AI Meets UX:
Shaping the User Experience for Personalised Routine Journeys in Volkswagen Cars

Bo Silkens, 2026



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Disclaimer

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Preface

The thesis that lies before you was developed as part of my graduation project for the Master's program in Integrated Product Design at the Faculty of Industrial Design Engineering, Delft University of Technology.

From a young age, I have been sketching cars. A dream of becoming an automotive designer emerged. To people asking me what I wanted to become when I grew up, there was always a clear answer: "I want to become a car designer".

During my studies at TU Delft, my passion for automotive design remained. Mobility design has marked the overarching theme throughout. My goals became more refined as I was introduced to design approaches like user-centred design. Alongside my passion for pure automotive design, I developed an interest in shaping digital experiences in the field of UX design.

In the meantime, the automotive industry was facing difficult times. The rapid shift toward electric vehicles, along with stricter environmental regulations and increasing competition from both established players and new entrants, has forced the industry to develop new, more efficient production methods and tighten budgets for research and development. It also had consequences for students: internship opportunities became ever scarcer.

After a previous bachelor's thesis internship at Volkswagen Group, I remained in contact with the team. At one point, my team lead from the previous project introduced me to Henrik, Eduardo and Hyunmin from the UX design team at Volkswagen brand design. The master's thesis internship of my dreams could finally be realised.

A thesis project at a major car manufacturer is not just like any other project. It has been a privilege to work surrounded by professional designers in a highly social work atmosphere. The expertise of others is incredibly valuable for evaluating ideas and concepts in a quick manner.
Also, the facilities and equipment available for user testing were remarkable. This allowed me to take user testing to the next level in this project.

My time at the design department of Volkswagen has been an amazing experience. I have felt right at home from day one and met amazing people on the way to graduation. It is an experience that I will never forget and will always be grateful for.

Acknowledgement

Edu & Min
Thank you for the continuous guidance and feedback throughout my project. From the very first day, you have shown me around and have made me feel at home at the design department and in the team. Without your creativity and knowledge, this project would not have looked the same.

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Thank you for supporting me throughout my studies. Ever since I joined TU Delft for the ‘people in transit’ minor, you have shown, motivated and taught me the path to become who I am today. In this project I especially valued how your design and interaction experience supported the project through critical feedback.

Gerd
Thank you for the support and mentoring of this thesis project. I appreciate your thorough feedback to academic and interaction-related aspects of the project, pointing out the essential questions that shaped the thesis.

Andro, Mathias, and the UX design team
Thank you for facilitating this project at the UX design team and for making me feel at home from the start. I am pretty sure we can all agree on the fact that the team is very connected and social and this wouldn’t have been the same without the two of you leading it.
I will miss all of the chitchats you and the team members, and, especially to Andro, our silly banter as well.

Fabian, Rouzbeh, Alena, and other VW design interns
Thank you for making life in Wolfsburg enjoyable. Without you guys and all of our activities, life in the city wouldn’t have been this fun. Your inspiring projects were a source of inspiration and provided me with something to hold on to and look up to during my thesis, with Alena’s UX-design-related collaboration in particular.
Especially to Fabian and Rouz, thank you for inviting me into the ‘Designers WG’. You were two of the most warm-hearted people to share a house and work with.

Isa
Thank you for always being there for me. You supported me through this adventure and allowed me to settle down and reflect every single day, showing me what really missing someone looks like along the way.

Mark, Cindy, and Floortje
Thank you for always supporting me, not only during this thesis, but during my complete studies. You have always shown interest in my passion. You made it possible to walk this educational path and your enthusiasm and support always motivated me in good and bad times.

Glossary and Abbreviations



Figure 0.1 *Abbreviations in the interior UX domain*

AI
Artificial Intelligence

ADAS
Automatic Driving-Assistance Systems.
It refers to a collection of automotive safety features that utilise advanced technology, including sensors and cameras, to assist drivers in safely operating their vehicles.

CID
Center Information Display. Also referred to as ‘center stack display’ or ‘infotainment display’, a CID refers to the centralised screen or interface located on the center console of a vehicle’s dashboard. It serves as a hub for accessing various infotainment features, navigation systems, climate controls, connectivity options, and other functions within the car.

DIM
Driver Information Module. In an automotive context, the car's instrument cluster, generally positioned in front of the driver.

HCI
Human-Computer Interaction is a field of studies that focuses on designing user friendly and efficient computer systems and interfaces, taking into account human capabilities and preferences.

HMI
Human-Machine Interface. It refers to the technology and design elements that facilitate interaction and communication between humans (users) and machines or devices, such as computers, smartphones, tablets, or automotive systems. The HMI serves as the point of contact through which users can access and control the functionality of the machine or device. The goal of a well-designed HMI is to enable users to interact with complex systems or devices in a natural and seamless manner, reducing the learning curve and enhancing the overall user experience.

IDE
Industrial Design Engineering. The name of the faculty at TU Delft of which this graduation project is part of.

IPD
Integrated Product Design. The specific master track of Industrial Design to which this graduation project belongs.

OEM
Original equipment manufacturer, referring to the automaker, its vehicles, and the factory parts that constitute them.

Routine Journey
A routine journey refers to a regular or established pattern of travel. Unlike a route, which is a specific path for physical travel, a routine journey encompasses habitual actions or activities performed regularly, such as commuting or daily errands.

SD
Standard Deviation

Touchpoint
In the context of UX design, a touchpoint refers to any instance where a user interacts with a product, service, or brand. In car interiors, these interactions can occur through various channels, including screens, the steering wheel, buttons, pedals, the VA, lights and speakers.

UI
User Interface (UI) refers to the space where interactions between humans and machines occur. It encompasses the visual and interactive elements that users engage with when navigating a website, application, or any digital product. The primary goal of UI is to facilitate effective operation and control of the machine from the human end while providing feedback that aids the user's decision-making process.

UX
User experience. How a user interacts with and experiences a product, system or service.

VA
Virtual Assistant

Executive Summary

This thesis documents the development of a personalised, adaptive interface with the aim to improve the user experience of routine journeys in Volkswagen cars.

Personalised software platforms like Spotify and Netflix have marked an age of personalised software and interface design. Intelligent systems support learning through such interfaces to optimise the user experience. How can such an interface optimise the user experience in the complex automotive domain?

Driving scenarios vary significantly, from daily commutes to long-distance trips with the whole family. This results in constantly changing user needs and contextual conditions. This project investigates how an interface can adapt dynamically to these variations, using AI-driven personalisation and user feedback to optimise the experience of each journey.

A structured design approach was applied using the Vision in Product Design method within the UX domain. This included an analysis of brand identity and strategy, a deconstruction of current products into interaction qualities, the construction of a future context based on emerging trends, and the strategic positioning of a future interface concept.

The design process incorporated co-design methods to explore personalised UI configurations, focusing on balancing consistency and variety in widget selection and layout. It also identified key factors influencing user preferences in interior and interface adjustments, while uncovering opportunities for adaptive and context-aware interaction.

The developed concepts were evaluated through user testing in a seating buck setup, assessing interaction and product qualities such as usability, desirability, perceived control, and brand alignment. Qualitative feedback supported comparative analysis and version ranking of the proposed interface solutions.

In addition, the thesis contributes a set of guidelines for adaptive interface design in the automotive domain. It further investigates the role of AI in shaping human–machine interaction, including journey prediction and personalisation strategies, outlining how intelligent systems can enhance everyday driving experiences while maintaining user trust and control.

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Project Introduction




11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

1.1 Assignment

Introduction

Personalisation

Personalisation is the act of making something suitable for the needs of a particular person (Cambridge Dictionary, 2026). In UX/UI design, personalisation can be seen as the process of customising digital experiences to satisfy the specific requirements, tastes, actions, or environments of particular users (Bhuptani, n.d.).

Personalisation can be split up into explicit and implicit (Koranteng et al., 2025):

- Explicit personalisation (customization): The user adjusts settings manually, such as setting the colour for ambient lighting and customizing the home screen's layout.
- Implicit personalisation (adaptation): The system learns the behaviour of the user and proactively suggests or assists with items in an adaptive interface.

For implicit personalisation (which is what this project is aiming for), the journey ahead and the further context play an essential part in enabling the personalisation process.

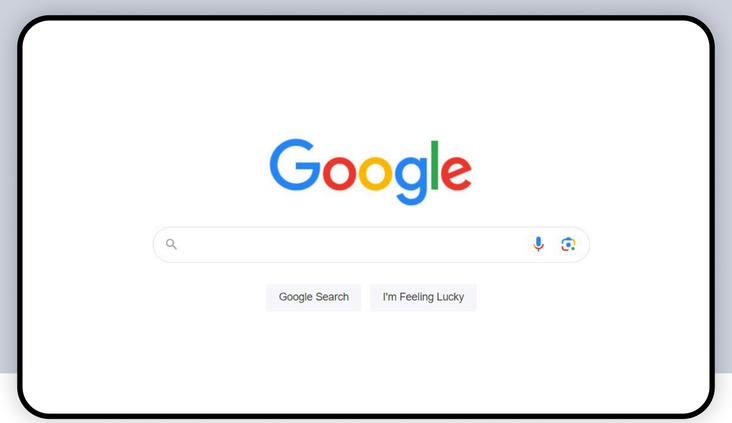
Figure 1.1 *Explicit personalisation: customization of UI*



Routine Journeys

Combining the definitions of "routine" and "journey", Cambridge University Press (n.d.), describes a routine journey as a usual way of travelling from one place to another. Commonly named routine journey examples are commuting, (grocery) shopping and leisure trips (Department for Transport, 2025; Eurostat, n.d.). These journeys show patterns in their respective context factors, e.g. time of the day, or person using the car, start location and car status.
These contextual factors play a key role for constructing and predicting specific routine journeys, and defining how the interface is going to be shaped by this.

Figure 1.2 *Static UI example: Google Search interface*

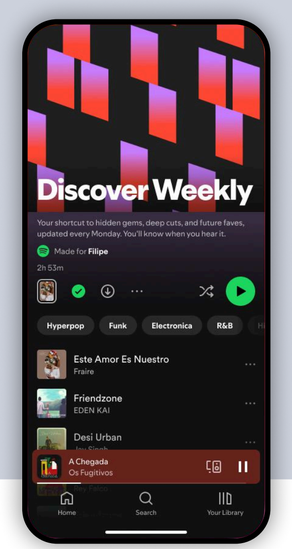


Personalised & Adaptive Interfaces

Since the introduction of the Graphical User Interface (GUI), the way we interact with computers has drastically changed over the years. Until recently, all interfaces were designed following 'one size fits all' principles. Each user was presented with the same static layouts, independent of individual needs and contextual factors. A clear example of a static user interface is Google Search, which elements and layout have remained consistent over the years (see figure 1.2).

Nowadays, software development has switched from a system-centered approach to a human-centered approach. Where the user normally had to learn system interactions, the system now learns how to best assist the user in an adaptive way.

Figure 1.3 *Personalised UI example: Spotify*



Such adaptive user interfaces (like Spotify, figure 1.3) allow for personalisation by tailoring layouts and content to individual users and contextual factors, easing system use, helping users deal with complex systems and avoiding cognitive overload problems (Lavie & Meyer, 2010).

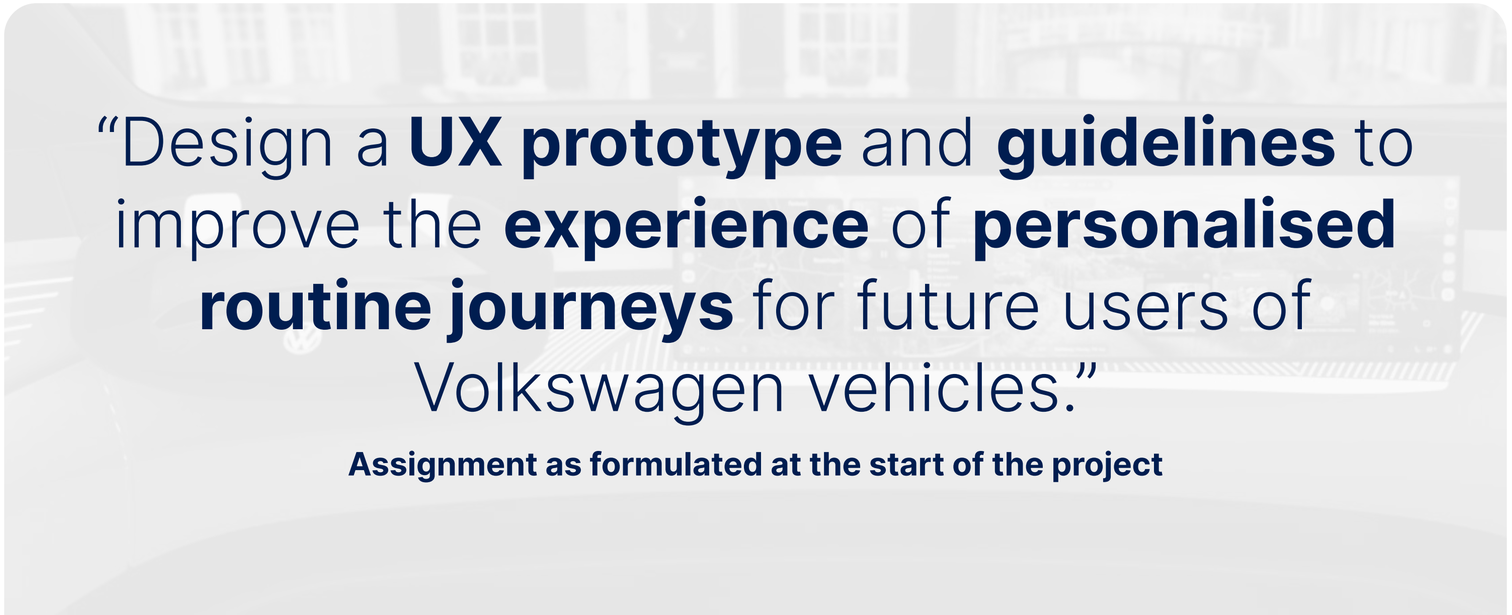
In the automotive domain, adaptive user interfaces can facilitate direct access to normally deeper-nested system functions. Which, as turns out from internal research, largely remain unused by customers.
System features often relate to specific driving scenarios, emphasising the potential to be recommended based on contextual factors. In this way, adaptivity can be utilised for personalisation beyond (the direct relation to) the user.

Assignment
The introduction of AI in the automotive UX design domain allows for endless new ways of analysing, generating, personalising, and providing information to fit user needs. This raises the question of how AI developments can be utilised to shape and optimise the user experience (of routine journeys), as user needs shift continuously. How to design interface adaptivity so that all users can be satisfied?

As part of the study, there has been a major focus on researching user needs regarding adaptive interfaces within the automotive domain during co-ideation and user testing sessions.
Throughout, the user has been dealt with as the central part defining design decisions.

The study focuses on research, exploring scenarios and defining the human-AI interaction, to answer the question "what happens when?" concerning the various contexts and combinations of data inputs that shape the personalisation of specific routine journeys.

The final deliverable of the study is an adaptive user interface concept that explores various relevant use cases that are close to Volkswagen's brand identity. At the end of the project, the prototype has been evaluated to construct guidelines for further development of adaptive and personalised interfaces in the automotive domain.



Stakeholders

Volkswagen
Volkswagen AG is one of world's leading car makers and its headquarter is located in Wolfsburg, Germany. Volkswagen has been the facilitator of this project, providing mentoring and facilities. They are a major stakeholder in this project as the concept and guidelines informs their development of future personalised interfaces for the brand.

The graduation project has been done while located in the UX/UI Design department in the Volkswagen brand design studio. The graduation project was part of an ongoing pre-development project on a similar topic. The project team have provided me with a lot of background information, building a strong foundation for the project.

The potential exists that parts of the project could move into series production, making Volkswagen's stakes in this graduation project even more significant. The main goal for Volkswagen is to generate new knowledge and interesting concepts in the in-car AI-human interaction and UI design domain.

From Volkswagen's side I have been supervised by Hyunmin Lee (UX designer) and Eduardo Luiz Viera (Creative project lead and UX designer).

TU Delft
TU Delft, and its faculty of Industrial Design Engineering are the university and design faculty that grounded the educational foundation of this graduation project. The project counts as the final part of the master track Integrated Product Design, also referred to as 'IPD'.

From TU Delft's side, the project has been supervised by E.D. van Grondelle (Elmer) and Prof. G.W. Kortuem (Gerd).
Elmer has an extensive professional background in automotive design and HMI research.
Gerd's research mainly revolves around AI in/for design and Human-Computer Interaction (HCI).
Combined, their knowledge is of invaluable importance for guiding the project in the right direction. The supervisory team made sure the project and deliverables lived up to the academic standards and assessed the graduation project during the graduation presentation.

The main interest from the academic side is that the master graduation project learning objectives and the Final Attainment Levels of IPD will be achieved. Furthermore, the IDE-specific pillars Business, Human and Technology should be integrated in the project and the knowledge produced should be relevant to the mission of the IDE Faculty: "Design for Our Future" (Delft University of Technology, 2024).

Me as a stakeholder
For me as the graduation student, UX design intern, and author of the written thesis, this is not an ordinary project. It is the final project in which I can express my capabilities in the automotive UX domain. It is essential that this project is going to be a success, as I pursue to continue my career in this exact field.

My learning objectives are mainly related to improving and learning new hard skills in industry-standard programs of UX development and optimally utilizing Volkswagen's facilities and equipment to take user testing to a higher level.

Market & Scope

This graduation aims to embrace AI technologies and explore their potential for improving the user experience of routine journeys in Volkswagen cars, which is relevant on a global scale. However, it is known that there are significant cultural differences in design preferences for automotive HMIs (Khan et al., 2015). The same applies for AI perception across cultures (Brauner et al., 2024). Since concepts are mostly tested internally with people from other departments, the decision was made to primarily focus on the European market, so that concepts would be suitable for user test participants. Still, the fact that UI and UX concepts that resulted from this project are not tailored mostly towards a European target market does not mean they are not relevant for Volkswagen's other markets.

Next to this, the timeframe has been defined by the overarching pre-development project, focusing on the years 2027-2030. This generates a realistically close future perspective for which the UI and other touchpoint automations could come to market.
The timeframe serves general guidance for the design of the experience and adaptive features in this project.

Further scoping will be done by primarily focusing on routine car journeys. Adaptive features will therefore be primarily tailored to solve struggles within the car journeys: from journey-specific interface setup, to adaptations while driving and optimization of the arrival at the final destination.

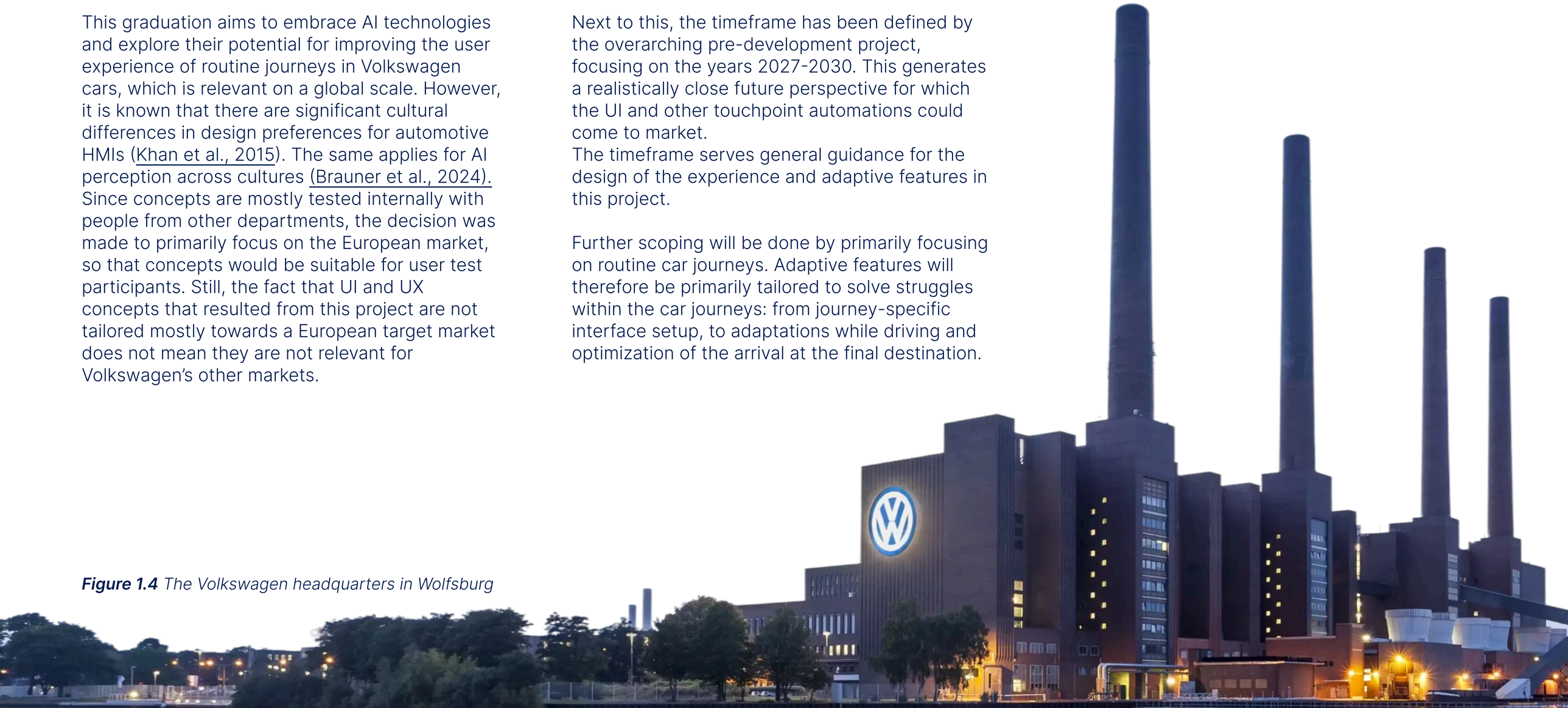


Figure 1.4 *The Volkswagen headquarters in Wolfsburg*

1.2 Approach & Methods

In the initial phase of the project, Vision in Product Design (ViP) has served as the primary design approach. ViP is a future-context-driven method aimed at innovation, with a strong emphasis on qualitative product and interaction aspects (Hekkert & Van Dijk, 2011). The process begins with a deconstruction phase, in which the current product is analysed in terms of interaction qualities, product qualities, and the contextual factors that shaped its development. This is followed by a construction phase, where future context factors are explored to define emerging domains and enable the strategic positioning of a future product concept.

Although ViP is traditionally applied to physical product design, its application within the digital domain of UI/UX design proved valuable; core ViP outcomes (such as the statement, interaction vision, and product vision) provided a clear conceptual foundation that guided the development of the final interface, particularly in defining its intended qualities and experiential direction.

Given ViP's abstract nature, it was complemented with competitor analysis and literature research to primarily support the construction phase. These methods provided practical grounding and ensured that insights remained closely connected to user needs and real-world applications.

While ViP is sometimes considered less suitable for short-term projects, its forward-looking perspective is particularly relevant in the context of rapidly evolving technologies such as AI. Developments that once seemed distant are increasingly becoming feasible, making a future-oriented approach both appropriate and necessary.

The research-intensive approach of ViP was connected to a second phase, in which concept development and user testing were the key focus. In terms of planning, it allows for co-ideation, two design iterations and two rounds of user testing in the seating buck. This was done with the aim to increase the quality and value of the final deliverables for all stakeholders involved.
The project is concluded with an interactive prototype and guidelines for further development of adaptive personalised UIs in the automotive domain.

Together, ViP and the two design loops create the complete method-related overview for the entire project (see figure 1.5).

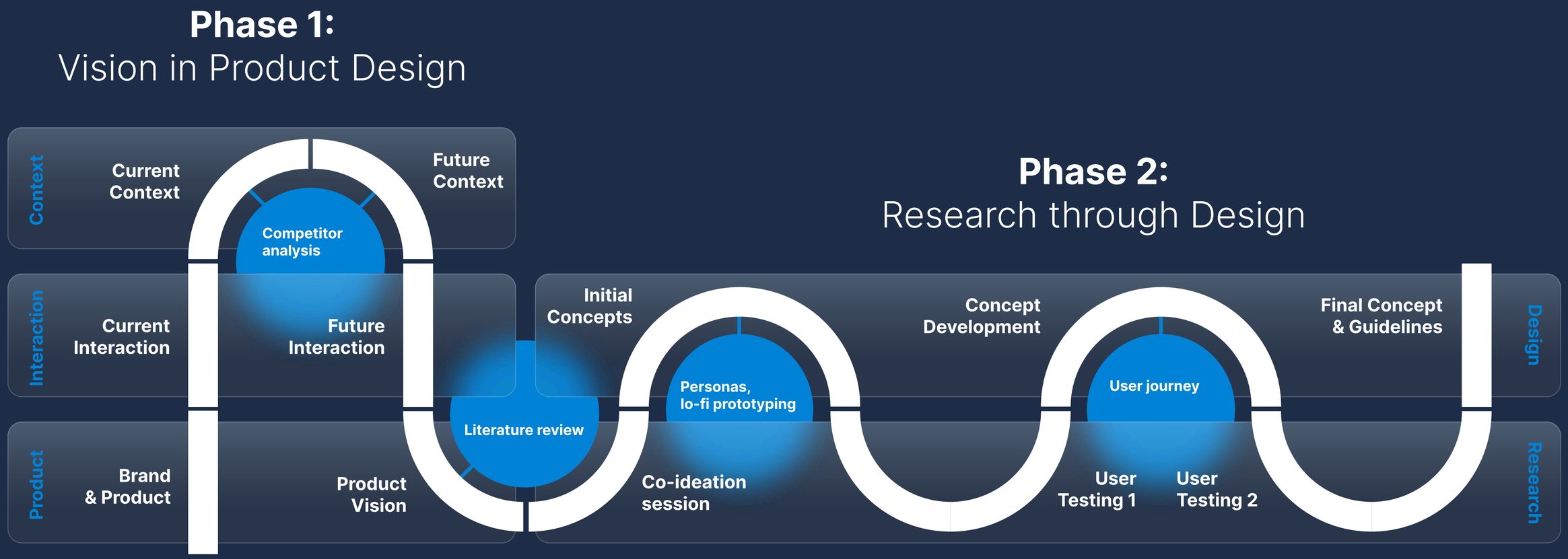


Figure 1.5 *Overview of methods applied in the UI design process*

02

Analysis


Panketal
Ahrensfelde
Neuenhagen
Schönefeld
RADIO 1
1:30
Charging Status
69%
1:34 h


11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

2.1 Brand Analysis

Volkswagen
Volkswagen is a German automobile manufacturer based in Wolfsburg, Lower Saxony, Germany. Volkswagen was established in 1937 by the German Labour Front. Today, it serves as the flagship marque of the Volkswagen Group. The Volkswagen Group as a whole comprises ten brands from five European countries: Volkswagen, Volkswagen Commercial Vehicles, ŠKODA, SEAT, CUPRA, Audi, Lamborghini, Bentley, Porsche and Ducati.

History
In 1938, the very first Volkswagen rolled off the production line: the Volkswagen Beetle. A timeless design that became a global symbol of freedom on the road (Martynova, 2025). With the establishment of the first official factory in Wolfsburg in 1947, and production of the Volkswagen Beetle being continued after the Second World War, the production of vehicles quickly grew. The first Volkswagen Type 2 (an idea developed based on a sketch by Ben Pon from 1947, see figure 2.1) was manufactured on 8 March 1950.
In the '70s, the Golf, Polo, Passat and Scirocco marked the new generation of Volkswagen vehicles. The Golf became one of the best-selling cars ever (Volkswagen AG, 2024).

Recent years have marked a turbulent era for Volkswagen. Starting in 2015, Volkswagen became engulfed in the Dieselgate scandal. Still, Volkswagen Group was the world's largest automotive manufacturer by vehicle production in 2016 and 2017 (International Organization of Motor Vehicle Manufacturers [OICA], 2017, 2018) and by global vehicle sales in 2018 and 2019 (F&I Tools USA, 2022). In the years after, Volkswagen saw a mayor decrease in sales, partly due to Covid-19. Sales remained limited due to slow adaptation of EVs, a semiconductor crisis, increasing competition in the EV landscape (particularly from China) and being hit hard by Trump tariffs. This led to recently announced factory cuts (Bloomberg News, 2025), as part of a larger plan to save €10 billion by 2026 (Reuters, 2023).

Figure 2.1 *Timeline: Volkswagen's milestones*



Strategy and Principles

Currently, Volkswagen is making strategic plans to boost its global position in the mobility landscape. According to the own news outputs of Volkswagen Group, it wants to play an active role in shaping the transformation of the automotive industry, as "The Global Automotive Tech Driver" (Volkswagen Group, n.d.). The Group's strategy until 2035 follows three fundamental principles:

- Resilience: to withstand the increasing political, economic and ecological crises.
- Adaptability: to adjust the strategy to technological leaps and constantly evolving customer requirements.
- Financial robustness: to sustainably invest in our future and be prepared for unforeseen events.

Furthermore, Volkswagen Group CEO Thomas Schäfer (2025) states that Volkswagen is shifting into “Boost Mode” as part of its strategic transformation toward improved performance, faster decision-making, and stronger customer focus. According to Schäfer, the ‘Boost2030’ strategy focusses on the following topics to fight increased competition:

- Inspired customers & employees
- Technology leadership
- Global brand
- High-performance organization

Zooming in, the design department specifically relies on 3 pillars:

- Stable
- Likeable
- Secret Sauce

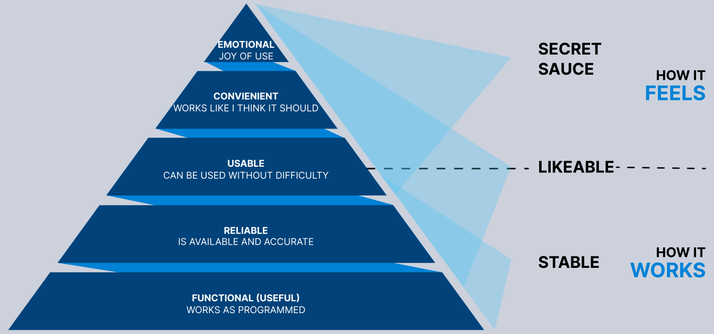


Figure 2.2 *Volkswagen’s strategic focus for UX/UI*

Lastly, for the UX/UI department specifically, the design pillars translates to a 5-layer pyramid. Starting from the bottom (the foundation), UX/UI design should be functional. Building on this, the UX and UI should be reliable, usable, convenient, and ultimately, emotional.











1983 1997 2015 2019 2026

Values

Ever since the establishment of Volkswagen, its core values have revolved around its name. “Volkswagen” literally means “people’s car” or “car for the people”, highlighting core values such as affordability and a user-centered approach. It also implies that that no matter who you are, there is a Volkswagen for you. This is exactly why, over the years, Volkswagen expanded its lineup to target a broad market, from compact cars to luxury vehicles (Volkswagen Group, n.d.).

Identity

Volkswagen Group (n.d.) clearly describes how it wants Volkswagen brand to be seen on their global website:

”Volkswagen is the brand with heart: likeable, high-quality and trend-setting – from the T1 Bulli to the Beetle and the Golf to the all-electric ID. Family. The company transfers the typical VW virtues into the new world of mobility: CO_2-neutral, digital and for everyone. The goal: to make VW the leading volume brand for customers worldwide.”

Figure 2.3 *Volkswagen’s brand identity*



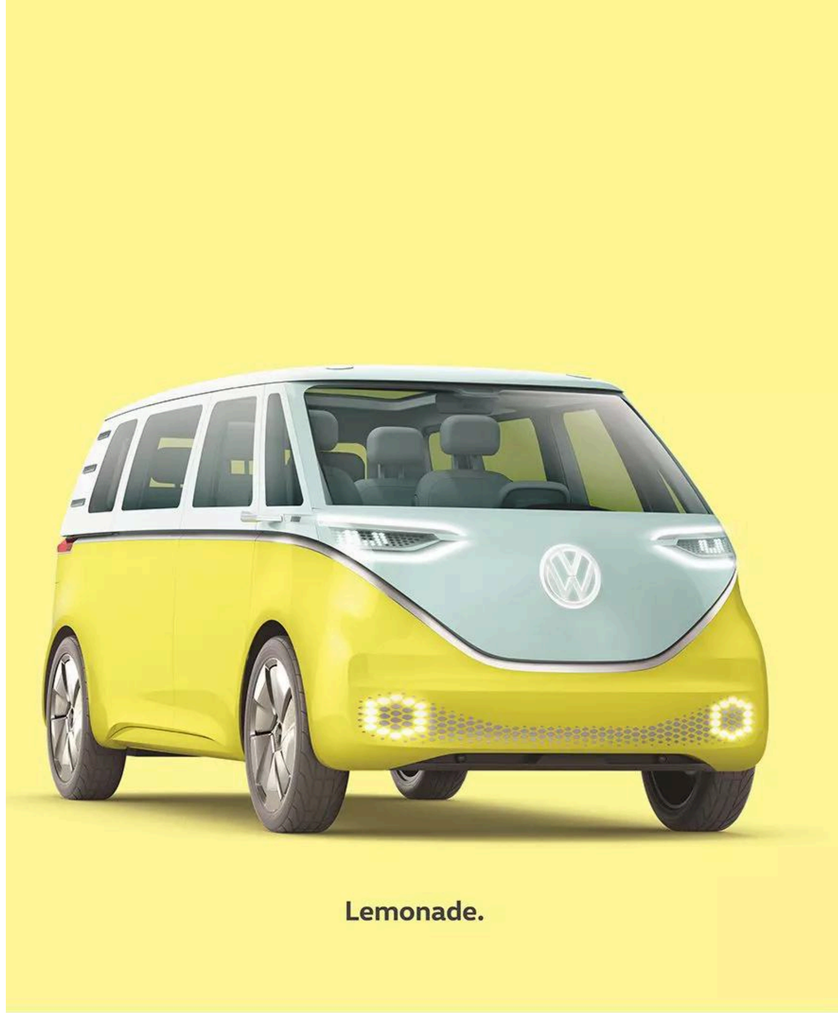


Figure 2.4 *2019 Volkswagen of America “think bigger” ad. Its subtext states that even the sourest situation can be turned into something sweet, a reference to moving from Dieselgate to electric mobility.*

Volkswagen clearly positions itself as a brand that is iconic, industry-leading and a global player in the automotive field. The company has taken responsibility to move on from the things that happened in the passed, and position itself as one of the leading brand in the field of electric mobility, with its ID-range (see figure 2.5).

Figure 2.4 is a clear example where the iconic brand identity and the strategic shift to electric mobility come together, hinting to historic versions of such posters, and symbolizing moving on to electric mobility. Generally, Volkswagen's advertising is striking, yet understandable and functional.

Brand image

Many see Volkswagen as a key example for German innovation (Bachmann et al., 2019). However, as mentioned before, Volkswagens brand image was severely affected by Dieselgate. Something that is still noticeable to this date. A study from 2024 investigated Volkswagen's efforts to rebuild trust after Dieselgate and argues that the scale of the scandal was so significant, it caused a complex recovery and lingering effects (Riswandi, 2024).

Next to this, when critically comparing Volkswagen to other brands, Volkswagen is quite a conservative brand. Even though the brand identity is strong and consistent, the designs the company launches are perceived relatively modest compared to its competitors.

Likewise, Volkswagen is internally described as a company that does not really push innovation themselves, but rather 'democratizes' innovation. To clarify, what this mean is that innovative features are often first introduced at more innovation-characterised brand such as Audi and Porsche and later make their introduction into Volkswagen vehicles. While providing similar technologies, Volkswagen's brand perception emphasises the importance of making such features understandable to the general public.

Volkswagen is also known as a company that listens well to customer feedback. Such feedback especially comes forward in recent reviews of interface updates, with people praising the comeback physical buttons of iconic graphics in a retro style (Potts, 2026).

Figure 2.5 *Selection of vehicles in the Volkswagen ID range*



2.2 Product & UI

History of UI

The user centered approach in product design is relatively new, and so are the concepts of UI and UX design. Since early developments of principles in during the industrial revolution, the first mayor breakthrough was the introduction of oN-Line System (NLS), which showcased the world's first graphical user interface (GUI). Later, Xerox, Apple, and Microsoft made personal computers (PC's) with more intuitive interfaces available to the mass. Then came the introduction of the mobile smartphone, which is currently the most prominent UI that we interact with.

In the car domain, Aston Martin introduced the first in-car digital screen in 1976, and Buick Riviera had the first CRT touch screen (see figure 2.6) (4screen, 2024).



