FORD MOTOR COMPANY & TU DELFT | CLÉMENT HEINEN

Creating liveable cities by democratising streets

A dialogic approach towards data sharing in autonomous parking ecosystems.

Figure 2.1 - A crossing in Shenzhen captured during field observations, the city was built around the modern car as it grew from 75.000 people in 1958 to more than 12,5 million people in 2019 (page 29)

“For generations, the automotive industry is largely focussed on that object, on only that part of the equation. But we know that won’t work when it comes to the new Smart Mobility. We need to take this broader system view.”

Hackett (2018) - CEO | Ford Motor Company

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PREFACE

Ford democratised mobility in the early 1900s by providing the freedom to move for a broad audience. Once again, we are on the verge of a mobility revolution, the industry is being transformed by autonomous drive, connectivity and electrification. Novel mobility product-services could change the way we spend our time, allocate urban areas and shape communities.

Looking back at how people envisioned today back in 1970, you might notice the dominant presence of cars and road infrastructure. Cities evolved around the car and people started to realize this might not be the cities they want to live in. At present, an European wide trend could be recognized of cities that are aiming to decrease the number of cars in cities and reclaim streets for people.

In the past five months I explored this shifting mobility and urban landscape by collaborating with Ford, observing metropoles across the globe and speaking with a wide range of industry experts. This report summarizes the main learnings and delivers a proposal that enables Ford to 'democratise streets' by dialogue for improved liveability and explores opportunities in the servitization of their business.

I would like to express my gratitude to Ford and the supervisory team for their strong commitment and their guidance throughout the project: they served as insightful resources of expertise, inspirations and enthusiasm and thereby they made the project a great finalization of my time in Delft.

Many thanks,

Clément Heinen

Figure 5.1 - Ford Greenfield Labs in San Francisco Bay Area was visited as part of the project. Additionally, obversations and interviews with industry experts were conducted.

INDEX

Reading guide

The report is split in part A-F, additional resources can be found in the Appendix and via the QR code. The left side bar of each page includes methods and references.

EXECUTIVE SUMMARY

A. Context

Introduction to the project assignment and the societal and business relevance for Ford. Elaboration on the project framework, methodologies and perspectives (interviews & field observations).

B. Analysis

Analysis of the conducted field and desk research as well as the expert interviews. Providing answers to the main research questions about liveability, urban mobility and the role of Ford.

C. Synthesis

Bringing the key insights of the understanding phase together and selection of the search fields. Concluding the framework for the product development phase.

D. Design

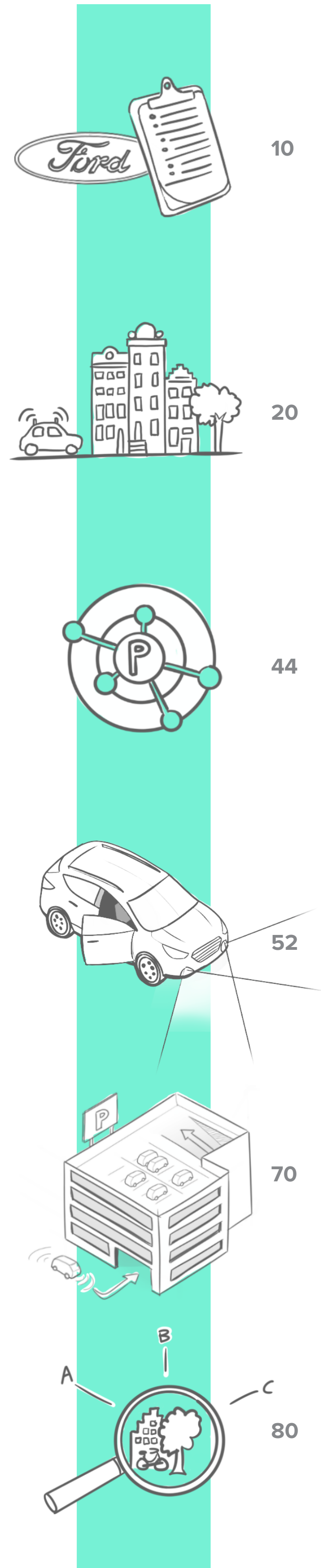
Connecting the ideation- and conceptualization outcomes and the rationale of the decision making of the “parking and intermodal travel” concept direction by the design thinking & creative sessions.

E. Proposal

Presents the final concept proposal by elaborating the system levels like functionality, data and experience. High-level overview of the product service and a validation of the maquette.

F. Conclusion

General conclusion and discussion of the overall project, reflecting on the research findings and concept proposal. Provides recommendations for next steps of the project.



ABBREVIATIONS

OEM	Original Equipment Manufacturer
AV	Autonomous Vehicle
AD	Autonomous Drive
L1-5	Level 1 -5 of AD
IoT	Internet of Things
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything
MaaS	Mobility as a Service
URP	University Research Program
B2B	Business to Business
B2C	Business to Consumer
R&D	Research and Development

GLOSSARY

Liveability	The degree to which an area is considered suitable for people to live in, this will be explained in depth on page 15.
Active modes	Modes of transportation where physical effort is required from the passenger like cycling, walking or running.
Micromobility	Transport category of vehicles, often electric-powered, that are smaller than cars: think of scooters, steps and electric bikes.
Car free area	Car-free area refers to an urban area that relies primarily on active modes or public transport, often with the aim of increasing liveability in the city.
Car- & ride sharing and hailing	Car sharing refers to multiple people sharing the same car on different moments. Ridesharing refers to organized carpooling. Hailing refers to services like Uber where a chauffeur is involved.
Mobility as a Service	Mobility-as-a-Service is the emerging counterpart of vehicle ownership, think of ridesharing services like Uber or Snappcar and the public transport.
Autonomous Vehicle	An autonomous vehicle is able to guide itself by means of computer vision, there are various degrees of the extent to which humans should be engaged.

PART A
CONTEXT

Figure 10.1 - Image courtesy of Ford Motor Company.

This part introduces the project assignment, approach and the research context. It elaborates the following questions:

- What is the ‘raison d’être’ of the project direction, what makes this relevant for Ford, specifically the European market?

- How does this project align with the University Research Program, what are the project objectives and deliverables?

- How is the project approached, what are the key methods and tools that were used across the phases.

> **“The meta-data from AV’s could be hugely beneficial for municipalities and third parties.”**
>
> Renee Shah - Emerging Products @ Google, Waymo

ASSIGNMENT

This project is a collaborative effort with Ford, who democratized mobility by initiating the car revolution early 1900s[1] by creating the first mass produced cars. The project explores the shifting mobility landscape and aims to deliver a proposal to improve liveability in future cities in Europe.

Raison d'être

The industry is being transformed by autonomous drive, connectivity and electrification[2]. Novel mobility product-services are changing the way we spend our time, allocate urban areas and shape communities. This project is a collaborative effort with Ford, who democratized mobility by initiating the car revolution early 1900s by creating the first mass produced cars. The project explores the shifting mobility landscape and aims to deliver a proposal to improve liveability in future cities in Europe. Additionally, the project's aim is to explore design methodologies for a future context to generate user and market insights and translate them into a product-service concept which allows Ford to *sense and seize*[3] on future European urban areas. This project is part of a larger collaboration between Ford and TU Delft IDE called University Research Project (more on page 14).

Problem definition

Projections show that *urbanization*[4] will increase rapidly in coming decennia, the growth of the world population in combination with people shifting from rural areas to urban areas will create fundamental logistical and societal challenges to urban areas. Cities will become increasingly complex and chaotic; however, we also see technologies emerge that could propose an answer by making our cities smarter.

The ambition of Ford is to provide 'mobility for a better world'[5]. Still the problem remains whether and how autonomous and connected vehicles could lead to thriving, liveable cities. While it might be easy to imagine the benefits of autonomous drive and smarter cities, it could also create threats like e.g. social isolation, privacy concerns and citizens feeling overcontrolled. How may a large mobility provider like Ford respond to these issues that can potentially impact the world on a similar scale as the early days of Ford? Ford aims to extend their understanding of sensing and seizing methods for future product-services. This project will address this aim by exploring and applying design methods that enable to anticipate on 'far' future time scopes, in this case 2030. Additionally, most of the R&D by Ford on future product-service concepts is focussed on the US market. This leaves a knowledge gap around the specific needs of the European market considering e.g. cultural, urban and economic differences.

Assignment

The project focusses on urban mobility scenario's in 2030-2035 synthesized from the research outcomes. The aim of the concept is to improve liveability in European urban areas by creating exceptional user experiences and humanizing* autonomous drive. The concept should support the mission of Ford and propose an answer to possible threats of emerging technologies. Part of the assignment is to explore and apply effective design methodologies for the future scope and gain understanding of the European market in relation to Ford's other markets in Asia and the US.

Outcome

The report includes a reflection on the applied methods for future product-services and includes a comprehensive overview of analysis outcomes from interviews, observations and desk research. This was the fundament for the concept proposal that demonstrates the user experience elements, required technology and the back-end stakeholder relations and enables dialogue on these topics.

[1] Ford history, based on multiple sources: conversations with the Company Supervisor N. Eikelenberg, Britannica (2019). Ford History. From: https://www.britannica.com/topic/Ford-Motor-Company
Ford (2019). Ford History. From: https://corporate.ford.com/history.html

[2] Gartner Mobility Cycle Autonomous and Smart Mobility (2018). Figure 13.1. From: https://www.forbes.com/sites/enroute/2018/08/14/autonomous-vehicles-fall-into-the-trough-of-disillusionment-but-thats-good/

[3] Berkeley (2019) - Sensing describes the assessment of the opportunities and consumer needs existing outside of the organization. Seizing refers to an organization's reaction to market needs to increase firm value. - https://cmr.berkeley.edu/blog/2016/8/dynamic-capabilities/

[4] Eolss (2019). By definition, urbanization refers to the process by which rural areas become urbanized as a result of economic development and industrialization. Demographically, the term urbanization denotes the redistribution of populations from rural to urban settlements over time. - http://www.eolss.net/sample-chapters/c04/e6-147-18.pdf

[5] Ford (2018). We are changing the way the world moves to make people's lives better. From: https://corporate.ford.com/microsites/sustainability-report-2018-19/assets/files/sr17-sr15.pdf

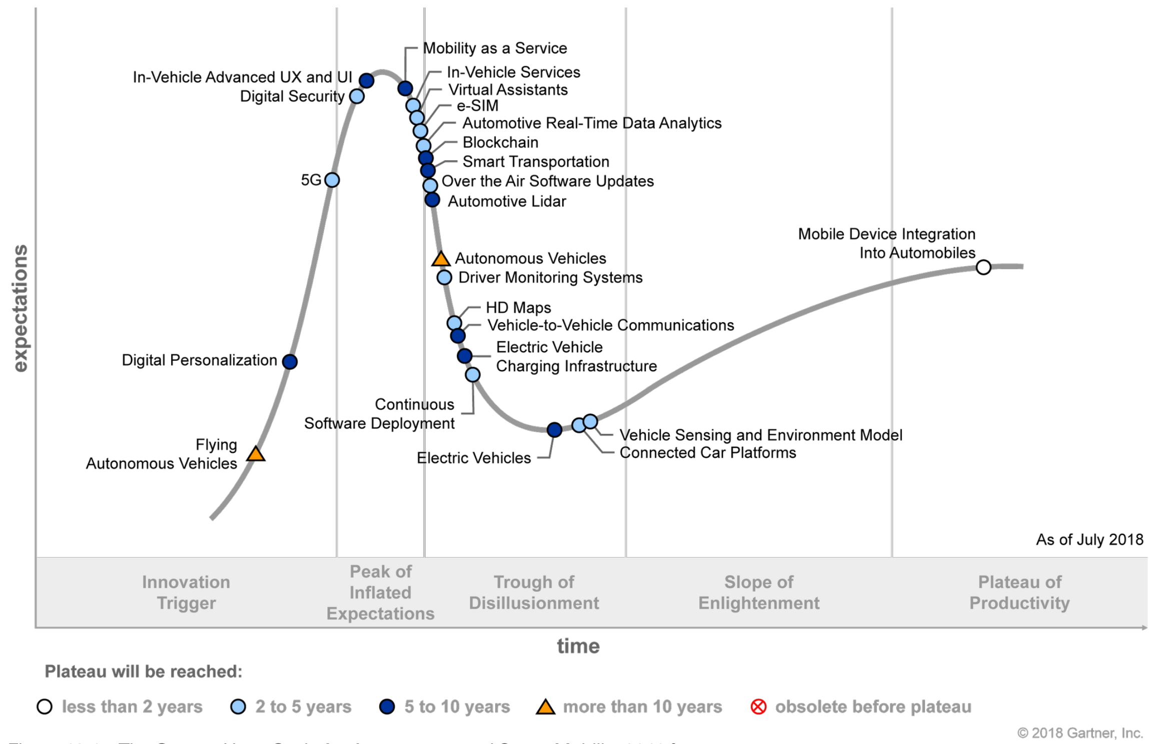


Figure 13.1 - The Gartner Hype Cycle for Autonomous and Smart Mobility 2018.[2]

o The concept should provide Ford with a tangible vision for 2030-35 that is easy to share internally to align the different departments and enable dialogue on the various layers (data, technology, experience).

o The report forms a stepping stone for further concept development by reflecting on the use of sensing and seizing methods around future contexts.

o The result should extend the understanding of the European market. The report will reflect upon differences and similarities across global markets with the aim of generating European specific insights (field research in the US and Asia is conducted to serve as benchmark).

o The commercial interest of Ford in the project is considered by reflecting on viability, feasibility and desirability during the design process.

Figure 13.2 - The influence of car traffic in urban environments can have significant effect on the spatial quality. Amsterdam is creating policy and redesigning streets to decrease the amount of cars in the city center. (Image by Koen van Weel, ANP)

FORD MOTOR COMPANY

The project is part of the University Research Program, a collaboration between Ford Motor Company and IDE, Delft University of Technology with the aim of sensing deep customer insights, and seizing creative opportunities for new mobility services.

History in a nutshell

In 1903 Henry Ford founded Ford Motor Company in Michigan with the mission of democratizing mobility by making the car affordable for a wider target group.[1] Henry Ford aimed to reach this mission by heavily investing in the innovation of the moving assembly line in order to reduce the manufacturing time and complexity and increasing the worker's wage. In 1908 the Ford Model T was introduced and is considered as the first affordable mass-produced car that enabled car travel for the middle-class.

Henry Ford considered affordable cars as an important attributor of the quality of life by providing freedom of movement and enabling improved access to healthcare, education and jobs. The production of the Model T ended in 1927 after more than 15 million cars were built. Ford continued consolidating a key market position in the industry following their mission. Currently, Ford is one of the largest automotive OEM's worldwide. In 2017 Ford had 202.000 employees in the factories across the US and Europe[2].

Belief and aspiration

The aim of democratizing mobility stills comes forward in their belief: *"Freedom of movement drives human progress[4]."* which does not only imply affordable mobility, but also seeks to empower inclusiveness from a broader view by providing mobility solutions for minorities in society.

The aspiration is formulated as: *"To become the world's most trusted company, designing smart vehicles for a smart world"[4]*. It is in 2018 when Jim Hackett, the current CEO of Ford Motor Company said: *"For generations, the automotive industry is largely focussed on that object, on only that part of the equation. But we know that won't work when it comes to the new Smart Mobility. We need to take this broader system view."*

It reflects the shifting focus of Ford towards servitization of mobility, in parallel to private vehicle ownership, as they strive to intensify collaboration with diverse stakeholders in the ecosystem of municipalities and other mobility providers.

URP | Service Innovation for Mobility

The Ford Research & Innovation Center in Aachen and IDE, TU Delft have joined their forces in the URP, University Research Program. The title of the collaboration is formulated as: *"Service Innovation for Mobility: Sensing deep customer insights, and seizing creative opportunities for new mobility services"[3]*.

In a time where connected, digital and autonomous technologies are changing the way the world moves, it is crucial for Ford to understand the new requirements and needs this paradigm shift will bring along. The URP explores novel design methodologies and exploratory prototyping for future products and services.

Greenfield Labs & Living Streets Project

Within this thesis alignment has been found with the Design Principles from the Living Streets Project[5] by Ford Greenfield Labs in Palo Alto. Greenfield Labs was created by Ford in collaboration with IDEO.

The studio created the "Living Streets Project" in collaboration with Gehl Studio, an urban design agency founded by Jan Gehl, and formulates design principles for liveable streets.

[1]Ford history, based on multiple sources a.o. conversations with the Company Supervisor N. Eikelenberg, Britannica (2019). Ford history. From: https://www.britannica.com/topic/Ford-Motor-Company
Ford (2019). Ford history. From: https://corporate.ford.com/history.html

[2]Ford (2017) Europe Fact Sheet. From: http://www.fordmedia.eu/wp-content/uploads/2017/07/Ford-of-Europe-Fact-Sheet-July_2017.pdf

[3]As described in the URP Project Application Ford & TU Delft: URP Proposal TUDelft_AG August 2016

[4]Ford (2019). Company Info. From: https://corporate.ford.com/company.html (2019)

[4]Greenfieldlabs by Ford Motor Company. From: http://greenfieldlabs.com/

[5]Living Streets Project (2018). By Greenfieldlabs and Gehl Studio. From: https://www.ourlivingstreets.com/

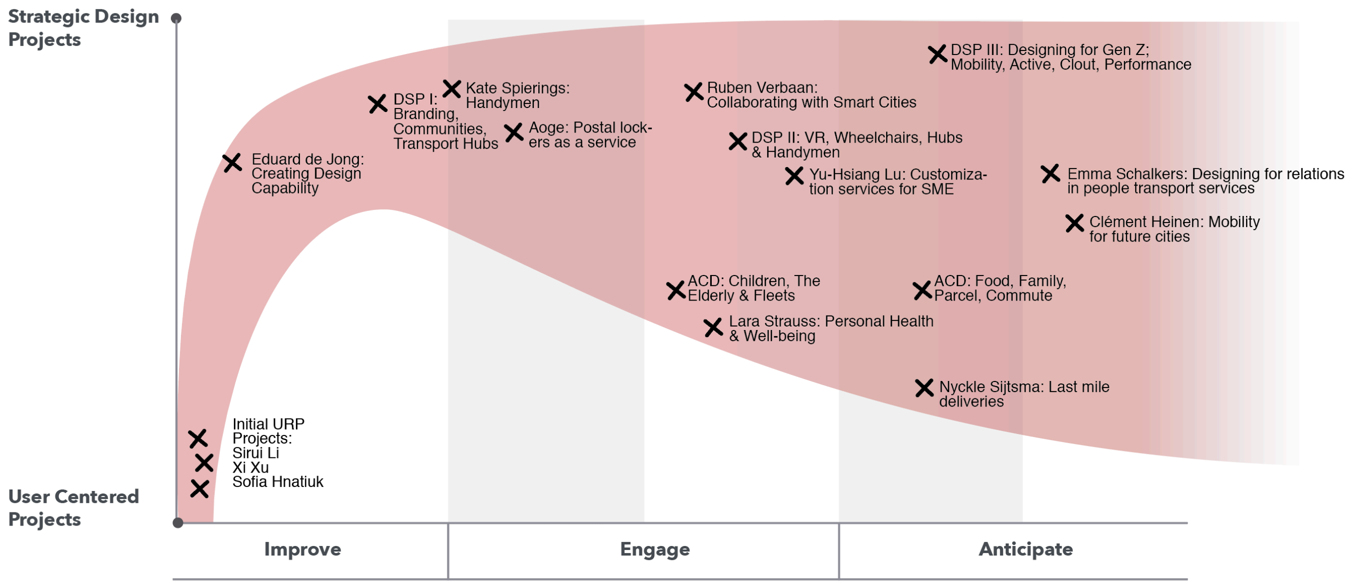
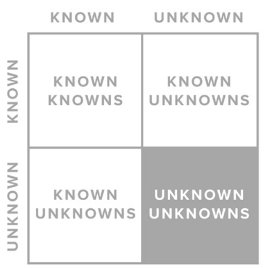


Figure 15.1 - Elephant model of URP graduation projects, showing the positioning of this project in the 'Anticipate' phase of the collaboration between TU Delft IDE and Ford Innovation Center in Aachen (scheme created by N. Sturkenboom).

Figure 15.2 - Ford Research and Innovation Center in Aachen, Germany.

APPROACH

This graduation project had a predefined time span of five full-time months, the challenge for the designer is to find a structure that empowers the chance of delivering a viable, feasible and desirable outcome. The URP is, at the moment of writing, focussed on concepts in the 'unknown-unknown'[1] area. In this part the structure and methodologies are described that have been used to guide and shape the results.



Key methodologies

The project followed three main phases which are defined as the *Analysis, Synthesis* and *Design* phases. During the Analysis phase research was conducted around the mobility, city, people and company context. This was followed by the synthesis phase were collaboratively with Ford the vision, mission and opportunity fields were formulated. The synthesis outcome formed the fundament for the ideation and conceptualization phase, were a final concept was defined by diverging and converging iterations. Project updates were generally provided in (bi)weekly meetings with the supervisory team and blog updates were published every 3-4 weeks (10 blogs in total). The following publications and methodologies have been of key importance during the project:

Urban observations by camera

Observations in various urban environments (The Netherlands, France, China, The United States and Japan) were conducted to gain deeper understanding in human behaviour, policy implementations, technology use and liveability. During the observations the findings were captured on camera. The materials served as discussion tools during creative sessions, expert interviews and team meetups. The observations are documented in the blogs (Appendix A).

Expert Interviews

People from selected fields of expertise have been interviewed to gather qualitative insights. The interviews have been conducted in a semi-structured format to remain open for unexpected topics that might be of interest. The selection of interviewees was based on search fields and the corresponding research questions to cover the knowledge gaps, the complete list can be found on page 21 (and insights in blogs, Appendix A).

Future Scenario Planning & Design Fiction[2]

As the project focusses on the context of 2030-2035, some tools inspired and supported in creating ideas that were relevant to the future context and served as reference for setting up creative sessions.

Transition Design

Transition design is an emergent discipline that describes how to design within radically new socio-economic and political paradigms[3]. The shift to off-street parking encompasses a behavioural change over a longer period of time, the more classical behavioural models of Fogg (2009)[4] or Ölander and Thøgersen (1995)[5] would be too limited for this intention. This theory was introduced relatively late in the project during the design phase, but still served as an important framework for the concept development and outcome (it was one of the major drivers for creating a dialogue tool).

Diverse Design Tools

The Delft Design Guide[6] offers a variety of tools for designers to generate insights and ideas. A selection of tools was applied during the project. Especially during the idea and concept generation the more practical methodologies like brainwriting and functional analyses were used. The Business Model Kit[7] from the Board of Innovation supported in mapping stakeholder relations and value exchanges.

