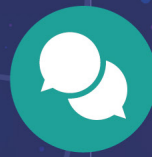


Calibrated Trust Toolkit



Designed and Developed by:
David Callisto Valentine

Welcome

The calibrated trust toolkit is designed to be used within the product development process of autonomous vehicles. It can also be extrapolated to be used to design for other automations but certain modifications will need to be performed. The toolkit consists of four parts, the manual covers the use of all the four parts of the Calibrated Trust Toolkit. The four parts of the toolkit are:

Sensitizing session: A session during the planning phase that allows for the design and development team to create a common understanding of trust and the factors influencing them. This is followed by creating a trust goal that is in line with the design direction.

Autonomous Function Visualizer: A human centred visualization canvas that allows developers to break down individual autonomous functions into technology, context of use and user behaviour. This creates a more holistic understanding of the autonomous, easy communication across various functions and the ability to capture iterations performed on the autonomous function throughout the development process.

User Decision Matrix: The user decision matrix is used in the detail design process to design HMI and eHMI systems. The basis of the matrix is based on how we make decisions, and what role the context of use plays in the making decisions.

Trust Enhancing Communication (TEC): TEC is a set of principles and requirements that are created for communicating with external stakeholders when moving from the product development process to the pre-use phase

The manual also follows this order of explaining the toolkit. At the end of the manual you can find the copies of the different parts of the toolkit to be printed out and used. For more details with regard to the use of the toolkit kindly refer to the project report.

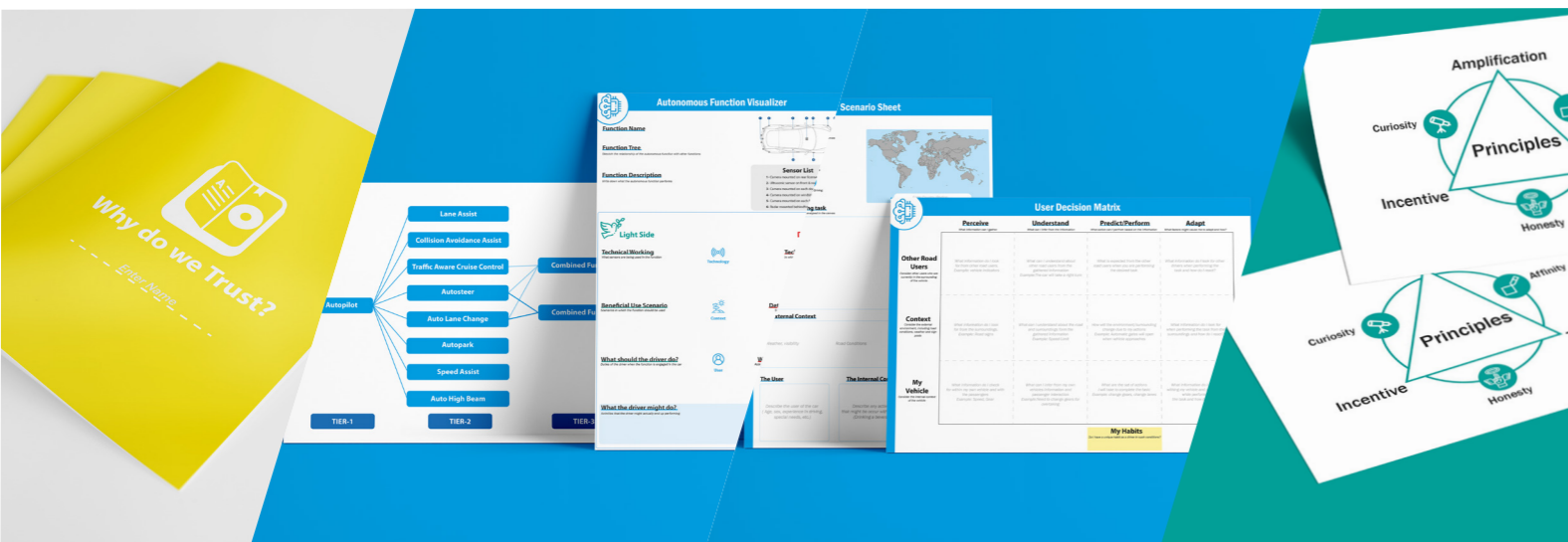


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Calibrated Trust Toolkit positioning within the Product Development Process

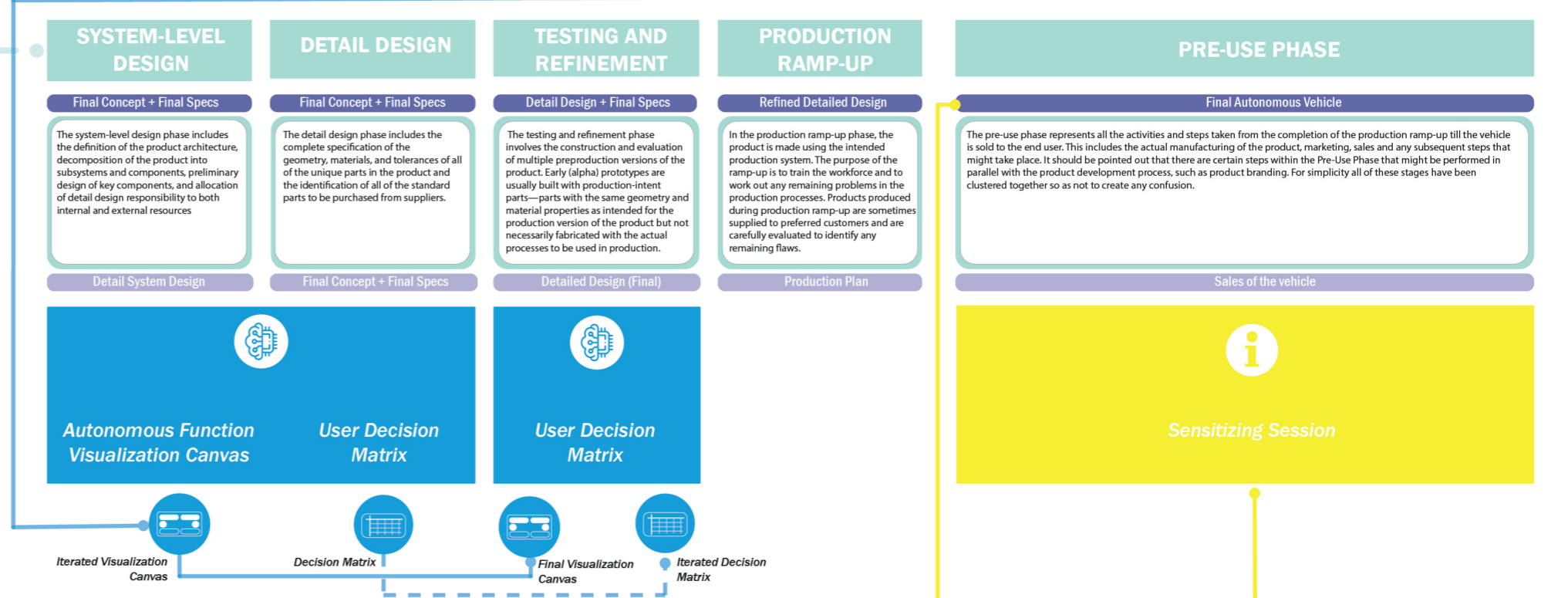
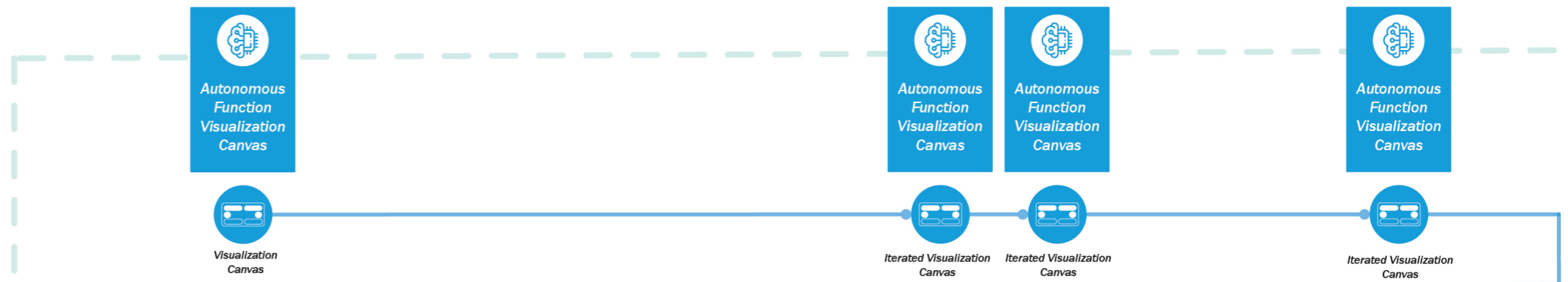
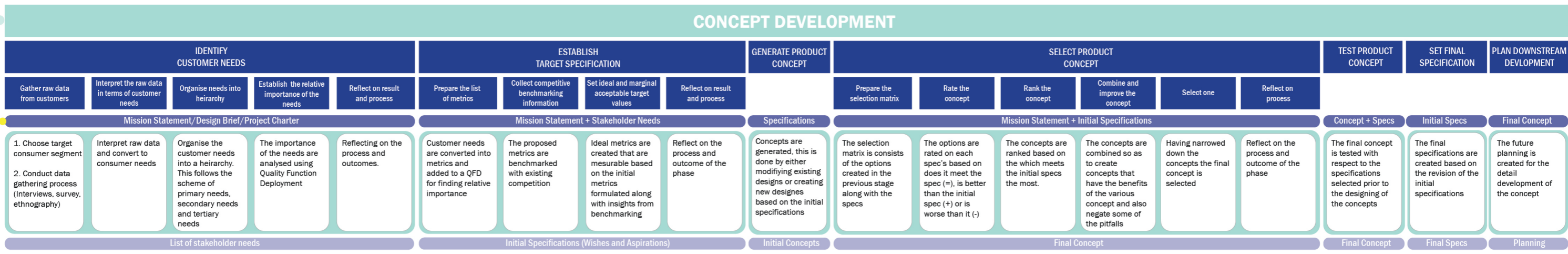
PLANNING