Figure 2.6 *The Buick Riviera introduced the first touchscreen CID*

Volkswagen's UIs

For a long time and like many other competitors, Volkswagen's user interfaces have been analog; speedometers, manual gear shifters and physical knobs. First LCD screens displaying radio frequencies were introduced on the Golf MK2 (Mihalașcu, 2017). The VW Golf Mk4 saw the rise of Multi-Functional Displays (MFDs) with coloured navigation maps and CD-changer integration. Volkswagn introduced its first touchscreens in some later versions of the Volkswagen Golf MK6.

MIB 1

The Golf Mk7 introduced the MIB1, the first version of the "Modulare Infotainment-Baukasten" (MIB). This term can be translated to "modular infotainment system". All variants had Bluetooth connectivity, while more premium variants also introduced voice control.



Figure 2.7 *Timeline of recent Volkswagen CID's*

MIB2

The second version, MIB2, looked pretty much the same as MIB1, but added smartphone integration (CarPlay/Android Auto), better screen resolution and responsiveness, and more advanced navigation and media features.



MIB3
The MIB3 added a customizable home screen with widgets (Schlee, 2023), multi-phone pairing and seamless switching, enhanced natural voice recognition, and SiriusXM with 360L: a system that combines satellite and streaming for personalised content (Arntson, 2020). It had over-the-air (OTA) updates available on some models (separating software and hardware), and expanded Car-Net services: remote start, vehicle health reports, Wi-Fi hotspot (West Houston Volkswagen, 2024).

MIB4
MIB4 was the latest interface module out there at the start of the project (see figure 2.8 & 2.9). It saw the introduction of IDA voice assistant with ChatGPT integration. It has fixed top and bottom bars for climate and quick-access controls, the top bar being customizable for one-tap access to key functions. Backlit touch sliders for volume and temperature fixed issues with using these functions at night (Groves, 2024). Conventional physical buttons on steering wheel returned, replacing touch-sensitive ones.
Due to it being the most recent product at the time, MIB4's product and interaction qualities will be discussed in more detail on the next page, to build a strong foundation for later steps of ViP.

The new Volkswagen interfaces
Early in 2026, Volkswagen announced their new software architecture. The system was showcased first in the ID.Polo, with images revealing that on the hardware side, the system appears in a more tablet-like design (Volkswagen AG, 2026). Later it was also shown in the ID.3 Neo. The system was especially praised for its "retro skin", alongside the comeback of classic physical buttons (Fitzgerald, 2026).



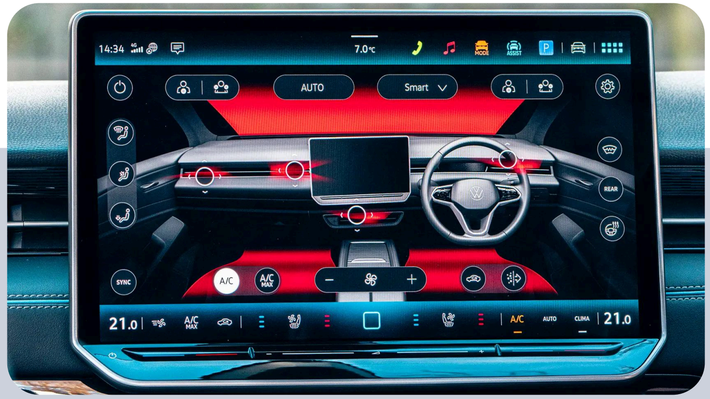




Figure 2.8 *The MIB4 UI: DIM & CID home screen*



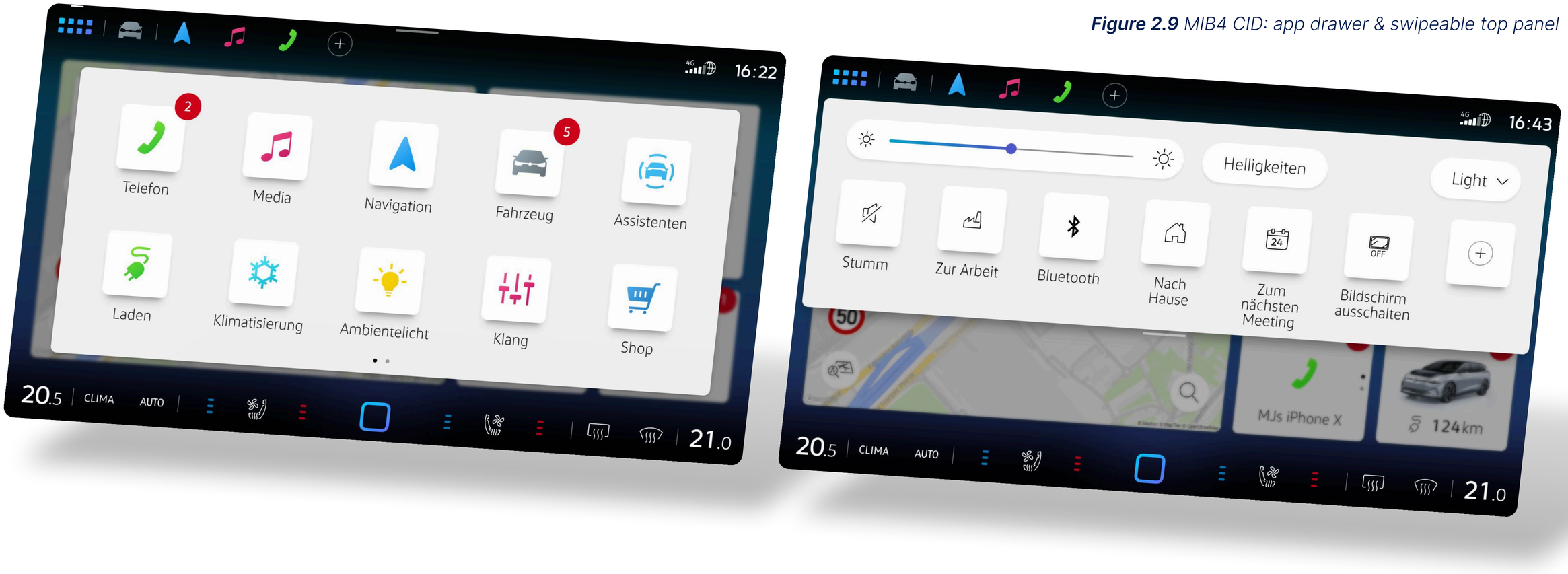
MIB4 Product Analysis

- **Unintegrated**
  From observing the MIB4 interface first-hand, it can be concluded that the tablet-like screen is huge. One could argue that the way it's shape sits more forward, unintegrated with the rest of the dashboard, makes it seem like an aftermarket product slapped on to the dashboard.

- **Driver-oriented**
  It sits in the center of the dashboard, slightly angled towards the driver. This makes the UI feel driver-oriented, in both the physical and metaphorical way.

- **Digital & Haptic**
  The touchscreen interface is combined with backlit haptic sliders for controlling the AC, and system volume. The absence of other physical buttons, confirms that the UI is largely screen-based.

Figure 2.9 *MIB4 CID: app drawer & swipeable top panel*



- **Conventional & Flat (2D)**
  The general impression of the UI design can be described as conventional and flat. The whole interface relies on “cards” that are 2-dimensional and all have the same colour.

- **Consistent**
  Although basic, many elements are consistent across the UI. For example, the bottom and top bar, containing key functions, are consistently available across all views. The same applies for icons and colours.

- **Customizable**
  The UI allows for customization. The home screen, for example, allows for manual adjustments to tabs and layouts. The top bar also has some editable slots for quick access to commonly used functions. Multiple coloured themes are available for UI and ambient lighting.

2.3 Interaction & UX

History of UX

Before we begin the analysis of the current system, briefly explore the history of UX design (in cars), to give a general perspective on this topic related to time.

In 1956, General Motors was the first car company establish a Human Factors Engineering Group, to study driver controls, displays and interior design. Ford followed closely after, with a similar department that additionally focused on ergonomics as well.

Years later, in 1986, Don Norman first coined the term “User Experience” to describe a holistic approach to design beyond just interfaces. This became increasingly important with the introduction of the World Wide Web (WWW) and mobile (smart)phones. Companies like Google and Facebook began using data-driven UX design. Around 2004, Toyota and Lexus began forming dedicated User Experience teams, focusing on digital interfaces and infotainment systems. In the mid-2000s, Audi and BMW followed with UX/UI Departments.

The UX department at Volkswagen in it’s current form only exits since 2018. Since then, it grew to a team that is similar in size to other design departments, e.g. exterior or interior design. Today, UX design is entering a new era, driven by AI and immersive technologies, such as AI-driven personalisation and multi-touchpoint experience design.

“User experience encompasses all aspects of the end-user's interaction with the company, its services, and its products.”

- Don Norman



MIB4 UX Analysis

This brings us to where we stand right now. An extensive analysis of the current user experience in relation to the UI was conducted to get a thorough understanding of MIB4's interaction qualities. The interaction analysis of the current system was threefold.

1. The first way being a first-hand analysis by means of a digital simulation of MIB4's software, in which the system's design and interaction qualities could be studied in the same way as in an actual car.
2. Secondly, an open-ended interview has been conducted while observing a regular MIB4 user inside the car. This allowed for a better perspective from someone who used the system for a longer period of time.
3. Lastly, both previous investigations were supported by desktop research, focusing on the claims by Volkswagen and the reviews of the system by the media.

Digital Simulation
Via a digital simulation in ShiftOS, the UI could be explored in fine detail, and in the same as it would work in production cars. Simulating touch interactions with a mouse, both changes on the DIM and CID can be observed and investigated.

- **Maze-like & Confusing**
  One of the main interactions, navigating through the system, might be confusing for some as there are many menus and views that can be shown on the screen. There is the home screen, the app drawer and even an additional panel with quick functions that can be accessed by swiping from the top (see figure 2.9), just like on mobile and tablet devices. From all of those views, key functions and deeper-layer settings can be accessed. So there are multiple ways to end up at the same screen or function. This might take some time for some users to get used to.

Interview/Observation
An observation in combination with an open-ended interview was done to gain insights from a user who has been interacting with the system over a longer period of time. In this case, the MIB4 was part of a 2025 Volkswagen Tiguan.

- **Multimodal**
  The system can be operated in more ways than just touch-based interaction. In some cases, only observing visual cues (such as pop-up notifications) are already enough for the user to understand the system. In many stationary cases, it is easiest to operate the system by touch interactions; pressing, holding, swiping, dragging, rotating, etc. Touch can also be used to operate the haptic sliders below the screen, and physical buttons on the steering wheel. However, in some scenarios, one might find it easier to interact with the system via IDA, Volkswagen's in-car voice assistant.

- **Responsive**
  The UI felt very reliable and responsive across all screens and views.



Figure 2.10 *Example of a recent Volkswagen interior layout, including the MIB4*

Reviews
Lastly, what does the media say about MIB4?

- **Distractive**
  Volkswagen's MIB4 requires "fiddly" touchscreen-based interaction to access functions while driving, for which safety concerns, like driver distraction and cognitive overload, exist since introduction of more complex infotainment systems (Groves, 2024; Krstačić et al., 2024).

- **Unexplored**
  Groves (2024) argues that new features, such as the Wellness app, might not be used more than once. Functions not being used at all is an issue that is also recognized internally.

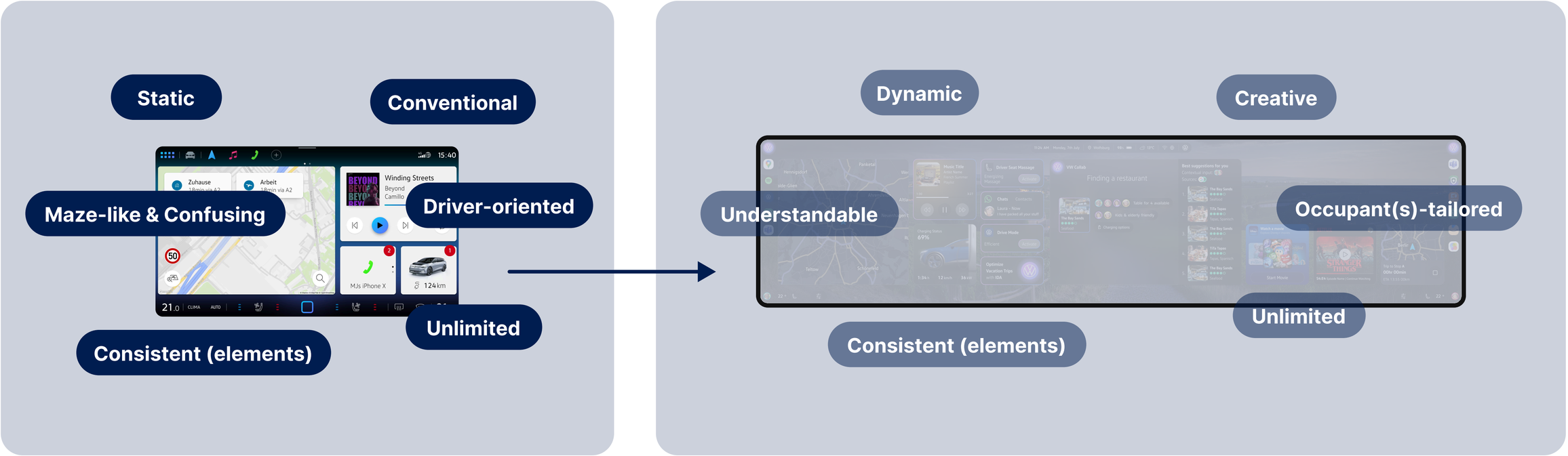


Figure 2.11 *Deconstructing the current product into product & interaction qualities*

Conclusion

The purpose of analysing the current product on both a product and interaction level is to get a good understanding of the current situation. It identifies some key product and interaction qualities that can be used to be kept, improved, or adjusted in the future product.

Some of the qualities are within the scope of the project, others are not. For example, the fact that the MIB4 looks unintegrated with the rest of the interior is not something that can be accounted for in the project. Some decisions have already been made at the larger predevelopment project scale.

Still, most of the interaction qualities can be reflected on. After conversion to product and interaction qualities, for the future product, serve as a foundation for creating the human-product relation. Those will be discussed in chapter 3.3.

2.4 Context

To study the context in which Volkswagen's MIB4 and the overall user experience were designed, an short open-ended interview was conducted with Yannis Tebaibi, one of the UI designers who worked on MIB4. He highlighted some main contextual influences that define a reasoning behind the design of the MIB4.

Creating a new brand image after dieselgate
Development of MIB4 started in 2022. According to Tebaibi, at that time, dieselgate was still hindering Volkswagen's brand image at the time of designing MIB4. There was an urge to move away from this and to create a new brand image, where electrification and customer experience were central.

Aftermath of a crisis at Volkswagen
As described before, Volkswagen has recently faced a lot of challenges in the recent years. The crisis caused Volkswagen to make some drastic decisions.

> **"We were mainly correcting what we did wrong with MIB3."**
>
> - Yannis Tebaibi, UI designer at Volkswagen

One of them was moving away from physical touch buttons altogether. Tebaibi stresses that this decision was made primarily because of budget reasons.
Now, in MIB4, the physical buttons are re-introduced. Tebaibi described this as a loop with no progress; "We are now back at where we were before. We were mainly correcting what we did wrong with MIB3".

Moreover, another cause of the crisis, Covid-19, had a major impact on the development of MIB4. Tebaibi reflected on the aftermath of Covid-19, stating that the situation regarding user testing was still "very tricky".
This might insinuate that there was a lack of user testing on the moment of deployment of the system.

Tesla as the main competitor, not China
The transition from physical buttons to touchscreens described before was not merely a budget decision. Rather, it was a universal trend in automotive UX design. One of the main pioneers of this and many other innovations at the time was Tesla.

Tebaibi describes Tesla as the "central competitor Volkswagen was looking at during the development of MIB4". They brought new technologies on a gigantic CID in a very minimalistic interior environment.
This goes hand in hand with another trend in automotive UI design at the time, where displays became bigger and bigger.
In projects after MIB4, the focus slowly shifted to Chinese competitors. "Chinese competitors were not even in sight at the time" says Tebaibi.

2.5 Competitor Analysis

Until now, only Volkswagen's UI and UX developments have been discussed. To get a better picture of how Volkswagen compares to other OEMs and to find UI/UX trends in the automotive field, a competitor analysis has been done.

User Interface Trends

Growing screens

A universal automotive trend is the growth in screen size. Screens now sometimes even stretch all the way to the passenger side, allowing for co-driver entertainment.

Figure 2.12 *The Mercedes MBUX system*



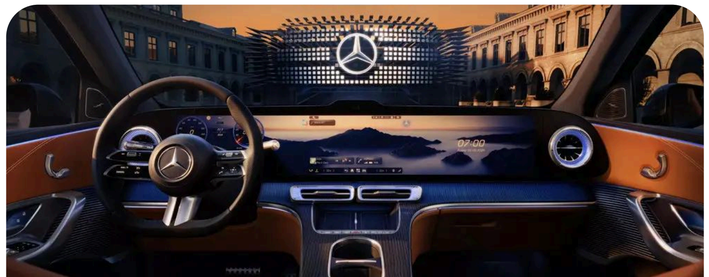
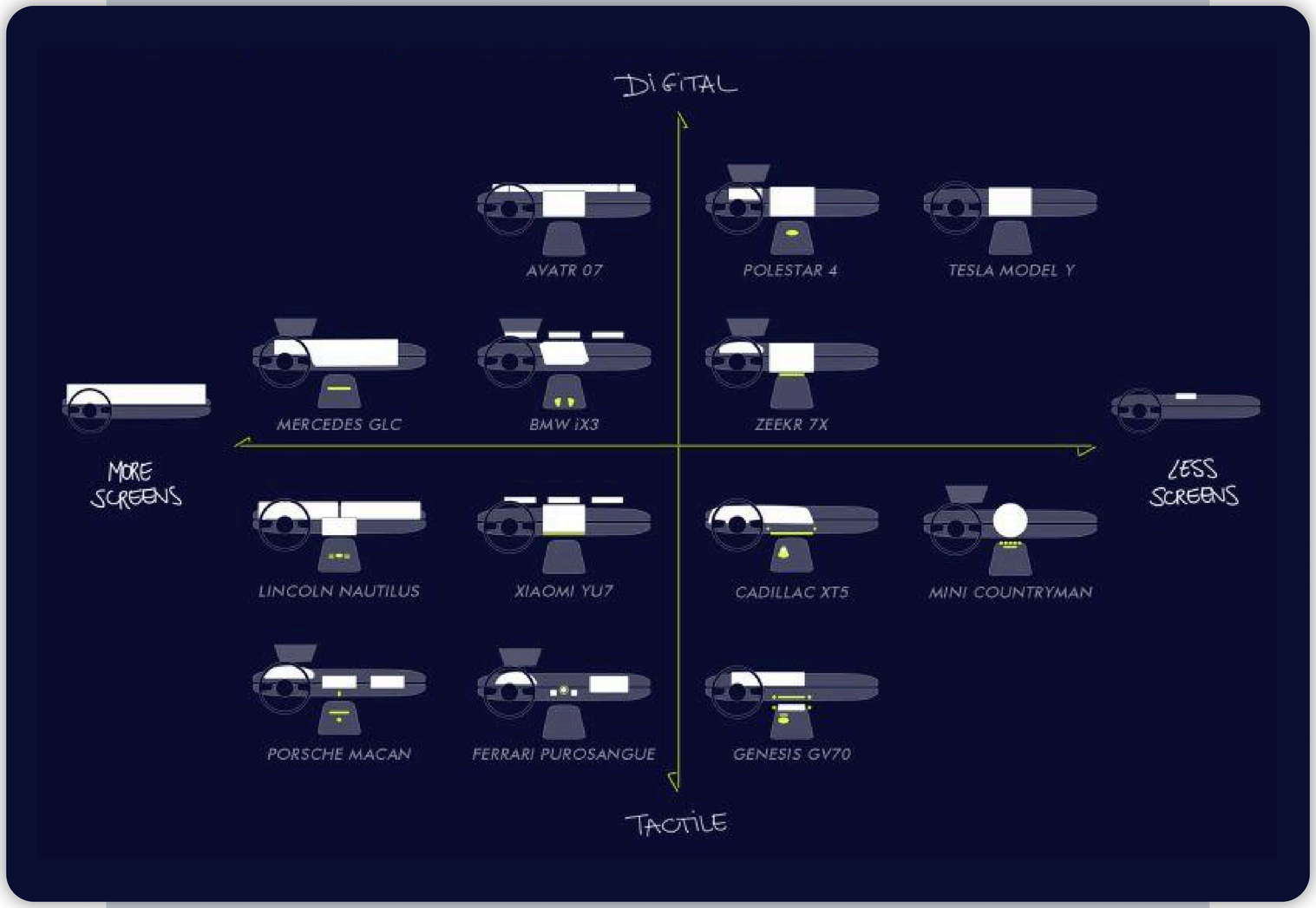


Figure 2.13 *Overview of the current automotive interface landscape*



The company starting this trend was Tesla, with its completely screen-based interface. It feels more like the ones found on phones; extremely minimal in terms of design, with only a CID and no complementary physical buttons. A deeper dive into the trend of car interfaces becoming more phone-like will be discussed on the next page.
Another more recent example is the Mercedes MBUX Hypersceen (see figure 2.12).
However, not all OEMs decided to follow this trend, with less screens or offering a more tactile experience. In figure 2.13, one can see an overview of the current automotive interface landscape.

Windshield-wide interfaces
A similar trend that we see nowadays is windshield-wide interfaces. Xiaomi's HyperVision panoramic screen (which is an edge to edge HUD, reflected on a black strip at the bottom of the front window), available in the Xiaomi YU7, gets rid of the conventional DIM entirely (see figure 2.14).
BMW's "Operating System X" offers "BMW Panoramic Vision" which is incredibly similar to the one in the YU7 (see figure 2.15).
Windshield-wide interfaces can also be found in some Lincoln and Avatr vehicles (see figure 2.16 & 2.17). Here, there are actual screens placed close to the windshield.

Figure 2.14 *Xiaomi's "HyperVision" panoramic screen*





Figure 2.15 *BMW's "Panoramic Vision" panoramic screen*

Figure 2.16 *Lincoln's panoramic screen*





Figure 2.17 *Avatr's panoramic screen*

Return of physical controls
For a long time, the large screen trend also went hand-in-hand with the disappearance of physical buttons. But recently, OEMs, including Volkswagen, have started re-introducing physical controls.



Figure 2.18 *Volkswagen reintroduces physical controls in it's ID. Polo interior*

User in control & unlimited customization
Xiaomi has a different approach. What makes Xiaomi special is the value for money they bring to the customer, also in terms of user experience. They leave it up to the car owner to decide whether or not they need physical controls, by allowing them to attach or detach a module of physical buttons (see figure 2.19).
Additionally, Xiaomi's YU7 model offers cooled charging pads for phones, and, in some trims, even a smart fridge (Moldrich, 2025). The car comes with a magnetic rail for storing items, such as a programmable track light. It also comes with a magnetic wireless button that can be stuck to magnetic surfaces in the car, and can be customized to control various car functions. It also has some connection points spread across the car to connect other accessories, such as a phone holder that car charges your phone on the go (Rainford, 2025). In short, a lot of customization options in a single car.

Figure 2.19 *Customization options in Xiaomi YU7 interiors*



Figure 2.20 *Tesla's popularizes OTA's*





Figure 2.21 *Apple Carplay Ultra takes over both the DIM and CID*

Software & User Experience Trends

Over-the-air updates

On the software side, over-the-air (OTA) updates have allowed OEMs to update their in-car systems' software from a distance. Popularized by Tesla, the feature has since become a standard feature in many modern cars (see figure 2.20). The split between hardware and software caused cars to become software-defined. In software-defined vehicles, features and functions, including driving, safety, and infotainment, are primarily managed, enabled, and updated through software rather than fixed, traditional hardware (IBM, n.d.).

In-car UIs becoming phone-like

Android Auto and Apple Carplay integration also have become a standard in newly produced vehicles. People have got used to the fact that they can display phone apps in their cars. In fact, car interfaces have become more like phones, blurring the transition between driving-oriented interfaces and smartphone functionalities.

Moreover, Apple recently revealed Carplay Ultra (Apple, 2025). Carplay already allowed apple users to mirror mobile apps on the CID, but now also takes over the DIM (see figure 2.21). This opens up a new level of connectivity, creating a seamless bridge between mobile and in-car UIs. The OEM is limited to predefined and customizable set of widgets. It is up to OEMs themselves whether they make Carplay Ultra available in their vehicles, but so far, only Aston Martin offers it in it's core model line-up.
The fundamental difference between an OEM-specific interface and Carplay Ultra is that for the latter option their is no way for OEMs to align it with the brand.

Driver profiles

Cars coming with a personal profiles has become an industry standard as well. In such user-specific profiles, a user can store his or her personal information and preferences. When stepping into the car such saved items can be activated automatically; the seat being adjusted to the preferred position, car mirrors moving in the right position and the ambient lighting switching to one's favourite colour.

Adaptive User Interfaces

A clear example of an adaptive user interface in the automotive domain is Elektrobit's Next-gen Cockpit concept presented at CES2025 (see figure 2.22) (Elektrobit, 2025). When communicating verbally that one is "driving though a jungle", the ambient lighting, system colours and 3D infotainment environment change accordingly to match the context.
What is limiting this concept is that it relies completely on a human voice input and only reacts in a passive way.

Instead, an intelligent system can learn from previous drives, user's behaviour, and actively try to suggest features that fit the contextual scenario. In such case, system can proactively anticipate to the learned and predicted needs of individual users. An example that does this in a very simple way is the Mercedes MBUX Zero layer infotainment system (see figure 2.23) (Mercedes, n.d.). Depending on the scenario, dynamic and situation-dependent modules (e.g., massage or weather) are recommended to the user as suggestions.

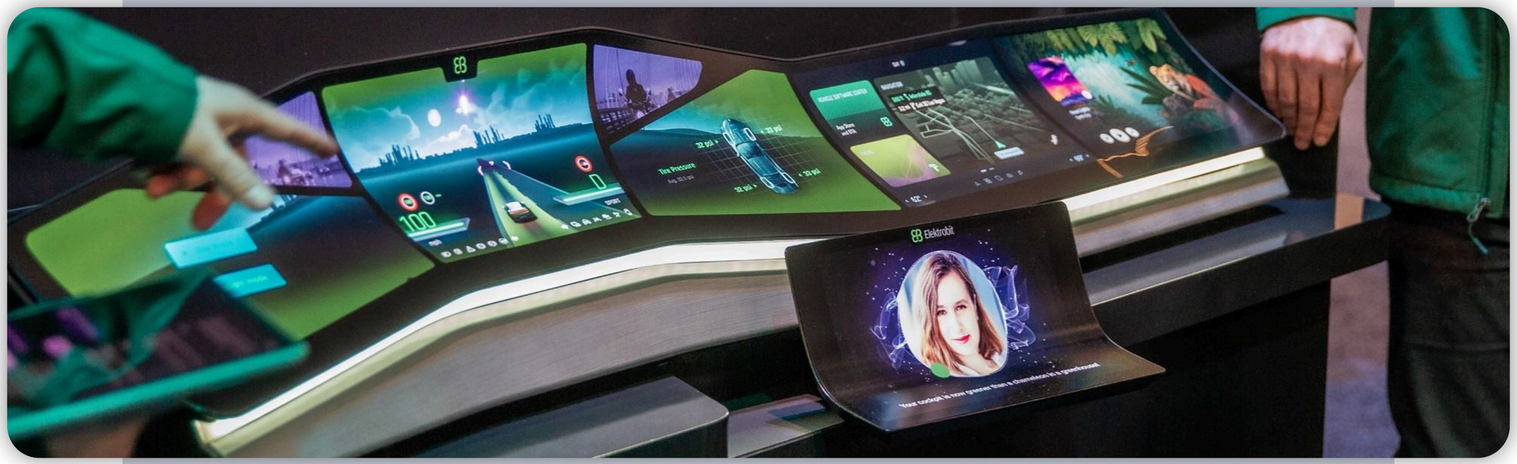


Figure 2.22 *Elektrobit at CES2025: Adaptive "Next-gen Cockpit" concept*

In summary, an analysis of current personalised HMI design features like the ones highlighted shows a focus on four aspects: high user involvement, high customizability, high degree of intelligence and good user experience (Liu, 2024).



Figure 2.23 *The Mercedes MBUX Zero layer infotainment system suggest widgets based on learned routines*



2.6 Literature Research

Existing research in personalised and adaptive automotive interfaces is limited. Still, since 2017, there has been an upward trend in research about automotive human-machine interfaces (Wirtz et al., 2024). The existing studies and theories from the broader (adaptive) HMI domain have been evaluated to shape the design and interaction of adaptive interfaces, and to provide scientific justification for the guidelines drawn up subsequently.

Adaptive interfaces & personalisation

The pros and cons of adaptive interfaces
Adaptive personalised interfaces allow for normally deeper-nested system functions (that often remain unused, shown by internal research) to be brought forward as a first-level system function, therefore inherently improving accessibility. Incorporating learning and modelling of user preferences enables adaptive intelligent systems to effectively respond to user needs (Rittger et al., 2022).

Comprehensive work from Wirtz et al. (2024) concludes that automotive adaptive HMI systems can minimize distractions and mental workloads, while improving the user experience. The use of adaptive interfaces facilitates user performance, minimizes the need to request help, eases system use, helps users deal with complex systems and avoids cognitive overload problems, which all help to improve the user interaction with the respective systems (Lavie & Meyer, 2010).

Alongside promising advantages of personalised interfaces, studies also show concerns, including lack of user control, and compromised (data) privacy (Eckl et al., 2026). Moreover, while some studies claim adaptive interfaces can help minimizing distraction and improving road safety (Wirtz et al., 2024; Rittger et al., 2022; Eckl et al., 2026; Grobelna et al., 2025), others highlight the dynamic nature of adaptive interfaces as a safety concern, as distraction from one's primary driving task can pose safety risks (Amditis et al., 2006).

Advantages, disadvantages and considerations of automotive adaptive interfaces are reflected on while proposing guidelines in chapter 9.1.

User-centered personalisation
Bos (2025) summarizes user-centered automotive interface personalisation in three categories:

- Me: How well the car knows you, your routines and your preferences and the system's ability to act on those.
- My place: How effective the system is at making you feel at home inside the car, by automatically adapting anything that can be adapted to your preferred settings.
- My stuff: How frictionless it is to get to your digital (phone) content and services while using the car.

Context-based personalisation
Alongside user-centered personalisation, studies also highlight the importance of adapting to the driving context (Hussain et al., 2018; Garzon, 2013). Already in 2012, tests with an context-aware personalised user interface were completed by Daimler Center for Automotive Information Technology Innovation (Garzon, 2012). Such context-based adaptation extends beyond traditional user-based personalisation, by reacting to the weather, light, location, date and time.

Routine-based personalisation
Next to user-based personalisation and context-based personalisation, this project introduces routine journeys as a factor triggering personalisation. Related research about adaptive HMI solutions in trucks shows that adaptive interfaces can help to mitigate the struggles that come with routine tasks (Eckl et al., 2026). Routine-based adaptation can be applied in the passenger cars domain to pursue similar results, as fully adaptive interfaces have shown to be beneficial while performing routine tasks (Lavie & Meyer, 2010)

Human-AI Interaction

An important consideration in the design process should be the interaction design, as the user's normal workflow should not be disrupted while adapting to the specific user needs and the given situation (Hartmann, 2009). Designing interaction for adaptive widget suggestions in an in-vehicle interface should therefore draw on a focused set of theories from human-computer interaction and user experience design that address intelligent adaptation.

First, mixed-initiative interaction (Horvitz, 1999) suggests that both the AI system and the user should be able to take initiative: the system proposes widgets based on patterns from similar drives, while the user can accept, dismiss, or adjust them, preserving a sense of control.
Second, principles from explainable artificial intelligence emphasize the importance of transparency, where brief explanations (e.g., "based on similar past trips") help users understand and trust recommendations (Miller, 2019).

Third, grounding the design in mental models supports usability and understandability, as users rely on clear and familiar system behaviour to make sense of interface elements and their functions, reducing confusion and facilitating intuitive interaction (Norman, 1983).
Finally, insights from cognitive load theory highlight the need to minimize mental effort in attention-critical contexts such as driving, requiring interactions to be simple, glanceable, and non-intrusive (Sweller, 1988).

Together, these theories support an adaptive interaction design that is intelligent yet controllable, transparent yet unobtrusive, and aligned with the cognitive constraints of in-vehicle use. Theories on interaction design will later be reflected on while designing the interaction.

03

Vision


Panketal
Ahrensfelde
Neuenhagen
Schönefeld
RADIO 1
1:30
Charging Status
69%
1:34 h


11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

3.1 Future Context

Liu (2024) highlights intelligence, automation, cross-platform, multimodal interaction, sustainability and environmentally friendly design as future trends in automotive personalised HMI design. Yet, the broader context in which personalised interface will exist in will change. To construct the future context for the final product to exist in, many context factors have been gathered; trends, observations, thoughts, theories, laws, considerations, beliefs or opinions.

Opposing worlds

While putting the context factors in a matrix, key contrasts emerged. An interesting insight is that society is drifting away from Volkswagen's brand identity. Volkswagen's identity is all about togetherness, family and creating memories. Yet, Individualism has generally risen across countries over time, consistent with modernization trends (Taras et al., 2012). Individualism also translates in modern-day mobility; research shows that single-occupant drives are most common across private transportation modes (Central Statistics Office, 2022). Here, a contrast emerges between routine drives and occasional multi-occupant drives (like family drives) that fit Volkswagen's identity.

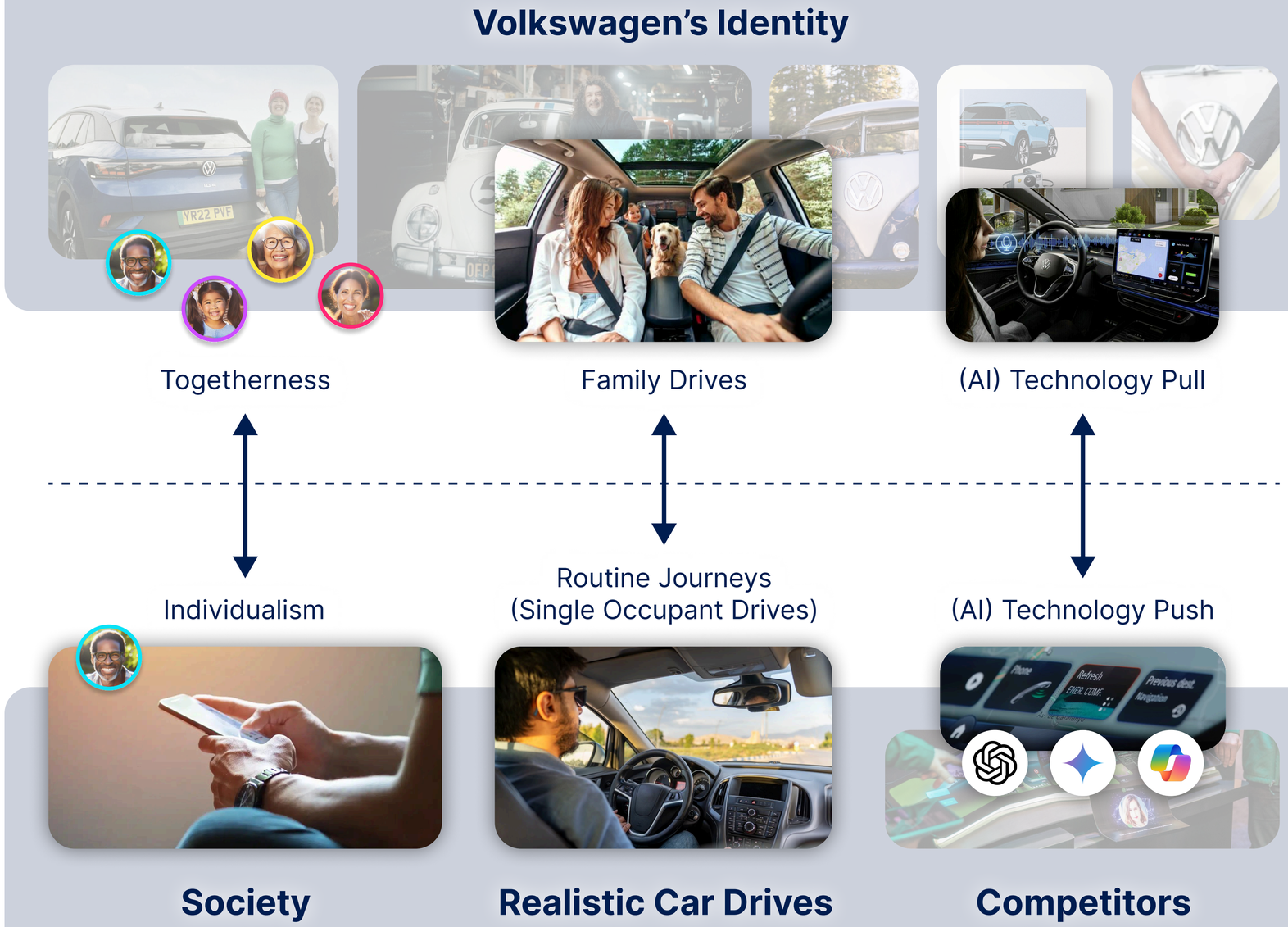


Figure 3.1 *Divergence between Volkswagen's identity/strategy and society/realistic car drives/competitors*

Another contrast is that many competitors are pushing technology, while Volkswagen has always been more conservative on the technology side. However, analysing their strategy revealed that Volkswagen has ambitions to become the automotive technology driver by 2035.