[1]In February 2002, Donald Rumsfeld, the then US Secretary of State for Defence, stated at a Defence Department briefing: *'There are known knowns. There are things we know that we know. There are known unknowns. That is to say, there are things that we now know we don't know. But there are also unknown unknowns. There are things we do not know we don't know.'* From: https://academic.oup.com/jxb/article/60/3/712/453685

[2] Paul Coulton (2017). Design Fiction as World Building. From: https://www.researchgate.net/publication/315697467_Design_Fiction_as_World_Building

Albert-de-la-Bruhèze and Eggink (2015). Design Storytelling with Future Scenario Planning. From: https://ris.utwente.nl/ws/portalfiles/portal/5527773/150611_DesignStorytelling_Cumulus2015_Eggink%26AlbertdelaBruheze.pdf

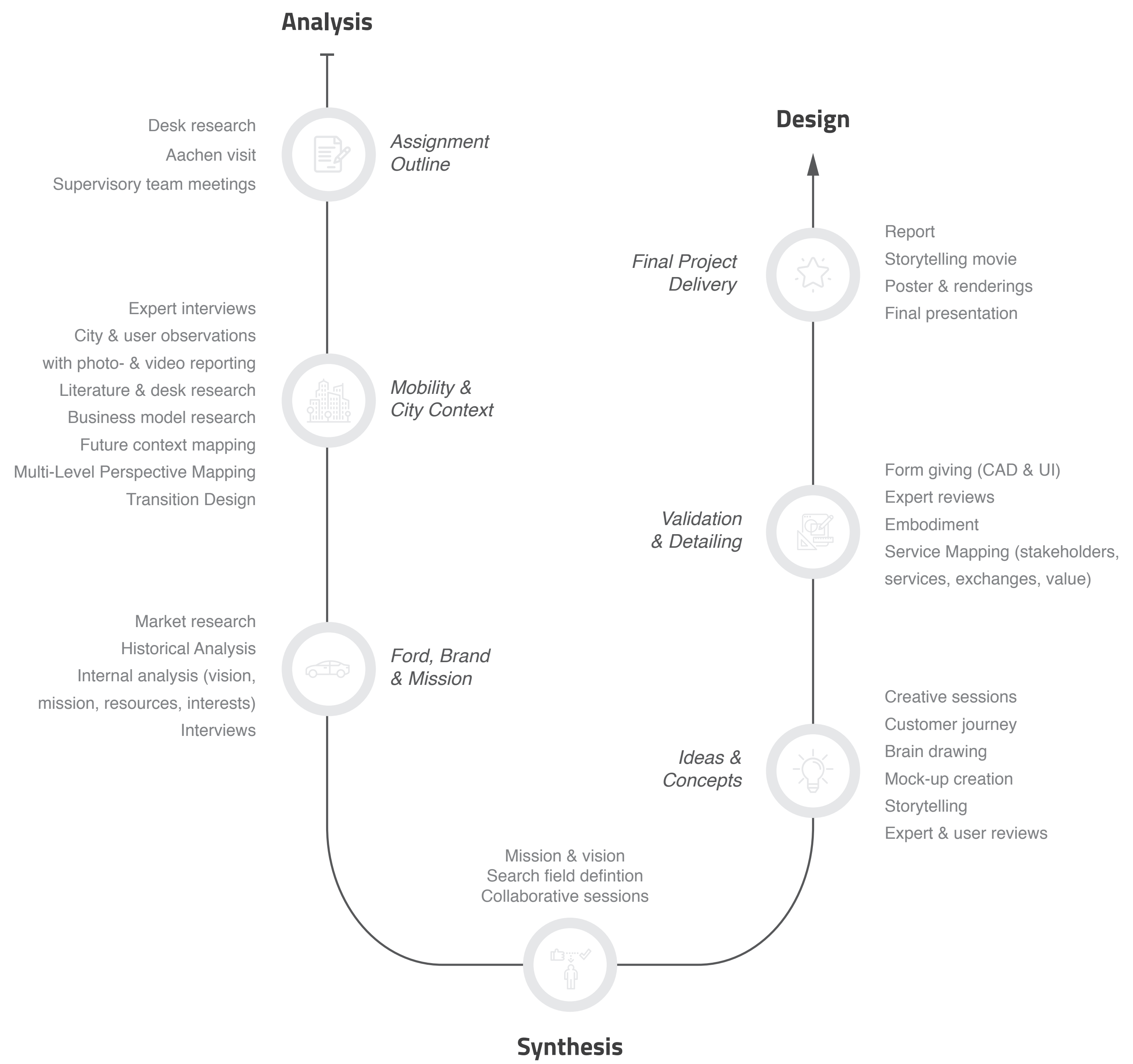
[3]R. Price (2019). In Pursuit of Design-led Transitions. (and a conversation with Prof. R. Price, TU Delft.)

[4]Fogg (2009) A Behavior Model for Persuasive Design. From: https://www.mebook.se/images/page_file/38/Fogg%20Behavior%20Model.pdf

[5]Ölander and Thøgersen (1995) Understanding of Consumer Behaviour as a Prerequisite for Environmental Protection. From: https://link.springer.com/content/pdf/10.1007%2FBF01024160.pdf

[6]Boeijen, Annemiek van, Jaap Daalhuizen, J. Zijlstra, and Roos van der Schoor. (2014) Delft Design Guide: Design Methods.

[7]Board of Innovation, Business Model Kit (2019) From: https://www.boardofinnovation.com/tools/business-model-kit/



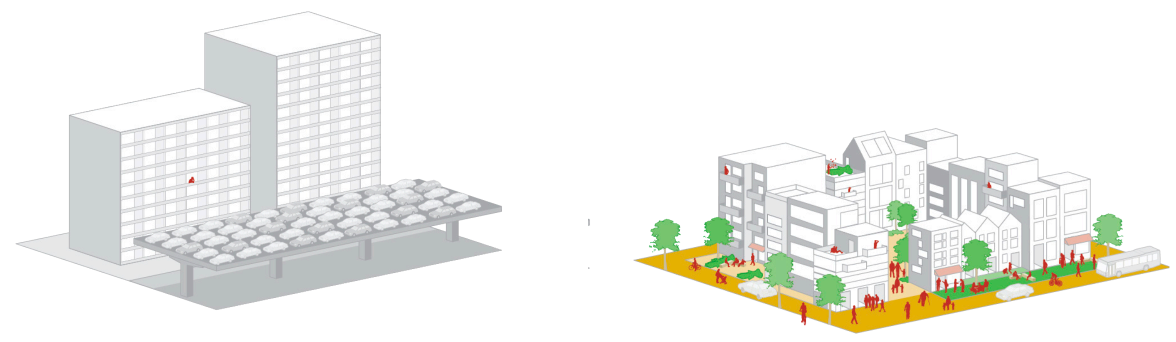


Figure 17.1: A transition towards liveable cities from the left to the right. Illustration by Greenfield Labs and Gehl studio from the Living Street Principle project. Source: https://www.ourlivingstreets.com/good-streets

PART B
ANALYSIS

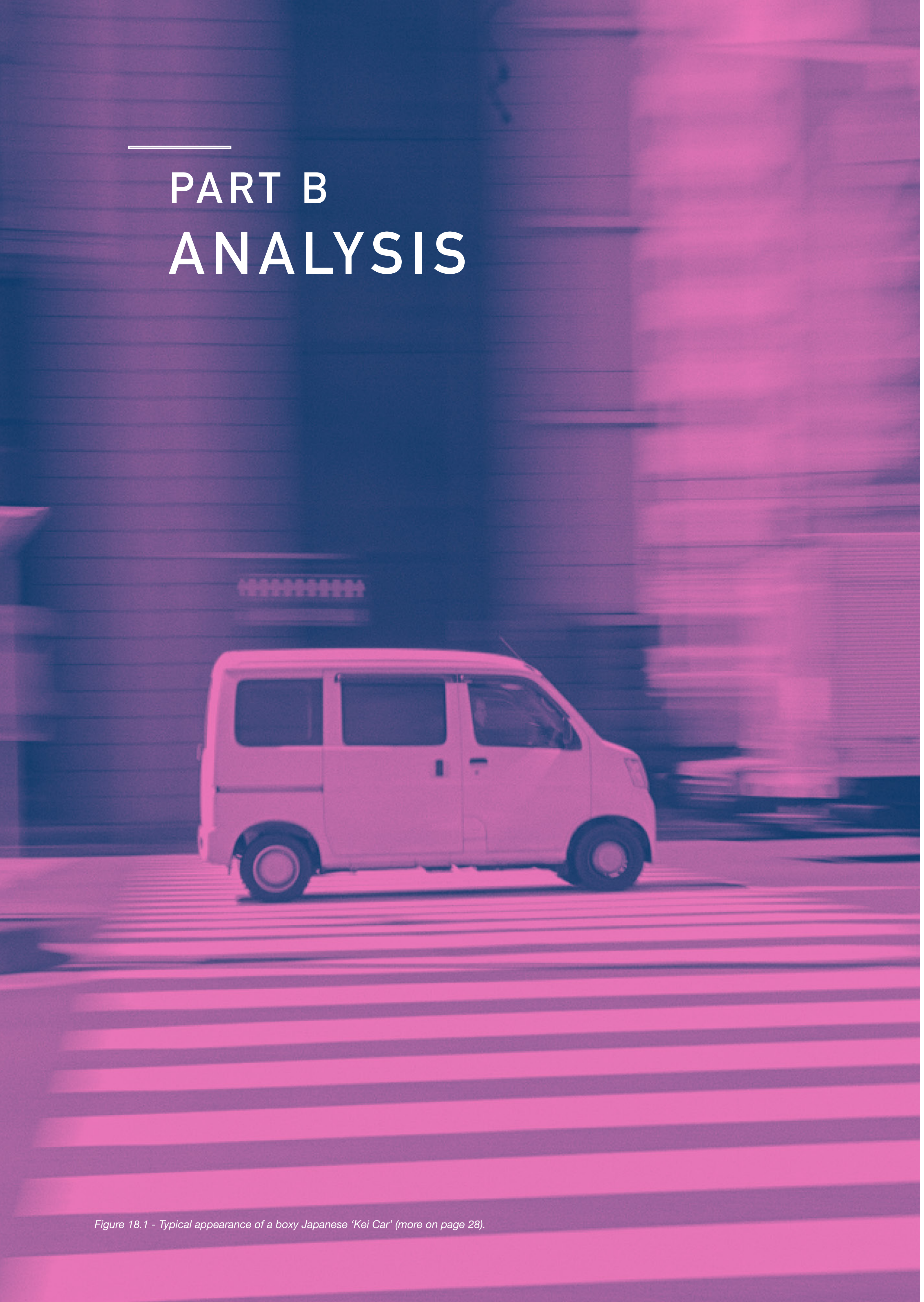


Figure 18.1 - Typical appearance of a boxy Japanese ‘Kei Car’ (more on page 28).

Part B encompasses the learnings of the analysis phase and strives to provide answers on the following key questions:

- How could we define and approach ‘*liveability*’ in the urban mobility context?

- How might the paradigm shift of autonomous, connected and electrified mobility shape our cities?

- What identifies the European market and cities and how is it evolving towards 2030-35?

To answer these questions, diverse sources have been consulted, from experts to leading publications to own observations.

> **“There is a lot to improve in the field of parking data, it could help us in smarter allocation of vehicles across parking spots. By aligning parking data we could create efficiencies beneficial for both drivers as parking lot operators.”**

Maarten Jagtenberg (2019) - MT @ Parkeerservice

Expert interviews

The urban mobility landscape is a rapidly emerging market with novel products and services being introduced on the market on a daily basis[1]. Both the industry as the government are exploring how it might shape cities and what their role will be. Some of the research questions and assumptions remain unanswered in the literature and online resources, key technologies like AD and IoT platforms find themselves in the *innovation trigger phase* of the *Gartner Hype Cycle*[2] and therefore lack best practices and policy.

Therefore, a total of 28 qualitative interviews (next to several more informal conversations) were conducted with experts, stakeholders and researchers around the urban mobility and liveability theme. The aim was to explore the challenges, interests and forecasts on the 2030-35 context. It also supported in gaining understanding of stakeholders relations and market dynamics.

The backgrounds of the experts were rather diverse: public transport operators, government officials, engineers working on AD and entrepreneurs in the shared mobility space. The interview insights can be found throughout the blogs in appendix A.

The interviews were semi-structured to provide the interviewees some space to expand their answers and it allowed additional topics that might not be formulated in the interview protocols. Example interview protocols can be found in appendix B.

[1]McKinsey (2015) Urban mobility at a tipping point. From: https://www.mckinsey.com/business-functions/sustainability/our-insights/urban-mobility-at-a-tipping-point

[2]Gartner (2019) Hype Cycle. From: https://www.gartner.com/en/research/methodologies/gartner-hype-cycle

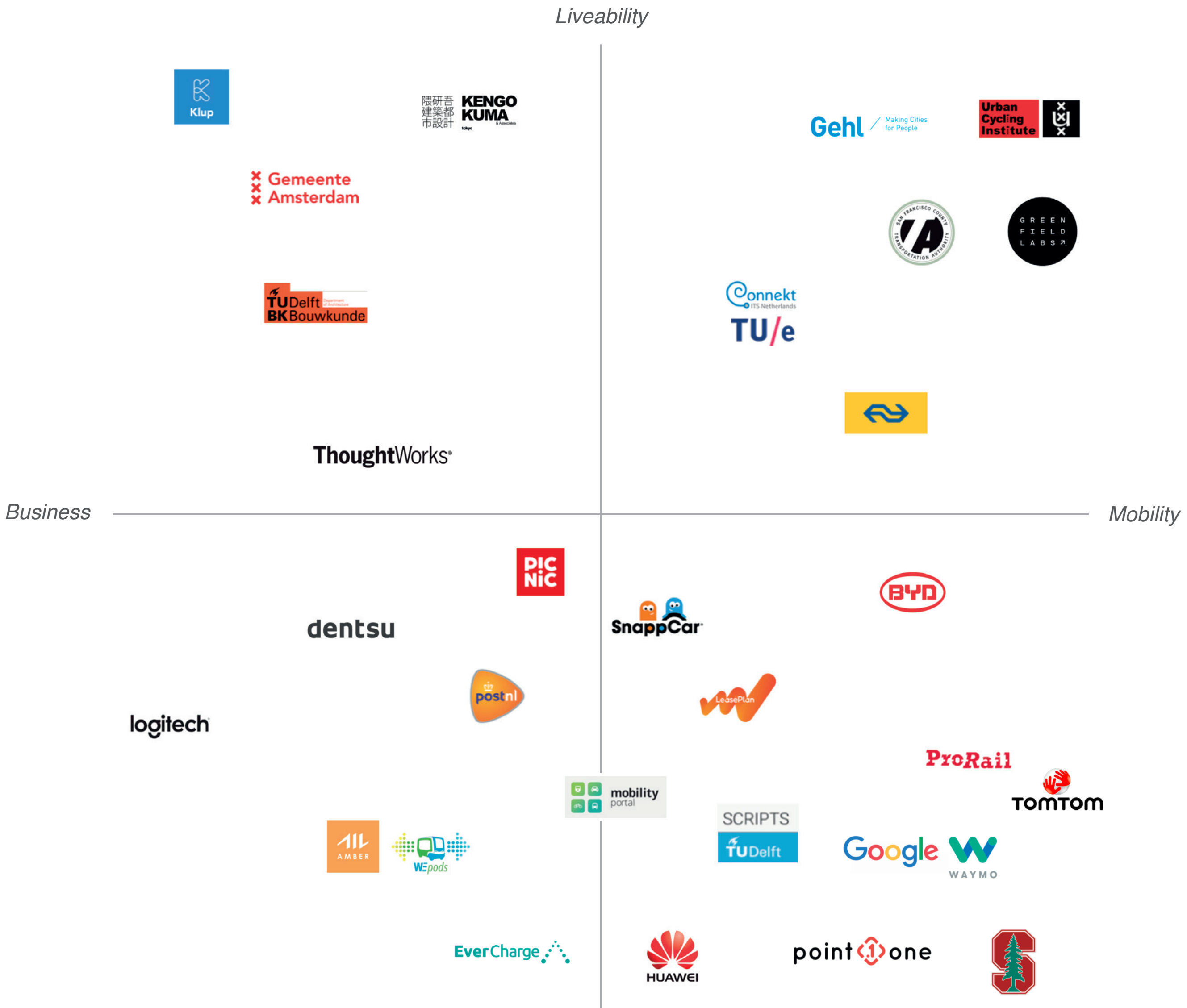


Figure 20.1 - The matrix indicates the main fields of interest that were discussed during the expert interviews.

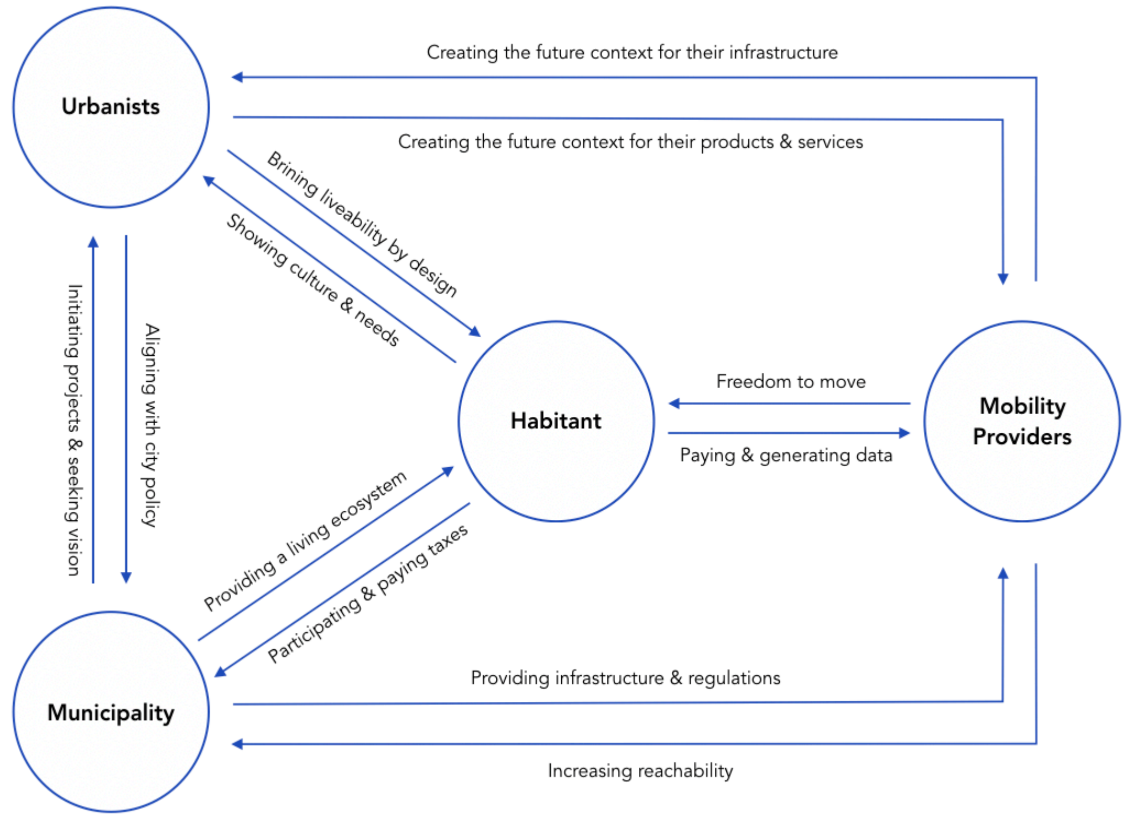


Figure 21.1 - Simplified stakeholder relations based on the interviews and desk research, focussed on the urban mobility context.

Company	Contact person	Position	Interview / Conversation Topic
Gehl Studio	Anna Muessig	Urban Designer (Living Street Project)	Street design, Liveable Streets Project, Urbanism, US Perspective
University of Amsterdam & Urban Cycling Institute	Prof. Marco te Brömmelstroet	Prof. in Urban Mobility Futures	Liveable cities, Cycling, Dutch urban mobility futures
Google, Waymo	Renee Shah	Business Developer	Autonomous technology, market, meta-data
SF Transportation Authority	Warren Logan	Sr. Transportation Planner	San Francisco mobility policy, innovation, liveability
NS, Dutch Railways	Edwin Boer	Strategy & Innovation	Future of rail, intermodal transport, user travel preferences
Connekt, TU Eindhoven	Carlo van de Weijer	Director Smart Mobility TU Eindhoven (& ITS EU, SingularityU, AutomotiveNL)	Urban mobility, liveability, electric driving, smart mobility.
BYD	Rosa Yueyang	Interior Designer	Vehicle design for the Chinese market, mobility innovations
SnappCar	Pijke Dorresteijn	Corporate Communications & Trust	Car sharing, free-floating, P2P models, mobility futures
LeasePlan Digital	Daan Oostveen	Head of Product	Leasing in the future, user preferences, challenges in the market
ProRail	Thijs Cloosterman	Program Manager New Technologies	Rail of the future, liveability (nuisance), capacity, autonomous trains
Greenfield Labs	Ryan Westrom	Partnership Leads (& Living Streets Project Lead)	Liveable cities, design drivers for Ford, example projects, Liveable Streets Project, mobility in the US.
	Anke Pierik	Design Director	Contrast between US & Dutch mobility, Ford, Greenfieldlabs Projects
Stanford	Vincent Laurense	PhD Autonomous Vehicle Control	Autonomous Technology advances (technical), parking lot context
Point One Navigation	Aaron Nathan	CEO & Founder	Autonomous Technology advances (technical), parking lot context
SCRIPTS (TU Delft)	Jishnu Naraya	PhD Candidate	On-demand and autonomous mobility models, forecasting.
Faculty of Architecture, TU Delft	Leo van den Burg	Urban Fabrics Expert	Urban fabric, urbanism, city liveability, role of urban designers, differences across the globe
	Prof. R. Dijkstra	Professor in Urbanism	Robotaxi & topics above as with Leo van den Burg
Huawei	Mavis Cheung & Huang (Lena) Lei	UX Designers	5G technology for mobility, Chinese mobility culture
Mobility Portal	Jurgen Rutgers	Mobility Portal	MaaS, intermodal travel, user preferences, IT Systems
Picnic	Joris Wolters	New Vehicle Development	New vehicle design, delivery operation, liveability, vehicle charging
PostNL	Jeroen vd Kerkhof	Process Innovation	Delivery operation challenges, micromobility, electric charging.
Amber, WePods	Robert van Hamersveld	Business Development for Amber, WePods, Urban Mobility Systems.	Differences of mobility in the US, smart and autonomous mobility.
Evercharge	Jason Appelbaum	CEO & Founder	Urban EV Charging
Dentsu	Yukiya Yamane	Automotive Consultant	Japanese automotive culture, shared mobility, car-free streets.
Logitech	Fajr Mohammed	Product Manager	UX Design for the Chinese market
Thoughtworks	Lin Zehan	HMI Design / Consultant	Chinese mobility culture, UX Design for the Chinese market
City of Rotterdam	Jeroen Maijers	Director Urban Mobility	Urban mobility future, city policy, liveability
Kengo Kuma	Nicolas Cazali	Senior Designer / Architect	Design for Liveability, Japanese urban design culture & mobility.
Klup	Michiel van den Berg	Co-founder	Social mobility, mobility for wellbeing, liveability.
Tomtom	Louis Debatte-Monroy	Head of Developer & Enterprise Product Marketing	HD Maps, MaaS, data exchanges
TransDev	Jonne van Eck	Corporate Communication	MaaS, data exchanges
Municipality of Amsterdam	Evelien van der Molen	Process Manager 'Agenda Amsterdam Autoluw'	Liveability, car-free zones, parking policy, city stakeholder interests, intermodal transport

Figure 21.2 - Overview of the expert interviews and conversations that were conducted during the project.