Sensitizing Session

Trust Goal

Reading Guide

- Product Development Phases
- Stages within a Product Development Phase
- Input to the stages
- Output of the stage



NOTE
The position of Trust Enhancing Communication has not been shown within the product development process because it can be used within any of the phases of the process after the Concept Development Process



Sensitizing Session

Sensitizing Session

Selecting the Facilitator

The facilitator plays an important role in the sensitizing session and is responsible for performing a number of tasks before and after the session. It would be ideal to have more than one person act like the facilitator to ease the workload. The basic requirement of a facilitator is a member of the design team that has experience with Scrum Master, Creative Facilitator or Agile coach. Additionally certain knowledge in the field of trust in automation or trust in AI would be beneficial, but is not a requirement. The responsibilities of the facilitator are as follows:

Pre-Session

- *Planning the sensitizing session, along with securing physical locations for conducting the sessions*
- *Selecting the participants for the sensitizing session, contacting them and scheduling the date of the session*
- *Creating the sensitizing packages and delivering them to the participants (In certain cases the participant might have question, the facilitator is required to address these queries)*
- *Preparing the material for the sensitizing session*

During the Session

- *Facilitate the session and discussion*
- *Record the discussion on the canvas*
- *Maintain the schedule of the session, including bio-breaks and refreshment*
- *Converging at a Trust Goal*
- *Hand participants the reflection package*

After the Session

- *Collect the canvas and sensitizing package to store or discard*
- *Communicate the Trust Goal to the other team members along with a brief explanation*

Reading Recommendation:

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors*, 46, 50–80.

Hoff, K. A., & Bashir, M. (2015). Trust in automation: Integrating empirical evidence on factors that influence trust. *Human Factors*, 57, 407–434

Selecting Participants

After selecting a facilitator. The facilitators first role is to select participants to be part of the sensitizing session. There are three criteria to select participants:

- **Expertise across multiple functions:** *Designing a vehicle is considered a complex design process with a number of functions and sub-functions such as power transmission, steering and suspension, aerodynamics, ergonomics, braking, etc. Thus, a collection of participants must be chosen that can cover a majority of expertise.*
- **Corporate Ladder:** *The second factor is to gather stakeholders from various levels of the corporate ladder to take part. Which would include engineers/developers to function heads and even department heads taking part.*
- **Influence Factor:** *The influence factor considers the association the participant will have with the development process of the vehicle, in terms of responsibility within the development process, the time dedicated to the project and the ownership of the project or sub-parts of the project.*

The total number of participants should be around 5-7 participants, more can be added if required but by no means should the number of participants cross more than 9. This makes conducting the session tougher and at the same time loss the value of the discussion.

Scheduling the session


The schedule of the session requires some planning as it spans over 7 to 10 days and has multiple activities. The steps for scheduling the session are as follows:

- **Scheduling a time for the sensitizing session:** *The main session will take the most time and so it is advisable to look to schedule that first and then plan backwards. The main session should take between 4 to 5 hours depending on the number of participants and the breakdown of the session. Thus, setting a time with the participants beforehand is helpful in the case.*
- **Schedule the start date of the sensitizing package:** *Having received the confirmation for the sensitizing session, work backwards to select a date on which you (facilitator) will hand the participants the sensitizing package. Keep in mind to have this start date a minimum of 7 days before the sensitizing session and at most 10 days. More than 10 days and the sensitizing package will lose its value, as the participants might forget to fill in the information or might require a recap during the main sensitizing session. Less than 7 days and the participants will need to spend more time to fill in the canvas per day.*

Sensitizing Package

The sensitizing package is self explanatory and thus does not require much work on behalf of the facilitator. There are however, certain pages in which the facilitator is required some information.

- The first thing to do is to add the contact details of the facilitator so that participants can easily contact the facilitator. This is done on the Welcome! Page of the sensitizing package. The sensitizing package specifies only email id, however it is up to the digression of the facilitator to provide additional information if they feel necessary.
- In the select word section, the facilitator needs to add words that resemble or are associated with trust, these words can be used from the word list presented or additional words can also be selected. In total there should be 25-30 words for the participants to choose from. The facilitator should note that the words should be diverse and not just synonyms of trust.




Welcome!

Thank you participating in the sensitizing session

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 physical session

For any queries/doubts/questions kindly contact on the email id:
(Enter Contact Details)




Select words that represent trust to you

Add 20-25 words within the box for participants to choose from




NOTE: Select at least 3 and at most 5 words from the word list

- Similar to the previous step, selecting of images needs to be done by the facilitator, again the facilitator is free to select a collection of images to add to the sensitizing booklet as their main aim for participants is to find an association and explain trust in an easier manner. There is no specific order the images need to follow but they just need to provide a diverse representation of trust. The facilitator can select the images from the collection in the toolkit manual or can add this/her own images.



Select images that represent trust for you

Add 20-25 images within the box for participants to choose from



NOTE: Select at least 2 and at most 4 images

- This is an important part of the sensitizing package, the facilitator needs to select an autonomous function to discuss. This autonomous function will further also be used in the main sensitizing session.

(NOTE: Select an autonomous function that all the participants have experienced and use commonly or have interacted with a number of times)



A Short Story.....

Describe the autonomous function that will be used for the sensitizing session with a short description by the use of a short story or introduction



- The last page of the sensitizing book also requires the selection of a collection of words, which can be copied from the first part or a new set of words can also be used.

After completing the necessary additions to the sensitizing session, the following steps need to be performed:

- Print out the sensitizing package
- Deliver the packages to the participants personally and clarify any immediate queries the participants might have. Remember to remind the participants to finish the sensitizing package before the session.
- A day before the session collect the sensitizing packages back from the participants, so that they can be distributed to the participants during the session and none of the participants forgets to get their sensitizing package to the session.



Select words that represent your trust towards the automation

Add 20-25 words within the box for participants to choose from



NOTE: Select at least 3 and at most 5 words from the word list

Word List

Confidence	Dependence	Predict	Respect	Benevolence
Credit	Certainty	Faith	Understanding	Integrity
Organic	Robust	Understand	Faithful	Dependability
Liability	Obligation	Government	Loyal	Purpose
Longevity	Entrustment	Pet	Complicated	Blue
Expectation	Friend	Nature	Simple	Fragile
Conviction	Hope	Religion	Transparent	Attitude
Reliance	Assurance	Parents	Mutual	Credence
Empathize	Experience	Spouse	Symbiotic	Belief
Positiveness	Situational	Suspicion	Difficult	White

The word list presented consists of 50 words that can be used within the sensitizing session. However, as the facilitator it is not necessary to use the listed words additional words can also be added. If all the participants hail from a specific region and speak a common language then native language words can also be included.

Another important point to note is the representation of the words in the sensitizing package. Do not create a table with words in the sensitizing package. Instead position the words in random sizes, fonts and positions within the designated space. This will make the participants read the words in a random order and at the same time create more associations. An example has been shown in the adjacent section.

NOTE: Keep the words legible in size and font, three examples have been shown of what not to do

