EXPLORING SHARED UNDERSTANDINGS OF FUTURE AI SYSTEMS THROUGH DESIGN

Masters Thesis
Design for Interaction

Delft University of Technology
Faculty of Industrial Design Engineering

August 2023

Shruthi Venkat

Exploring shared understandings of future AI systems through design

Master Thesis
Design for Interaction
Faculty of Industrial Design Engineering
Delft University of Technology

Shruthi Venkat
Student Number- 5234492

Graduation Committee
Chair
Dr. Roy Bendor
Faculty of Industrial Design Engineering
Department of Human-Centered Design

Mentor
Iohanna Nicenboim
Faculty of Industrial Design Engineering
Department of Human-Centered Design

In collaboration with DCODE Network and FreedomLab

Company Mentor
Arief Ernst Hühn
Head of FreedomLab

August 2023

FOREWORD

I discovered design in high school and little was I aware it would become such a big part of my life. As someone who studied industrial design, my goal used to be to build products to solve problems. Quite early into this, I realized I only enjoyed some parts of this process. I enjoyed making things tangible and working with people. So one of my main goals while applying to TU Delft was to find my niche in design, and focus on what I enjoy doing. During my time here I was surrounded by such inspiring and exciting work. If I could use one word to summarise my journey it would be 'transformational'. This graduation project is a culmination of my discoveries both personal and professional. While the future remains wide open and uncertain, I am content and happy to wrap this project up. Before delving into the project I want to take a moment to thank everyone that helped along the way.

Firstly I would like to thank my supervisors. All three of them were always responsive to the multiple update documents and meeting requests I sent them. Roy, it's been a pleasure to learn from you. It has made me a better designer and critical thinker for sure. Iohanna, I will forever be thankful for familiarizing me with this space of AI and more than human design. Arief and everyone at Freedom Lab who took a chance on me, let me pitch the project, and gave me the resources and opportunity to explore it. I want to thank all the participants that gave me time out of their busy schedules, hope you had just as much fun as I did. I am thankful to the multiple researchers at the faculty that I reached out to for chats both before and during the project. I am grateful for the support of all my mentors who helped me get here.

I would like to thank my friends in Delft who went on this journey beside me and the ones I had to be in touch with through text, calls, and emails. You kept me sane. To Vivek, thank you for the constant support and encouragement. To Amma and Appa, I owe it all to you. Thank you for being my source of strength and comfort. Thank you to everyone that heard me talk about this project endlessly for the last six-ish months. Hope you enjoy reading it!

Shruthi

SUMMARY

Artificial Intelligence (AI) systems are becoming a more integral part of our daily life. In this regard, understanding how these AI models work is crucial for the practical deployment of these systems. This is vital to not only those building the models but also to those affected by them. This graduation project focuses on finding ways to build shared understandings as a means to comprehend future AI systems. The three main aspects of the project are AI systems, shared understandings as an approach, and the methods to do so. Based on the literature study on the Explainability of AI, two main gaps were identified: the stakeholder's backgrounds are not accounted for during the design of systems and there is a need for a more holistic approach that considers social and technical implications. To address these gaps, the project aimed to move from explainability to building situated understandings. Criteria for shared understandings were defined based on literature to guide the project. The main design approaches chosen were speculative design and FreedomLab's Stack. The focus was on speculative design, providing immersion and context, and the Stack facilitating the breakdown, and analysis of an AI system in layers.

A case study relating residential shared mobility was looked into as the future AI system. The stakeholders included a real estate company, a mobility provider, and behavioral researchers to name a few. The goal was to bring tensions and challenges within the system to the surface and try to establish a shared understanding among the stakeholders. Seven participants took part in the project. They were interviewed to understand their backgrounds and views on the future system. Insights from the interviews revealed different interpretations of shared mobility, varying stakeholder priorities, and challenges related to technology implementation.

Four speculative artifacts were designed to surface tensions in the system. These artifacts represented future objects related to shared mobility. The stakeholder sessions were conducted in two phases, with the first phase involving individual interactions and the second phase focused on group discussions. The sessions aimed to sensitize participants to the case study, encourage their active involvement and gather their perspectives and reflections.

The evaluation of the project was conducted through discussions during and analysis after the sessions. Overall, the fostering of shared understandings of future AI systems was sought by the project through the consideration of stakeholder backgrounds, the employment of design methodologies, and the addressing of social and technical implications. The methodologies and sessions of the project successfully facilitated discussions and reflections among the participants, contributing to a deeper understanding of the shared mobility system and its future possibilities. The project concludes with insights on using shared understandings as an approach to explainability.

TABLE OF CONTENTS

CHAPTER 1
Introduction

This chapter introduces the initial assignment of the project. Firstly, the project space is introduced, with the problem definition and assignment.In addition, it includes a personal motivation that drove the project in the first place. To conclude, it details the project approach and the structure of the report.

1.1 Initial Assignment

- Introduction
- Problem Definition
- Assignment
- Motivation

1.2 Freedom Lab

1.3 Project Approach

1.1 Initial Assignment

Introduction

Artificial intelligence is a big part of our everyday life. AI is used in decision-making processes both in everyday scenarios as well as in crucial domains. For example, studies have shown that AI can have harmful consequences such as perpetuating or even amplifying existing human biases (Aizenberg & Van Den Hoven, 2020). Furthermore, in most cases, there are many parties (or multiple stakeholders) involved and affected by these AI-driven systems. For example, AI-assisted policymaking involves policymakers, citizens, and regulatory bodies (Dignum,2020). These stakeholders have varying levels of autonomy within the system. But not all these parties have an idea of how the system fully functions or what implications it has. If the AI system would have to be explained to all the stakeholders, it would have to be through different means. There's not one single explanation for AI that could work for everyone.

Explainable AI (XAI) has been an attempt to enable human users to understand, manage and therefore trust AI decisions (Turek, 2020). From a policy standpoint, the 'Right to Explanation' has been added to the GDPR in an attempt to improve clarity and inclusiveness. However, having this right is just the first step in making this technology legible to the variety of people affected by it. As one of the approaches for my project, I am looking at shared understandings which suggests a more situated and relational approach (Nicenboim, 2022).

This approach is relevant and holds significance as it delves into not just delineating the actions and limitations of AI, but also its impacts on everyday existence. It is important to consider the different stakeholders and their varied entanglements with the AI systems. The goal would be to design for the possibility of multiple understandings based on the user's background, technical knowledge, and expertise.

Problem Definiton

The explainability of AI depends on situated factors, hence my goal is to create a process through which shared understandings of AI can emerge among different stakeholders. FreedomLab uses the Stack as a tool to understand, analyze and find opportunities in digital systems. It offers a shared language and mental model when discussing digital systems in multi-stakeholders contexts. I will use this tool as my starting point, and find ways to adapt it to explore some of the gaps in Explainable AI. Because some of the consequences of AI involve a high degree of uncertainty and take place in the future, I will make use of design fiction and speculations to engage with stakeholders to develop shared understandings of the AI system.

My ultimate goal is to use artifacts to connect stakeholders with the technology and build narratives relating to what stakeholders already know. This can help speculate and reflect on possible opportunities for the field of XAI in the future.

Assignment

My project will take place in three stages. First, I will review the existing literature on explainable AI, its limitations, and opportunities. I will also analyze and critically look at FreedomLab's version of the Stack from a design perspective. Second, I will use the Stack as a starting point to build a tool to express some of the chosen gaps and limitations in XAI. The goal will be to create future scenarios and rethink how the Stack can be used as a participatory tool to explain certain AI systems. During the third stage, I will conduct sessions with stakeholders using the Speculative artifacts.

The project will help various stakeholders understand their relation to AI systems through Research through design(RtD) methods. For example, one such method I plan to use is the Open prototyping approach which has a framework to imagine, navigate, and shape collaborative research and co-creation projects (Hemment et al, 2020). I believe using Speculative methods within an RtD process is an appropriate approach to this challenge because it will open up the context of the future through prototypes and other such artifacts. It gives me the freedom to experiment and find interactive ways to explain complex systems. The current version of the Stack used by FreedomLab is a tool to help clients break down complex digital systems. Through this project, I will find ways to adapt this tool into a participatory tool that can be used with AI-based systems as well. It will help FreedomLab's attempt to make the Stack workshops more interactive and hands-on.

1.2 Freedom Lab

This project was done in collaboration with FreedomLab, a think tank that helps public and private companies navigate future scenarios through transdisciplinary research and Speculative methods. The company helps organizations develop transformative opportunities for their business and society. FreedomLab is currently using a model based on Bratton's notion of "the Stack" (Bratton, 2016) as a tool to understand the anatomy of interrelated components of complex digital systems. The tool was developed by FreedomLab and has been used in sessions with Dutch Ministries and other such organizations to explain digitization in general. As a part of my assignment, I will assess the potential of using this tool to explain complex AI systems.

1.3 Project Approach

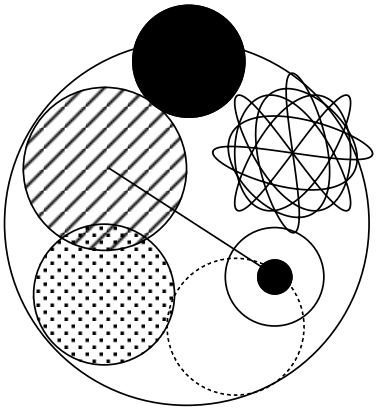
The report is divided into three sections:

Phase 1: Defining
This phase consists of defining and understanding the project space better. There are three main parts to it. Firstly, the background research into the Explainability of AI and the approaches to tackle it. The second part was to study possible methodologies such as Speculative design and the Stack to see how they could be used within the project. The final part is defining the residential shared mobility case study which is the future AI system that was explored in the project.

Phase 2: Executing
The theoretical background that was defined in the previous phase is applied in this phase. Interviews were conducted with the stakeholder participants, followed by design ideation based on their responses. The final design artifacts were presented in two multi-stakeholder sessions. This phase closes with the results from these two sessions.

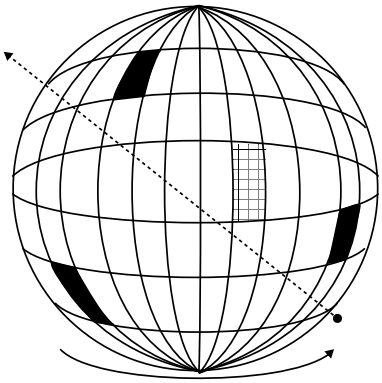
Phase 3: Reflecting
The final phase of the project involved mapping insights from participant interactions. This also included reflecting on the process and generalizing findings to contribute to research and practice.

01.Defining



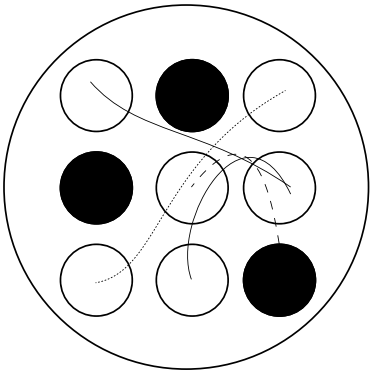
Ch 2. Explainable AI
Ch 3. The Stack
Ch 4. Speculative Design
Ch 5. Design Process
Ch 6. Case Study- Residential Shared Mobility

02.Executing



Ch 7. Field Research- Interviews
Ch 8. Design Proposal
Ch 9. Sessions with Stakeholders

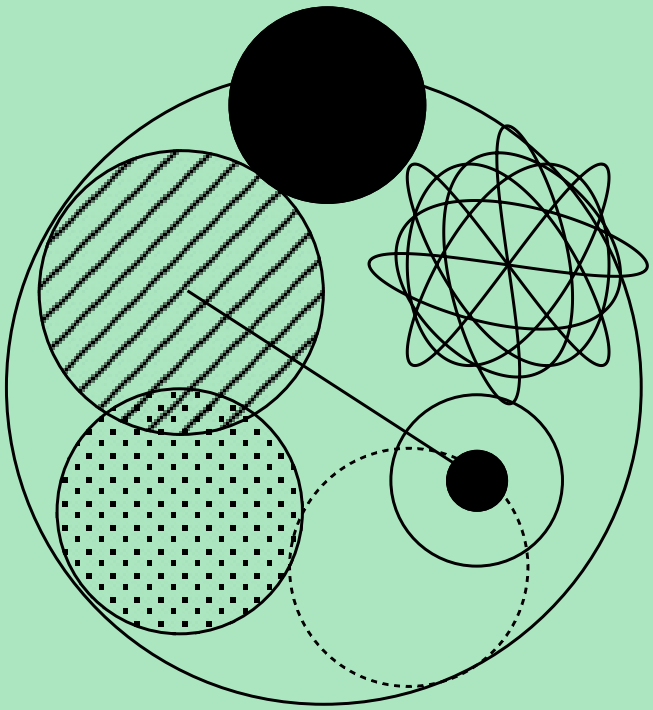
03.Reflecting

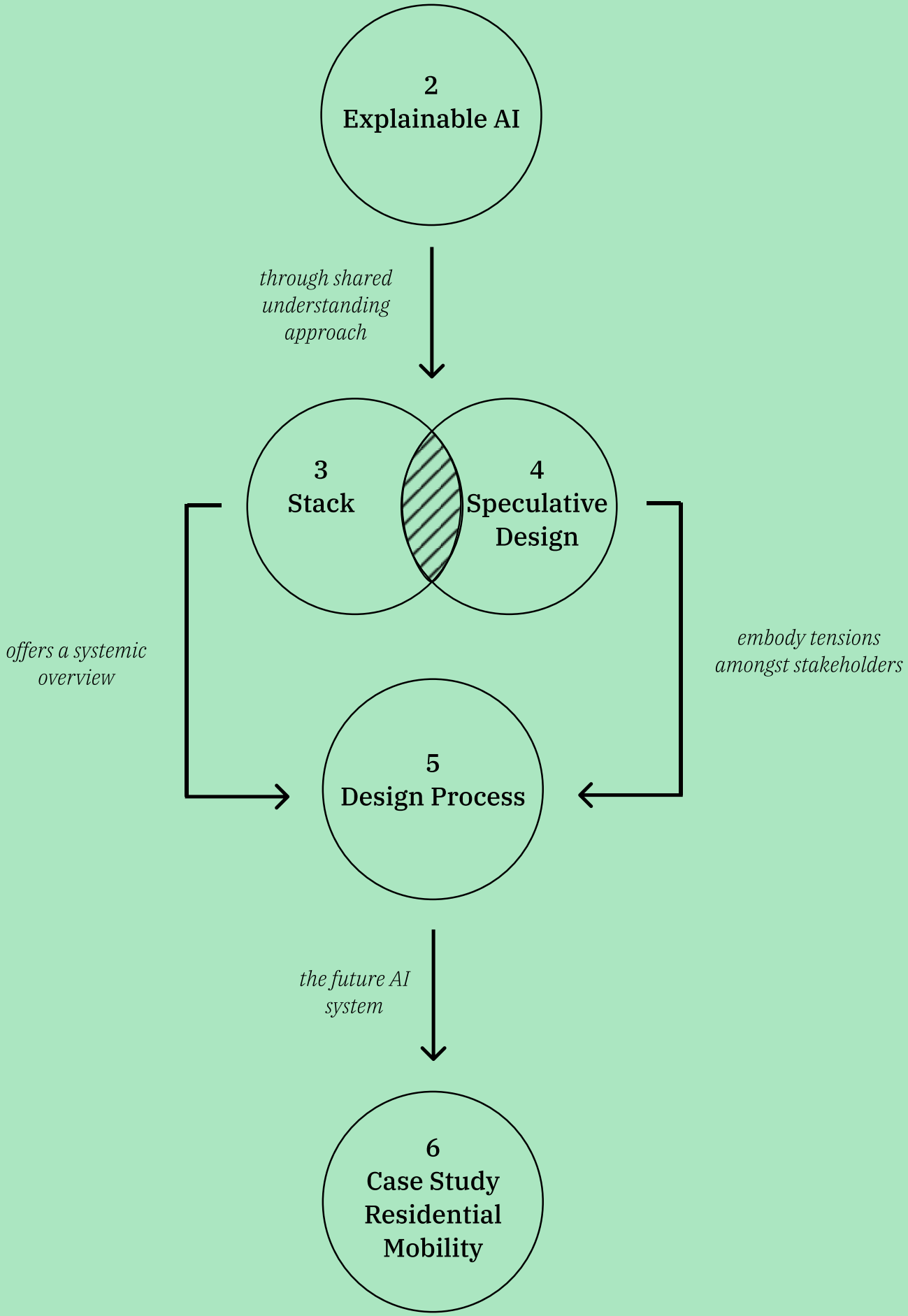


Ch 10. Insights
Ch 11. Conclusion of the Project

PHASE 1
Defining

This part contains five chapters. It starts with an introduction about the Explainability of AI(XAI). Moves towards looking at shared understandings as an approach to XAI. The final part is a study into tools to develop shared understandings. For this project, the Stack model from FreedomLab and Speculative Design were chosen. The phase ends with detailing the case study: residential shared mobility that is the future AI system in this project.




2
Explainable AI
through shared understanding approach
3
Stack
4
Speculative Design
offers a systemic overview
embody tensions amongst stakeholders
5
Design Process
the future AI system
6
Case Study
Residential
Mobility

CHAPTER 2

Explainable AI

This chapter contains the theoretical foundation of the project. It consists of the literature study on Explainable AI(XAI). It defines the need for XAI and its limitations in its current form. Shared understandings as an approach to XAI are defined. The chapter ends with the criteria for shared understanding that was built based on the literature study.

2.1 Motivations and goals
- The need for Explainability
- The target audience for XAI

2.2 Terms and definitions

2.3 Approaches to Explainability

2.4 Gaps and Limitations

2.5 Shared understandings

2.6 Criteria for Shared understandings
- Functionality
- Situatedness
- Relatability
- Expectations

2.1 Motivations and Goals

As AI has become an integral part of daily life, it is important that people who are affected by it understand the decisions that those systems automate and their consequences. In this context, The Guidelines for Human AI Interaction (Amershi et al., 2019) emphasizes transparency by "making clear what the system can do" to help users understand the capabilities and limitations of AI systems. Transparent communication about the AI system's functionalities empowers users to understand the automated decisions it makes and the potential consequences of those decisions. By providing clear and comprehensive explanations, users can make informed choices, manage expectations, and hold AI accountable for its actions. This transparent approach fosters a more constructive and equitable partnership between humans and AI, promoting the ethical development and deployment of AI technologies that align with human values and preferences.

The Need for Explainability

To understand the need for explainability and approaches a literature review was carried out. The goal was to ensure a breadth and variety of sources and viewpoints. The key filtering criteria for the material were relevance to the theme of explainability and new possible definitions or approaches to it. Fig 1 shows some relevant papers on the Explainability of AI, which was used as a starting point to find more research material. Based on this literature review, a few takeaways were:

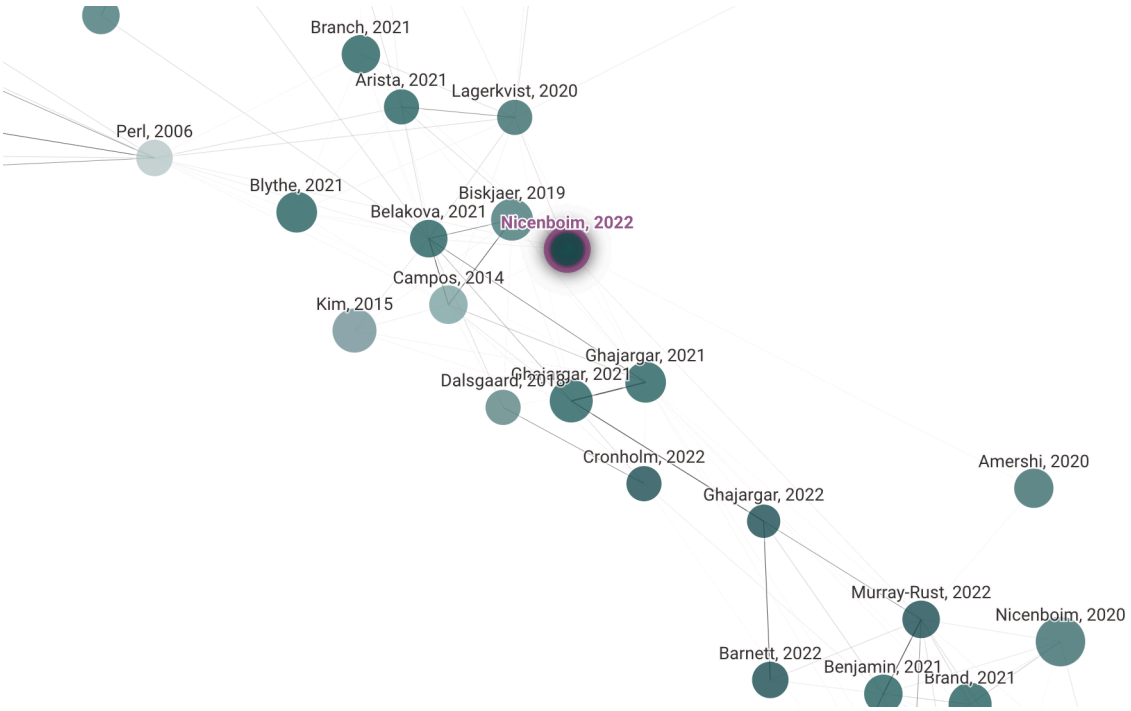


Figure 1. Connected Papers overview of relevant papers (from www.connectedpapers.com/)

1

Explainability catering to technical needs

Explainability stems from supporting human-AI relationships. These can be useful to understand and trust the current system but also manage upcoming relationships.

2

Socio-technical approach

One of the main gaps in the space is the need to move from just understanding the explanation to a socio-technical approach (Gerlings et al., 2021; Kerr et al., 2020; Nicenboim, 2022). The AI systems and models need to be looked at with contextual influences and actors as opposed to the system in isolation. This is a step towards ensuring all stakeholders and users are aware of the implications of the system. People's definitions of the system are highly affected by the social groups they are a part of. Instead of being able to draw from their own experiences, they usually tend to be affected by social expectations (Miller, 2019).

3

User expectations and social influences

The stakeholders involved with and affected by the process are not usually aware of the moral significance and unintended consequences. What the general public anticipates from AI and what is possible with the technology at this time differs significantly. An abstract concept like AI is typically difficult for users to conceptualize (Kerr et al., 2020). There is a need for building explanations that users can understand, based on their level of dependency on the model.

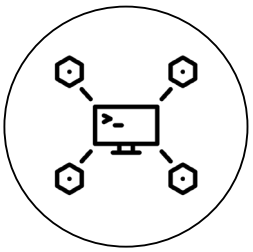
4

This refers to considering the individual contexts of the users and stakeholders involved. Each stakeholder has different needs for explanations based on their backgrounds. It is also well known that this is not a one solution fits all problem; the context, background, and knowledge of the stakeholders need to be taken into consideration as well (Gerlings et al., 2021, p 1286). The shift needs to move towards a more user-centric approach, where the people affected by these technologies can express what sort of explanations they need.

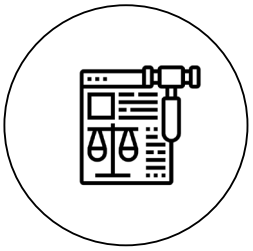
Explainability paves the way for more ethical practices, accountability, and transparency. This is often termed 'Responsible AI'. (Arrieta et al., 2019) define responsible AI as a method of large-scale implementations of AI methods with fairness, model explainability, and liability. More than a rundown of the internal operations of the systems, what users need is a way to understand its impacts and effects. There needs to be space for users to be able to question the data, the algorithm, and the humans participating in the process. In a study by (Kerr et al., 2020), the main concerns about not understanding AI systems were found to be safety, privacy, and security.

The target audience for XAI

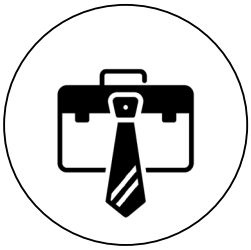
One of the main gaps with XAI has been a lack of accounting for the background of people interacting or being impacted by the AI systems. Most failed AI-assisted public programs do so at least in part because the community and those affected or neglected by the program are not involved in the decision-making process (Andes.S, 2020). Hence, it is important to define who these people or stakeholders are. While these will differ from specific use cases and systems, this is a general overview of possible actors in an AI system.



Who?
Domain experts/users of the model
Why?
Trust the model itself, gain scientific knowledge

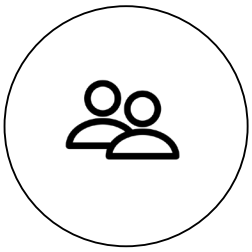


Who?
Regulatory entities/agencies
Why?
Certify model compliance with legislation in force



Who?
Managers and executive board members
Why?
Assess regulatory compliance, understand corporate AI applications

Who?
Data scientists, developers, product owners
Why?
Ensure/improve product efficiency, research new functionalities



Who?
Users affected by model decisions
Why?
Understand their situation, verify fair decisions

Figure2. Target audience for XAI (Arrieta et al., 2019)

2.2 Terms and Definitions

The term Explainable AI is often used in a world where AI has become an integral part of daily life. Even with a lot of work happening toward making AI explainable and understandable, there is a lack of consensus on a concrete definition for the term. XAI can be defined as methods and techniques seeking to provide insights into the outcome of a machine learning model and present it in qualitative understandable terms or visualizations to the stakeholders of the model (Gerlings et al., 2021, p.1284).

There are a few commonly used terms concerning explainability. This table, drawn from Arrieta et al. (2019), gives a good overview of the similarities and minor differences between them.

A black box often refers to a device, system, or process whose internal workings are not visible or understandable to an outsider. AI systems are often considered to have black boxes because the input and output are clear but the system itself is unknown to an observer or user. Explainability is sometimes defined as the opposite of a black box – a completely transparent and understandable system (Arrieta et al., 2019). XAI is directly influenced by how simple or complex the actual model is. So transparency of a model has multiple aspects to it. It can be the overall model, the algorithm itself, or even the data being fed into the system.