MAPPING THE LANDSCAPE

Urban mobility is a complex landscape that is shaped by a mixture of elements like culture, urbanism, policy, technology and industry[1]. For the designer there lies a challenge in getting a feel of the dynamics, needs and requirements of the future context and its transition. Therefore, a selection of stakeholders and environments are chosen to support in the process of gaining understanding.

Urban observations

This project aims to deliver a proposal for the European market, which implies there is a difference with the other markets Ford is active (as described on page 12). The observations provided insights on market differentiations in fields like urban structure, transportation solutions, policy and cultural aspects of liveability and mobility. It was especially interesting to observe how transport modes are used and perceived differently across the world[2].

Think of Uber[2] as one example; a ride hailing service that operates worldwide but has different selling points across the world. In San Francisco, where the service was initiated, people mainly indicated they use the service to reduce time and money compared to traditional taxis. However, in Mexico safety seems a key selling point, since traditional taxis are not registered and are perceived as being unsafe[3]. These differences might ask for a different approach of the design of product-services in specific markets.

Urban observations were conducted in order to gain understanding of the implications of mobility solutions across landscapes, not only by observing European cities (in specific Dutch ones), but by comparing it with external markets.

The method was quite straightforward: striking and characteristic mobility elements were captured using a camera. The visual content served as input for meetings and creative sessions (page 14).

On high-level fundamental differences were found in city structures, the way municipalities allocate space for vehicles, their policy and initiatives, how people act in public spaces and transport and how the industry anticipates their value propositions on specific regions. The observation documentation with the learnings and visual content can be found in Appendix A as part of the blogs.

[1]Elaboration on this complex 'Urban Fabric' can be found on page 26

[2]Blogs and vlogs were made during the project to document the learnings and observations. Appendix A

[3]Personal experience using taxi's in both San Francisco as Mexico City. Online forums where people share their experiences were an additional source of reference.

Flyertalk (2016). Forum discussionamong Uber users. From: https://www.flyertalk.com/forum/mexico/1805939-taxis-uber-other-livery-mexico-city-safe.html

Figure 22.1 - An overview of the cities were observation research was conducted, result can be found in Attachment A or by scanning the QR code on page 23.

Urban Observation

Amsterdam | Hong Kong | Paris | SF Bay Area

Rotterdam | Shenzhen | Osaka | Kyoto | Tokyo

PUBLICATIONS

In addition to the expert interviews and observations, a selection of publications about city liveability and urban design has been studied for this project. The publications contain both personal as analytical views on the urban context. Some publications provides in-depth perspectives on the role of mobility on liveability and reflections on the evolution through the past century.

Donald Appleyard, Livable Streets (1980)[1]

As Professor of Urban Design at the University of California, Donald Appleyard spend his career on advocating for the design of more liveable streets. In 1969 he publicized his research that demonstrated the negative effect heavy traffic has on intra-street social connections[2] (figure 25.1). He compared three streets and found a relation between the traffic amount and the degree of social connections within a street. In 1981 he describes fundamental principles of creating liveable streets in his book “Livable Streets: Protected Neighborhoods?[1]”. Many of his principles seem to align with future city initiatives and policy that Amsterdam is currently creating around *Amsterdam Autoluw*[3] (more info on page 34)

Liveable Streets Principles, Greenfield Labs & Gehl Studio (2018)[4]

The creators of the “Principles for the Living Street of Tomorrow (2018)” have formulated a set of design principles that could serve as touchstones for future street design. They approach liveable streets from three angles: street form, mobility and street stewards. The project was a response against the domination of streets by cars, striving to initiate a new area of urban design by providing design principles.

During the visit to Gehl Studio in San Francisco, the co-creator of this project, Anna Muessig, explained how they conducted practical experiments around these principles together with municipalities in urban areas across the US (blog 8). Three of the design principles had a major role in this project: Good mobility: “provides a variety of real choice”, “delivers access and opportunity” and “promotes sharing with others”. These principles can be recognized in the elements of the envisioned parking ecosystem.

Jane Jacobs, The Death and Life of Great American Cities (1961)[5]

Jane Jacobs is a writer and activist who attacked the modernist movement in urban planning, with key figures as Le Corbusier and Robert Moses. She states that urbanists should not design cities and neighbourhoods with rationalist and modernist philosophy but should approach it by putting emphasis on observation of the existing ecosystem, and move on from there towards a desired environment. She describes the urban context as a complex ecosystem that should be approached from a human scale. In the book she analyses what does make a good city. She proposes neighbourhoods that enforces socioeconomic diversity, architecture and small businesses to make them flourish.

The observational approach of Jacobs has been fundamental in this project. Additionally, her principles for good cities find strong parallels with the Liveable Street Project and the objectives of *Autoluw Amsterdam* to reclaim the streets for people.

Richard Sennett, Building and Dwelling, Ethics for the City (2018)[6]

As sociologist and writer, Richard Sennett elaborates on his lifetime experience on what makes a good cities by reflecting on a variety of cities, influential thinkers and history. He advocates for the idea of ‘open cities’ that allows more experimentation and embraces the complexity. This book helped in providing perspective on ‘liveable cities’ and outline how European cities like Paris, Barcelona and New York have evolved to what they are today.

[1]Appleyard, D (1980). Livable Streets: Protected Neighborhoods?

[2]Appleyard, D (1969). Bristol Analysis From: https://mattturner.blog/revisiting-donald-appleyards-the-environmental-quality-of-city-streets-a-residents-viewpoint-in-21st-century-britain/ (see figure 25.1)

[3]Agenda Amsterdam Autoluw (2019). Amsterdam Autoluw aims to decrease the amount of cars in the city center by policy and street design. From: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/fijne-buurten/autoluw/

[4]Greenfieldlabs & Gehl Studio (2018) Liveable Streets Principles From: https://www.ourlivingstreets.com/
Studio Gehl (2019) Company website: https://gehlpeople.com/

[5]Jacobs, J. (1961). The death and life of great American cities. From: https://www.buurtwijs.nl/sites/default/files/buurtwijs/bestanden/jane_jacobs_the_death_and_life_of_great_american.pdf

[6]Sennet, R (2018). Building and Dwelling, Ethics for the City

Reflection

Key learnings

Where the car has been the symbol for freedom for a long time (and still is in many perspectives) by enabling people to connect with family, friends, jobs and activities over longer distances, the publications inspired me to think about the car differently, especially in the urban context. Liveable cities might not only be about overcoming distances, but about empowering closeness by connecting with the people in your own neighbourhood and creating streets that are safe to play, embrace socio economic diversity and enable strong communities. To create a liveable city, it takes a broader view on the complex human systems than considering function alone as the modernists pursued.

Integration in next steps

Where the car once democratised mobility, it might be interesting to consider a broader view and think about how we might democratise streets - the role of the car might be reconsidered in this perspective.

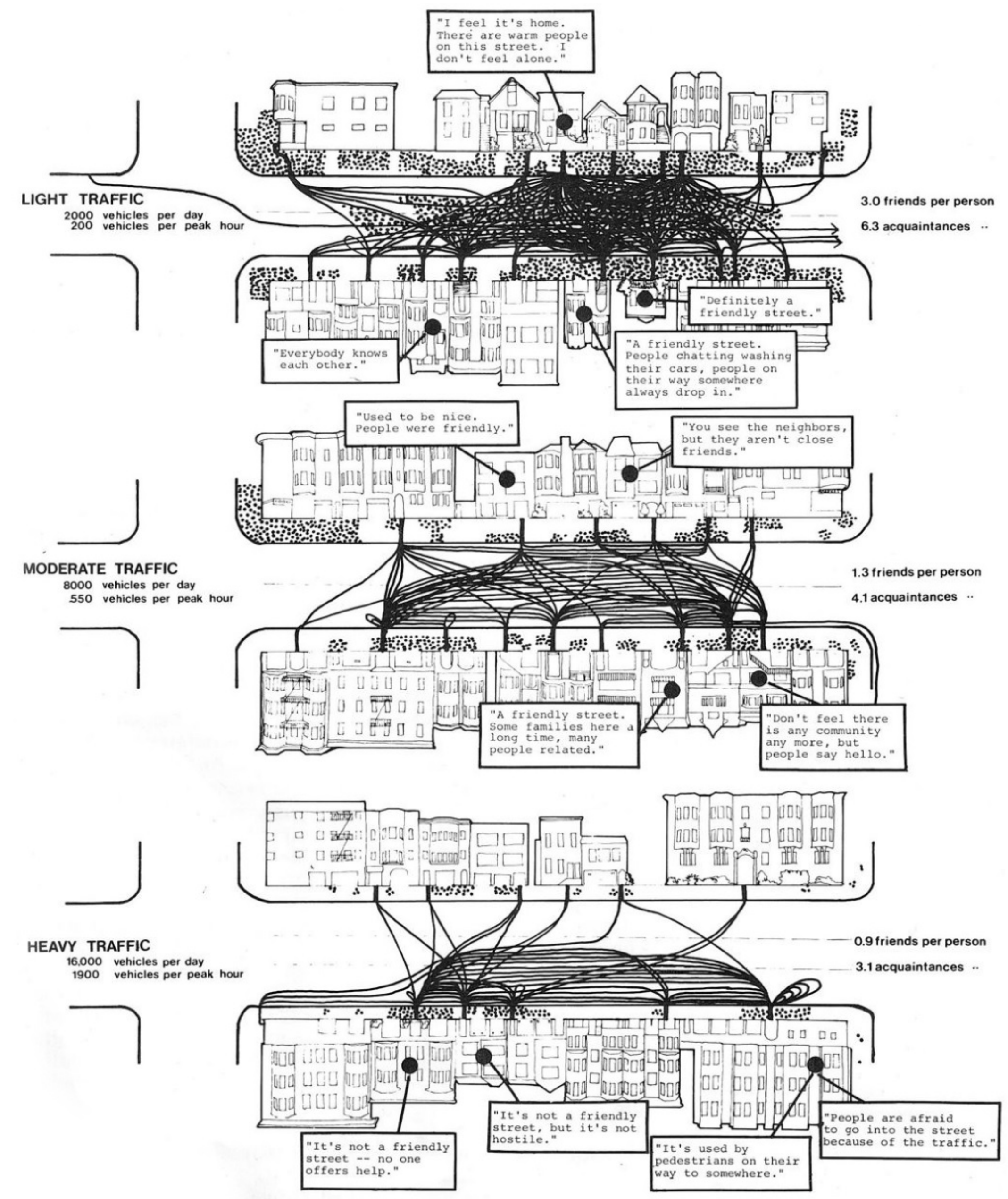


Figure 25.1 - Donald Appleyard (1969) visualization of intra-street social connections of neighbors. The lines indicate social connections and the dots indicate where people gathered.

UNDERSTANDING LIVEABILITY

If you would ask people what liveability means to them, you can expect different interpretations dependent on their background. Where an urbanist could define it by the spatial quality and the relation between people and buildings, a policy maker could approach it by a calculation with a set of parameters like the access to education or air quality[1].

So, what definition of liveability is used in this project? The urban context is a complex and dynamic system with various stakeholders with their own views, interests, challenges and assets. In order to gain understanding on this definition space across city stakeholders, multiple perspectives are required. An initial stakeholder map was created (figure 21.1) to identify the key players and their relations.

From there, various city stakeholders were interviewed about their interpretation and approach towards creating more liveable cities. In addition to the interviews, city vision reports were used to gain understanding about the perspective of municipalities. From there, the meaning of liveability for this project and Ford was defined.

In this part some of the perspectives are elaborated, these insights have been gained during the interviews and from desk research (a.o. city vision reports from municipalities, appendix C).

Urbanists

Prof. Ir. R. Dijkstra and L. van den Burg from Urbanism TU Delft were strongly relating to liveability as a function of the layers in the *urban fabric* that together shape the spatial quality.[2] It is up to the urban designers to find the effective mix of elements like housing, parking spots, sidewalks, shops, greenery and room to play. They believe urban design fundamentally shapes the spatial quality and thereby the quality of life.

Architect Nicolas Cazali from Kengo Kuma and Associated underlined how the meaning could be perceived differently across the world[3]. Cultural elements like values, rituals and social behaviour could lead to different requirements for a liveable environment: characteristics of liveability are not necessarily universal.

Social platform Klup

Michiel van den Berg, founder of social platform Klup (for the 50+ generation) introduced the term social mobility: "*Having an environment that enables people to engage socially is of key importance to their perception of liveability. We created a digital environment to mobilize this generation, since some neighbourhoods do not offer this by themselves*". For Klup, liveability is about having access to social connections, they approach more liveable environments by facilitating people to meet.[4]

Municipalities

Derived from the city vision reports[5] and the conversation with Jeroen Maijers from the Municipality of Rotterdam[6] and Amsterdam[7] the meaning of liveability feels more categorized in measurable themes like safety, air quality, education and inclusiveness. These are empowered with their tools (e.g. policy, initiatives and construction) and departments. Where sociologists may have a more holistic approach[8], municipalities define the more practical perspective on liveability.

Mobility (service) providers

The NS, Snappcar or Swapfiets might have different value propositions, use cases and modes of transport, they share a common vision on achieving liveability: offering people the freedom to move, providing access and enabling people to connect over distances in an effective and comfortable way.

[1]Economist (2019) The Global Liveability Index. From: https://www.eiu.com/topic/liveability

As experienced during the interviews with various stakeholders. There are various liveability index number around.

[2]Urban Fabric TU Delft (2019). From: https://www.tudelft.nl/onderwijs/opleidingen/masters/aubs/msc-architecture-urbanism-and-building-sciences/master-tracks/urbanism/programme/graduation/urban-fabrics/

Prof. R. Dijkstra from the Faculty of Architecture explained how creating liveable cities is about gaining deep understanding in a broad set of city elements that together form the urban fabric.

[3]Blog 6. Interviews in Tokyo.

[4]Blog 3. Interview with Michiel van den Berg, founder of Klup. From: https://kluppen.nl/

[5]Appendix C. Overview of city reports that have been consulted during the research.

[6]Blog 8. ITS Congress, conversation with Jeroen Maijers - Team Manager Urban Mobility at the City of Rotterdam.

[7]Blog 9. Interview with Evelien van der Molen

[8]As interpreted from the work of Jane Jacobs, Gehl Studio and Richard Sennet.

Some of the mobility providers also seek to develop environments that empower social interaction.[9]

Delivery operators

Picnic and PostNL explained how they feel responsible for safeguarding liveability in cities from a societal and nuisance aspect.[10] They acknowledge that their aim to do so is also of interest in building a positive brand image and in keeping a good relationship with the municipalities. For them, liveability is about minimizing the traffic they generate in streets (also of operational interest) and providing a social role when delivering: one of their examples was their role of connecting with socially isolated elderly.

Habitants

When asking this question to a demographic mix of ten people living in The Netherlands (+/- 15 people), they described liveability from their individual perspective and experiences: How far is the convenience store from my house? Do I have access to a private parking spot? Can my kids play safely on the street? Demographics seemed to be of large influence on what was important to them, some acknowledged it was very dependent on life phase as well: *"During my student life I wasn't bothered by having a small room in a noisy street. Now, I wouldn't be able to return to that part of the city."*

This demonstrates that the definition is not only different over people, but also over time and context.

Ford

Ford mentions[11] inclusiveness as one of the important pillars for liveable cities, mobility should be accessible to minorities that are limited by e.g. economical or physical means. A liveable city is about democratized mobility, being accessible for everyone. This defenition can be recognised in a broad variety of initiatives by Ford e.g. in the Chariot service and the Living Streets Project.

Reflection

So, what meaning and approach to liveability is chosen for this project? The Living Street design principles[12] have been an important reference for creating a proposal that empowers liveability. The various interviews demonstrated that an approach to liveability is too complex for a 'one size fits all' approach. The main take away from this analysis was to proceed with a broader system view.

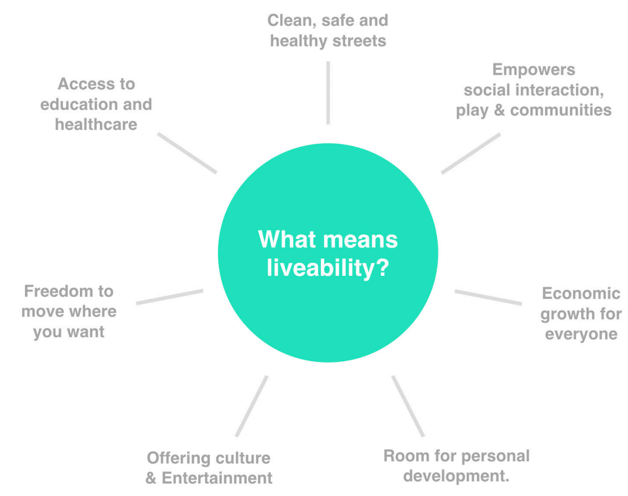


Figure 27.1 - Overview of diverse perspectives on liveability.

> **"Take out car traffic and urban mobility can return to a symphony of human interaction!"**
>
> Marco te Brommelstroet - Prof. Urban Mobility Futures, UvA

Figure 27.2 - One approach to liveability by one of the interviewees Marco te Brommelstroet, advocating for more active modes.

[9]As mentioned in the interviews with a.o. NS, SnappCar, ProRail in Blog 2 and Blog 3.

[10]NRC (2015). Additional tasks for deliverers and cashiers. From: https://www.nrc.nl/nieuws/2015/12/16/caissiere-en-postbode-gaan-helpen-in-de-buurt-1570828-a636856

Interviews with Picnic and PostNL can be found in Blog 3.

[11]Ford Foundation (2019). From: https://www.fordfoundation.org/ideas/equals-change-blog/posts/why-we-need-to-build-just-and-inclusive-cities/

Additional info from company Supervisor, Nicole Eikelenberg and web source:

[12]Greenfieldlabs and Gehl Studio (2018) Living Streets Project. From: https://www.ourlivingstreets.com/

HOW MOBILITY SHAPED OUR CITIES

Our cities are constantly in the process of reshaping, expanding and rethinking themselves. How has the role of mobility evolved over time, what concepts have transformed the scene and who are the thinkers behind the cities of today? This part will reflect on a selection of people, concepts and movements that influenced how our cities look and how it changed perception on liveability.

Ford T, the first mass produced car[1]

It was Henry Ford who introduced the Ford T, which was the first mass produced car which was cheaper than its alternatives at that time. Additionally, he raised the workers' wages to $5 a day. This combination initiated a revolution where the horse was replaced by the car on grand scale. In terms of liveability it had positive influence on street safety (compared to horses), dirt (by horses) and democratised mobility enabling workers to live outside the city.

Le Corbusier's Plan Voisin[2]

He was one of the most influential architects of the 20th century - and great believer of functionalism - many people would prefer he did not build anything. He proposed a plan where the city center of Paris would make place for modernism buildings that would follow functional and mathematical principles.

Although that plan was rejected, many buildings in the suburbs around a.o. Paris and East-Berlin followed his belief, which have led to neighbourhoods that are not considered as liveable places. It demonstrates how liveability is a complex thing that cannot simply be reached by approaching it from a pure functional perspective.

The Japanese Kei Car[3]

The Kei Car is a small and boxy car category introduced by the Japanese government to reduce space used by cars in the cities. Apart from having tax benefits when buying a Kei Car, it also fits the Japanese "Shinto" mentality, which encompasses the principle of honouring earth and other human beings. One of the elements of this mentality is to keep your footprint minimal and share what you can, having a large car wouldn't fit that mindset.

Superblocks, Barcelona[4]

In response to excess traffic, unsafe roads and low air quality, the municipality of Barcelona searched a new direction to solve its problems. The solution enables wide scale pedestrianization by making use of their street grid and is called 'Superilles' (Superblocks).

They basically merge smaller blocks together into one large block to create mini neighbourhoods which is where cars can only drive very slowly to create space for pedestrians and cyclists.

The Witkar & White Bike Plan in Amsterdam by the Provo movement[5]

The Witkar is the first shared and electric car worldwide, it made its first ride in 1968 in Amsterdam and was invented by Luud Schimmelpennink (part of the Provo movement). His objective was to make the streets of Amsterdam safer, cleaner and more social. The action radius was 15 kilometres and had 5 stations in the city center of Amsterdam. It also had the first cashless payment system by using a magnetic key that could register the number of minutes. Although the system had its last ride in 1988, a new shared car system by Schimmelpennink is currently operating in The Netherlands.

Before introducing the Witkar he introduced the Whitebikeplan in 1965, this was a free to use free-floating model following the mission of the Provos of introducing goods for collective use in the society.