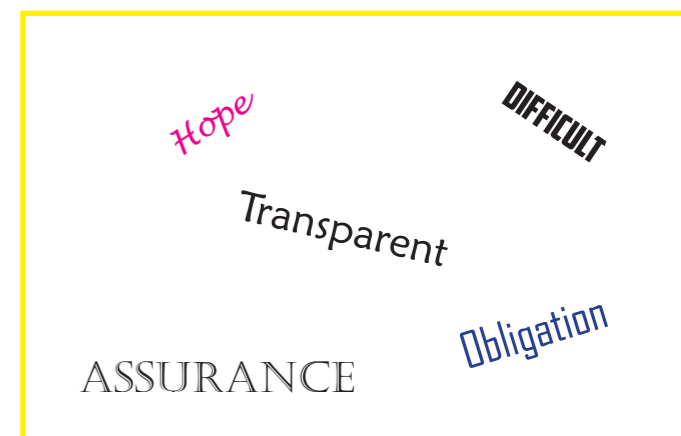
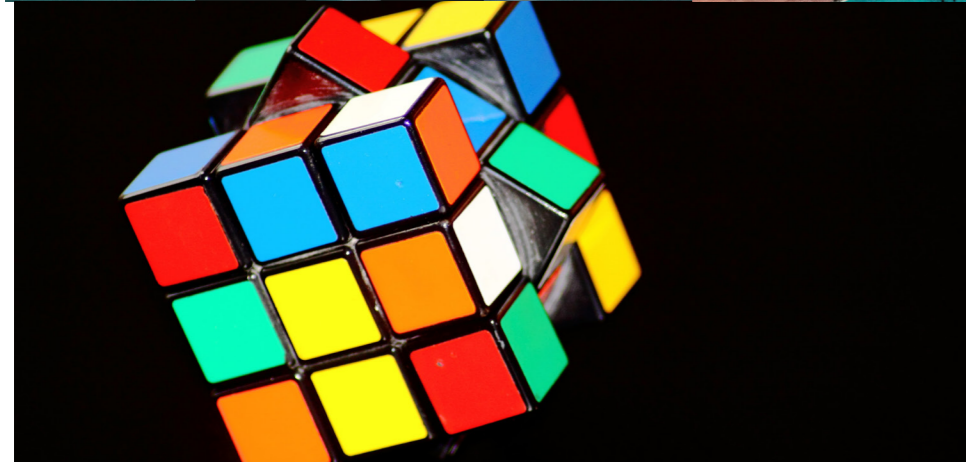
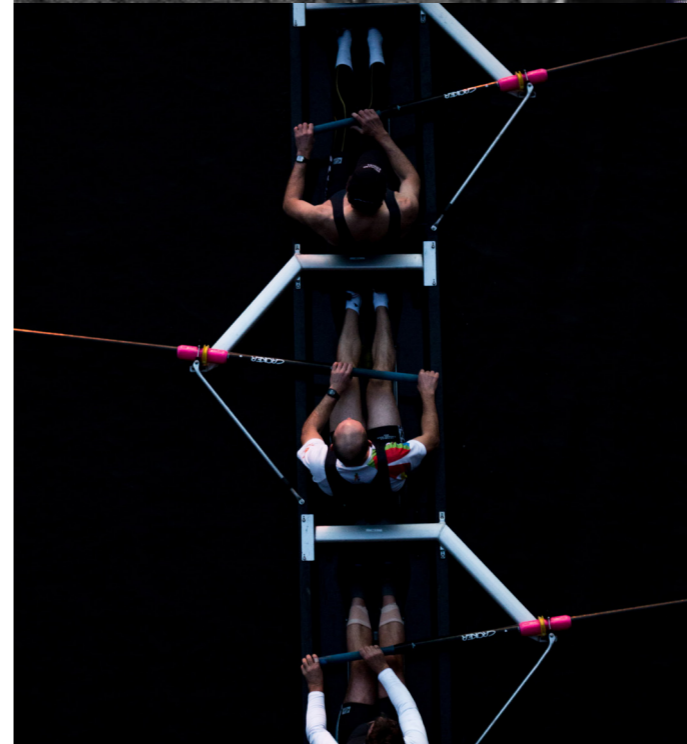
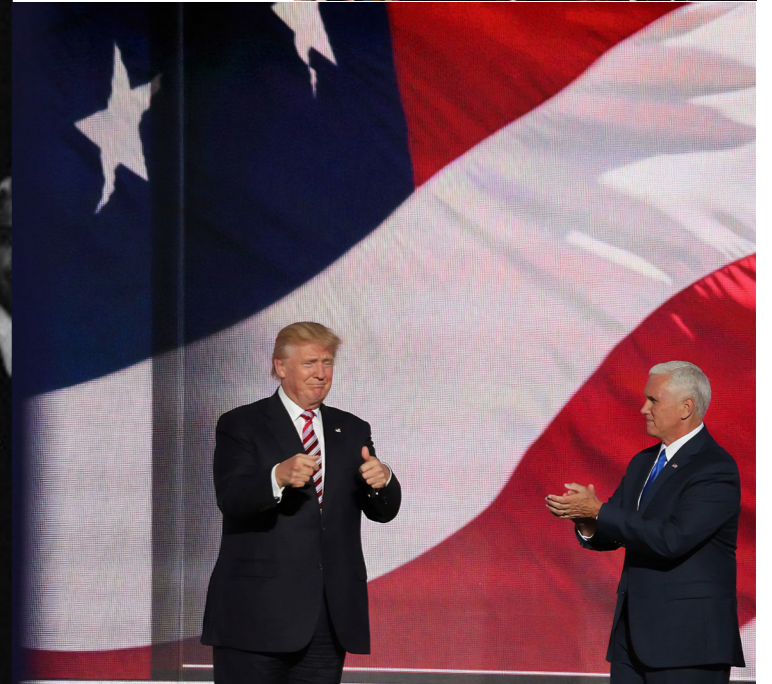
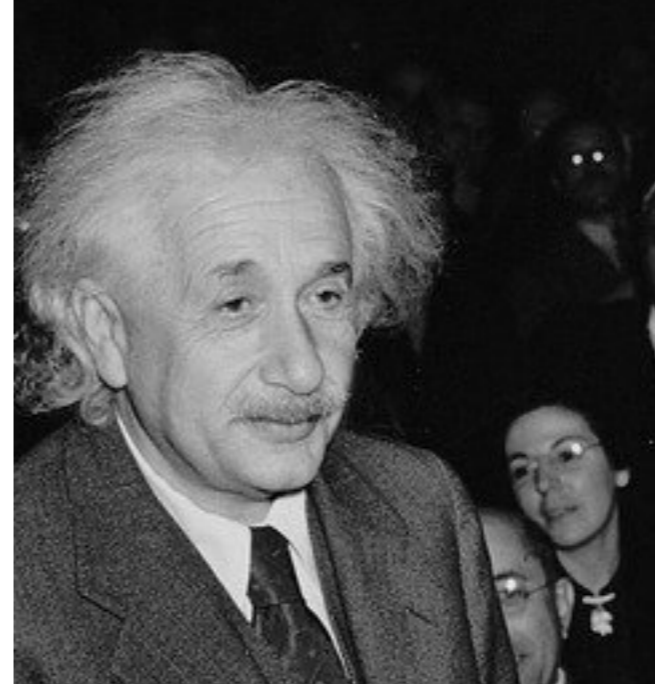


Image Cluster



Master Thesis | Designing for Calibrated Trust

2020 | David Callisto Valentino



Master Thesis | Designing for Calibrated Trust

2020 | David Callisto Valentino



Similar to the word list the cluster of images is not the only images that can be used. As the facilitator feel free to add or remove images. The aim of the images is to provide the participants a trigger to think about trust or create associations that makes explaining trust easier.

The images also should not be presented in an organised manner but must be random, in composition, size and orientation.

In case of images, the quality of the image not a problem as it opens it to multiple interpretations. This is opposite to when selecting words, they must be legible so that the participant can recognise the word.

An example of the layout has been shown below:

NOTE:

Do not overlap the images, maintain a certain amount of space so that the images are clearly visible and not obstructed by other images

Use different types of images, such as photographs, sketches, murals, art etc. This breaks the monotony of the images and opens it to further interpretation when being selected by the participants.



Sensitizing Session

Before the Session

Room selection: Book a room to conduct the session, there are certain requirements that the room should meet that will make conducting the session more easier and fruitful.

- **Less distractions:** A quiet room away from noise and distractions allow for conducting the session in a better manner.
- **Proximity to facilities:** The washroom, vending machine proximity make break's shorter than spending the break travelling back and forth from the facilities.

Material: The session requires some material that need to be prepared:

- **The sensitizing canvases:** In total there are 8 canvases, 7 canvases do not need any modification and can be directly printed on A3 or A2 size pages whichever is convenient, however if given a preference A2 are easier to work with in a group.
- **Stationary**
 - Print out of the images provided in the sensitizing package
 - Print out of the words provided in the sensitizing package
 - Scissors
 - Post-it Notes
 - Markers
 - Masking tape/double sided tape
 - Dot stickers
 - Print out of the reflection package

Select the rules of the session: The 8th canvas titles "Welcome!" consists of rules of the session. The facilitator should select 3-4 rules that need to be observed by the participants while taking part in the session. These rules make the session move smoothly. The collection of rules are as follows:

- **Postpone Judgement:** Do not judge a person's opinion and respect every participants insight and responses
- **Open inside closed outside:** What happens in the session remains in the session and we take away our thoughts in the reflection package. There is no need for the outside world to know what mental stepping stones were taken during the session.
- **Engage in the session:** All participants must participate and are requested to turn off their communication devices or put them on mute.
- **Acknowledge the team effort:** Support the ideas and opinions of others and respect their participation.
- **Have fun:** Fun fosters a more positive and open climate during the session and allows for better flow of the session especially during the brainstorming phase that comes in the latter phase.
- **Our time:** Respect the schedule and maintain the time slots given to breaks, one participant's delay will affect all the other participants

Set the Schedule: Within the 8th canvas there is also a section for the schedule, the facilitator should fill in the details of the schedule as well in the following order:

- Start time
- End time
- Break time and duration



Welcome !

Session Rules
Set down the session rules for the participants

Session Plan
What is the session plan and timing

Discussion

Canvas-0
“Welcome!”
 20 minutes

Introduce the plan of the session and set some ground rules

Unboxing Trust

Thoughts

Visuals

How would you define trust?
 I think trust is...

Discussion

Canvas-1
“Unboxing Trust”
 30 minutes

Explore the groups understanding of trust in general, using the sensitizing booklet as a starting point

Dispositional Trust-Understanding each other

Personality

Gender

Age

Culture

Discussion

Canvas-2
“Dispositional Trust”
 20 minutes

Dive into the four factors that influence dispositional trust and understand the groups experience with respect to the four factors

Trust in Automation

Name:
 Purpose:

I don't trust it at all

I understand the capabilities of the automation technology

I trust it completely

I do not understand the capabilities of the automation technology

Discussion

Canvas-3
“Trust in Automation”
 30 minutes

The canvas collects the insights about trust in automation as discussed in the sensitizing booklet. Also introducing calibrated trust

Trusting Process

Performance
Competency of the automation technology to achieve the desired goal

Process
Understanding from the automation technology to able to achieve the desired goal

Purpose
Does the purpose of the automation technology align with that of the user

Discussion

Canvas-4
“Trusting Process”
 30 minutes

Explore the process of trust/ distrust with respect to the automation by breaking it into the trust formation process

The Devils Advocate

I do not trust you!!