Term	Definition
Understandability	is the characteristic of a model to make a human understand its functions: how does the model work
Comprehensibility	is the ability of a learning algorithm to represent its learned knowledge in a human-understandable fashion
Interpretability	is the ability to explain or provide meaning in understandable terms
Explainability	the notion of explanation as an interface between humans and decisions makers
Transparency	the model is considered transparent if it is understandable by itself

Figure3. Table of definitions

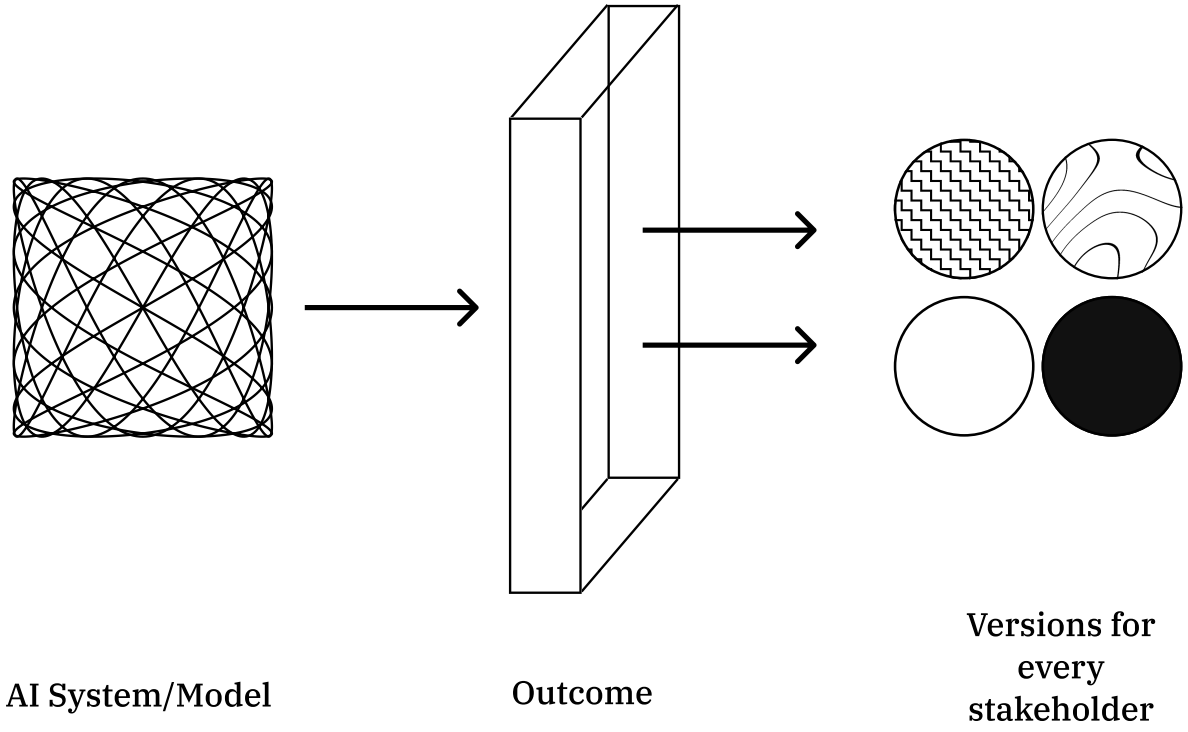


Figure 4. Visualisation of a definition of Explainability of AI

Referring back to figure 4, this project looks at XAI from an understandability approach. Understanding AI and technology opens up a door to a relational approach to responsibility by recognizing the intricate web of stakeholders involved. In this view, responsibility extends beyond just the designers and developers of the system by the organizations enabling them, the policy makers regulating them and the broader society affected by it. This relational approach highlights the need for collaborative efforts and shared accountability of these systems. A complete understanding of the whole system is not possible and not the goal either. The strategy is to look at a ” “kind of outward transparency as we are looking at the relationship between AI and the system of things external to it, how and why the system was developed, transparency and values, and how much the user knows” (Walmsley, 2021).

2.3 Approaches to Explainability

Scholars in HCI have proposed multiple approaches to XAI. One of these approaches is Experiential AI. Experiential AI can be defined as creating experiential means to challenge the developing understanding of AI systems- their operations, limitations, and implications (Hemment et al., 2019). Another approach is Graspable AI, which can be defined as an approach to XAI through tangible and embodied interaction perspectives. The goal is to go beyond understanding and perceptions and look at cohesiveness and accessibility as well (Ghajargar et al., 2021). The third approach considered was moving from explanations to shared understandings. This could possibly help bridge the gaps of current work in XAI which overlooks possible biases and looks at these systems in isolation. (Nicenboim, 2022).

Out of these three, this project focuses mainly on the shared understandings approach, while still gaining inspiration from the other two approaches . Shared understandings can be characterized as a way to build situated and dynamic understandings. The idea of shared understandings draws upon the work done in other areas such as feminist theory, technology studies, and philosophy. (Nicenboim, 2022).

2.4 Gaps and Limitations

The obvious limitation is that transparency is not going to be a one size fits all solution. It's unlikely that there is one explanation that all the public can understand together. The ideal approach is to redefine and help users understand the limits of AI in complex social contexts and thereby bridge the gap between societal expectations and real-world AI practice (Kerr et al., 2020). Ananny and Crawford (2018) also mention that transparency is only one step in this direction. Transparency doesn't necessarily build trust as different stakeholders trust differently. It is only one aspect of XAI to make the systems transparent. Building trust and confidence in the systems would be the next step in the process. To summarize the findings from literature, there are some clear limitations to the current approach to XAI.

1. Different stakeholder needs are unaccounted for. People that are a part of or are affected by these AI systems have different cognitive needs. For example, a developer and a policymaker don't need to have the same level of understanding of the code for an AI security camera. The explanations need to be catered to the person at the receiving end. Their backgrounds and varying levels of expertise also need to be taken into consideration.
2. There needs to be a more holistic approach to explaining AI systems. Explanations that consider the social and technical implications of the functioning of the system. The understanding should be happening in situations and not in isolation. Only then is it possible to account for all the other interactors in the system (Nicenboim, 2022).

2.5 Shared understandings

The two main gaps that were recognized in the literature review are: different stakeholder needs and the lack of socio-technical implications. To address them, a few different approaches were considered. This project explores the idea of making abstract concepts like AI systems tangible and experiential. The goal of this approach is to use participatory methods to help stakeholders develop an understanding of the limits and implications of particular AI systems. This can help stakeholders understand the implications and effects of the system they are interacting with. Not all stakeholders have the same level of understanding or expertise, the shared understandings approach can help people connect with the system in their own individual way. It can help them contextualize it in their own lives. This is beneficial in the move towards a more situated and multidimensional approach to this complex and context-dependent topic (Schwaninger et al., 2021). To approach shared understandings more practically within this project, a criteria was defined, based on the literature review. It was a framework for the project in order to develop shared understandings. It was a good measure to check if the methodology helped arrive at shared understandings among the stakeholder group.

2.6 Criteria for Shared Understandings

These criteria were created from the literature study. Ten papers relating to shared understandings, shared meanings, and explainability of AI were shortlisted. The takeaways relating to building shared understandings from these papers are grouped intp four main clusters which forms the criteria. This criteria was a benchmark for defining the later stages of the project. The four main criteria that emerged were

→ Functionality
→ Situatedness
→ Relatability
→ Expectations

Functionality

This is the first level of understanding be it shared or individual. It looks at the capabilities and performance of a system. This will help identify shared assumptions within the group. In this criterion, functionality refers to looking at the functions of the system but also its limitations and failures. By exposing limitations and failures, valuable insights are gained into the system's behavior and potential risks. Exposing limitations and failures is a pathway to understanding (Nicenboim, 2022). This process of uncovering shortcomings acts as a pathway to enhance transparency, trust, and responsible development of future systems. This will help stakeholders gain a more nuanced perspective, recognize the boundaries of the system, and make informed choices about their usage.

Situatedness

This criterion refers to the ability to situate the system in a larger context. To consider some possible contextual and situated factors such as domain, sector, area, and time. Knowledge, as described by Haraway (Haraway, 1988), is always situated and influenced by the perspectives of positioned actors. Stakeholders need to be able to understand their positionality and the infrastructures behind AI to grasp its complexities. This also helps reflect on the different dimensions of the system like the larger infrastructure they are embedded in. This criterion is also important because situating the system is key in anticipating all the contextual influences that will affect the approach of explainability toward different stakeholders (Langer et al., 2021).

Relatability

Relatability refers to different stakeholders being able to ground the systems in their own lives and realities. The stakeholders should have the ability to relate the system to their surroundings. This helps stakeholders better understand and engage with the system, leading to increased trust and confidence. Values like trust are important in stakeholders' interactions with these future systems. This also is directly influenced by and connected to how people relate to the system (Schwaninger et al., 2021). The level of reliability influences stakeholders' perception and adoption of AI systems, ultimately driving positive societal outcomes.

Expectations

Expectations play a pivotal role in developing a deeper understanding of future AI systems. Emphasizing shared expectations in the development of future AI systems fosters a more inclusive and participatory approach. Understanding stakeholders' expectations can provide valuable insights to guide researchers and innovators in addressing societal needs, ethical considerations, and potential risks. It can influence future research and innovation activities. So having this as a criterion is another means to develop understanding. If participants can set expectations for future systems, it's an indication that they are aware of the intricacies of emerging technology. Expectations can be defined as statements that say something about the future (Kerr, Barry, & Kelleher, 2020). The active involvement of stakeholders in shaping the future through their expectations aligns the technology more closely with the collective aspirations and values of society.

CHAPTER 3

The Stack

This chapter focuses on the Stack model used by Freedom Lab. It starts with an introduction to how FreedomLab uses it and compares it to other Stack-based models as well. The chapter concludes with ideas of how the Stack could be used to discuss future AI systems.

3.1 Introduction to the Stack
3.2 FreedomLab's version of the stack
3.3 Comparision to other stack based models
3.4 Using the stack to explain AI systems

3.1 Introduction to the Stack

FreedomLab uses a tool, the Stack, to understand, analyze and convey the anatomy of digital systems. The model is inspired by the work of Benjamin Bratton. It is proposed as a model for new geopolitical architecture and a technological apparatus. (Bratton, 2016). Bratton explores six layers: Earth, Cloud, City, Address, Interface, and the User. It takes into account the social and human factors of systems. It draws inspiration from the mental model for network technologies of protocol Stacks. This perspective gives a holistic view of systemic infrastructures.

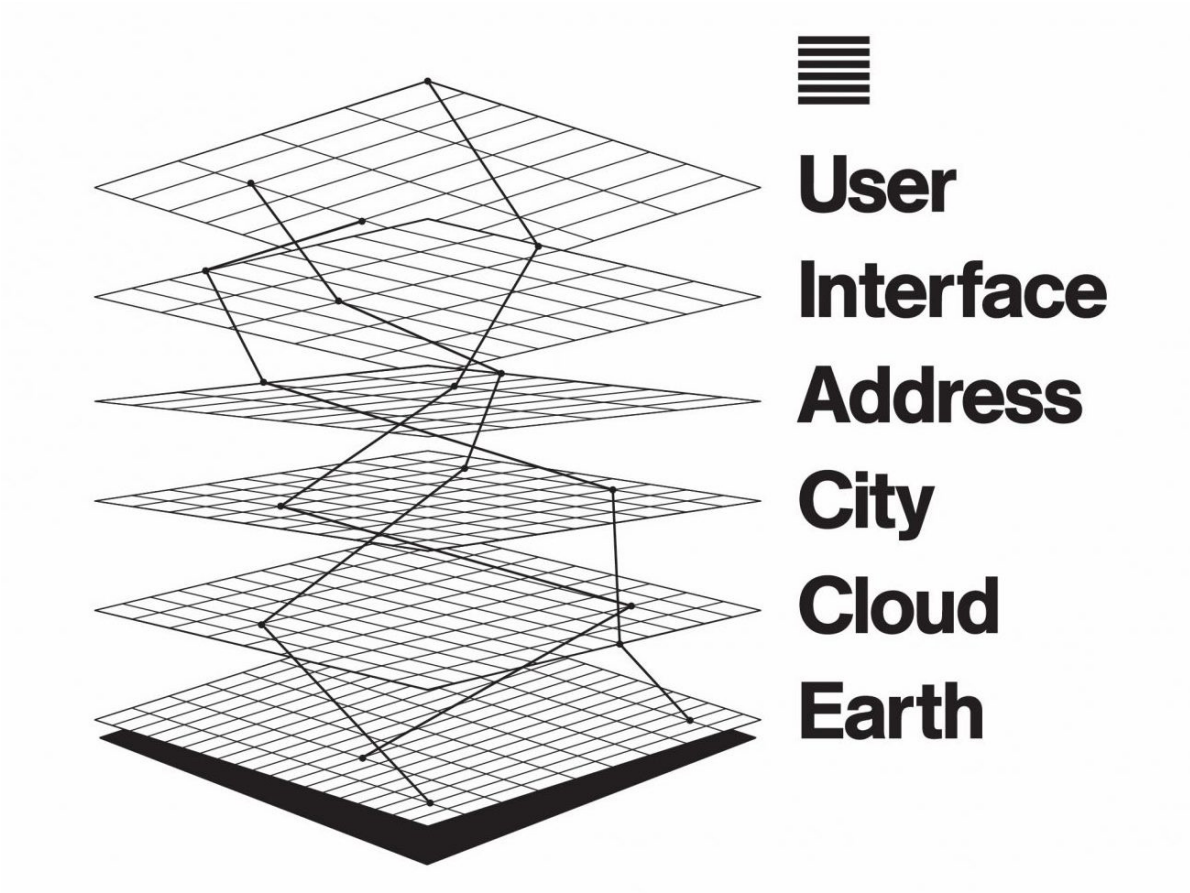


Figure 5. Benjamin Bratton's Stack (Bratton, 2016)

3.2 FreedomLab's version of the Stack

FreedomLab uses the Stack as a framework to understand and analyze the anatomy of digital systems, provide multi-stakeholder contexts with a shared vocabulary to discuss digital systems and use it as an ideation tool to design new digital systems. Bratton's work was reinterpreted into a tool for analysis and strategic decision-making. The mental model is used to think about 'how digital technologies have reshaped society in the past and how they will do it in the future' (The Stack, 2022). It is used within the team but also with clients. The model also accounts for the social and political impact of these systems. The layers of the Stack are as follows:

1. Neo governance- Refers to new forms of governance that have emerged due to digitization, either because digital systems enable new forms of governance or digital systems require a new form of governance
2. Neo collectives- Refers to cultural practices and communities-both in the physical and virtual realm
3. Smart habitat- Refers to the digitized living environment such as smart cities, smart homes, and ambient spaces.
4. (User) interface layer- Refers to the interface systems (both hardware- and software-based) that allow users to interact with a digital system, e.g. graphical user interface, augmented/ virtual reality goggles, touch screen interface,
5. Service/application layer- Refers to the application/service and the underlying service- and business model that aims to solve certain tasks at hand
6. Intelligence layer- Refers to the smart algorithms and AI models
7. Data layer- Refers to the nature of the data, e.g. contextual data, personal data, biometric data, etc.
8. Soft infrastructure- Refers to the software building blocks such as middleware, operating systems, network protocols, APIs, and software development kits
9. Hard infrastructure- Refers to the hardware elements of a digital system such as processors, storage, connectivity, and sensors
10. Resource layer- Refers to the resources and materials that are being used to run a digital system

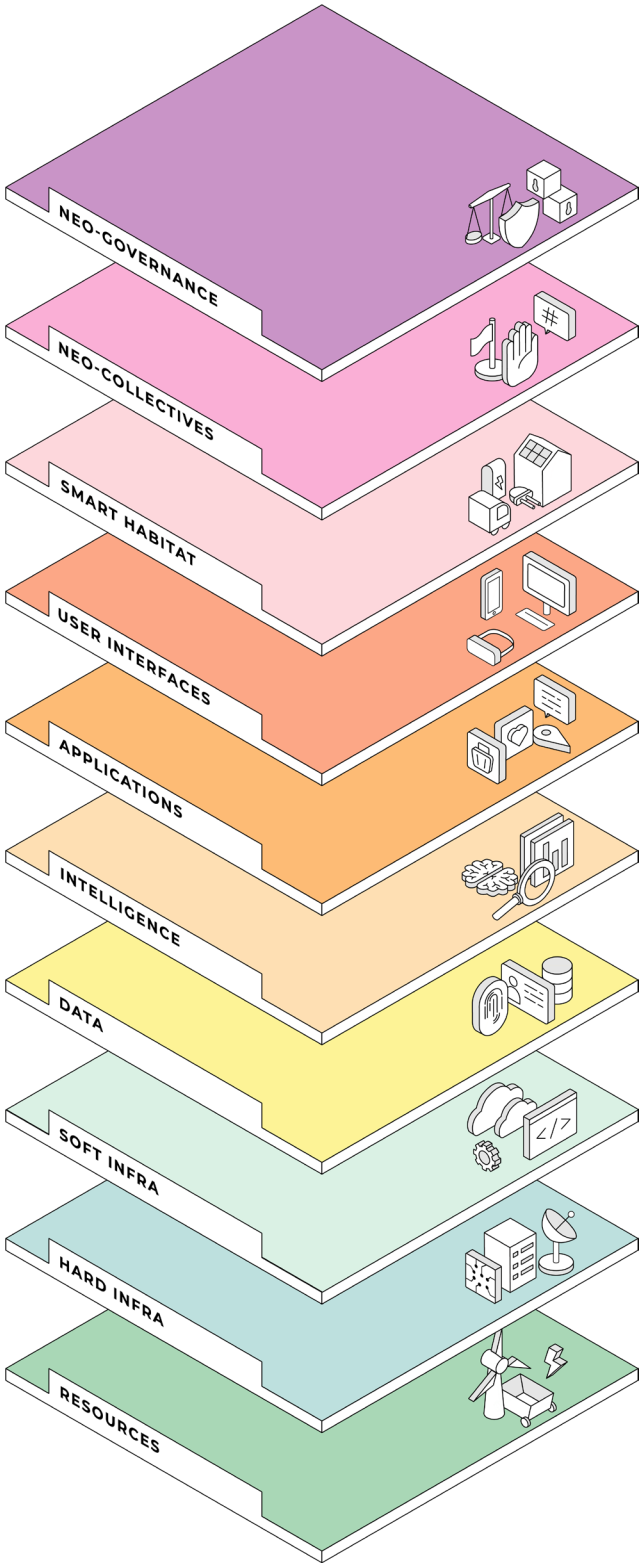


Figure 6. FreedomLab's version of the Stack (The Stack, 2022

In this project, the stack will be used to build shared understandings among stakeholders of incipient systems. To see how effective it is as a tool, an analysis was carried out. The purpose of the analysis was two-fold-

To understand the strengths and weak points of the Stack as a tool for multi-stakeholder systems

→ A SWOT (Strengths, Weakness, Opportunities, Threats) analysis was conducted of the tool. This analysis was conduced based on use of the tool and the information provided by FreedomLab in their documentation from previous uses.

To evaluate the suitability of the Stack as a tool to build shared understandings.

→ This was done using the shared understandings criteria. The Stack is currently used as a collaborative framework. For the purposes of this project, the goal for the outcome would be to develop consensus and understanding of the way ahead.

The Main Takeaways

1. Holistic perspective and societal impact

The Stack is well adapted to think about digital technologies from a holistic perspective. It goes beyond just the system and looks at its impact and offers an opportunity to place the system in society. It acts as a good starting point to identify opportunities at a minute level on every layer. It offers a thorough breakdown of the functioning of the system.

2. Considering multiple perspectives

Due to the organizational nature of the tool, it is usually used to think of society and opportunities from a systems perspective. It could be useful to also look from a user or stakeholder perspective.

3. Connecting the layers

It might be useful to find a connection between the layers as they don't work in isolation. Some aspects of the Stack work better with a full working knowledge of the system. There's also scope for modifications to make it better suited for looking at AI systems in particular. For example, an addition of a value lens might be interesting.

4. Utilizing the Stack

To build shared understandings for an upcoming system, the Stack could be used in multiple ways. It could be used as a means of communicating this future system, as a way to build the system together, or even as a starting point to raise concerns and challenges.

3.3 Comparison to other models

The Stack model is used as a format in different contexts and has been developed into different versions. As a part of the study into the Stack, some of these models were probed. The method of analysis was the same as the one used for FreedomLab's Stack but less extensive. A quick SWOT analysis followed by an evaluation using the criteria for shared understandings was conducted. These lead to some useful insights and takeaways to help make the Stack a more appropriate tool for developing shared understandings for upcoming AI systems.

The Ethical Stack

The Ethical Stack was created as a part of the VIRT-EU program at CIID in collaboration with some other partners. The goal of the Stack is to " encourage reflection among developers on the relationship between technological innovation and societal concerns". The tool is presented through an interactive website, where users create their own versions of the Stack. The creators take a value-based approach to the framework. The tool builds upon the theories of virtue, care, and capabilitiesm (The Ethical Stack,2017).

1. Laying out the product- In the first part of the tool, users are invited to break down aspects of their product.
2. Moving from 'issue' to 'challenge'- The idea of core ethical principles based on virtue ethics is introduced in the next stage. Users are prompted to attach values to different aspects of the system.
3. Takeaways- Based on the value and material connections, a map of care ethics is created. This map helps users reflect on the core of the system but also the role it plays in the larger picture of society.

While FreedomLab's Stack is more of a tool to understand, analyze and find opportunities, the ethical Stack is a reflective tool. The values map encourages users to self-assess the system and realign their goals. The Ethical Stack builds connections between the layers and rethinks the impact of the system with the value-driven approach. Unlike FreedomLab's Stack, it is less detailed on the functionality and intricacies of the system. There are only 5 layers, so the breakdown is not too detailed. The focus is on ethics and impact rather than the layers of the Stack itself. The value definitions can be a little constricting and might deter users from openly thinking about their system's impacts. In its current form, the model is aimed at developer and creator teams to evaluate their own products. This approach might also be useful for other stakeholders that play a role in the functioning of systems. For example, for policymakers to evaluate, what ethical concerns might be an issue to citizens affected by the said systems.

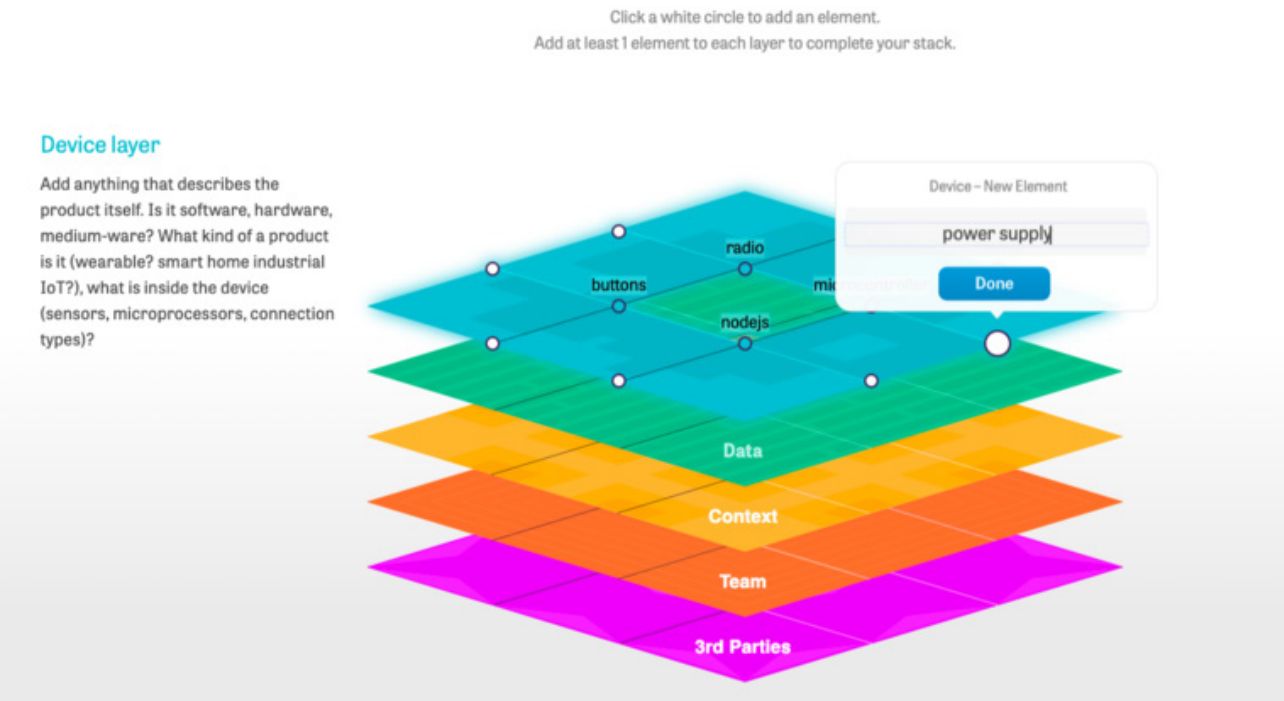


Figure 7. A visual representation of the ethical Stack (The Ethical Stack,2017)

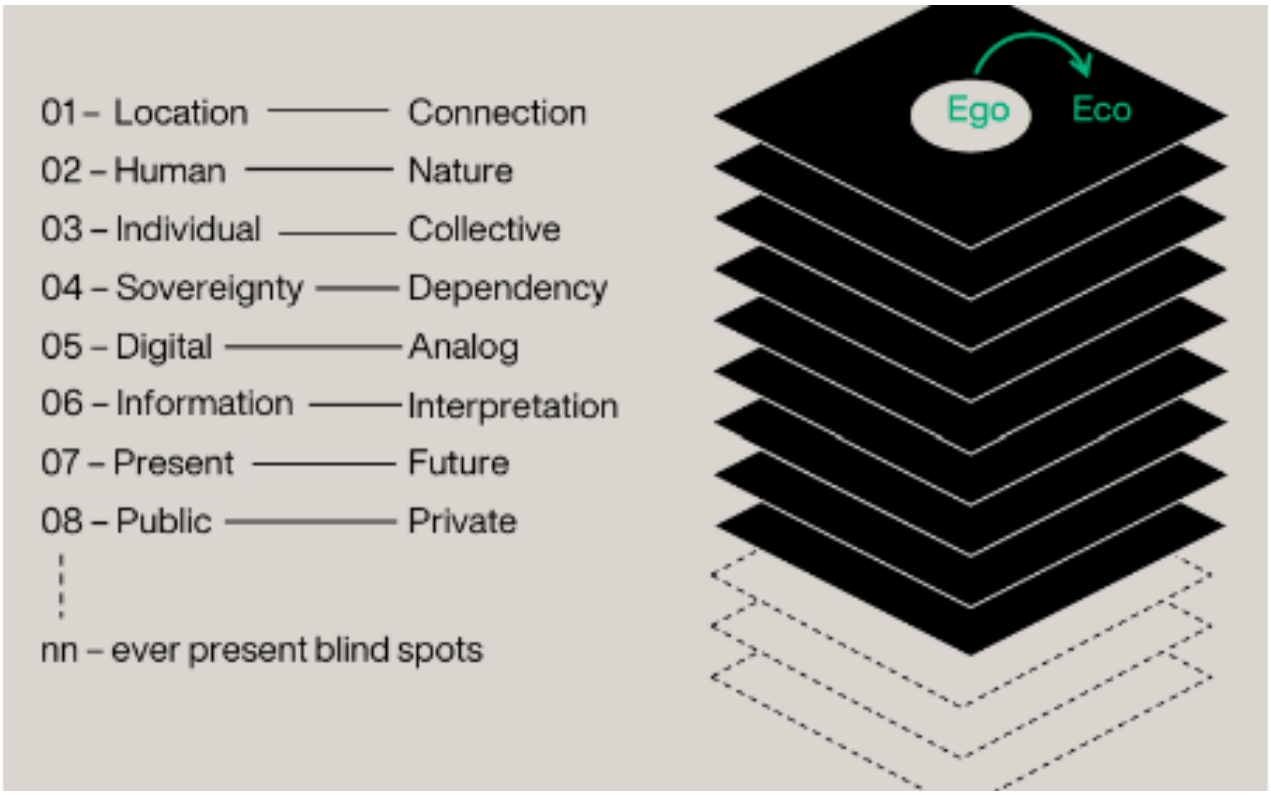


Figure 8. Visual representation of the Hybrid City Lab model (What got us here, won't get us out of here, 2022)

Hybrid City Lab's Stack Model

The Stack-based model developed by Hybrid City Lab (What got us here, won't get us out of here, 2022) introduces a unique perspective that encourages a transition from self-centeredness to a more ecologically oriented mindset. Its core objective is to construct innovative mental frameworks for administration, with a particular emphasis on offering universal basic services. This model delves into eight specific categories within the realm of basic services, fostering a holistic approach that extends beyond human actors.