Adapting to the context
In the end, the decision has been made to not design the personalisation concept for one of the contrasting types of drives. Rather, I want the concept to be able to adapt to the changing contexts in realistic scenarios.

Mission Statement

Mission

“I want to initiate an effective cooperation between occupants and AI in an in-car environment that allows for an optimal experience of routine journeys”

Domain

3.2 Interaction

Human-product relation

The connection between the user, the vehicle and the intelligent system start when logging in with a user profile. This is the first data that streams from the user to the intelligent system. The more drives are completed, the more data flows into the intelligent system and the easier it is to recognize patterns and to present relevant features to the user. Likewise, user input and feedback across the various touchpoints of the car enable the user to improve the system's personalisation performance and their in-car experience. Ultimately, the interaction between the user and the intelligent system becomes a continues loop where drive data and user feedback play essential roles for the system's personalisation and experience-improving capabilities.
Therefore, the intended interaction imaged for this concept is cooperative. A strong combination should emerge between system automation and human control. Mutual understanding should ideally be optimized from the start, but essentially improve over time.

AI-to-Human
In one direction, AI to human, the intelligent system should adaptively support the user in an effective and personal way. Specific interaction qualities targeted are 'adaptive', 'creative', 'meaningful', 'suggestive', 'user-centered', 'proactive', 'enriching', 'automatic', 'personalised', 'assistive', and 'routine-optimizing'.

Human-to-AI
In the other direction, from human to AI, the user should feel in control of unlimited personalisation. Feeling in control means always being able to specify what data is and what data is not used as an input for the intelligent system.
Next to that, human interaction should aways be perceived and treated as superior over features automated or suggested by the system. Human interactions should therefore always overwrite the intelligent system. Interactions from user to AI should maximize safety (by minimizing gaze duration and cognitive load) and be understandable for the wide range of Volkswagen customers. Interactions should therefore feel quick and straightforward. In the end, even though a lot might be optimized by the intelligent system, the user should still feel in control about their personalised in-car experience.

The interface as an intermediary layer
The user interface, together with other in-car touchpoints, functions as an intermediary layer that enables bidirectional communication between the user and the intelligent system, translating complex processes into understandable representations while capturing user input in a system-interpretable form.

In the system-to-user direction, the interface applies principles from explainable artificial intelligence by making system behaviour transparent, communicating how data is processed, journeys are predicted, and features are suggested (Miller, 2019). It also reflects and summarizes changes to the interface and vehicle interior, supporting user understanding.

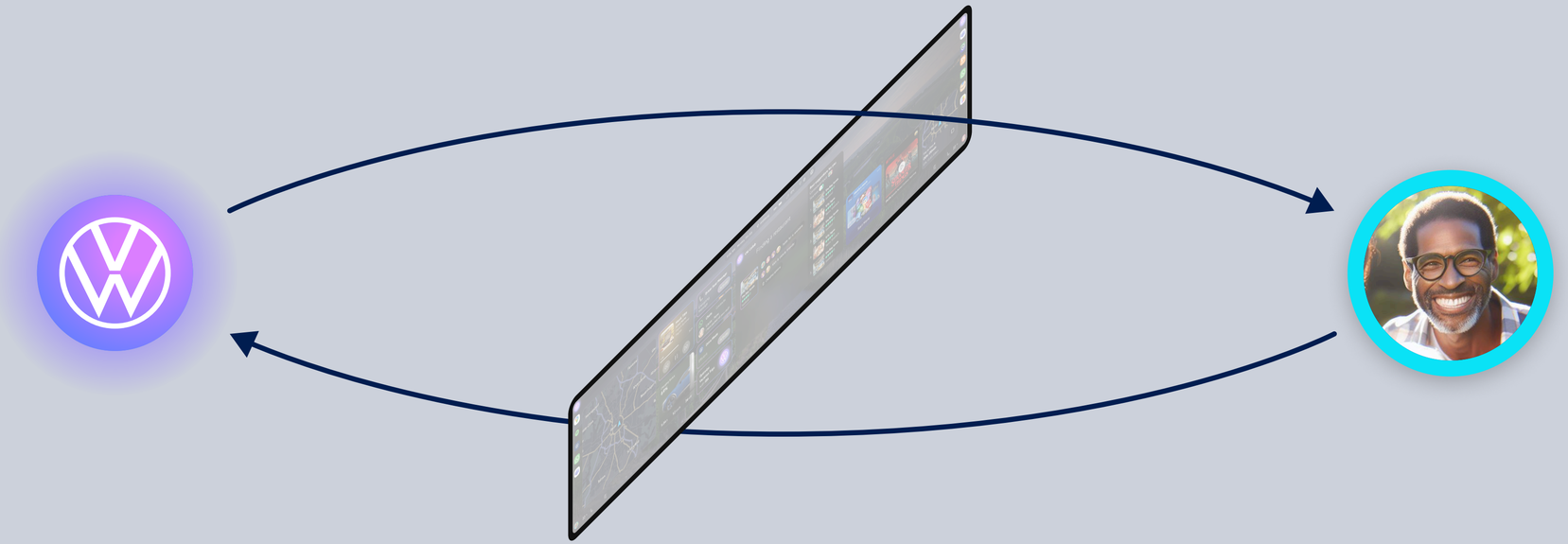
In the user-to-system direction, the interface enables feedback and control in line with human–computer interaction concepts such as mixed-initiative interaction (Horvitz, 1999). Users can confirm, reject, or adjust system suggestions, providing explicit input that helps refine future system behaviour and maintain alignment with user preferences.

Human-AI Interaction Model

Understandable | Desirable | Brand-fitting

AI provides the user

Personalised | Journey-fitting | Suggestive | Assistive



System learning through user feedback

User-centered | Controlling | Steering | Unlimited

Figure 3.2 *Human-AI Interaction Model including product & interaction qualities for the future product*

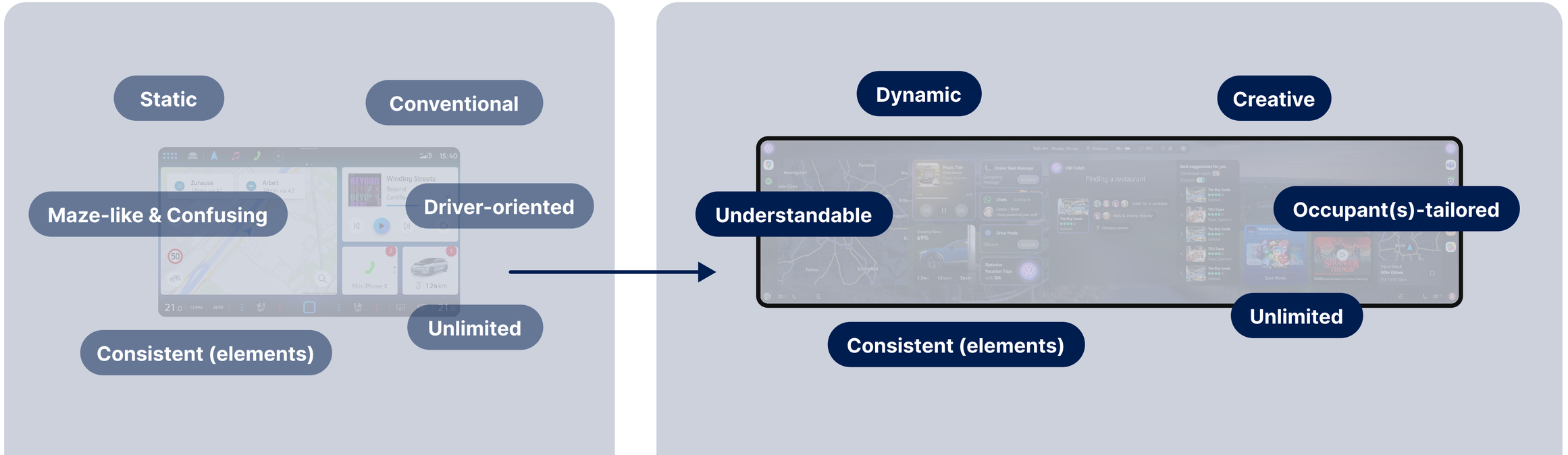
3.3 Product

Analysing the current interfaces and the experience provided key product and interaction qualities. Those qualities were transformed to interaction qualities aimed to be provided with the final concept. Combining those with product qualities defined by the project itself, created a foundation for the ideation phase.

Project-defined product qualities
One of the benefit of this thesis being part of a larger predevelopment project was that a seating buck was available for user testing. However, using this prototype for user tests also implied some indirect consequences for the final product. For example, the seating buck largely focusses on screen interactions on a large central display. Therefore, screen dimensions were largely defined from the start.
Next to this, integrated sound, ambient light and roof projections are controlled by programming and are therefore to costly and time-consuming to be customized for user testing.

Transformed product & interaction qualities
After analysing the current product, some of the product and interaction qualities have been left unchanged and were adopted for the new product. Of other qualities, the exact opposite was taken. Some qualities have also been defined independently of original product and interaction qualities, primarily revolving around the project topic and its aims. A summary of all project and interaction qualities that were central for the later ideation and prototyping phase can be found in figure 3.3.

Figure 3.3 *Defining new product & interaction qualities for the future product*



04

UX Design Phase 1




11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

4.1 Co-ideation Session

Methods

Study Design

This initial study employed a qualitative co-creation approach to investigate the relationship between users, trip destinations, and in-car user interface (UI) layouts for routine journeys. The session was designed to:

1. Investigate user-designed configurations and underlying reasoning for the target trip purposes of commuting, grocery shopping, and leisure.
2. Investigate the relation between interior & UI elements and the main factor for those to be adjusted.

Participants

A total of N = 8 participants took part in the study. Participants were recruited through the ‘probandenpool’, an internal pool of voluntary research participants at Volkswagen. The sample consisted mainly of people with a background in engineering or research.

Materials

A low-fidelity (lo-fi) prototyping toolkit was developed for the session. This consisted of a 1:2 scale foamboard representation of a generic in-car display, which served as the base interface. In addition, a set of paper-based widgets in various predefined sizes was provided. These widgets represented common UI elements, including navigation, media (e.g., music), vehicle-related settings, phone applications and entertainment. Participants could freely arrange these components to construct interface layouts.

Procedure

The co-creation session was conducted in the design building and lasted approximately 15 minutes. The session was structured into three phases.

In the first phase, participants were asked to estimate the number of trips they complete in an average week, focusing on three predefined routine journey types: commuting, grocery shopping, and leisure. They were also asked to report any additional trip purposes not covered by these categories.

In the second phase, participants designed a UI layout for each of the three journey types using the provided toolkit. They arranged widgets on the foamboard interface according to their preferences and perceived needs for each scenario. The resulting layouts were documented through quick sketches, capturing widget placement, size, and content. Additional qualitative observations and participant comments were document as well.

In the third phase, participants were asked to reflect on personalisation strategies across both UI elements and related in-car touchpoints. Specifically, they indicated the primary factors influencing adjustments to features such as seat position, steering wheel position, climate control, ambient lighting, driving mode, advanced driver-assistance systems (ADAS), as well as UI elements including background, navigation, and media. Participants selected from predefined options: (1) consistent across all trips, (2) dependent on trip purpose/destination, or (3) dependent on other contextual factors (e.g., date, time, mood, weather). Multiple selections were permitted.

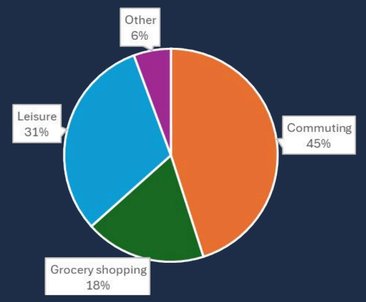
Results

Trip purpose

As expected, commuting has turned out to be the most common trip purpose (figure 4.1). The broad-ranging trip purpose “leisure” was the second most common trip purpose, with 31% of all trips. In third came grocery shopping, with 18%, and only 6% of all trips having a not-predefined purpose.

It is important to not that these results do not include trips where one drives back home. From specific participant comments, it can be assumed that around 4 in 5 outgoing trips also have a directly related trip that brings you back home, with the remaining trips combining multiple destinations before returning back home. When including this, driving back home accounts for about 45% of the total trip purpose share.

Trip purpose
excl. driving home



Trip purpose
incl. driving home

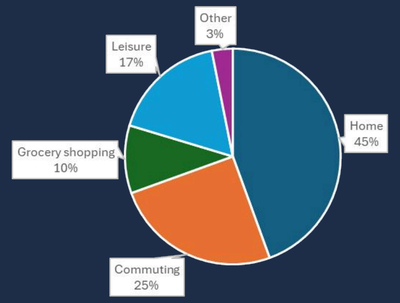


Figure 4.1 *Trip purpose split incl. and excl. driving home*

Widget inclusion (universal trend)

The overall inclusion of specific apps as well as the arrangement of the navigation, music, phone/ WhatsApp and vehicle data widget were found as universal trends.
When combining all participants layouts, the music, navigation, vehicle data and phone/ WhatsApp widget were each selected for over 87.5% for all trip purposes (see figure 4.2).
This suggests to universally include these “essential” widgets alongside user/scenario-specific widgets.

Inclusion of widgets for each trip purpose (%):

Commuting	Groceries	Leisure
100%	100%	100%
87,5%	87,5%	100%
87,5%	87,5%	87,5%
87,5%	87,5%	87,5%
25%	25%	12.5%
25%		

Figure 4.2 *Inclusion of widgets for each trip purpose (%)*

Widget arrangement (universal trend)

Next to this, when creating a heatmap combining all layouts for each trip purpose (see figure 4.3), a clear pattern in widget placement emerges; navigation being the left-most widget in 62.5% of all layouts for each trip purpose, music being in the middle column for 50% of all layouts for each trip purpose, and, for both the vehicle data and the phone/WhatsApp widget, appearing on the right-most column in up to 62.5% of layouts for each trip purpose. This is summarized in figure 4.4.

Commuting



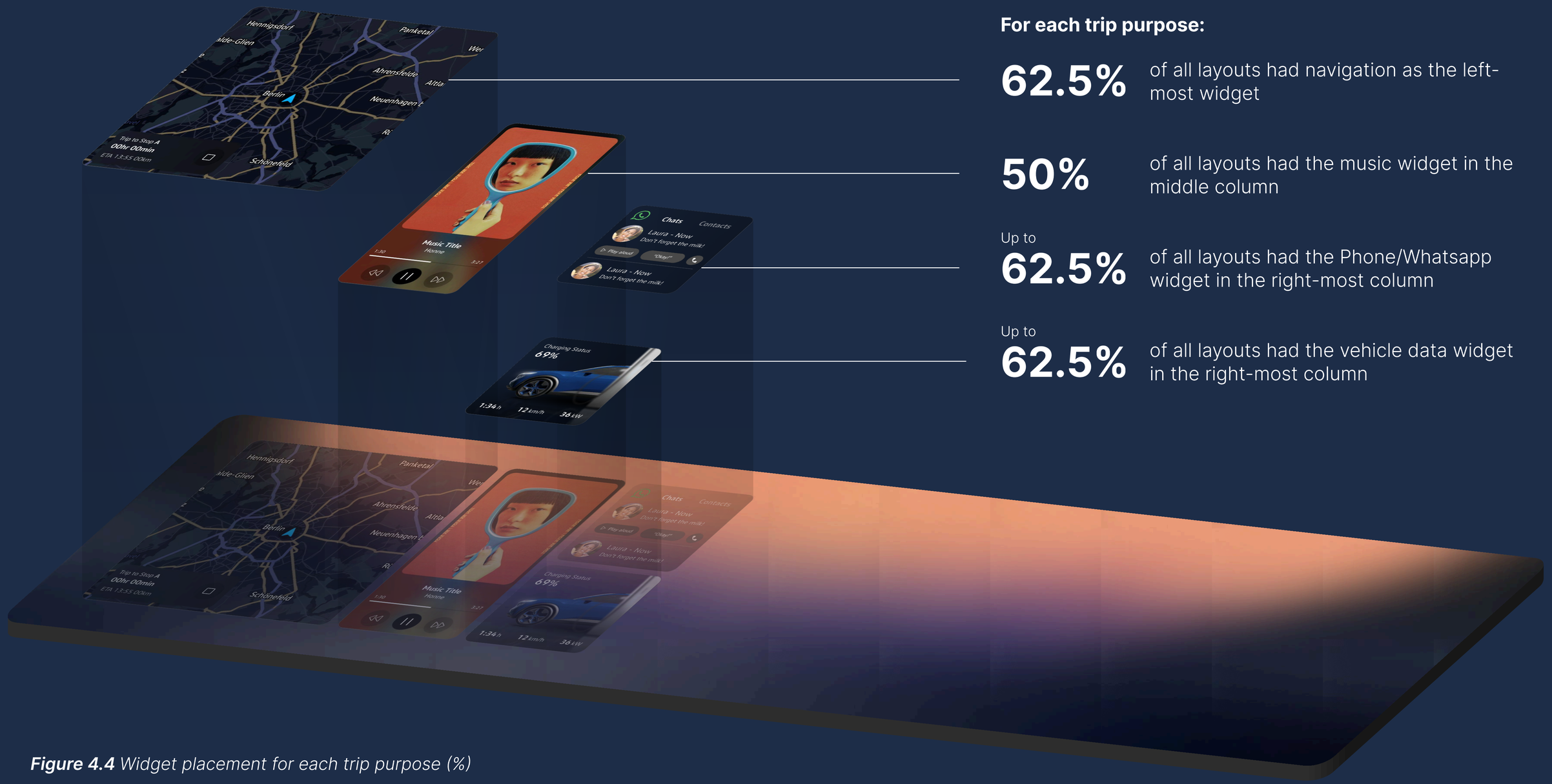
Grocery shopping



Leisure activities



Figure 4.3 *Color-coded widget arrangement for each trip purpose*



For each trip purpose:

62.5% of all layouts had navigation as the left-most widget

50% of all layouts had the music widget in the middle column

Up to **62.5%** of all layouts had the Phone/Whatsapp widget in the right-most column

Up to **62.5%** of all layouts had the vehicle data widget in the right-most column

Figure 4.4 *Widget placement for each trip purpose (%)*

User-specific trends
Even though general trends in UI layout can be found, layouts turn out to be highly user-specific as well, with user-specific layouts staying fairly consistent across trip purposes. Once a layout and contents were defined for the first trip purpose, there was sometimes only a minimal change when moving on to the grocery shopping and leisure activity journeys. In fact, for 37.5% of the participants the UI layout did not change at all depending on the trip purpose.

Journey-specific trends
Journey-specific trends were not significant. This highlights the argument that the default layout of the interface should primarily be tailored to the individual customer. Personalisation should come first, and should then be optimized for this specific user for the specific scenario (routine journey).

Furthermore, many participants indicated that UI layouts are highly dependent on number of people in the car and the specific activity within the domain of leisure trips. Some participants specifically highlighted a split in trips with one person inside the car versus multiple people inside the car.

Together, this suggests to split up leisure activities into better-defined journeys, alongside splitting them up into single and multi-person trips.

Touchpoint settings & widget contents
Similar to the widget arrangement, widget content and touchpoints outside the user interface do not solely change depending on the trip purpose in many cases. Especially seat position, steering wheel position and ADAS settings stay the same for many participants as they directly relate to the person inside the vehicle.
Furthermore, change in touchpoint settings and widget contents also turns out to be highly user-specific.

Key insights were that:
- There is are opportunities for automation and adaptive features beyond routine journeys, as many touchpoint settings and widget contents change based on other factors such as date & time, mood and weather.
- Navigation could go into a more passive mode during common trips.

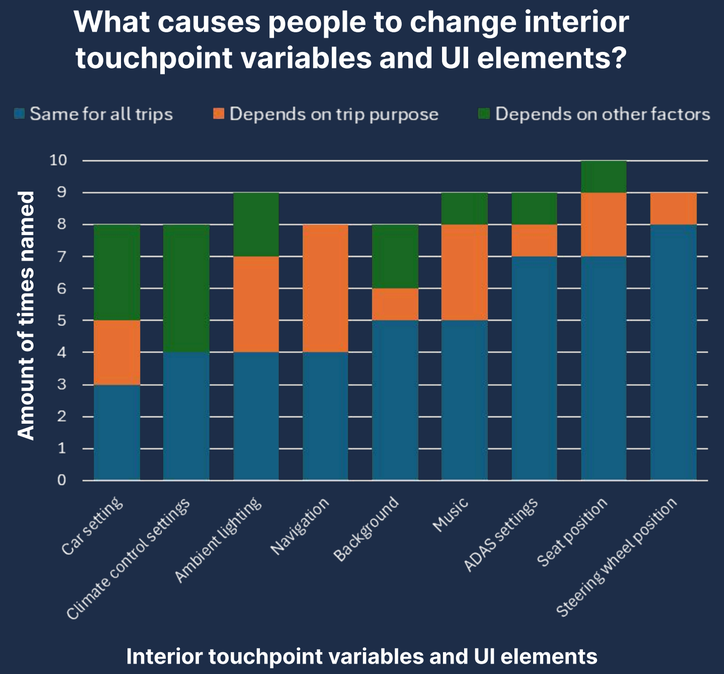


Figure 4.5 *Factor dependency for changing interior touchpoint variables and UI elements*

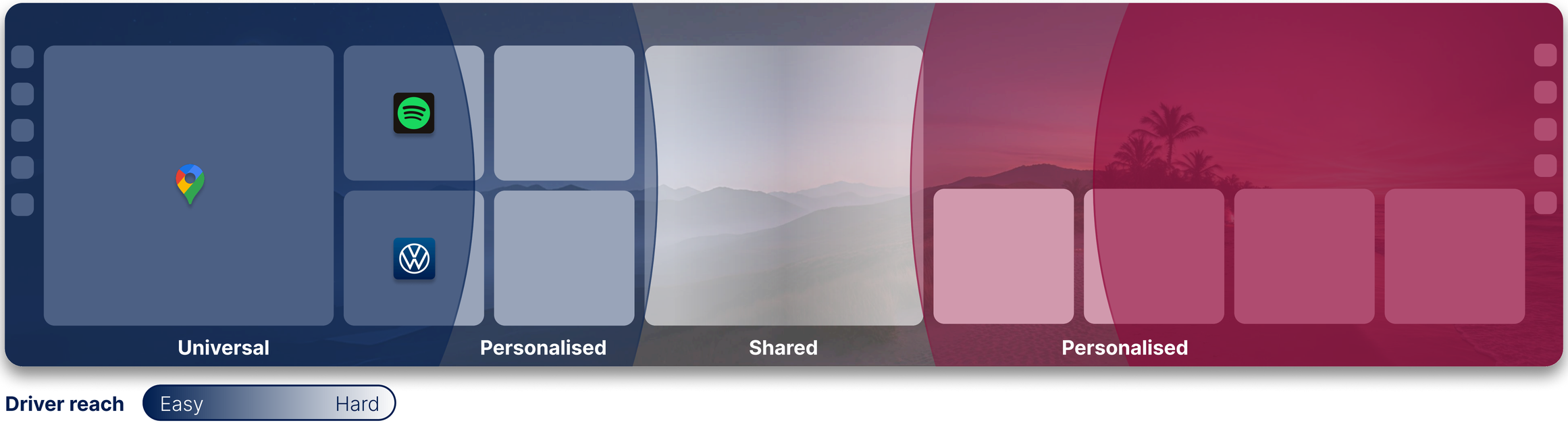
4.2 General UI Layout

The high inclusion of navigation, music and car settings in the co-ideation session led to the decision to permanently include these widgets across users and journeys. The set of these widgets could be seen as ‘essential’, and are therefore strategically placed in the leftmost area of the interface of both personas, being most reachable for the driver (while driving).

This leaves one more row for personalised content on the driver’s right-hand side.
Among such personalised content, the user test has shown that the WhatsApp/phone widget is most commonly used across users and scenarios. Its widget is therefore included as the most commonly used for both personas.

Other personalised content has been split per persona, as it allows to highlight user-specific differences in the final prototype. Frank is often the main driver and his content therefore includes commuting-focused widgets, while Laura (often in the co-driver seat) receives more entertainment-focused widgets.

Figure 4.6 *General UI Layout and occupant ergonomic reachability on a large central display*



4.3 Personas & Lo-fi Prototyping

The personas serve as a general representation of what a Volkswagen customers could want and need in the domain of personalisation. The personas therefore come in the form of profiles in which key information defining their personalisation can be found.
The first type of preferences define basic personalisation regarding ergonomics, such as seat and steering wheel position and mirror angles. Automatically setting up these components have become a standard in premium vehicles across the automotive field.
The second type of preferences relate to the interior and includes ambient lighting an AC settings.
Because all of the settings above cannot be automated or simulated in the seating buck, the focus in mainly on the third type of preferences: personalisation within the UI. Such preferences include background image, UI colour theme, most frequent journey types and related most used phone applications in the car.



Figure 4.7 *Co-ideation-based personas: family Schneider*

To define what a realistic Volkswagen user needs, research-based personas have been created. The co-ideation session served as the foundation for the personas of Frank (driver) and Laura (co-driver) and their driver profiles (see figure 4.7, 4.8 & 4.9). For example, for both personas, the most commonly experienced trips align with the findings co-ideation session. Commuting, grocery shopping and leisure activities being the most common trip purposes is supported by research (Department for Transport, 2025; Eurostat, n.d.). For each trip, the percentual inclusion of widgets for each trip purpose found in the co-ideation session served as the main reference for translating routine journeys into UI layouts, as it indicates which widgets should be shown when. Alongside this, journey-specific widgets have been developed to be shown in addition to the widgets provided in the co-ideation session. The standard layouts for Frank and Laura is shown in figure 4.8 & 4.9.

For multi-user journeys, the profiles of Marina (daughter) and Granny are also involved. their more extreme ages have an impact on the design of the UI itself, with a more minimal layout for both and enlarged text for Granny.



Frank Schneider

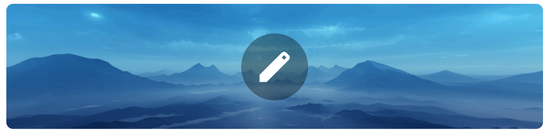
Age: 53

Ergonomics

- Seat position & settings
- Steering wheel position
- Mirror Angles

Interface

Default BG image: Hills



Default colours:

Connectivity

Commonly used apps:

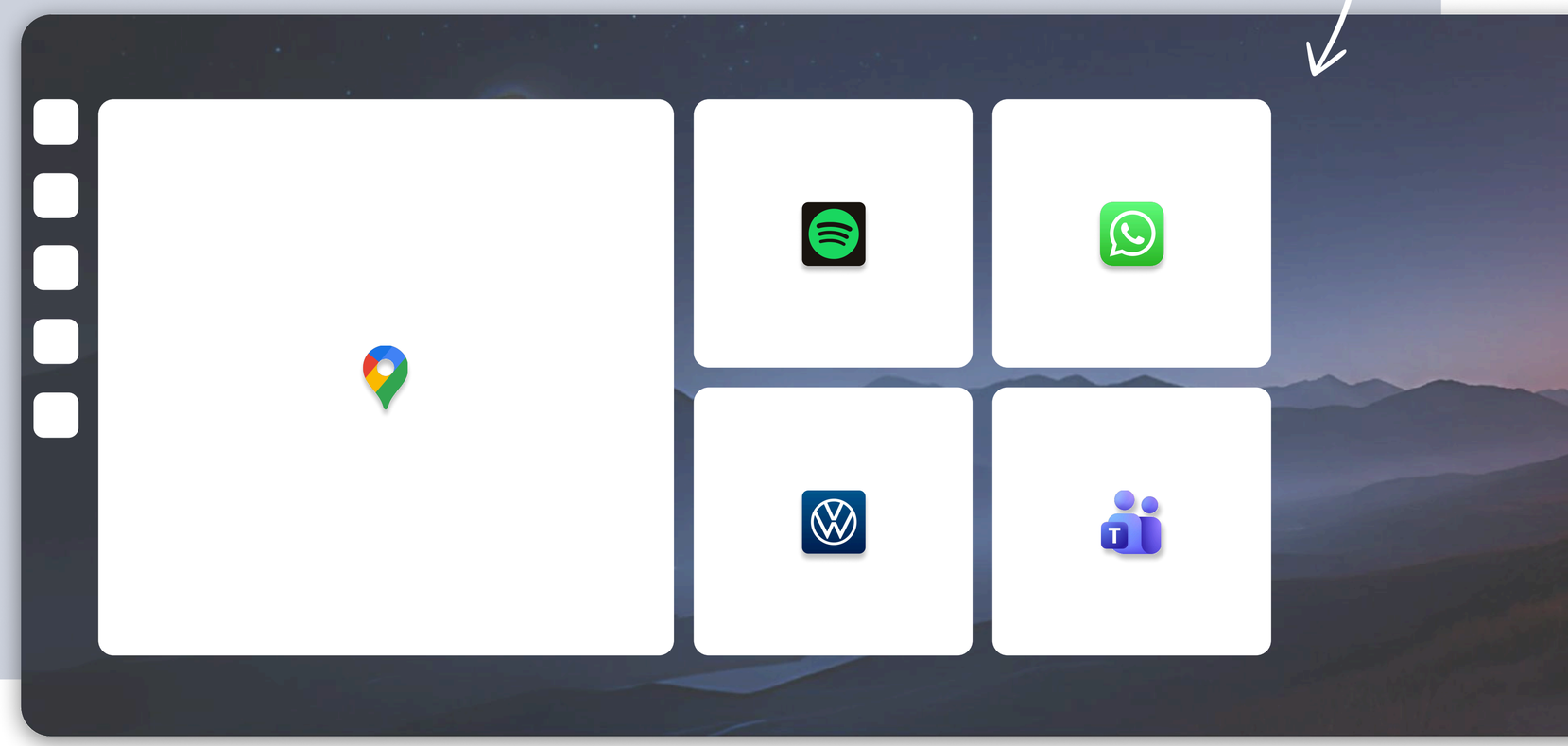
My trips:

- Work (50%)
- Grocery shopping (13%)
- Sports (10%)
- Family trips (8%)
- Visiting friends & Family (8%)
- Date nights (5%)
- Other (6%)

Alternative widgets that can be suggested in different scenarios ▼



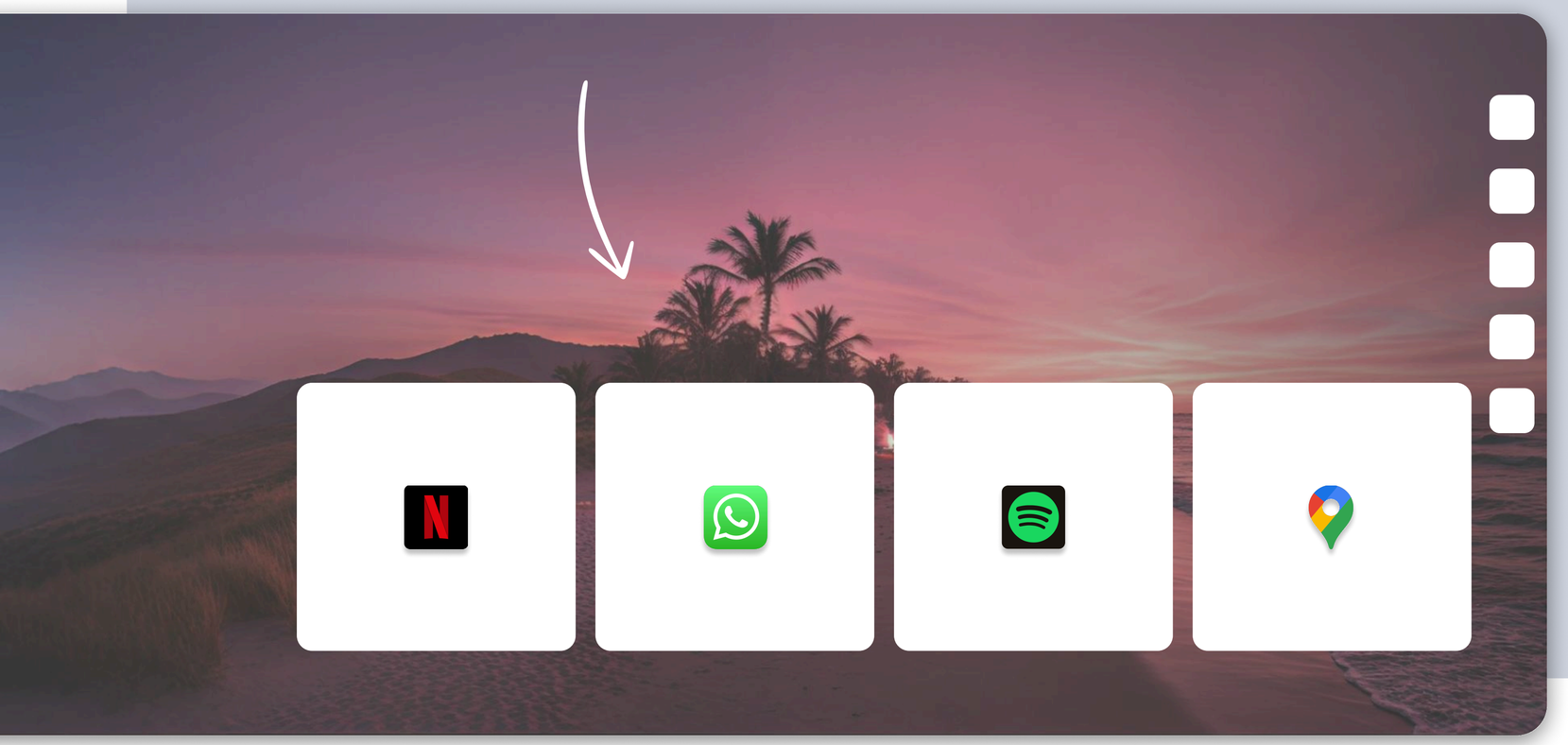
Figure 4.8 *Standard layout for Frank (driver)*



▼ **Alternative widgets that can be suggested in different scenarios**



Figure 4.9 Standard layout for Laura (co-driver)

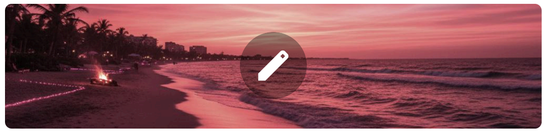




Laura Schneider
Age: 44

Ergonomics
- Seat position & settings
- Steering wheel position
- Mirror Angles

Interface
Default BG image: Beach

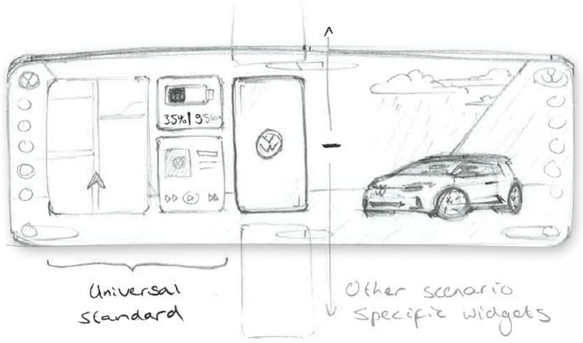


Default colours:

Connectivity
Commonly used apps:

My trips:
- Work (40%)
- Grocery shopping (23%)
- Sports (14%)
- Family trips (8%)
- Date nights (5%)
- Visiting friends & Family (4%)
- Other (6%)

4.4 Ideation



Initial & journey-specific UI Setup

With a focus on effective collaboration between human and AI, various ways of how adaptive widgets could move around and be interacted with by the user were explored. The initial setup and further adjustments of elements were a major topic in the initial sketching phase. From here awareness was raised for the fact that the interface would have to adapt to the contexts it would be used in.

