, or extremely hot or cold temperatures) are interfering with sensor operation.
The sensors are affected by other electrical equipment or devices that generate ultrasonic waves.

An object mounted to Model S (such as a bike rack or a bumper sticker) is interfering with or obstructing a sensor.
Visibility is poor and lane markings are not clearly visible (due to heavy rain, snow, fog, etc.).

Lane markings are excessively worn, have visible previous markings, have been adjusted due to road construction or are changing quickly (for example, lanes branching off, crossing over, or merging).

WARNING: The lists above do not represent every possible situation that may interfere with Lane Assist warnings. Lane Assist may not operate as intended for many other reasons. To avoid a collision, stay alert and always pay attention to the roadway when driving so you can anticipate the need to take corrective action as early as possible.

Traffic-Aware Cruise Control

Traffic-Aware Cruise Control (if equipped) uses the forward looking cameras and the radar sensor to determine when there is a vehicle in front of you in the same lane. If the area in front of Model S is clear, Traffic Aware Cruise Control maintains a set driving speed. When a vehicle is detected, Traffic-Aware Cruise Control is designed to slow down Model S as needed to maintain a selected time-based distance from the vehicle in front, up to the set speed. Traffic-Aware Cruise Control does not eliminate the need to watch the road in front of you and to manually apply the brakes when needed.

Traffic-Aware Cruise Control is primarily intended for driving on dry, straight roads, such as highways and freeways. It should not be used on city streets.

CAUTION: Ensure all cameras and sensors are clean before each drive. Unclean cameras and sensors, as well as environmental conditions such as rain and faded lane markings, can affect Autopilot performance.

WARNING: Traffic-Aware Cruise Control is designed for your driving comfort and convenience and is not a collision warning or avoidance system. It is your responsibility to stay alert, drive safely, and be in control of the vehicle at all times. Never depend on Traffic-Aware Cruise Control to adequately slow down Model S. Always watch the road in front of you and be prepared to take corrective action at all times. Failure to do so can result in serious injury or death.

WARNING: Although Traffic-Aware Cruise Control is capable of detecting pedestrians and cyclists, never depend on Traffic-Aware Cruise Control to adequately slow Model S down for them. Always watch the road in front of you and be prepared to take corrective action at all times. Failure to do so can result in serious injury or death.

WARNING: Do not use Traffic-Aware Cruise Control on city streets or on roads where traffic conditions are constantly changing.

WARNING: Do not use Traffic-Aware Cruise Control on winding roads with sharp curves, on icy or slippery road surfaces, or when weather conditions (such as heavy rain, snow, fog, etc.) make it inappropriate to drive at a consistent speed. Traffic-Aware Cruise Control does not adapt driving speed based on road and driving conditions.

To Use Traffic-Aware Cruise Control
To use Traffic-Aware Cruise Control, you must be driving at least 30 km/h, unless a vehicle is detected ahead of you. If a vehicle is detected ahead of you, you can use Traffic-Aware Cruise Control at any speed, even when stationary, provided Model S is at least 150 cm behind the detected vehicle.
You can set the cruising speed to either:

Your current driving speed. The minimum speed you can set is 30 km/h and the maximum is 150 km/h. It is the driver's responsibility to cruise at a safe speed based on road conditions and speed limits.

The speed limit, plus any offset you have specified To set the cruising speed to your current driving speed, move the cruise control lever up or down.

Traffic-Aware Cruise Control maintains your set cruising speed whenever a vehicle is not detected in front of Model S. When cruising behind a detected vehicle, Traffic-Aware Cruise Control accelerates and decelerates Model S as needed to maintain a chosen following distance, up to the set speed. Traffic-Aware Cruise Control also adjusts the cruising speed when entering and exiting curves. You can manually accelerate at any time when cruising at a set speed, but when you release the accelerator, Traffic-Aware Cruise Control resumes cruising at the set speed.