The Stack takes into perspective the past and the present while offering space to imagine the future. It also has a fluid form presenting the chance to add layers depending on one's own needs. The layers also go beyond just an individual but place them in a collective space with other actors, be they human or non-human. The layers in themselves open up a lot of interesting questions about future possibilities. They act as very good starting points to reimagine systems and services.

3.4 Using the Stack to explain AI systems

FreedomLab's Stack is occasionally used to explain AI systems. The goal of the project was to see if the Stack is an appropriate tool to build shared understandings for upcoming AI systems. The objective was also to see how the Stack can be used as a co-creative tool. One approach was to break down a generic future shared mobility system and see what aspects fall into each of the layers of the Stack. This was a good starting point to see what conversations are important and what topics might be interesting to explore. The topics also offer insight into the intricacies of the system whichmight not have arisen during the participatory process. Hence, this was also used as a guide for Speculative ideations.

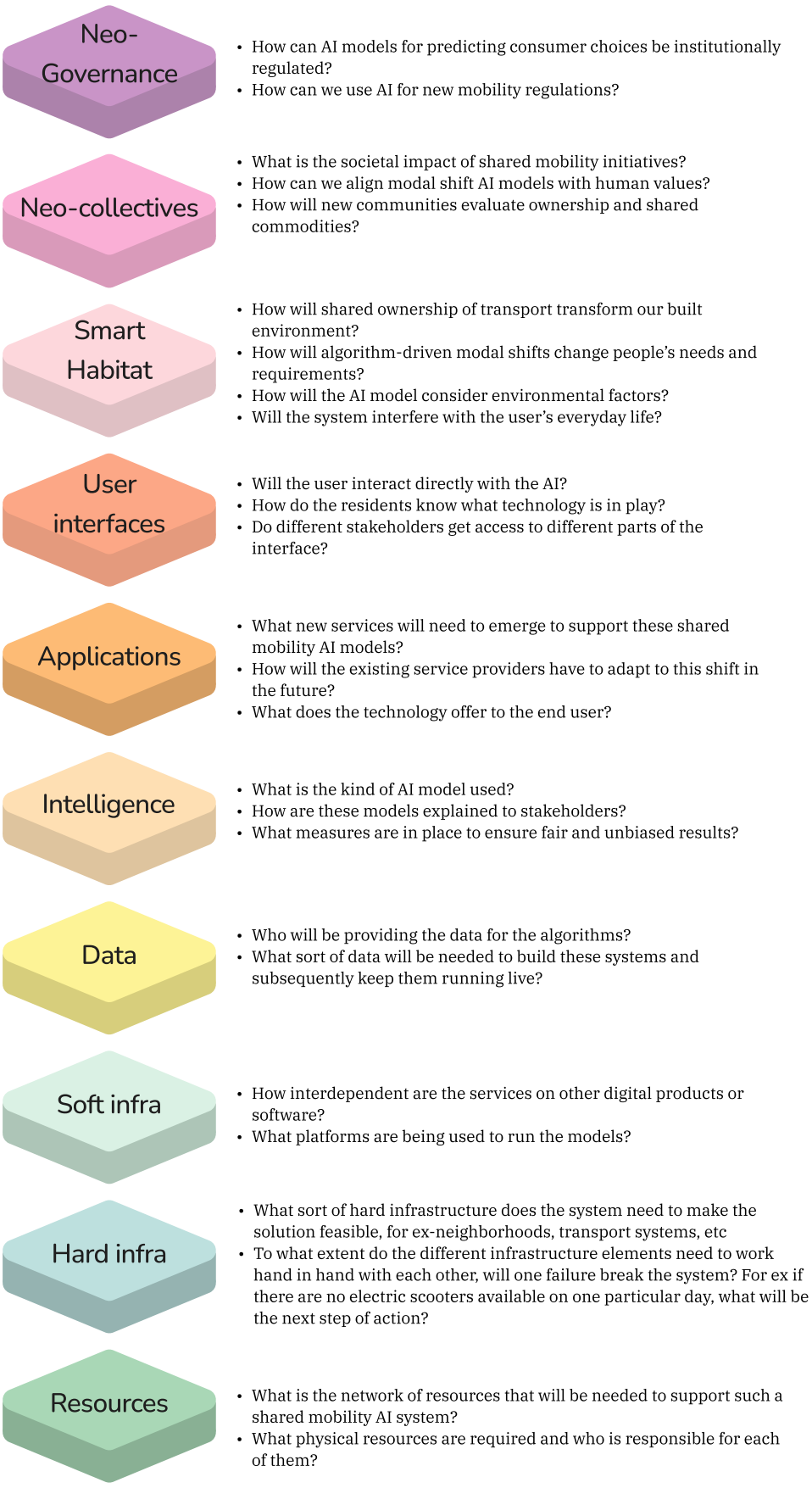


Figure 9. Possible exploration questions on each layer of a shared mobility Stack

CHAPTER 4

Speculative Design

This chapter provides details on the role of speculative design in the project. It starts with the theoretical foundation of speculative design. This is followed by an exploration of how speculative design methods could be used to build shared understandings.

4.1 Speculative Design as a part of the process
4.2 A tool to build shared understandings

4.1 Speculative Design as a part of the process

James Auger (2013) claims Speculative design "combines informed, hypothetical extrapolations of an emerging technology's development with a deep consideration of the cultural landscape into which it might be deployed, to speculate on future products, systems, and services" (Auger, 2013,p. 11-35). Speculative design goes beyond traditional design problem-solving to provoke thoughtful discussions and ideate on alternative futures. As an approach, it is used to surface tensions that might exist in a given system. It challenges existing assumptions, questions norms, and explores potential consequences.

Hence it fits quite well within the scope of the project. Given that the AI system is still being built, speculative design methods could be a tool to develop shared understandings amongst stakeholders. The outcomes of the speculative process can assist stakeholders in conceptualizing possible futures. The speculative artifacts act as anticipatory objects to help the stakeholders imagine what kind of futures could exist. The objective of using speculative artifacts is future-oriented and conveys an anticipated future in which some intended transformation is underway(Light, 2021). This could help stakeholders envision the future of the system and have conversations that are relevant not just in the present world but also for the years to come.

4.2 A tool to build shared understandings

Speculative Design could be used as a means to embody tensions and provoke stakeholders to have reflective critical discussions around shared mobility. Figure 10 explains the shift from the 'traditional' design process and outcome by focusing on tensions. These sorts of provocations can help us imagine the future of the AI system more concretely. In this case, speculative design helps broaden the scope of possibilities and shed light on key aspects of the system that go beyond surface-level discussions. Tensions are addressed by practitioners as strategies to better conceptualize, deploy and evaluate alternate futures (Mitrović et al., 2021, p. 94). This also opens up space for stakeholders to be critical of the technological process and its implications. One of the goals of the project is to help the stakeholders question their assumptions. This can also be imagined as a means to empower the stakeholders to make sense of the upcoming system in a tangible, interactive manner.

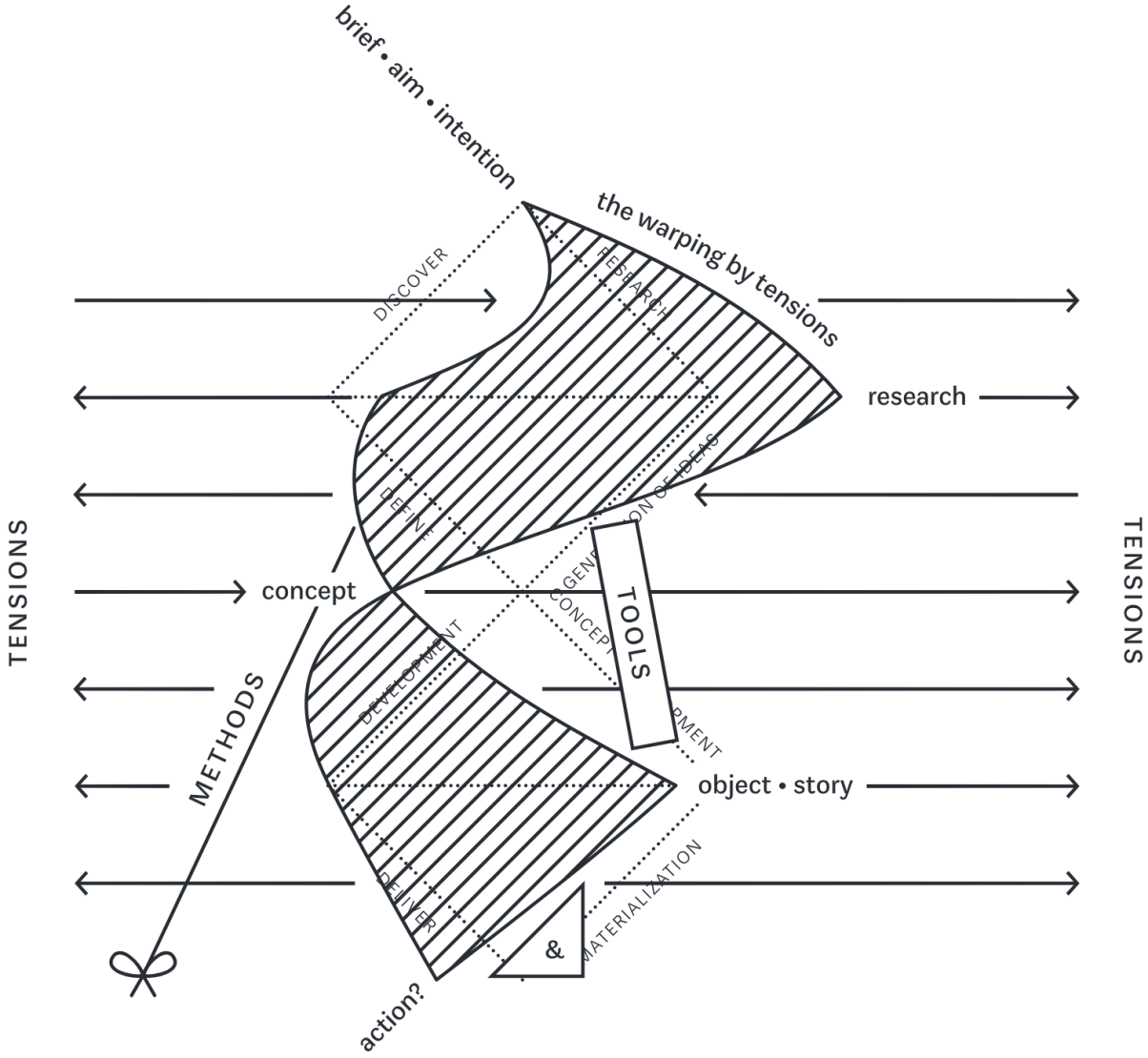


Figure 10. Double diamond vs Tensions (Mitrović, Auger, Hanna, & Helgason, 2021, 162)

CHAPTER 5

Design Process

This chapter details the plan to execute the project, based on the takeaways from the literature review and design methodologies. The chapters explain how the Stack and Speculative design tools are used as a part of the participatory process. The chapter ends with a framework defining the approach undertaken during this project.

5.1 Design approach

The goals for stakeholder participation
Who to involve
Which methods to use

5.2 Project Framework

5.1 Design approach

Based on the research, it was noticed that there's a lack of means to arrive at shared understandings in real-world cases. Specifically for this project, building a shared understanding amongst the multiple stakeholders involved in the residential share mobility system. There are a few means of defining shared understandings here. It could be a consensus amongst all the stakeholders about how they view the system or define certain aspects of the future AI system together as a group. Collectively shared expectations often influence the upcoming system. There are three forces of expectations: they raise attention and legitimacy, help coordinate the network of stakeholders and provide direction to research activities (Kerr et al., 2020).

Hence the design goals was to co-create shared understandings for the upcoming mobility system. There are a variety of stakeholders involved in the system. One method to promote shared understanding amongst these stakeholders was to bring them together to one table. The Stack and speculative design offered possible tools to mediate a discussion between the stakeholders. As a part of the preparation phase, there were three main aspects to be considered:

1. The goals for stakeholder participation
2. Who to involve
3. What methods to use

The goals for stakeholder participation

→ Given the system is still currently being built, there is a communication and interest gap between the stakeholders. Conversation and discussion can be facilitated through the sessions. These would help bring tensions and disagreements to the table.
→ Knowledge building- For stakeholders to visualize and build this future system together

Who to involve

There are a few parties involved in the case study. For this project, not all of them were able to participate. The participants directly involved in the case study- Real estate developers, Mobility providers, behavioral researchers, and sustainability researchers. The project is driven by profits, so to have more critical discussions, some participants from outside were invited. For an outsider's perspective, people that were not directly benefiting from the shared mobility system were also invited. This included researchers from FreedomLab, an urban planner/designer, and an AI specialist.

5.2 Project Framework

Which methods to use

The Stack is a good tool to give an overview of the socio-technical system. It is beneficial to give an intricate breakdown of the different layers needed to make the shared mobility system successful. From the shared understandings criteria, the Stack is quite efficient to consider the functioning of the system and setting expectations of what the system can do. In terms of situatedness and reliability, it could be hard to get different stakeholders to build a Stack together from their different backgrounds. To help this process speculative design was introduced. The speculative artifact brings friction, materiality, and context. This approach could help participants situate the system and relate to it from their specific roles. All participants have different backgrounds, so the approach will aim to ensure equal opportunity for discussion.

The approach was to combine speculative design and the Stack for building these shared understandings. The focus was to make the session participatory while also exploring tangibility as a way to gain understanding. The residential shared mobility system in its current form is still abstract. The goal should be to develop a method for facilitating conversation and early engagement (Schwaninger et al., 2021). This is an important step because it helps explore interconnected and entangled contexts with multiple stakeholders and interests (Dark Matter Labs, 2022).

The proposed method is a generative activity as opposed to a reflective activity to develop shared understandings. The general methodology was to conduct interviews with the participants to comprehend their understanding of the context, their background, and future visions. Based on the insights from the interviews, a participatory design session would be created. In the session, speculative artifacts would be used to explain the future world, followed by an activity with the Stack to build the system and its layers.

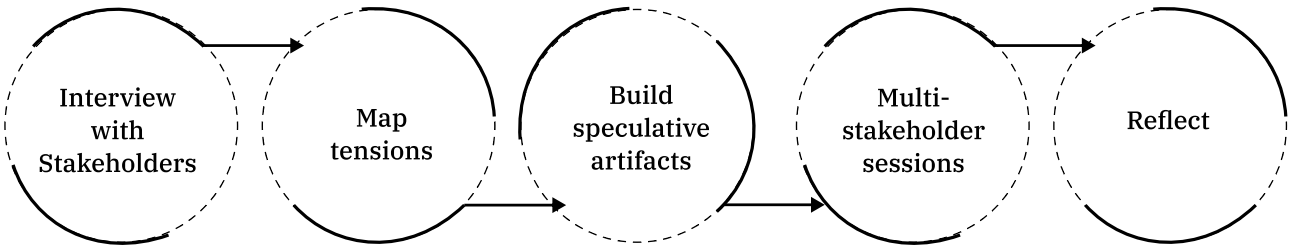


Figure 11. Overview of the project framework

CHAPTER 6

Case study Residential shared mobility

This chapter introduces the case study of residential shared mobility which is the future AI system explored. The chapter also maps the partners involved and the requirements for this multi-stakeholder system.

6.1 Defining the case study
6.2 Stakeholders involved

6.1 Defining the case study

The case study of residential shared mobility was chosen to be the focus.
The project is a Co-exploration between several companies: Dalpha Real Estate(and other developers), Dalpha Bright, Louwman Group, and Mobility Invest Group

The case study looks at residential shared mobility as a mobility use case. One specific location that is being considered for the pilot study is Haarlem Schalkwijk in the Netherlands. It is a collaboration between private parties and occasionally the local municipality. All involved parties are interested in setting up a sustainable and viable shared mobility system for the long term. The proposed system will be in place in 2025, one year before the residents will move into their new homes. The goal is to create a solution that is modular and scalable. The focus is on creating a shared mobility system specific to a residential space. All residents living in the building will have access to different means of transport including public transport that will be shared amongst them.

It is a fairly complex system that is in development at the moment. The different parties involved have a variety of vested interests in the system, but it will only be successful if all the stakeholders (from real estate developers to future residents) are involved at the right moments of time in order for them to benefit from the system.

It is envisioned as a community-driven system, which values shared responsibility among the residents. The goal is to reduce residents' dependence on their own cars.

Shared cars, bikes, cycles, and scooters are provided as alternatives for personal vehicles. The initiative aims to create a more sustainable and efficient transportation system while considering the environment and promoting shared resources. The proposal is to have a mobility contract added to the rental contract. Another part of the proposition is to offer a 100% mobility guarantee so people can trust and buy into the system more seamlessly.

For this system to be successful there are quite a few barriers to be crossed. First off, in the proposed system residents are promoted to let go of their personal vehicles. This requires a behavioral change and shift in mindset around ownership that must be managed properly and in a timely manner. Second, shared transport initiatives have failed over the last few years due to insufficient consideration of the contextual factors that make or break the system. Factors such as parking and permit availability or involvement of residents should be considered when designing the system to promote a sense of (co)ownership and responsibility.

This case is relevant to explore because of its multi-stakeholder nature. It is also a complex upcoming socio-technical system. The system is still being defined, so this is a good moment to see if some tensions can be solved by building a shared understanding. Technology is going to play a big role in enabling this system and making it a reality. The role of AI and intelligence is interesting to explore from different stakeholder perspectives.

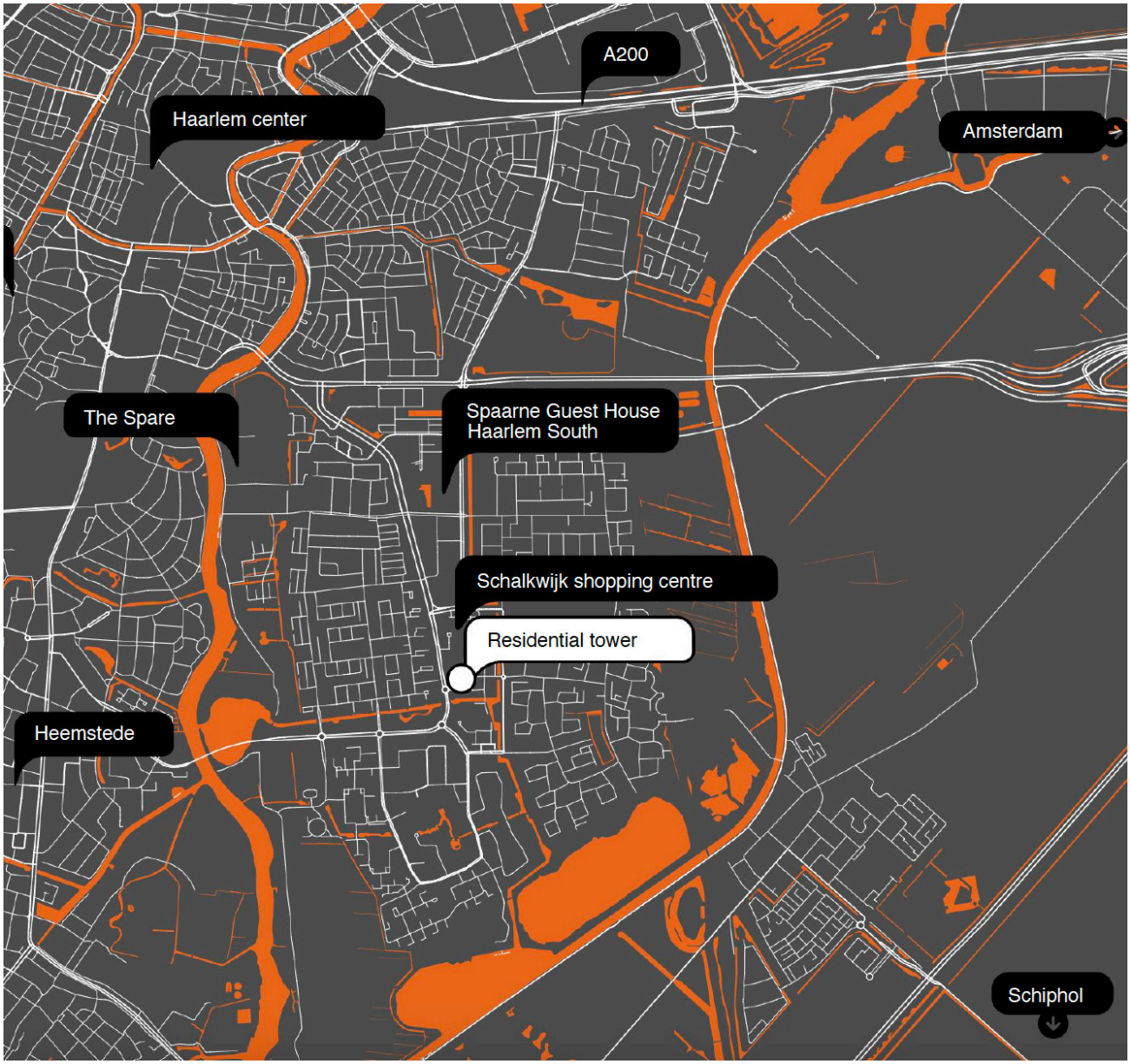


Figure 12. Location for the residential space in Haarlem (DalphaBright,2022)

6.2 Stakeholders involved

The groups of people that are directly or indirectly involved in the project have been mapped out based on the information provided by the real estate company. There are several stakeholders involved in this case.

→ Municipality officials- For the current case it's the Municipality of Haarlem, Netherlands.
→ Prospective residents that might use the system- This is a stakeholder group that will exist in the future and is currently not represented.
→ Real estate developers/ owners- They are responsible for the residential space within which the mobility system is planned to be set up. In this case, the company is also a sister company to FreedomLab.
→ Innovation unit from the real estate company- They are responsible for future-proof solutions to complex urban issues.
→ Mobility Service Providers- They offer assets and modalities such as bikes, e-cars, etc for the system.
→ Behavioral researchers- They approach the system from a psychological perspective to find means to reach the ideal target groups.
→ Freedom Lab Employees- Some of them are directly related to the shared mobility case study but otherwise, they were invited to give an unbiased critical perspective.
→ Designer/Researcher working with AI
→ Urban planners or architects

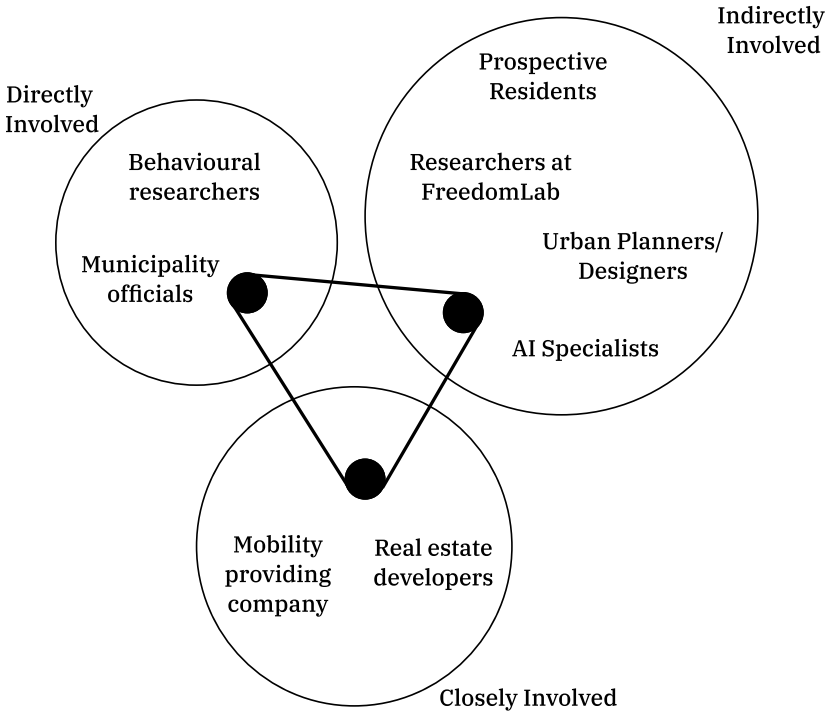


Figure 13. Stakeholder map for the case study

In Fig 13 the stakeholders directly related to the case are mapped out. For this project, some external stakeholders ie an AI specialist, and an urban planner/designer were invited to facilitate a more critical discussion. This also helped balance out the group with stakeholders that did not have profit-driven motives with respect to the shared mobility case. Some stakeholders in the group evidently help more power with regards to decision-making. Throughout the project, it was ensured that power dynamics don't overpower the discussions ensuring that every participant gets their voice heard.