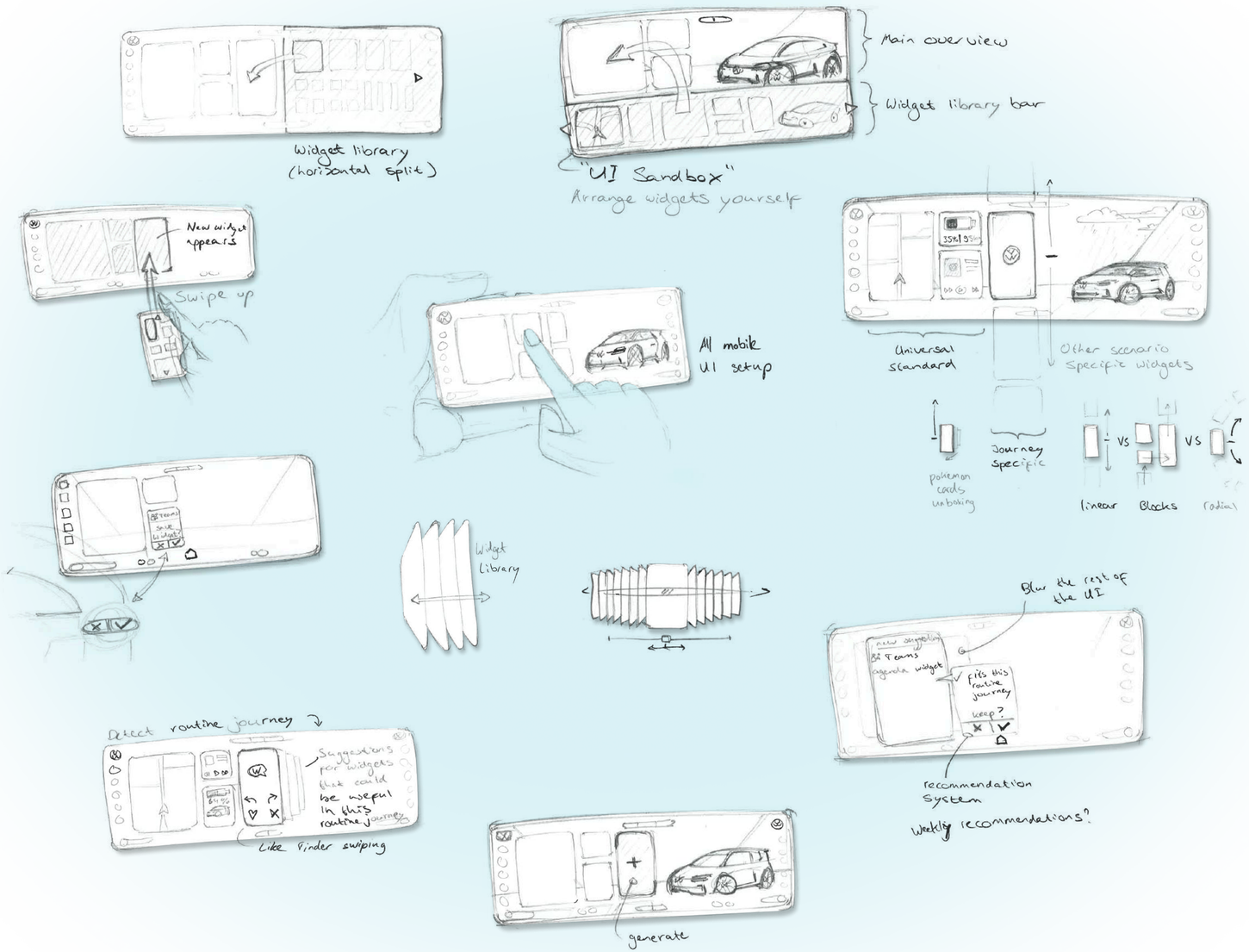


Figure 4.10 *Initial & journey-specific UI Setup ideation sketches*

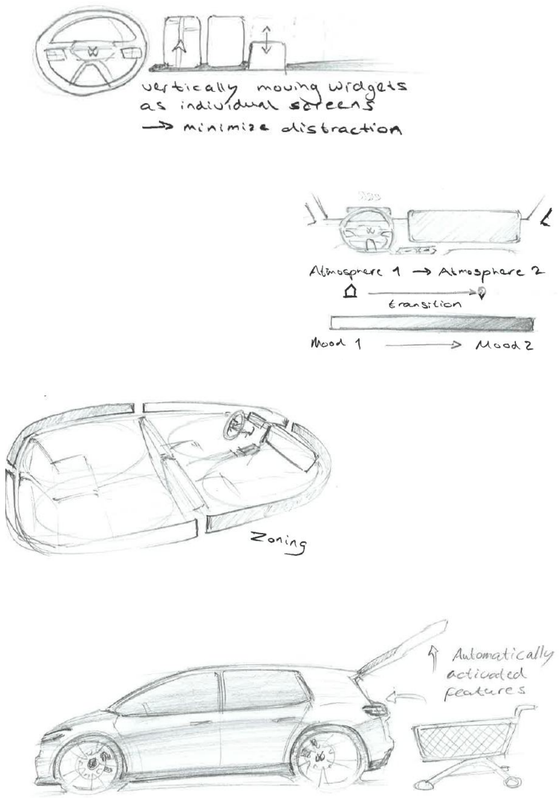


Figure 4.11 *More ideation sketches*

Journeys & Navigation

Alongside the setup ideas, some ideas regarding journeys and navigation were explored. Next to nowadays widely available alternative route suggestion, journeys were explored as a personalisation element.
Volkswagen already saves basic trips statistics, but there might be some potential unexplored of how to use this data in a more meaningful way.

One of the ways in which AI could play a role is generating a 360-degree of the final destination location

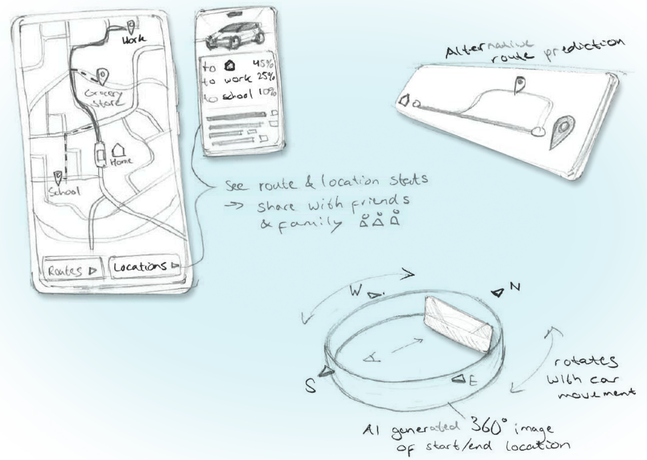


Figure 4.12 *Journeys & navigation ideation sketches*

Collaboration

Lastly, a main topic that was explored initially was in-car collaboration. With multiple occupants in the car sometimes, the question was raised how to effectively mix and match preferences such as music tastes. Some Spotify-like ideas were explored, as well as ways to control a shared playlist across the various screens inside the car.

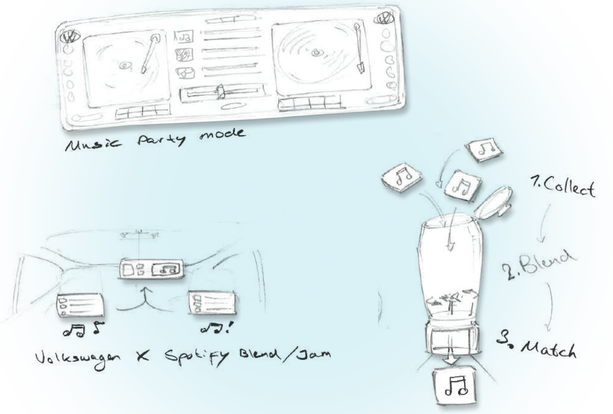


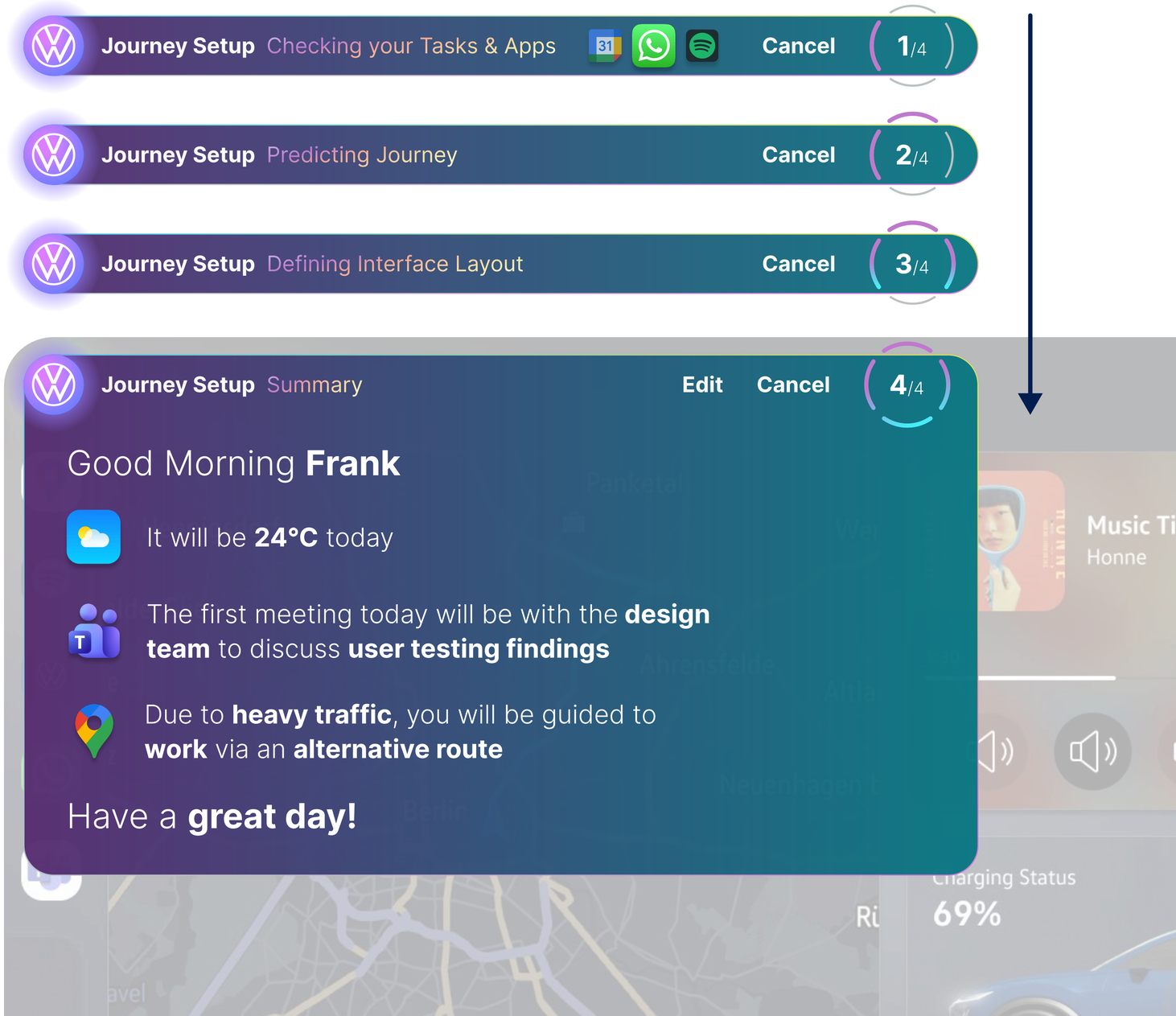
Figure 4.13 *In-vehicle collaboration ideation sketches*

4.5 UI Prototyping

Ideas where brought together in an initial concept. This initial concept was an animated Figma prototype in which multiple adaptive features were connected to simulate a complete experience of an adaptive interface.
The main features include the interface setup for a specific journey (named ‘Journey Setup’) and adaptive features that triggered based on the type of journey (‘Adaptive widgets’)

Journey Setup
The initial concept for the Journey Setup followed 4 steps: Checking tasks and apps, predicting the journey based on this, defining the interface layout, and summarizing the changes. Upcoming events and tasks are checked, from which the journey can be predicted and the interface layout including its elements can be defined. Finally, a menu would be shown to summarize and explain all actions the system took. Buttons to edit and cancel also appear by this point, giving the user the opportunity to revert any actions taken by the system.

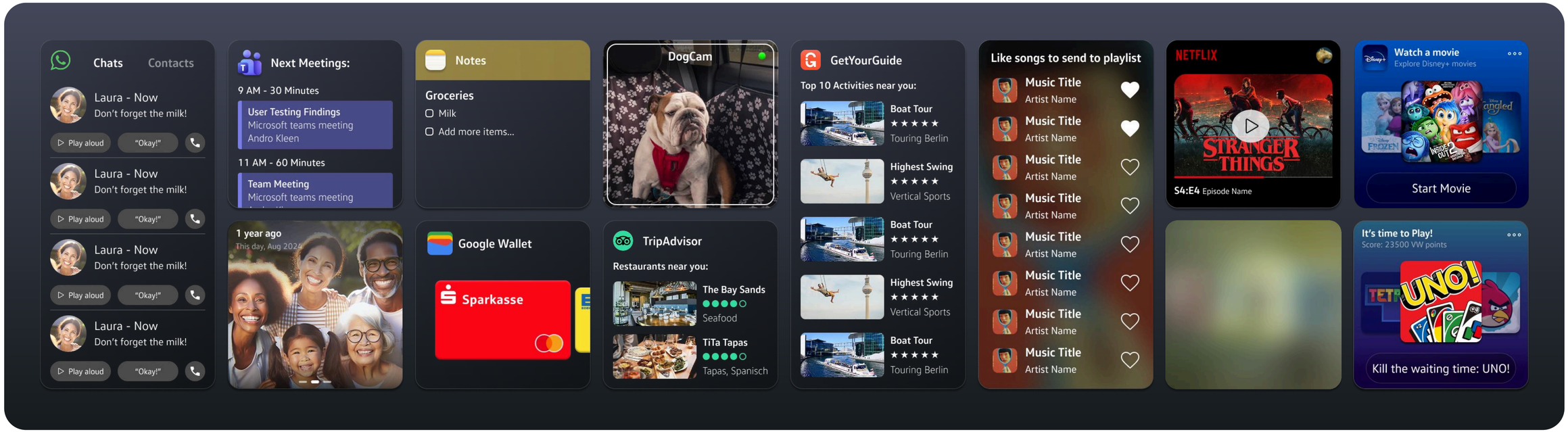
Figure 4.14 *Initial concept for journey setup*



Adaptive widgets

Next to the Journey Setup, various widgets were designed to be used in various journey contexts. One of them is blurred due to confidentiality. The batch of 13 types of widgets were created in both square and rectangular versions. In this way they could be resized depending on the scenario.

Figure 4.15 *Set of adaptive widgets used in the initial prototype*



4.6 Initial Concepts

For each specific journey, the final destination was displayed in the background. Due to confidentiality of other elements of the interface, only a small part of the background can be shown in some of the interfaces.

The main reason for having the background reflect the journey destination was to make it understandable for users that the system knows where you are travelling to.

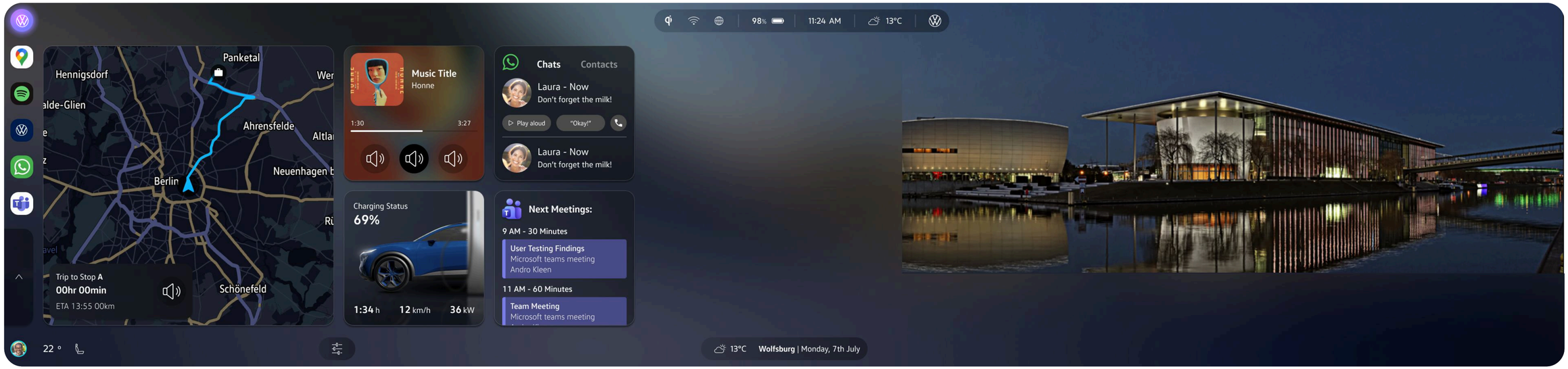
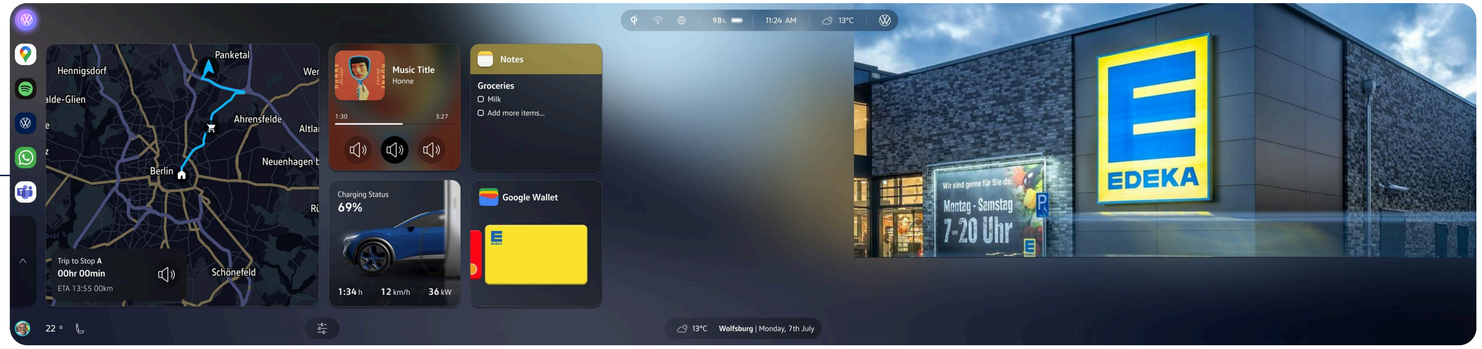
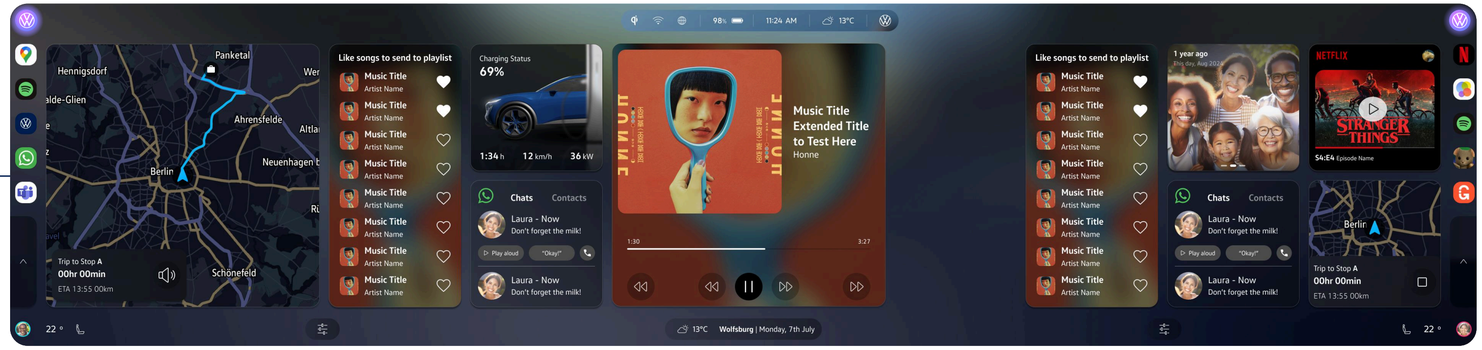


Figure 4.16 *Initial concept: start-up screen*

Grocery Shopping



Music Jam



Charging



Child screen mirroring & ordering food

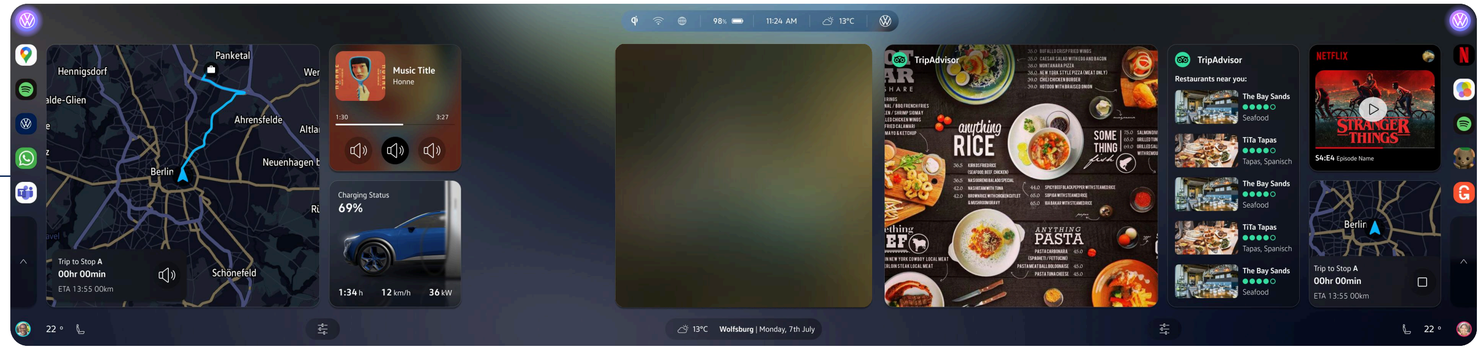


Figure 4.17
Initial concept screens for various scenarios

05

User Testing 1




11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

5.1 User Testing 1

Methods

Study Design
A qualitative user testing study (N = 8) was conducted to evaluate the initial concepts and explore user-centered opportunities for adaptive and personalised features. The study combined evaluative testing with exploratory co-ideation, aiming not only to assess the interaction qualities of the current concept but also to generate new ideas for adaptive use cases.

Participants
A total of N = 8 participants were once again recruited from the probandenpool. Participant ages ranged from 25 to 53, with a standard deviation of 10.5. 75% of the sample was male, with the other 25% being female.

Materials
The study utilized an animated prototype developed during the project, which was presented within a seating buck environment simulating an in-car setting. The seating buck had interior that was similar to the one found in the Volkswagen ID3. Neo (see figure 5.1).

The prototype included animated screens and was designed to demonstrate key adaptive and personalised interface features across various scenarios. Additional materials included a form in which all questions and blank space to document participant answers.

Procedure
The user testing session took place in the design building and lasted approximately 30 minutes per participant. The session was divided into three main phases: introduction, concept review, and co-ideation.



Figure 5.1 *Volkswagen ID3. Neo interior (similar to the one in the seating buck used during the study)*

In the introduction phase, participants were asked a series of background questions to contextualize their responses. These included demographic information, self-reported familiarity with artificial intelligence, insights into their personal mobility patterns (common trip types) and recurring challenges or pain points experienced during their journeys.

In the concept review phase, participants engaged with the UI prototype in a guided seating buck simulation. After this, participants evaluated the concept based on predefined interaction qualities, where perceived personalisation, assistance and routine-optimization of the features were key. Ratings were collected on a 1-to-10 scale and qualitative feedback was gathered through open-ended comments and discussion.

In the co-ideation phase, participants were encouraged to extend the presented concepts. They were stimulated to propose potential improvements, additional use cases, and new adaptive features based on their needs and expectations. This phase aimed to uncover opportunities for further development of adaptive UI behaviour.

Results

Introduction questions

As part of the introduction phase of the study, it was found that journeys can be summarized as single-occupant trips, multi-person trips and trips that can be experienced both individually or with multiple people in the car. Typical single-occupant trips include commuting and business trips, while mentioned multi-person trips include car-sharing, weekend trips, and bringing/picking up kids to/ from school and bus stops. Trips that fit both single- and multi-person occupancy include grocery shopping, sports, vacation, visiting friends/family, driving to other mode of transport (bus station/airport), and going to church.

Additionally, pain points mentioned largely revolved around the topics of setup & profile activation, (lack of) connectivity, audio, drive assist malfunctions, and reach. Some participants also pointed out they had outdated interfaces, but got used to the struggles or did not have any struggles at all. Interestingly, nobody specifically pointed out a lack of personalisation or adaptiveness.

Concept Review

In the first part of the user test, participants were guided through the current UI concept displayed in the seating buck's interface, while being seated in the driver seat.

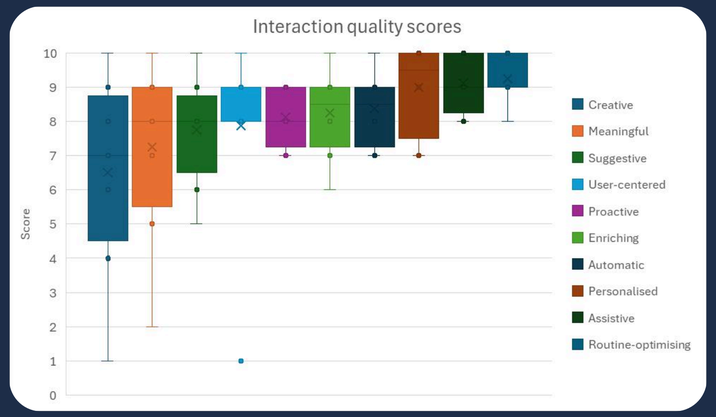


Figure 5.2 *User test 1 interaction quality scores*

Participants were asked to rate the overall adaptive experience based on predefined interaction qualities.
Even including the outliers, the average score across interaction qualities was surprisingly high, with an average score of 8.15 out of 10. The score for creativity was rated the lowest, with a 6.5 on average, while also being the most diverse among participants (SD≈2.9). Average scores for the interaction being personalised, assistive and routine-optimizing each came out at a 9.0 or higher. See figure 5.2.

Similar to the interaction quality scores, the positivity towards the concept also came forward in the further feedback and comments.
(Sometimes basic) functions were often already seen as great features.

Additional comments suggest that the positive results is due to the proposed concept being a greater leap into an innovative direction compared to recent UI developments.

Praised functions

Regarding the feedback towards specific features, participants especially praised the following:

- The combination of automation and manual control
- The Journey Setup top bar/popup window, especially the summarizing overview
- Music and entertainment widgets for the passenger
- Phone app mirroring
- Remembering historic data & receiving reminders

Feedback

A major concern among some participants was the prototypes privacy sensitivity. Interestingly, individual perspectives towards this topic varied a lot. For example, some people really liked the automatic reminders based on phone data, yet others said that supporting actions went to far (e.g. teams running in the car itself, the car analysing your incoming text messages, the car knowing where others normally go for groceries). Because of this, privacy has been a major topic while designing the underlying intelligent system.

Some participants also had some feedback to the design of concepts themselves. Participants indicated that predicting the journey is not always required for some routine journeys. During such drives, participants indicated that the cancel button should be more prominent and that instead of predicting the journey, quick destination options should be displayed inside the navigation widget.

Another point of criticism that was screen distraction.
One participant even suggested making a no distraction mode that would automatically activate based on the scenario. Yet, the fact that such a big screen would be present in the car seemed to be the underlying problem for most.

In the user test, the prototypes stretched across 2 screens. Participants indicated this “secondary screen” (the screen on the passenger side) would be too distracting (in driver-only scenarios) or should not be there at all. One participant even argued that she would never buy a car with such a big screen and that a child should not be looking at a screen (when seated in the passenger seat). Kids being present inside the car turned out to be a major topic during the later co-ideation part.

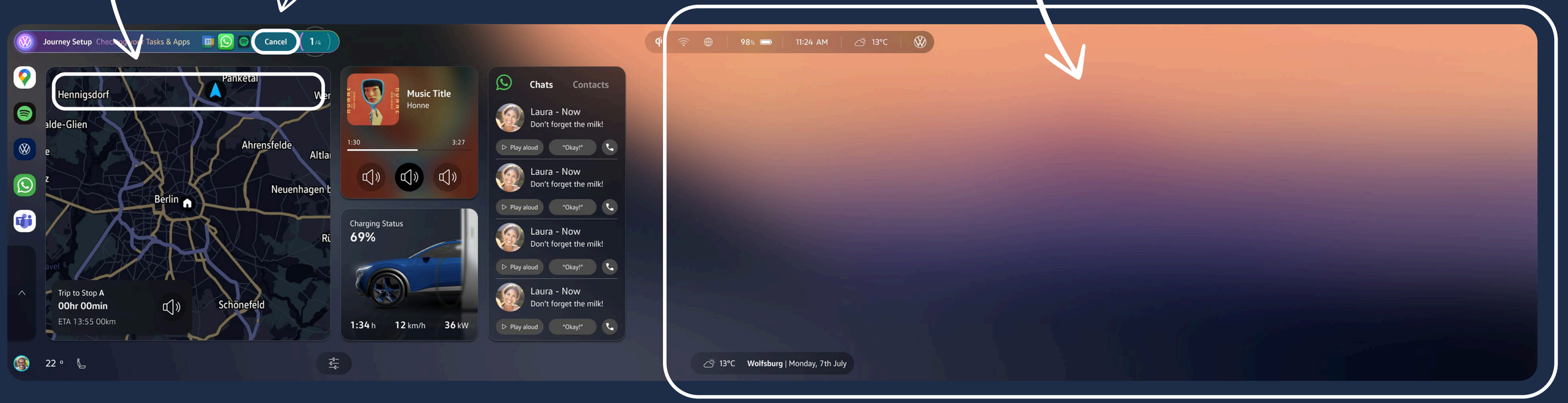


Figure 5.3 *Feedback to the initial UI concept*

Adaptiveness Co-ideation

In scenarios with a child (or multiple) being present in the car, there were varying opinions towards how they should be dealt with. Whether or not they should be able to activate the screen in itself was indefinite. Assumingly, a major factor in this is age.

Furthermore, one participant noted that being in the car with kids can become quite chaotic. Another participant noted that mirroring the rear seat screen would be a great feature to have. Additionally, making this window interactive to help them navigate the screen was also requested.

One participant described the recurring in-car scenario where a child did not understand to that he or she should speak up when music was on. For the participant (in this case the driver), it led to a continues interaction with the audio volume, decreasing and increasing the volume when the child would talk to them. The idea arose for the audio to be adaptive itself, extending the concept of adaptive features beyond the UI itself. The main benefit would be the significant reduction in interactions with the system.

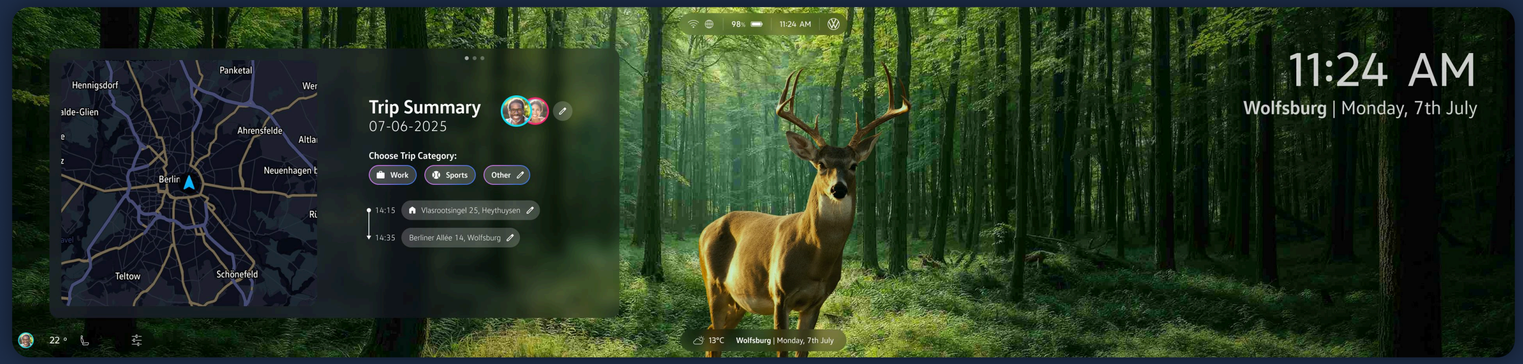


Figure 5.4 *End-of-journey screen for a hunting routine journey, based on results from user test 1*

Next to this, noteworthy scenarios highlighted by individual participants were journeys related to ‘hunting with friends’ and ‘(indoor) skydiving’. Both scenarios were indicated to occur on a regular basis.

Together with the participant, the scenario of driving towards the hunting location with a group of friends was explored in detail. The participant defined all features that could be helpful in a proposed ‘Hunting Mode’. The main features discussed all related to getting to the final location while minimizing the disturbance of the environment and the animals living in it. The participant indicated that in an ideal scenario, entering the forest would trigger the audio volume to decrease and the ambient lighting to turn to red (because wild animals don’t see this colour).

Another scenario explored was the drive home after a reoccurring sky-diving activity. This activity varied a bit. Sometimes it would be indoors and sometimes outdoors. Sometimes friends would join, sometimes the participant would go alone. This indicates that within an overarching routine journey, contextual factors could be different. The participant noted that, during the return journey, the co-driver often edited a video based on action camera footage, shot during the skydiving activity, on laptop. It was argued that the same task could be done on the cars UI when both the action camera footage could be accessed and the editing software could run or be mirrored on the car UI.

In both scenarios, adaptive features proposed were clearly connected to the final destination and the activity at this place.

Next to these more extensively discussed scenarios, there were also some other features and functionalities that were proposed during the co-creation session.
Like such, one participant suggest a widget with home automations. This could be an interesting adaptive widget, as it would be relevant for both journeys when departing from and returning back home.
Other suggested functionalities include 2-phone connectivity for 1 person, proactive ‘Start your trip’ phone notifications and a zoning suggestion with headphones for each occupant.

Insights
Next to the discussed scenarios and features, there were also some other insights from the user test.
One of the main insights was the fact that, although generally being quite positive, perspectives towards adaptive features were not always positive. Especially in common scenarios some participants did not see the purpose of such features, as many did not want anything to change at all.
However, one participant said: “When I first saw a Teams widget in a car UI, I hated it. Now, I would love to have it.” This comment suggest that the perspective towards adaptive features can change over time.

Yet, the main conclusion from the co-ideation part was that the scenarios and journeys that were highlighted as relevant for adaptive features by the participants were diverse and rather specific for each user.
Likewise, each participant named different adaptive features that would be relevant for their personal scenarios. This highlights the insight that both routine journeys and corresponding relevant adaptive features are closely related to the specific user. Since the intelligent system can predict the user’s needs or such specific requests, the initiative should be to the user instead. A new approach will be further discussed in the synthesis.

“When I first saw a Teams widget in a car UI, I hated it. Now, I would love to have it.”

Perspectives towards adaptive features can change over time.

Synthesis

Four main action point resulted from the user test.

Personalisation beyond the journey itself
User testing shows that adaptive features should not rely only on the type or purpose of a journey (e.g., commuting, leisure). This approach is too limited and does not reflect how people actually experience driving situations. Instead, adaptiveness depends on a broader set of contextual factors.
Participants highlighted several concrete triggers for personalisation. For example, the specific occupants in the vehicle (“when we are travelling with this group of friends”, time of the day (“when it gets dark outside”), and car location (“when entering a forest”). Moreover, in a more complex way, it can also be a combination of multiple factors (“when I am alone in the car and listening to a podcast”).

The inclusion of such contextual factors for defining the holistic personalisation experience reveals that the focus should shift away from optimizing the experience based solely on the destination or journey type. Instead, further development should prioritize real-time context and situational factors to create more holistically personalised experiences. This design approach was central for the further development of the journey setup, which was translated in a 2-step setup procedure that better integrates contextual factors. This development will be discussed in more detail in chapter 6.4.

Unpredictable adaptations
Alongside contextual factors, the scenarios proposed in the co-ideation part also came with interesting insights. Some of the desired adaptations proposed by the participants would be impossible to guess for an intelligent system, because of the complex connection between trigger (input) and system function automation (output). Instead, the initiative for starting an interaction for creation of specific automation and adaptivity request should be started by the user him- or herself.

This takes away the automatic setup (and possible magic feeling) of such features, but allows users to specifically express their desires. Based on this input, the intelligent system can take over again. The development of an alternative for creating specific automated functions initiated by the user will be explored in chapter 6.8.

Personalisation beyond the user interface
The tests also revealed that adaptive behaviour should not be limited to the user interface. Personalisation extends across multiple touchpoints in the vehicle, including sound, ambient lighting, temperature, and seat haptics. Although users perceive the experience holistically, the user interface remains the primary interaction layer.

Privacy
Privacy has been mentioned as one of the major concerns among test participant. Personal data usage should be minimized for predicting journeys to optimize privacy.