Discussion

Canvas-5
“The Devils Advocate”
 30 minutes

Use negative analogies to explore situations that can create distrust

Trust Misconceptions

- We should design all technologies/ automation for trust
- Once a user has the right amount of trust in a technology/automation it does not change
- As a designer we can measure trust
- Trust is the balance of user expectations and technological capabilities

Discussion

Canvas-6
“Trust Misconceptions”
 20 minutes

Discussion on certain misconceptions we have with respect to trust

Trust Goal

What would be our trust goal

Let's Brainstorm

Discussion

Canvas-7
“Trust Goal”
 30 minutes

Brainstorm on creating a trust goal that will be the outcome of the session

Conducting the session

Introduce the participants to the session

Introduce the participants to the session and the outcome of the session, highlighting the rules of the session and the schedule of the session (Canvas-0)

“Aim of the session is to dive into the concept of trust and understand the factors that influence and trust. From there we will focus on one specific autonomous function and understand our trust relation with the autonomous function. We will then zoom out and ideate upon what should be our trust goal of the new autonomous vehicle we will be developing”

The rules of the session have already been elaborated previously, kindly refer to their explanation.



Canvas- 1 “Unboxing Trust”

Ice breaker

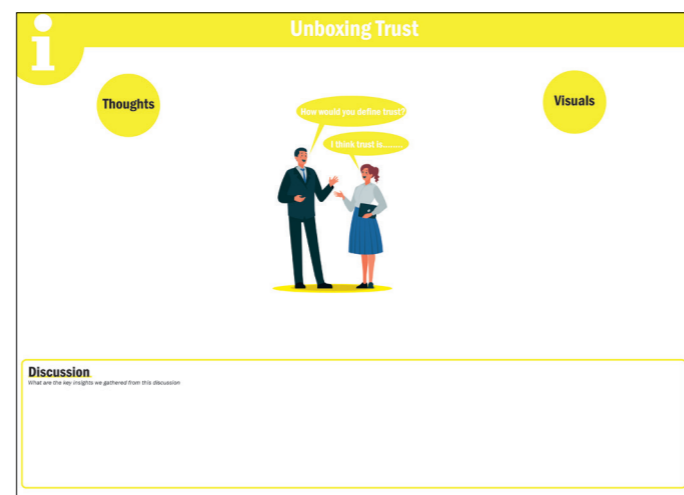
Now that the basic layout of the session has been explained along with the schedule and rules, the next part is to allow the participants to introduce themselves. Ask the participants to state their name and their responsibility within the development team. Once this is complete, move onto an ice breaker activity to get the participants into a positive mindset. Ice breaker games can be selected from multiple websites. Keep in mind that the ice breaker must not take too much time.

Canvas-1 “Unboxing Trust”

We begin by asking the participants to place the images and words that they selected to describe trust onto the canvas, using tape to stick them on. Following this go around the table asking the participants to describe their meaning of trust in 2-3 minutes. Following this, open the floor to discussions about the various opinions. During the period encourage the participants to jot down their thoughts or key points onto Post-its and place it in the discussion section. As the facilitator keep in mind to allow all participants to speak and put forth their points. Also, discussion on abstract ideas such

as trust can lead to deviation to other topics. Keep an eye out if such an instance occurs and bring back the conversation to the theme of trust. With 5 minutes remaining, ask the participants to wrap-up their discussion and jot down main points that they feel are important onto Post-its and place it within the discussion section.

After filling in the canvas, take the canvas away from the table and stick it onto a wall or board within the room. Move onto the next canvas.

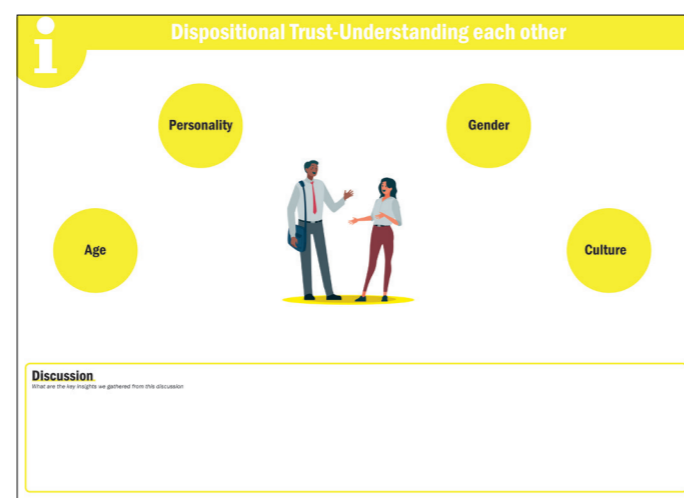


Canvas- 1 “Unboxing Trust”

Canvas-2 “ Dispositional Trust”

Ask the participants to discuss their thoughts on the four factors (Age, Gender, Culture and Nationality) that influence trust. Follow the same rules as the previous part. Again keep in mind keep the discussion under 20 minutes and 5 minute before the end time, ask the participants to write down the main points onto Post-its and paste them onto the discussion section.

After filling the canvas, take the canvas away from the table and stick it onto a wall or board next to the previous canvas. Move onto the next canvas.

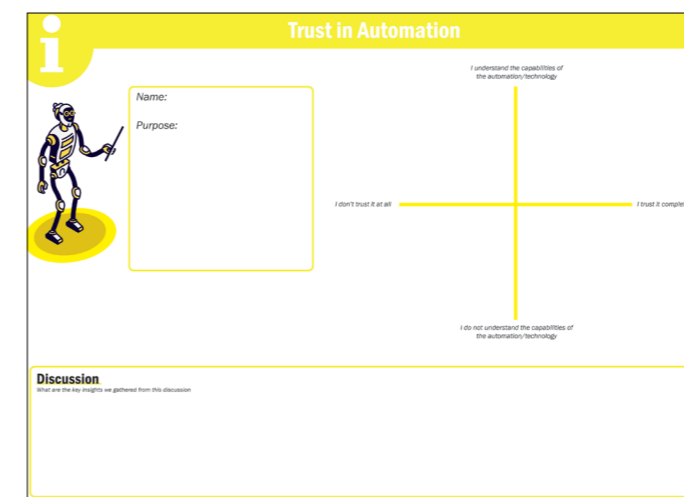


Canvas- 2 “Dispositional Trust: Understanding each other”

Canvas-3 “Trust in Automation”

Start by describing the automation that was chosen for this discussion, just as a recap for the participants. Write down the name of the autonomous function, within the space provided. Ask the participants to explain the use of the autonomous function or the perceived use of the function and write it down in the space provided.

- Give the participants a dot voting Post-it and ask them to place the dot on the matrix in the position, as they had done in the sensitizing booklet. Also, get the participants to mark their initials on the dot so that it is easier for identification.
- Once this is complete ask the participants to explain the reason for their positioning of their dots on the matrix? (10 minutes)
- After the discussion, pose the question “What would be the ideal position of trust within the matrix?”, provide the participant with a different colour dot and ask them to again place it on the matrix.
- Discuss with the participants this variation of the answer and the reason for this for (10 minutes).
- The last part draw a diagonal 45 degree line crossing the x axis in the positive quadrant. This line represents the calibrated trust line. Explain the concept of calibrated trust to the participant: It is the balance between the capabilities of the autonomous function and the expectations of the user. Highlight that mistrust is when the trust level is higher than the capabilities of the system and distrust is when the trust level is lower than the capabilities of the system.
- Discuss the meaning of calibrated trust with the participant for the next 10 minutes
- Record the insights on Post-its and add it to the discussion section.

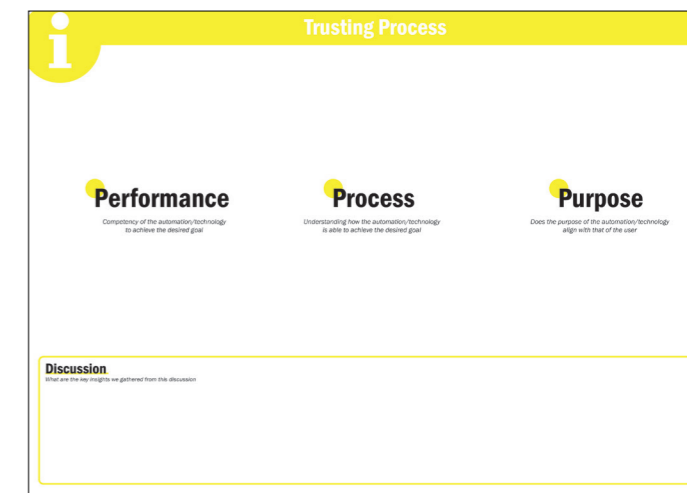


Canvas- 3 “Trust in Automation”

Canvas-4 “Trusting Process”

Introduce the participants to the process by which trust formation takes place. Performance refers to the ability of the autonomous technology to achieve the desired goal. Process refers to the understanding of how autonomous technology achieves this goal. Purpose refers to the aim of autonomous technology and how it aligns with the users needs and goals.

- Ask the participants to discuss which of the three influences their trust and in which case they damage trust.
- Use the discussion section to collect important insights
- Relate the previous canvas “Trust in automation” to explore the trust formation process further and allow the participants to provide more insight.
- 5 minutes before the ending of the time ask the participants to wrap up their thoughts by putting them on Post-its.
- At the end of this canvas take a 15 minute break, if the session starts midday then use the lunch break instead of the 15 minute break.