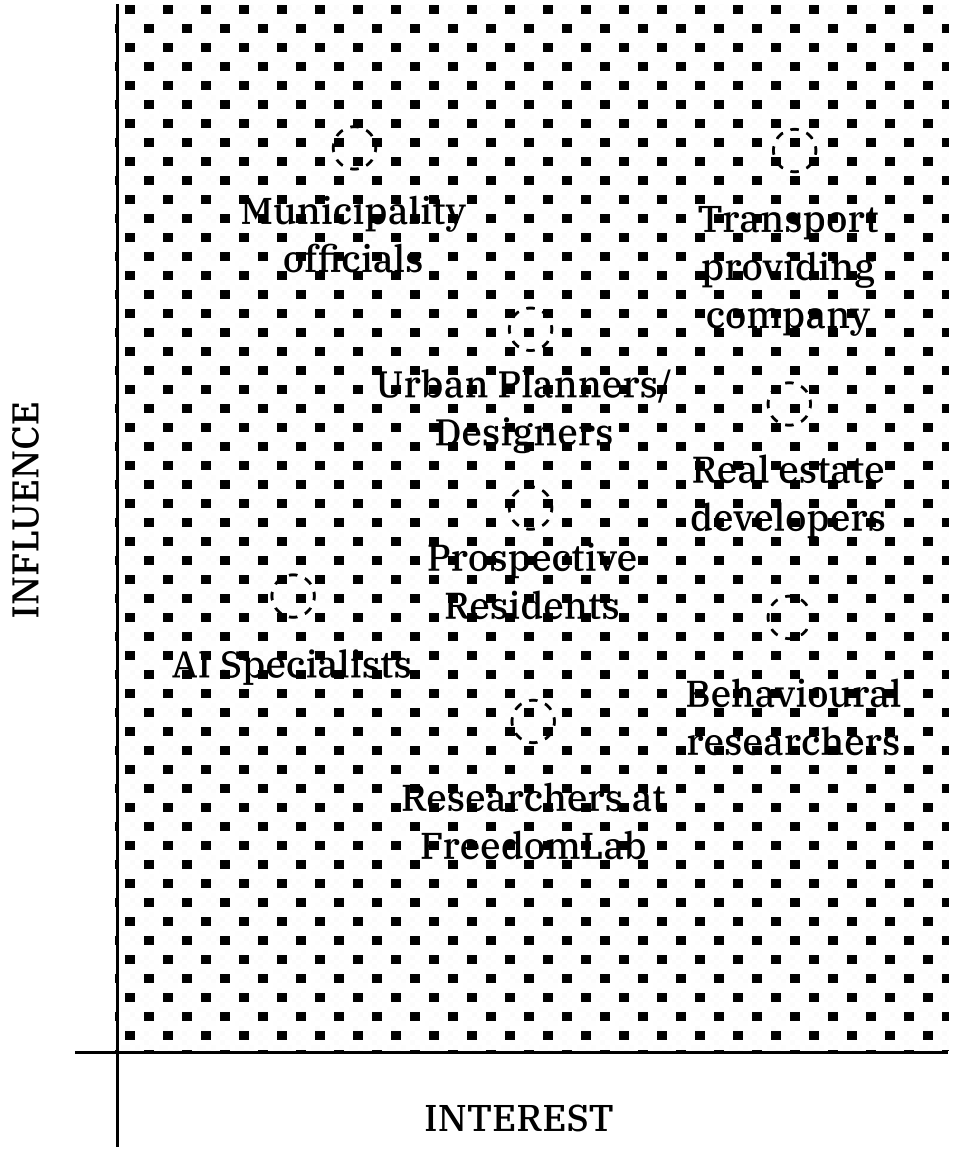
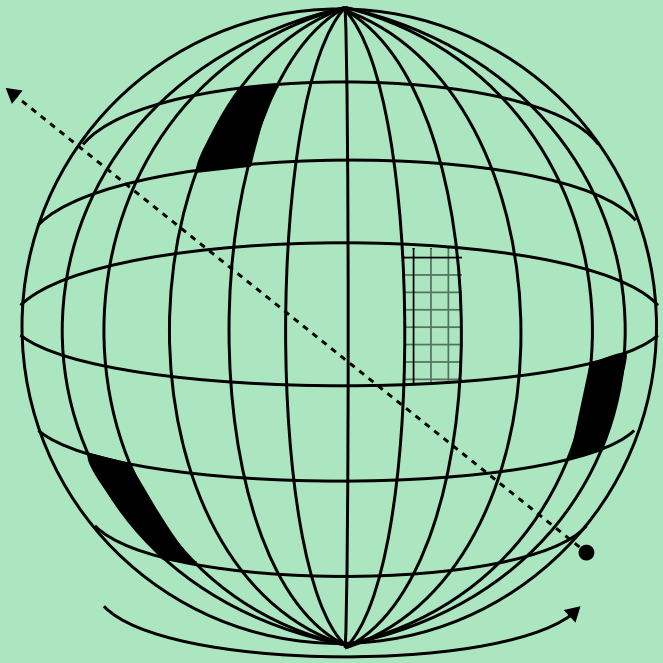
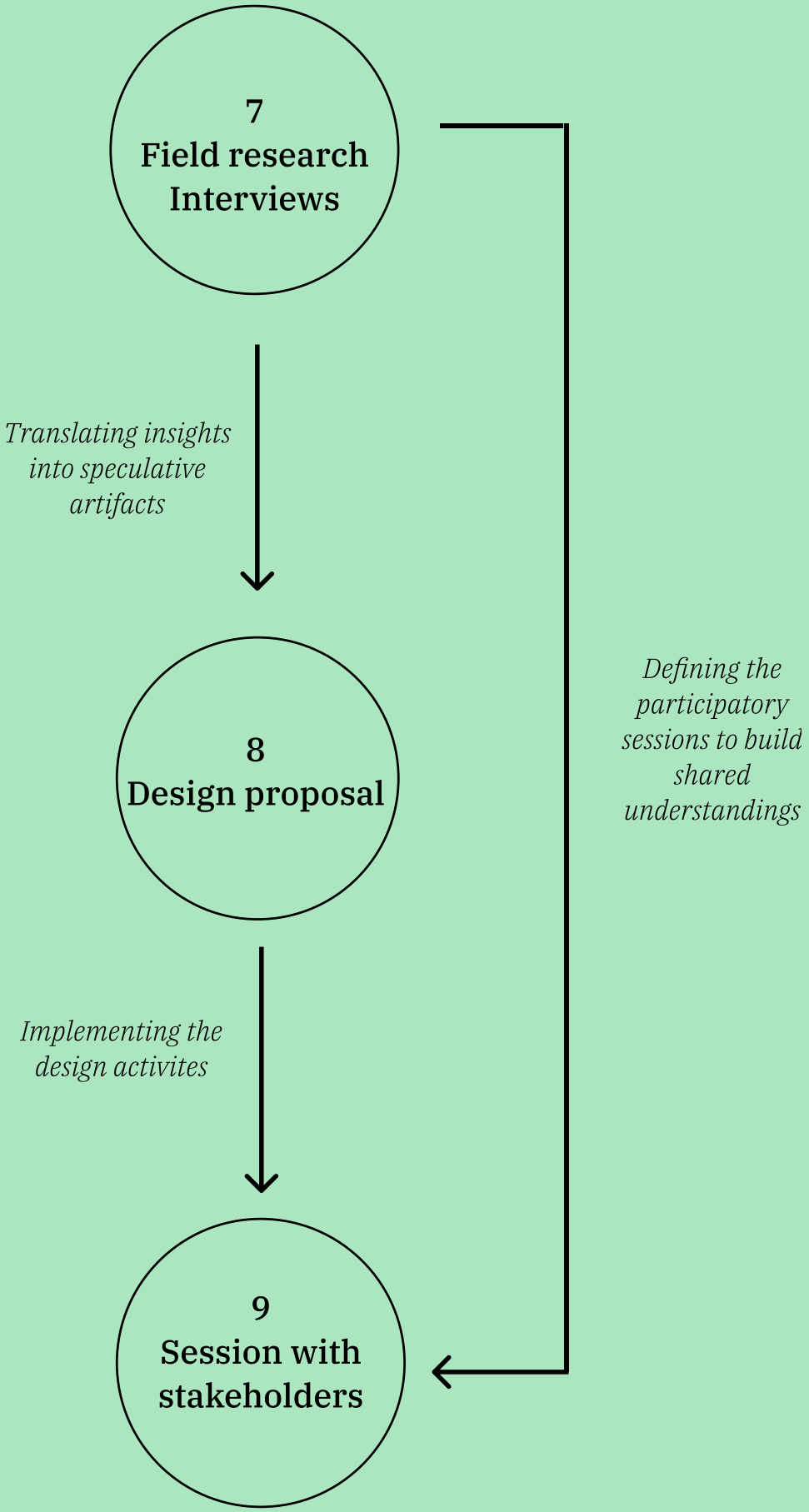


Figure 14. Mapping the interest vs influence of the stakeholders involved

PHASE 2
Executing

This phase focuses on the activities executed in the project. It starts with interviews with stakeholders, followed by mapping insights and tensions. These tensions were used to define the speculative artifacts that were used in the two design sessions. The phase concludes with a structured breakdown of how the sessions were planned and executed.




7
Field research
Interviews
Translating insights into speculative artifacts
8
Design proposal
Implementing the design activites
9
Session with stakeholders
Defining the participatory sessions to build shared understandings

CHAPTER 7

Field Research Interviews

This chapter focuses on the interviews conducted as a part of the research. These interviews were done with stakeholders from different backgrounds. The chapter elaborates on how the interviews were executed and concludes with results and insights from the interviews.

7.1 Interview Procedure
7.2 Interview Analysis Method
7.3 Interview Results

7.1 Interview Procedure

The goal of the interviews was to understand the perspective of the stakeholders. To help get an understanding of what the stakeholders associate with the system, and how they envision the future shared mobility systems to be. A more detailed Interview guide is mentioned in Appendix B. The questions in the interview were derived from criteria for shared understandings. Some such questions are mentioned below :

Functionality
→ What comes to your mind when you think of the future of shared mobility? Can you imagine what the system would be like? How do you imagine this system would work?
→ What does the system do? How does it work?

Situatedness
→ What values relating to these systems are important to you in your life? What role do you play in this system? Who else are the actors involved in the system?
→ Can you imagine how different actors in society would interact with this system?

Relatability
→ What does the system look like? Can you imagine it and envision it happening in the next few years?

Expectations
→ What are your current expectations of how the system will look like?
→ Do you think there can be one well-designed system that will cater to everyone's needs and wants?

The interview structure was divided into three parts- a current understanding of the context, the stakeholder's background and concerns, and a vision of the future.

Figure 15. Outline of the interviews

There were 7 participants that participated in the project. The participants :
Directly Related to the case

→ Participant A- a behavioral researcher working on the Residential Shared Mobility project. Their main role is to approach the case from a cognitive psychology perspective. Their work focuses on how to help more people adopt and buy into the system of shared mobility.
→ Participant B- Innovation strategist at the mobility-providing company. Their role is to find new mobility solutions for the company.
→ Participant C- Sustainable business innovator at the real estate company. They work directly with all the stakeholders involved in the case.
→ Participant D- A researcher at FreedomLab who works with a sustainability from a business perspective

Indirectly related to the case

→ Participant E- Designer and urban planner who focuses on designing with technology. They were a good addition to the group because of their previous work with urban futures.
→ Participant F- A researcher at Freedom Lab, works at the intersection of technology, economics, and culture. They offered a more critical view on the case study.
→ Participant G- AI and technology specialist, that works with quantum computing. They have worked with shared mobility in the past.

7.2 Interview Analysis method

The interviews were audio recorded for further analysis. All participants signed a consent form to participate in the project. (Appendix A) The interviews were conducted via the Microsoft Teams application, so the automated transcription was extracted. The transcription was cleaned up by listening to the audio recordings to ensure accuracy.

After going through the transcripts, a thematic analysis was conducted. Aligned with Grounded theory (Birks & Mills, 2015). The codes were clustered in some main themes that are described in the next section. Another round of focused coding was conducted to notice any emerging tensions between the stakeholders. These tensions manifested in a few forms. While some were explicitly mentioned, some were indirectly and the interests of different stakeholders had to be compared to see the difference.

7.3 Interview Results

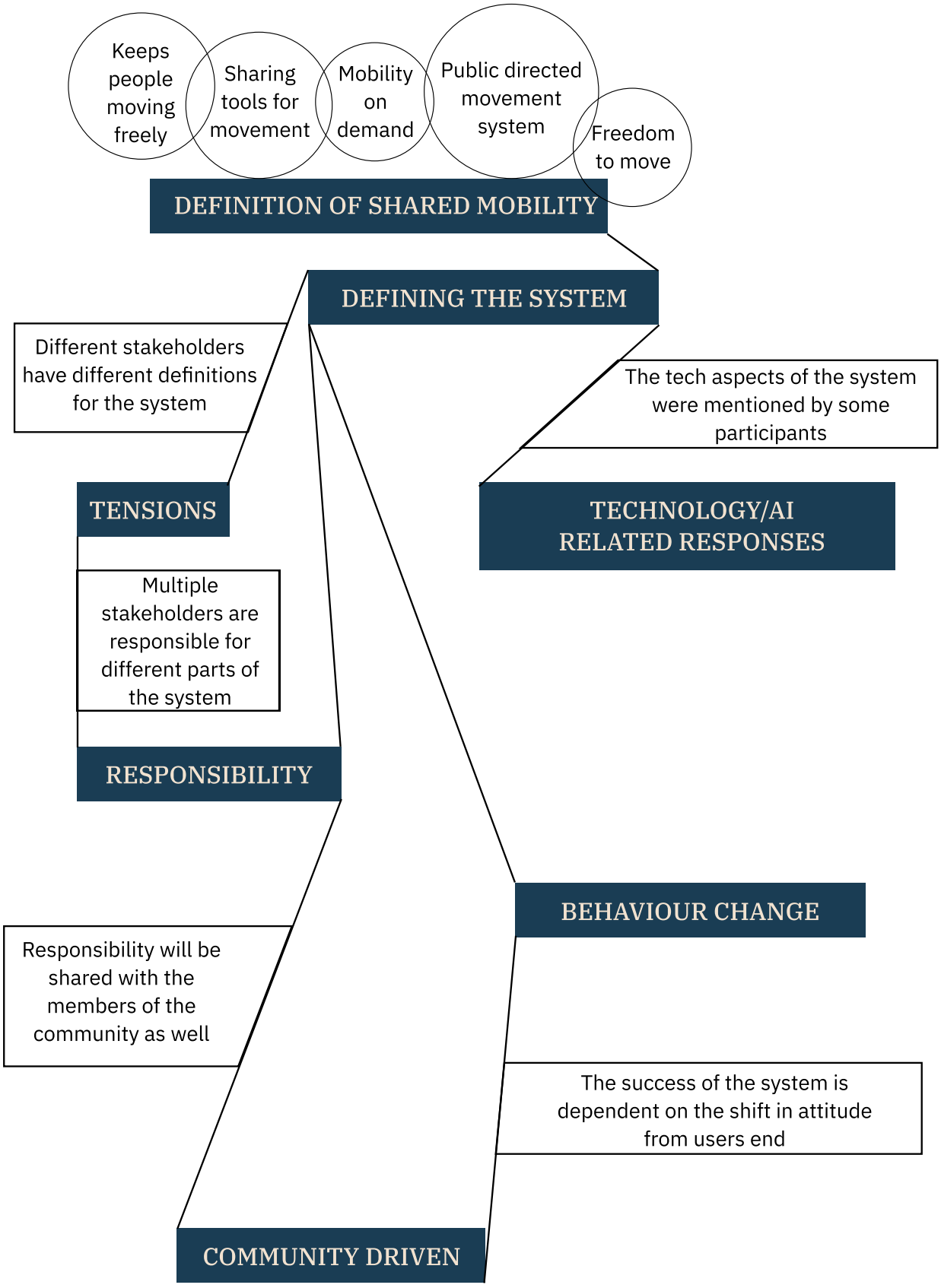


Figure 16. Mapping insights from the interviews

Some of the themes that emerged were-

Defining the System
Different participants explained a variety of visions of what they envision the system to be. There were different values attached to it. Some were trust, openness, reliability, and predictability.

"I think there should be some sort of iterative process in the whole system."
Participant E, Designer, and urban planner

Goals for the system
All the stakeholders mentioned different goals for the system. Some of the points brought up were:

"It should be a system that keeps people freely moving in their mobility behaviors"
Participant B, Innovation strategist at the mobility-providing company

"Mobility is about the ability to go places and the freedom to move around."
Participant E, Designer, and urban planner

"It can be defined as mobility on demand"
Participant C, business innovator at the real estate company

"It can also be defined as sharing the tools for movement"
Participant E, Designer, and urban planner

"The end goal would be to have no private mobility, and everything is free floating in the closed community"
Participant D, A researcher at FreedomLab, works with sustainability

Responsibility
For the shared mobility system to be successful, responsibility is an important value. Be it in terms of physical assets like vehicles or even digital assets like data.

"So a sense of responsibility has to do with risk management, we can't build a business case based on insecurities about how people treat the assets."
Participant B, Innovation strategist at the mobility-providing company

Community Driven
Given that it's a shared mobility system for a residential space, the community aspect is key. All stakeholders approach this differently. The goal is to make the system collective-driven and focus on making it easy for people to join in. The stakeholders aim to begin building the community before residents even move into the space.

"Shared mobility is the choice. It's cost-efficient. It's good for the environment. I do it with the community. I'm not the only one. The whole building does it." What is new about the proposition is that we already want to connect with the community while they're not living there yet"
Participant C, business innovator at the real estate company

Behavior Changes
Behavioral aspects were mentioned quite often by the participants. For people to be a part of the system, there will need to be a shift in how mobility is currently viewed. This process could be made rapid through incentives and other such schemes. While the system aims to help people get rid of their cars, this would be opposed to current norms of ownership.

Technology AI-related responses

The shared mobility system is going to be dependent on technology and AI for functioning, enabling, and execution. This was mentioned by some participants as a concern but also a solution to solving some of the bigger issues. There were two perspectives amongst the responses. Some looked at the interface, and end-users' needs through a technological lens, while others looked at how it might be vital to the running of the system itself.

As a solution

"It will be needed to maintain user behavior and patterns."

Participant A, a behavioral researcher

→ End users will need to be informed about how the system works and offer technology knowledge to make this shift easier for them. It was suggested that chatbots and online support lines might help in this regard.

→ End-users will need to find trust in the system to be able to use it as a part of their daily life. Questions like who's taking what decisions might be key to convey.

As a system driver

→ Data was a major concern among many interviewees.

"The infrastructure on the back end is needed to set up this system, specifically with data warehouses and partners, it is considered a challenge."

Participant B, Innovation strategist at the mobility-providing company

→ AI will be vital to optimizing and calculating the modal shift. While this was mentioned in terms of functions and needs, not a lot of participants were able to explain how this can be done technically. This makes sense, given not a lot of them are from a technological background, but this also reiterates the need for XAI regardless of the stakeholder backgrounds.

"A predictable occupancy rate. That's the most important part, and that makes the business case"

Participant C, a business innovator at the real estate company

→ This was mentioned quite often. Predicting the occupancy rate is important to quite a few stakeholders involved in the system in being able to gauge the success and need for such a system.

→ Participant G, AI and technology specialist mentioned how a lot of the challenges in the system could be solved by using quantum computing methods.

Tensions

→ While all the stakeholders are working from their perspectives, there's a gap in higher-level perspective when looking at it all together.

→ While the system will function better on a post-ownership model, there are a lot of norms associated with ownership. It might be hard for people to let go of it.

"Economy is the idea of having property but is also something that gives you freedom in a sense. Even though it's not sustainable. That is the most efficient way to spend your money, so to say, I mean owning a car."

Participant F, A researcher at Freedom Lab, works at the intersection of technology, economics, and culture

→ Stakeholders need to be aware of their rights when they become a part of or begin using the system.

→ The system imagined is quite vulnerable and volatile. In the future, there are also multiple means to pitch mobility to people. Adding mobility contracts to rental contracts when people move into a new place in one such idea. Another idea could be connecting work and mobility.

"There are multiple routes to the same person"

Participant B, Innovation strategist at the mobility-providing company

→ There is a lack of common understanding in terms of what the system will look like. This was mentioned by a few participants. It also justifies approaching the system through the perspective of shared understandings.

Building shared understandings can be an attempt to bring a shared meaning amongst all the stakeholders.

→ One aspect that was a matter of concern for quite a few participants was responsibility. There were questions about how the responsibility is split for different actions in the system. It was mentioned as one of the key factors that would determine the success of the overall system. This refers to sharing responsibility amongst the stakeholders but also finding ways to see how the end-users can use the modes of transport responsibly.

→ There are multiple stakeholders involved in the system, both private and public. During the interviews, a few participants referred to the shared mobility system as a business case or business model. There's a clear tension around how profits will be made and distributed amongst the stakeholders. It can also be considered from the end user's perspective, as the system needs to be affordable and accessible.

→ A few participants speculated that the success of the system hinges on users being able to trust the system and being guaranteed that there will be assets available for them to use. So the goal is to guarantee to end users that whenever they need to travel, the system will support them in this endeavor.

"We are going to find out if it is possible for people to feel secure with this feeling of there's enough availability."

Participant C, a business innovator at the real estate company

CHAPTER 8

Design Proposal

This chapter combines the takeaways from the literature review and the interviews. The research findings, with insights from the interview and the criteria for shared understandings helped define a design framework. Risks and opportunities that can be explored in the design phase are also mentioned. Six final design ideas were compared against the criteria for design ideas. The chapter concludes with the final design concept and the plan for executing it.

8.1 Emergent Tensions

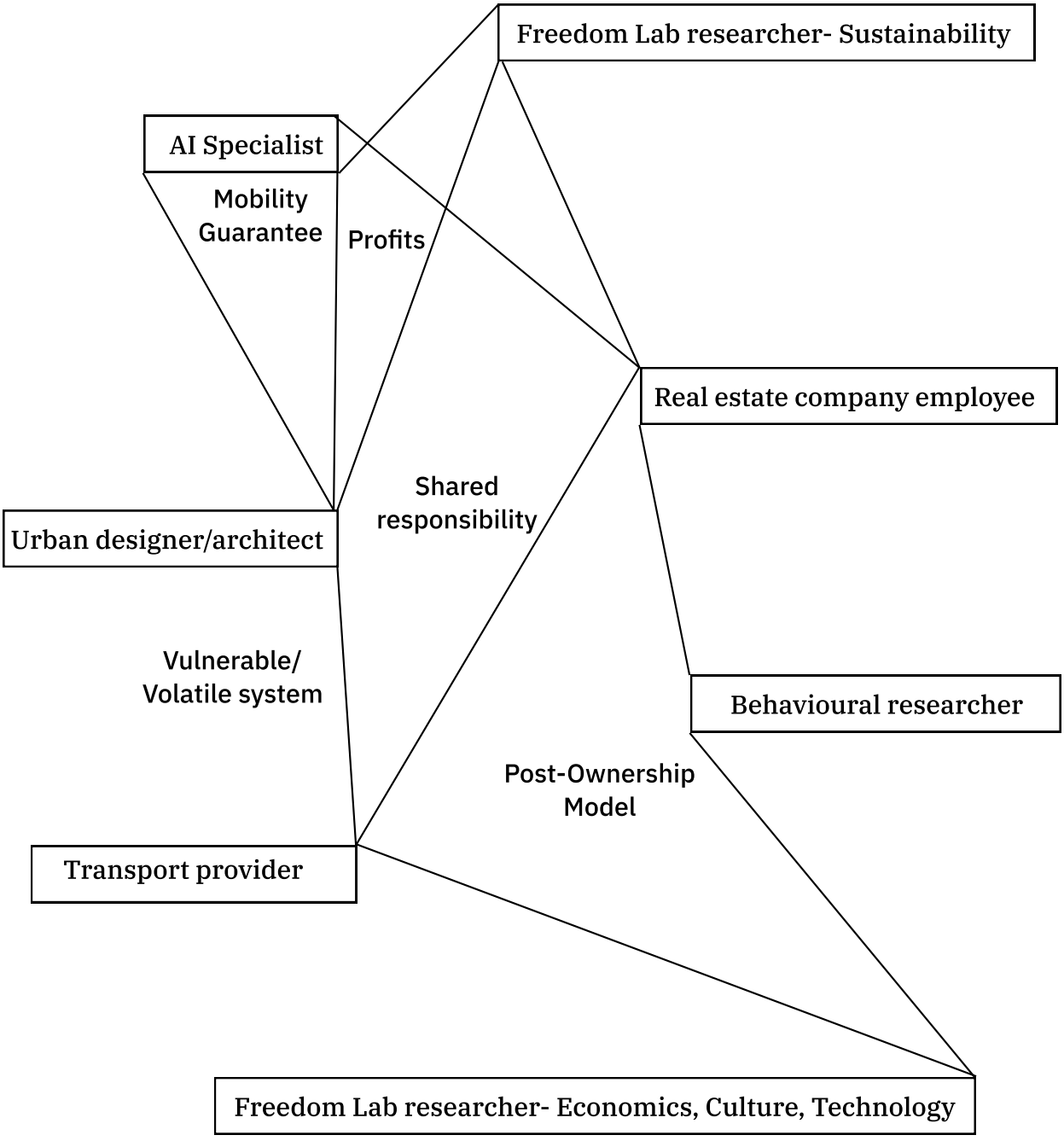


Figure 17. Mapping tensions between stakeholders

The interview responses showcase some clear agreements and disagreements between the participants. These tensions were mapped out to see which are important and can be most efficiently discussed in the given time frame.

From the list of tensions that emerged, four specific ones were chosen. These four tensions are quite key to the functioning and the success of the system in its current stage. The goal was to ensure that all involved participants were affected by or involved in the chosen space. The decision was also dependent on the participants of the session itself—some of the friction points that emerged from the interviews involved parties like the municipality. Due to the lack of representation at the session, these tensions were left out. The four chosen tensions were:

Individual vs Shared responsibility

For the mobility system to work, a certain entity will have to be held responsible for the assets like electric cars and bikes. In the envisioned system, the mobility provider and real estate company share responsibility for the first few years, and then the community takes over. Certain members of the community take the initiative and take care of these needs. This would be an added role to play expected from the end-users. So it's hard to assume how it would work out. Given that, a lot of shared mobility solutions fail because of a lack of liability and trust (Boer, M.,2022).

"So a sense of responsibility and that has all to do with our risk management, we can't build a business model based on insecurities about how people treat the assets."

Participant B, Innovation strategist at the mobility-providing company

"Shared bikes is very interesting because when it's not yours, you just like to leave it anywhere and don't have any responsibility of taking good care of the bike"

Participant F, A researcher at Freedom Lab, works at the intersection of technology, economics, and culture.

Profit Margins vs User Cost Savings

The multi-stakeholder system has a lot of parties playing different roles. For the shared mobility system to become ubiquitous, there needs to be a collaboration between private and public parties. Based on the interviews, there was a distinction among the participants. There was a clear indication concerning profit-driven motives and how that would define the final system. This might not always lead to the best of decisions. There's also an angle of profit and investment from the end-users side. A shift in how people move, and travel will entail decisions that are heavily defined by affordability.

"Think as a part of the pilot, they need to think of the business perspective where they need to ensure that it is viable or they are making profit out of it or they see it as a profitable business over a long run."

Participant E, Designer, and urban planner

"It has never been profitable to offer residential shared mobility. They can only be profitable if a lot of people use it."

Participant C, a business innovator at the real estate company

Shared mobility guarantee vs User convenience

One key aspect that the system will be built upon is assurance and guarantee. The end-users should be able to trust the system to start using it. Some interviewees mentioned it as the 'mobility guarantee.' This is vital to the users but also from a stakeholder perspective. Any time any of the users in the residential space would like to use the system, there need to be vehicles available for use. This is also a technological problem, to some extent, as to the planning and allocation of vehicles.

"So they want to establish mobility, but then it's really convenient if they can do it in like, new built apartments."

Participant A, a behavioral researcher

"They offer mobility on demand. So you really have this guaranteed."

Participant C- business innovator at the real estate company

Individual freedom vs Post ownership

One point talked quite about was ownership. Some interviewees agreed that the sharing economy performs well in a world where ownership is not that important to people. Some others raised concerns about imagining this future with no/little ownership. This will also be a part of the filtering process for prospective residents in this community. The participants want to try and bring in people that don't own their personal vehicles only.

"So this kind of freedom of movement is no longer limited to your private possessions."-

Participant E, Designer, and urban planner

"Yeah, I mean, exit is more important than ownership. On the other hand, I think ownership also can be a valuable thing in itself, like really owning."

Participant F, A researcher at Freedom Lab, works at the intersection of technology, economics, and culture.

8.2 Criteria for design ideas

The goal of the speculative artifacts was to surface the tensions present in the upcoming system and start a conversation about them. These tensions were derived from the individual interviews with the participants. A success criteria was created to give this design phase more structure. This criteria would help compare different design directions and choose a way forward.