06

UX Design Phase 2

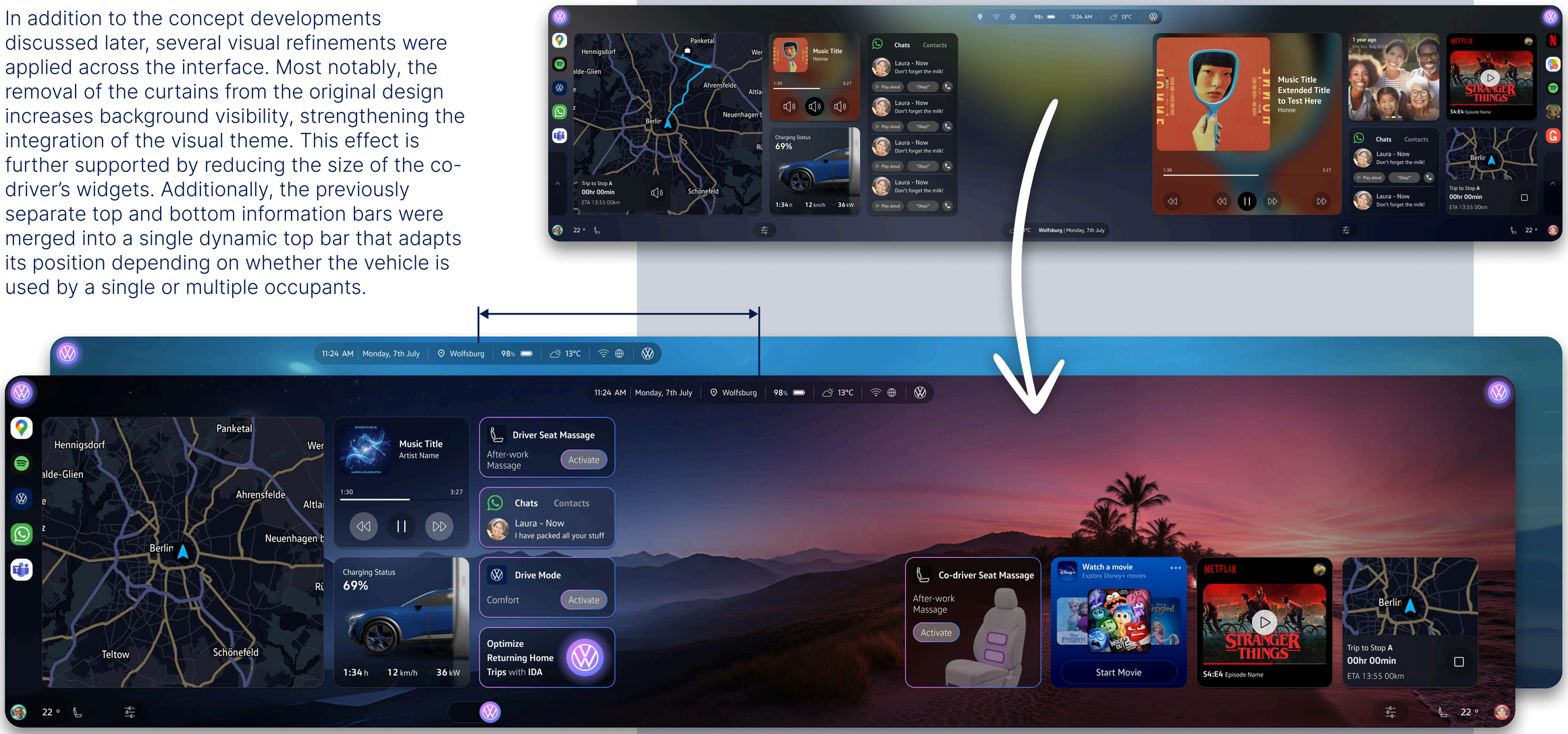



11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

6.1 Visual Design Iteration

In addition to the concept developments discussed later, several visual refinements were applied across the interface. Most notably, the removal of the curtains from the original design increases background visibility, strengthening the integration of the visual theme. This effect is further supported by reducing the size of the co-driver's widgets. Additionally, the previously separate top and bottom information bars were merged into a single dynamic top bar that adapts its position depending on whether the vehicle is used by a single or multiple occupants.

Figure 6.1 *Visual updates to the UI design: Giving the background a more prominent role for personalisation and adding adaptiveness to the top bar*



6.2 User Journey

Before diving into the further development of concepts, the opposing journey types of routines and family drives were revisited. The intention was to clarify the storyline for which features could be (further) developed. Discussions with the stakeholders involved in this project revealed that alongside concept development, brand alignment was also a significant consideration.

From here, it was proposed to not only focus on basic routine journeys (such as commuting), but also on more brand-aligned journeys, such as family trips or a holiday with friends. The fact that Volkswagen's brand identity largely revolves around togetherness and creating memories requires the journey specifications to be multi-user and somewhat more out of the box (less of a routine journey).

In the end, the choice was to combine routine journey with the more brand aligned journey of going on a weekend trip to France with the family. The reasoning behind this decision was that, in this way, it could be highlighted how an adaptive interface is coping with an environment in which various context factors change: occupants, preferences, car location, weather, and time.

Routine Journey: Leaving work to pick up Laura and drive home



At start of journey (work)

Journey prediction

Personalisation

Adaptive suggestion



While driving

Personalisation Switch

Background change: weather

Background change: day to night



While picking up Laura

Privacy

Background merging



While driving

Contextual adaptations



At end location (home)

Home automation widget

Layout change: reversing

Figure 6.2 *User journey part 1 (routine journey): Leaving work to pick up Laura and drive home*

With the user journey set up, it was considered in which part of it personalisation features could play a key role. This came with the insight that, with a focus on personalisation, the interior and user interface should change to optimize the experience according to what the context requires.

Therefore, in the user journey, contextual changes highlight the key opportunity moments for automatically activating or suggesting personalisation features.
From that point concept exploration continued with the defining scenarios in mind. It helped to design more specifically for given situations, resulting in concept proposals that were continuously reviewed by the internal team.

Ultimately, a combination of a review of the requirements identified in previous user test, a more significant focus on brand-alignment, and change-driving scenarios laid the groundwork for new personalisation features.

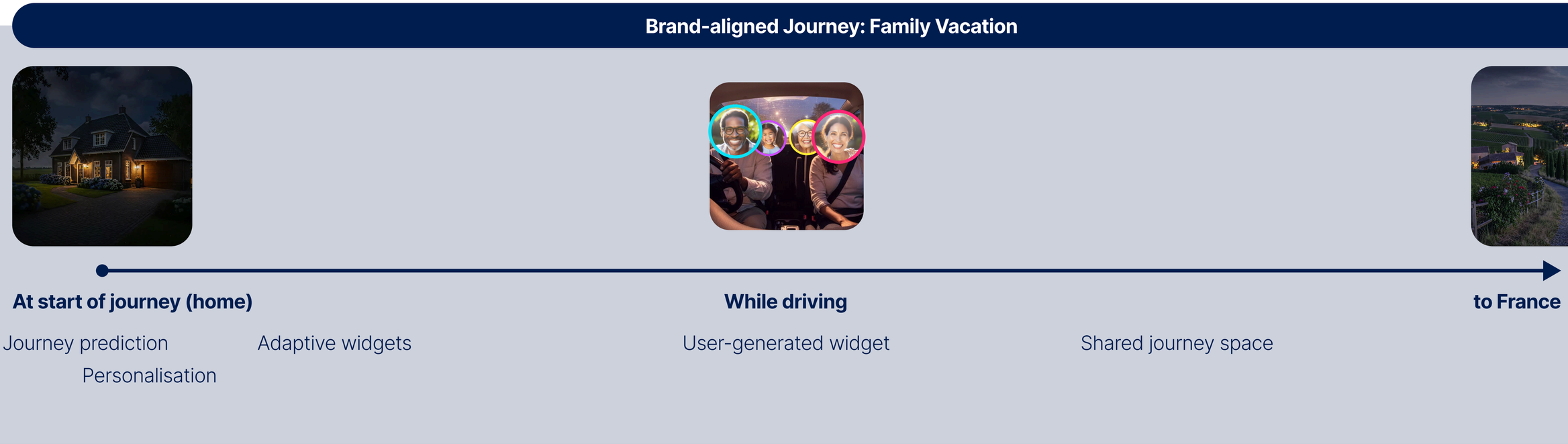


Figure 6.3 *User journey part 2 (brand-aligned journey): Family Vacation*

6.3 Input Variable Landscape

The user journey was one of the means to stimulate concept development. Similarly, creating a clear overview of the input variable landscape has helped to clarify what personalisation triggers exist. Especially the relations between trigger, the (prediction of) the journey ahead and the actual personalisation have helped in the (further) development of the journey setup feature, as well as features anticipating contextual change.

User Data

Occupants, profiles and preferences
The occupant(s) present in the car has/have a strong direct connection to many settings and personalisation features inside the car, such as ambient light colour, seat position and AC settings. Such preferences are often saved in a user profile, which allows for quick sourcing of a significant set of user-based preferences.

Individual and multi-occupant journeys
Figure 6.5 shows that, in 64.3% of cases, there will be only one person inside the car, who will therefore always be the driver (Department for Transport, 2025). The interior of the car can therefore be completely optimized for this person, and his/her preferences.
With multiple people inside the car, decision might have to be made to configure these settings. What music will be played? What will be done with the ambient lighting?
In such cases, there might be a split in scenarios where the in-car experience should be approached individually or collectively.
'Occupant(s) present in the car' is also a major influential factor for predicting the journey destination. While some journeys might be relevant for scenarios where there is 1 occupant inside the car, other journeys (such as going to a restaurant) might be more relevant when there are multiple people present in the car.



Figure 6.4 *User data is an important input source for personalisation*

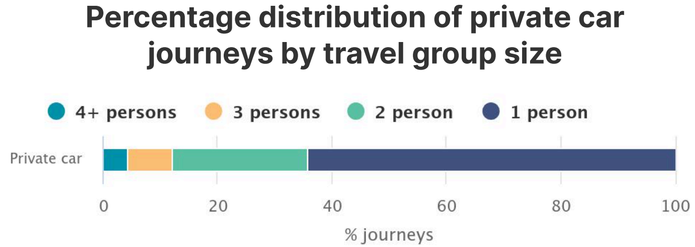


Figure 6.5 *Percentage distribution of private car journeys by travel group size (Department for Transport, 2025)*

Occupant age
Another direct way in which occupant information influences screen graphics is age.
Fore example, for elderly people one might want to increase letter size, while for young kids the screens should not be activated at all.

Date & time

The connection between date & time and the actual journey experience might seam marginal. Yet, the fact that a UI often switches to dark mode at a certain time, proves that there is a close relation. In some cases, the music one listens to might even relate to the time of the day or the specific trip one is making.

More importantly, basic data about date and time when starting a new journey is a key factor for predicting routine journeys. It is generally known that during weekdays, people often travel to work in the morning and go back home in the late afternoon. During weekend evenings, there might be a higher chance for people to visit family and friends, or to go to a restaurant. When gathering larger amounts of journey data, such clear patterns could emerge for a specific time or day of the week. Or, on a larger scale, monthly or seasonal trend could be found.

(Departure) location

The departure location is another data variable that can be used to power adaptive features. It can, for example, be used for predicting the final destination of the journey. Namely, if the start location is not at home, there is a significant chance one is driving back home.

The car's GPS location could also be helpful to create adaptive features during and at the end of a journey. When entering a specific area, such as a forest or a city, one could change the background, play audio effects, or display information about this specific place.

Final destination & journey type

By combining the previously described data and a predictive system, one can generate new types of data. One of these is information about the type of journey and its final destination. If one can autonomously predict this, it unlocks essential factors for routine-based personalisation. The final destination in it's turn reveals more information about closely related factors such as journey type and journey length (in terms of both time and distance).

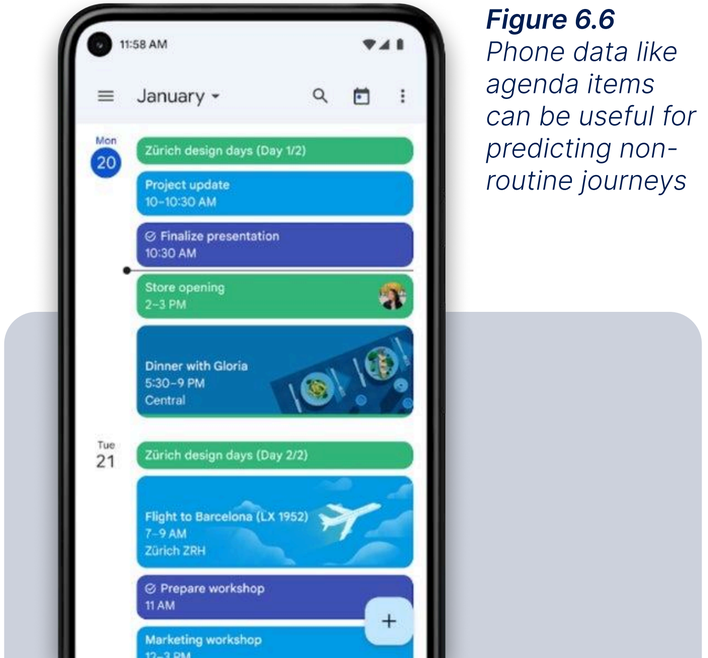


Figure 6.6
Phone data like agenda items can be useful for predicting non-routine journeys

Additional data

Phone data
If date, time, occupant(s) and start location do not clarify the final destination of the journey ahead, phone data, such as calendar items can be a great indicator for the type of journey or final destination (see figure 6.6). Generally, such data can be used for gathering detailed information about the context of the drive ahead.

Weather
Another useful external data variable for experience optimization is the weather. The weather could directly influence driving mode, and, when acting proactively, could preheat the car in cold weather.

There could also be a slight influence for the journey prediction, as drives to outdoor activities are less likely to happen during bad weather.

Vehicle sensor data
Live vehicle sensor data, such as battery percentage or fuel level, are essential data variables for suggesting respective actions such as charging/refuelling stops during car journeys.

6.4 Design the AI System

With a clear input factor overview in mind, the question about the logic behind the AI system remained. The goal was to get a meta-level understanding of how the AI system should act to predict the journeys and how it could suggest and assist with personalised features and automations accordingly.

Designing the journey prediction algorithm

Journey prediction experiment
In the user test, privacy was mentioned as one of the major concerns in the perspective towards adaptive interfaces. Therefore, an experiment was carried out to find exactly how much input data a system would need to find accurately predict the journey ahead. For a week of time, a journey prediction experiment was played with a voluntary car user. Every time the participant started a car trip, a message was sent to clarify the departure time, start location and occupant(s). Based on this basic information, a manual prediction can be made about the final destination.

The experiment was initiated to act out the AI system with the aim to clarify which of the input variables played the most significant role as well as what additional data would be needed to predict the correct type of journey. The determining question behind the experiment was whether it was even possible to predict journeys accurately at all.

As a result, in total, 25 of 35 trips were predicted correctly (≈71%). Especially journeys that showed a clear repetitive pattern were predicted correctly in most cases. Destinations that were predicted correctly most often, were:

- Journeys to work (4 out of 4 correct, 100%)
- Journeys to the participant's partner (10 out of 11 correct, ≈91%)
- Journeys back home (10 out of 12 correct, ≈83%)

Together with journeys to the grocery store (1 out of 2 correct, 50%), these are the journeys in which there was a clear routine. In total, for these routine journeys, 25 out of 29 journeys were predicted correctly, averaging out on ≈86%.

An interesting example of a predictable pattern is connected to when you would expect one to be at home (or at the partner's place), such as during dinnertime and before going to bed. With clear patterns present about where one would eat or sleep, car journeys just before these times would mostly go to this specific place.
Lastly, there is a clear connection between going somewhere, and returning back to the same location during the next trip.

Predicting the journey destination becomes harder (or even impossible) if the data does not fit a pattern at all. None of the 6 uncommon trips in the experiment were predicted correctly.
For predicting such scenarios, one would need more information, through additional data sources. One of the clear sources that could help clarify unexpected car journeys is the occupant's phone data, especially agenda items. The main reasoning for this is that non-repetitive journeys are often related to a special activity, such as shopping in the city centre, going to a restaurant, visiting friends/family, or other leisure activities. And for such non-routine activities, people commonly set up agenda items (Southerton, 2003).

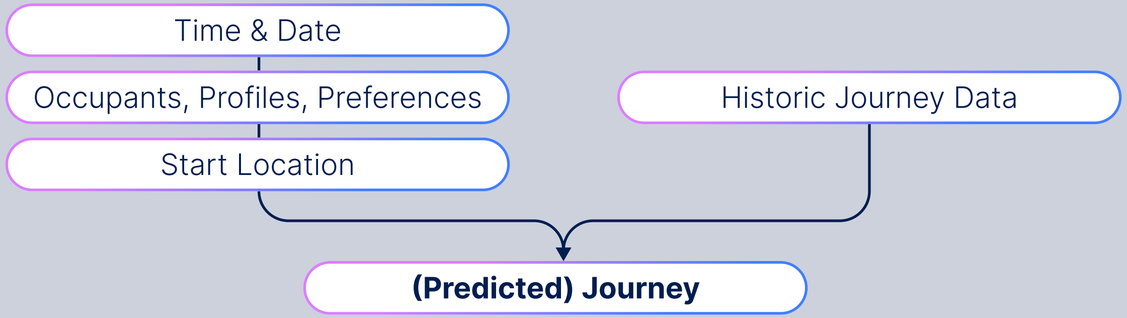


Figure 6.7 *Predicting the journey*

Journey prediction
It has been found that, to make sense out of basic input data (date & time, user and departure location), it needs to be compared to the user's routines in terms of their previous journeys. For the predictive system to learn typical car journeys, it needs to build a dataset containing all car journeys, including their basic information, such as departure date & time, occupant(s) and departure location.
By creating an ever-growing dataset of car journeys, the system can identify daily/weekly/monthly patterns. Such journey patterns are essential to predict future journeys. Once a new journey is started, and data comes in, this can be compared to historic data of past journeys, to see if the data fits in with one of the previously defined patterns. When this is the case, one can accurately predict the destination of that journey.

Even though it might be harder to predict less common journeys, the system could still suggest few options that could fit the journey.
For journeys to a new location, all manual changes should be stored and, if necessary, more questions should be asked to the driver to optimize the experience of similar drives in the future.

Predicting adaptive features

The prediction of the journey ahead is the essential step to provide journey-based personalisation. Yet, a second step is needed to go from a predicted journey to a context-adapted experience; the personalisation step (see figure 6.8).

In the user test, it was found that focusing solely on the journey ahead does not cover the personalisation process as a whole. Therefore, alongside the predicted journey, the occupant(s) and contextual input such as the weather are included in the personalisation process. Combined, these input factors define the suggested widgets, the UI background, UI colour theme, seat and steering wheel position, ambient lighting colour, AC settings, and other automatically activated or selected interior functions.
As this project mainly involves UI functions, the main focus is on the adaptations that happen in the interface, with the suggested widgets as the main priority. Widget suggestions are essentially a homepage shortcuts to normally deeper-nested system functions that influence the in-car experience.

While designing such suggestions, an essential question that emerged is how the adaptive widget suggestions are provided to the user. To address this, various approaches and methods were explored. To make a better consideration of what would be the best approach, the benefits of potential prediction methods are discussed in the next paragraph.

Recommendation based on previous drives
Leveraging the contextual information (user, car location, time, date, etc.) in relation to historic journey data can not only help to predict the journey ahead, but also what adaptive features should be suggested. In fact, the predicted journey category can be used as an additional factor to determine suitable adaptive features.
The total approach would require to construct a general relations between the historic usage of adaptive features (for a specific journey) and real-time contextual variables. It is obvious that some features are clearly related to the time of day (morning massage), the car location (city lighting settings) or could emerge directly from the user profile settings (seating & steering wheel position). On the other hand, some features have a weaker link to contextual variables, requiring prior user-interface interaction behaviour insights to define when they should be suggested. Examples are the background image, the ambient lighting colour and music settings.
Still, suggesting purely based on past drives and behaviour would only present users with features they have used before. It would be like playing your own music playlists over and over again; it will get boring over time. Instead, addition methods should be used to stimulate users to try out other features.

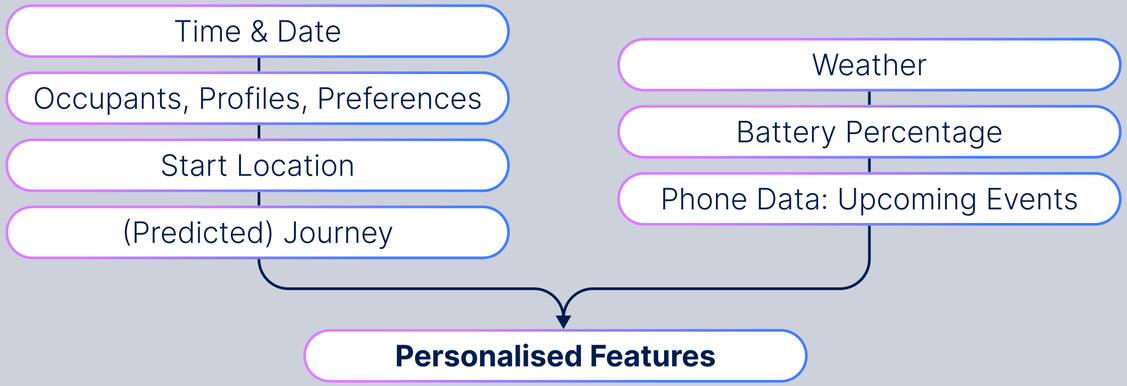


Figure 6.8 *Predicting personalised features*

Collaborative filtering
To provide users with relevant features that are new for them, a strategical method is needed. For this, we can look at the recommendation strategies of companies like Spotify and Amazon. They both use collaborative filtering to recommend songs and shopping items respectively.
Spotify uses user-based collaborative filtering: user B, who is very similar to user A additionally also likes item X, and therefore you recommend item X to user A. In the case of recommending features, one would try to find a similar user (user B) to check what additional features this users tends to use. Based on that, such features can then be recommended to user A. This approach focusses on correlation between individual users and suggest features based on this.

Alternatively, one can use a different collaborative filtering approach, called item-based filtering, which is famously used by Amazon. This approach focusses on correlation between individual items. People who buy item X, often also buy item Y. Therefore, when you buy item X, item Y can be recommended to you. In this case, if feature X is often used together with feature Y, and a user often uses feature X, then feature Y can be suggested as well.

Both methods can be used to recommend features that a user has never explored before.

The cold start problem
There is another question which is about how to deal with the user's first few drives with the car. At that point, there is basically no historic data available with which the adaptive feature prediction system can be fed. The absence of historic data makes it harder to predict the type of journey as well as what adaptive features can be suggested. There are a few ways to deal with this.

Firstly, there is the option to ask users directly. Directly asking "what do you need" does not help, as it was found during the user test that people struggle to define their needs on the spot.
However, more contextual information can be gathered while setting up the user profile, during the initial setup of the interface (including the first time wizard) and during the setup at the beginning and summary at the end of individual trips. The latter can be done by providing options that clarify the scenario. Prime examples are the previously discussed quick selection items in the navigation widget, and similar quick selection items in the trip summary at the end of a trip.
However, the main downside of this method is that it most probably takes away most of the automation magic when asking users directly about their needs.

Secondly, one can leverage the contextual information (user, car location, time, date, etc.) to predict what adaptive features should be suggested. This method requires constructing general relations between adaptive features and real-time contextual variables, without a historic comparison. In fact, some features are clearly related to the time of day (morning massage), the car location (city lighting settings) or could emerge directly from the user profile settings (seating & steering wheel position). On the other hand, some features have a weaker link to these variables, requiring user behaviour insights to define how they should be set up. Examples are the background image, the ambient lighting colour and music settings.

The third method relies on universal trends and popularity to suggest adaptive features. A database of worldwide VW users and their UI behaviour in comparison to contextual factors can reveal clear clues for universal feature recommendation. For example, on a global scale in early workday hours, people tend to travel to work, which could show a relevancy peak for features such as energizing massage, or videocall and work email widgets. This method can also be applied as a pretraining for the prediction system to provide suggestions right from the first journey.

Creating a hybrid model
In the end, the real solution is to use a hybrid model for considering adaptive features. In this, previously used widgets are a priority, as they represent routine patterns of UI behaviour accurately. Both widgets used across journeys and for the specific journey ahead are suggested, to create a complete package of user- and journey-tailed widgets. Alongside this, with a less significant urgence, collaborative filtering and universal trends are included to keep a randomized factor in widget suggestion. In this way, each time a user is exploring less-prioritized suggestions, one is presented with new suggestions each time.
To define the exact distribution between the three discussed suggestion methods, further research is required.

6.5 Interaction design

In chapter 2.6. excising research conclusions and theories and have been described. These insights informed the development of three variants of the personalised UI setup procedure, which differ in their levels of system transparency and user control (see figure 6.9, 6.10 & 6.11). Building on principles from explainable artificial intelligence and mixed-initiative interaction, the variants explore how different degrees of explanation and initiative-sharing affect the user experience.

Specifically, the designs vary in how explicitly the system communicates the reasoning behind its adaptive widget suggestions, as well as in how much control users are given to influence or override these suggestions during setup. This allows for a structured comparison between more system-driven and more user-driven interaction styles.

In addition, the personalised UI setup is designed to include specific moments where user input may be particularly valuable.
The personalised UI setup variants and user control moments are further examined in the later discussed user test, in order to better understand when and how users prefer to engage with and influence the adaptive system.

Personalised UI setup variant 1

Step 1: Journey Prediction

Step 2: UI Personalisation: Background & Widgets

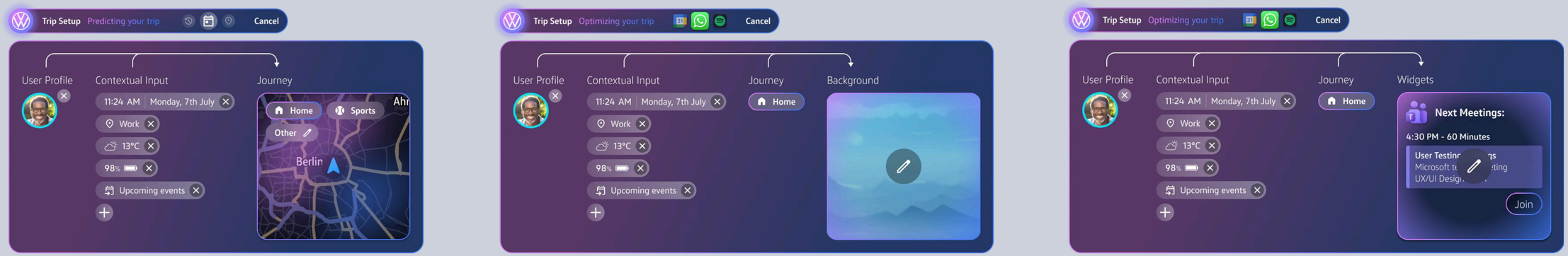
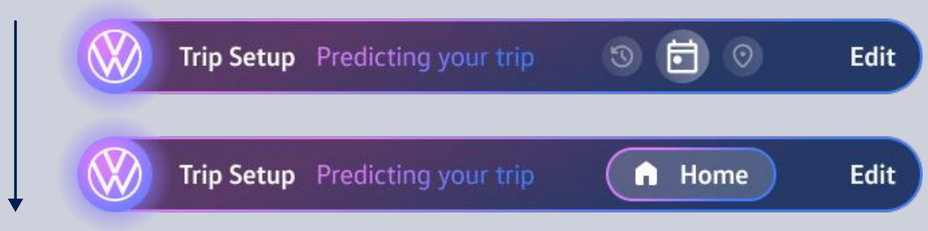


Figure 6.9 *Personalised UI setup variant 1*

Personalised UI setup variant 2

Step 1: Journey Prediction



Step 2: UI Personalisation: Background & Widgets

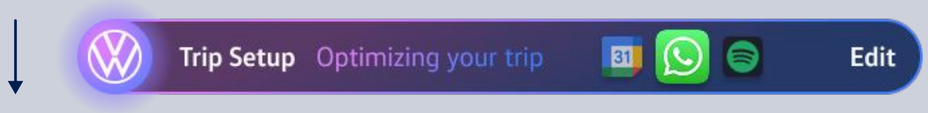
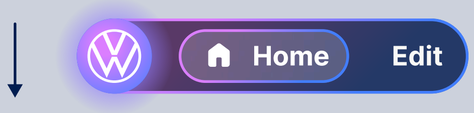


Figure 6.10 *Personalised UI setup variant 2*

Personalised UI setup variant 3

Step 1: Journey Prediction



Step 2: UI Personalisation: Background & Widgets



Figure 6.11 *Personalised UI setup variant 3*

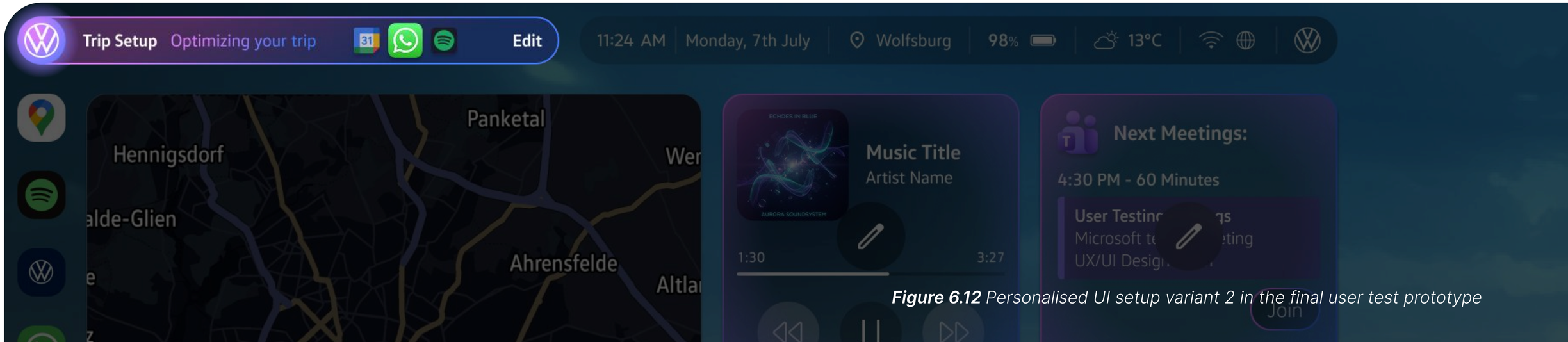


Figure 6.12 *Personalised UI setup variant 2 in the final user test prototype*

6.6 Personalised UI Setup

The personalised UI Setup is the most impactful design intervention, as it defines the entire interior and UI experience at the start of a new journey. The predicted journey, occupants and contextual information determine the personalised user experience. The complete personalised setup procedure consists of two steps; the journey prediction and the personalisation. The personalisation step, in its turn, includes defining user-specific personalisation (e.g. seat position), interior atmosphere (e.g. the ambient lighting and AC settings), and the UI design (e.g. background and adaptive widgets)

Journey Prediction

The initial step of the personalised UI setup, the journey prediction, has already been extensively discussed in chapter 6.5, ‘Design the AI System’. The variants introduced in this chapter were compared in a later discussed user test. This user test defined the final design of the journey prediction, alongside adjustments in the design.

Figure 6.13 Logic behind constructing the background



Personalisation

Background & Ambient lighting

The design of the UI background and ambient lighting personalisation for specific journeys follows a layered approach that balances brand identity, individual preferences, and adaptive system behaviour. Based on internal design explorations, the concept combines consistent visual foundations with AI-driven personalisation to create a cohesive in-vehicle experience.
The first layer consists of grayscale, brand-consistent backgrounds aligned with Volkswagen’s visual identity, which users can select according to their preferences. Building on this, a second layer introduces personalisation through user-specific colour themes, where AI techniques generate a fully coloured version of the grayscale background that reflects individual tastes while maintaining visual harmony.

In scenarios where both a driver and co-driver are present, a third adaptive layer is introduced: since both users share the central display but may have different preferences, generative AI is used to create a seamless visual transition between the driver’s and co-driver’s backgrounds, resulting in a blended transition zone in the centre of the interface.

This concept extends beyond the display into the physical environment, as the vehicle’s ambient lighting dynamically mirrors the UI by adopting the respective colour themes on each side and reproducing the same smooth transition in the central area. Together, this creates a unified and immersive experience in which digital interface and interior lighting are visually synchronized.

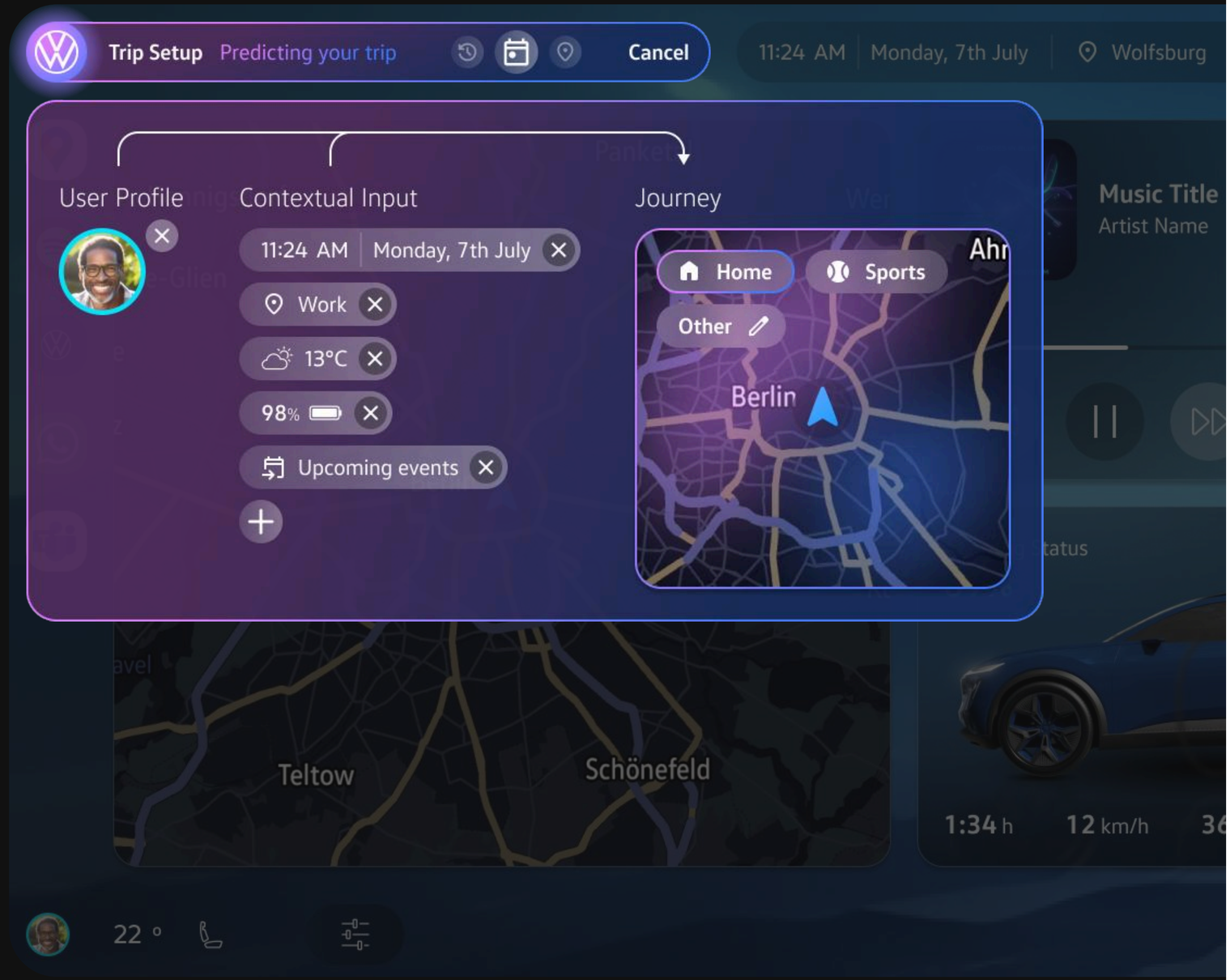


Figure 6.14 *Personalised UI setup variant 1 in the final user test prototype*

In addition, a background overwrite mechanism is introduced for non-routine journeys, where the destination itself becomes the primary driver of the in-vehicle atmosphere. In such cases (typically associated with special or occasional destinations) the system replaces the personalised background with a visual representation of the destination. This image is adapted using generative AI to fit the exact dimensions of the interface, ensuring a seamless and high-quality appearance. By doing so, the system prioritizes contextual relevance over persistent personalisation, creating a stronger emotional connection to the journey. The ambient lighting adapts accordingly, extracting and reflecting the dominant colours of the destination-based background, thereby extending the visual theme into the physical interior and reinforcing a coherent, immersive experience.