[1]Ford history, based on multiple sources a.o. conversations with the Company Supervisor N. Eikelenberg, Britannica (2019). Ford history. From: https://www.britannica.com/topic/Ford-Motor-Company
Ford (2019). Ford history. From: https://corporate.ford.com/history.html

[2]Business Insider (2013). How Corbusier's "Plan Voisin" almost destructed our Paris. From: https://www.businessinsider.com/le-corbusiers-plan-voisin-for-paris-2013-7

Le Figaro (2015). Le Corbusier wanted to destroy Paris: https://immobilier.lefigaro.fr/article/quand-le-corbusier-voulait-detruire-paris_2ebe1af0-215f-11e5-ab3a-648d85cc7f54/

[3]Autoevolution (2012). Kei Car evolution. From: https://www.autoevolution.com/news/history-of-the-japanese-kei-car-49720.html

Additional background was given during the interview with Dentsu (Blog 5)

[4] Vox (2016) Superblocks explaination video. From: https://www.youtube.com/watch?v=ZORzsubQA_M

[5]Witkar (2019) From: https://www.witkar.nl/geschiedenis-witkar/
Groen7 (2018): https://www.groen7.nl/de-geschiedenis-van-de-witkar/

The Guardian (2016). White Bike Plan (Witte Fietsen Plan) history. From: https://www.theguardian.com/cities/2016/apr/26/story-cities-amsterdam-bike-share-scheme

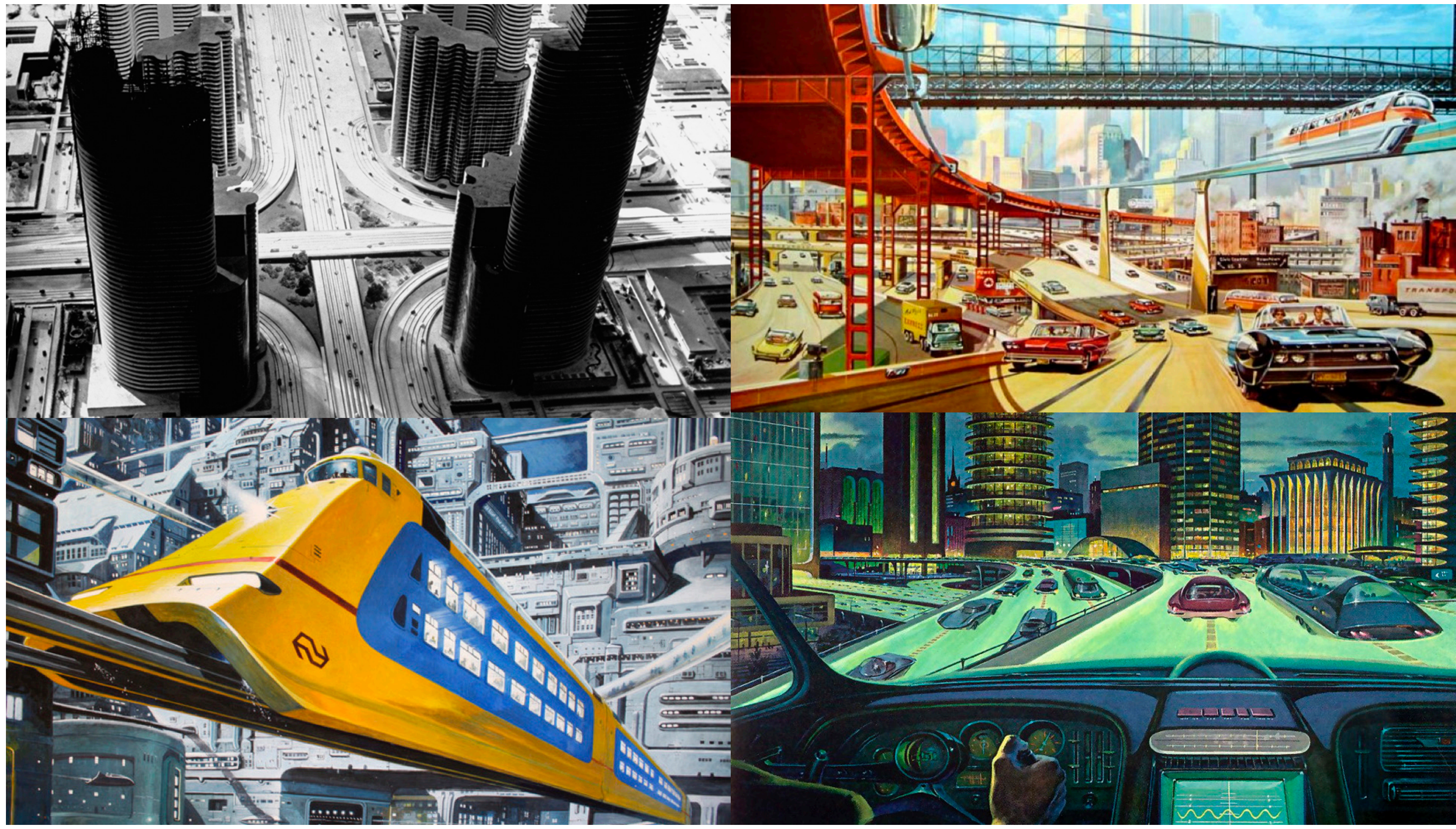


Figure 29.1 Utopian images around the 1960 where transport solutions and infrastructure has a highly dominant role. Do we still consider this as pioneering and liveable cities? (Sources in blog 2)

Fast Growing Shenzhen[6]

This city in Guangdong area, China is situated in the most densely populated area of the world and grew from 175.000 people in 1985 to more than 12,5 million people in 2019. The growth was initiated by China after its designation as Special Economic Zone. It is striking how the city had its largest growth in a time where urban planners had knowledge of the modern car: compare that to context when the old city centers of Amsterdam and Paris were built. The current composition of modalities seems to be highly correlated with the city policy on car ownership, shared systems, small electric vehicles.

Reflection

Although the various concepts above might not have an obvious relation at first glance, they all provide specific views and insights on the role of innovation, practices and policy on city mobility. To conclude the key learnings of these 'mini-analyses':

- It required change on various levels to initiate the large transition from horses to cars. The combination of increased wage, mass production and the problems around the status quo enabled this shift.

- City policy can have large influence on such transitions: the Keicar, Superblocks and the regulations around EV's and micro mobility are living examples of the importance of the policy layer.

- The market adoption of innovations in technology is in many cases highly dependent on timing and external factors. The Witkar concept might have been far ahead of its time, while the technology was ready for operation, the policy and people weren't.

The emerging design practice called Transition Design reflects on the various layers of a complex system in order to initiate large transitions (e.g. in creating more liveable cities). An elaboration on initiating transitions and the Transition Design practice can be found on page 50 to 53.

[6]Wired (2016). Shenzhen: The Silicon Valley of Hardware (Full Documentary): https://www.youtube.com/watch?v=SGJ5cZnoodY

Blog 5. Shenzhen insights from observations.

PARADIGM SHIFT

An assessment of emerging technologies and services has been conducted to gain understanding on what we might expect in 2030-2035. The aim was to present a realistic proposal, not driven by idealistic arguments but based on identified challenges and expected technology advances. Therefore, a set of emerging technologies and services relevant to Ford have been analysed as indications are strong that they will have an increasingly important role in the (urban) mobility scene and liveability.

Electrification

It is in the late 19th and early 20th century when the first electric cars gained serious traction in the automotive market, in the US around 38% of the vehicles were electric around 1900. Compared to steam-powered and gasoline cars the electric car did not had the bad smell, noise, long start-up times and manual effort to get started. They were often called cars for women because the handling was easier.[1]

However, battery technology found itself in an early stage, causing very limited range and charging infrastructure (some swappable battery services were on the market as well) and the popularity of EV's declined and gasoline took over. In late 20th, battery developments revived interest in EV's and from 2010 the market for EV's really began to flourish driven by the aim for more environmental friendly mobility. Large efforts in battery innovation extended the energy density and decreased the price per KWh.

Governments and third parties have joined efforts to built a dense charging infrastructure. Amsterdam has announced to aim for a fully electric car infrastructure in 2030 (more on page 34). It is in 2019 Bill Ford said: *"When we first started talking about electrification, there was this thought that there had to be a trade off: It was either going to be green and boring and no fun, or really exciting but burn a lot of fossil fuels," "Electrification has come to the point that you can do both."*[2] This statement might indicate a tipping point for Ford's transition to electric vehicle production.

Servitization

As in many other industries, the mobility industry is experiencing a shift towards servitization. Let's take Apple as an example of a company that has shifted from a hardware company to a model where services obtained large importance: where their business model was initially driven by hardware sales, their services around entertainment, payments and applications are now of key importance in their business.[3]

A similar shift might be identified in the mobility industry, where e.g. sharing, on-demand fleets, in-car delivery, maintenance services are causing a (partial) shift from vehicle ownership to pay-per-use and subscription revenue models. Think of services like Uber, Mobike, Car2Go and Swapfiets but also revenue streams from over-the-air updates, in-car deliveries (like Amazon) and trip guidance. More information on their business models on page 33. This might have implications for the future of Ford, as Ruben Verbaan describes in his graduation thesis with a proposed strategy (URP Graduation Project, Ruben Verbaan in 2018).

Micromobility

During the observations the upcoming micro mobility solutions in many cities like Paris and San Francisco were analysed[4]. A key conclusion is that cities are challenged by street pollution caused by free-floating models, some cities like Rotterdam indicate that experimentation is of great essence in this phase to learn about these new systems quickly[5]. Fleet mobility companies are challenged in

[1] Energy.gov (2019). Electric car history. From: https://www.energy.gov/articles/history-electric-car

Autolife (2019). Electric car history. From: http://www.autolife.umd.umich.edu/Gender/Scharff/G_casestudy1.htm

Interesting Engineering (2019). Electric car history. From: https://interestingengineering.com/a-brief-history-and-evolution-of-electric-cars

[2] Future Car (2019). From: https://www.futurecar.com/3028/Ford-Developing-Electric-Mustang-Crossover-That-CEO-Says-Will-Go-Like-Hell

[3] Tweakers (2019). Transformation of Apple. From: https://tweakers.net/reviews/6822/de-transformatie-van-apple-van-hardware-naar-diensten.html

[4] Blog 3-6, micromobility observations in Paris, Shenzhen, San Francisco.

[5] Blog 7. Interview with Jeroen Maijers - Manager Urban Mobilility, City of Rotterdam.

Electrification

Micromobility

Autonomous Drive

Servitization

Mobility Cloud

Shared Mobility

optimising their charging and allocation operation. Ford is engaged in this transition as it has acquired the electric scooter company Spin[6].

Autonomous drive

In 2018 Ford invested $1 billion in the autonomous technology company Argo AI[7] to consolidate a strong position in the development of self-driving cars. In blog 6.0 the expected timeline is described from the interviews with autonomous drive experts from Waymo, Stanford and Point One Navigation. The bottom line is that full self-driving capacities (L5)[8] are not expected in all urban environments by 2030-35, but specific scenario's like the highway and parking lots could form a strong use case by that time.

Mobility Cloud

As cities and mobility is becoming smarter and connected, a framework for data exchanges between various parties is required[9]. During the ITS congress and during the interviews with various parties like the NS, the City of Rotterdam and Snapcarr the challenge of data sharing was one of the key topics for the coming mobility era (blog 3.0). Ford recently acquired 'Autonomic' to develop the: "Transport Mobility Cloud" (TMC), to join efforts in offering aligned services to clients.[10] The platform serves as a data exchange platform between the vehicle and external elements like infrastructure and other stakeholders in the city ecosystem.

Shared Mobility

Ford showed interest in offering shared mobility services by acquiring the shuttle service Chariot. Although it shut down its operation early 2019[11], the Ford team continued to express interest in the field of shared mobility during the internal interviews.

Reflection

An obvious parallel found in all these technologies is the the upcome of novel business models (page 32-33) and role of data communication between stakeholders, the mobility cloud might have a central role here. In the next steps enablers for such conversations are developed.

[6] The Verge (2018). Ford bought dockless electric scooter company Spin for $100 million, according to Axios. From: https://www.theverge.com/transportation/2018/11/7/18073046/ford-electric-scooter-spin-acquisition

[7] Ford (2017) Argo AI investment by Ford. From: https://media.ford.com/content/fordmedia/fna/us/en/news/2017/02/10/ford-invests-in-argo-ai-new-artificial-intelligence-company.html

[8] Truecar (2019) Levels of automation.

Level 0 – No Automation.
Level 1 – Driver Assistance.
Level 2 – Partial Automation.
Level 3 – Conditional Automation.
Level 4 – High Automation.
Level 5 – Full Automation.

From: https://www.truecar.com/blog/5-levels-autonomous-vehicles/

[9] Blog 7, ITS Congress. Elaboration on data exchanges in the smart city.

[10] Ford (2019). Ford bought Autonomic (TMC) From: https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/23/ford-motor-company-autonomic-amazon-web-services-collaboration.html

[11] Techcrunch (2019) Chariot service shutdown in 2019. From: https://techcrunch.com/2019/01/10/ford-is-shutting-down-chariot-shuttle-service/

BUSINESS MODELS

To gain deeper understanding in the novel business models that have been introduced in the past years, an overview has been created where the models are evaluated on aspects like value proposition, revenue stream, target user, price and elements why they might have been successful or form a potential threat in the coming years.

The business model comparison is conducted using learnings from the interviews (Leaseplan, SnappCar, Amber, OV Fiets in blog 3.0) and desk research.

Conclusions[1]

Based on the matrix exercise we could conclude that
- P2P services like Snappcar & Blablacar have longer transaction times than B2C fleet services.
- Long term renting services have a longer initial registration time, but then offer higher flexibility and shorter 'book-a-trip' times since you are not dependent on the platform.
- Station based and free-floating services have a smaller coverage area, but are cheaper when using them in low frequency compared to long term lease
- Free-floating services have a more negative impact on street pollution than station based or privately owned vehicles, however, the same vehicle can provide mobility to a larger group.
- On-demand services might have the potential to serve even more people than free-floating services.
- Individual used vehicles degrade slower than (often more heavily used) shared vehicles.
- Long-term services generally offer a higher level of personal service compared to short trip services, this is their USP compared to vehicle ownership. Their USP compared to short trip services is cost reduction when the usage reaches a higher frequency.
- Short trip services are more expensive per single trip but can be cheaper in cases the monthly need for mobility is lower.

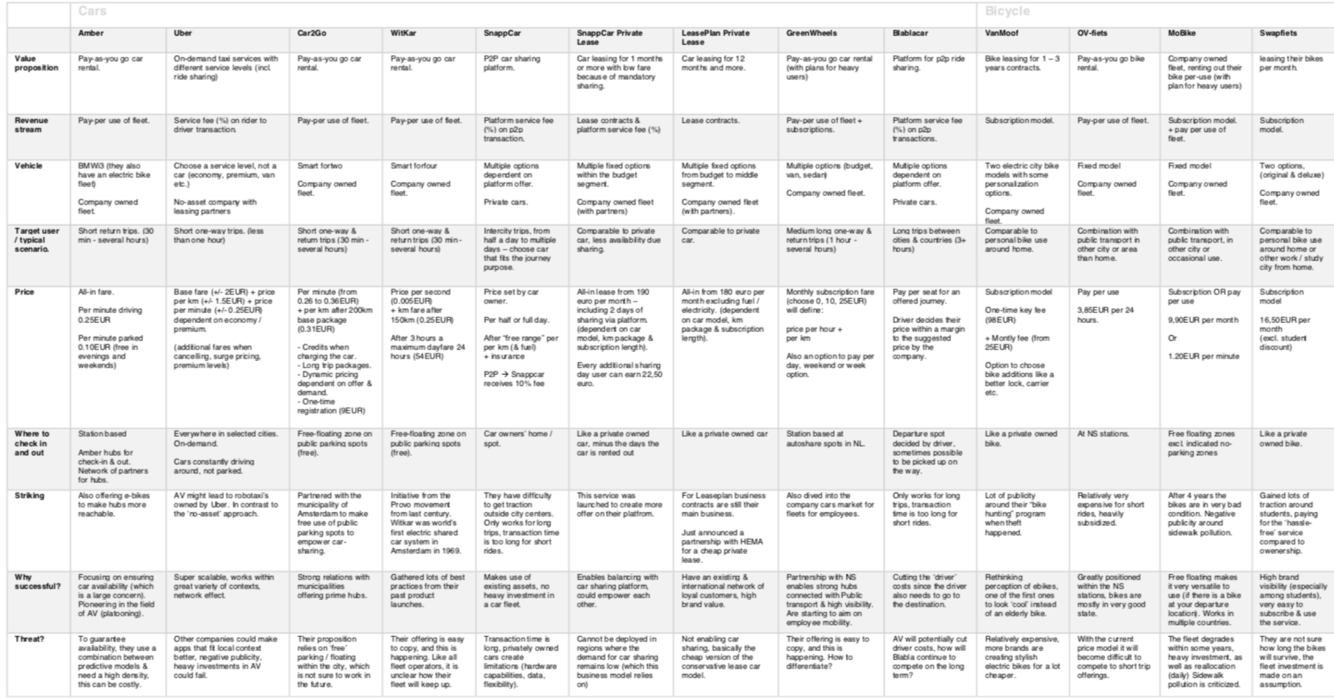
This exercise served to get a sense of business models and propositions, these conclusions might differ per user scenario and context.

[1]Attachment C. Full scale overview of the business model analysis can be found in attachment. Larger versions of figure 33.2 can be found in Blog 5.

Swapbike - "Lease a (working) bike"
- the bike follows you
- the bike waits when you're done
- the bike sticks to one location per time (one city)
- the bike is quite expensive
- the bike does not travel so much
- park where you want
- swap is the bike you know

Mobike - "Rent a bike per use, free-floating model"
- you follow the bike
- you seek for a waiting bike
- the bike in omnipresent
- the bike is cheap
- the bike travels a lot
- no parking
- mo is the bike that knows you

Figure 32.1: Research exercise where Mobike and Swapbike were compared with simple sentences to catch the key characteristics.



	Cars								
	Amber	Uber	Car2Go	WitKar	SnappCar	SnappCar Private Lease	LeasePlan Private Lease	GreenWheels	Blablacar
Value proposition	Pay-as-you go car rental.	On-demand taxi services with different service levels (incl. ride sharing)	Pay-as-you go car rental.	Pay-as-you go car rental.	P2P car sharing platform.	Car leasing for 1 months or more with low fare because of mandatory sharing.	Car leasing for 12 months and more.	Pay-as-you go car rental (with plans for heavy users)	Platform for p2p ride sharing.
Revenue stream	Pay-per use of fleet.	Service fee (%) on rider to driver transaction.	Pay-per use of fleet.	Pay-per use of fleet.	Platform service fee (%) on p2p transaction.	Lease contracts & platform service fee (%)	Lease contracts.	Pay-per use of fleet + subscriptions.	Platform service fee (%) on p2p transactions.
Vehicle	BMWi3 (they also have an electric bike fleet) Company owned fleet.	Choose a service level, not a car (economy, premium, van etc.) No-asset company with leasing partners	Smart fortwo Company owned fleet.	Smart forfour Company owned fleet.	Multiple options dependent on platform offer. Private cars.	Multiple fixed options within the budget segment. Company owned fleet (with partners)	Multiple fixed options from budget to middle segment. Company owned fleet (with partners).	Multiple options (budget, van, sedan) Company owned fleet.	Mutiple options dependent on platform offer. Private cars.
Target user / typical scenario.	Short return trips. (30 min - several hours)	Short one-way trips. (less than one hour)	Short one-way & return trips (30 min - several hours)	Short one-way & return trips (30 min - several hours)	Intercity trips, from half a day to multiple days – choose car that fits the journey purpose.	Comparable to private car, less availability due sharing.	Comparable to private car.	Medium long one-way & return trips (1 hour - several hours)	Long trips between cities & courtries (3+ hours)
Price	All-in fare. Per minute driving 0.25EUR Per minute parked 0.10EUR (free in evenings and weekends)	Base fare (+/- 2EUR) + price per km (+/- 1.5EUR) + price per minute (+/- 0.25EUR) dependent on economy / premium. (additional fares when cancelling, surge pricing, premium levels)	Per minute (from 0.26 to 0.36EUR) + per km after 200km base package (0.31EUR) - Credits when charging the car. - Long trip packages. - Dynamic pricing dependent on offer & demand. - One-time registration (9EUR)	Price per second (0.005EUR) + km fare after 150km (0.25EUR) After 3 hours a maximum dayfare 24 hours (54EUR)	Price set by car owner. Per half or full day. After "free range" per per km (& fuel) + insurance P2P → Snappcar receives 10% fee	All-in lease from 190 euro per month – including 2 days of sharing via platform. (dependent on car model, km package & subscription length). Every additional sharing day user can earn 22,50 euro.	All-in from 180 euro per month excluding fuel / electricity. (dependent on car model, km package & subscription length).	Monthly subscription fare (choose 0, 10, 25EUR) will define: price per hour + per km Also an option to pay per day, weekend or week option.	Pay per seat for an offered journey. Driver decides their price within a margin to the suggested price by the company.
Where to check in and out	Station based Amber hubs for check-in & out. Network of partners for hubs.	Everywhere in selected cities. On-demand. Cars constantly driving around, not parked.	Free-floating zone on public parking spots (free).	Free-floating zone on public parking spots (free).	Car owners' home / spot.	Like a private owned car, minus the days the car is rented out	Like a private owned car	Station based at autoshare spots in NL.	Departure spot decided by driver, sometimes possible to be picked up on the way.
Striking	Also offering e-bikes to make hubs more reachable.	AV might lead to robotaxi's owned by Uber. In contrast to the 'no-asset' approach.	Partnered with the municipality of Amsterdam to make free use of public parking spots to empower car-sharing.	Initiative from the Provo movement from last century. Witkar was world's first electric shared car system in Amsterdam in 1969.	They have difficulty to get traction outside city centers. Only works for long trips, transaction time is too long for short rides.	This service was launched to create more offer on their platfrom.	For Leaseplan business contracts are still their main business. Just announced a partnership with HEMA for a cheap private lease.	Also dived into the company cars market for fleets for employees.	Only works for long trips, transaction time is too long for short rides.
Why successful?	Focusing on ensuring car availability (which is a large concern). Pioneering in the field of AV (platooning).	Super scalable, works within great variety of contexts, network effect.	Strong relations with municipalities offering prime hubs.	Gathered lots of best practices from their past product launches.	Makes use of existing assets, no heavy investment in a car fleet.	Enables balancing with car sharing platform, could empower each other.	Have an existing & international network of loyal customers, high brand value.	Partnership with NS enables strong hubs connected with Public transport & high visibility. Are starting to aim on employee mobility.	Cutting the 'driver' costs since the driver also needs to go to the destination.
Threat?	To guarantee availability, they use a combination between predictive models & need a high density, this can be costly.	Other companies could make apps that fit local context better, negative publicity, heavy investments in AV could fail.	Their proposition relies on 'free' parking / floating within the city, which is not sure to work in the future.	Their offering is easy to copy, and this is happening. Like all fleet operators, it is unclear how their fleet will keep up.	Transaction time is long, privately owned cars create limitations (hardware capabilities, data, flexibility).	Cannot be deployed in regions where the demand for car sharing remains low (which this business model relies on)	Not enabling car sharing, basically the cheap version of the conservative lease car model.	Their offering is easy to copy, and this is happening. How to differentiate?	AV will potentially cut driver costs, how will Blabla continue to compete on the long term?

	Bicycle			
	VanMoof	OV-fiets	MoBike	Swapfiets
Value proposition	Bike leasing for 1 – 3 years contracts.	Pay-as-you go bike rental.	Company owned fleet, renting out their bike per-use (with plan for heavy users)	leasing their bikes per month.
Revenue stream	Subscription model.	Pay-per use of fleet.	Subscription model. + pay per use of fleet.	Subscription model.
Vehicle	Two electric city bike models with some personalization options. Company owned fleet.	Fixed model Company owned fleet.	Fixed model Company owned fleet.	Two options, (original & deluxe) Company owned fleet.
Target user / typical scenario.	Comparable to personal bike use around home.	Combination with public transport in other city or area than home.	Combination with public transport, in other city or occasional use.	Comparable to personal bike use around home or other work / study city from home.
Price	Subscription model One-time key fee (98EUR) + Montly fee (from 25EUR) Option to choose bike additions like a better lock, carrier etc.	Pay per use 3,85EUR per 24 hours.	Subscription OR pay per use 9,90EUR per month Or 1.20EUR per minute	Subscription model 16,50EUR per month (excl. student discount)
Where to check in and out	Like a private owned bike.	At NS stations.	Free floating zones excl. indicated no-parking zones	Like a private owned bike.
Striking	Lot of publicity around their "bike hunting" program when theft happened.	Relatively very expensive for short rides, heavily subsidized.	After 4 years the bikes are in very bad condition. Negative publicity around sidewalk pollution.	Gained lots of traction around students, paying for the 'hassle-free' service compared to owenership.
Why successful?	Rethinking perception of ebikes, one of the first ones to look 'cool' instead of an elderly bike.	Greatly positioned within the NS stations, bikes are mostly in very good state.	Free floating makes it very versatile to use (if there is a bike at your departure location). Works in multiple countries.	High brand visibility (especially among students), very easy to subscribe & use the service.
Threat?	Relatively expensive, more brands are creating stylish electric bikes for a lot cheaper.	With the current price model it will become difficult to compete to short trip offerings.	The fleet degrades within some years, heavy investment, as well as reallocation (daily) Sidewalk pollution is criticized.	They are not sure how long the bikes will survive, the fleet investment is made on an assumption.

Figure 33.1: This overview compares key properties of the business models like value proposition, revenue stream, vehicle use, pricing of a selection of mobility operators. Full overview of the business model comparison can be found in Appendix B.