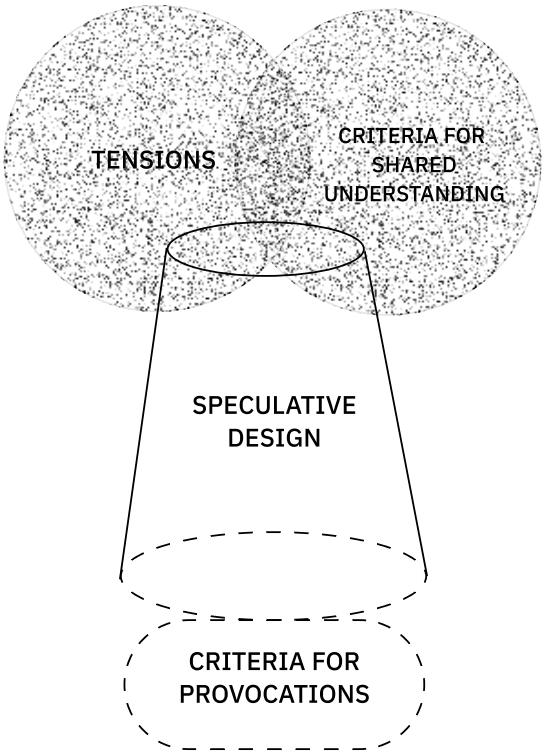


Figure 18. Process to arrive at the provocation criteria

The criteria helped rank the speculative artifacts and was derived from the tensions and the shared understandings criteria.

1. 'The artifacts illustrate the abstract system concretely while leaving room for imagination.'
Given that the system is still being built, there's a lack of understanding of what it looks like. While the notion of the system is abstract, the goal with the artifacts will be to visualize the system more tangibly.

2. 'The artifacts address aspects of functionality of the shared mobility system.'
Looking at the system overall and all its functions could be hard in the given time frame. Hence the goal would be to discuss a few possible functions within the system. For example, conversations around how the mobility sharing will occur and who will take responsibility for it.

3. 'The artifacts are provocative and present a perspective that can help define expectations about the system.'
The artifacts, while opening the space for current understandings, should also prompt the participants to set expectations for the future. The interactions also offer the space to open up tensions around the power dynamics between the stakeholders. For example, what could the system look like? Who would be more accountable within the system? Who is the system most profitable for?

8.3 Design Directions

4. ‘Brings together participants from different backgrounds regardless of their level of knowledge of the system.’
These sessions will be held with stakeholders from different backgrounds. It would be important to ensure that the artifacts bring these different participants together while letting them situate the interactions in their own lives. Some goals, like guaranteeing mobility for all users of the system, were common amongst all stakeholders. But the interviews shed light on how each participant had a different definition of what this meant. This opens up the space for the artifacts to bring them to a consensus.

5. ’The artifacts are relatable for the participant to imagine ways it can be brought about as a reality’
Even though the artifacts are imagined in the future, the goal would be to ensure the participants walk away with real actionable steps. Each of the participants should have the opportunity to relate to the artifacts from their backgrounds and see what can be done in their power to help build this ideal system.

Based on the tensions and entanglements six design ideas were conceptualized. The goal of these ideas was to create fictions that surface tensions. One approach that was useful to compartmentalize these ideas was to grade them from a level of engagement. To what extent will the participants be able to interact with the artifacts?

Idea 1- Building Together
What- A way for participants to build a system together physically in a space.
How- A box with an instruction manual will be offered, that consists of some blocks that can be used to build different parts of the system together
Background- Different blocks can be associated with key values and used to build together
Expected Outcome- A structure/ building of sorts that embodies the system.

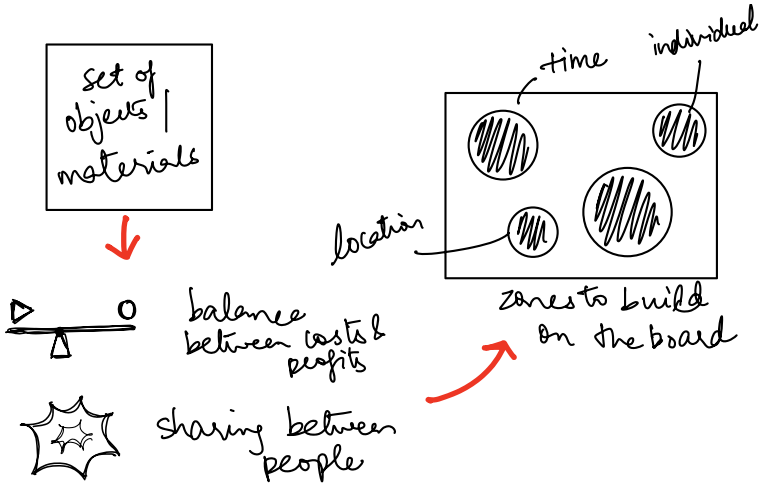


Figure 19. Visualisation of Idea 1

Idea 2- Object-oriented approach
What- Using objects as entry points into a future world. The objects will make the future scenario more tangible and experiential.
How- Participants interact with the objects and imagine the system from there on.
Background- Using threshold objects/ interactions as starting point for participants to imagine the system
Expected Outcome- Ideas of what the system can be or what participants imagine it to be

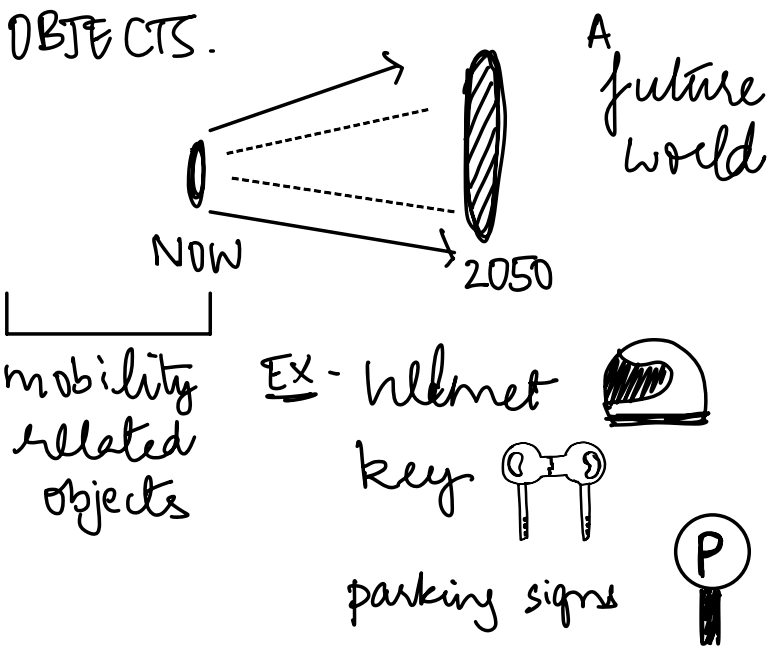


Figure 20. Visualisation of Idea 2

Idea 3- Road map
What- A fictional map with challenges/ a board game of
How- Participants play the game from start to end and work together to get past different challenges. The end goal would be a complete system with details.
Background- The challenges can be extrapolated directly from the tensions.
Expected Outcome- Consensus on some of the problems that have already come up

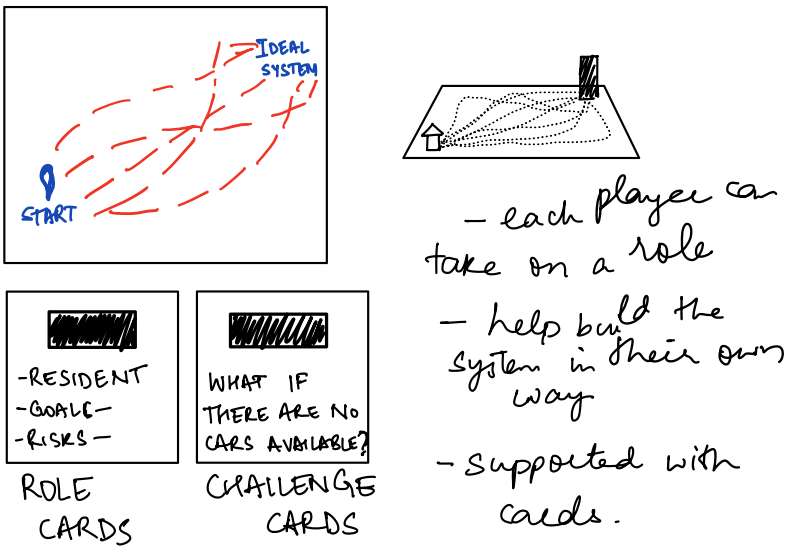


Figure 21. Visualisation of Idea 3

Idea 4- The black box
What- Four different boxes that embody different versions of the system
How- Each box comes with a description of the system, and the participants can go around building on it
Background- The idea that systems like these driven by technology and AI are often black boxes where the internal process is unknown
Expected Outcome- Four variations of what the system could look like, starting point to discuss what the ideal one would be.

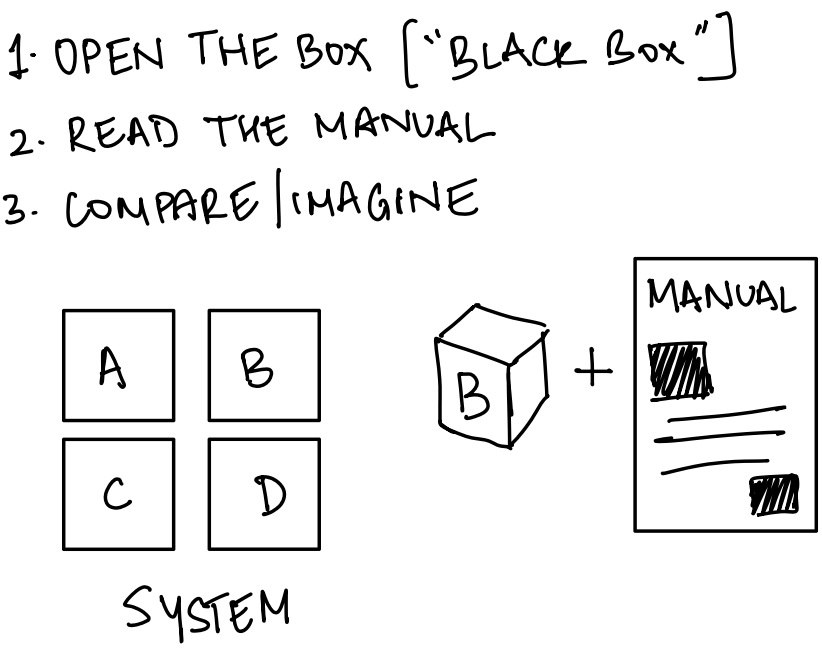


Figure 22. Visualisation of Idea 4

Idea 5- The timer

What - A clock that counts weeks, months, years

How- Participants can move the scale, and build at every stage on what the system will be like, what functions there are, and what influences it.

Background- A way to ground the system in reality and help them imagine it part by part

Expected Outcome- A developing system that also showcases how the progression could take place.

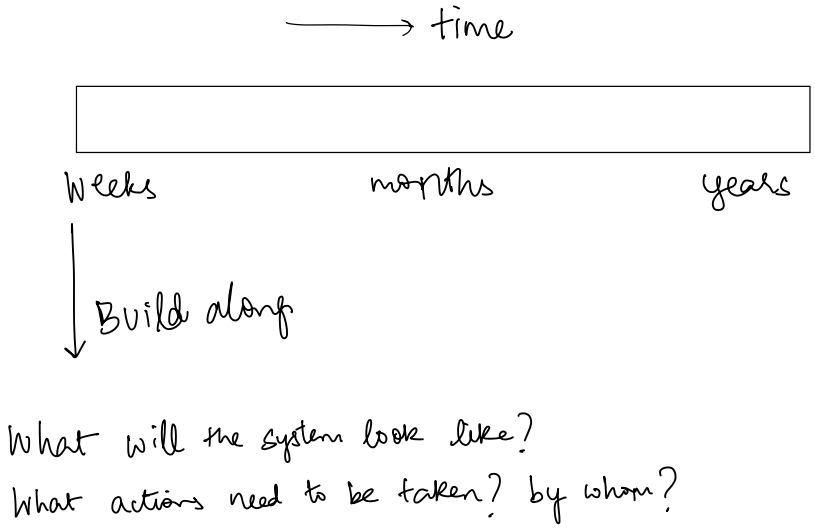


Figure 23. Visualisation of idea 5

Idea 6- Tension Dice

What- Each side of the dice visualises a tension/ concern

How- Participants can toss it around and depending onwhatever side it lands on, they can fill in aspects of the system

Background- There are many forces at play within the system, some of which will align and some won't.

Expected Outcome- An attempt to solve some of the tensions between stakeholders.

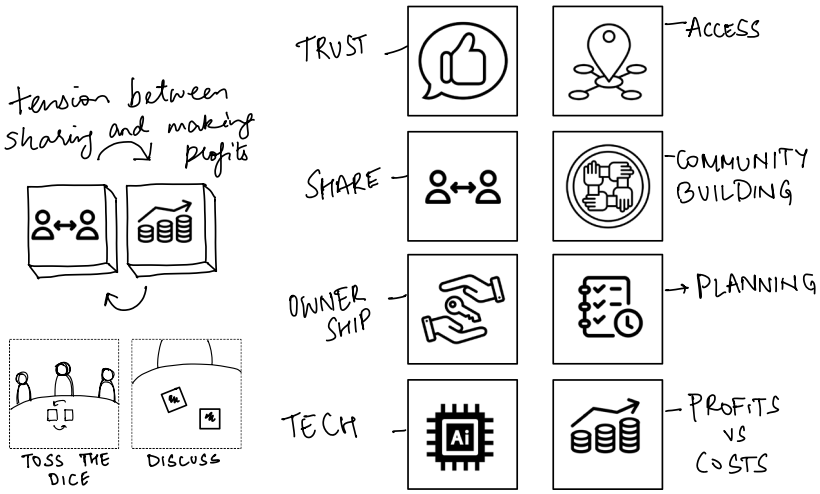


Figure 24. Visualisation of Idea 6

8.4 Choosing the final design

The six ideas were compared against the success criteria for the speculative artifacts. This helped to analyze which approach would work best. The comparison was marked with Yes, No, and Maybe. While 'Yes' and 'No' rate the criteria in absolutes, 'Maybe' signifies that it would depend on factors such as execution.

	Criteria 1- Address some aspects related to the shared mobility space	Criteria 2- is provocative	Criteria 3- Illustrates the abstract system	Criteria 4- Is relatable	Criteria 5- Brings together participants
Idea 1- Ritual Based	Maybe	Yes	No	Maybe	Maybe
Idea 2- Object-oriented	Yes	Yes	Yes	Yes	Maybe
Idea 3- Road Map	Yes	Maybe	Yes	No	Yes
Idea 4- Black Box	No	Maybe	Yes	No	Yes
Idea 5- The timer	Yes	Yes	Yes	Maybe	Maybe
Idea 6- Tension dice	Maybe	No	No	No	Yes

8.5 Final Concept- The Speculative Artifacts

Based on the criteria matrix, Idea 2- 'Object oriented approach' was the best performing idea. The idea uses objects as a starting point to give participants an insight into this upcoming system. The set of objects will embody points of entry into this system that exists in the future.

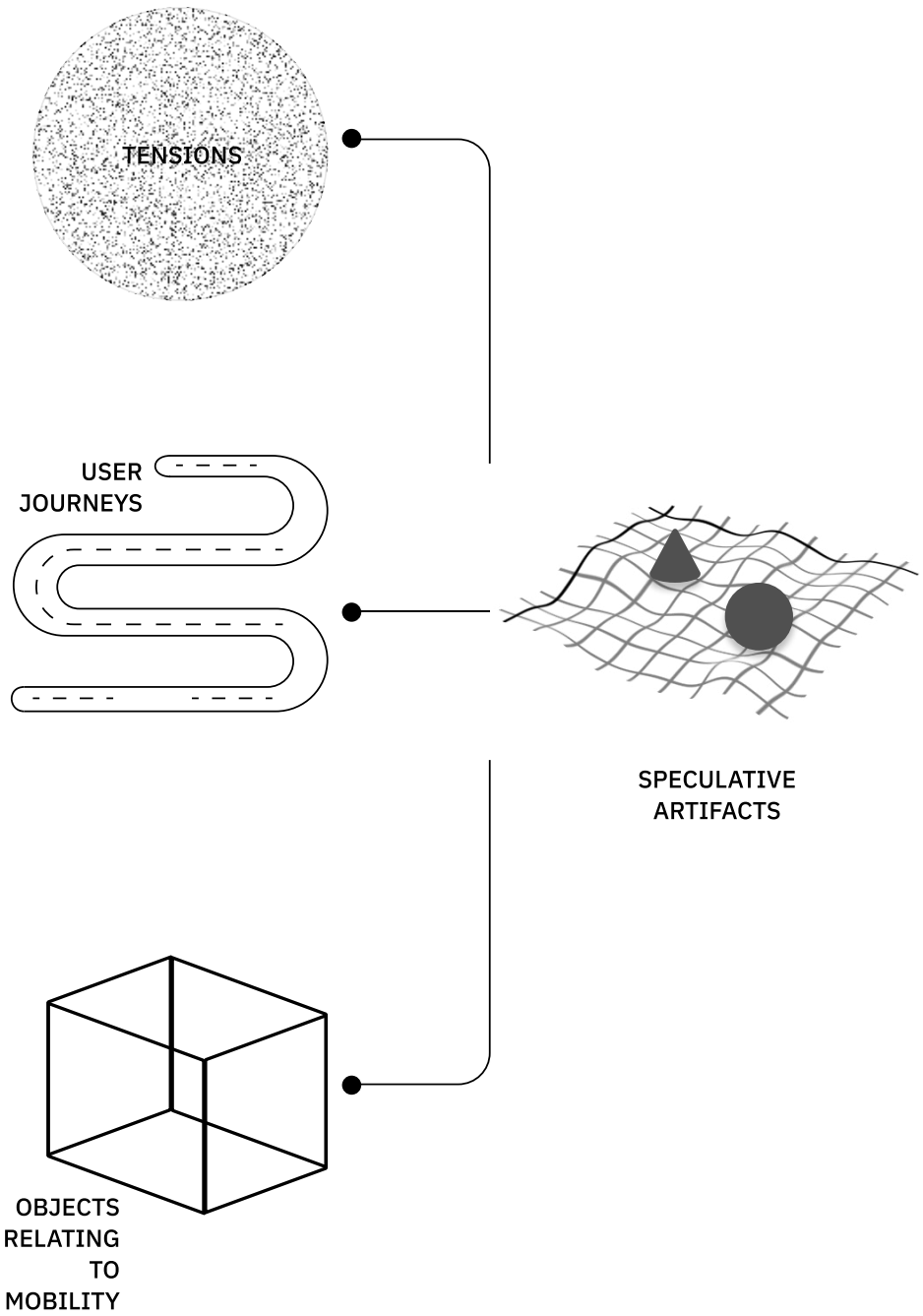


Figure 25. Plan to arrive at the final set of artifacts

Figure 26. User journey for current/future residents

The idea was to choose artifacts that participants are familiar with but also embody aspects of the future system. Understanding the interactions between humans and objects is crucial, both for designing improved or novel items and comprehending the human customs associated with these items (Murray-Rust, Gorkovenko, Burnett, & Richards, 2019). To help participants come up with their own stories and connections with the object and the system. These artifacts were set in 2035 in a world where shared mobility systems are already in place and would act as an entry point into this imagined system.

The decision to choose four objects out of the rest was based on a few reasons.

The goal was to ensure that the participants are familiar with the objects, use them, or can see themselves using them. The other aspect to consider was to see if these objects would exist in the future, can their current form be tweaked to convey a sense of futurism. Four objects fit both these conditions well and hence were chosen. The four objects were prototyped and made tangible. The artifacts: Urban signs, Navi-scape map, and Move card were digitally created and printed, the Nexus keys were clay molded. There was a difference in the finish between the articles and this was taken into consideration during analysis of the participant interactions. However, the varying levels of finish did not affect the interactions too much as will be described and explained in the next chapter.

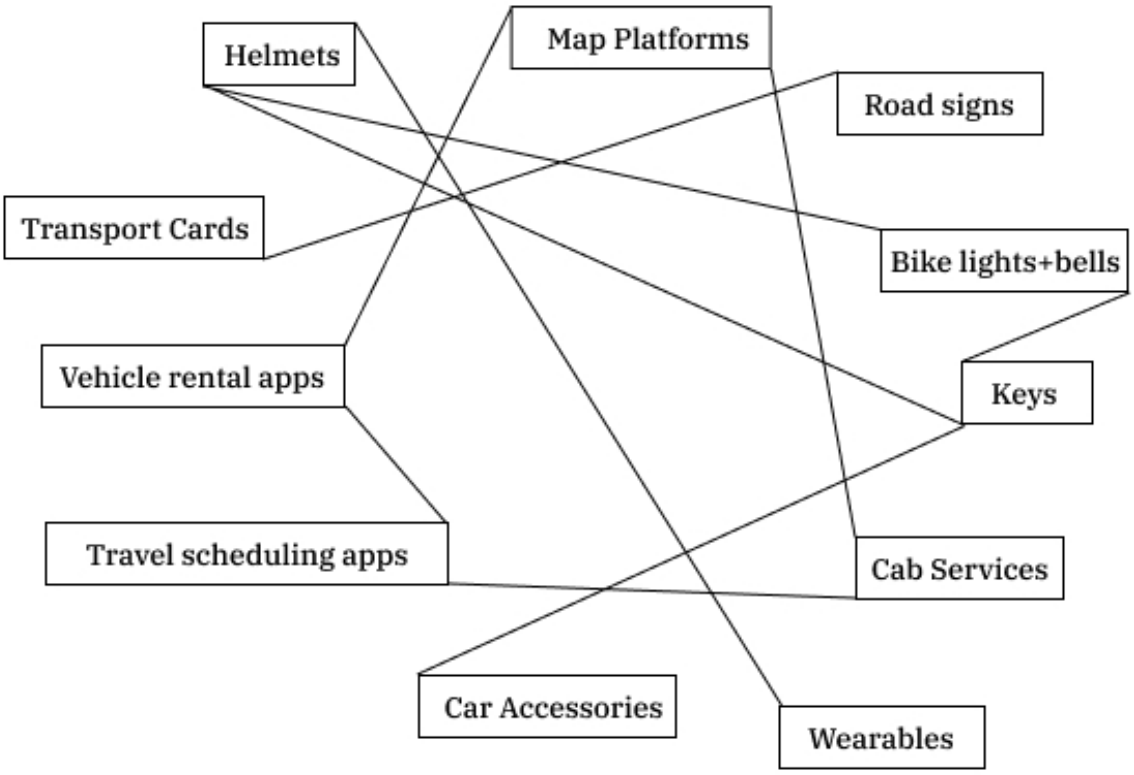


Figure 27. Possible objects for artifacts

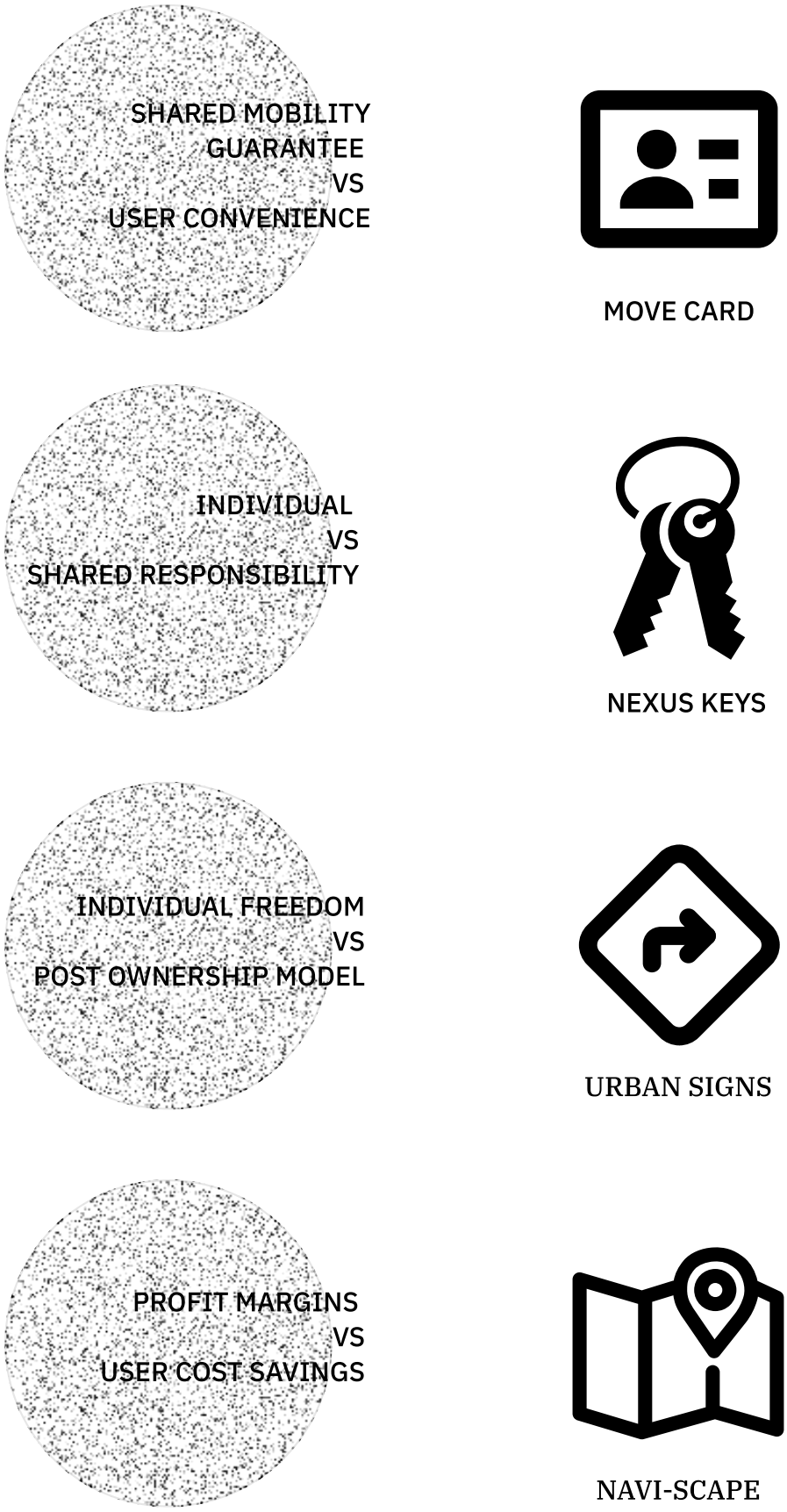


Figure 28. Relating artifacts and the tensions

Nexus Keys
They are a set of futuristic keys that can be shared among people to open shared vehicles.

→ This idea explores the concept of a ‘universal key’ that can be used to open any sort of shared transport.
→ It is connected to the cloud and also acts as a data storage.
→ There’s also a chance to connect the keys with neighbors and share transport.
→ To discuss shared responsibility, the main points of focus were sharing physical commodities and building something that participants consider their own but will be required to share to use more effectively. Keys were one such pair of objects. Keys to privately owned commodities like cars and houses are commonly used. What if participants were required to share these keys? Or a new function is unlocked when they are shared? The pitch for Nexus Keys also talks about the opportunity to open any shared vehicles available in the vicinity. This raises questions of who’s vehicles are being opened and who takes care of them.