Adaptive widget suggestions

The last step of the personalisation phase is setting up the adaptive widgets. In chapter 6.4, the reasoning behind and working of the adaptive widget suggestions has been described. In summary, the system uses a combination of widgets used in previous (similar) drives, collaborative filtering, and universal trends to suggest widgets that are relevant for the user, the journey, and the context of the drive.

6.7 Interactive Widgets

Once the personalisation process is completed, the user is presented with personalised widgets. These widget suggestions have been made interactive to allow for user control at the end of the setup procedure. With the the possibility that undesired widgets show up in the interface, users are enabled to customize the content that is suggested to them by interacting with the individual widgets.

To answer the question what kind of customization interaction is preferred by users, 3 variants of the customization interaction have been developed.

- In the first variant, multiple suggestions are visually stacked on top of each other. On the right-hand side of the top widget, a small part of the underlying widgets is visible. A horizontal **swipe** motion allows the user to delete the top widget, triggering the next widget to come forward and be presented to the user. A continuation of this interaction allows users to explore other suggestion that could be relevant for their journeys.
- In the second variant, a single widget is presented with not other visual cues hinting towards the required interaction to change the suggested widget. A **click-and-hold** on the widget triggers a button to appear next to the widget for 4 seconds. Clicking this button allows the user to regenerate this item, causing a new widget to be displayed.
- Lastly, in the third variation, the same regeneration button as in the second variation is always present on top of the suggested widget. A **click** on the button causes a new widget to be generated.

The interactive nature of the widget enables continuous system feedback, allowing the experience to improve over time. By capturing which features are used by which users in specific journey contexts, the system learns usage patterns. When a user replaces a widget, this preference is incorporated into future predictions, so that in similar journeys the newly selected widget is suggested proactively.

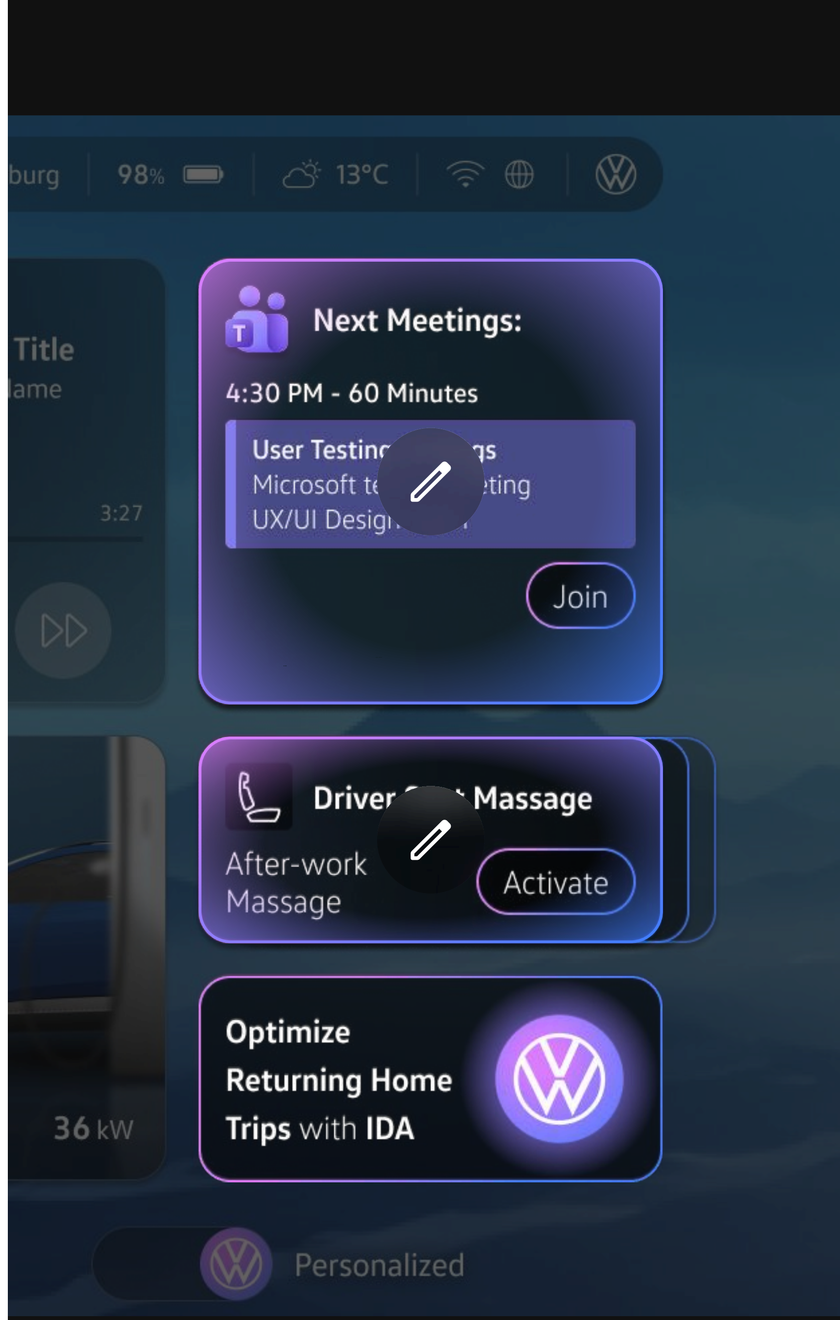


Figure 6.15 *Interactive widgets in the final user test prototype*

6.8 Personalisation Switch

Personalisation and adaptive content is not always desirable. Results from the co-ideation session concluded that 37,5% of the participants don't want their UI to adapt depending on the type of journey ahead. Next to this, some participant indicated that for some journey types, especially routine journeys, adaptive features are not needed.
Although the user test was done with a limited amount of participants, the absence of need for adaptiveness (in some journeys) is supported in larger-scaled research.
Research shows that adaptive automotive UIs are not universally desired and that adaptive systems can be perceived as patronizing (Pätzold, 2023).

In chapter 9.2 it will be discussed whether adaptive interfaces are desirable for Volkswagen at all. Yet, at this point, the (journey-specific) variance in demand for adaptive features has triggered the development of minimal UI element that allows users to turn off all adaptive widgets with a single screen interaction.



The ‘Personalisation Switch’ is a switch that (de)activates adaptive widgets all at once. In the default state, with the adaptive widgets, the user does get the personalised experience. With a swipe interaction, the other state is enabled. In this ‘Focus’ state, adaptive widgets disappear. This allows the user to not be bothered with personalised widgets in the scenarios they are not desired or are perceived as too distracting.

The reasoning for the underlying learning process in the interaction with the switch is human-centered. The system learns for which journey types the adaptive features would typically be on and off. When a new journey begins, the personalisation process will (not) start based on the predicted journey type. This allows users to only be automatically assisted with personalised content when they desire it. On top of this, live manual control is treated as leading. therefore, there is always the option to switch between (not) displaying adaptive widgets in the moment itself.

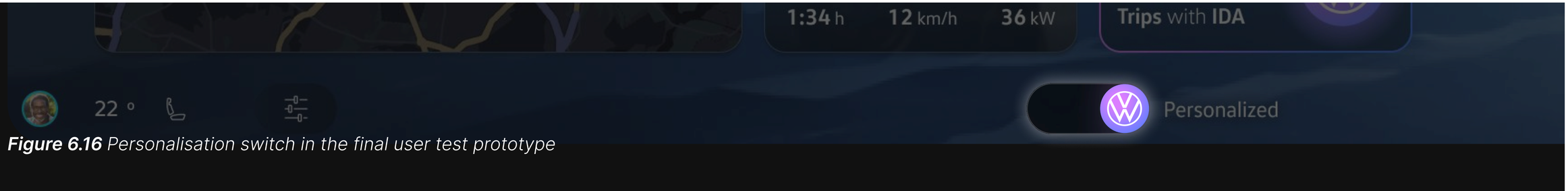


Figure 6.16 *Personalisation switch in the final user test prototype*

6.9 Gen-AI Widget

The first user study indicated that adaptive feature preferences are often highly individualized and complexly connected to contextual triggers. In many cases, the relationship between a situation and the desired system response remained ambiguous, limiting the effectiveness of purely context-driven adaptation. As a result, an intelligent system cannot reliably infer user intent based on context alone. To address this limitation, enabling explicit user input becomes essential, allowing users to articulate personalised automation needs that would otherwise remain inaccessible. This approach allows users to actively shape their in-car experience. At the same time, the integration of generative AI reflects Volkswagen's strategic ambition to position itself as an innovation leader within the automotive industry.

To operationalize this concept, the 'Gen-AI widget' enables users to generate custom widgets and automations through generative AI. The interaction is initiated by selecting the widget on the home screen, which opens a guided interface providing instructions for creating a new automation. Users can express their intentions via natural language through IDA, Volkswagen's voice assistant.

The system then processes this input using natural language processing to transform the spoken request into structured system requirements. These requirements are passed to a reasoning large language model (LLM), which maps the user's intent to a predefined set of input and output variables, including contextual triggers and controllable vehicle functions. When relevant variables are identified, the system establishes a functional link between them, thereby implementing the desired automation.

If applicable, the system further employs generative AI, guided by a Volkswagen design system, to create a corresponding custom widget that allows users to manually control or override the automation. In the final step, the system generates a concise multimodal explanation of the implemented changes, combining natural language generation with text-to-speech output. This closing feedback loop ensures transparency and provides users with the opportunity to refine or adjust the automation, with the aim to reinforce both usability and user control.

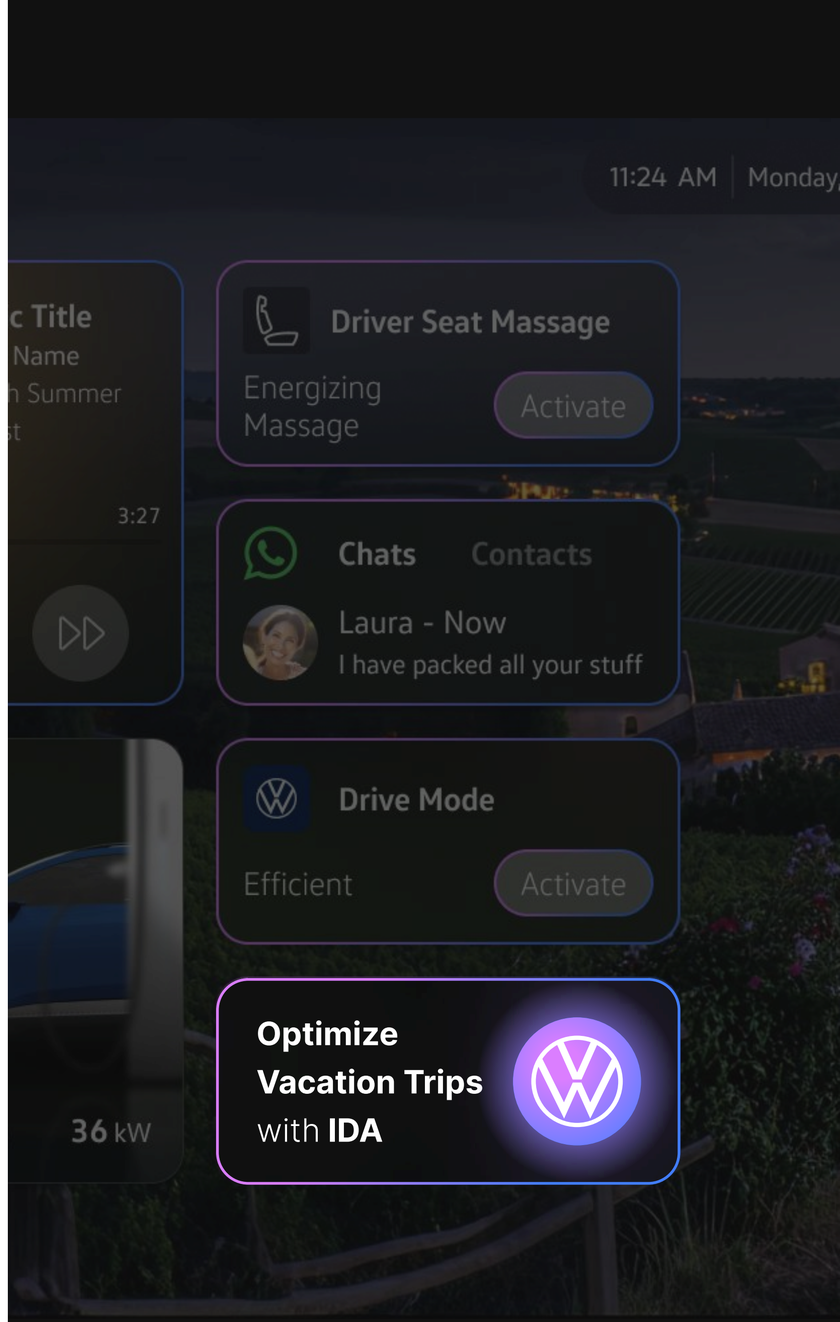


Figure 6.17 *Gen-AI widget in the final user test prototype*

6.10 Shared Journey Space

The final personalisation element is the ‘Shared Journey Space’, designed to align with Volkswagen’s brand values by fostering shared experiences and natural in-car interaction. Rather than focusing solely on individual personalisation, this feature emphasizes collaboration, enabling occupants to collectively shape and reflect on their journey.

The Shared Journey Space is accessed by swiping up a central panel on the display, where users can select the current or revisit past journeys. Once a journey is selected, context-specific actions are presented, allowing occupants to collaboratively add photos, pin locations or restaurants, generate journey-themed stickers, and explore conversation prompts. In this way, the interface functions as both a memory space and a catalyst for interaction, supporting engagement with the journey and its destination.

The concept initially aimed to centralize AI-driven decision-making, such as suggesting optimal restaurants along a route and enabling in-car voting. However, this approach risked replacing natural, spontaneous conversations with mediated digital interactions, which conflicts with the intended brand experience. As a result, the concept was refined to better balance digital support and human interaction.

While retaining selected digital functionalities, the Shared Journey Space now actively encourages natural conversation. It introduces journey-specific conversation cards generated through AI, offering prompts that users can naturally explore together. Additionally, generative AI is used to create playful, journey-themed stickers, targeted specifically to younger passengers. Through this combination, the feature supports both shared memory creation and authentic social interaction within the vehicle.

Figure 6.18 *The initial concept for the Shared Journey Space (the “VW Collab” widget)*

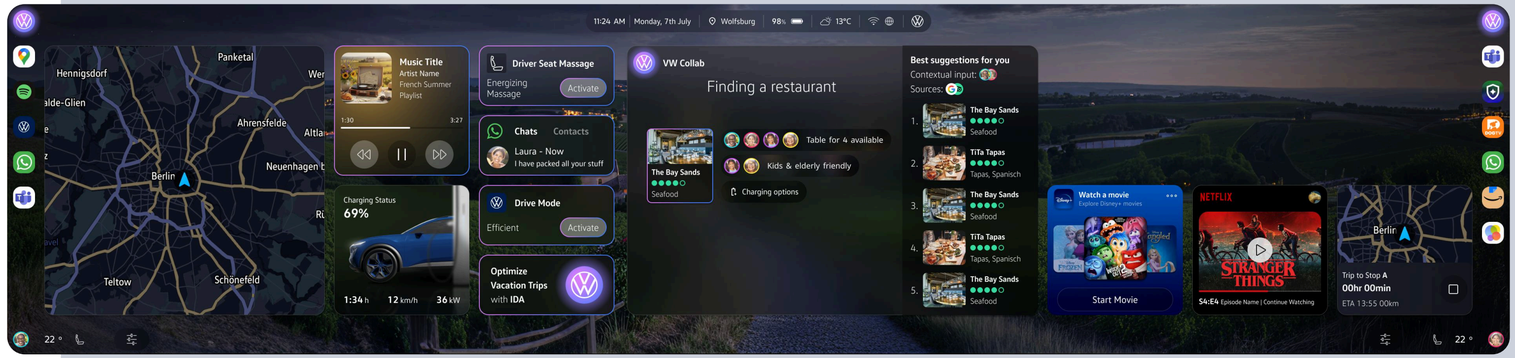




Figure 6.19 *The Shared Journey Space in the final user test prototype*

6.11 Additional Adaptive Features

The concepts discussed so far can be seen as the pillars of the final prototype. They play major role in the later discussed user test, in which their exact design and interactions will be exanimated. Next to this, a range of additional adaptive features have been developed as an extension of personalisation, where adaptive features cover the complete journey experience. Because these involve simpler interactions, these smaller features play a secondary role in the user test.

Contextual background changes
The first additional personalisation feature is contextual background changes. The UI's background image utilizes generative AI to adapt to the weather and time of day, while preserving the general theme of the background (see figure 6.20). In the user test, the predefined scenarios of changing from sunny to rainy and changing from day to night were evaluated.

Figure 6.20 *The final prototype included a transition between day and night*



Automated ETA messages
The second additional feature is an automated estimated time of arrival (ETA) message that is sent to the person you will be driving to as soon as you start your drive.

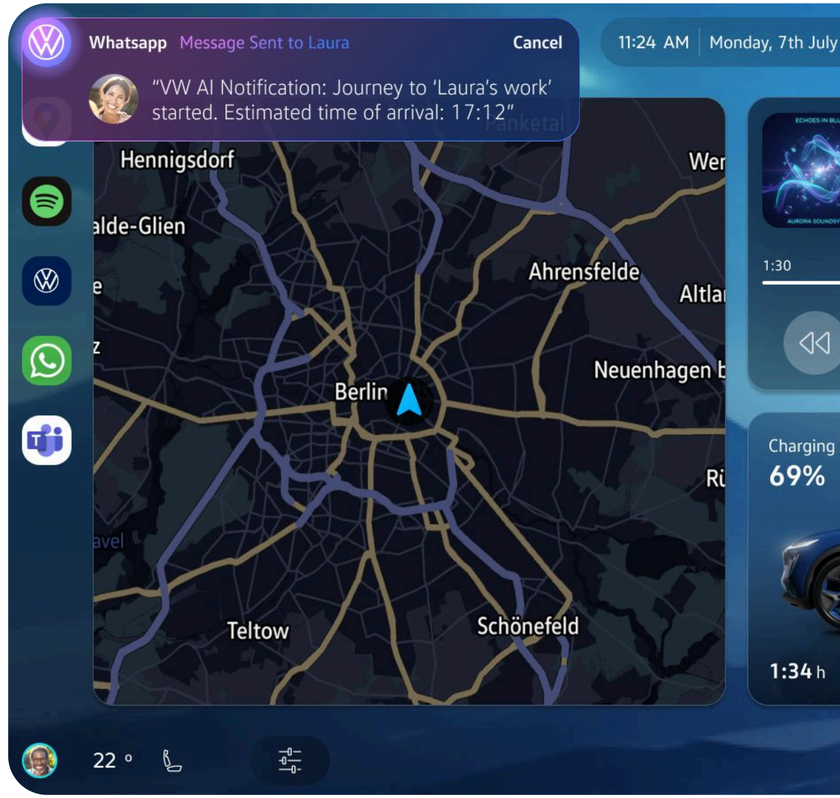


Figure 6.21 *Automated ETA messages in the final user test prototype*

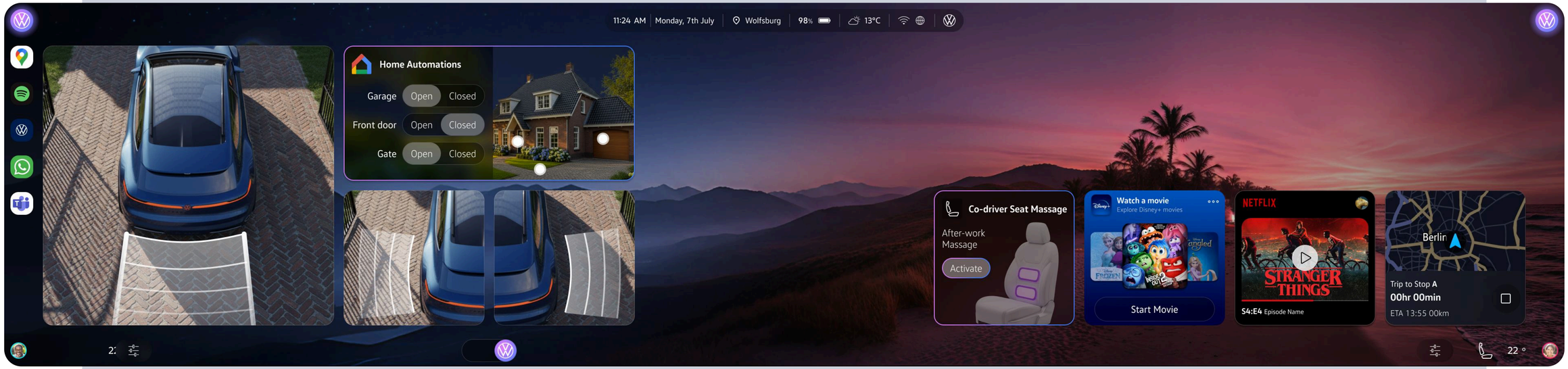


Figure 6.22 *UI overwrite: Reversing into one's parking spot and home automations*

UI overwrite: Home automations
Lastly, an interface overwrite scenario was prepared for the user test. While arrive home, the standard content of UI widgets was overwritten with more meaningful content in such a situation:

1. Multiple views of the environment around the car to assist with reversing the car into its final parking spot. This does not only apply to home automations, but parking situations and navigating tight spaces in general.
2. A widget that autonomously controlled home automations based on car location, such as opening up the gate and garage door, as well as unlocking the front door.

07

User Testing 2




11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

7.1 User Test 2

The final user test served as the final review of the UI prototype by UX/UI design experts. To test personalisation features, an high-fidelity animated Figma prototype was integrated in the seating buck.

Methods

Approach & Study Design
The test used a mixed-method approach to test multiple metrics; usability, desirability, user control, brand-connection, and A/B/C testing/ ranking within features. All were evaluated quantitatively, yet supported by qualitative feedback.
Generally, the main aim of the study was to question the concepts' usability and desirability. The product's usability was tested for all proposed personalisation features in both interaction directions: system-to-human and human-to-system.

- **System-to-human:** Do people understand what the system is doing?
- **Human-to-system:** Do people know how to complete specific task in the UI?

Alongside this, desirability was evaluated for each feature by asking participants whether or not they would want it in their car, as well as gathering qualitative information about the reasoning behind their answer.
To gain more insight across key features additional questions were asked to evaluate user control, opinions on feature variations, and brand-connection. This was not done with all features because of user test time constraints.
All were qualitatively supported by feedback.

Participants
A total of 12 participants took part in the study. Participants were aged between [23–39 years] (M = 30.8, SD = 5.9) and included 5 female and 7 male participants. The sample consisted of internal designers with a background in UX/UI design, interior (module) design, and visualization with an expertise level ranging from novice to expert in relation to adaptive and personalised user interfaces.

Materials
The test was conducted using a Figma prototype implemented into a seating buck. The study took place in the design department facility at Volkswagen's headquarters in Wolfsburg.

Scenarios
The user journey described in chapter 6.2 was followed during the user test, highlighting and evaluating the various personalisation features in along the way. Participants first took place in the driver seat, role-playing the user journey's driver (Frank). At the point in the user journey where Laura gets in, the participants were asked to switch to the co-driver seat, acting out tasks for Laura from that point. Throughout, participants were asked to use their own opinion to answer research questions.

Procedure & Tasks
Each session lasted approximately 45–60 minutes and followed a structured procedure.
First, participants were welcomed and given a brief introduction to the purpose of the study. Next, they were asked to provide their age, gender, nationality, working department, their phone's operating system (Phone OS), whether they drove a car, and if so, their most commonly used in-car operating system (Car OS, e.g. one of Volkswagen's native systems, Android Auto, or Apple Carplay).

Participants were then guided through the user journey, assessing the features one by one. The following features were evaluated:

1. **Personalised UI Setup 1** (single occupant)
   - Journey prediction
   - UI personalisation (background & widget setup)
2. **Interactive suggestions**
3. **Personalisation switch**
4. Automatically sent messages
5. Contextual adjustments (weather & day/ night-switch)
6. UI changes (additional user)
7. Home automations & UI overwrite (reversing)
8. Personalised UI Setup 2 (multi-occupant)
9. **Gen-AI Widget**
10. **Shared Journey Space**

Fundamentally, all features explored usability (AI-to-Human, Human-to-AI, or both) as well as desirability. They were all supported with additional feedback.

- To evaluate usability correctly, the examination was split based on the interaction perspective, with AI-to-Human being examined with reflective questions (What just happened? Explain why you think this happened) and Human-to-AI being examined in task-form (all single-step). Note that, to gain a honest first impression usability assessment participants were equally split across versions for both steps of the personalised UI Setup.
- Desirability was assed by asking a sequence of questions: Would you want it in your car? What would be the main benefit/disadvantage of this feature?

Additionally, key features (highlighted boldly in the list) were evaluated more extensively. For all key features, VW branding was examined by assessing the statement “This feature fits the Volkswagen brand” on a 7-point Likert scale, ranging from strongly disagree to strongly agree. For the Personalised UI Setup and the interactive suggestion, additional A/B/C testing included a version ranking where all 3 variations for both features were ranked as a top 3.

Lastly, for the Personalised UI Setup, it was assessed when in the setup process people desire user control, given a total of 5 options ranging from before, during, and after the journey prediction and personalisation steps.

If needed, the examination procedure allowed for additional qualitative feedback for all metrics discussed.

Question answers and feedback were gathered on a worksheet, and were later converted to a digital environment for further analysis.

Note that in the UI changes step, a repetition of the UI setup happens, as well as adjustments to the background. While the background adjustments are a newly introduced feature, the rest of this step is just there to create a logical chronologic user journey. The same applies for personalised UI setup 2, which is a reoccurrence of the personalised UI setup at the start of the user journey. While in this case the start-up includes more occupants, the setup procedure remains largely the same.
For this reason, both of these features are only assessed on usability, questioning whether the user understood the system-powered changes.

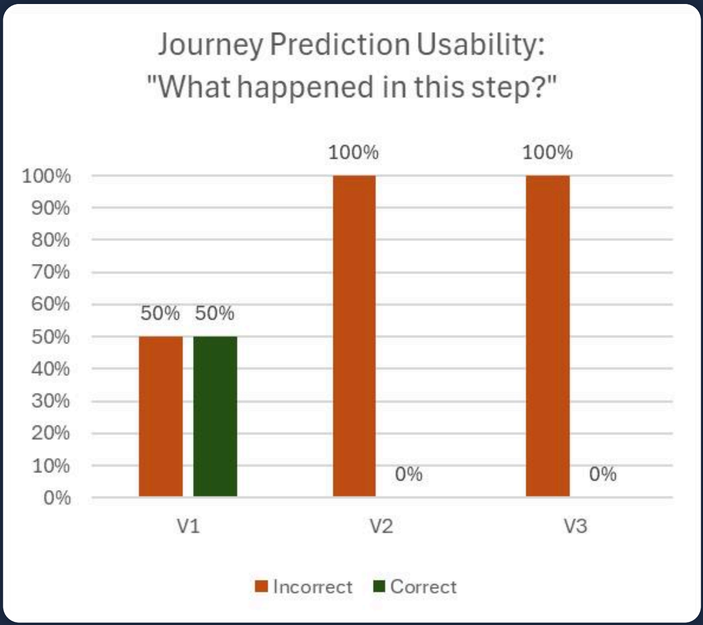
Results

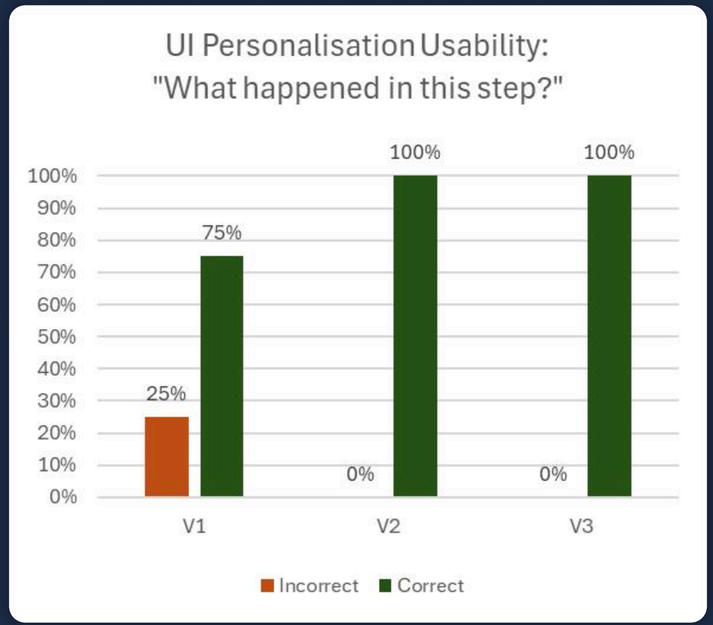
Personalised UI Setup
Starting with usability for the personalised UI Setup, the overall understandability of the first step (journey prediction) scored significantly worse than the second step (UI personalisation). For the journey prediction step (V1+V2+V3), the system action was correctly identified by the participant in only 2 out of 12 cases, while in the UI personalisation step (V1+V2+V3), in 11 out of 12 cases the action was correctly identified.

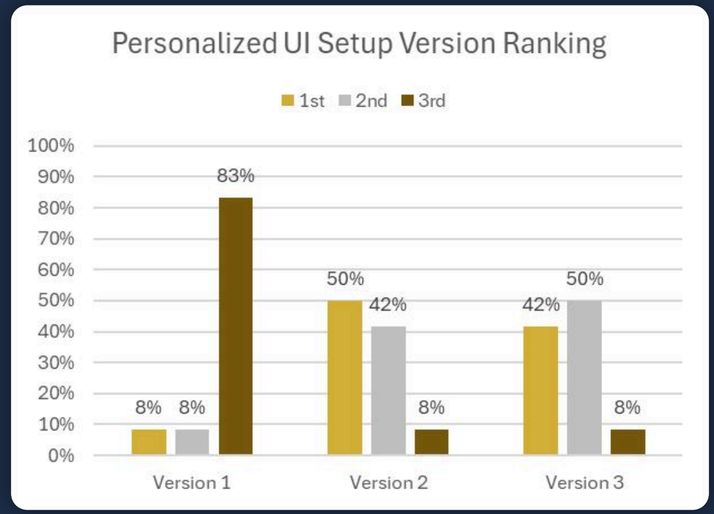
In the Journey prediction step, version 1 scored the best, with the system's action being identified correctly in 2 out of 4 cases (50%).

In the UI personalisation step, version 2 and 3 scored the best, with the system's action being identified correctly in 4 of 4 cases (100%) for both.

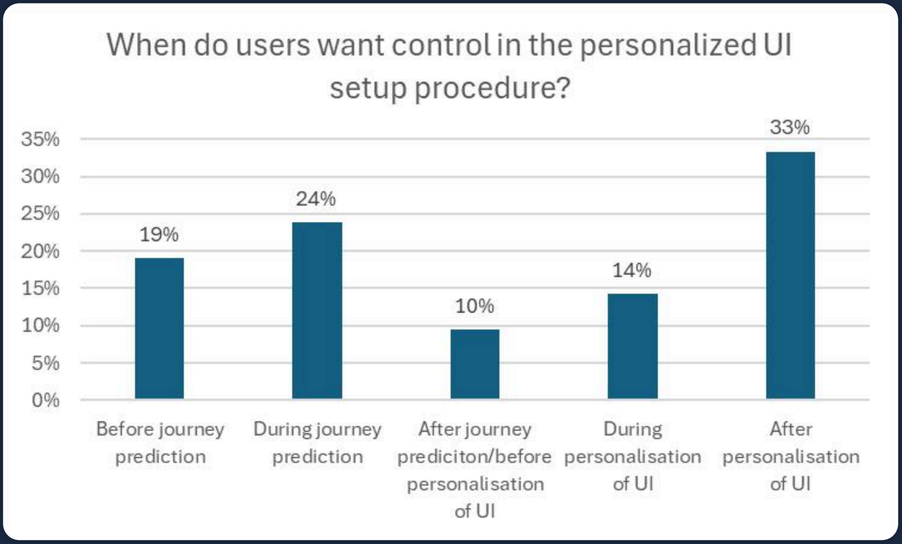
Secondly came the A/B/C testing including a version ranking, where Version 2 and 3 significantly outscored version 1.
Version 2 and 3 were each chosen as the first or second favorite option for a combined 92% of the participants.



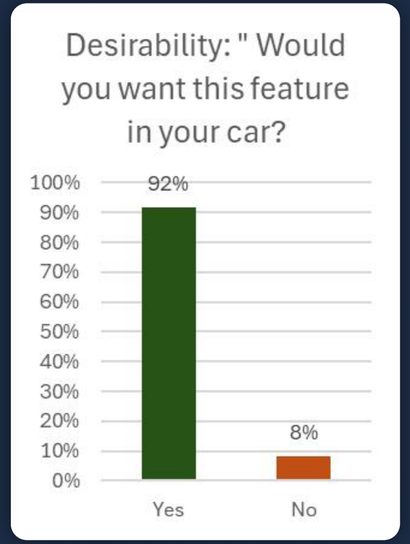




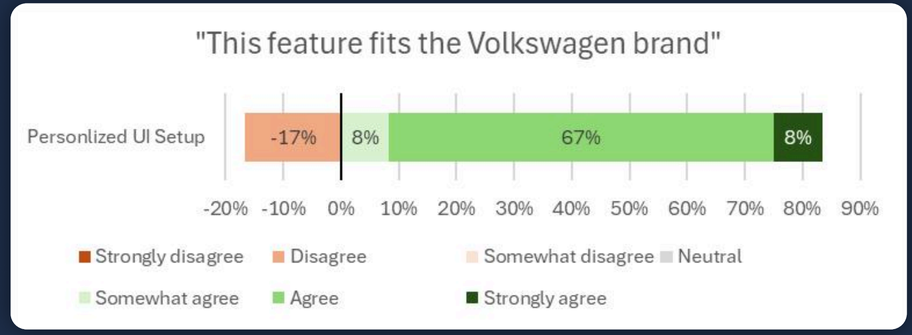
In terms of user control, people's needs differed. While allowed to select multiple options, none of the control moments was selected more than 50% of the cases. Before/during the journey prediction and after the personalisation came out as most selected. Additional comments revealed that this respectively had to do with the possibility to cancel the journey prediction process and to change the personalised widgets.



Next, personalised UI setup desirability was high, with 92% of participants wanting it in their car.



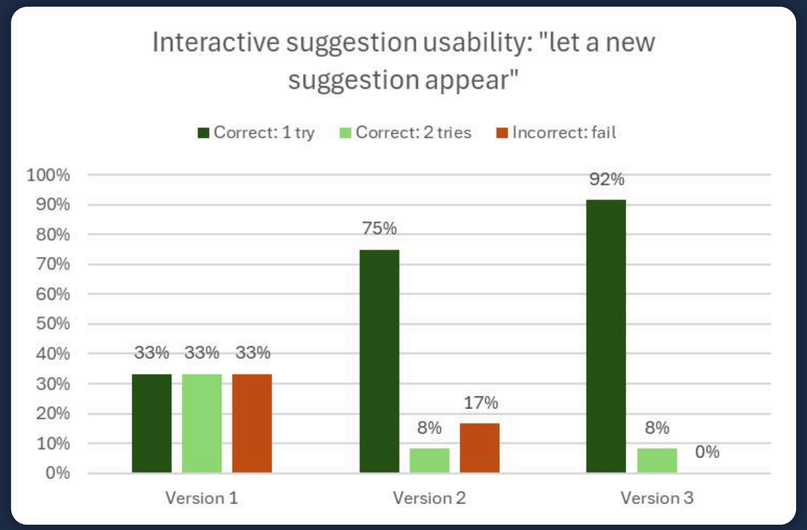
Alongside this, 83% of participants (to certain extent) agreed with the statement "this feature fits the Volkswagen brand". 17% of participants did not agree with this. Additional comments revealed that this disagreement correlates with Volkswagen being seen as a conservative company in terms of such innovations.