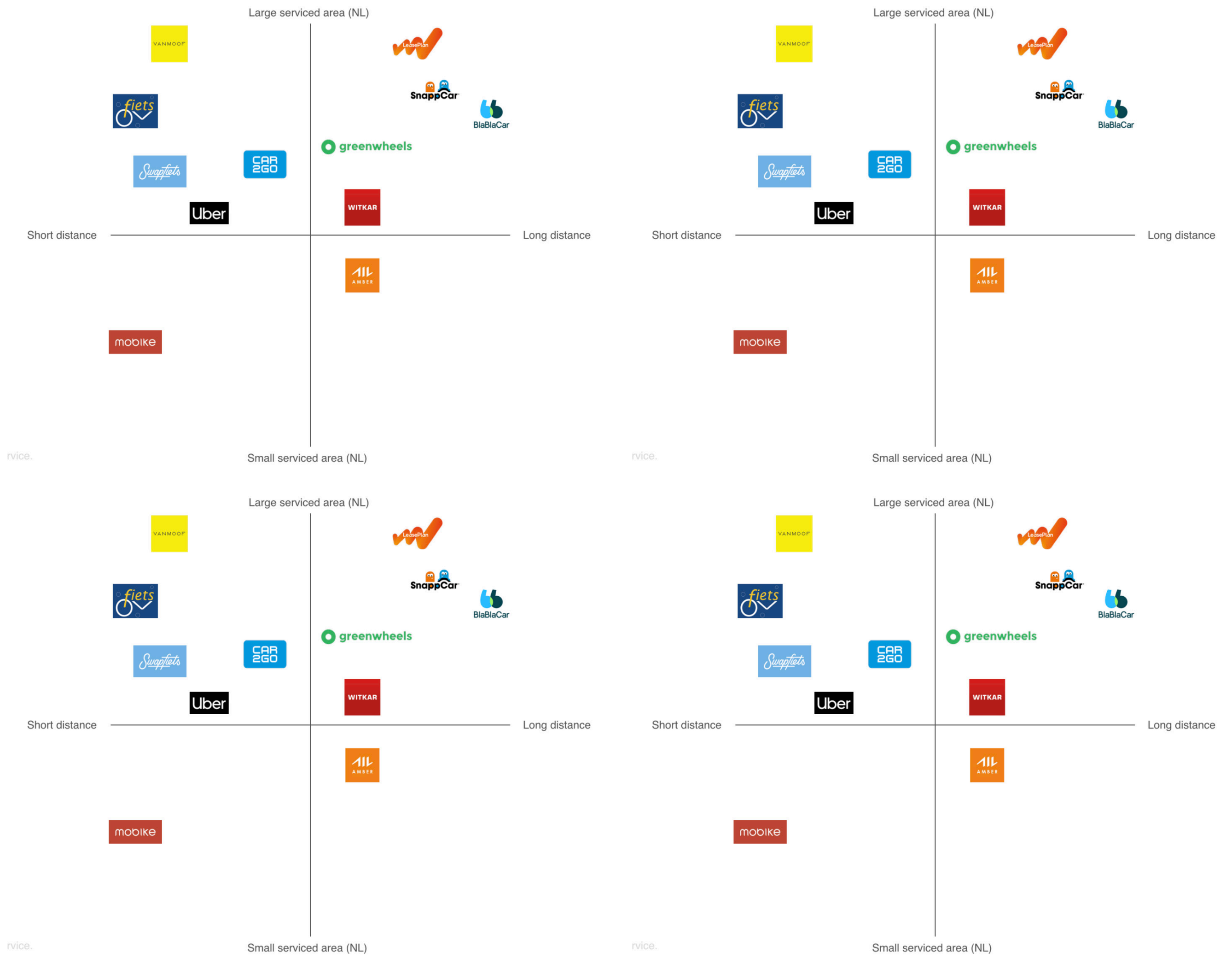


Figure 33.2: The business models were compared in a set of matrices to evaluate them from different perspectives like usual range, price, pollution etc.

DEMOCRATISE STREETS

Ford democratised mobility in the early 1900s by lowering the costs of a car and increasing the workers' wage (page 14). In many ways the car brought freedom and prosperity to people. However, the rise of cars in urban areas also came with its cost like safety issues, air quality and decreased social connectedness within streets (page 24). Is it time to 'democratise streets'?

Among Amsterdam, various cities in Europe have presented mobility visions that aims to put more emphasis on active modes and public transport, rather than the car.[1] An analysis of city policies was conducted to get a sense of city initiatives and policy on their future mobility (blog 4 & Appendix C). This part provides the key elements of the analysis of Amsterdam and their approach towards mobility.

Commuting in Amsterdam

In 2017 the Amsterdam region had 1.485.000 jobs, while only 1.272.000 working people lived in this region[2]. This means that there are more people commuting towards the Amsterdam region than outwards. This might explain that in 2015 the average commuting distance was 15km for people living in Amsterdam, which is shorter than in most other municipalities (23km on average and it was 15km in 1985)[3]. So what does this mean for this project? A significant amount of the commutes to work are from outside Amsterdam, which makes it difficult to completely rely on active modes. As Prorail and NS mentioned they could be reaching a maximum capacity by 2030[4] (Blog 3.0), the car is remains essential in reaching Amsterdam (at least the outer zones).

Car ownership

Habitant of Amsterdam have the lowest number of cars per household, however, due to relatively high density of the city and from outside the city, the amount of cars per square kilometres is the highest of The Netherlands. In Amsterdam there are 4 cars for every 10 households, where The Netherlands has on average 9 cars per 10 households[5]. It is expected that the cars per household will decrease.

Car sharing

The municipality joined forces with several shared mobility companies (a.o. Car2Go and Greenwheels) by providing them with dedicated shared parking spots. As parking spots are scarce and expensive, especially in the city center, the (free) dedicated parking spots offer a strong advantage compared to private vehicle ownership (read more in blog 5).

Parking spots

As shown in figure 35.1 the allowance for car parking was quite different, the introduction of the Witkar (page 28) was a response to the overflow of cars in the public space. It is around 1970 the municipality started to reclaim space from cars for people using active modes, more on this on page 38.

Emission free mobility

In May 2019 the municipality presented the "Action Plan Clean Air"[6] to create emission free mobility. The GGD announced that the current air quality is equal to smoking 6 cigarettes a day[7]. They aim to prohibit all diesel and gasoline cars by 2030. This plan is also criticized by many people as it requires significant investments for habitants and business owners in EV's, additionally more than 50.000 charging points have to be built for this incentive.

Supporting active modes

The Netherlands is well known for its sophisticated bicycle infrastructure, the contrast in the infrastructure is evident when comparing it to bicycling in San Francisco, Paris and Shenzhen (blog 2, 5 and 6). Car drivers seem more used to sharing

[1]Agenda Amsterdam Autoluw (2019). Amsterdam Autoluw aims to decrease the amount of cars in the city center by policy and street design. From: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/fijne-buurten/autoluw/

Municipality of Amsterdam (2019) Liveability Amsterdam Initiatives: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/fijne-buurten/

Municipality of Amsterdam (2019) Car Sharing Agenda. From: https://www.dropbox.com/s/oltgq6vnqo8qqw6/Agenda%20Autodelen%20gemeente%20Amsterdam.pdf?dl=0

[2]CBS Statline (2019). Mobility statistics. From: https://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37209hvv&D1=0-17&D2=609&D3=12-16&VW=T

Municipality of Amsterdam (2019) Economische Verkenningen Metropoolregio Amsterdam (EVMRA) From: https://public.tableau.com/profile/gemeente.amsterdam.economie#!/vizhome/

[3]Nu.nl (2017). Travel distances, From: https://www.nu.nl/tips-en-achtergronden/4876916/files-en-afstand-wennen-vanzelf-als-ver-van-werk-woont.html

[4]Treinenweb (2019) Maximum capacity 2030 ProRail and NS. From: https://www.treinenweb.nl/news/7699

[5]CBS (2016) Car ownership per household. From: https://www.cbs.nl/nl-nl/nieuws/2016/49/veel-auto-s-in-grote-steden-ondanks-laag-autobezit

[6]FD (2017) Decreasing car ownership, source: https://fd.nl/fd-persoonlijk/1221737/waarom-kopen-jongeren-minder-auto-s

[6]GGD (2019) Action Plan Clean Air, Amsterdam & GGD. From: https://www.ggd.amsterdam.nl/publish/pages/910216/actieplan_schone_lucht_2019.pdf

[7]NOS (2017) Six sigarettes a day. From: https://nos.nl/nieuwsuur/artikel/2184829-vuile-lucht-in-amsterdam-ik-wil-niet-roken-maar-dat-doe-ik-nu-toch.html

Figure 35.1 - Around the 1960-70's Amsterdam had a large amount of parking lots, back than the car was still largely perceived as a sign of freedom. Current policy shows a backwards direction. (Image sources blog 2)

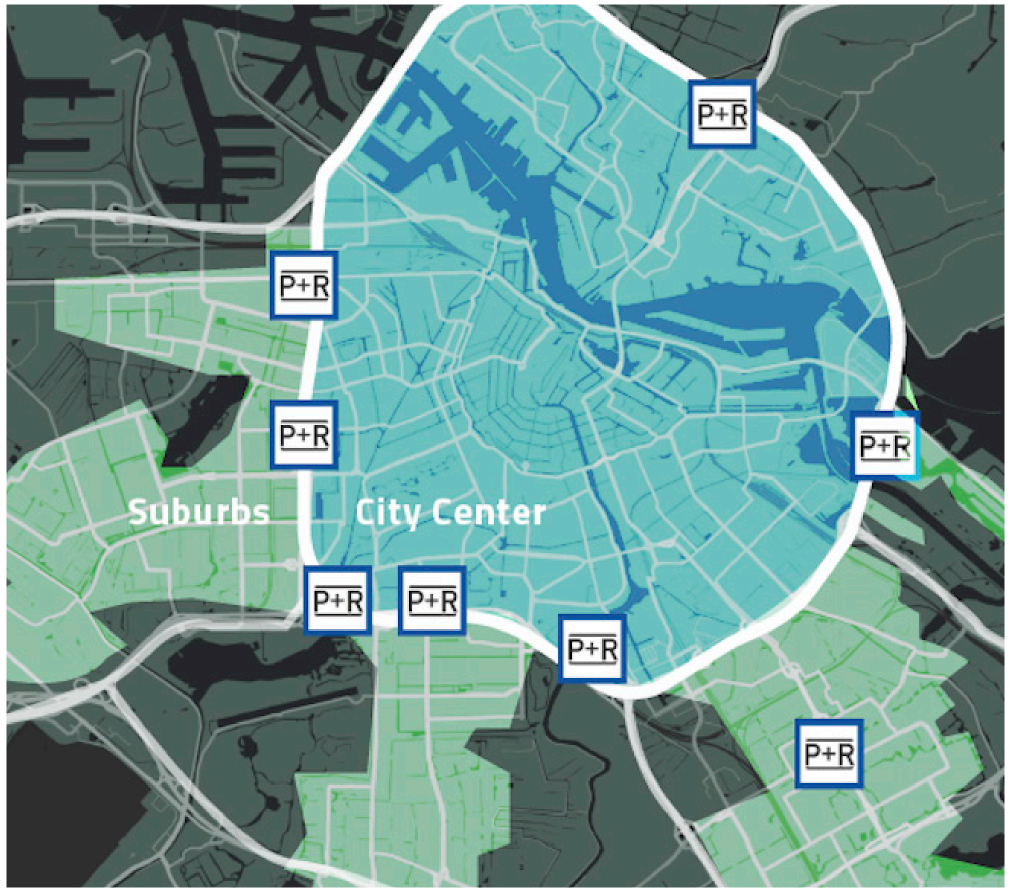


Figure 35.2: P+R stations were people can park their car and continue their journey by other modes.

[1] Rijksoverheid (2018) Investments in bicycle infrastructure: From: https://www.rijksoverheid.nl/actueel/nieuws/2018/11/23/honderden-miljoenen-voor-doorfietsend-nederland

Vervoerregio (2016). Investment Schedule Bicycle. From:https://vervoerregio.nl/pagina/20160121-investeringsagenda-fiets

Vervoerregio (2018). Investments bicycling. From: https://vervoerregio.nl/artikel/20180207-overheden-metropoolregio-amsterdam-bundelen-invester

[2] NRC (2018). Employers incentivising active modes of transport and public transport. From: https://www.nrc.nl/nieuws/2018/07/11/iedereen-voortaan-op-de-fiets-naar-werk-a1609658

[3] GVB (2019) Statistics daily transport numbers Amsterdam. From: https://over.gvb.nl/ov-in-amsterdam/

[4] Wijnemenjemee (2019). Impact study of the North-South line in Amsterdam. From: https://wijnemenjemee.nl/divers/nieuws/impactstudie-naar-de-noord-zuidlijn

the road with bicycles and the street design provides clear rules to ensure safety. The municipality of Amsterdam is continuing to invest in bicycle infrastructure and bicycle parking lots next to public transport stations to offer alternative to the car.[1] Not only the municipality does so, many employers incentivise their employees to use the bike or public transport with special programmes[2].

Public transport

The GVB and the NS are the main local public transport operators in Amsterdam. The GVB is responsible for the metro, bus, tram and ferry and transports 843 thousand people on an average working day[3], it is expected that this number will continue to increase to 1 million people. To keep up with the demand, the network density and line capacity is being increased. The underground North-South line has been one of the major projects to increase the capacity of the public transport network[4]. The NS strives to turn its stations into spaces that cover social and retail needs, positioning itself more as a hub than a train station. In that perspective they also seek for collaborations with other mobility operators to facilitate intermodal transport. The OV-bike is one of their initiatives and they will continue to open their ecosystem for third parties to connect with their stations (more in blog 3).

P+R parking lots

The municipality aims to decrease the number of cars in the city by making the public transport more attractive for people coming from outside of Amsterdam (page 34). Therefore P+R parking lots (Park + Ride) are built to facilitate a seamless

Figure 36.1: Impression of an undesirable 'old style' and desirable 'future' street in Amsterdam priotization of pedestrians and cyclists. (visual by De Natuurlijke Stad, 2019)

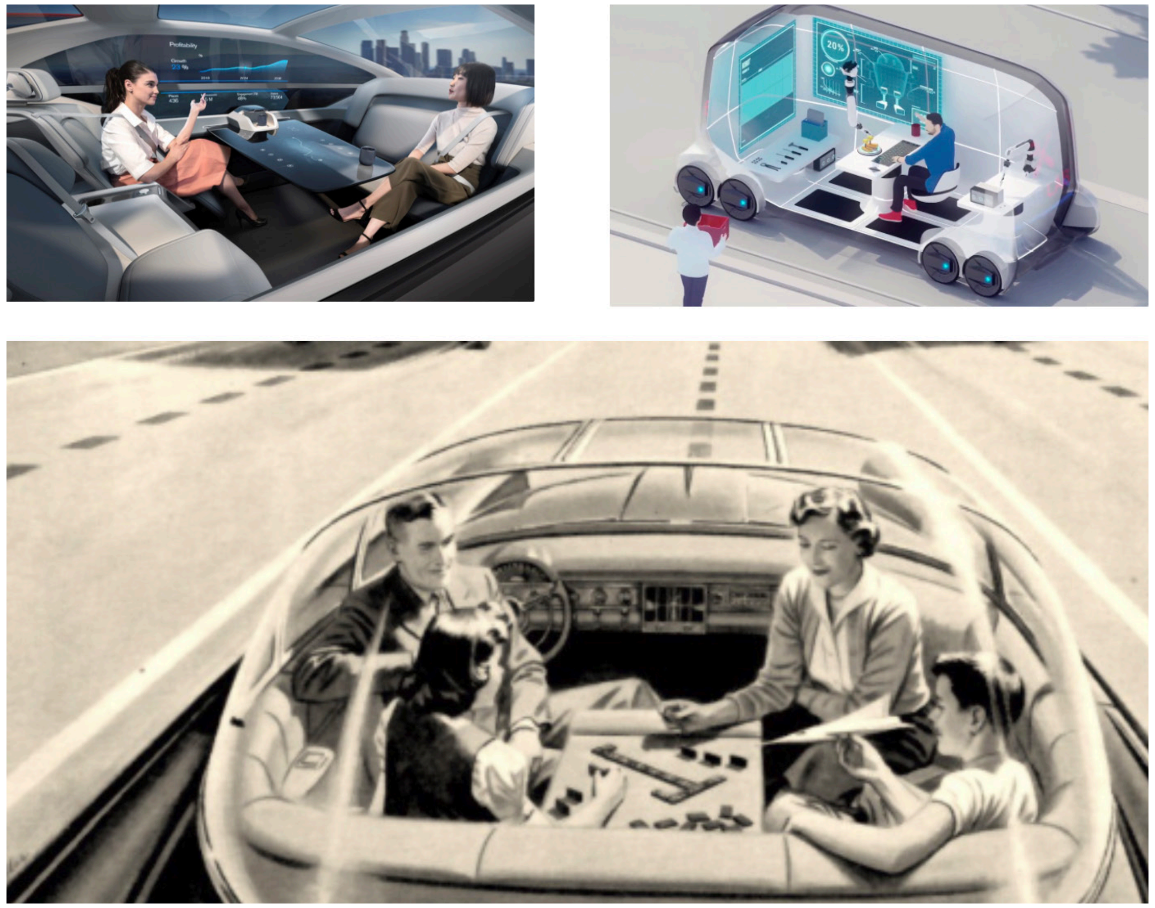


Figure 37.1 - Much of the future car concepts focus on the travellers inside the car, how might we think about cars in a broader perspective, how might Ford increase liveability for people not using the car?

[5] Municipality of Amsterdam (2019) Continious investments made in new P+R spots. From: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/verkeer-vervoer/volg-beleid-auto/

transition between car and rail. Figure 35.2 demonstrates the current network of P+R spots[5].

Delivery operators

The interviews with PostNL and Picnic provided the insight that the delivery operation is becoming rather challenging in neighbourhoods like 'De Pijp'. As the amount of available parking spots is low, their door-to-door time is high which leads to an ineffective operation. They mentioned that the future will oppose many challenges in delivering packages in such crowded neighbourhoods where parking spots are scarce (more in blog 3).

As part of the URP, the project of Nyckle Sijtsma explored how autonomous technology could be used (and humanised) for the delivery operation.

During the interview PostNL mentioned that they are looking into AV but considers it as a long shot, drone delivery did not seem feasible to them in short term[7].

[7] Retailtrends (2014). Drone delivery experiment by PostNL. From: https://retailtrends.nl/news/35623/postnl-test-pakketbezorging-per-drone

Reflection

There seems to be a conflict between the urban visions that cities like Amsterdam are presenting and the concepts proposed by the automotive industry. Many of the concepts seem to focus on creating more reasons and applications for vehicle usage, while cities are striving to decrease this amount.

If we aim to increase liveability, it might be interesting to think about Ford from a broader perspective: how might Ford facilitate the freedom to move, without pushing the cars as the single solution in a context where it might conflict with car free city centers policies.

The issue of parking seems to relate closely to liveability and is mentioned as being very challenging for delivery providers, the municipality, habitants and commuters. The following part elaborates the challenges and opportunities in and around the parking ecosystem.

PARKING EVOLUTION

Cars are parked 95% of the time[1] and are accountable for a significant footprint on public space in Dutch urban areas. The municipality of Amsterdam has announced their plans to increase space for bicycles, pedestrians and greenery by reducing the amount of on-street parking spots.

This part will discuss the key trends and innovation within the parking context identified during the interviews, observations and desk research.

P&R and Carpool Parking Lots.

P&R stands for "Park and Ride (in Dutch: "Parkeer en Reis"), this is a parking facility next to a public transport station. The aim is to reduce car traffic in urban areas by incentivise people to park their car outside of the city and use the public transport to continue their journey. Generally, the parking fare for P&R spots are free or very low compared to parking within the city center[2].

Carpooling Parking Lots are strategically placed parking lots that are commonly found next to highway exits and junctions near cities focussed on sharing tips like the daily commute with colleagues. By sharing the ride, transportation costs (fuel & parking) can be reduced. However, it may result in additional travel time since people are more dependent other people than in individual rides[3].

Automated parking garages

As observed in the Japanese metropoles, automated parking garages, sometimes referred as 'park robots, are also gaining popularity in Dutch cities[4]. Travellers can leave their car in the entrance of the garage and a mechanical system will automatically position the car in a designated spot. The main selling points of this concept is space reduction compared to traditional parking garages, as the human parking manoeuvre and spot finding demands room. However, the initial investment and maintenance costs of this system are much higher and are therefore only found in places where additional space was not available.

Autonomous valet parking

Traditionally, valet parking refers to the handover of the traveller's car to a driver who will take care of the parking. This is most commonly offered as a service by e.g. hotels and airports to save effort and time of the traveller. With autonomous technology being developed, this might be possible without involvement of a driver[5].

In the AD expert interviews, autonomous valet parking was evaluated as a feasible functionality of AV's in the 2030-2035 timeframe (by Aaron Nathan from Point One Navigation, Renee Shah from Waymo and Vincent Laurense from Stanford)[6]. Interestingly, the parking garage setting allows more conservative driving as the slower speed due the defensive driving behaviour of the AD system would not be experienced by the traveller since he or she won't be seated in the car. However, the waiting time for the pick-up should be taken into consideration.

IoT Parking Sensors

Multiple companies[7] have introduced wireless parking sensors that communicate whether a spot is available or not. The technology varies from the use of camera's with image recognition (one camera for multiple spots) to small proximity sensors for each parking spot. These systems enable parking operators and municipalities to get real-time insights into the locations of available spots. More traditional systems are able to determine available spots by counting the number of cars entering and leaving.

EV Charging during parking

With the introduction of electric vehicles (EV), the demand for a battery charging infrastructure has taken a flight[8]. The amount of EV chargers in the

[1] Knack (2018). Fact checker on time a car is parked, 95% is concluded (and still seems conservative by some researchers). From: https://www.knack.be/nieuws/belgie/factcheck-auto-s-staan-95-procent-van-de-tijd-geparkeerd/article-longread-1202843.html?cookie_check=1561299505

[2] More information on P+R in Amsterdam, source: https://www.amsterdam.nl/parkeren-verkeer/parkeren-reizen/

[3] Volkskrant (2018) Up and downsides of carpooling (NL). From: https://www.volkskrant.nl/economie/zo-veel-voordelen-en-toch-zo-weinig-animo-voor-carpoolen~ba1cb214/

[4] Blog 5. Interview with Maarten Jagtenberg, Parkeerservice.nl

[5] AVP Project (2019) Potential of valet parking. From: http://avp-project.uk/why-autonomous-valet-parking

[6] More information in blog 6.0, interviews with Waymo, Point One Navigation and Stanford on Autonomous Mobility.

[7] IoT park sensor examples:
Bosch: https://www.mcs-nl.com/producten/bosch-parking-lot-sensor/
Parkeagle: https://www.parkeagle.com/
SensIT: https://www.nedapidentification.com/nl/producten/sensit/sensit-ir-flush-mount-nb-iot/

[8] VNG (2018) Increasing demand for charging infrastructure by VNG (association of Dutch municipalities). From: https://vng.nl/files/vng/20180208_rapport_vng_def.pdf

Netherlands has raised from 400 in 2010 to more than 122.000 in June 2018, of which more than 32.000 are public chargers (accessible in the public infrastructure for a 'charging fee')[9].