Figure 29. Nexus Key

Move Card

It is a future transport card that can be used on public transport but also for community-shared vehicles.

→ This future transport card resembles the existing travel passes with a few changes. There are two tiers represented in the cards- a gold and a silver tier.

→ The major changes between the two are in the possible access points and movement level. The access points define what modes are available to the users, while the movement level offers perks.

→ The goal was to imagine a future when shared mobility is a big part of the system and integrated with public transport.

→ The move card builds on the idea of a mobility guarantee. Transportation cards currently offer access to public modes of transport and assure the ability to move. The guiding question for the design was what these cards would look like. If this was to be adapted to a future where shared transport would become a reality. The idea was to gamify the idea of access a little. Hence there are two versions of the card. Each offers different access points and 'movement levels.' This is useful to imagine a future where if a resident has a 'gold' pass, they are more assured of means of movement.

Figure 30. Move Card

Navi-scape

This is a reimagined version of Google maps, where the maps would suggest shared transport as a mode of travel. It also has a timeline that goes in-depth about patterns and monetary benefits of sharing.

→ In this version, shared transportation is offered as a means of travel when looking for options.

→ When looked at in detail, the map suggests the shared means of transport as the best and quickest way. It is a combination of driving a shared car, taking the train, and walking.

→ There's also a sharing summary page that showcases the use of shared transport over the previous month. It also has a heat map visualizing how much money the end-user has saved by using shared means. The goal of this visualization was to trigger responses on incentivizing and nudging people to opt for shared means.

→ The digital map extension imagines a future where shared transport is a norm. Users are suggested shared modes of transport to arrive at their destinations. The tension around profit emerged from the interviews but mainly from the stakeholder perspective. The map, however, has an extension that visualizes money saved by the user by using shared means of transport. This explores the idea of profit from the user's perspective but also pitches the idea of money as an incentive to use the system.

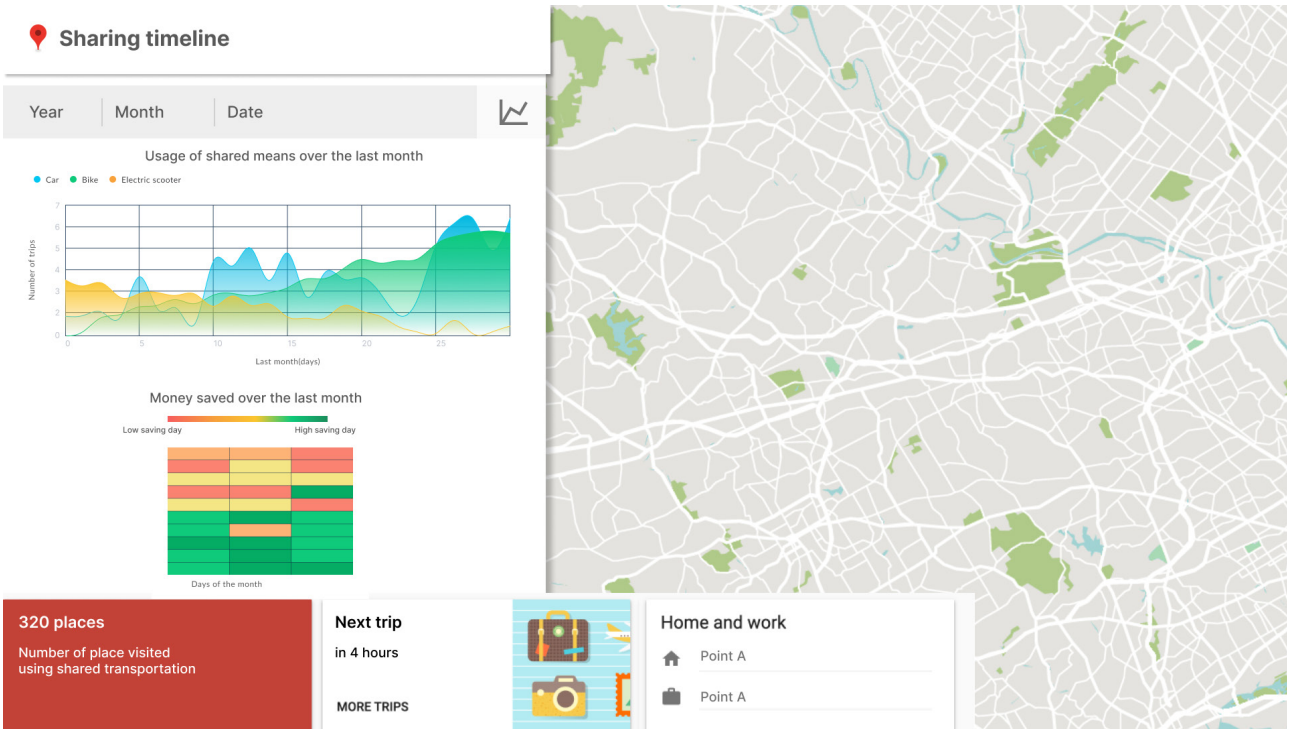
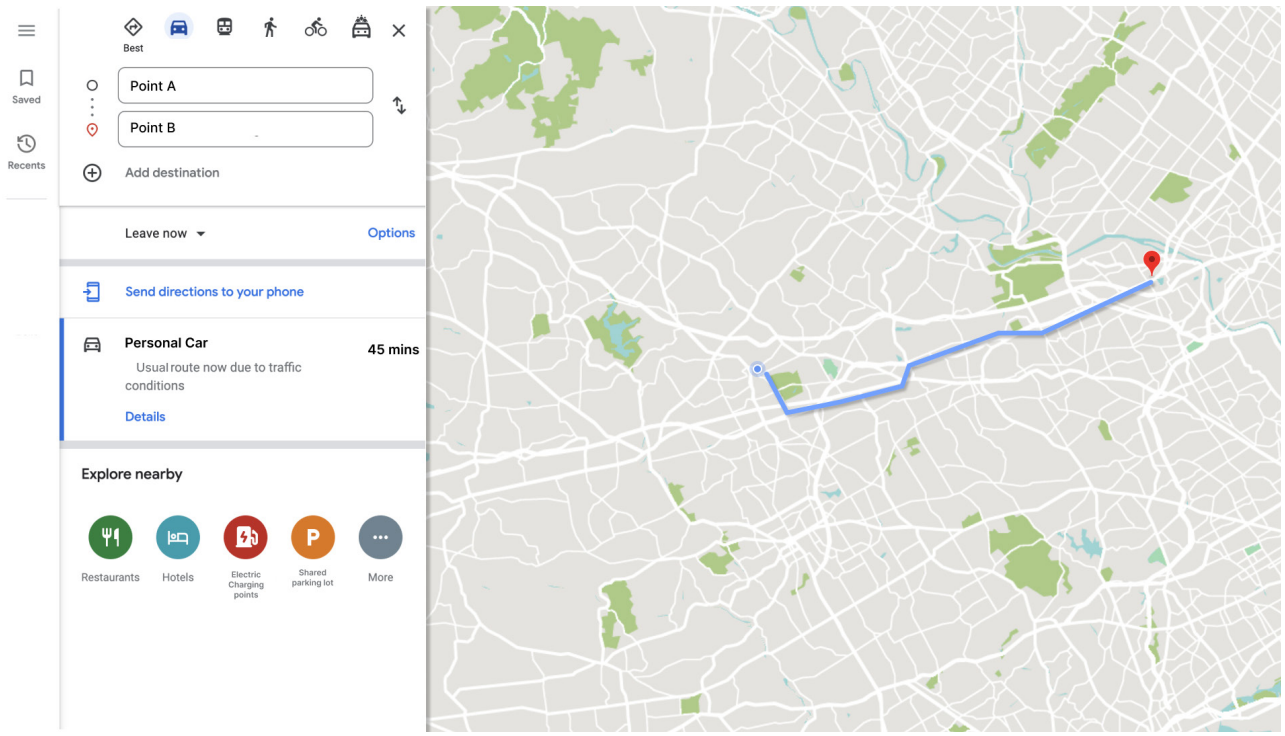


Figure 31. Navi-scape



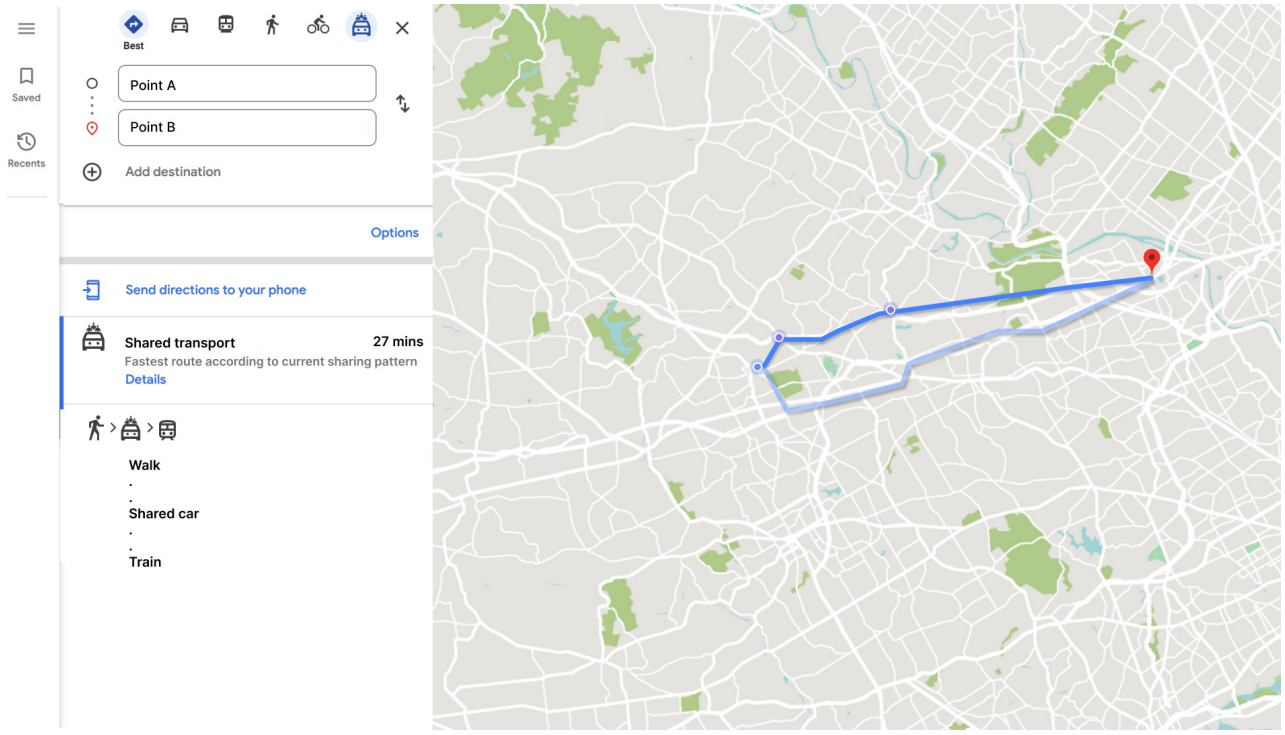


Figure 31. Navi-scape

Urban signs

These are road signs of the future for both public and residential spaces.

→ The road signs are imagined to be placed in public and private spaces.

→ The signs detail

- Pick-up points for shared vehicles.
- Parking spaces/Urban areas that will be specifically reserved for shared vehicles at certain times of the day
- Shared vehicles have priority lanes on highways to promote this behavior.
- An availability board to inform people what modes are available to be picked up
- Some specific areas in the city where private vehicles aren't allowed

→ The goal of these signs was to imagine the intersection of private and public spaces when shared mobility would become a reality. Think about the infrastructure changes that will be needed to make this system a successful reality.

→ To explore the idea of post ownership, the idea was to go beyond the realm of the other three speculative artifacts. While the other three are more one-one user interactions, the road signs set the scene in society. In this future, where shared mobility is a norm, road signs act as a guide for residents. They also connect the private and public spaces in a manner. They embody incentives for users that share transport, for example- easier parking space and priority lanes.

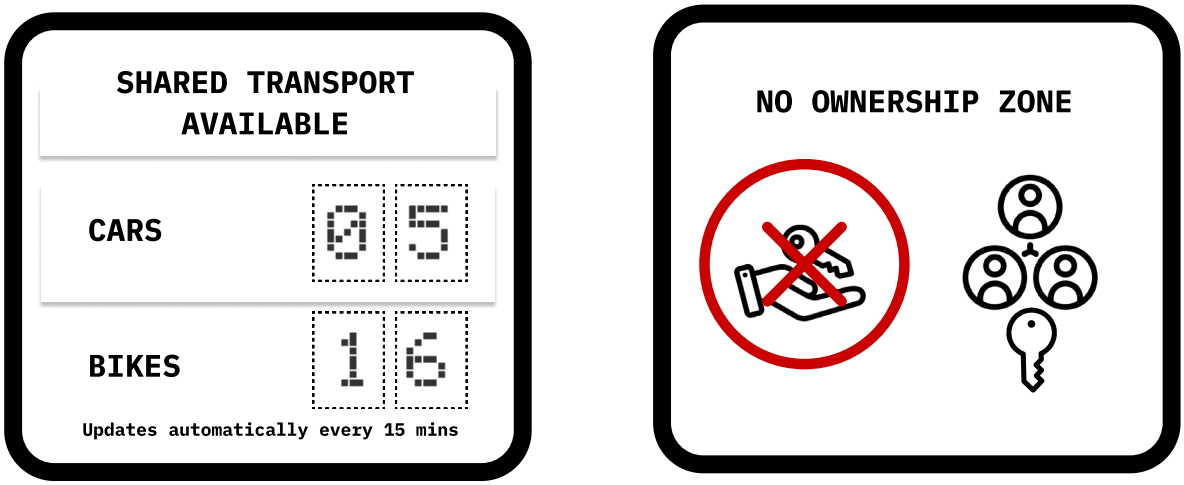


Figure 32. Urban Signs


PRIORITY
LANE


NO PERSONAL
VEHICLES FROM
7PM-9AM

CHAPTER 9

Sessions with Stakeholders

This chapter provides a comprehensive explanation of the multi-stakeholder sessions, delving into their purpose and objectives. The plan for these sessions, along with the activities involved, is thoroughly described. The chapter concludes by offering concise summaries of both the sessions themselves and the outcomes derived from them.

9.1 Session preparation and set up

The research question guiding the stakeholder sessions was, 'How can we co-create shared understandings for an upcoming AI system.' The stakeholders were split into two groups, both with a mix of directly involved participants and external participants. The goal of the session was to imagine what this system could look like and see if any consensus could be reached. This was done using speculative artifacts and the Stack. One week before arriving at the session, participants were sent a sensitizing document. The sensitising document is presented in Appendix C.

- → The goal of the sensitizing document was to inform and invite. The participants didn't need to do any prep work for the sessions.
- → The document had some details about the case study that was relevant to the sessions. The location, type of neighborhood, personas of prospective users, etc., were consciously emitted. This was done in an attempt to keep the conversation specifically about tensions within building the system and what a residential shared mobility system could look like.

The general structure for both sessions was similar. Some additions and changes were made to the second session based on feedback from the first. This was the general structure of the sessions. A more detailed Session script is presented in Appendix D.

Session setup
The general plan for the session was to break it down into four aspects- Understand-Reflect-Imagine-Co-create. In the first phase, participants understand and reflect individually. In the second phase, they imagine and co-create the system together.

Introduction
The session would start with a quick introduction. The project, research question, and case study of residential shared mobility will be introduced to the participants. This would be followed by the participants introducing themselves.

Setting the scene
Before introducing the speculative artifacts, a future world scenario was introduced. The participants were asked to imagine this world and take on the role of a user/resident in this world.
"The year is 2035. You live in a residential space/building. You are a resident/user. Personal vehicles are not practical to own or use anymore. So you rely on shared mobility and public transport. "

Activity 1
The participants were made aware of the future world they will be imagining themselves in. The participants were asked to imagine themselves as residents of this future system. The main reason for this were- the speculative artifacts are all interface entry points into the imagined system. All the artifacts objects were entry points from a user perspective. One of the takeaways from the interviews was that the user's perspective was not accounted for. Hence this was a good approach to get stakeholders to think of the end users

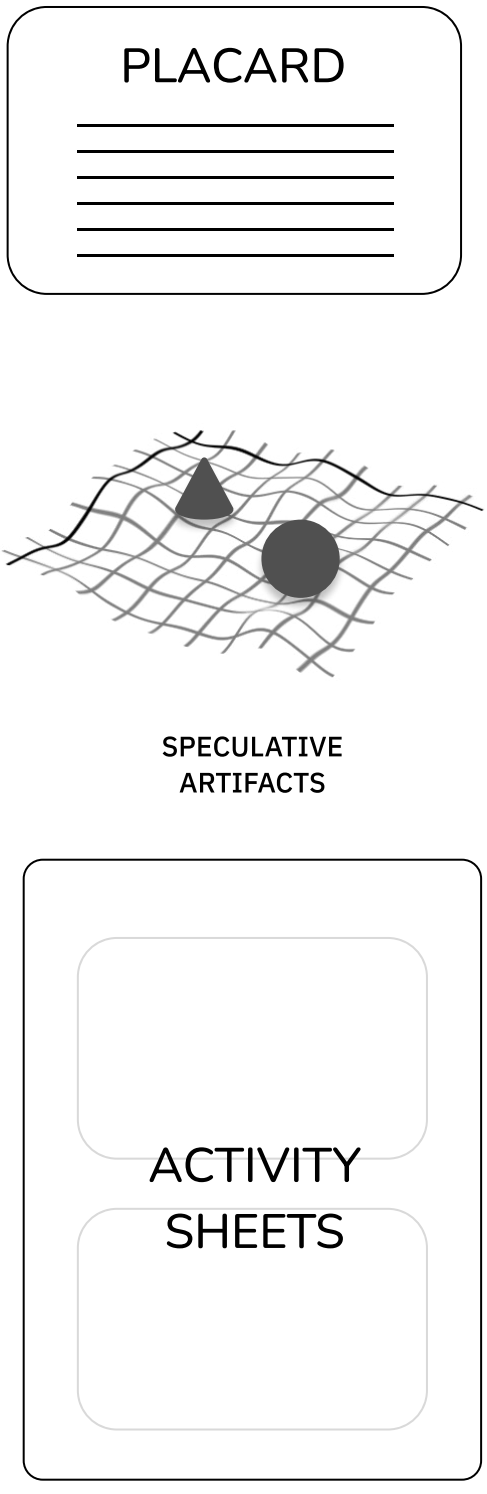


Figure 33. Plan for Activity 1

In the second activity, the participants were able to think from their own perspectives making the session multi-dimensional.

Each speculative artifact also had a small placard that had a short description of the artifact. The goal of the placards was to inform participants about the artifacts and expand on the physical objects. They lacked intricate details, inviting interpretation, and imagination. The detail and the finish combined with short explanations that describe their functions, and mode of interaction entice the audience into exploring the concept of the future (Auger, J., 2013).

The participants were also handed an activity sheet. The individual worksheet had two questions- “How would you use this object? What more would you need to know? “. The activity sheet was used to help participants reflect on the objects and give them time to collect their thoughts. The four speculative artifacts were

→ Nexus key- the shared smart keys
→ Navi-scape- the map system
→ Move Card- transport card
→ Urban Signs- traffic and parking signs

Each participant would interact with an artifact and write down their thoughts on the activity sheet. Each participant had seven minutes to do this. Once the time ran out, the participants would exchange the artifacts with each other. This would be done until all the participants had interactions with all four objects.

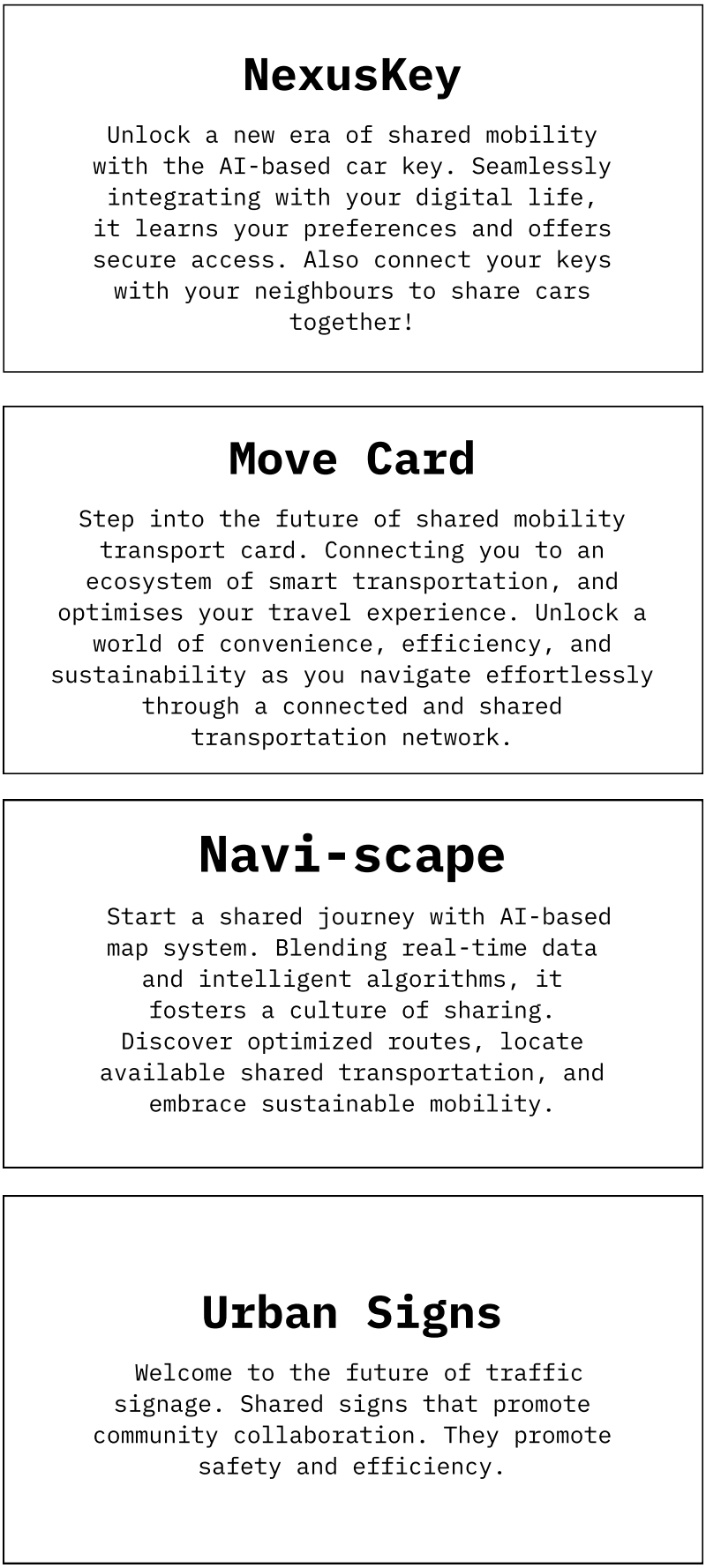


Figure 34. Placards describing the objects

Name: ---------- **Date:** ----------

Object 1:

How would you use it

What more do you need to know

Object 2:

How would you use it

What more do you need to know

Object 3:

How would you use it

What more do you need to know

Object 4:

How would you use it

What more do you need to know

Figure 35. Individual activity sheet for Phase 1

9.2 Session 1

Activity 2
The second activity was more of an open-ended discussion about thoughts from the first activity in order to see what general questions/concerns or ideas arise. This was facilitated using the Stack. Two different approaches were tested between the two sessions. With this activity, the goal was to get a system-level perspective, discuss the tensions and ideally work towards a consensus. The mission of this part was to co-create the best possible shared mobility system and how it can be achieved.

Wrapping up
The last ten mins of the session were reserved to have a quick reflection on the co-creation and the shared understandings part. The discussions checked if participants felt like they were building upon each other's ideas. Some questions based on the shared understandings criteria were discussed within the group.

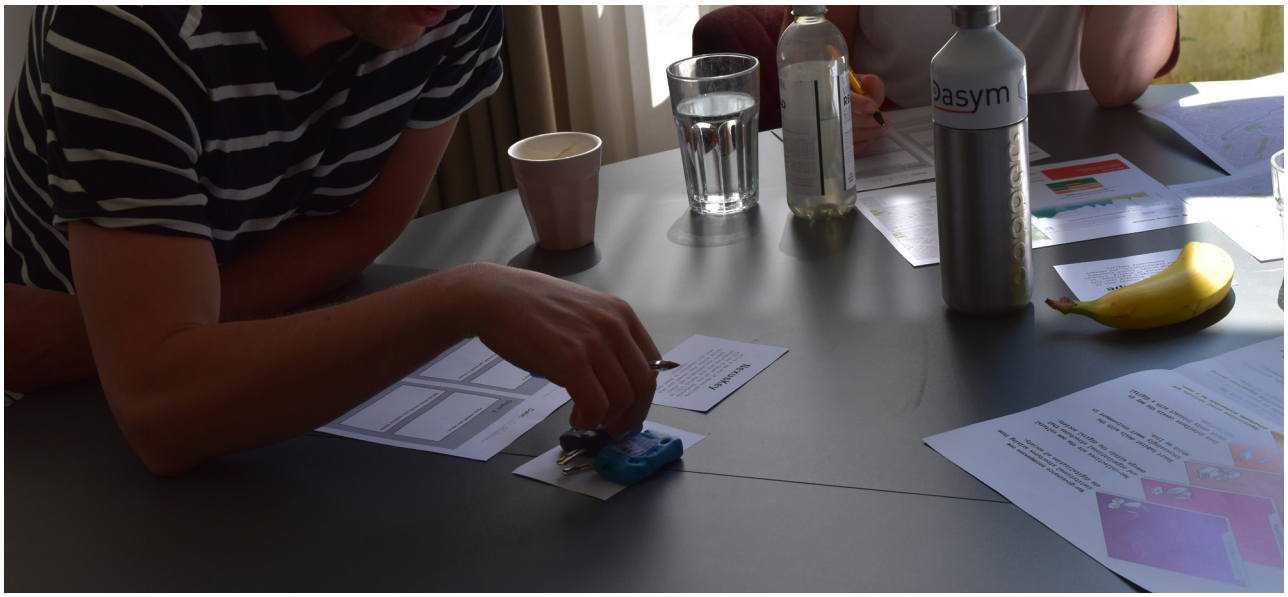
Post Session
Based on the findings from the session, a reflection document was sent to all the invited participants. The data from both sessions were collected for this.

In the first session, there were four participants. While Participants C and D were directly involved in the case study, Participants E and F were new to it.

1. Participant C- Sustainable business innovator at the real estate company. They work directly with all the stakeholders involved in the case.
2. Participant D- A researcher at FreedomLab, works with the case looking into sustainability and a business perspective
3. Participant E- Designer and urban planner who works with designing with technology. They were a good addition to the group because of their work with urban futures.
4. Participant F- A researcher at FreedomLab, works at the intersection of technology, economics, and culture. They offered a more critical view of the case study.

First activity
Each participant got 10 mins to interact with the objects and write down their thoughts on the activity sheet.