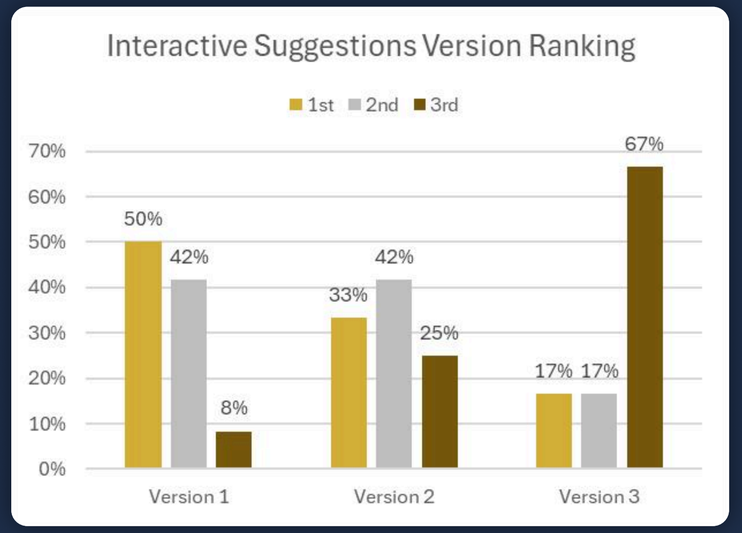


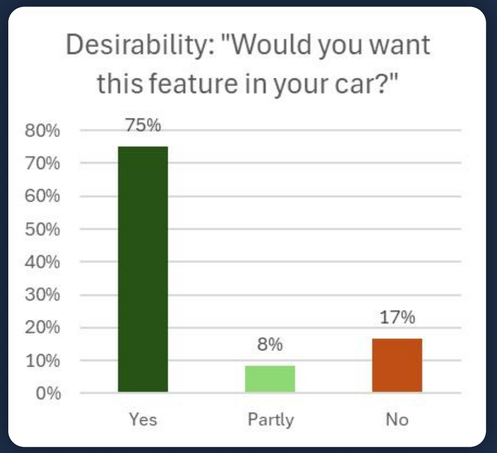
Interactive Suggestions
After the Personalised UI Setup, the interactive suggestions were evaluated, starting with usability. The task of letting a new suggestion appear was tested among 3 interaction concepts. Here, version 2 (click & hold) and 3 (permanent button) significantly outscored version 1 (swipe). Version 3 performed best with task being correctly completed in the first try in 92% of the cases, and after 2 tries in the remaining 8% of cases.

On the contrary, in the A/B/C version ranking, interaction concept version 1 (swipe) and 2 (click & hold) significantly outscored version 3 (permanent button).
Version 1 came out on top, with it being ranked as the first preferred option in 50% of cases. It came second in 42% of cases and last in 8% of cases.

Interactive suggestion desirability was high, with 75% of participants wanting it in their car, and 8% wanting it, but in a way that was not tested in the study. In contrast, 17% of people indicated they did not see the need of interaction with personalised widgets.





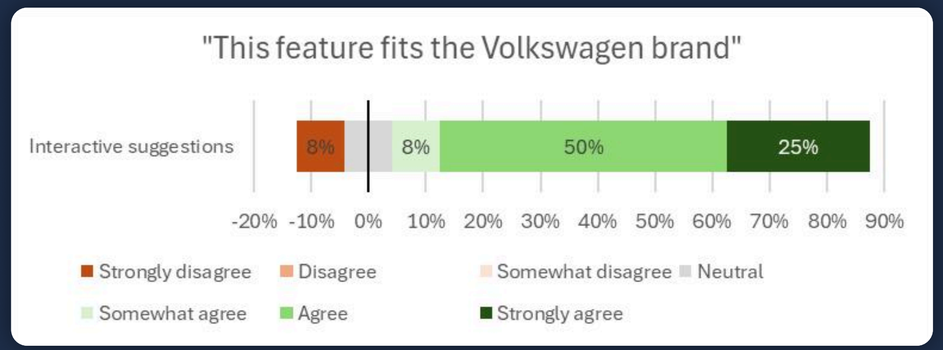


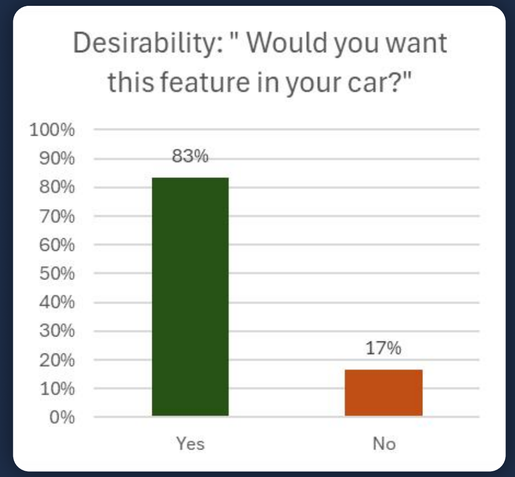
In terms of brand alignment of interactive suggestion, 50% of the participants agreed with the statement “This feature fits the Volkswagen brand”. Moreover, 25% strongly agreed. The options ‘strongly disagree’, ‘neutral’ and ‘somewhat disagree’ were answered by 1 participant each, representing the remaining 25%. Each of them accounts for a rounded 8% of the responses.

Personalisation switch
In terms of usability of the personalisation switch, 58% completing the task in a single try. 8% needed 2 tries, 17% needed 3 tries and 17% failed to complete the task.

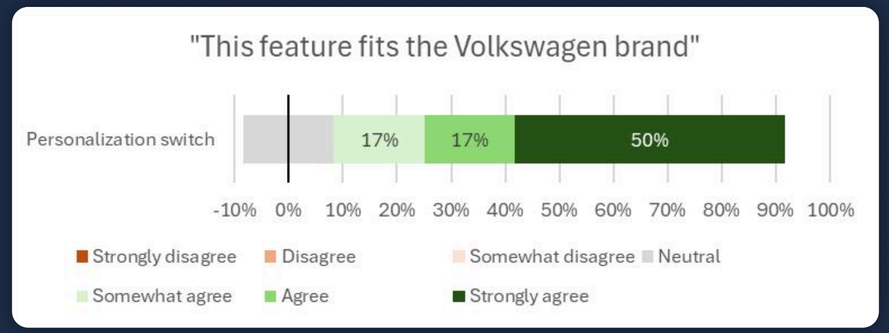
Desirability was high, with 83% of participants wanting the feature in their car.

In terms of Volkswagen branding, 50% of people agree with the statement ‘the personalisation switch aligns with the Volkswagen brand’. Each ‘agree’, ‘somewhat agree’ and ‘neutral’ accounted for 17% of the responces.









Automated ETA Message
Regarding usability of automated ETA messages, only 1 out of 12 participants (8%) understood what happened. Feedback hinted to misinterpretations because of how the element was designed.

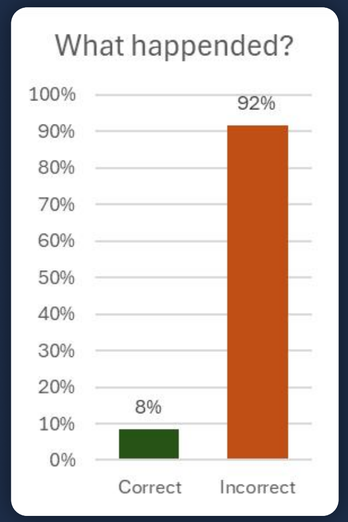
Desirability of the automated messages revealed that 50% of participants want the feature in their car in a different way. Once again the additional feedback reveals that the changes is largely in terms of the design. The other 50% of opinions were split, with 25% of participants wanting it in their car and 25% not wanting it.

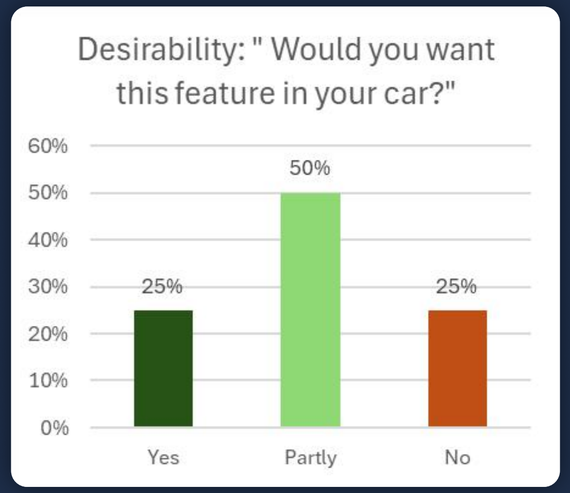
Contextual Background Changes
Usability scores for the background changes were high for both the weather-based adjustment (75% correct in 1 try) and the transition between day and night (100% correct in 1 try). Additional feedback revealed that some participants did not notice the change based on the weather.

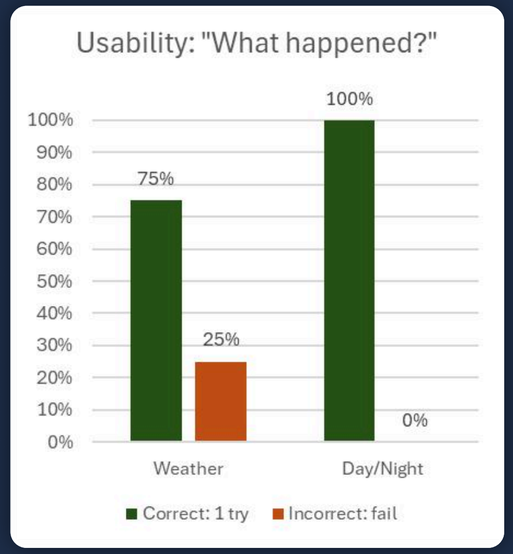
Desirability was mainly positive, with 58% of participants wanting it in their car, and 33% wanting it, but in an adjusted way.

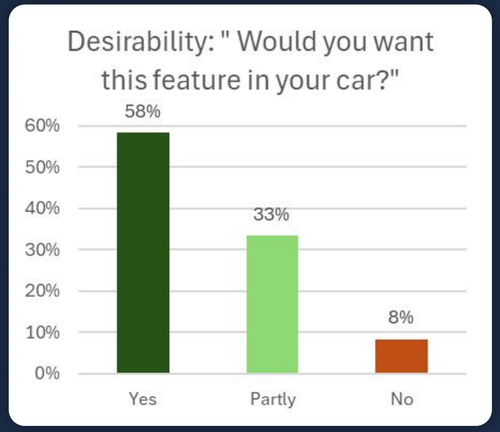
UI changes (additional user)
The usability scores for UI changes caused by an additional user stepping into the car was 100% correct. Yet, it is important to note that not all changes were explicitly mentioned by each participant.

Home Automations
Home automation features scores were also 100% positive in terms of usability, with everyone understanding the UI overwrite for reversing and automating the scene of the arriving home.



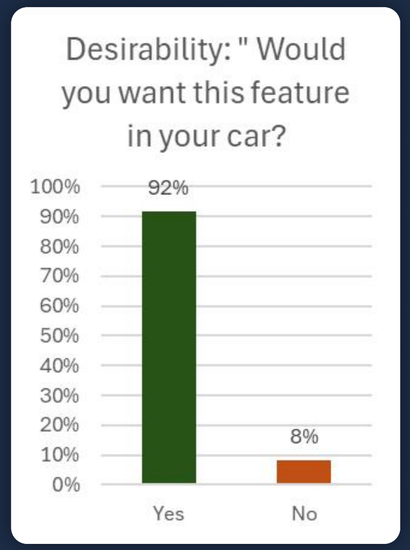






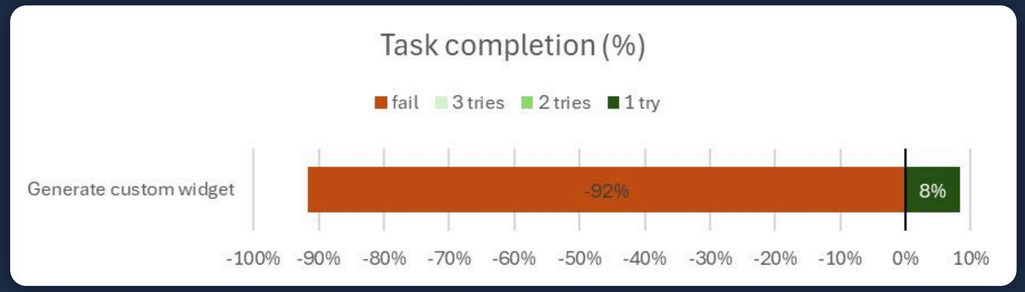
Desirability of home automations was high, with 92% of participants wanting it in their car. The other 8% did not want it in their car.

Additional feedback revealed privacy concerns by some. The main request among the comments was to have a human confirmation before opening the gate, garage and front door.



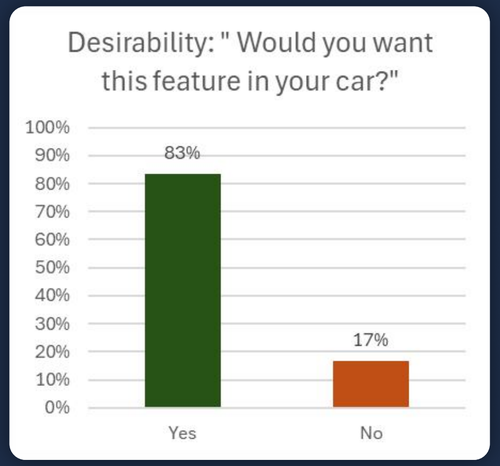
Personalised UI Setup 2
Just like the additional user UI changes and home automations, the usability score for the second personalised UI setup was 100%, with all participants understanding what happened in this step. This did not come as a surprise, as all participants had already gone through a setup at the start of the user test, including an explanation of how it worked afterwards.

Gen-AI widget
In contrast, the usability score for generating a custom widget was low, with only 1 of the 12 participants understanding the how to initiate the correct interaction. Additional comment reveal that this was mainly due to a mismatch between the function of the widget and the text, placement and design style of the widget.



In contrast, all participants (100%) were able to explain what happened after a human command initiated a new system process (custom widget creation).

Desirability of the Gen-AI widget was high, with 83% of participants wanting it in their car. The remaining 17% did not.

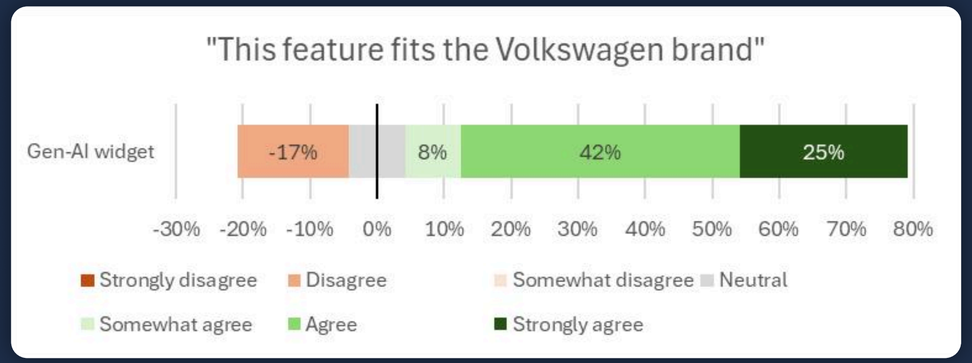


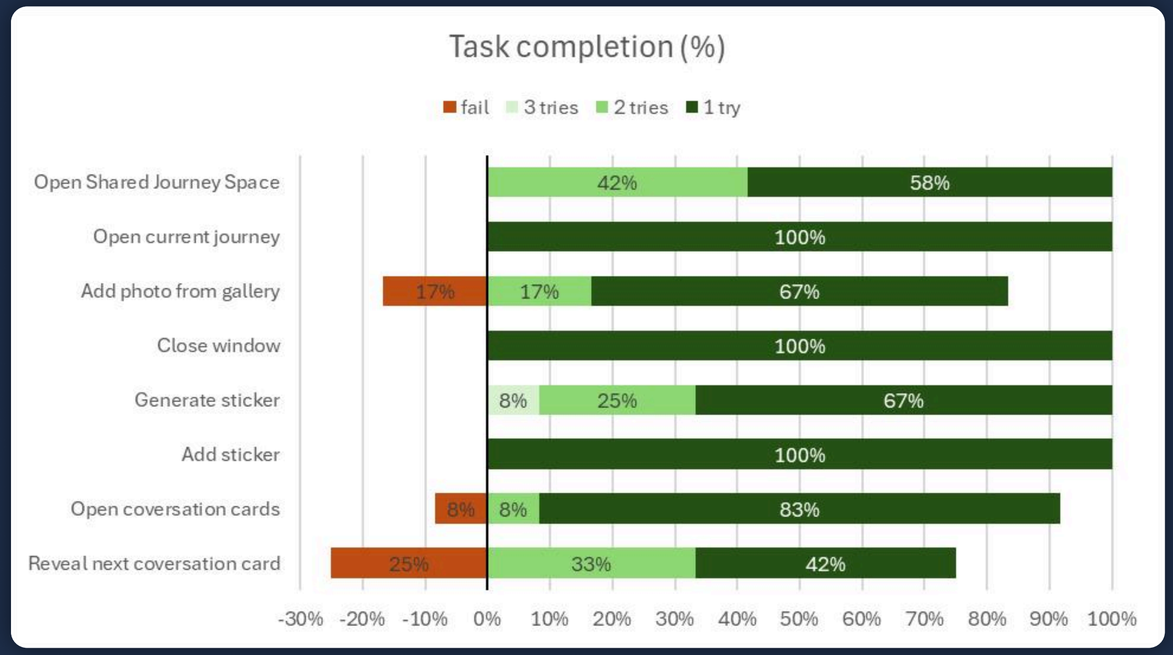
In terms of brand alignment, 25% strongly agreed with the statement “this feature fits the Volkswagen brand”. 42% agreed, 8% somewhat agreed, 8% responded neutral and 17% disagreed. Like before, additional comment revealed that some participants thought this feature pushed innovation that much that it does not align with Volkswagen’s more conservative identity in terms of innovation.

Shared Journey Space

For the shared journey space, a sequence of tasks were tested as part of the usability assessment. Each selecting the current journey, slowing the gallery window and adding a sticker were completed correctly at first try across participants (100%).

Allowing for a second try, all participants are able to open the journey space (58% correct at first try, 42% correct at second try). Additional comment reveal that people expected a click interaction instead of a swipe motion for this specific task. Also allowing for a third try enables all participants to complete the ‘generate stickers’ task. Opening the conversation cards was also a generally understood task.



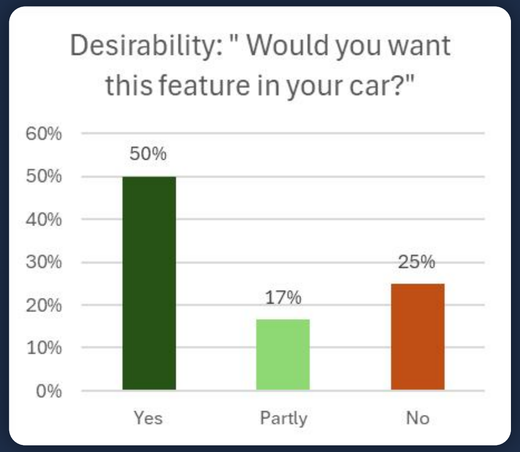


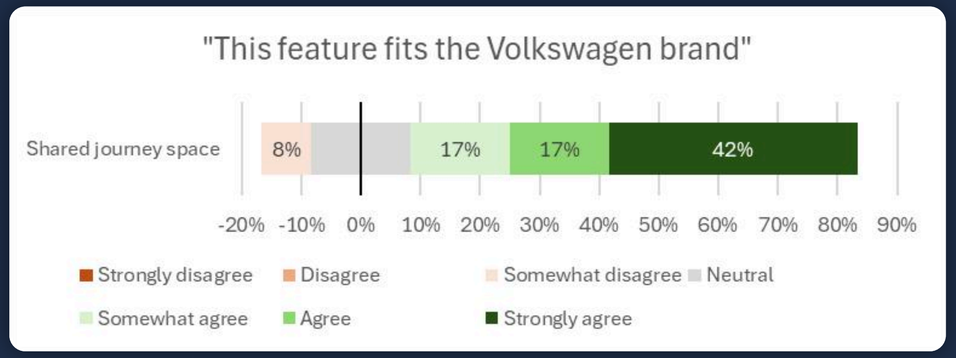
Additional comments revealed that many clicked the emoji icon instead of the sticker icon. In other task, people also failed. Additional comments reveal that:

- For adding a photo from the gallery many clicked the sticker icon instead of the plus icon.
- Revealing the next conversation card failed mainly because of participants swiping to the left instead of to the right.

In terms of desirability, 50% of participants answered they would want the Shared Journey Space in their car. 17% want it to some extent, and 25% does not want it.

Lastly, 42% of participants strongly agree with the statement “this feature fits the Volkswagen brand”. Furthermore, 17% agree, 17% somewhat agree, 17% respond neutral, and 8% somewhat disagrees.





7.2 Synthesis

Usability & version preference
Generally, usability scores came out reasonably high, with 71.4% of system actions (AI-to-human) being correctly identified. Next to this, tasks (human-to-AI) were completed in 1 try in 69.4% of the cases, with an additional 13.7% completed in 2 tries, 2.4% in 3 tries and 14.9% failing.
Some features scored significantly worse than others. For those, the compromised usability was mainly caused by design flaws. For example, the Gen-AI widget activation was unclear due to the design and text being “confusing”. Also, the placement does not line up with the AI-powered function of the widget. An new iteration will be presented in the next chapter.

Interesting insights appear when comparing usability scores to version preferences of the UI setup and widget interaction. For the personalised UI setup, version 1 came out on top in terms of usability, due to it’s explicit communication about each step of the automated procedure. However, people ranked both other versions significantly higher, as they were more minimal in terms of design and condensed system information. Participants indicated that over-communication was the problem in version 1, causing visual overload and excessive user control.

Similarly, usability of widget interactions did not align with the preferred variation. Here, version 3 (permanent button) scored highest in terms of usability, yet both version 1 (swipe) and version 2 (click & hold) were preferred. Participants highlighted the importance of aesthetics, as a permanent button would ruin the appearance of suggested widgets. Interestingly, people prefer the swipe and click & hold variants because of learned interaction behaviour:

- Swiping items to the side is a common gesture used to remove items out of a listed format (e.g. emails).
- Long-pressing an item is a common interaction to (enter a mode to) edit, replace and remove (used by phone operating systems such as IOS and Android).

Desirability, privacy and safety.
Desirability generally rated high. On average, in 69,8% of cases people wanted the feature in their car. 13.5% wanted it to some extend or in an adjusted way, and in 15.6% of cases people didn’t want the feature. Qualitative feedback reveals that privacy and safety were a major concern causing lower desirability scores. Participants stressed that privacy- and safety-critical actions required a human-confirmation step.

User Control
During the user test, an additional question was asked to better define desired user control in the personalised UI setup procedure. Results show a peak at the start and the end of the setup. Additional comments reveal the reasoning for these answers. Some participants desired the possibility to cancel the setup procedure, especially early on in the process. Others voiced the preference for editing the final suggested widgets after the setup is completed over editing input factors in the initial stages of the setup. Together, results suggest to only have an option to cancel the procedure during the setup, and to allow for further user control (to edit, replace and remove widgets) after the setup is completed.

Brand Alignment
Participants largely agreed with the statement “this feature fits the Volkswagen brand”. Still, not all agreed. Some participants argued that Volkswagen is not a company that pushes innovation that much. Therefore, for some, adaptive, generative and automated aspects of the features felt to future-oriented to be introduced in Volkswagen ahead of more premium brands.

7.3 Visual updates

Some final adjustments were made to the UI design based on the well-represented results of the second user test.

Widget interaction iteration

One of those is the way people interact with suggested widgets to remove, replace and edit items. Although swiping and press & hold interactions were already explored in the user test, people described a list of widgets could be added for replacing widgets, instead of letting AI predict another widget.

This was then combined with an updated swipe-to-replace interaction, as it was highlighted by Volkswagen UX designers that allowing for multiple types of interactions to suit multiple customers is a common strategy used when building UI systems.

AI switch alignment

Another design update was the alignment of the switch. Participant's comments caused the switch to be left-aligned with the right-most column of widgets in the final version.

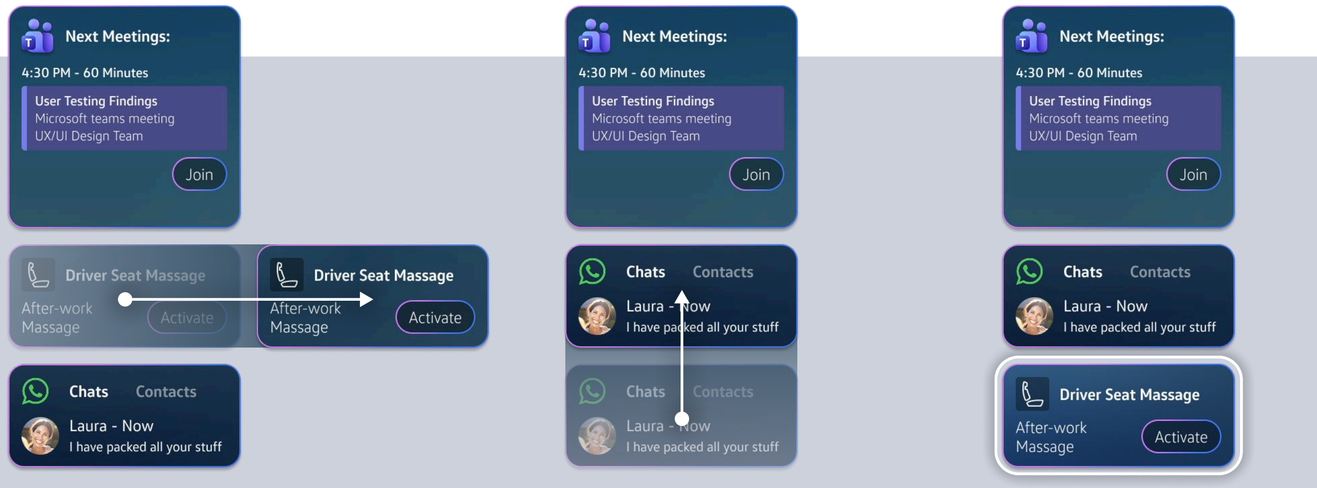


Figure 7.1 *Envisioned mechanism for removing widgets (by swiping)*

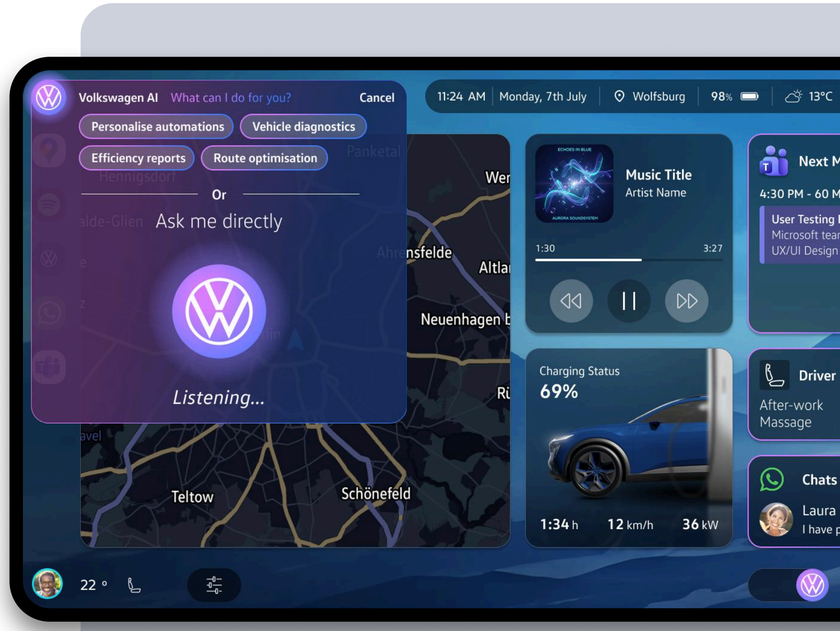


Figure 7.2 *Final implementation of user-initiated generative automations*

Gen-AI widget iteration

The user test also revealed that accessing the feature to generate custom widgets via a permanent widget on the home screen is illogical. The majority of participants agreed to classify the tool under the top-left AI button as an 'AI feature'. From here, the rest of the feature's interaction flow was kept the same, as it showed great usability scores in the user test.

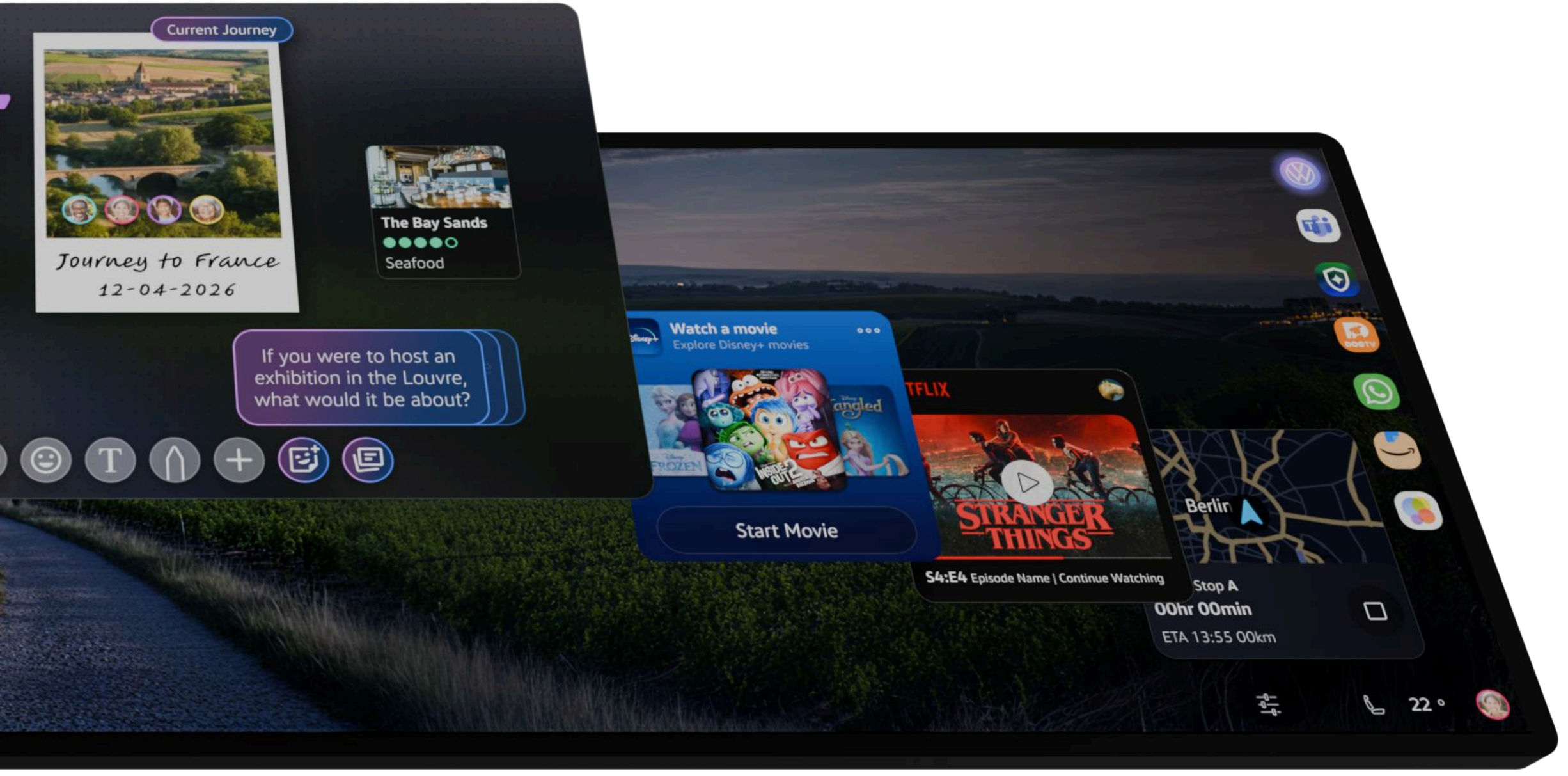
08

Final prototype

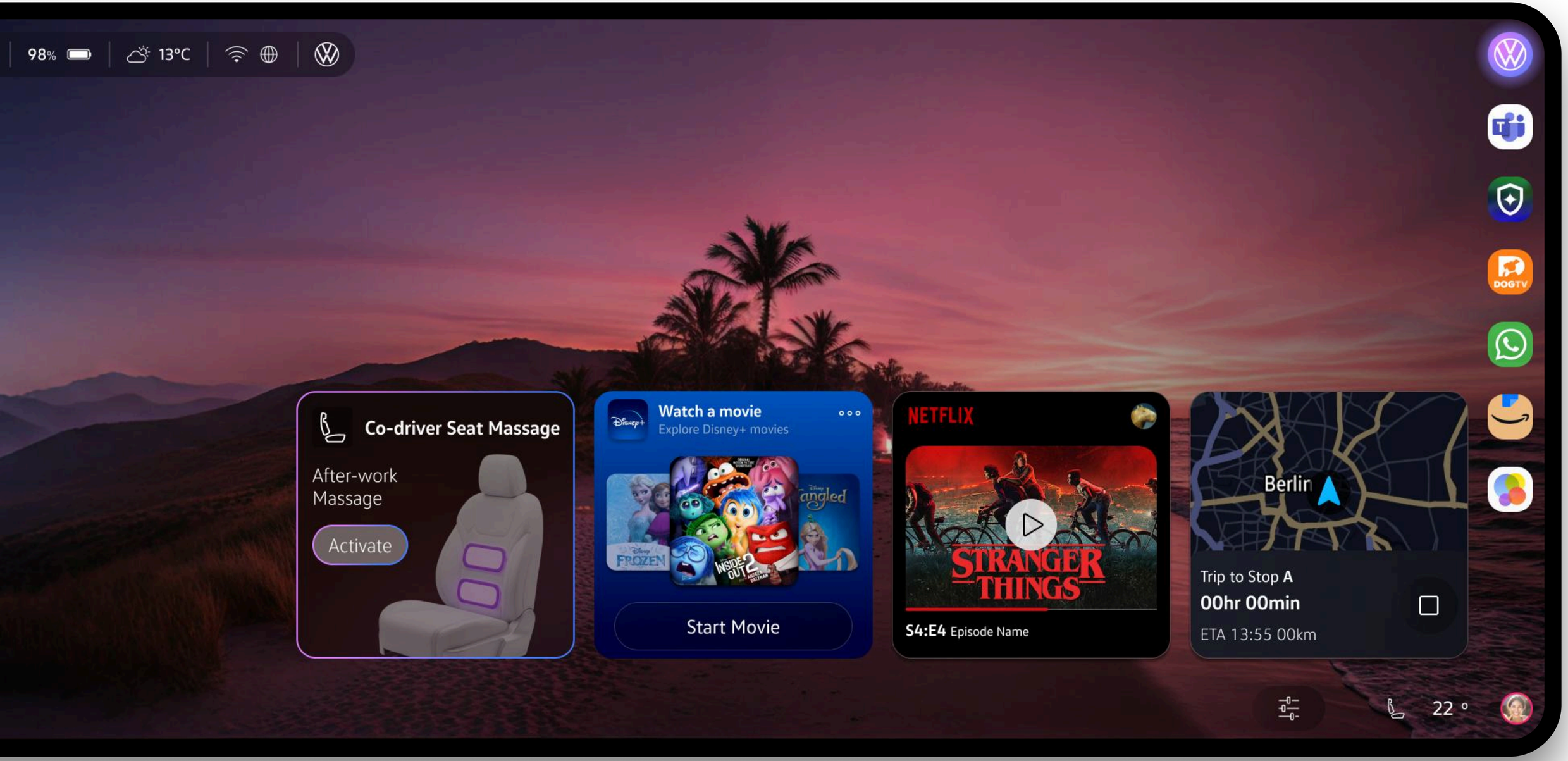



11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July


Adaptive Audio
Auto. Volume Adapt
Volume Reduction -11 dB
0 dB -35 dB
Shared Journey Space
Music Title
Artist Name
French Summer
Playlist
1:30
Driver Seat Massage
Energizing Massage
Activate
Chats
Contacts
Laura - Now
I have packed all your stuff
Charging Status
69%
1:34 h
12 km/h
36 kW
Drive Mode
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Activate
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Panketal
Ahrensfelde
Berlin
Teltow
Schönefeld
22 °


Current Journey
Journey to France
12-04-2026
The Bay Sands
Seafood
If you were to host an exhibition in the Louvre, what would it be about?
Watch a movie
Explore Disney+ movies
Start Movie
TFLIX
STRANGER THINGS
S4:E4 Episode Name | Continue Watching
Berlin
Stop A
00hr 00min
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Trip Setup
Optimizing your trip
Cancel
11:24 AM
Monday, 7th July
Wolfsburg
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Music Title
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Next Meetings:
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User Testing Findings
Microsoft teams meeting
UX/UI Design Team
Join
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After-work Massage
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After-work Massage
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Explore Disney+ movies
FROZEN
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Tangled
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11:24 AM
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Microsoft teams meeting
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09

Wrap up


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11:24 AM
Next Meetings:
9 AM - 30 Minutes
User Testing Findings
Microsoft teams meeting
Andro Kleen
11 AM - 60 Minutes
Team Meeting
Microsoft teams meeting
Driver Seat Massage
Energizing Massage
Activate
Optimize Work Trips with IDA
36 kW
13°C
Wolfsburg | Monday, 7th July

9.1 Guidelines for In-car Personalisation

This chapter brings together the insights, evaluations, and design explorations developed throughout the project to establish a coherent set of guidelines for further development of adaptive personalisation in in-car interfaces. Building on the empirical findings and discussions presented in earlier chapters, this section shifts from analysis to synthesis, translating observed user needs, behavioural patterns, and system capabilities into actionable design principles. These guidelines aim to support the development of adaptive systems that are not only context-aware and responsive, but also transparent, trustworthy, and aligned with driver expectations. By framing personalisation as a dynamic interaction between user, vehicle, and environment, this chapter provides a structured foundation for designing future in-car experiences that balance automation with user control.
Although not specific to the automotive domain, the guidelines for adaptive user interfaces proposed by Schröder (2021) are highly relevant due to their broader applicability; a comparison shows that the guideline themes derived from this study's user test results strongly align with those proposed in the existing literature.