NOTE: When Traffic-Aware Cruise Control is actively slowing down Model S to maintain the selected distance from the vehicle ahead, brake lights turn on to alert other road users that you are slowing down. You may notice slight movement of the brake pedal. However, when Traffic-Aware Cruise Control is accelerating Model S, the accelerator pedal does not move.

WARNING: Traffic-Aware Cruise Control may occasionally cause Model S to brake when not required or when you are not expecting it. This can be caused by closely following a vehicle ahead, detecting vehicles or objects in adjacent lanes (especially on curves), etc.

WARNING: Due to limitations inherent in the onboard GPS (Global Positioning System), you may experience situations in which Traffic-Aware Cruise Control slows down the vehicle, especially near highway exits where a curve is detected and/or you are actively navigating to a destination and not following the route.

WARNING: Traffic-Aware Cruise Control cannot detect all objects and, especially in situations when you are driving over 80 km/h, may not brake/decelerate when a vehicle or object is only partially in the driving lane or when a vehicle you are following moves out of your driving path and a stationary or slow-moving vehicle or object is in front of you. Always pay attention to the road ahead and stay prepared to take immediate corrective action. Depending on Traffic-Aware Cruise Control to avoid a collision can result in serious injury or death. In addition, Traffic-Aware Cruise Control may react to vehicles or objects that either do not exist or are not in the lane of travel, causing Model S to slow down unnecessarily or inappropriately.

WARNING: Traffic-Aware Cruise Control may be unable to provide adequate speed control because of limited braking capability and hills. It can also misjudge the distance from a vehicle ahead. Driving downhill can increase driving speed, causing Model S to exceed your set speed (and potentially the road's speed limit). Never depend on Traffic-Aware Cruise Control to slow down the vehicle enough to prevent a collision. Always keep your eyes on the road when driving and be prepared to take corrective action as needed. Depending on Traffic-Aware Cruise Control to slow the vehicle down enough to prevent.

WARNING: Traffic-Aware Cruise Control cancels, or may not be available, in the following situations:

You press the brake pedal.

Your driving speed exceeds the maximum cruising speed of 150 km/h.

You shift Model S into a different gear.

A door is opened.

The view from the radar sensor or camera(s) is obstructed. This could be caused by dirt, mud, ice, snow, fog, etc.

The traction control setting is manually disabled or is repeatedly engaging to prevent wheels from slipping.

The wheels are spinning while at a standstill.

The Traffic-Aware Cruise Control system is failing or requires service.

When Traffic-Aware Cruise Control is unavailable or cancels, Model S no longer drives consistently at a set speed and no longer maintains a specified distance from the vehicle ahead.

WARNING: Traffic-Aware Cruise Control can cancel unexpectedly at any time for unforeseen reasons. Always watch the road in front of you and stay prepared to take appropriate action. It is the driver's responsibility to be in control of Model S at all times.

Limitations Traffic-Aware Cruise Control is particularly unlikely to operate as intended in the following types of situations:

The road has sharp curves.

Visibility is poor (due to heavy rain, snow, fog, etc.).

Bright light (such as from oncoming headlights or direct sunlight) is interfering with the view of the camera(s).

The radar sensor is obstructed (dirty, covered, etc.).

The windshield is obstructing the view of the camera(s) (fogged over, dirty, covered by a sticker, etc.).

WARNING: The list above does not represent an exhaustive list of situations that may interfere with proper operation of Traffic-Aware Cruise Control.

Iteration-1 Autonomous Function Visualization Canvas

Human Centered Autonomous Function Information Sheet

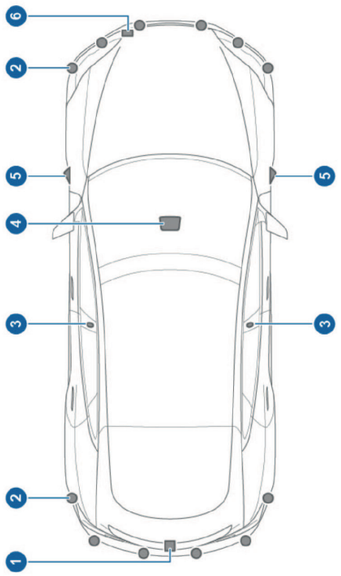
Function Description
Write down what the autonomous function performs