Second Activity
During the introduction, the Stack was introduced as a tool to imagine socio-technical systems. All four participants had interacted with FreedomLab's Stack in some capacity. The employees use it more actively in their work while the others don't. In this phase of the session, the Stack was reintroduced, and a visual representation was shown to the participants. It was suggested that they use the layers as lenses to think about the system in case they get stuck/ run out of ideas.



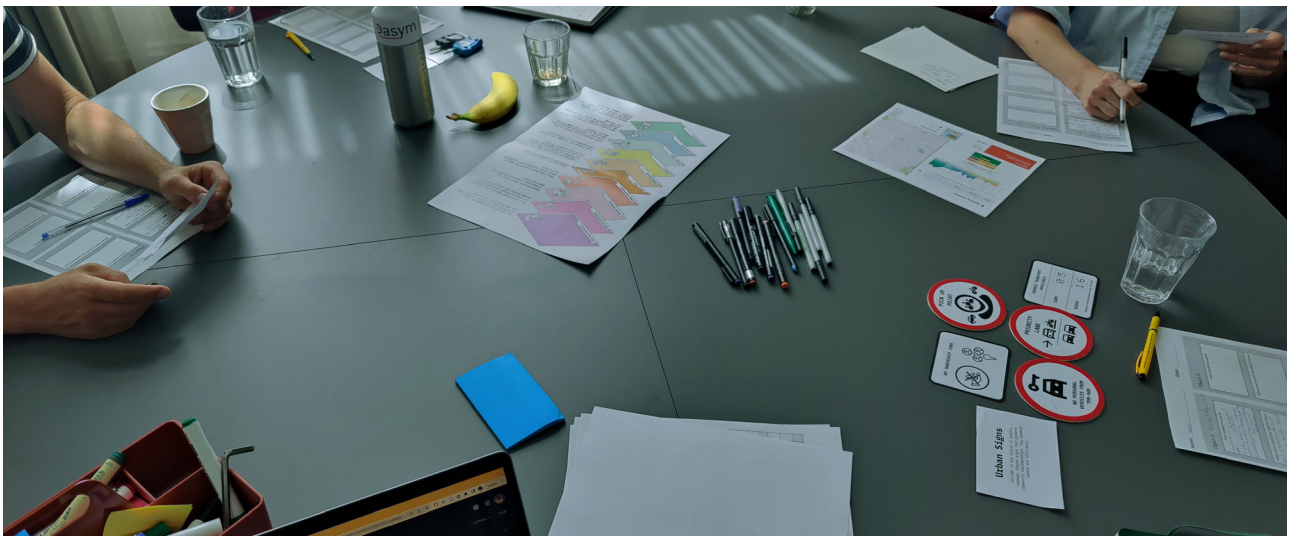


Figure 36. Participants during Session 1

9.3 Outcomes

What worked

→ The prototypes worked quite well and started off a lot of conversation. Participants recognized familiar objects but were also able to imagine a system or a future with these artifacts. It acted as a good entry point into the system.

→ The activity forms worked very well and participants took their time to fill it in detail. The format of individual activity followed by a group activity worked well and was even mentioned by some participants. It gave them a chance to think, create opinions and then have more in-depth discussions.

→ The format of having a discussion worked, given the experience and professional levels of all participants. The discussions were thoughtful and self-facilitated. They were building upon each other's ideas as well. Even though the Stack was not explicitly used, discussions around the intricacies of the system occurred. All the layers of the Stack were spoken off even if it wasn't mentioned in the same terminology.

→ Participants felt like they were building together and had a say in what the system constituted.

Points for iteration

→ The future scenario was not clear enough to the participants, so a different approach was taken in the second session. To find a way to make the vision of the future more explicit.

→ In the first activity, the interaction per object was about 10 mins which was a little too long. So this was reduced in the second session, which also offered more time for discussion.

→ There were some doubts about the boundaries of the shared mobility system in terms of how the residential shared mobility system would interact with the public transport systems or if shared mobility systems could exist in isolation. So this was better defined in the second session to ensure more directed and fruitful discussions.

→ While the Stack was used more passively in the first session, there was an attempt to see if it could be made more co-creative and actively help the discussion phase.

9.4 Session 2

In the second session, there were four participants as well. While Participants A,B, and C are directly involved in the case study, Participant G was new to it.

1. Participant A- a behavioral researcher working on the Residential Shared Mobility project. Their main role is to approach the case from a cognitive psychology perspective. Their work focuses on how to help more people adopt and buy into the system of shared mobility.
2. Participant B- Innovation strategist at the mobility-providing company. Their role is to find new mobility solutions for the company.
3. Participant C- Sustainable business innovator at the real estate company. They work directly with all the stakeholders involved in the case.
4. Participant G- AI and technology specialist that works with quantum computing. They have worked with shared mobility in the past.

First activity

Interaction with the speculative artifacts
Based on some feedback from the first session, the time per speculative artifact was reduced to 7 mins. Participants wrote down their ideas on the activity sheets.

Second Activity

Stack-based discussion
All but one participant in this session was new to FreedomLab's Stack. During the introduction, the Stack was introduced as a tool to explore socio-technical systems. It was also explained using the example of ChatGPT. All the intricacies of the system were broken down using the layers of the Stack. In this phase of the session, the layers of the Stack were placed on the wall. The goal of the discussion was to populate the layers of the Stack with ideas, thoughts, and questions about the shared mobility system. To work towards a Stack that visualizes this upcoming AI system in some sense.

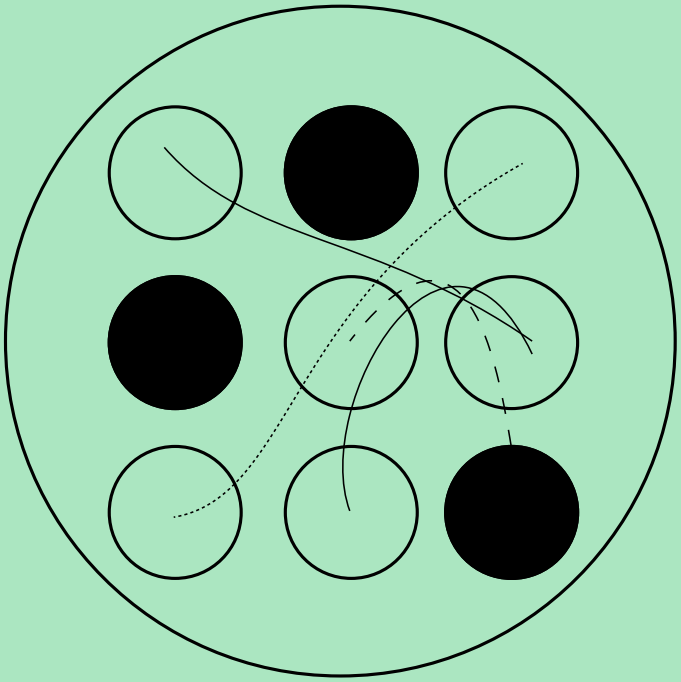
Figure 37. Participants during session 2

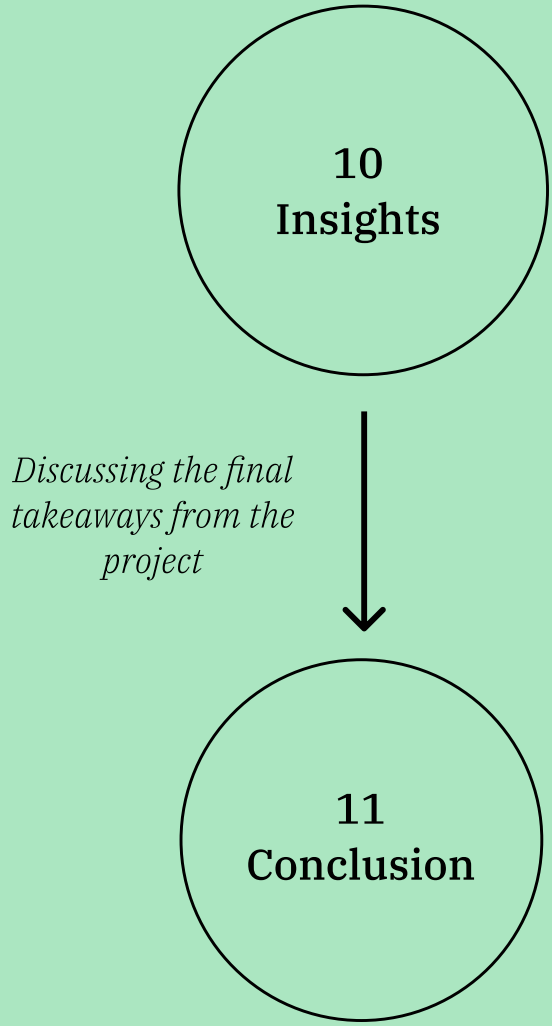
9.5 Results

- → The speculative artifacts worked very well to start the conversations about the system. They acted as an entry point into this future AI system. Participants responded well and were able to imagine functioning systems through these objects.
- → The activity sheets in phase one were effective in helping participants put down their thoughts. This also ensured more effective discussions in the second phase. Scans of the participant activity sheets are presented in Appendix E. Participants had enough time to put down their ideas, thoughts, and questions for each of the artifacts.
- → The discussions were very fruitful, be it structured or not. Participants were able to build upon each other's ideas and arrive at a consensus around some challenges as well.
- → The Stack was useful in giving people a common terminology to use while talking about the system. Participants worked together to build a Stack that embodies some aspects of the shared mobility system.
- → Participant C, the sustainable business innovator at the real estate company participated in both sessions. Being the owner of the case, they wanted to first-hand experience both sessions. While this is not ideal, it was looked into specifically in the evaluation phase. The two sessions were quite similar and conversations/discussion points initiated by participant C in session two were accounted for.
- → Participants felt like they were building together and had a say in what the system constituted.

PHASE 3
Reflecting

This phase focuses on the insights from the stakeholder sessions. It starts with the insights and themes that emerged from the sessions and connects them back to the literature study. This is followed by a discussion of the findings and what it means for research and design practice in general. This phase concludes with mentioning the limitations of the project and recommendations for further study.




10
Insights
Discussing the final takeaways from the project
11
Conclusion

CHAPTER 10
Insights

This chapter starts with the evaluation plan that was followed for analysis. The findings from the sessions are categorized into insights into the future of shared mobility and building shared understandings.

10.1 Evaluation Plan

10.2 Insights

Insights into the future AI system- Shared Mobility

Insights into building shared understandings

10.1 Evaluation Plan

Within the sessions, there were multiple avenues for data collection. The main ones that were considered were the individual activity sheets from Phase 1, the mapping of the Stack in Phase 2, and the discussions.

The activity sheets were analyzed to see what new ideas and queries the participants had relating to the artifact or the entire shared mobility system. This was done in comparison with the placards offered with each of the artifacts. The placards offered an introduction to the functions of the artifact. In the activity sheets, participants went beyond these descriptions. The goal of analyzing these worksheets was to understand the effectiveness of the artifacts to surface tensions and see how different stakeholder backgrounds shaped their responses.

The sessions were recorded and transcribed. Grounded theory method(GTM) (Birks & Mills, 2015) is chosen as the data analysis approach to find insights from the sessions. First, all the session transcripts are transcribed using the transcription feature in Microsoft Word. They are re-transcribed and compared to the audio files to prevent errors. The first round of coding is conducted to get general insights. The second round of coding is done on particular themes mentioned below. The coding process and quotations are managed in Atlas TI. The takeaways are later transferred to Miro to help build visual clusters more easily.The Miro Board screenshots are presented in Appendix F. The session transcript was coded for a set of themes. The theme list consisted of two subgroups.

→ The criteria for shared understandings- the conversations analyzed to see in what cases a shared understanding was created amongst the participants. While sometimes there was verbal confirmation for the consensus, other times it was more nuanced and had to be extracted from how the discussion progressed. These findings were categorized into the four criteria for shared understandings created at the start of the project i.e. functionality, situatedness, relatability, and expectations. This was useful to categorize conversations within the sessions but also to compare the insights from the individual interviews.

→ A more general list of codes was defined to filter through the long transcript in an attempt to pick on any other findings from the conversations. These four codes were derived from the evaluation plan followed during the interviews.

- Collective agreements- To see if the tensions that defined the speculative artifacts came up in the conversations.
- New tensions and concerns- to see if stakeholders were able to voice their problems
- Technology-related discussions- to see how AI-related topics are discussed and perceived
- Solutions- to see if the participants could work together and find any actionable steps ahead

Two major groups of stakeholders were not represented at the sessions- the municipality officials and the prospective residents. Their participation would have been of great value to this project. This was duly noted in the analysis when issues relating to the municipality of the prospective users arose. The observations were more critical because the parties were not present to put forth their views.

In order to structure the results of the evaluation, the insights are split into two categories.
1. Insights into the future of the shared mobility AI system
2. Insights into building shared understandings

10.2 Insights

Insights into the future AI system- Shared mobility

There were discussions about different aspects of the upcoming residential shared mobility system. The insights were divided into a few categories.

General Insights

Everyone's responsibility is important: There are quite a few stakeholders involved and impacted by the system. It was unanimously agreed that the stakeholders participating in the session need to share responsibility. Through shared responsibility, these stakeholders not only acknowledge the unique contributions they bring but also the mutual dependencies that bind them.

" I think there are mechanisms that can make sure people take responsibility, like in an open system. It could just be a reputation mechanism or fees."

Participant F, A researcher at Freedom Lab, works at the intersection of technology, economics, and culture

As a future AI System

Technology was discussed in a very positive light, as a means to enable the system and its functioning.

" I would definitely say there are so many evolving technologies that can really make this and put this in a whole different trajectory of solutions."

Participant F, A researcher at Freedom Lab, works at the intersection of technology, economics, and culture.

Some specific use cases such as being able to offer customized solutions based on user preferences and predictable occupancy rates were discussed during the sessions.

" Because you can make shared mobility very cost efficient when they have a predictable occupancy and they can only do that you know if everyone says yeah, but if I keep my own car. It won't work."

Participant C, Business innovator at the real estate firm (Session 1)

Transparency of the system: Participants wanted to make an effort to unravel the complexities inherent in their respective roles. The absence of 'prospective users' seemed to make the participants hyper-aware of their roles in making the intricate model more clear. So the discussions were around making the models transparent and easy to understand for themselves but also for the end users.

" How objective is the system?"

Participant B, Innovation strategist from the mobility providing company

Concerns

Mobility guarantee- The mobility provider and the real estate firm needs prospective users to feel secure about the availability of the shared means of transport. This mobility-on-demand offer is referred to as a mobility guarantee. The need for a mobility guarantee to help users trust the system. This was viewed as a possible pitfall.

" With residential shared mobility, you know already, you get a guarantee of mobility. You make assumptions before you go to live there. You know they will be shared. It's connected to your home. "

Participant C, a business innovator at the real estate company

The success of the system is quite dependent on the adoption rate. This is dependent on the preliminary adopters of the mobility model. Some of the stakeholders with profit-driven interests view this as a bottleneck.

" That is, it has to be adopted by 20 people. I think Urban Sign can work if it's only for one building. But if you want it to be affordable. Then you need a high adoption rate of shared services."

Participant D, a researcher at FreedomLab, works with sustainability

Solutions

The participants collaborated on the idea of having a sustainability slider on the map artifact. Depending on the user's mood they can choose how sustainable they want to be and the system would offer means of transport accordingly.

" 80% sustainable, but also like I'm willing to spend a certain percentage of time more to be more sustainable. If you are in a hurry you can put it on zero. I don't want to spend any more time. And then maybe the system already adjusts your level of sustainability to the most sustainable? "

Participant B, Innovation strategist from the mobility providing company

" Be more sustainable. And what I was also we are wondering the bias of the algorithm, can it be biased towards sustainability, can it always give you the most sustainable option, and then you can still manually change it but can it be biased towards sustainability"

Participant A, behavioral researcher

Participants also discussed the idea of possible subscription models to define the shared mobility system. This stemmed partially from the artifact-mobility cards. The cards had two versions, a gold, and a silver tier.

" You need to pay different amounts for subscription because I get the idea that maybe the gold people should have more vehicles available. But sustainable vehicles are available for everyone and then very luxurious cars are available for critical people."

Participant A, behavioral researcher

" Maybe you can think of other variables in which you can differentiate, like saying you just use it during rush hour so you get like a rush hour subscription, more adapted to people's patterns."

Participant E, Designer, and Urban Planner

Participants discussed that incentive models of some sort would be a good way to get more users involved to adopt and experiment with the shared mobility system.

" "What is the incentive structure for me to either use more mobility or to contribute to the network that we're building a shared mobility net? "

Participant F, A researcher at FreedomLab, works at the intersection of technology, economics, and culture.

" So if the government is involved also by planning the routes and the roads and everything. Then that could be an incentive for me to participate or use it."

Participant B, Innovation strategist from the mobility providing company

Insights into building shared understandings

The criteria for shared understandings served as a guide to facilitate the discussion and analyze if a shared understanding was arrived at. There were a few means to arrive at a shared understanding. Firstly, the participants had the opportunity to discuss their disagreements and arrive at a shared consensus and explicitly stated so. The second was through the discussions facilitated using the speculative artifacts and the Stack. These tools helped start discussions on some topics related to the future mobility system which provided space for the participants to build a shared understanding of it together. The third was from observation as a facilitator and analyzing the transcripts from the sessions. As a part of the analysis when the sessions were coded, some shared meanings evolved amongst the participants even if it wasn't stated explicitly at that time.

Functionality

Participants went beyond mentioning the possible functions of the system. There were discussions about the limitations and potential failures of the system. The speculative artifacts also acted as a starting point for participants to see what the potential advantages and disadvantages of the system could be. For instance,

On the topic of data storage and security, the discussions were facilitated through the speculative artifacts and the Stack. The topic first came up when participants started discussing the functions of the Nexus Key. The description on the placard of the key talks about learning user preferences and offering secure access. Five participants mentioned it in their activity sheets as well. This was again brought up during the discussion of the Data layer of the Stack. Participants had varying thoughts on who owns the data and who it is shared with. Together the participants decided that this is one of the main aspects of the system that is still unclear and needs to be considered while taking it further.

" Also data storage and data analysis would be something that I would be interested in."

Participant D, A researcher at FreedomLab, works with sustainability

" It is about ownership, so who obviously owns the data of the platform that is being built and how is this data being shared or possibly monetized. Is it by the users or by an external party?"

Participant F, A researcher at FreedomLab, works at the intersection of technology, economics, and culture

"And I think every party doesn't matter which party is trying to own the data and it's now seen as your business model, you don't sell products or services, you sell the data or the knowledge that you gain. "

Participant B, Innovation strategist at the mobility-providing company

One of the participants brought up the idea of decentralization and how it might benefit a multi-stakeholder system such as this. Decentralization in terms of data, responsibility, and accountability to name a few. This was debated within the session because private partners such as the real estate company and the mobility provider have a higher stake and hence higher power within the system. But upon discussion, the group arrived at a consensus that assigning and clarifying roles at the current stage of the project will be beneficial in the longer run.

" All stakeholders have to commit to plugging into an additional decentralized mobility system, where responsibility is shared. Costs are divided. "-

Participant D, A researcher at FreedomLab, works with sustainability

" I would also like to imagine what kind of more decentralized mobility solutions can be developed. And it could be a big threat to the current structure."

Participant F, A researcher at FreedomLab, works at the intersection of technology, economics, and culture.

"There are profit-driven companies involved, so I also feel like to answer these kinds of questions we need to experiment with decentralization"

Participant D, A researcher at FreedomLab, works with sustainability

Ownership was another aspect of the system that was discussed in depth. This began with the artifact Urban signs and dialogue on who owns these signs: the community or the local government. This raised questions about ownership of vehicles, and all other supporting resources required for the system to be functional. Two participants mentioned it in their activity sheets as well. Stakeholders like the mobility provider had an idea of what they would own but not a lot of ideas about the other supporting infrastructure that might be needed for the system to be in place. Community ownership of the vehicles would be ideal but the users not having the right tools to support this ownership was discussed as a possible failure point for the system. The participants decided that defining an ownership structure at this stage would be valuable to the smooth running of the system.

" We need to clearly define the ownership structure. Through the companies that are involved, to experiment and see what works and what doesn't."

Participant D, A researcher at FreedomLab, works with sustainability

" The ownership goes to the community but they need to have tools to use it."

Participant C, Business innovator at the real estate firm

" What transport is available and what are the rules of ownership"

Participant D, A researcher at FreedomLab, works with sustainability mentioned in the activity sheet

Situatedness

Participants were able to situate the shared mobility system in larger contexts and existing infrastructure. There were also questions about the contextual influences that could affect the system in the future. There were concerns about how it might be difficult for the mobility model to plug into existing systems because of shared responsibility. In some instances,

Connecting the residential shared mobility system with the public transportation system had the group divided during the sessions. Some participants debated that it might be hard for this system to fit into existing public infrastructure. When this was discussed participants realized that this would be easier to do if the municipality was more actively involved in the development of the system. The common consensus was that discussions and ideating with the municipality can help identify ways in which this residential system can work in hand with the public transport system. In a manner to benefit all parties involved.

There were doubts and concerns as to how the current mobility model could be scaled. The future system is imagined for a residential space, but some participants raised questions about what the next step would be. The conversations moved back and forth between not being scalable to finding ways to make it scalable. Even though there were some ideas for expanding the system, the participants came together and agreed that it would be hard to do in the current model. The participants concluded that to be scalable the mobility model will have to be changed in some aspects such as connecting to the public infrastructure.

" I think it is way more difficult because you're plugging into open systems and public systems that you are not in control of."

Participant D, A researcher at FreedomLab, works with sustainability

" I think there's a huge difference between public and shared and I cannot combine it in my head."

Participant C, business innovator at the real estate company

" Use mobility in places where public transport doesn't go"

Participant E, Designer and Urban Planner mentioned in the activity sheet

"To make this a scalable solution, it could be interesting. I mean, let every residential building have their mobility system. Make sure that there is another layer that connects them all into one big platform "

Participant F, A researcher at FreedomLab, works at the intersection of technology, economics, and culture.

" It's not very scalable right now, but it can be done. There are some initiatives that do it currently that can be looked into as inspiration. "

Participant C, business innovator at the real estate company

Relatability

Participants were able to ground the system in their own lives based on their backgrounds and relate it to their surroundings. Each participant had insights on what to do to work towards building the shared mobility system together. For instance,

Participants compared the future system to existing sharing and rental models. Some participants mentioned personal experiences with renting their own cars out as well. They were able to relate to the system not only in their professional roles but also as possible users of the system. The discussion revolved around how all the participants at the sessions would want to partake in future AI systems in some capacity.

"Yeah, because currently, I'm renting my car through Snap Car(a private car rental platform). "

Participant D, A researcher at FreedomLab, works with sustainability

"I rent a car anytime I need it, so I don't have to have my own car but just need to use the platform to book one. "

Participant E, Designer, and urban planner

" would use the shared car to meet friends/family - going to remote places, holidays - rent out a car and earn money"

Participant D, A researcher at FreedomLab, works with sustainability mentioned in the activity sheets

The topic of sustainability was brought up often in the discussions. The details mentioned on the Navi-scape map artifact triggered these discussions. Each of the participants had different definitions of sustainability and how the shared mobility system could promote it. Not all the participants agreed that this shared mobility model is sustainable and environmentally friendly because it still promotes movement. Upon discussion, a consensus was reached that the participants found it hard to imagine a fully remote world with no travel needs. It was concluded that in such a world, a shared means of transport would be better than an own vehicle.

"But if you take it from a sustainability perspective, you're still promoting movement."

Participant G, AI, and technology specialist

"Simulating movement can be sustainable, but it also cannot be sustainable. So at least let's be sustainable."

Participant B, Innovation strategist from the mobility providing company

"Does the algorithm bias towards sustainable options?"

Participant A, behavioral researcher mentioned in the activity sheet

Participants were able to go beyond their own roles in the system and imagine how possible users might interact with the system. The participants from non-profit-driven perspectives suggested ideas for involving prospective residents. One suggestion was for residents to move into the space, use the mobility system for a bit and then have a chance to opt out if they don't like it. This was discussed to some extent because, in an ideal world, this would work and open up space for iteration and improving the system. But in the current model that would be risky financially for the mobility provider and the real estate firm. So the participants discussed other means of getting future residents involved. One such idea was to conduct focus groups with prospective residents already and involve them in the defining of the system.

"Well, if the residents move in and try it out for a while, how do they like the system?"

Participant E, Designer and Urban Planner

"So I think at some point there have to be some focus groups with the potential residents"

Participant D, A researcher at FreedomLab, works with sustainability

Expectations

By the end of the session, participants were able to set expectations for the shared mobility system. The discussions went into the intricacies of the emerging technology needed to support the system as well. Some instances were

The speculative artifacts as well as a few layers(like the user interface layer) in the Stack raised questions about the tangibility of the system. The participants were faced with questions about making this abstract future system tangible not only for the sessions but in the final mobility system as well. Some participants were taken aback by the idea of having more than just an app to support the mobility system. But through discussions in the sessions, a consensus was reached as to how it would be nice to have more physical interactions to support the mobility system and it would be something to look forward to.

"Just like you see with like current keys or books, it would be nice to have something physical"

Participant B, Innovation strategist from the mobility providing company

"And I also thought it would be nice to have something physical that has my preferences in it with me, like my jewelry."

Participant C, Business innovator at the real estate firm

"Feels more tangible, like an idea connected to your smartphone or watch"

Participant C, Business innovator at the real estate firm mentioned in the activity sheet

There were discussions about the system's needs for predictability from different perspectives. Prospective users would like to know the availability and ease of access. Three participants mentioned predicting information in their activity sheets as well. For mobility providers and real estate owners, it is vital to predict the occupancy of the vehicles to ensure the success of the system. The participants discussed these aspects and deduced the role technology plays in all these aspects. Technology enables a lot of these solutions but there were still open questions on how this would be executed.

"Make shared mobility very low cost efficient when they have a predictable occupancy"

Participant C, Business innovator at the real estate firm

"If you really want to use it for commute, it needs some kind of predictability about when it's available."

Participant E, Designer and Urban Planner

The idea of shared mobility was heavily based on simulating a community-first feeling. The long-term running of the mobility model is heavily dependent on public initiative and participation. Two participants mentioned inducing a community feeling in their activity sheets.There was a clash in this aspect where some participants thought too much was being asked from the prospective users. There was a debate about the responsibility the users hold vs the power that they possess in the overall system. One of the ideas to overcome this was to involve a specific group of users from the start of the project, in the development phase itself. This could possibly help prospective residents feel more responsible and involved in the functioning of the system.

"Through the system, you also want to stimulate social cohesion and community feeling"

Participant D, A researcher at FreedomLab, works with sustainability

"As a community or a society agreed on something because if not, then it won't work. We all decided together."

Participant B, Innovation strategist from the mobility providing company

"And in these mobility type cases, there's always like a super proactive minority that kind of leads the way and takes the decisions and the rest will just follow"

Participant E, Designer and Urban Planner

There were multiple instances mentioned where participants attempted to build a shared understanding of the system. In some cases, it started with disagreements between the stakeholders that were solved, or at least a consensus was reached. In some other cases, it was more about building an understanding together of a certain aspect of the future AI system. In the discussions and the approach, there was a shift from traditional explanations. The approach was more practice-oriented and context-dependent. This helped participants have a more holistic and situated understanding (Schwaninger et al., 2021). This is amplified when the sessions were analyzed through the lens of the criteria as well. The analysis suggests that through the speculative artifacts and the Stack, participants were able to build understandings of the abstract mobility system, individually and as a group. Participants from different backgrounds were able to express their personal understanding and work towards a common ground.