1. Scope personalisation responsively

Apply personalisation only when relevant
Personalisation should not be treated as a default solution. Designers must assess whether it meaningfully addresses the interaction problem and carefully select only those system variables and contextual factors that support the intended outcome. Irrelevant inputs should be excluded to avoid unnecessary complexity and reduced clarity.

Extend Personalisation Beyond the Journey
Findings from co-ideation and user testing show that user needs are influenced not only by the journey itself but also by factors such as occupants and broader context. Effective personalisation should therefore consider multiple contextual dimensions in a balanced way. While multi-factor personalisation is not always required, it represents a valuable direction for increasing relevance in automotive interfaces.

Preserve Consistent Elements
At the same time, not all interface elements should be personalised. Insights from co-ideation revealed a clear preference for structural consistency, with core functions such as navigation, media, and vehicle settings consistently present. This highlights the importance of maintaining a stable layout while applying personalisation selectively. Preserving key elements supports usability and balances adaptability with reduced cognitive load.

2. Find a fitting recommendation method & visual approach

Recommendation method
Multiple methods for suggesting widgets have been proposed, yet some are more usable than others depending on personalisation demands.
In the prototype proposed in this thesis, the system preferably predicts and suggests based on the user's historic drives. Items that are used before (during similar journeys/across journeys) are suggested.

Additionally, one can also make predictions based on:

- Collaborative filtering. Widgets used by similar users can be suggested.
- Universal trends. Widgets that are globally or regionally used a lot can be suggested.

Further research (by means of additional user testing with integrated models that combine recommendation methods) should define the exact division between proposed widgets recommendation methods.

Visual personalisation approach

Schröder (2021) proposes attributes, approaches, and purposes for the adaptation of interface elements as well as content and information personalisation, which also apply to the automotive UIs. By clarifying the purpose of the personalisation or adaptation (e.g. shortening the interaction path, improve accessibility or personalising content recommendation), specific approaches can be used (e.g. highlighting or rearranging UI elements) to visually adapt UI attributes. It is the task of the designer to define what approaches are suitable to fit the personalisation purpose.



Figure 9.1 *Example of an introduction for personalised features*

3. Design for understandability

Introduce personalisation features

In the second user test participants opinions aligned for having a one-time introduction to personalisation features such as the UI setup, explaining all of its steps in detail, to maximize understandability. They stress that having such explicit information and control is only desired for first time use of the features. Although highlighted as helpful for this thesis' UI setup, it can not be claimed this is a general requirement for all types of personalisation in the automotive UI domain.

Explicit communication

Principles from Explainable Artificial Intelligence emphasize to communicate system handling explicitly (Miller, 2019) Apply to both the one- time feature introduction and the communication about system-initiated personalisation from this point. The second user test shows that people still prefer to be informed about the systems actions only in a more concise way. The next guideline reflects on this result, finding common ground between explicitness and minimized distraction.

Visual distinction of adaptive elements
In the later stages of the project it became evident that users require consistent UI elements and cues to maximize understandability. Insights from user test 2 reveal that in adaptive systems, this consistency (through colour schemes, typography, iconography, and interaction cues) allows users to more easily identify functions and anticipate outcomes, even when content is personalised. A key point of discussion was the difference between personalised and non-personalised items, which must be distinguished accordingly in the visual design.
It is recommended that Volkswagen develops a consistent, brand-aligned visual style for AI-powered adaptive UI elements, such as suggested widgets.

4. Design for safety

Minimize distraction: UI elements
Conflicting with guideline to explicitly communicate AI-to-human actions is the theory to minimize mental effort of UI elements in attention-critical contexts, such as driving (Sweller, 1988). Results of user test 2 reflect the common ground between theories, where system acting is communicated explicitly, yet in a minimal way, requiring low cognitive effort.

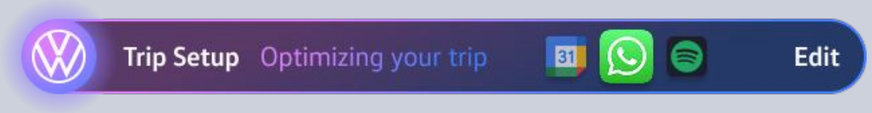


Figure 9.2 *The final Setup notification finds common ground between explicitness and safety*

Next to this, notifications, pop-ups, and widgets should aim to avoiding animations and bright colours. The overarching goal is to minimize distraction from non-critical notifications. Figure 9.2 shows an example for a personalised UI setup notification in which information is condensed; solely communicating the systems action in that step.

Minimize distraction: Interface level
Complementary to item-level distraction reduction, minimizing mental effort should be pursued on an interface level, as distraction has been a major discussion point throughout the project.

The dynamic nature of adaptive interfaces and the general fact that a highly present CID is used in this project raised concerns about distraction on a larger scale. Especially in single-occupant scenarios, when right-side part of the interface is unused yet remains on to displays the background image, participants voiced distraction complaints.

For future work, 2 approaches an be suggested to reduce distraction:

- Software level: Reducing saturation and contrast, darkening or completely turning of the right-side area were all suggested during user tests to reduce distraction.
- Hardware level: Volkswagen could also explore distraction reduction on a hardware level. For example, one could hide the righthand-side area of the CID behind interior surfaces or split up the CID in two screens and only showing the one closest to the driver. Alternatively, recent technologies in rollable displays allow for parts of the CID to curve 180 degrees to the back, thereby not being visible for the occupants anymore.

In summary, non-essential design elements, animations and use of bright colours that may cause distraction should be avoided as much as possible.

5. Eliminate system errors

In some cases, system errors can occur, input information can be too limited or reasoning can be undecided about what journey is ahead or what widgets could be best suggested. Strategies should be worked out to deal with such scenarios.

Define the default
During system errors, it should always be possible to rely on default settings for main UI elements, such as the background, colours and basic preferences. For designing personalised interfaces, it is therefore important to let users define default settings in the initial stages of UI onboarding.

Solve the cold start problem
For initial drives, where the system did not learn about the user and his/her routine journeys and interior behaviour to accurately personalise the experience, universal (journey-specific) trends can help solve the cold start problem. Items that are globally/regionally most used or popular (in the specific journey category) can always be suggested, which is therefore recommended as a recommendation strategy in the initial stages of use.

Provide options if uncertain
During system errors or when non-conclusive about the destination, it is always possible to provide the user with options, allowing for user feedback to clarify what journey is ahead. As the system can learn through feedback to optimise the experience for future scenarios, it is therefore always suggested to provide such options.

6. Shape widget interactions with learned gestures

In the second user test, participants voiced a need for user control and interaction to adjust suggested widgets. It is was found that people preferably apply learned interactions to complete common configuration tasks on the interface (e.g. deleting, editing and replacing items). For further development of Volkswagen interfaces the focus should be on learned behaviour (see figure 9.4), such as:

- Swiping to get rid of items (based on removing items in email inboxes)
- Press & hold to edit and replace items (based on editing home screen applications on both IOS and Android devices)

Figure 9.3 *Example of how options for journey category can be provided to the user*

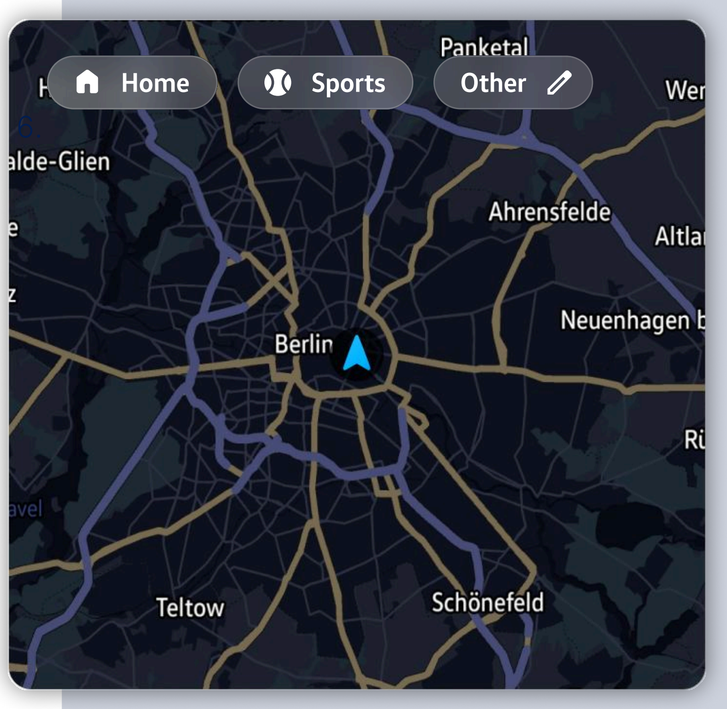
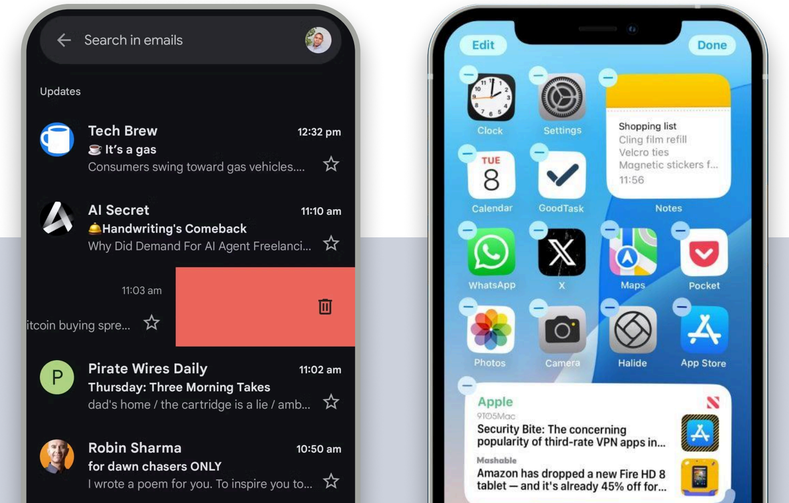


Figure 9.4 *Widget interactions should be shaped based on learned gestures like swiping to get rid of items and press & hold to edit and remove items*



7. Don’t force adaptivity

Although perspectives towards personalised and adaptive features are generally positive, user testing has also highlighted the more critical perspective towards such interfaces. Although a minority, this user group should also be included to ensure a widespread acceptance across Volkswagen’s broad target audience. The interface should therefore be designed in a way that works for personalisation enthusiasts, non-users and everyone in between. Interfaces should not force users to use adaptive features. In this project, widget suggestion is designed as an addition to the core UI widgets. Additionally, the personalisation switch is a clear example of providing user control in whether or not users want to be provided with personalised UI content.

8. Allow for user control & learn through user feedback

Throughout the project, research participants have stressed that human adjustments should be treated as dominant over system suggestion and should be guiding system learning. Even though people are generally positive about automatic system actions, the user should always be allowed to overwrite them in a quick and accessible way. Clear examples are the personalisation switch and widgets that can be interacted with, allowing the system to learn through user feedback.

Like so, findings about user control in the second user test indicate that users should be able to cancel the personalised UI setup at any point during the process, ensuring a sense of control. Additionally, participants expressed a clear preference for adjusting system-generated suggestions after the initial setup, rather than modifying the underlying input factors.

Together, findings suggests that adaptive systems should allow for and prioritize output-oriented adjustments by the user, guiding system learning through manual feedback.

9. Allow both parties to initiate personalisation

The first user test has shown that the relation between trigger and personalisation action that people describe to be useful can sometimes become so complex that it would be impossible for an AI system to predict this autonomously. Therefore, a way for users to initiate and describe their desired personalisation adaptations should be included in the interaction design of personalised interfaces.
In this project, the generative AI widget has been proposed as a solution for such user requests.
In this way, personalisation can be initiated both proactively from the system side as well as manually from the human side, ensuring a co-operative process (Lavie & Meyer, 2010).

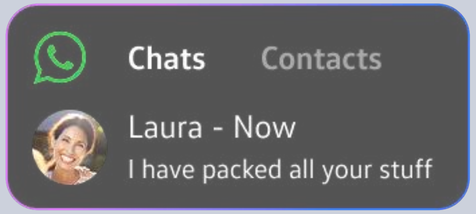
10. Design for privacy

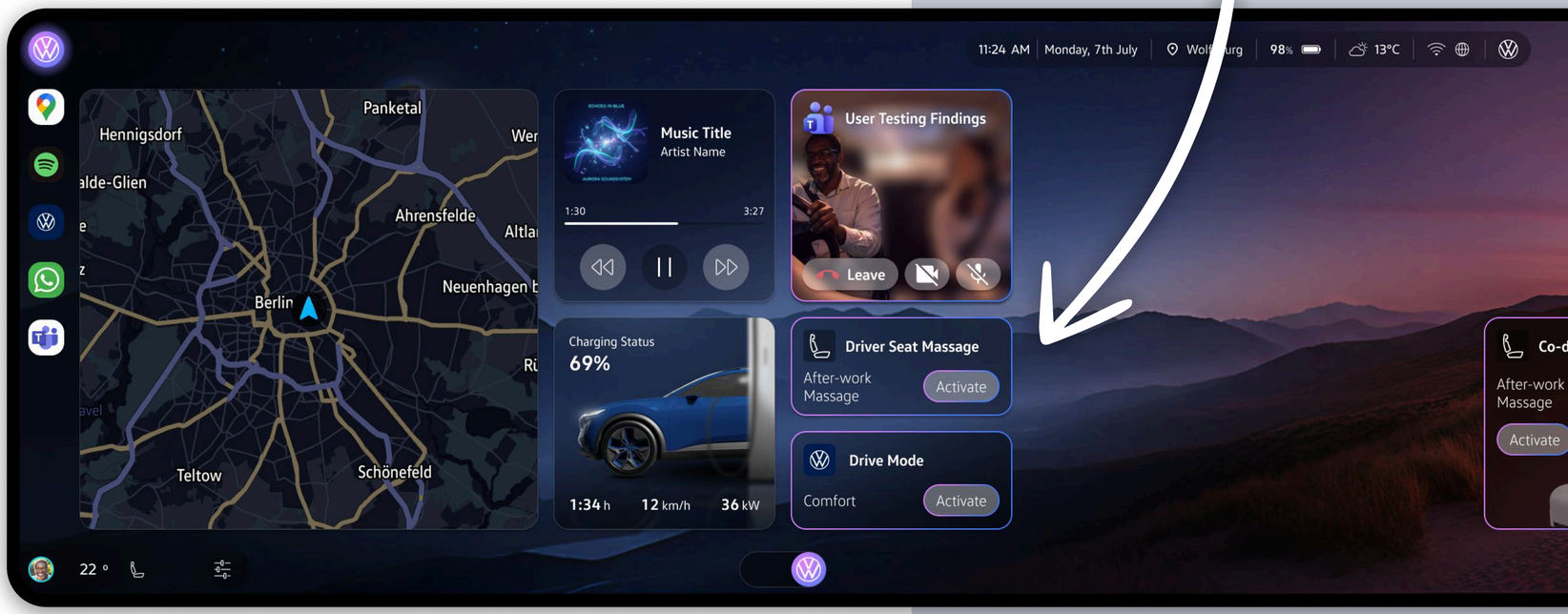
Personal data usage
In all cases, one should try to eliminate input factors that do not influence the personalisation process. Data should only be used for personalisation and not for other purposes. Early indications suggest that a combination of occupant(s)/user profile(s)/preference(s), date & time, and start location are enough to predict virtually all routine journeys. Additionally, only when the driver agrees on this, additional personal information (e.g. calendar items) can be included for journeys that could otherwise not be predicted. Users should be given the option to include or leave out such information.

Privacy risks of personalisation features
Likewise, privacy and user control have been a major topic in the discussion of both the first and second user test. People want to preserve human control in privacy- and safety-critical personalisation automations initiated by the system. Therefore, users should be presented with controls to cancel or confirm such system-initiated, yet safety-critical actions in personalised interfaces.

Additionally, The ever-changing context requires responsible handling of privacy-critical scenarios on a content level. Split-second reactions to sudden changes to preserve privacy are essential. For example, a user is in a video call (with interior camera on) and additionally was suggested with a chat widget (such as WhatsApp). Then, this user picks up a friend, who joins in the co-driver seat. In such cases, privacy-ensuring adaptations (such as blurring the teams background, removing the chat widget) should be carried out.

Do not show!





9.2 Discussion

This thesis shows great potential for personalised and adaptive user interfaces in Volkswagen cars. Participants largely reacted positively towards proposed personalisation features, which generally show high desirability. Throughout, participants highlighted efficiency and convenience as the main benefits compared to static interfaces. Continuous user feedback through co-ideation and user testing allowed for multiple design iterations and evaluation of product and interaction qualities, as well as findings on usability, desirability, user control and brand-alignment. Project conclusions have largely already been discussed, as they were transcribed into guidelines for further development of personalised user interfaces in the previous chapter.

Beyond these applied outcomes, the project also sheds light on higher level considerations to be discussed in this section.
Additionally, the split in perspectives towards adaptive interfaces and the conflict between personalisation and brand identity will be discussed to conclude this project.

Are personalised UIs needed?
The necessity of adaptively personalised interfaces in automotive contexts warrants critical examination rather than assumption. While personalised UIs promise to reduce cognitive load by providing normally deeper nested system functions more efficiently, the fact that such personalisation continuous adapts to the driving context suggesting functions on top of static items implies a higher cognitive load compared to static interfaces. It creates a paradox on a critical level; safety. While further research is needed to define exact levels of distraction and cognitive load, participants concerns reflect the unneglectable importance of safety, which should never be compromised while shaping the user experience of personalised interfaces.

Moreover, adaptive interfaces can cause confusion. For instance, if a system anticipates user needs incorrectly or changes interface behaviour over time, it can disrupt established mental models and create uncertainty. This would be an undesirable outcome in safety-critical environments like driving.

Consequently, rather than framing adaptive personalisation as a necessity, it is more appropriate to view it as a conditional enhancement; valuable only when it supports driver goals without compromising usability, control and safety. A recommendation for further development of adaptive interfaces is to carefully justify where adaptation is truly needed, and where simplicity and consistency may provide a superior user experience.

Is AI needed for personalisation?
AI is not strictly required for all forms of adaptive personalisation in in-car interfaces, particularly when identifying recurring journey routes or frequently used interface behaviours, where rule-based systems or simpler pattern-recognition approaches could suffice with greater transparency and predictability. However, in this project, personalisation extends into a more complex, dynamic layer: widgets are suggested based on the specific drive, the user, and the real-time driving context, while the system continuously learns from user feedback (users engage with, remove, or replace widgets).

Additionally, the interface evolves during the journey, as contextual changes trigger UI changes and new widget suggestions. In such a setting, it becomes increasingly difficult to model the relationships between multiple live inputs and resulting interface actions, or to determine which elements should be prioritized at any given moment. Here, AI becomes particularly valuable, as it can process multidimensional inputs, learn nuanced patterns over time, and make context-sensitive decisions that would be challenging to define through static or rule-based logic alone.

At the same time, the inclusion of AI introduces important ethical considerations. Deploying such systems at scale (potentially across millions of vehicles within the Volkswagen Group) raises concerns about cumulative energy consumption and environmental impact, as well as broader questions of responsible technology use.

Despite these concerns, avoiding AI altogether may be difficult, as competitive pressure and rising user expectations are driving widespread adoption of AI-powered features in everyday products, including cars. This creates a tension between innovation and responsibility, making it essential to carefully evaluate where AI provides meaningful value and where simpler, more sustainable alternatives may be preferable.

Mental models

An important question emerging from this project is whether a complete understanding of system behaviour is always necessary for a successful user experience. Findings from the second user test indicate that the complexity of adaptive personalisation in automotive interfaces affects users' mental models: participants generally understood what the system was doing, but more frequently struggled to explain why certain suggestions were made.

This raises a broader discussion point. While explainability is often considered a key principle in interaction design, the results suggest that a lack of full understanding may not necessarily constitute a critical usability issue in all contexts. Users appeared tolerant of this ambiguity, particularly when system behaviour aligned with their expectations or provided clear value.

A comparable example can be found in Spotify, where users typically do not understand the exact reasoning behind automatically generated song recommendations once a playlist ends. Despite this limited transparency, the feature is widely accepted, suggesting that users do not always require explicit explanations as long as the outcomes feel relevant and beneficial.

Applied to the automotive context, this suggests that understanding why a system behaves in a certain way may be less critical than ensuring that its behaviour is predictable, useful, and non-disruptive. Rather than fully exposing the underlying logic of personalisation, designers may instead prioritise aligning system actions with user expectations and providing subtle cues that reinforce a sense of control.

Personalisation conflicting with brand identity
Another key tension in adaptive in-car interfaces lies in the conflict between adaptive personalisation and preservation of a coherent brand identity. As users are given more control over interface elements (such as preferred colour schemes or AI-generated widgets tailored to their needs) the resulting UI may begin to diverge from the carefully crafted visual language and interaction principles defined by the brand. For automotive companies like Volkswagen, whose identity is closely tied to consistency, clarity, and recognizability, this raises important design challenges. Excessive personalisation risks fragmenting the user experience, potentially reducing usability, trust, and brand recognition. Therefore, a balance must be struck in which personalisation operates within defined boundaries, allowing meaningful user adaptation while preserving core brand characteristics and ensuring a consistent, high-quality interface experience across all vehicles.

Perspectives towards adaptive interfaces
User perspectives on adaptive interfaces revealed a clear split throughout the project. A majority of participants responded positively, expressing curiosity and enthusiasm toward personalised and adaptive features, often perceiving them as innovative, efficient, convenient and likeable. At the same time, a smaller but notable group remained critical, raising concerns that ranged from mild skepticism about usefulness to outright rejection of such systems in their vehicles. Some participants felt that adaptive interfaces introduced unnecessary complexity or unpredictability, while others argued that they were “too innovative for a brand like Volkswagen”. This divergence highlights the importance of designing a user experience where adaptiveness as an option, instead of a requirement.

Limitations

This project is subject to several important limitations that should be considered when interpreting the findings.

The prototype
First, the prototype was realized by means of a Wizard of Oz approach rather than fully implemented software with actual AI integration. As a result, system behaviour was simulated, which limits the ability to accurately assess real-world performance, scalability, and potential technical constraints. Certain aspects such as latency, system errors, or the complexity of real-time data processing may therefore not be fully represented. In addition, the prototype focused primarily on a single interface touchpoint, without incorporating other elements that contribute to the holistic in-car user experience (e.g., physical controls, auditory feedback, or cross-device interactions), as these were not feasible to prototype within the scope of the project.

Research
Another key limitation is the absence of longitudinal studies. While initial user reactions to adaptive and personalised interfaces were captured, the project does not provide insights into how user perceptions, trust, or behaviour might evolve over extended periods of use. This is particularly relevant for adaptive systems, where long-term exposure and learning effects play a crucial role in overall acceptance and usability.

Next to this, the later stages of the project highlighted the importance and lack of clarity regarding distraction and cognitive load in personalised interfaces within the automotive sector. However, in this project, the concept effect on cognitive load was not assessed, as this would require more in-depth analysis using a more advanced prototype. Additional studies, including (simulated) driving scenarios are required to better understand cognitive effects.

Furthermore, the conclusions are based on small-scale empirical research, which restricts the generalizability of the findings. Although the results demonstrate internal consistency and align with existing literature, a larger and more diverse sample would be necessary to validate the outcomes more robustly.

Limited hands-on UI experience
Finally, as the author, designer and researcher of this thesis, my limited experience with in-car interfaces (because of never having owned a car) may have limited my ability to fully anticipate certain contextual or habitual aspects of driving interactions.
On the other hand, this distance may have reduced personal bias, allowing for a more exploratory and less assumption-driven design approach.

Personal reflection

This project challenged me to balance innovation, user needs, and brand identity within the context of Volkswagen. Through an iterative process of co-ideation and user testing, I learned to actively integrate user feedback into my design decisions, improving both the quality and relevance of the final concept.

A key challenge was maintaining a clear overview of the full scope of adaptivity. I often found myself shifting focus between emerging insights, making it difficult to stay centred on a single problem. Structuring the concept into distinct features with clear functions helped me manage this complexity and maintain direction throughout the project.

The project was well received by Volkswagen, with the Head of UX/UI, as well as Eduardo and Hyunmin, highlighting the relevance of the guidelines for the further development of personalisation features.

In the end, I am grateful for the opportunity I had at Volkswagen. I am proud of what I achieved and, perhaps even more importantly, of the people I met along the way.

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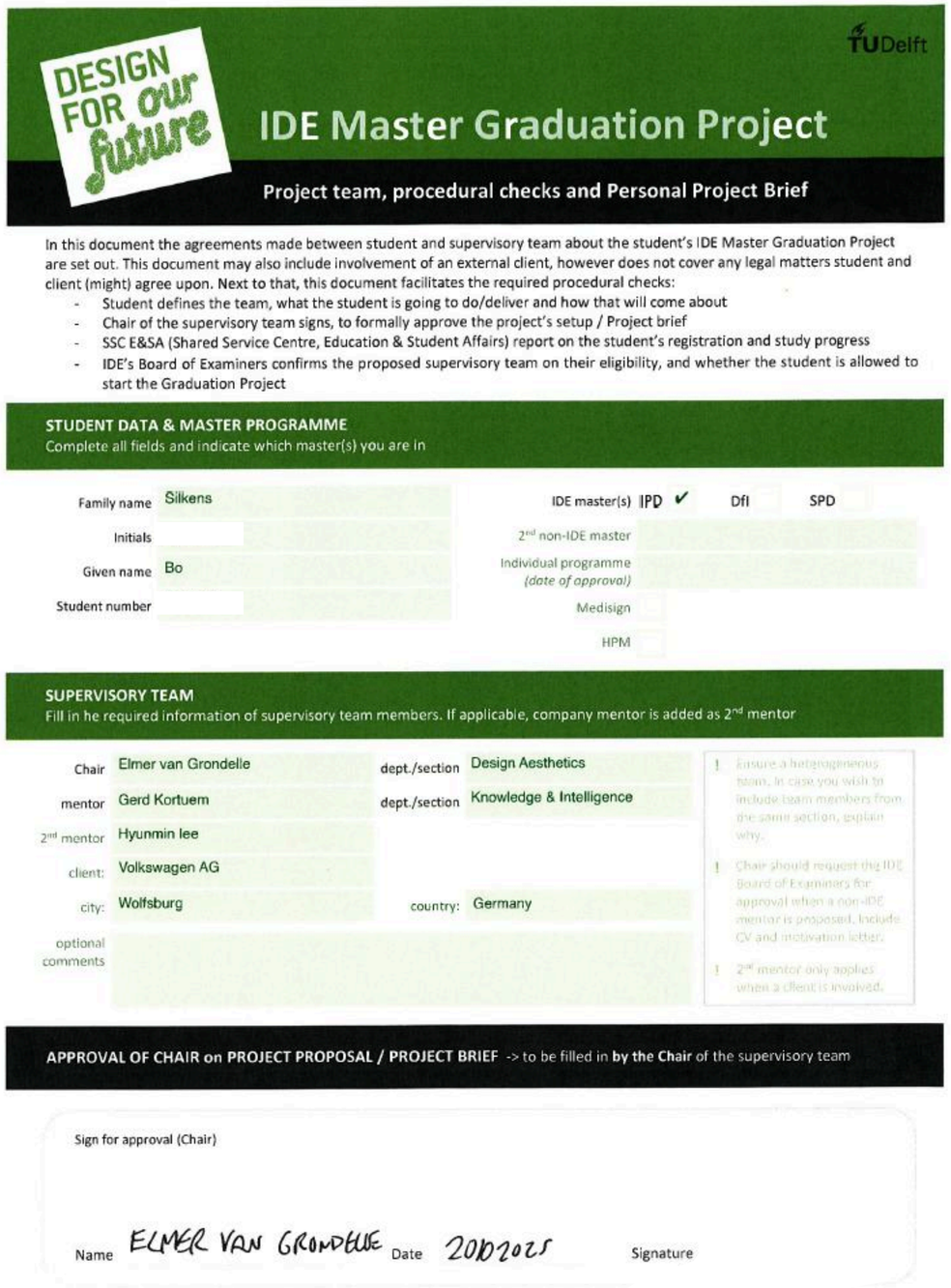
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Appendices

Appendix A: Project Brief



DESIGN FOR our future

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

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

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Silkens	IDE master(s)	IPD ✔ Dfl SPD
Initials		2nd non-IDE master	
Given name	Bo	Individual programme (date of approval)	
Student number		Medisign	
		HPM	

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Elmer van Grondelle	dept./section	Design Aesthetics
mentor	Gerd Kortuem	dept./section	Knowledge & Intelligence
2nd mentor	Hyunmin lee		
client:	Volkswagen AG		
city:	Wolfsburg	country:	Germany
optional comments			

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

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Name ELMER VAN GRONDELLE Date 20/02/25 Signature

CHECK ON STUDY PROGRESS

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

Master electives no. of EC accumulated in total	EC
Of which, taking conditional requirements into account, can be part of the exam programme	EC

	YES	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Name Date Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES		Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

	ALLOWED to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Name Date Signature

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Bo Silkens **Student number** 5103215

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing the user experience for personalised routine journeys in Volkswagen cars

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

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Project domain & context
This thesis project will focus on designing a UI (User Interface) prototype and guidelines for personalised and adaptive routine journeys in Volkswagen cars. The thesis will be carried out in the UX/UI (User Experience/User Interface) team at the Volkswagen Design department in Wolfsburg.

Main stakeholders and interests
- Volkswagen (Main stakeholder) is one of the world's largest car manufacturers. My team is responsible for shaping new UI concepts and immerging in-car interactions. This thesis will contribute by exploring adaptive concepts that fit the needs of future Volkswagen users.
- TU Delft: Within the Integrated Product Design (IPD) master, TU Delft emphasizes and values human-centered approaches, structured methodologies, and critical reflection. By combining this academic rigor with Volkswagen's industry perspective and my personal creative skills, the project can generate outcomes that are practical, user-friendly and forward-looking.
- Myself as a stakeholder: My aim is to develop strong skills in UX design and digital prototyping (Figma/ ProtoPie), while delivering results that hold both academic and professional relevance. This supports my ambition to build a career in automotive (UX) design after graduation.

Limitations & Opportunities
- Because the focus will lay on digital interactions, limited physical prototyping can be seen as a limitation. However, there will be a seating buck available for immersive user testing and evaluation including touchpoints beyond just digital prototypes.
- The fact that there has only been limited deployment of AI-human interaction systems in this domain, make interaction concepts and guidelines valuable for the automotive industry.

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introduction (continued): space for images



image / figure 1



image / figure 2

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

The introduction of AI in the automotive UX design domain allows for endless new ways of analyzing, generating, personalizing, and provinding information to fit the user needs. This raises an industry-wide question how AI developments can be utilized to shape and optimize the user experience (of routine journeys).
At the same time, user requirements are shifting continuesly. Individual perspectives towards (AI-driven) assitive and automated systems seem to be increasingly diverse. These different perspectives causes a real challenge, also in the context of personalisation, such as routine journeys. How to design to satisfy ALL users?
The real problem emerges when looking at Volkswagen's current UX direction, where user interfaces seem to be designed for extreme users with a technology-seeking mindset. What if you don't want continues personalisation, automation and assitance while driving the car?
Next to this, there currently seems to be limited research into the question "what happens when?" conserning the various contexts and combinations of data inputs that generate a specific routine journey.
I think it would be valuable for Volkswagen, TU Delft, and myself to provide reasoning, structure, and automation-depth variety, in terms of personalisation interactions with routine journeys in Volkswagen cars.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design a UX prototype to improve the experience of personalized routine journeys for diverse users of Volkswagen cars.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

Project approach
I believe it would be valuable to apply Vision in Product Design (ViP) in the unusual digital context of UI design, since the foundation for further conceptualisation and development (the statement, the interaction vision and the product vision) seem ideal for designing the final holistic user experience, including the adaptive UI and interaction guidelines.
What I suggest could be equally valuable, is to supplement and combine this comprehensive method (ViP) with other UI design-specific methods (such as architecture flowcharts, personas, user journeys, competitor analysis, co-creation, A/B testing, usability testing) as well as more conventional methods (such as literature research and expert interviews), as they can both complement specific steps of ViP's (de)construction phases.

Building on ViP, I aim to complete two design cycles so that there is room for two rounds of user testing with the seating buck, thereby increasing the quality and value of my final deliverables for all stakeholders involved.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting, green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	13 Oct 2025
Mid-term evaluation	5 Dec 2025
Green light meeting	13 feb 2026
Graduation ceremony	27 Mar 2026

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

The main reason for me to start this project with Volkswagen is my personal ambition to continue working in the automotive (UX) design field after graduation. This is something I have been dreaming of and working towards since I was young. I strategically worked towards this moment, developing my creative & artistic skills in the automotive design domain by selecting relevant elective courses and going for an exchange to Coventry university.

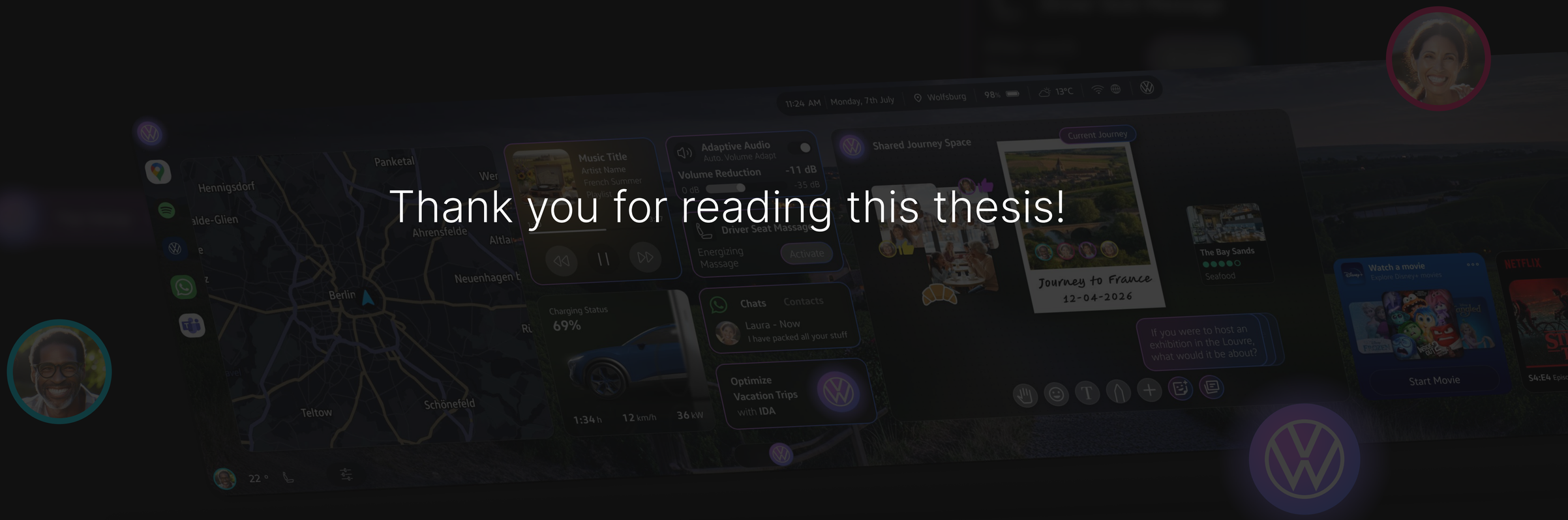
Competencies I want to prove:
- Utilizing social skills to actively contribute to and collaborate with the team in this professional working environment.
- Creative & artistic skills in the automotive design domain.

Competencies I want to develop:
- Using, combining and adapting (parts of) design methods to create an approach that is new, logical, clear and suits the context of a project. All while maintaining clarity in the project management.
- Learn how to utilize a seating buck setup and generative AI for effective iterative user testing.

Personal learning ambitions:
- Getting fimiliar with new UI prototyping tools like ProtoPie and AI integration to develop a high-fidelity prototype.

Academic knowledge:
- Setting up guidelines for transparency regarding personal data used in AI automations, suggestions, and image

Thank you for reading this thesis!



AI Meets UX: Shaping the User Experience for Personalised Routine Journeys in Volkswagen Cars

Bo Silkens, 2026