Fast charging technologies (charging rate of 20KM an more) enable EV drivers to charge their vehicle in less than half an hour, dependent on the charging rate and battery capacity. However, the hardware is expensive and fast charging demands high peak capacity from the grid and does not seem to be ready for large scale implementation in urban environments[10]. The largest part of the infrastructure consists of charging speeds lower than 20KW which can take several hours to fully charge a battery (18.681 public regular chargers against 920 fast chargers in June 2018[9]. For this reason, charging facilities during parking has become an important requirement for EV owners.

Parking garage operators and municipalities are continuing to invest in infrastructure as the amount of EV's will continue to increase in coming years (Amsterdam announced their vision where only EV's may enter the city by 2030[11]). Initiatives around 'smart charging' are striving to answer the challenges around grid peak capacity and the high costs of infrastructure. J. Appelbaum from Evercharge mentioned that charging infrastructure is significantly cheaper when centralized on parking lots and garages.

Smartphone applications for parking

A variety of companies are innovating in the parking sector as 'parking brokers' by automating payment by smartphone, online availability check-up of spots and sharing platforms of private company parking spots on moments the occupancy is low (a.o. ParkBee and ParkMobile[12]). M. Jagtenberg from Parkeerservice.indicated how the sector expects major room for optimization when data streams are exchanged effectively (blog 5).

Small Electric Vehicles (SEV)

The municipality of Amsterdam is challenged by the upcoming popularity of SEV like 'Canta's' and 'Biros' with a 45km/h speed limit. Originally, they were created for elderly and disabled people, but then became very popular amongst young professionals as well. At the moment of writing, the policy on these vehicles becomes more strict and are under discussion as they are causing sidewalk pollution[13].

Reflection

The city policies around car-free city centers, AV's and electrification creates a strong opportunity field for service innovation around the parking ecosystem. Various signals indicate room for efficiencies that could benefit both habitants as city stakeholders. The design phase will elaborate this ecosystem.

Figure 39.1 - Small Electric Vehicle on a bicycle spot, this Biro is gaining popularity in Amsterdam since as it can park everywhere.

[9] Nederland Elektrisch (2109) Statistics on charging infrastructure. From: https://nederlandelektrisch.nl/actueel/verkoopcijfers

[10] Blog 6. Interview with Jason Appelbaum from Evercharge.

[11] Volkskrant (2019) Amsterdam wants to ban ICE (Internal Combustion Engine) cars from 2030. From: https://www.volkskrant.nl/nieuws-achtergrond/amsterdam-wil-benzineauto-s-verbieden-vanaf-2030~ba48c361/

GGD (2019) Action Plan Clean Air, Amsterdam & GGD. From: https://www.ggd.amsterdam.nl/publish/pages/910216/actieplan_schone_lucht_2019.pdf

[12] Examples of digital parking apps:
ParkBee: https://parkbee.com/
ParkMe: https://www.parkme.com/
ParkMobile: https://parkmobile.nl/

[13] Parool (2019) Small Electric Vehicles are not allowed on the bicycle lane and parking spots anymore. From: https://www.parool.nl/nieuws/rechter-biro-moet-van-het-fietspad~b9cabcd9/

RESEARCH REFLECTION & CONCLUSIONS

In the assignment the following objective was described: “The aim of the concept is to improve liveability in European urban areas by creating exceptional user experiences and humanizing* autonomous drive” (page 12). This part will reflect and conclude the research phase and serves as connection between the research and the synthesis.

The research phase focussed on catching the essence of this objective by exploring the following questions: How could we define and approach ‘liveability’ in the urban mobility context? How might the paradigm shift of autonomous, connected and electrified mobility shape our cities? What identifies the European market and are its cities evolving?

To gain insights on these socio-technical questions, expert interviews formed the backbone of the research phase. From the initial research questions above ‘knowledge fields and gaps’ were formulated that served as reference for choosing the appropriate experts. A selection of academia, municipalities and industry experts were interviewed about their perspectives on liveability, emerging technologies and urban mobility.

To gain understanding in the market differentiators and to gather inspiration, observations were done in Paris, San Francisco, Tokyo, Shenzhen, Hong Kong, Osaka and Kyoto. The observations provided perspective on how mobility is organised in across cities and showed the practical implications of culture, urban planning and mobility concepts.

The knowledge from leading researchers and experts like Donald Appleyard, Richard Senett and Jane Jacobs were used as reference. It helped in identifying larger trends in the last century that shaped the urban mobility context of today.

In the present mobility ecosystem, a paradigm shift was identified in new business models and technologies like micro mobility, electrification and servitization of travel. An analysis on Dutch emerging business models was conducted to grasp the essence of their target groups, user scenarios and they differentiate in their value propositions.

In order for the proposal to fit Ford, the research phase also focussed on learning about the vision, resources, values and market position of Ford. Both Ford Europe as the US (Greenfield Labs) were interviewed. This supported in identifying the characteristics of the European market.

The definition of liveability was put in relation with mobility, it was identified how cars provide freedom to move, but could also negatively impact the spatial quality, safety and connectedness in urban areas. It became clear how municipalities are questioning the role of cars in cities. They seem to shift towards a ‘richer’ ecosystem of modalities to improve liveability for its habitants. This shift is also a preparation for the expected growth in mobility demand in cities like Amsterdam (blog 10). The increasing demand for mobility also creates challenges for the industry, like delivery- and public transport operators. Picnic and PostNL feel challenged by car-free zones.

Blogs and vlogs served as mind map where learnings and inspiration from the desk research, interviews and observations were collected and communicated with the supervisory team. The informal character of the blogs and vlogs facilitated the documentation.

Going forward in the next phase, the parking lot ecosystem was identified as the main opportunity field for this project as it closely relates to the presence of cars in urban areas. Additionally, some of the emerging technologies seems closely related with this context. The synthesis elaborates the translation from research to vision and provides insight in the vision and the design approach.

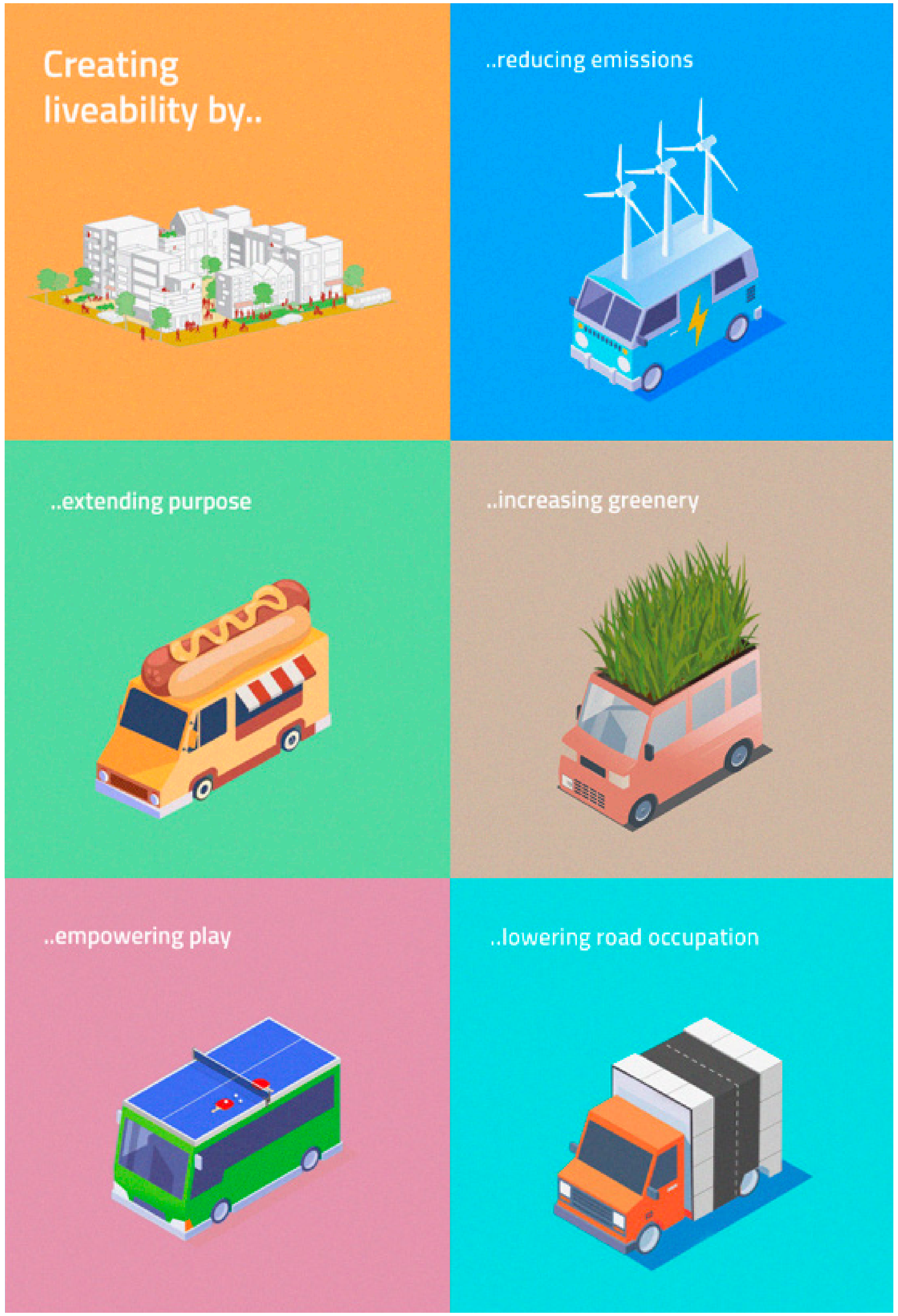


Figure 41.1 - Exploration on how the purpose of vehicles might be extended to impove liveability.

PART C
SYNTHESIS

Figure 42.1 - Parking lot operators are important initiators of shared mobility in Japan, as they own suitable spots for hubs across the city

In part C the synthesis process and outcome will be elaborated by answering the following questions:

- What are the five main fields of interest from the analysis phase?

- What are the design goals and vision serving as fundament for the concept phase and how have they been formulated?

- What are the design steps that led to the concept proposal?

Design Vision

"I want to create more liveable cities by making Ford enabler of the shift to off-street parking. Therefore, I envision a novel parking ecosystem that enables a dialogic approach towards data sharing."

SYNTHESIS

The research explored a broad variety of elements that shape the urban fabric[1], mobility, the industry and liveability. This page brings the main fields of interest together as an extraction of the research phase. The five fields formed the stepping stone for the ideation and concept development. For each of the fields, a selection of initial questions were formulated to spark ideas.

1 Urban Fabric TU Delft (2019) Urban fabric refers to the physical urban environment (elements, materials, form, scales, density and networks), and to its psychological, socio-cultural, ecological, managerial and economic structures. From: https://www.tudelft.nl/en/architecture-and-the-built-environment/research/research-at-bk-bouwkunde/urbanism/design-of-the-urban-fabric/

Democratise Streets (page 26-29, 34-37)

The desk research on city policy publications, future visions and interviews with urbanists indicated the desire to decrease the number of cars within city centers and push for shared- and active modes of transportation. Among Donald Appleyard, influential sociologists and urbanists already advocated for more public space in the 20th century as response to the modernist (where cars dominate) movement.

Ford: What is the role and presence of an OEM like Ford in a future Amsterdam and how might Ford contribute by 'Democratizing Streets'?

Coverage & Peaks (blog 2.0, 3.0, 5.0)

Both private as public companies struggle with a mobility coverage gap in suburban areas by public transport and shared fleets. The areas are often unprofitable since the demand is lower than in vibrant city centers, which leads to a low density (or non-existent) network. SCRIPTS Delft researches opportunities in on-demand mobility in these areas.

Mobility and logistic providers indicated increased challenge in managing peak demand. Think of the daily peaks for the public transport, Christmas for logistic providers and the increased pressure on the energy grid because of electrification. The experts indicated that infrastructure is overpowered most of the time, there might be a lot of unused potential.

Ford: Will private car ownership remain the best way to cover suburban areas? How might the efforts of Ford in shared mobility, logistic solutions and servitization translate to these areas? How to approach peak demand challenges in the energy grid and demand for mobility?

Autonomous Tech (blog 7.0)

Reflecting on the context of 2030-35, experts indicate full autonomous drive won't be feasible in busy city centers where pedestrians and cyclists mix up organically. Controlled areas like highways and parking lots are more viable on the short term.

Ford: What might we expect from AD in 2030-35? What are opportunity areas for such technology?

Data exchanges (ITS blog, page 60-63)

The interviewed mobility and service providers are striving to create more integrated and intermodal services for their customers e.g. based on people's schedules and preferences. The industry is seeking for data ecosystems where data can be gathered, exchanged and used for product improvement.

Ford: Who will 'own' such platforms? What role might the TMC have in empowering partner ecosystems? What kind of data should be exchanged to enable functionality? What is the role of vehicle telemetry?

Parking (Blog 5.0, 7.0 and page 38-39)

Cars are parked 95% of the time, claiming a large amount of public space in urban areas and negatively impacting spatial quality. Cities are increasingly introducing policy and urban planning allowing fewer cars within the city. Emerging technologies might offer perspective for novel services in the parking ecosystem.

Ford: What are the current barriers in off-street parking? What services could Ford introduce to facilitate the shift to off-street parking while delivering freedom to move to users?

Figure 45.1 - Where ride hailing is very common in San Francisco, conventional taxi's were dominant in Tokyo (picture from the field trip).

PROJECT GOALS

The project goals represent the key objectives that should be covered in the proposal. They are formulated with the parking ecosystem as strong field of interest in mind. The four goals bring together the original assignment goal alongside with more specific solution-space oriented goals.

1. Increase liveability for city habitants

As formulated from the start of the project, we aim to deliver a concept that does not only deliver value to the traveller, but offers a positive attribution to city liveability in general by 'democratising streets'.

2. Open the doors for Ford to create ecosystems

The Transport Mobility Cloud and internal interviews provided concrete indications that Ford seeks collaboration with city stakeholders. This project seeks to empower the creation of such ecosystems by leveraging the TMC and enabling dialogue.

3. Rethinking the potential of a vehicle

Let's think differently about what a car can do while it is not used. Currently 95% of the time a car are parked, the goal is to subtract more value from these unused moments and assets.

4. Offering peace of mind to the traveller

As described in the initial assignment, cities will become increasingly complex and chaotic, however, we also see technologies emerge that could propose an answer by making our cities smarter. The goal is to use these technologies to offer peace of mind to the traveller when travelling.

Increase liveability for city habitants.

Open the doors for Ford to create ecosystems.

Rethinking the potential of a vehicle.

Offering peace of mind to the traveller.

VISION

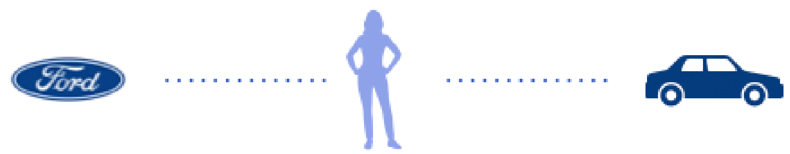
The following vision was formulated based on the research synthesis, interest and resources of Ford. It served in getting everyone on the same page for the concept direction. An elaboration on the dialogic approach and data sharing is given in the following parts of the report.

Solution Qualities

The solution qualities describe the key characteristics the proposed solutions should have to be evaluated as a good solution

Interaction anologies

Analogies were formulated that describe the relation between Ford, the Product Service and the traveller. It helped in defining the feeling and function the product service should have.,



Relation Ford & User

Like relation between an investor and his advisor
- *Trustful*
- *Communicative*
- *Explorative*
- *Evolving*
- *Guiding*

Relation User and Product-Service

Like relation between the guest and his host
- *Welcoming*
- *Unburdening*
- *Empathic*
- *Explorative*
- *Intuitive*

DESIGN THE OFF-STREET PARKING SHIFT

Incentivising the transition from on-street parking to alternatives like parking garages outside the city centers demands for an approach with a broader perspective than then the systematic behavioural models presented by Ölander and Thøgersen (1995) and Fogg (2009). To gain understanding in the role of design and designers in Socio-Technical Transitions prof. R. Price provided guidance in involving the emerging practice of Transition Design.

Initiating shift

The research phase provided a combination of insights and trends that are visible in the urban environments and the industry. As described in the design vision, we aim to empower the shift from on-street parking in city centers to off-street parking like parking garages and P+R parking lots. Currently, a set of both social as technical barriers are blocking this shift to take place.

M. Jagtenberg, Business Manager of Parkeerservice mentioned how car drivers experience anxiety about intermodal trips and a lack of incentive (e.g. by policy of economic reasons) to do so. This kind of intended transitions might be a too large challenge to solve with traditional design methods and behavioural models. Traditional behaviour models focus on triggering users on microlevel by creating the right alignment of motivation and ability in order for people to act in a specific scenario and moment of time (Fogg, 2009 or Ölander and Thøgersen, 1995)[2].

The need for dialogue

This challenge might demand a socio-technical system approach by enabling the shift of multiple levels in the system (Geels, 2002). This approach encompasses not only product or service design from an individual company like Ford, but collective efforts on multiple layers like policy, infrastructure, industry and culture.

Prof. R. Price explained how such a transition can take place when both public as private organizations collaborate and interact. An important requirement for this to happen is that the stakeholders should be able to have dialogues to understand the perspectives and complexity of each other's interests, challenges and resources.

The ideation phase of this project explored a set of practical solutions areas that already exposed the need for dialogue on data sharing and environment design. Some of the following questions came up: How might we initiate collaboration to guide transition to off-street parking? What could be the role of Ford in this system? What are the design interventions over time than enable this transition?

[1]. Blog 5.0, interview with Maarten Jagtenberg from Parkeerservice.nl

[2].Ölander and Thøgersen (1995) Understanding of Consumer Behaviour as a Prerequisite for Environmental Protection. Source: https://link.springer.com/content/ pdf/10.1007%2F-BF01024160.pdf

Fogg (2009) A Behavior Model for Persuasive Design. Source: https://www.mebook.se/images/page_file/38/Fogg%20Behavior%20Model.pdf

[3]. Geels (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. From: https://www.sciencedirect.com/science/article/pii/S0048733302000628

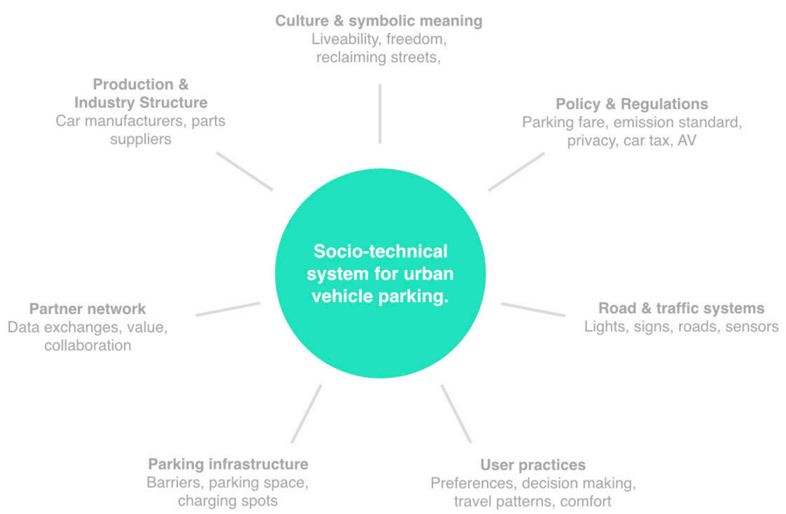


Figure 48.1 - The Socio-Technical Systems for urban vehicle parking, based on socio-technical system theories of Geels (2005)

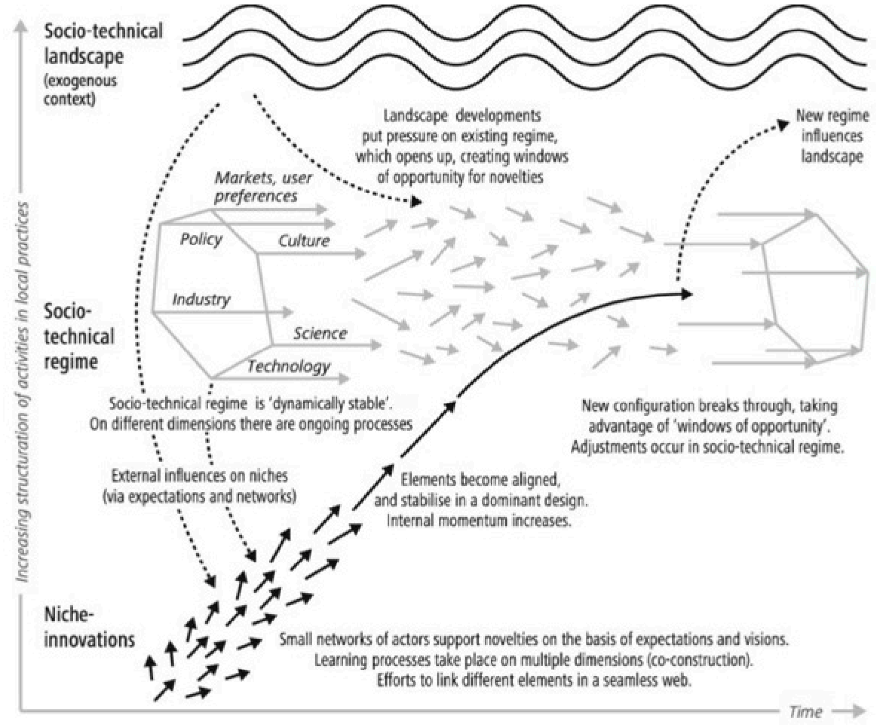


Figure 49.1 - How to enable transition: The collective shift of multiple levels of a system, prof R. Price.

Transition Design

The transition design practice (Irwin, Kossof & Tonkinwise, 2015[4]) describes how design-led transitions can take place. Transitions can be created by breaking up the lock-ins that define the present ecosystem. A destabilised system creates space where the existing Socio-Technical system can be replaced by a new system and thereby guides the transition. This room is also referred as *window of opportunity*.

The timing and speed of this transition require attention by the designers of them for successful transitions[5]. Although the Transition Design Framework is a comprehensive methodology across projects, some ideas from this framework have been used (relatively late) in the conceptualization phase of this project.

[3]Irwin, Kossof & Tonkinwise (2015). Transition Design: A Proposal for a New Area of Design Practice, Study, and Research. From: https://www.researchgate.net/publication/282432370_Transition_Design_A_Proposal_for_a_New_Area_of_Design_Practice_Study_and_Research

[5]Price, R (2019). In Pursuit of Design-led Transitions.