Canvas- 4 “Trusting Process”

Canvas-5 “The devil’s advocate”

The aim of this canvas is to look at negative situations that influence trust. This canvas is a brainstorming canvas

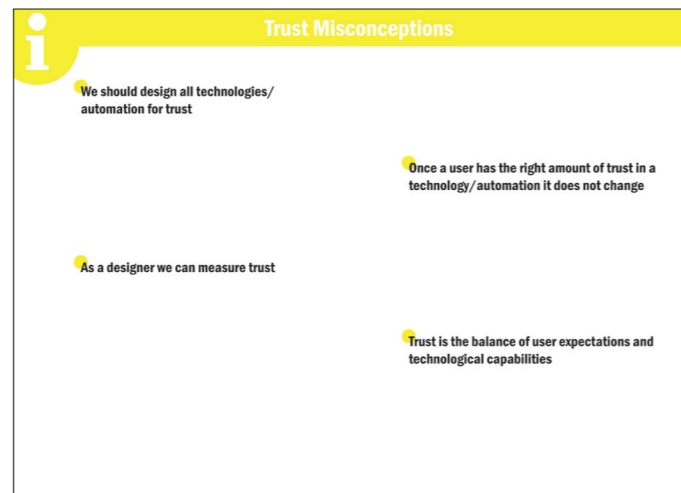
- Ask the participants to write down the in 5 minutes as many scenarios as they can think about that negatively influences the trust formation process when using the specific automation selected.
- After 5 minutes introduce one of the four cards as a point of inspiration and continue the process.

- If the frequency of ideas reduces, introduce another card and follow the process until the canvas is filled.
- Ask the participants to cluster the insights in 5 minutes.
- Once the clustering is finished ask the participants to take a minute to go over the canvas and then remove it from the table and add it to the with the other canvases.

- *“Trust is the balance of user expectation and technological capabilities”*- Yes, this goes back to the calibrated trust and the importance of balancing both of them simultaneously. At the end of each statement ask the participant to reflect on the statement for a minute and write down their main insights on Post-its.
- Once completed move onto the next canvas



Canvas- 5 “The Devils Advocate”



Canvas- 6 “Trust Misconception”

Canvas-6 “Trust Misconceptions”

This canvas is a reflection canvas with four statements. As the facilitator reads one statement at a time and asks the participants their thoughts on the statement.

- *“We should design all technologies/automation for trust”*- No, we need to design technologies for appropriate level of trust so that the user uses the technology in the indented format and context. This is important from the perspective of the design team as well because it allows for getting the right feedback from users. Thus, the aim should be to design for an appropriate level of trust a balance between trusting and challenging the technology whenever required.
- *“Once a user has the right amount of trust in a technology/ automation his trust level does not change”*- No, trust continuously changes, there is no threshold for a level of trust and depending on the context of use and the previous experiences with the technology trust level can change. Thus, trust is an ever changing process.
- *“As a designer we can measure trust”*- Yes and No, it is challenging to measure trust but there are methods that are present to provide an estimate of the level of trust. But this does not mean that they are 100% accurate and once measured will not change. As discussed in the previous statement trust is continuously changing.

Canvas-7 “Trust Goal”

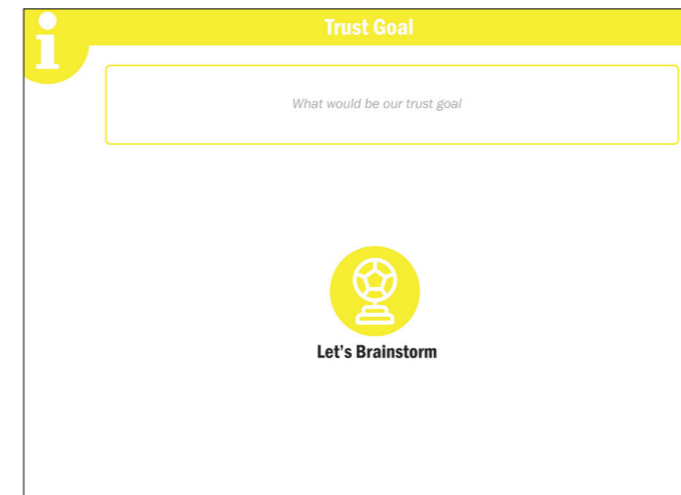
The last canvas is designed to formulate the trust goal. The following steps need to be taken for completing this canvas:

- Ask the participants to go over the previous 6 canvases as a shot recap. As the facilitator guide the participants through this by highlighting some of the key points that were discussed (5 minutes)
- Start a brainstorming session with the question “What should the trust goal be for our new autonomous vehicle?” Use the experience as a creative facilitator or scrum master to provide the participants the motivation to think out of the box and also consider the discussion that had taken place throughout the session.
- Perform this activity for 15 minutes.
- At the end of 15 minutes ask the participants to look at the options generated and cluster them.
- Following the clustering, the final step is to create one trust goal that the participants should agree upon. (10 minutes)
- Having done this use the SPARK method to make the goal more attractive:

- **Specific & Sharp:** Is the question specific towards a specific goal or one concrete objective?
- **Positive:** It should not have criteria or denials
- **Ambitious:** The question must be energizing and immersive
- **Relevant:** How relevant is it to the design of the new autonomous vehicle
- **Keep it simple:** Is it easy to remember and communicate
Once the question has been SPARKed formally bring the session to a close, thanking the participants for their participation. Ask them to use the reflection package to reflect on the session and insights that they would like to carry forward.

Post Session

- Clear out the room
- Keep the canvases safely and create digital copies
- Mail a brief overview of the session to the participants
- Inform the design and development team about the trust goal and the reasons for selecting the trust goal.



Canvas- 7 “Trust Goal”

Once the question has been SPARKed formally bring the session to a close, thanking the participants for their participation. Ask them to use the reflection package to reflect on the session and insights that they would like to carry forward.



Autonomous Function Visualization Canvas

&

User Decision Matrix

Autonomous Function Visualization Canvas

The manual illustrates how to use the Autonomous Function Visualization Canvas. The canvas has three stages which have subsequent steps

Stage 1: Identifying autonomous functions

Stage 2: Creating the function tree

Stage 3: Filling the Autonomous Function Visualization Canvas

Prerequisite information

Before starting the process of filling the visualization canvas, there is a need for some prerequisite information that will make the filling of the canvas not only easier but also faster. The first is the information with regard to the sensors present in the vehicle and the data that they will be gathering. The second is a list of autonomous capabilities that the vehicle is desired to be equipped with.

These prerequisites are for the first time the visualization canvas is used, as we move further along the product development process this information can be referred from the previous iterations of the visualization canvas.

Stage 1 : Identifying the Autonomous Function

The first stage is identifying the autonomous function that will be present in the autonomous vehicle. The process of identifying an autonomous function uses the “sense-think-act” loop to identify and segregate the various autonomous functions. This stage is performed to distinguish the various autonomous functions in a systematic manner.

- Select one of the autonomous functions that you would like to analyse.
- Start by describing the sense (What sensors are used and what information do they gather?) part for the autonomous function
- After completing the sense section move to the think section, describe what information will be generated from the data gathered in the sense section.
- The last part is the Act section, describe what would be the outcome of the information that is created in the think section? Or what type/form of actuation would be performed in response to the information generated in the think section?

Perform this step for all the autonomous functions so that there is a clear distinction between the various autonomous functions in either of the three (sense, think, act).

	Sense	Think	Act
Lane Assistance	Uses cameras and ultrasonic sensors to monitor lane markings as well as surrounding areas	Calculates the distance and location of the vehicle with respect to road markers and other road users	Displays the information to the driver to make a decision on future actions
Autosteer	Use cameras, ultrasonic sensors and radar sensors to detect lane markings and the presence of vehicles and objects	Calculates the distance and location of the vehicle with respect to road markers and other road users	Maneuvers the vehicle to keep it within the lane markings and also performs lane change when the turn signal is activated

Stage 2 : Creating the Function Tree

The function tree is a visual representation of how the various autonomous functions described in the previous stage are related to each other. The autonomous functions are arranged in three columns called Tiers.

Tier 1: The collective terminology given to the autonomous functions of the vehicle (example: Autopilot is the collective term given to the collective autonomous function of Tesla).

Tier 2 : list of all the autonomous functions

Tier 3 : Combination of autonomous functions. These are functions that are created by combining multiple single autonomous functions to function as one pseudo autonomous function.

The steps for creating a function tree are as follows:

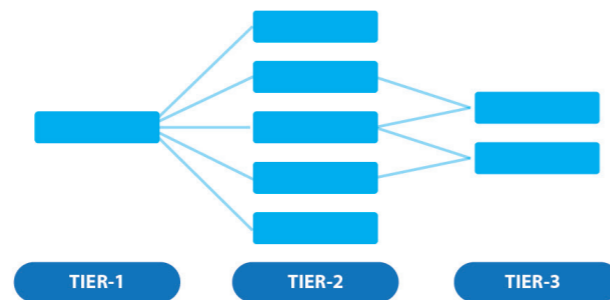
- Start by filling in the Tier 1 with the collective term used to define the autonomous function of the specific vehicle.
- Add the individual autonomous functions to the Tier 2
- Look for a combination of the various autonomous functions and add them to the Tier 3.
- Revisit the Function Tree to see if any function had been missed or placed in the incorrect tier



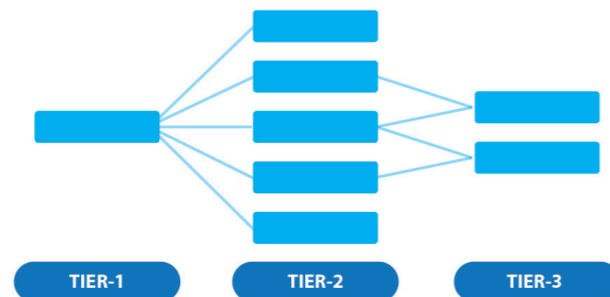
1. Create the three tiers



2. Add the functions along the different tiers



3. Move to tier 3 and add the combination functions



4. Reflect on the process

Stage 3 : Filling the Autonomous Function Visualization Canvas

The last stage is to fill the Autonomous Function Visualization Canvas. The autonomous function visualization canvas is used for each individual autonomous function in Tier 2 and Tier 3. The steps for using the autonomous function visualization canvas are as follows:

- Select one of the autonomous function for which the canvas needs to be filled
- Start filling the canvas from top to bottom, first fill in the Function Description. Describe what is the aim of the autonomous function.
- The second question is describing the autonomous functions position within the function tree
- The next part is the Technology section, there are two questions, the first is the technology (sensors/software) used within the function. The second question is related to conditions in which the sensors will not work or operate

NOTE: These conditions can vary from sensor to sensor and thus each condition with regard to specific sensors must be specified

- Fill in the context section in a similar manner as the previous question.