CHAPTER 11

Conclusion of the project

This chapter starts with a discussion that generalizes the findings from the previous chapter. It also defines the limitations of the project and proposes opportunities for future research and practice.

11.1 Discussion
11.2 Limitations
11.3 Reccomendations

11.1 Discussion

As mentioned in the chapter on insights, a wide variety of conversations took place during the session and the general course of the project. The goal of using speculative artifacts was to surface tensions in the future system and find ways of resolving those tensions. The tensions defined in Section 8.1 were discussed and the participants aligned together on a few aspects of the system.

Topics such as
→ reducing the usage of cars
→ having a transparent pricing mechanism
→ the need for all involved stakeholders to agree on the rules together
→ rewarding or incentivizing the users of the shared mobility system

These alignments between the participants can be traced back to some of the tensions that were formulated based on the individual interviews.

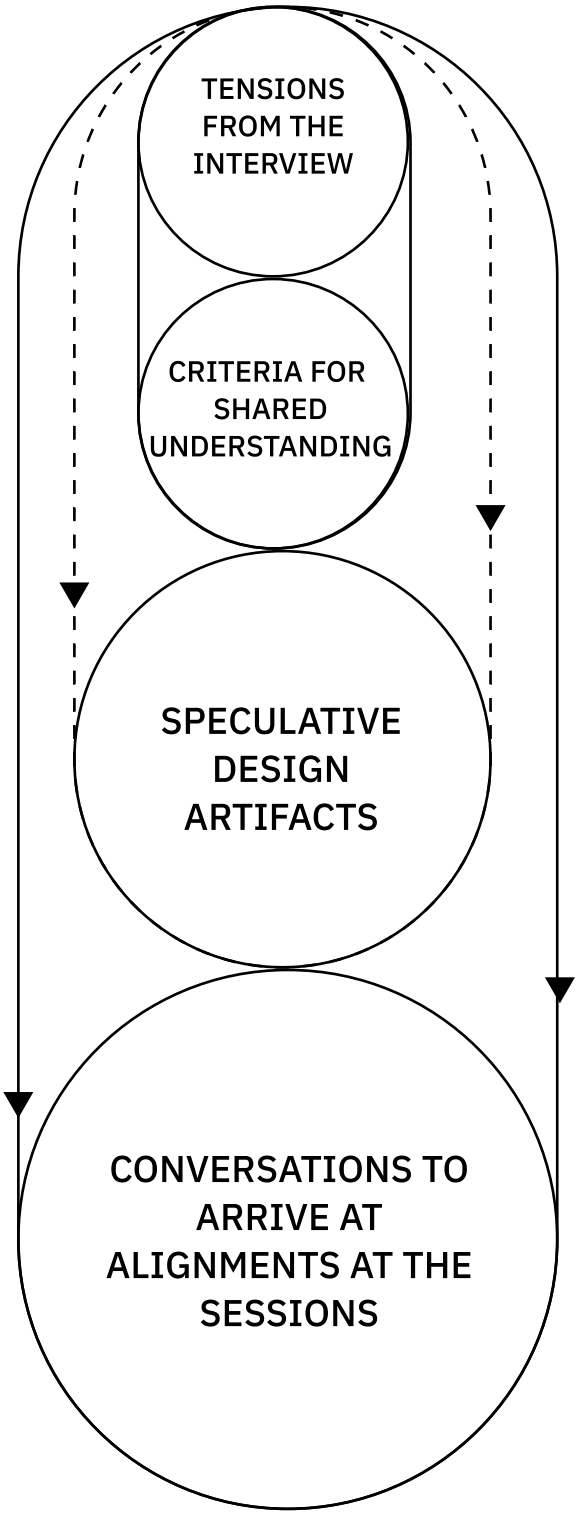


Figure 38. Overview of the interactions

The ultimate goal was to use artifacts to connect stakeholders with technology and build narratives relating to what stakeholders already know. This could help speculate and reflect on possible opportunities for the field of XAI in the future. This project did not propose an objective means to evaluate if a shared understanding was achieved amongst the participants. But through analysis, observation, and coding instances of shared understandings were derived. The methods and design tools used to build these understandings served their intended purpose and supported the participants. The stakeholders were related to the future AI system in distinct ways and came from different backgrounds as well. Through the sessions, the stakeholders were able to discuss aspects of the future AI system. This included tensions between their roles, their concerns, and possible solutions. By the end of the sessions, the stakeholders had ideas on what they can do in their role to work towards this system. But also as a multi-stakeholder group, they shared concerns on certain aspects of the residential shared mobility system. The criteria for shared understandings was one of the key frameworks guiding this project. The criteria were useful to define the activities as well as to evaluate the methodologies used to arrive at these shared understandings. The criteria are generic and offer the opportunity to be used for other AI systems as well.

Generalising the insights from Shared understandings to Explainability of AI

In terms of the overall process, seeking shared understandings was one approach to tackle the explainability of AI. Approaching shared understandings from the perspective of speculative design is a novel approach. More specifically surfacing tensions and resolving them to arrive at shared understandings in multi-stakeholder groups. The discussion at a lot of points went into depth about data and algorithmic functions within the shared mobility system. The participants were aware that the speculative artifacts although just touch points into the system collected data and presented automated decisions. So the discussion was not just about this surface-level interaction but also about how it integrates into the larger system.

Accounting for different stakeholder needs

Different stakeholders approach the future AI system from different perspectives. This was clear from the start, where different participants had different ideas of what shared mobility is. Through the sessions, participants were able to question the functions, limitations, and implications of the system. The tension and dynamics between the stakeholders manifested through the artifacts. The sessions ended with participants coming to a consensus and building a shared understanding on certain aspects of the system. At the same time, they were also able to relate to the system individually. Three of the participants mentioned how they now had a different approach to the shared mobility system and had new ideas to implement in their own roles.

This was possible because participants were equipped with the design tools like the Stack to understand the intricacies of the system from their own perspective.

A more holistic approach to explaining AI systems

Explanations should consider social and technical implications, and go beyond technical functions. The speculative artifacts as well as the Stack ensured that the future AI system is looked at as a whole and not in isolation. This paved way to discuss the implications of the system as well. The limitations and possible failure points of the shared mobility system were discussed as well. Once participants were able to situate the mobility system in the future, they were able to discuss the intricacies of its functioning with more ease. Based on the approach followed during the project, it is clear that participants are able to discuss the workings and the implications of an AI system better when it's situated in a larger context. The participants were given the opportunity to build their own narratives and understandings and work as a group, in the end, to arrive at a shared understanding about certain aspects of the future AI system.

Reflections on the Methodology

After conducting the literature review and understanding the residential shared mobility case study, a process of engagement was created with clear goals including some speculative methods. The process used to arrive at these shared understandings started with conducting one-on-one interviews with stakeholders related to the system. The interviews worked very well to understand the background of the stakeholders concerning the case. It was also useful to gauge how different stakeholders currently understand the system and imagine the future of the system to be. The interviews concluded with a discussion of the future scope of the shared mobility system. The insights from the interviews acted as a good starting point to map the stakeholders in the system. This showcased some tensions between different stakeholder interests. The next step was to bring these stakeholders together in a participatory session. Two sessions were held in this regard. The two main tools chosen to facilitate these sessions were speculative artifacts and the Stack from FreedomLab. The tools helped facilitate more thorough discussions by prompting the participants through reflection on the artifacts and the layered structure of the Stack. The goal of using both these tools was because they complement each other well. The Stack offered a concrete structure to break down the system but lacked tangibility and provocation to think about the future, the speculative artifacts helped participants anticipate the future but only from an interaction-level perspective.

Speculative Artifacts

The goal of using speculative design in this project was to surface tensions present within the current system. The challenge was also to use speculative design tools for a concrete real-world problem and test it with participants outside the design community. The artifacts also helped participants look across the system. The designed artifacts manifested tensions that emerged from the one-one interviews. The artifacts were daily-use objects designed for a shared mobility system set in 2035. This helped participants be immersed in the future AI system and explore possibilities through the interaction level. It offered some context to the abstract systems. Within the activity, participants interacted with the objects individually and wrote down their thoughts on an activity sheet. This gave participants time to reflect and construct their thoughts before moving to the discussion phase. The activity sheets also acted as a means to discover existing shared understandings and surfaced them in the discussions. Participants overall reacted positively to the artifacts. They were very intrigued by the possibilities of the system when seen through these objects. They were able to build a frame of reference around it which is visible in the analysis of the activity sheets. Each participant had a different approach to the artifact and this was driven by a variety of reasons: their backgrounds, how they related to the system, and how they imagined it.

Navi-scape

Five participants mentioned user preferences on their activity sheets. The participants wrote about how the map would be more useful if it is personalized to the users. They also mentioned the predictions of timings and routes in the maps will help inform user decisions.

Nexus Key

Six participants mentioned data-related issues in the activity sheets when talking about the Nexus keys. Issues around data storage, privacy, and system optimization were mentioned as well.

The artifacts did beyond expected where tensions emerged but also new ideas and aspects of the system were being questioned.

Move Card

The tension between 'shared mobility guarantee vs user convenience' manifested in the form of the Move card. This tension emerged in how the participants interacted with it as well. Participants mentioned ideas on how the transportation card could help increase prospective users' interactivity with the shared mobility system.

"The card can increase user's level of confidence in shared mobility "

Participant G- AI and technology specialist

"It would be nice if it would adjust to my travel style"

Participant D- A researcher at FreedomLab

Urban Signs

The tensions between 'Individual freedom vs Post ownership' was explored through the Urban signs artifact. This is reflected in the thoughts participants put down in the activity sheets. Topics of availability, ownership, and collective values were mentioned.

"What transport is available and What rules of ownership apply and to who? "

Participant F- A researcher at Freedom Lab

"These signs if in place, look like we agreed on something as a collective. More users would trust it too"

Participant B- Innovation strategist at the transport-providing company

Stack

In the second half of the session, the Stack from FreedomLab was used to facilitate conversations. It was introduced and explained with an example for participants not familiar with it. It was used to converge ideas and thoughts from Phase 1 but also expand on the intricacies of the system on every layer. It provided vocabulary and an anchor for all the participants to work together. It was useful to understand a thorough breakdown of the system and what aspects of it still need to be defined. It offered a systemic overview and a mental model for participants to image the shared mobility system as a reality. The Stack was effective as a collective sensemaking tool for the multi-stakeholder group. It was particularly useful to support shared understandings via Functionality and Expectations. It gives an overview of the intricasies of the system raising questions of how something can happen?

It would have been nice to have more time for this part of the session given that the stack is a complex model and hard to grasp fully the first time. But in the limited time, it was effective to open up conversations about a variety of topics that weren't considered before. It also offered the participants the terminology to navigate building a future AI system. The Stack was also a means to reflect on the discussions and the output of the session.

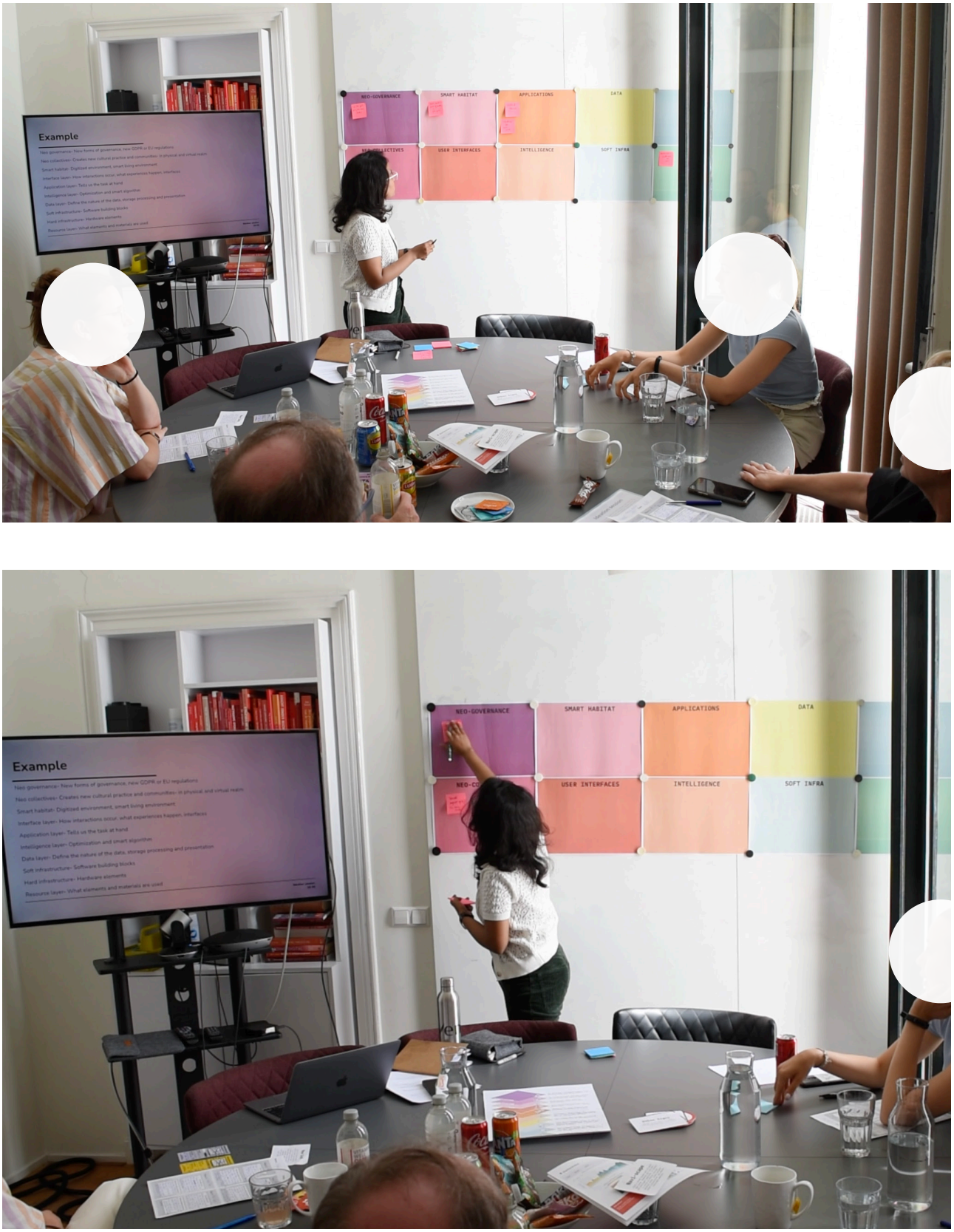


Figure 39. Screenshots from the session recording

Figure 40. Screenshots from the session recording

11.2 Limitations

There were a few limitations that need to be addressed concerning the overall project.

→ While participants involved in the project came from a variety of backgrounds and roles, there was a lack of representation from two stakeholders.Firstly, the residential shared mobility system is imagined to be at the intersection of public and private mobility. In this regard, it would have been nice to have some participants from the local municipality or government. This would have added a new dimension to the discussion and conversations of making it practical and situating the future system within the existing infrastructure. In the interviews as well two of the private partners complained about not being able to explain or reason with the public officials. Secondly, the prospective residents. Three out of the seven participants fit the target user group for the mobility system. Due to the project being in its early stages there are no prospective residents involved. In an ideal case scenario, it would have been nice to involve a resident of the particular neighbourhood (in this case Haarlem). This would have been useful also to assess their decisions of wanting to move in this future residential space.

→ One participant, from the real estate firm participated in both sessions. While the sessions had some changes between them, the speculative artifacts remained the same. While looking back at the results and insights the participants' input was noted to ensure no spill-over between the two sessions topics and instigation based on previous experience.

→ In terms of using the Stack as a tool. It needs to be noted that some of the participants involved in the project are more familiar with and use the stack as a tool in their daily work. Other participants had no idea of the tool at all. Familiarity with a complex module like the stack does offer some ease and frame of reference. The Stack was also used in different ways in the two sessions. In the first one it was offered as a suggestion to guide conversations while in the second one, the goal became to build a stack for this future mobility system. Thus, the factors mentioned were taken into account when assessing the effectiveness of the Stack.

→ Although this study is valuable in involving the broader context, the relation between the artefacts and AI in the narrow sense (algorithms, intelligence layers) can still be explored.

→ There could have been more synergy between the artifacts and the Stack layers. For example, an object for each layer of the Stack. They could also be used to relate specifically to AI, or look at the intelligence layer. This would have helped scope down the conversation from the broader context.

11.3 Recommendations

Based on the literature review and the thesis results, a few opportunities for future research and practice are recommended.

1. The project opens up the space for possible approaches to building shared understandings. Speculative artifacts and the Stack were explored during this project but there is an opportunity to find more generalizable and co-creative ways to do so.
2. Future studies could build on the notion of customized explanations to help stakeholders build their understanding of the AI system.
3. In this project the artifacts were specific to the shared mobility system however this model could be used for other future AI systems as well. Future work can build on the insights for building shared understandings mentioned in the previous sections. There can also be quantitative improvements for example a survey for the participants to report percieved shared understandings post the session.
4. The model of bringing together multiple stakeholders in a participatory session worked well to bring forth ideas and emerging tensions. This opens up the space for participatory design solutions that can build on ideas of collaboration and shared meaning-making.
5. While using tools such as the Stack, there is a need for proper briefing on its functionality and usage. The complex framework could be hard to understand for participants interacting with it for the first time. This is an avenue for further work : means in which the Stack can be explained effectively.

Based on the criteria defined for shared understandings at the start of the project and the study conducted with participants regarding the residential shared mobility system, some recommendations have been drawn for designing understandable AI systems.To promote a shared understanding of future AI systems designers/researchers need to make sure that

→ All involved stakeholders have an idea of not only the functionalities but also the possible limitations and failure of the systems. Exposing limitations and failures can lead to valuable insights into the behavior of the system (Nicenboim,2022). Through the project, it was found that discussions on possible risks were useful when defining the future AI system. For example, discussions around data security issues also included looking at the overall structure of the system and who is responsible for what aspects. It was also useful to offer participants a higher-level perspective of the system before breaking it down into intricacies. This approach helped promote discussions of the decentralization of the mobility system. Participants had a more nuanced perception and were able to recognize boundaries and make informed choices. (Functionality)

→ The system needs to be explained in context to existing infrastructure and not in isolation. Stakeholders need to be able to understand the positionality and the infrastructure behind AI to grasp its complexities. During the session, participants had the opportunity to discuss the infrastructure that would be needed for the shared mobility system currently and in the future. This was facilitated through the artifacts which acted as entry points into the system but also connected to other existing infrastructure. For example- the Move card had public transport options, and the Navi-scape map was an extension to existing map platforms. This helped participants consider the contextual influences affecting the system. (Situatedness)

→ Stakeholders understand and engage with the system better from their roles. This grounding of the system in their own lives can lead to increased values like trust and confidence in these future systems. (Schwaninger et al., 2021). During the session, the participants were able to connect to hte shared mobility system. Participants spoke about current sharing practices like renting out their cars or using carpooling solutions. participants were able to bring their values and imagine it in relation to the future system. (Relatability)

→ Stakeholders need to have enough knowledge to be able to set expectations for the future system. Understanding stakeholder expectations can provide valuable insight to guide researchers and innovators in addressing societal needs, ethical considerations, and potential risks. It can influence future research and innovation activities. During the session participants had opportunities to make their expectations heard, through the activity sheets and by filling up the stack layers. The participants began setting expectations for the future AI system as a group. This supported them in building their understanding within the group. (Expectations)

Final reflection

This graduation project investigated two key gaps in the field of explainability of AI: the lack of accounting for stakeholder backgrounds, and the need for a more holistic approach considering social and technical implications. The goal was to explore ways of building a shared understanding of future AI systems. To achieve this, the project focused on speculative design and the Stack as the main design approaches. These approaches were specifically applied to the case study of residential shared mobility. A process of engagement was designed and tested. The project was successful in fostering an environment for stakeholders to build a shared understanding of certain aspects of the shared mobility system. The approach suggests that a situated understanding of AI systems can help expose a different dimension of artificial agents, from their identities to the larger infrastructure they are a part of. Reflecting on my process I am confident that I was able to achieve the goals I had set out for this project. I wanted to explore the space of public interaction with AI. The residential shared mobility system was a great opportunity for this. It combines two fundamental needs: living and transport. I wanted to experiment with speculative design methods in a participatory manner. I was able to do this with both the speculative artifacts and the Stack. These approaches help stakeholders imagine and experience the future critically and reflectively. I am happy to have brought stakeholders from different backgrounds together for this project. Although there were difficulties in handling expectations, everything eventually came together successfully. I wanted to define an inclusive approach to understanding the everyday uses of artificial intelligence. While explainability is not a solution that fits all problems, this approach is a start to making it situated. The findings from this approach to building shared understandings can surely be taken forward, improved, and applied to different scenarios. My final goal was to explore tangibility as a means of understanding. I was quite persistent on this goal and am quite confident that the artifacts I designed were impactful. I had a few conversations with participants where they expressed enthusiasm about being able to hold and interact with objects as a part of the session. With this, I mark the end of my master's program at TU Delft. I have grown both as a person and a designer. I am wrapping this project up with confidence in my abilities to work with multi-stakeholder groups and excitement to build more tangible experiences.

References

A

Aizenberg, E., & Van Den Hoven, J. (2020). Designing for human rights in AI. Big Data & Society, 7(2), 205395172094956. https://doi.org/10.1177/2053951720949566
Amershi, S., Weld, D., Vorvoreanu, M., Fourney, A., Nushi, B., Collisson, P., ... Horvitz, E. (2019). Guidelines for human-ai interaction. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. doi:10.1145/3290605.3300233

Andes, S,(2020) A Policy Maker's Guide to Artificial Intelligence for State and Local Governments: Reaching Safe, Effective and Equitable Scale)

Arrieta, A., Díaz-Rodríguez, N., Kasabov, N., Bennetot, A., Tabik, S., Barbado, A., García, S., Gil-Lopez, S., Molina, D., Benjamins, R., Chatila, R., & Herrera, F. (2019). Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities, and challenges toward responsible AI. Information Fusion, 58, 82–115. https://doi.org/10.1016/j.inffus.2019.12.012

Ananny, M., & Crawford, K. (2018). Seeing without knowing: Limitations of the transparency ideal and its application to algorithmic accountability. New Media & Society, 20(3), 973–989. https://doi.org/10.1177/1461444816676645

Auger, J. (2013). speculative design: Crafting the speculation. Digital Creativity, 24(1), 11–35. doi:10.1080/14626268.2013.767276

B

Birks, M., & Mills, J. (2015). Grounded theory: A Practical Guide. SAGE.

Boer, M., Türetken, O., & Adali, O. E. (2022). A Review of Business Models for Shared Mobility and Mobility-as-a-Service (MaaS): A Research Report. Eindhoven University of Technology.

Bratton, B.H. (2016) The Stack: On software and Sovereignty, MIT Press. Available at: https://direct.mit.edu/books/book/3504/The-StackOn-Software-and-Sovereignty

C

Candy, S., & Dunagan, J. (2017). Designing an experiential scenario: The people who vanished. Futures, 86, 136–153. doi:10.1016/j.futures.2016.05.006

D

Dalpha Bright (2022), Haarlem Scheiwijk-Internal report- unpublished

Dignum, V. (2020). Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way (Artificial Intelligence: Foundations, Theory, and Algorithms) (1st ed. 2019). Springer.

F

Farias, P. G., Bendor, R., & van Eekelen, B. F. (2022). Social dreaming together: A critical exploration of participatory speculative design. Proceedings of the Participatory Design Conference 2022 - Volume 2. doi:10.1145/3537797.3537826

G

Gerlings, J., Shollo, A., & Constantiou, I. D. (2021). Reviewing the Need for Explainable Artificial Intelligence (xAI). Proceedings of the . . . Annual Hawaii International Conference on System Sciences. https://doi.org/10.24251/hicss.2021.156

Ghajargar, M., Bardzell, J., Renner, A. S., Krogh, P. G., Höök, K., Cuartielles, D., ... Wiberg, M. (2021). From "explainable ai" to "graspable AI". Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction. doi:10.1145/3430524.3442704

H

Haraway, D. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. Feminist Studies, 14(3), 575. doi:10.2307/3178066

Hemment, D., Bletcher, J., & Coulson, S., 2020. Open Prototyping: A framework for Combining Art and Innovation in the IoT and Smart Cities. In The Routledge Companion to Mobile Media Art

Hemment, D., Aylett, R., Belle, V., Murray-Rust, D., Luger, E., Hillston, J., ... Broz, F. (2019). Experiential ai. AI Matters, 5(1), 25–31. doi:10.1145/3320254.3320264

K

Kerr, A., Barry, M., & Kelleher, J. C. (2020). Expectations of artificial intelligence and the performativity of ethics: Implications for communication governance. Big Data & Society, 7(1), 205395172091593. https://doi.org/10.1177/2053951720915939

L

Light, A. (2021). Collaborative speculation: Anticipation, inclusion and designing counterfactual futures for appropriation. Futures, 134, 102855. https://doi.org/10.1016/j.futures.2021.102855

M
Matter, D. (2022). Retrieved from https://provocations.darkmatterlabs.org/dm-note-7-visualising-and-communicating-complexity-be461086fb29

Mitrović, I., Auger, J., Hanna, J., & Helgason, I. (2021). Beyond speculative design: Past, present - future. Split: Arts Academy, University of Split.

Miller, T. (2019). Explanation in artificial intelligence: Insights from the Social Sciences. Artificial Intelligence, 267, 1–38. doi:10.1016/j.artint.2018.07.007

Murray-Rust, D., Gorkovenko, K., Burnett, D., & Richards, D. (2019). Entangled ethnography: Towards a collective future understanding. Proceedings of the Halfway to the Future Symposium 2019. doi:10.1145/3363384.3363405

N
Nicenboim, I. (2022). From explanations to shared understandings of AI. Proceedings of DRS. https://doi.org/10.21606/drs.2022.773

S
Schwaninger, I., Güldenpfennig, F., Weiss, A., & Fitzpatrick, G. (2021). What do you mean by trust? establishing shared meaning in interdisciplinary design for Assistive Technology. International Journal of Social Robotics, 13(8), 1879–1897. doi:10.1007/s12369-020-00742-w

T
The ethical Stack is a series of tools to support creators of new connected technology to reflect on their product's ethical and social impacts. The Ethical Stack. (n.d.). https://ethicalStack.virteuproject.eu/

The Stack.(2022). https://www.freedomlab.com/frameworks/the-Stack

Turek, M. (n.d.). Explainable Artificial Intelligence. Defense Advanced Research Projects Agency, Program Information. Retrieved June 7, 2020, from https://www.darpa.mil/program/explainableartificial-intelligence

W
Walmsley, J. (2021). Artificial intelligence and the value of transparency. AI & Society, 36(2), 585–595. https://doi.org/10.1007/s00146-020-01066-z

What got us here, won't get us out of here. What got us here, won't get us out of here. (2022). https://whatgotushere.hybridcitylab.com/