Figure 49.1 - In the spirit of Henry Ford who democratised mobility, the current discussions in municipalities and urbanists in The Netherlands focus more on reclaiming streets for people. Might it be time to 'democratise streets'? (picture from Newae.nl)

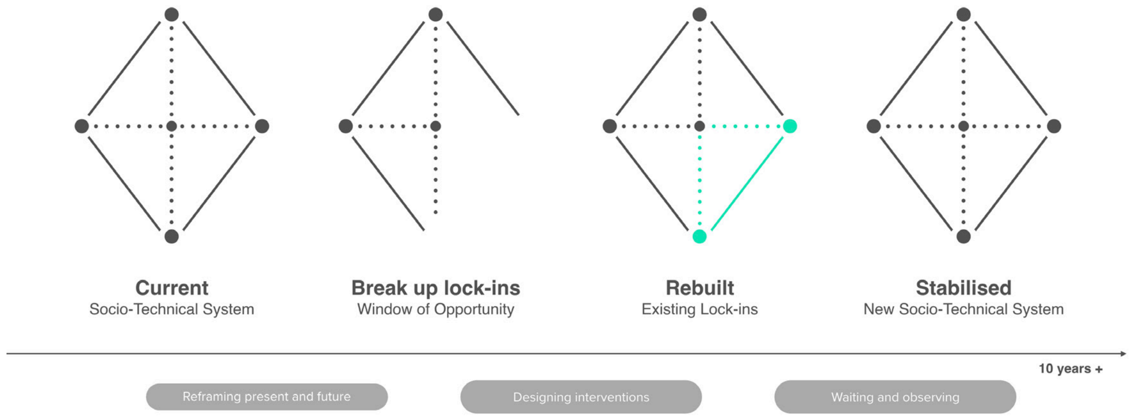


Figure 50.1 - How to enable transition: The collective shift of multiple levels of a system, prof R. Price.

Multi-Level Perspective Map

A multi-level perspective analysis was conducted to gain understanding of the macro market dynamics and trends across the century.[1] It explores elements of the various levels of a socio-economic system and their relations over a period of time. For this exercise the timeframe was chosen from early 1900s until +/- 2040. The three levels are: landscape, regime and niche (figure 44.2). The following macro trends were formulated (divided over unequal timeframes):

[1]Transitiepraktijk (2019) Hand-out from de 'Transitiepraktijk was used as reference for the MLP method. From: https://transitiepraktijk.nl/files/Hand-out%20MLP%20Assignment.pdf

Cars democratise mobility, increased distances

As described on page 14, the mass-produced car in combination with the increased wage by Henry Ford democratized mobility. It initiated the large-scale transition from horses to cars, drastically changing the landscape, especially visible in larger and modern cities like New York, Detroit and Paris.

Cars as symbol for freedom and status

As the cars gained important presence in cities and the infrastructure became more mature, the car market diversified and increasingly became a symbol for freedom and status for a broader part of society. Urban planning was focussing on prioritizing the car in street design (e.g. increase of parking spots,

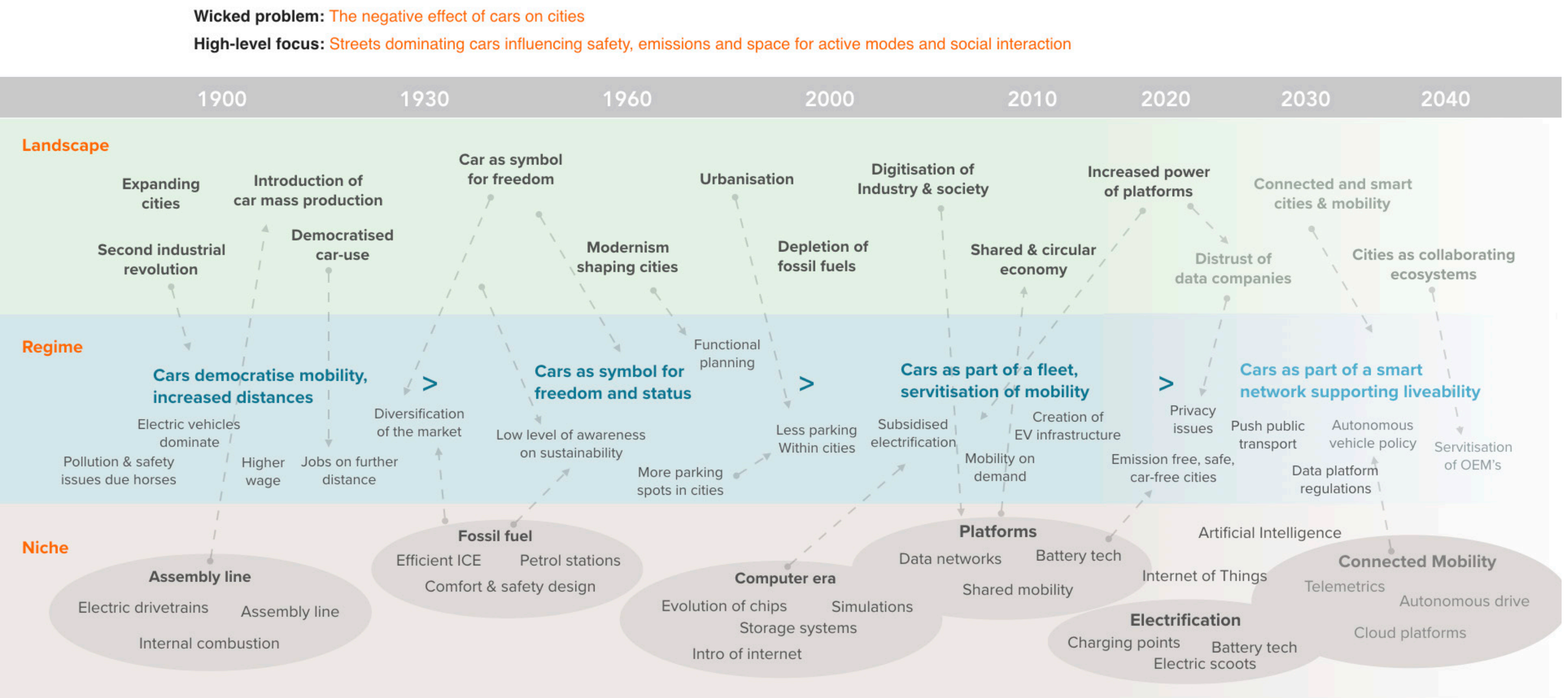
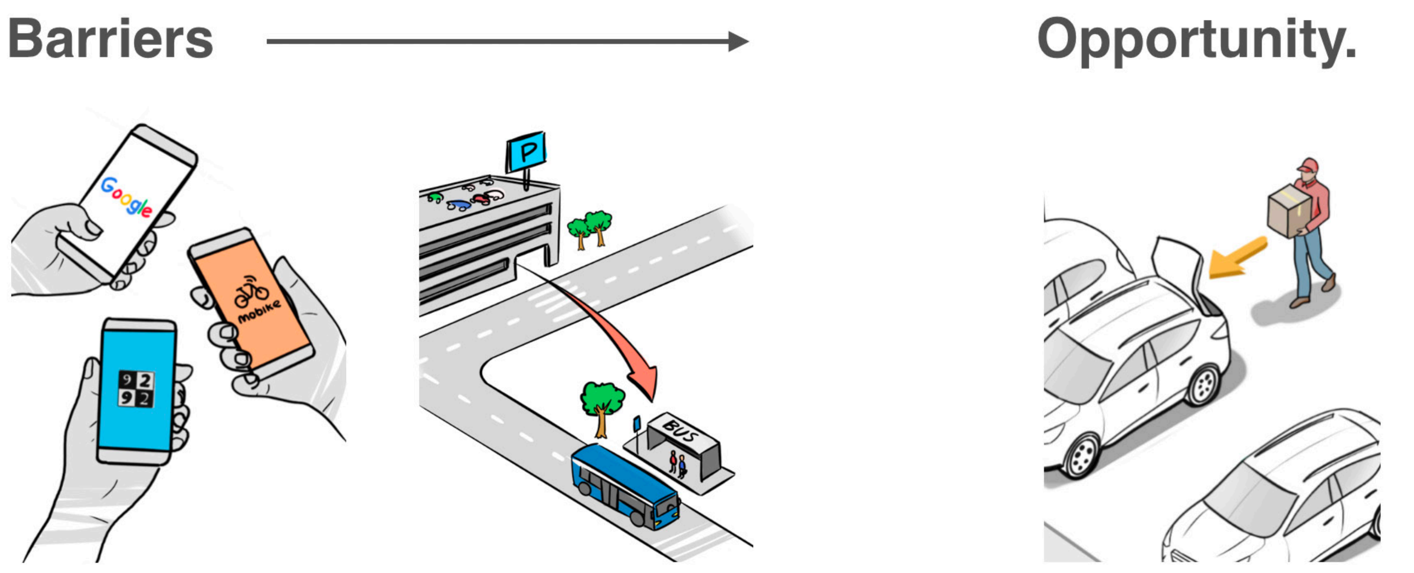


Figure 50.2 - In the spirit of Henry Ford who democratised mobility, the current discussions in municipalities and urbanists in The Netherlands focus more on reclaiming streets for people. Might it be time to 'democratise streets'?



- Limited intermodal integration
- Hard to compare choices

- Lack of seamless connections
- Uncertainty on fleet availability

- Additional services
- Cost & time reduction and sharing

Figure 51.1 - Barriers in the current system that should be broken, in order to rebuilt a new system by design interventions, creating opportunity for the transition to off-street parking.

highways and signage). Additionally, cars became capable of driving large distances which enabled international tourism on a large scale.

Cars as part of a fleet, servitization of mobility

The introduction of the computer and internet era enabled new business models, as people started to carry smartphones, services like Uber disrupted the mobility market with the servitization of mobility in large cities. Car ownership starts to shift towards mobility as a service, millennials perceive emerging business models differently and seem more open to MaaS value propositions instead of car ownership.

Cars as part of a smart network supporting liveability

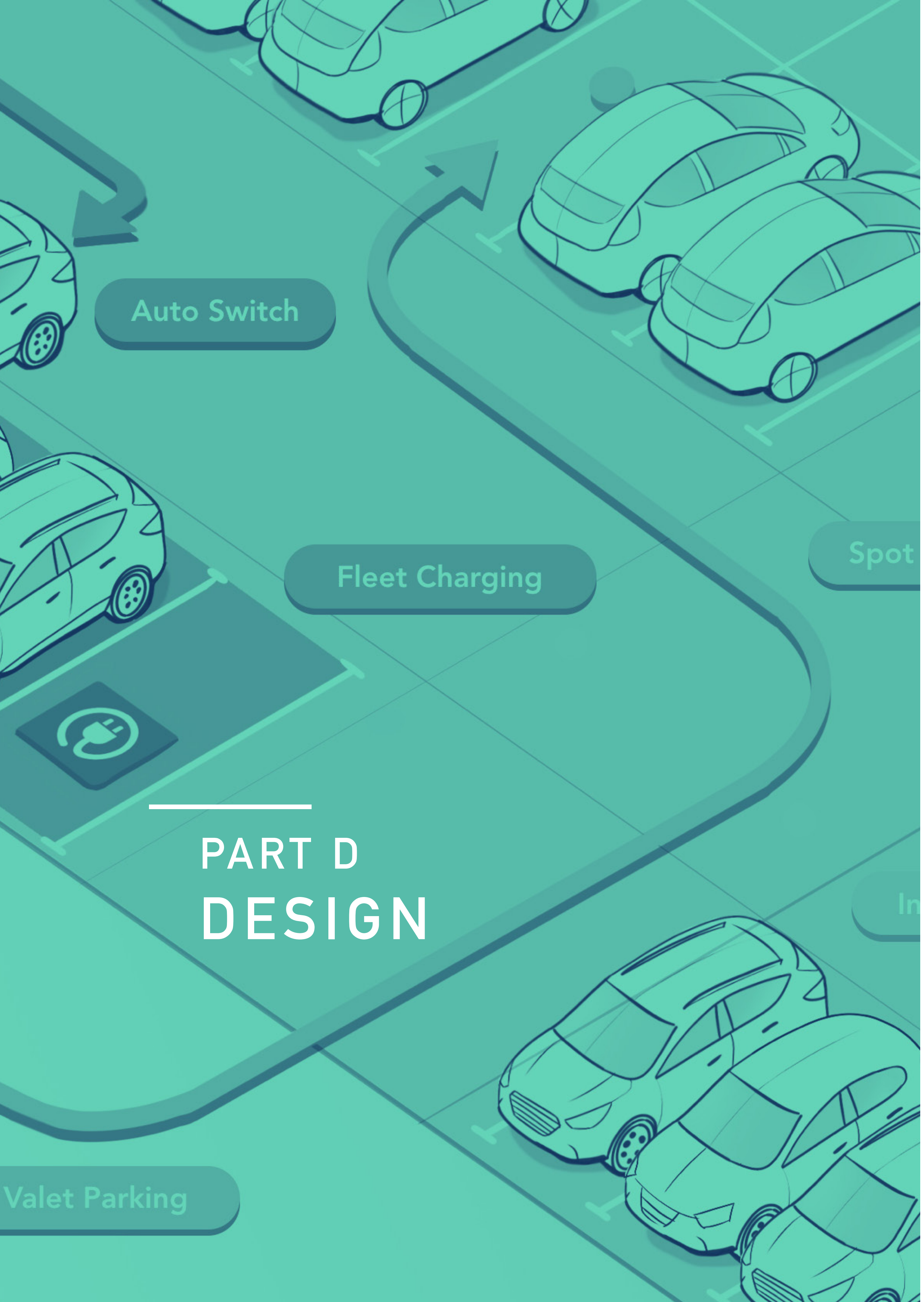
Large IT companies like Google, Amazon and Apple are entering the mobility market, as cars shift from 'stand-alone' devices into 'driving smartphones'. AD and V2X communication enable new value propositions, enhanced safety and optimal traffic regulation on macro scale. The car becomes part of a fleet and infrastructural network.

Reflection

Although the Transition Design theory was only introduced relatively late in the project, it changed the approach towards the deliverable. Initially the intention was to create a one-off product service proposal, but then realised such transitions demands a broader approach on various levels.

Going forward, the project was approach by considering the broader perspective of stakeholders, interests and abstraction levels. The intention of the deliverable shifted towards a more open-ended proposal, that leaves space for design interventions by enabling dialogue. The product-service proposal remained part of the deliverable as it served as a framework and enables communication; it makes the underlying ideas concrete.

In the Design Phase the envisioned parking ecosystem is created and the Ford Transport Mobility Cloud and valuable data exchanges within this environment are explored.



PART D
DESIGN

This part elaborates on the design process, methodologies and the outcomes. This phase was an iterative process and the directions have continuously been aligned with Ford to ensure the outcome is in interest of the Ford Aachen team.

"Defining the role of Ford in future liveable cities is about finding the right partners and being concise about what part of the chain Ford can deliver value."

Ryan Westrom (2019) - Partnerships Lead @ Greenfield Labs

OPPORTUNITY FIELDS

An illustration was made to loosen up the mind as preparation of the ideation phase (figure 43.1, page 41). From there, opportunity fields for the product service were synthesised from the research as fundament for the design phase. This part elaborates the rationale of the product service pillars.

Product service

During the project kick-off, the aim was to create a product-service, aligning with the transformation of Ford moving from the value chain of 'production of product' to 'servitization' (as described on page 30). The need for a dialogic approach was identified after the initial design vision was formulated and had implications for the deliverable. Still, the product-service was maintained as deliverable as it provides a more tangible perspective on the system approach as described from page 66.

Seamless multimodal journeys

Parking off-street could improve liveability by declining the number of cars in the public space (page 34). However, off-street options like P+R and parking garages are often not on a reasonable walking distance from the destination (figure 35.2), there is a last mile that should be bridged. A well aligned combination of different modalities could enable faster and cheaper travel. However, *mode transfer* could be experienced as a hassle, dependent on the transfer time and ease.[1]

There are some reasons that may cause people not to consider intermodal travel: it may be time consuming and complex to seek and organise information on multiple digital platforms to align information on parking availability, public transport schedules and pricing.

Many of the mobility providers offer planning tools that are limited to their services and their partner networks. This situation can lead to anxiety and misalignment when trying to plan a journey. For this reason, 'Seamless journeys' have been defined as a desirable characteristic for the concept. It should be noted that Google Maps is has started to integrate additional transport modes into its trip planner like Uber and it recently added the electric scooter network of Lime in more than 80 cities[2].

In this search field (seamless journeys) ideas around providing guidance (think of a fully integrated planner or assistant), automatic payment (of the trip, parking and charging) and the facilitation of the transfer to the last mile mode were defined as opportunity spaces (page 56).

[2] Engadget (2019. Integration of Lime in the Google Maps application. From: https://www.engadget.com/2019/03/04/google-maps-lime-scooters-80-locations/?guccounter=1

[1.] CVS (2014). Research on the rating of transferring between modalities. Results indicate that a transfer of 8 minutes is preferred on average. Source: NS - Waardering van een overstap tussen bus/tram/metro en trein. From: https://www.cvs-congres.nl/cvspdfdocs_2014/cvs14_048.pdf

Figure 54.1 - Collaborative session with the Ford Aachen team to explore how Ford might be of value in fictional roles, this exercise helped understanding the capabilities, resources and interests of Ford as a company - in perspective to the research outcomes.

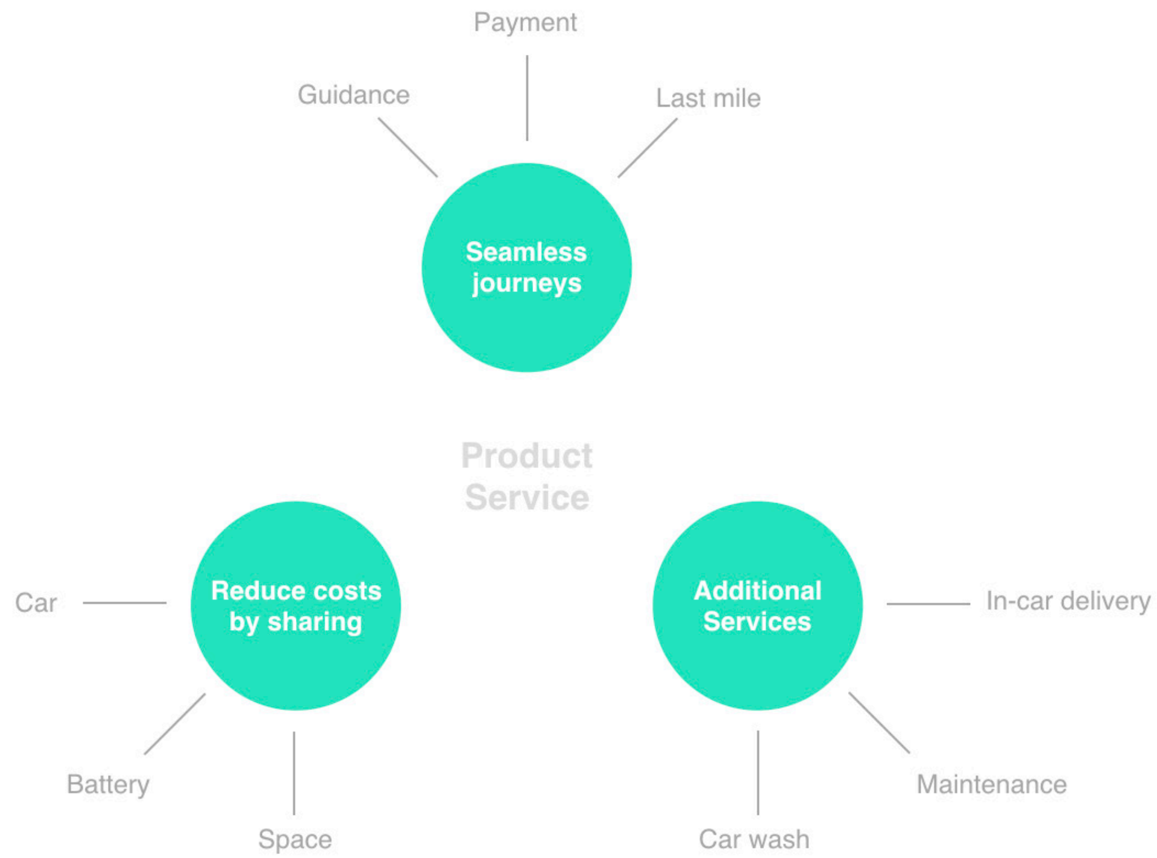


Figure 55.1 - Overview of the opportunity spaces of the product-service, these spaces served as focus areas for the idea generation.

Reduce costs

The costs of a journey could be a motivator for people to choose between journey options. Ideas were explored on how to reduce costs of a journey could when choosing for off-street parking. Part of the Amsterdam Autoluw plan[3] is to increase the costs of parking in the city center significantly, dynamic parking fares are used to disincentivise people to park during high demand time frames. The same principle applies to electric charging, where grid operators provide energy for lower fares during low peak[4]. Next to anticipating to low and high peaks, vehicle sharing (and its assets) could help in decreasing costs of travelling, a car could be shared while the owner is gone for his or her working day (as mentioned in the interview with the P2P sharing platform SnappCar, Pijke Dorresteijn).

Additional services

Connected cars enable third parties to interact with the vehicle while the owner is somewhere else. Recently Ford partnered with Amazon on In-Car Delivery services. Comparable third-party services while the car is parked can be imagined around maintenance and car cleaning.[5]

This opportunity space can be interesting as off-street parking generally happens in parking lots where a large amount of cars can be found. This centralised area for cars sparked new ideas, imagine how in-car delivery would be much faster when the delivery guy has all his deliveries in the same parking lot building, this creates efficiencies that were absent when cars are decentralised in a city.

Conclusion

These opportunity fields served as input for ideation methods like brainwriting and ideation sketching. In the following part, concrete product service ideas around the parking ecosystem are presented. The crux was to generate ideas that have a competitive advantage when relating it to the parking ecosystem.

[3]Amsterdam Autoluw (2019). Amsterdam aims to decrease the amount of cars in the city center by policy and street design. From: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/fijne-buurten/autoluw/ (2019)

Amsterdam (2019) Liveability Amsterdam Initiatives. From: https://www.amsterdam.nl/bestuur-organisatie/volg-beleid/ambities/fijne-buurten/

[4]Tweakers (2018)Van snelladen tot slim laden. From: https://tweakers.net/reviews/6639/9/van-snelladen-tot-slim-laden-voldoende-laadpalen-voldoende-stroom-tot-slot.html

This was also discussed during the interview with Evercharge (blog 8)

[5]Ford (2019) In-car delivery for the connected vehicle. From: https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/30/ford-amazon-key-in-car-delivery-service.html

IDEA GENERATION

The opportunity spaces seamless journeys, reduce costs and additional services formed the fundament for the idea generation. It is around these spaces that ‘how to’s’ were formulated. The key ideas have been translated to the sketches on page 53. This part will discuss a selection of the ideas and methods used for the idea generation.

Ideation methodologies & approach

The Delft Design Guide[1] served as a reference for techniques: brainwriting, how to’s, mind mapping, storyboarding and functional analyses were used during this phase. The opportunity spaces served as focus areas for the idea generation.

Third party services

Ford started collaborating with Amazon around the In-Car Delivery[2] service that is enabled by sharing a digital key. Key sharing together with autonomous drive (within the parking lot) could create opportunities like maintenance and car washing while the user is away, saving valuable time. Parking lots provide a centralised service area.

Calendar based connections

By using user agenda data, the car can communicate to third parties how long the car is available for services. For example: a car can automatically log in to a P2P car sharing network while the owner is away to earn some money[3].

Personal assistant

Guidance can be provided with a personal assistant, that humanizes the contact between user and the hardware. AI will enable digital assistants to conduct conversation with users in a more natural way.