NOTE: There exists certain overlap between the answers of Technology and Context, it is important to segregate the contextual aspects from the condition of use. Consider the example, cameras as sensors should not be used in heavy rain, here the context is heavy rain whereas the condition of the sensor not working is reduced clarity of the lens because of water. The former answer goes into the Context part of the canvas whereas the latter goes into the Technology section of the canvas.

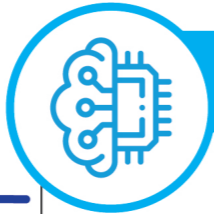
- The last section of the canvas is the user behavior, fill in what is the desired behavior of the driver when operating the function and what behavior will be detrimental to the use of the function.

NOTE: There is a possibility of interpreting the question in a manner that can cause overlap of the answer with the Context. However, the section must be filled by excluding contextual factors and focusing on the driver. Building on the previous example, the autonomous function must not be used in heavy rain as a contextual factor, this can also be rephrased as the driver should not engage the automation during heavy rain. This form of answering converts the context into user behavior and thus must be avoided so that there is not a high degree of overlap between the details filled in the three sections: Technology, Context and User.

- The last step is to reflect on the canvas with the team to check if all the information is filled.

TIPS: Here are certain tips for filling in the canvas that might be helpful for the team and future users:

- Write key words and if necessary explain in one or two sentences
- Do not abbreviate words or phrases, unless or until it is a common abbreviation that is used with the product development process
- Repeat the process of filling in the canvas a couple of times for each autonomous function will allow for creating a precise and clear canvas



Autonomous Function Visualizer

1 Start by describing the function and it's position on the function tree

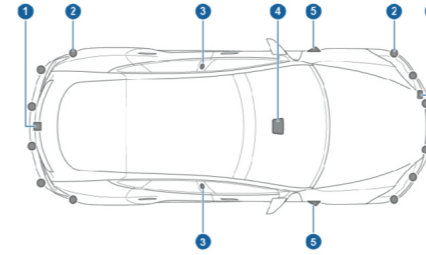
Function Name

Function Tree

Sketch the relationship of the autonomous function with other functions

Function Description

Write down what the autonomous function performs



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 behind front bumper



Light Side

Technical Working

What sensors are being used in the function



Technology



Dark Side

Technical Limitations

In which conditions will the sensors not work

3 Explain the user scenarios and under which context should the autonomous function be used.

Beneficial Use Scenario

Scenarios in which the function should be used



Context

Detrimental Use Scenarios

Scenarios in which the function should not be used

2 Explain what technology is being used. Focused on the sensors

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

4 Explain the expectations of the user

What the driver might do?

Activities that the driver might actually end up performing

User Decision Matrix

This section explains how to use the User Decision Matrix. The User Decision Matrix consists of two parts, the first is the Scenario Sheet and the second is the Decision Matrix. The Scenario Sheet is filled first and we subsequently fill in the Decision Matrix.

Scenario Sheet

The scenario sheet consists of describing the driving task that will be analysed in the decision matrix. A driving task is defined as a single maneuver a driver performs while driving (taking a turn, overtaking, stopping at a red light etc.). It is important to not consider multiple maneuvers as it will clutter the decision matrix and key insights will be lost. Consider the example of a car pulling out of a driveway followed by merging into moving traffic. In this scenario, we will consider pulling out of the driveway as one driving task and merging with moving traffic as the second driving traffic.

The layout of the scenario sheet consists of four parts: Driving task description, visualization of the scenario, external context and internal context. The process of filling in the scenarios sheet is as follows:

- Detail out the driving task that you want to analyse in the user decision matrix.
- Select the country or region in which we are creating the scenario
- Select the driving direction: Left handed or right handed
- Visualize the driving task so that it is easier to communicate the context.

NOTE: The visualization can be in the form of an image, a sketch, a 3D render or even a simple mock prototype.

NOTE: It is important to detail out the visualization so that the assumptions made in the latter stages are reduced. Thus, adding details such as road signs, objects around the road and other road users make filling the user decision matrix easier.

- The next step is to specify the “External Context”, using the visualization of the driving task as the starting point, describing the external context. The external context consists of all factors excluding the vehicle and the users within the vehicle

- **Weather & Visibility:** What is the weather and how does it affect the visibility.
- **Road Conditions:** What is the condition of the road?(Lane markings, bumps or potholes, narrow or wide roads etc.)
- **Road Signs:** Are road signs and information visible while driving?
- **Other factors:** Any further factors that might influence the driving task or must be taken into consideration.
- The next part to be filled is the “User”, this section consists information about the person driving the vehicle. The section can be considered as a brief persona of the user with key information such as age,sex, experience in driving, special needs and driving behaviour. Additional information can also be added with regard to this section depending on the relevance to the scenario sheet.
- The “Internal Context” describes the secondary activities (drinking a beverage, listening to music etc.) and passengers present in the vehicle.

NOTE: Do not neglect the importance of detailing the internal context of the vehicle as it plays an important role in the decisions the user makes.

- The last section to detail out is the “Vehicle”, the section consists of the details with regard to the vehicle being used and the autonomous capabilities it has equipped it for addressing the desired driving task.

User Decision Matrix

The user decision matrix consists is a 4*3 matrix consisting of 12 blocks and an additional 13th block which will be explained in due course. The matrix is filled from top to bottom and left to right. The layout of the matrix has been described in brief:

Along the X axis (Columns) is the process of decision making as proposed by Endsley, it consists of four stages: perceive, understand, predict/perform and adapt. These steps have been described briefly:

Perceive: The information that is received by the user in a given instance. This includes not just visual information but also auditory, haptic and any other form of information.

Understand: What can be interpreted about the situation from the perceived information?

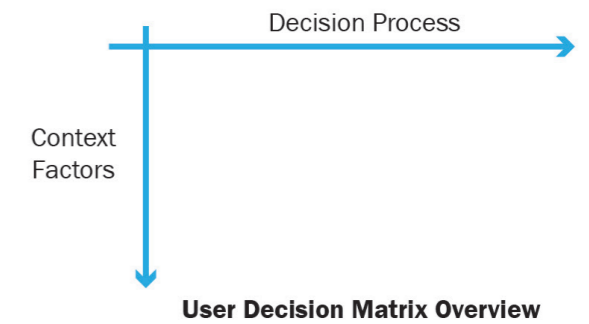
Predict/Perform: The action that will be performed based on the understanding of the situation and the driving task that needs to be performed

Adapt: What further information would the user look for and how would it influence the users actions.

The Y axis (Rows) contains the factors influencing the context: Other road users, the external context and my vehicle.

The procedure of filling in the user decision matrix is as follows:

- Start at the top left square and fill in the required information, in this case the response would be what information does the user perceive from other road users.
- Once completed move onto the square beneath the first one and fill in the required information.
- Continue this process till you finish filling in the first column.
- Move back to the top of the second column and write continue the same process and described from step 1 to step-3
- For the third column, start filling from the bottom and move up. This is done because when the user performs an action it will be in his own vehicle and the other factors will be influenced by that action.
- After completing filling the third column, move onto the last column and fill it from top to bottom repeating step-1 to step-3
- Reflect on the process and check for any missing information



User Decision Matrix Overview

User Decision Matrix				
	Perceive	Understand	Predict/Perform	Adapt
Other Road Users	1	4	9	10
Context	2	5	8	11
My Vehicle	3	6	7	12
				My Habits

Order of filling the matrix



Trust Enhancing Communication (TEC)

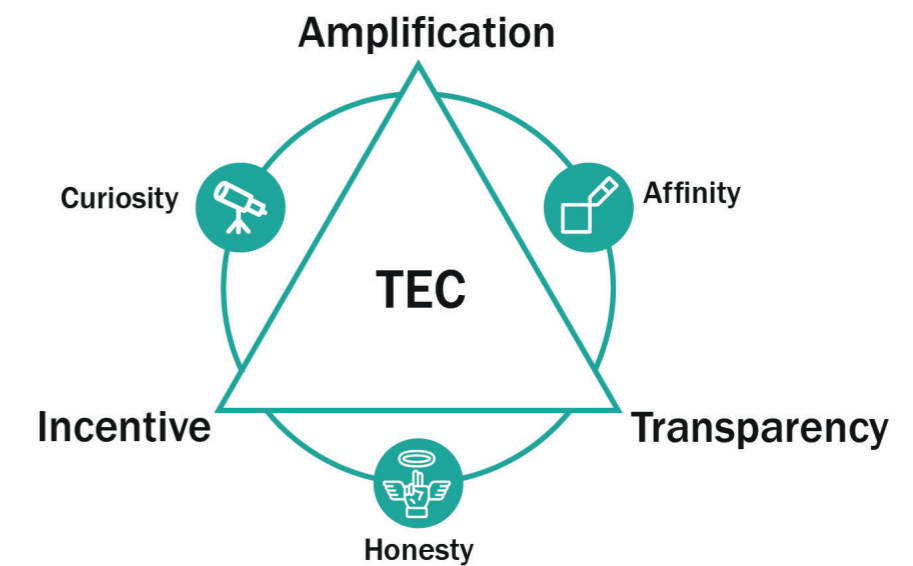
User Decision Matrix

The manual explains how to use the user decision matrix. There are three stages to the filling of the user decision matrix. The use cases will be discussed and elaborated in the latter stages of the manual. The User Decision Matrix consists of two parts, the first is the Scenario Sheet and the second is the Decision Matrix. The Scenario Sheet is filled first and we subsequently fill in the Decision Matrix.