Name:

Function Tree
Sketch the relationship of the autonomous function with other functions

What should the driver do?
Duties of the driver when the function is engaged in the car

What should the driver not do?
Activities the driver should not partake in when function is engaged



Sensor List

1- Camera mounted on rear license plate
2- Ultrasonic sensor on front & rear bumper
3- Camera mounted on each door pillar
4- Camera mounted on windshield
5- Camera mounted on each front fender
6- Radar mounted behindfront bumper

Technical Working
What sensors are being used in the function

Technical Limitations
In which conditions will the sensors not work

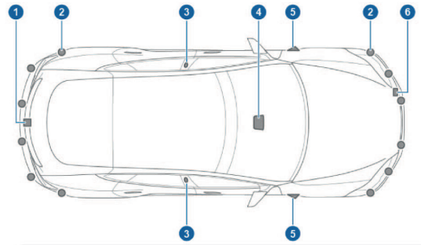
Detrimental Use Scenarios
Scenarios in which the function should not be used

Beneficial Use Scenario
Scenarios in which the function should be used

Iteration-2 Autonomous Function Visualization Canvas

Autonomous Function Visualizer

Function Description
Write down what the autonomous function performs



Function Tree
Sketch the relationship of the autonomous function with other functions

Sensor List

1- Camera mounted on rear license plate
2- Ultrasonic sensor on front & rear bumper
3- Camera mounted on each door pillar
4- Camera mounted on windshield
5- Camera mounted on each front fender
6- Radar mounted behindfront bumper

Light Side

Dark Side

Technical Working
What sensors are being used in the function

Technology

Technical Limitations
In which conditions will the sensors not work

Beneficial Use Scenario
Scenarios in which the function should be used

Context

Detrimental Use Scenarios
Scenarios in which the function should not be used

What should the driver do?
Duties of the driver when the function is engaged in the car

User

What should the driver not do?
Activities the driver should not partake in when function is engaged

Appendix- JI Iteration of the User Decision Matrix

Iteration-1 User Decision Matrix

	Percieve *What information can I gather*	**Understand** *What can I infer from the information*	**Predict/Perform** *What action can I perfrom based on the information*	**Adapt** *What factors might cause me to adapt and how?*
Other Road Users *Consider other users who are currently in the surrounding of the vehicle*				
Context *Consider the external environment, including road conditions, weather and sign posts*				
My Vehicle *The information your own vehicle is providing*				

My Habits
Do I have a unique habit as a driver in such conditions?

Iteration-1 Scenario Sheet

The Scenarios Sheet

Driving Task
Describe the driving task that will be analysed in the canvas

Driving Direction
Is the vehicle left hand drive or right hand drive

Visualize the driving task
Describe the driving task that will be analysed in the canvas

The Context

Weather, visibility | *Road Conditions* | *Road Signs* | *Other Factors*

The Vehicle
Describe the details of the car along with the autonomous function being deployed

The User
Describe the user of the car (Age, sex, experience in driving, special needs, etc.)

Appendix-K | Sensitizing Package

The sensitizing package used for the testing is different from the one presented in the final design. While the major themes described are the same the design used for the test phase of the sensitizing session was a Power Point presentation. This was done because it would be easier for the participants to fill in the booklet. The current example is from on of the participants.

Slide-1

Sensitizing booklet

Jellie

Slide-2

Welcome!

Thank you participating in the sensitizing session on "Trust in automation"

This sensitizing booklet is the first part of the complete session. The booklet has been designed to be completed within a week by dedicating 5-10 minutes a day to each task in the booklet. Further, the design allows for anonymity of the participant. Additional information can be found in the subsequent pages.

I hope you enjoy using the booklet and excited to meet you during the online session/part-2 of the sensitizing session.

For any queries/doubts/questions kindly contact on the email id: d.c.valentine@student.tudelft.nl

Slide-3

How to use the booklet

The booklet has been designed to make it easier to use in a digital manner and should not require a lot of effort to use.

For entering text a box with a black border ( ) is present. Other details have been indicated on each page as and when required.

The booklet has 6 pages of activities, you are free to choose how many to complete in a day.

NOTE: Kindly don't change to order of pages or resize images

Slide-4

What is your definition of trust and trusting someone?

Being able to rely on somebody or something. I think it is about promises being kept/fulfilled, to be sure you won't be let down. It entails a mutual relationship between people/things based on this assurance.

Slide-5

Select words that represent trust to you

Confidence, Credit, Organic, Liability, Longevity, Expectation, Conviction, Protection, Positiveness, Dependence, Certainty, Reliance, Empathize, Entrustment, Friend, Hope, Assurance, Robust, Obligation, Experience, Predict, Faith, Understand, Situational

Note: Select at least 3 words and at most 5 words by highlighting them as done with this note

Slide-6

Select images that represent trust to You

Note: select at least 2 images and at most 4 images by placing a dot on them

Kindly do not resize the images

Slide-7

Why do you trust someone?

Culture

If culture is described as nationality, then trust is built slowly, whereas seeing from my religious background trust inside is established quicker since it is a small community. Outsiders would have a harder time to get in, to get trusted.

Gender

I suppose there might be a difference, since women are more emotional and men more rational. I suppose this would influence the speed and manner of trust, but I cannot say for sure how exactly.

Jellie

Age

I suppose with age comes experience and knowledge. I have learned to read people better over the years, aiding me in deciding whether to trust them or not.

Personality

I know I can be naive and impulsive at times, which would make me trust people a little too easily. On the other hand I feel like trust is very much a gut feeling, not something you can easily rationalise.

Slide-8

A short story....

The COVID-19 pandemic has brought a lot of uncertainty and challenges in our lives. One of these challenges is remote working/working from home. Thankfully with a multitude of video conferencing tools available we have been able to communicate with our peers without much difficulty.

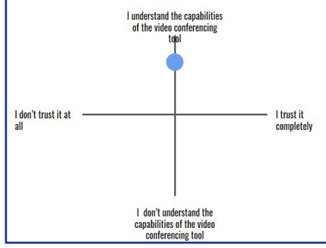
This section of the booklet focuses on your experience with one of these video conferencing tools more specifically why do you trust the tool.

Name of the video conferencing tool you use the most: Skype

Slide-9

My Trust Grid

Plot your trust with regard to the selected video conferencing tool on the matrix



Skype is a faily straightforward tool, it does not have too many functions, therefore is easy to use.

If it comes to trust there are two sides to it: safety-wise, I trust Skype to be secure. I do not think my computer will be breached through Skype.

However, lately the program seems to crash more often than normally, as well as using a lot of computing power from my computer. I think this many users of the platform recently are putting too much strain on it. I have heard similar complaints from friends, we all agree we do not completely trust it to work flawlessly anymore.

Note: Use the dot to mark your response

Slide-10

Select words that represent your trust towards the video conferencing tool

Confidence, Credit, Organic, Liability, Longevity, Expectation, Conviction, Protection, Positiveness, Dependence, Certainty, Reliance, Empathize, Entrustment, Friend, Hope, Assurance, Robust, Obligation, Experience, Predict, Faith, Understand, Situational

Note: Select at least 3 words and at most 5 words by highlighting them as done with this note

Slide-11

Thank You

I hope you enjoyed working on the sensitizing booklet. Looking forward to discussing your insights further during the group session.

A reminder, kindly email the filled sensitizing booklet back minimum 1 day before the group sensitizing session.

For any further questions/queries/doubts kindly contact via the email d.c.valentine@student.tudelft.nl

#StaySafe#StayStrong

Slide-12

Design for Calibrated Trust for
Acceptance of Autonomous Vehicles