- Choose which stakeholder is the recipient of the information
- Select the information that needs to be communicated e.g. details of an autonomous function
- Start by checking the information for the satisfying the requirements
- **Affinity:** Collect all the relevant information about the autonomous system, no information should be withheld as it is up to the recipient to create their understanding of the autonomous system.
- **Honesty:** Arrange the information in a manner that does not distortion or alter the information.
- **Curiosity:** List down the various modes of communication (boundary objects), the list must not only consist of conventional communication methods but also methods that allow for interaction with the information such as prototypes, simulations, provotypes or sensitizing sessions

NOTE: This is the one part of the TEC that require thinking out of the box, it is easy to satisfy the first two requirements

- Having completed the requirements we move on to the principles, as we are free to choose any principle to start with. The procedures are provided for all three:
- **Amplification:** Arrange the information in a manner that allows for prioritising information that focuses on calibration of trust/ creating the appropriate mental model.
- **Transparency:** Make sure to provide all the relevant information to the stakeholder. This goes hand in hand with the first principle of amplification. In amplification we organise the information, whereas transparency acts like the check to not miss out on any relevant information.
- **Incentive:** This principle can take two forms. The first is creation of barriers to prevent misinformation or incorrect interpretations. The second is incentivisation of stakeholders to interact with the information. Depending upon the stakeholder either of the two forms of incentive can be user or both can be considered simultaneously.





Welcome !

Session Rules

Jot down the session rules for the participants

Session Plan

What is the session plan and timing



Unboxing Trust

Thoughts

Visuals



Discussion

What are the key insights we gathered from this discussion



Dispositional Trust-Understanding each other

Personality

Gender

Age

Culture



Discussion

What are the key insights we gathered from this discussion



Trust in Automation



Name:

Purpose:

I understand the capabilities of the automation/technology

I don't trust it at all

I trust it completely

I do not understand the capabilities of the automation/technology

Discussion

What are the key insights we gathered from this discussion



Trusting Process

Performance

*Competency of the automation/technology
to achieve the desired goal*

Process

*Understanding how the automation/technology
is able to achieve the desired goal*

Purpose

*Does the purpose of the automation/technology
align with that of the user*

Discussion

What are the key insights we gathered from this discussion



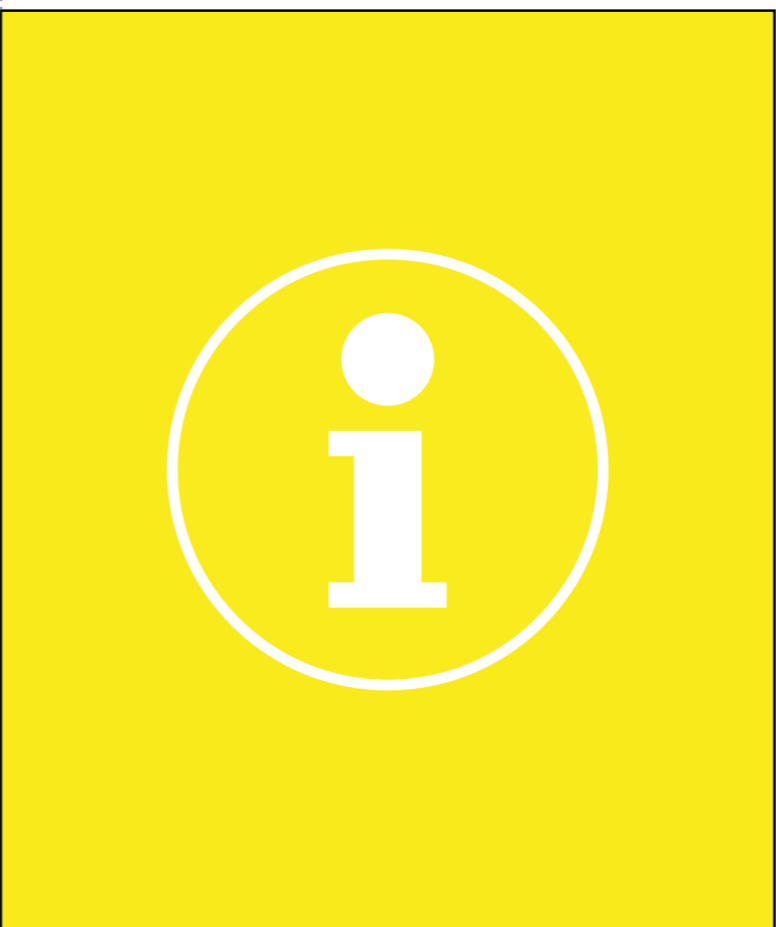
The Devils Advocate



I do not trust you!!

Front Face of Card

Back Face of Card




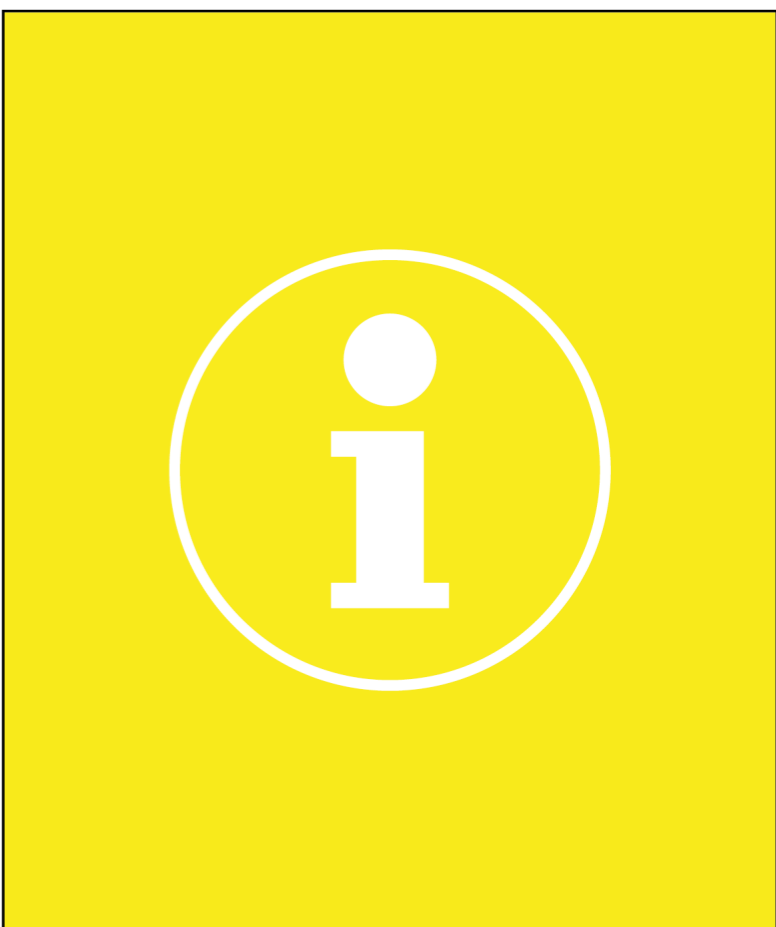
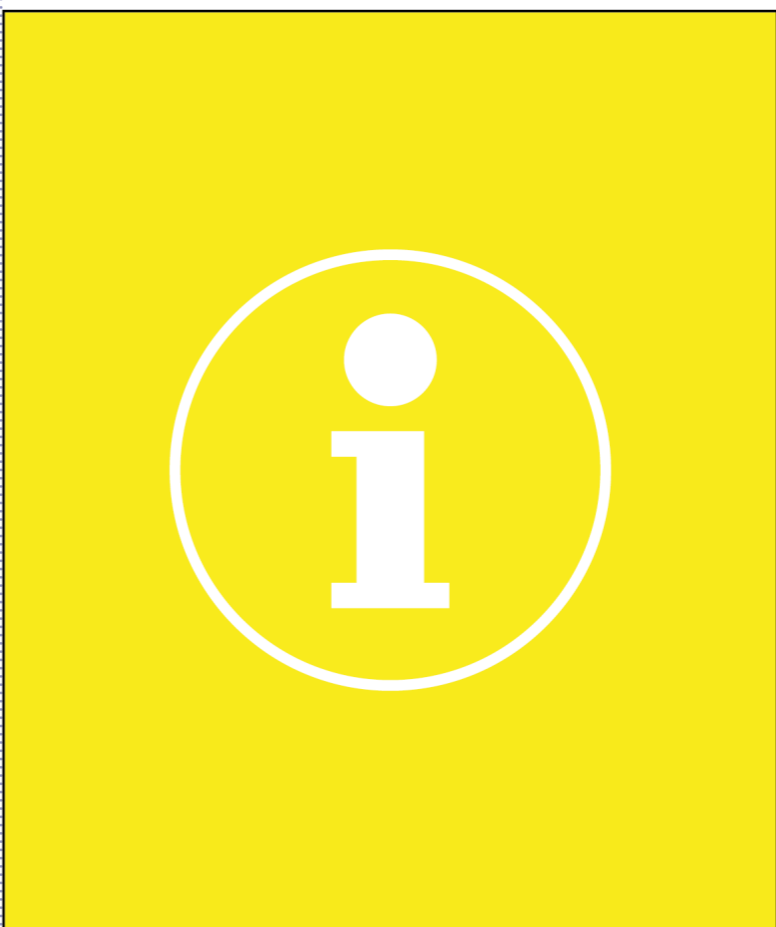
Context Chaos

What happens when the context of use itself becomes a problem? Consider how the external environment can change in the way we intend to use automation.




Ethical Dilemma

What situations might arise when using the automation that might compromise your ethics? Situations that challenge your moral being and beliefs

Personal Demons

What happens when my personal bad habits are the cause of a bad scenario? Imagine your personal deamons (e.g. ego) coming to the fore front



Technology Hell

What challenge could the technology create that causes you as a user/developer/designer to feel helpless?






Trust Misconceptions

**We should design all technologies/
automation for trust**

**Once a user has the right amount of trust in a
technology/automation it does not change**

As a designer we can measure trust

**Trust is the balance of user expectations and
technological capabilities**

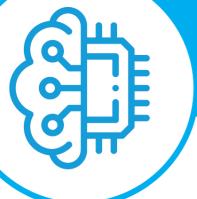


Trust Goal

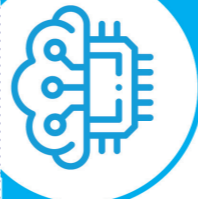
What would be our trust goal



Let's Brainstorm



Autonomous Function Visualizer



Scenario Sheet

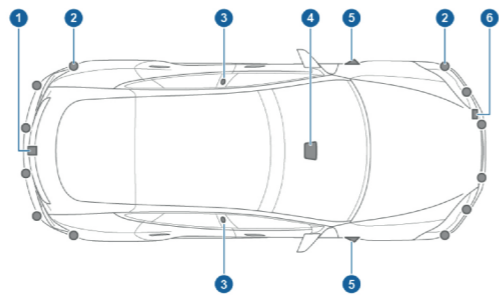
Function Name

Function Tree

Sketch the relationship of the autonomous function with other functions

Function Description

Write down what the autonomous function performs



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 behind front 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

What the driver might do?

Activities that the driver might actually end up performing

Driving Task

Describe the driving task that will be analysed in the canvas

Driving Direction

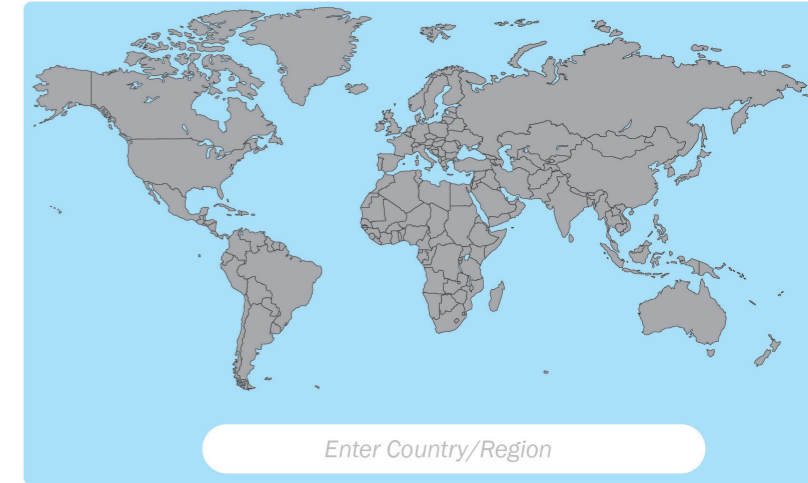
Is the vehicle left hand drive or right hand drive



Left Hand Driving



Right Hand Driving



Visualize the driving task

Describe the driving task that will be analysed in the canvas

The External Context

Weather, visibility	Road Conditions	Road Signs	Other Factors
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The User

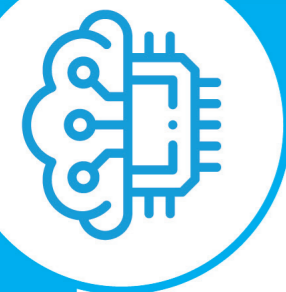
Describe the user of the car (Age, sex, experience in driving, special needs, etc.)

The Internal Context

Describe any activities that might be occur within the car (Drinking a beverage)

The Vehicle

Whats are the autonomous capabilities of the vehicle, in the context of the current task?



User Decision Matrix

Perceive

What information can I gather

Understand

What can I infer from the information

Predict/Perform

What action can I perform 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

What information do I look for from other road users.
Example: vehicle indicators

What can I understand about other road users from the gathered information
Example: The car will take a right turn

What is expected from the other road users when you are performing the desired task

What information do I look for other drivers when performing the task and how do I react?

Context

Consider the external environment, including road conditions, weather and sign posts

What information do I look for from the surroundings.
Example: Road signs

What can I understand about the road and surroundings from the gathered information
Example: Speed Limit

How will the environment/surrounding change due to my actions
Example: Automatic gates will open when vehicle approaches

What information do I look for when performing the task from the surroundings and how do I react?

My Vehicle

Consider the internal context of the vehicle

What information do I check for within my own vehicle and with the passengers
Example: Speed, Gear

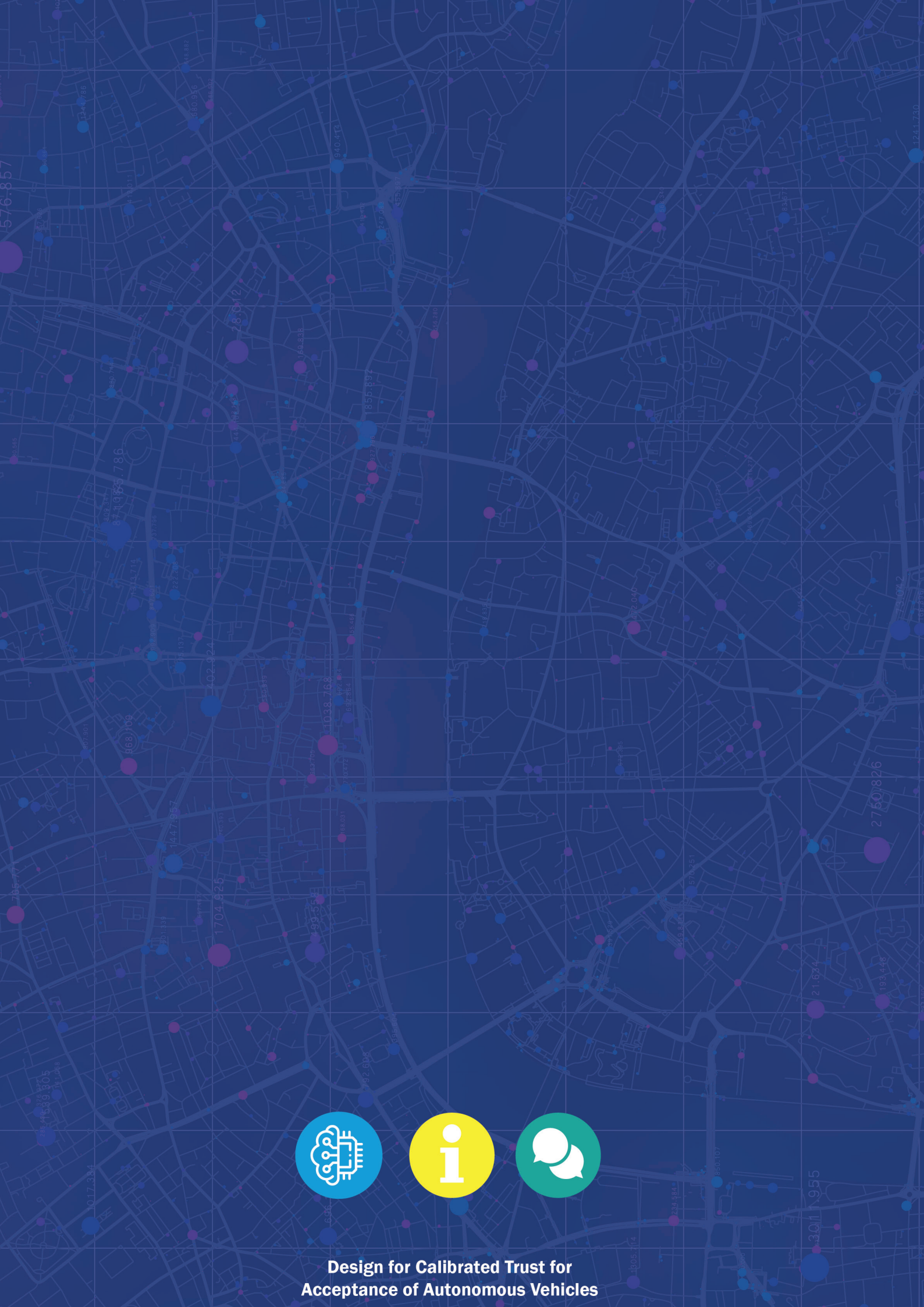
What can I infer from my own vehicles information and passenger interaction
Example: Need to change gears for overtaking

What are the set of actions I will take to complete the task:
Example: change gears, change lanes

What information do I look for withing my vehicle and passangers while performing the task and how do I react?

My Habits

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



**Design for Calibrated Trust for
Acceptance of Autonomous Vehicles**