Vehicle 2 vehicle and grid

In perspective of the electrification trend, future parking lots with a significant number of electric cars in one building could be considered as a power plant where lots of energy can be collectively stored an redistributed. This storage and redistribution can be managed by a system that keeps track of expected usage, energy price and time of stay.[4]

FordPass Platform

Integration with the FordPass platform[5] would leverage the existing user base and behaviour. Region specific features (based on policy, mobility provider and infrastructure of that area) could offer services and experiences anticipating on the location of the user.

Car to bike transitions[6]

This is an idea inspired by the bike racks and compartments in the public transport of San Francisco, enabling intermodal journeys that are non-dependant on last mile fleets systems.

Autonomous spot detection & valet

On-car cameras could crowdsource data on parking lot availability, improving the accuracy of trip planners. Valet parking could make the transfer between modalities smoother.[7]

Conclusion

The ideas that sparked most insterest at Ford were the ideas around data sharing, AV metadata and leveraging the fact that cars might find synergies as they are centralised in one building. The more practical ideas around bike racks were evaluated as less desirable by Ford.

[1]Boeijen, Annemiek van, Jaap Daalhuizen, J. Zijlstra, and Roos van der Schoor. (2014) Delft Design Guide: Design Methods.

[2]Ford (2019) In-car delivery for the connected vehicle. From: https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/30/ford-amazon-key-in-car-delivery-service.html

[3]Blog 3 - Interview with SnappCar, Pijke Dorresteijn on P2P car sharing.

[4]Blog 7. with Jason Appelbaum from Evercharge on V2G solutions.

[5]Ford (2019). FordPass platform for the connected car. From: https://owner.ford.com/fordpass.html

[6]Blog 7. Bike racks on buses and bike compartments in CalTrain enable people to drive the fist and last mile by a personal bike.

[7]Blog 7 - Interview with Point One Navigation, Waymo and Stanford about spot detection with AV.

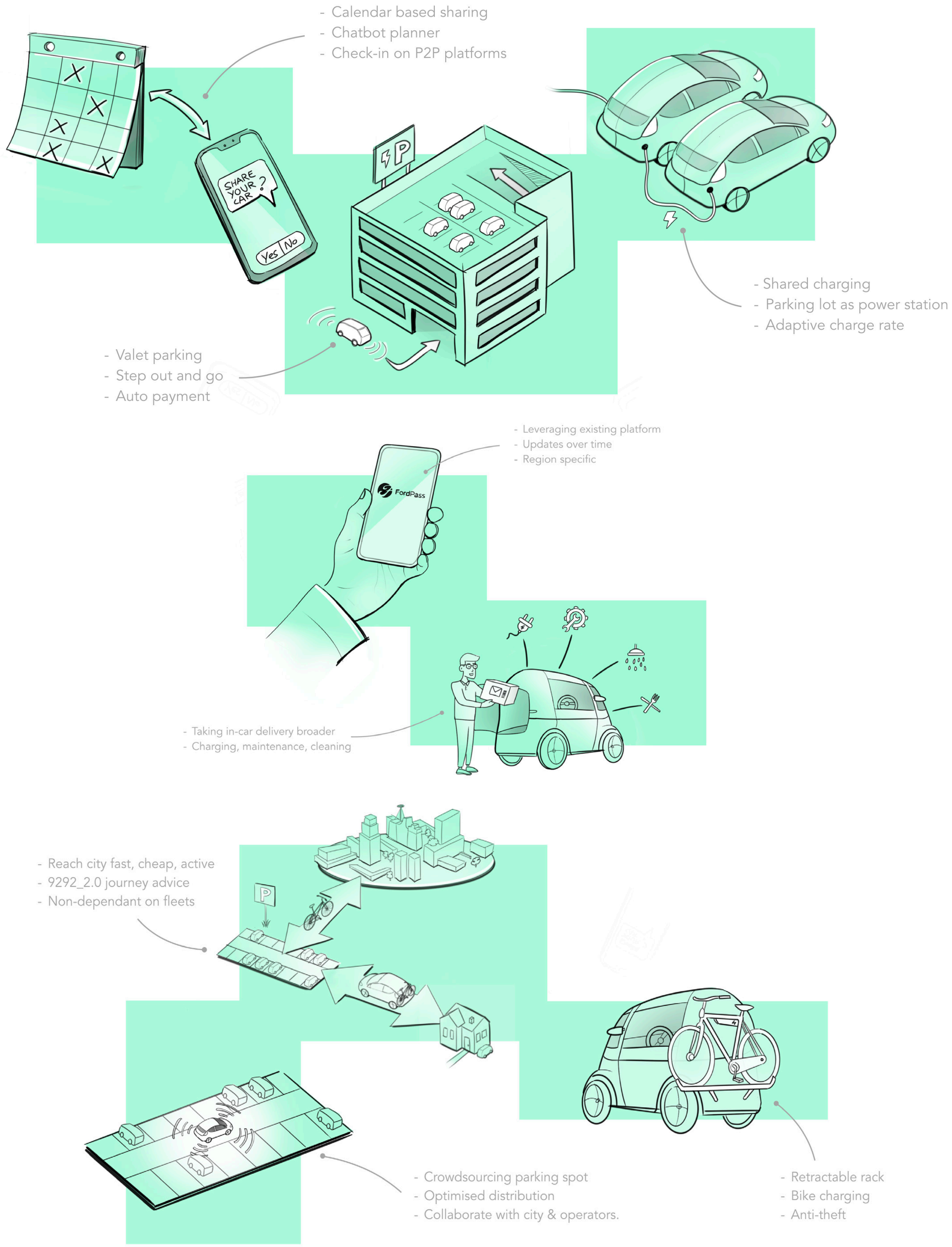


Figure 57.1 - Ideation sketches were made to communicate the key ideas during the ideation phase.

PARKING ECOSYSTEM

A sketch of the envisioned parking ecosystem was made to bring the key concepts and ideas together. The ideas share the objective of unburdening the traveller during his or her journey and offering additional services. The sketch served as a communication tool during the design process.

Mode Transfer

Instead of planning a journey considering only one modality per trip, combinations between different modalities could be considered. Where this is allready prevalent within the public transport ecosystem (9292OV planner) and some P+R (car and public transport) locations, there might be a unused potential that could be unlocked when the digital trip planners seeks combinations between modalities.

Valet Parking

Just leave the car in front of the parking lot and the car will find its way to an empty spot. Autonomous technology enables parking in empty spots without inteference of a driver. During the expert interviews with Point One Navigation, Stanford and Waymo it was pointed out that the AD system can drive more conservatively, as the driver left the car (which makes this scenario feasible in the timeframe).

Induction Charging AD Switching

Installing charging points on every parking spot is expensive as a lot of hardware is required, which also adds up to the installation costs. Additionally, grid capacity may be limited, which would cause slow charging speeds. Autonomous drive enables an automatic switching operation between cars and using induction charging no human interaction is required to start charging.

Fleet Charging

Looking forward in 2030-2035 there will be a significantly larger amount of EV's in parking lots, some initial pilots are launched around Vehicle 2 Grid (V2G), this may be especially interesting in the parking lot context as it centralizes a lot of cars in a small amount of space. The parking lot may be considered as one large battery that makes optimal use energy price peaks and lows.

Spot Detection

Where valet parking uses its vision system to identify empty spots, multiple AV's could also crowdsource data about parking spot availability for other cars. There are various parking sensors available on the market, but they require relatively expensive installation and maintenance. It could be preferable to leverage the meta data from AV's to gather data about available spots. One downside: the refresh rate would be lower than a permanent sensor for each spot.

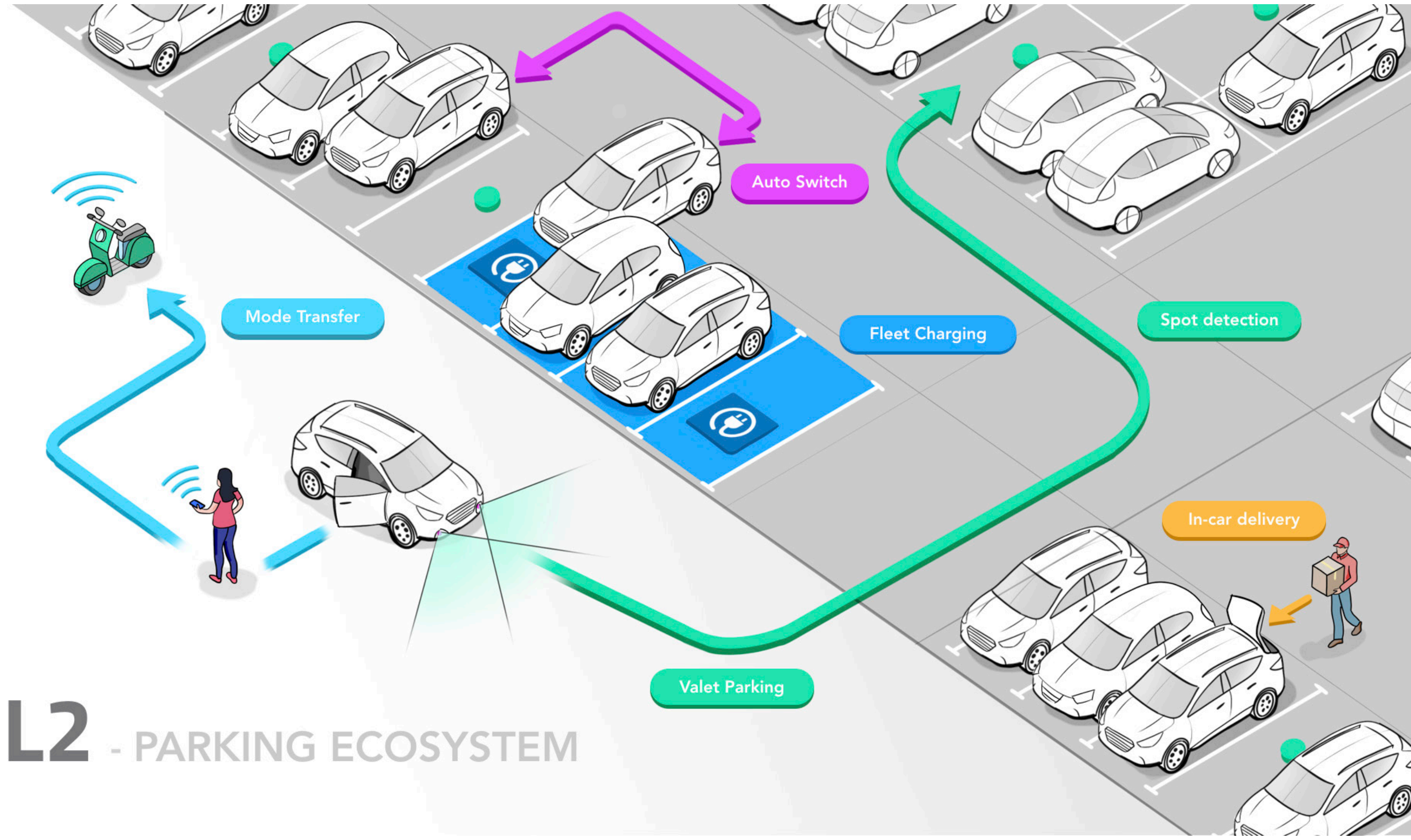
In-car Delivery

Amazon started In-car delivery with Ford and several other OEM's. The parking lot environment could boost the operation efficiency as a lot of cars are parked closeby. As learned during the interview with Picnic and PostNL, the 'door-to-door' time is an important parameter for the operation costs. Centralizing delivery points (cars) in a parking lot could eventually make delivery cheaper in the future. The delivery operators should somehow have access to the parking lots.

Required sensors

Carlo van de Weijer mentioned one of his beliefs during the interview: *"Don't create smart roads and infrastructure, but use smart vehicles to do those tasks."*. He believes that is it much more scalable to

Figure 59.1 - Parking ecosystem overview with the integration of various concepts.



leverage sensors that are (or will be) allready in the car instead of adding expensive sensors in the road.

Car Sharing

The car owner could be given the possibility to share his or her car during time the car is parked. If the parking time is long enough (let's say more than half a day), the car could show up as available on P2P sharing platforms like SnappCar. During the interview with SnappCar, Pijke Dorresteijn allready mentioned they put effort in making it as easy as possible to offer the car on their platform when not used.

On-location Maintenance

Instead of having to drive to a service center, the service center could come to the car for small issues, or even pick up and drop off the car from the parking lot if the time allows. The car could be opened with a digital key after access is granted to the service provider (the same applies to a car wash).

Optimised parking space

In the current parking ecosystem, travellers decide which spot they take based on what they see. In a future where vehicles and the building can communicate, a more optimised distribution can be envisioned that leads to a smoother flow. Additionally, the space between cars can be minimalised as people do not have to step in or out of the car when parked next to another valet car.

Payment

Automated payment of the parking fare seems an obvious (and existing) integration. There are currently several applications like ParkBee that offer digital payment and resevation of spots.

Conclusion

In the next steps, a selection of ideas is elaborated on several layers like technology, data and experience requirements.

DATA CONVERSATIONS

Users, infrastructure and vehicles are increasingly interconnected, some ideas from the ideation require communication between stakeholders, infrastructure and vehicles. Think of intermodal travel, fleet distribution and in-car delivery: they all require data exchanges to enable functionality by making decisions on a system level. So, what are those data points? How do they lead to functionality? What new combinations might we think of?

Talking infrastructure

The 3 examples below illustrate the role of data in mobility operations as learned during the interviews and desk research.

Intermodal travel

As described on page 54, intermodal transport can be beneficial in some scenarios. In order to calculate an optimal route considering the two mobility providers e.g. train and bike, their services should be aligned in some way. This requires information about the train schedule and the availability and location of the shared bike.

Fleet distribution

During the interview with SnappCar and Amber the distribution of their fleets was considered as a major challenge, as the natural balance of such systems is not necessarily the best answer to cover offer and demand. Let's take MoBike as example, in order to balance their bicycle fleet over a city, they have to know the current distribution and desired distribution. They use location data and a distribution model to decide how to distribute their bikes.

In-car delivery

The deliverer should know where to find the car at what time, additionally he should receive a digital key that enables him to open the car. At the same time, the user would like to receive status information.

Conversational Prototyping

Inspired by the 'acting out' method, fictional conversations between vehicles and external devices were conducted which were called 'conversational prototypes'. The result was a set of humanized conversations between e.g. the car and a charging point and a delivery operator with the vehicle and user. The aim was to gain understanding into data exchanges between stakeholders, infrastructure elements and vehicles.

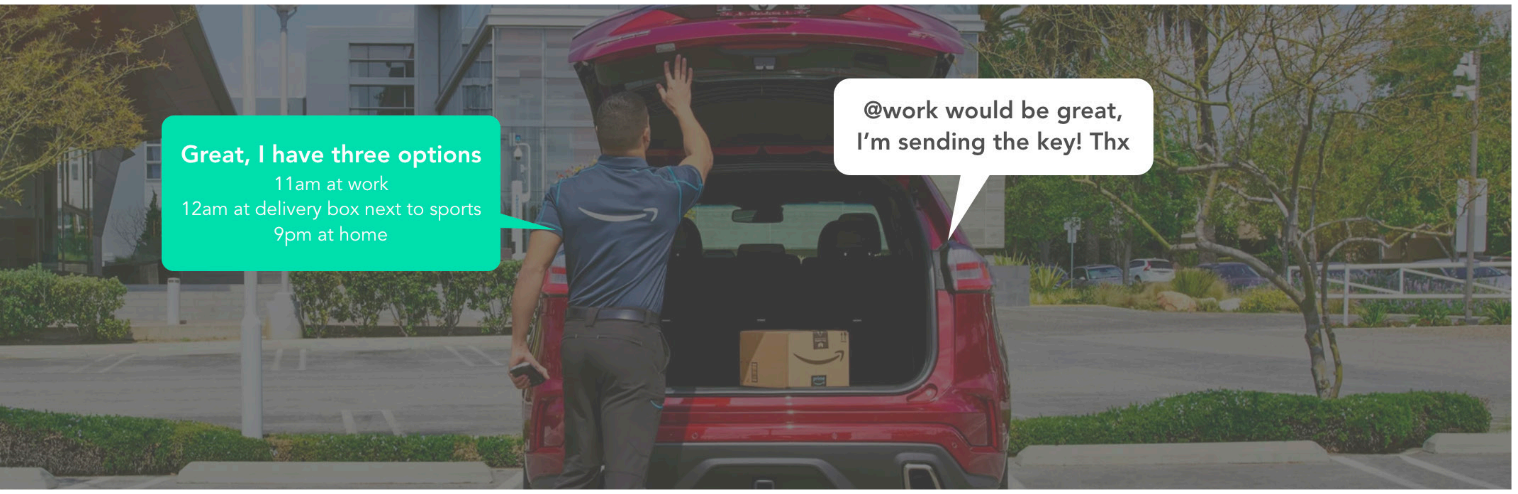


Figure 60.1 - Part of the conversational Prototyping to define data exchanges for the in-car delivery scenario.

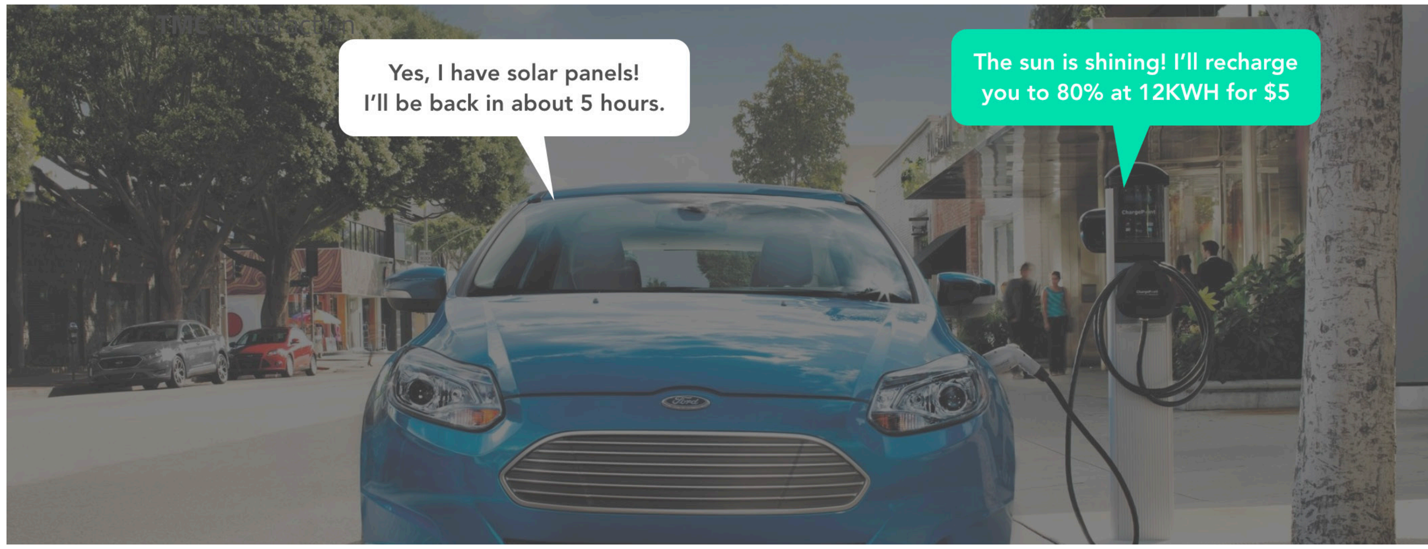


Figure 61.1 - Conversational Prototyping for the EV Charging scenario.

The 'human' communication style facilitated the process of decrypting the basic data points that are exchanged to enable functionality. These 'mini-exercises' were initially conducted with fellow students, but later formed the basis for the maquette as dialogue tool.

Reflection

Humanizing the technical back-end of data exchanges seemed to open the dialogue for people with a non-technical background and shifted focus from a technical oriented discussion, to a more value focussed discussion. One of the exercises was about in-car delivery, someone mentioned: *"Hey, I'm doing sports in the afternoon, there is a supermarket close by with delivery lockers - that would be great as I often combine sports with grocery shopping"*. This example might illustrate how conversational prototyping opens the way to broader thinking.

One conclusion from this exercise is that humanising technical systems in the form of fictional dialogues could facilitate the exploration of data exchanges and also spark ideas on new relevant data points.

Figure 61.2 - Basic data point decrypted from a conversation around a traveller that want to visit the Amsterdam ArenA for an event.

TRANSPORT MOBILITY CLOUD

This part elaborates how the partner network can send and receive data via the TMC to provide personalised service. The partner network exists of the various stakeholders in the city that might collaborate on smarter mobility solutions, think of the municipalities, grid operators and mobility providers.

Ford Transport Mobility Cloud

Early 2018 Ford announced the acquisition of Autonomic to build the Ford Transport Mobility Cloud (TMC). The Ford TMC enables stakeholders to exchange data to make such connection and find synergies by offering an industry standard and cloud platform. The TMC platform can gather data from devices embedded in infrastructure, vehicles, public transport and travellers. A simplified version of the TMC framework is shown in figure 61.2.

It archives the data from these multiple sources and translates it to standardized data bases that enable intercommunication. It is basically an enabler of data sharing and IoT in the field of mobility. Such data platform could be of important value for the shift to off-street parking by being an enabler of data exchanges between various stakeholders around the parking ecosystem. Let's take the concept of automated valet charging as example: Cars should be able to communicate with each other to orchestrate their position switch when one car is charged. Additionally, the charging point should be informed that a new car arrived to manage the payment. This illustrates the kind of data exchanges that are required to enable functionality.

[1]Ford (2019). Ford bought Autonomic (TMC) From: https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/23/ford-motor-company-autonomic-amazon-web-services-collaboration.html

Autonomic: https://autonomic.ai/

Exchanges

Figure 60.1 shows an initial explorative overview of potential stakeholders around the parking ecosystem, the basic data points they own, their

	Stakeholder	Data	Interest
L1 - City	Municipalities	Traffic flow, spots, pricing	Shift to off-street, liveable
	Public Transport	Occupancy, schedule, pricing	Balance peak demand
	Shared Mobility Operators	Distribution, demand, pricing	Balance offer & demand
L2 - Parking lot	Parking Lot Operator	Availability, pricing, facilities	Increase occupancy
	Grid Operator	Energy capacity, forecasting	Balance energy distribution
	Service Providers	Promotions, services	Attract customers
	Delivery Operator	Orders, delivery network	Decrease 'door-2-door' time
L3 - People	User	Schedule, requirements, services	Travel seamless and cheap
	(Fleet) vehicle	Battery level, assets, AD vision	Charge, clean, redistribute
	Destination host	Schedule, location	Offer hospitality & access

Potential exchanges

- AD vision + parking lot map **= update parking lot availability map & valet**
- Spot availability + network of other modes + preferences **= personal journey advice**
- Grid capacity + user schedule + vehicle battery **= smart, cheap charging**
- Personal requirements + spot and mode facilities **= inclusive travel**
- Traffic flows (events) + lot distribution + modal network **= traffic regulation**
- Parked car schedule + Delivery operation **= in-car delivery**
- Customer schedule + location+ 3rd party service **= personalised promotions**

Value propositions

Increase liveability
- Decrease on-street parking in city center
- Empower inclusiveness by transparency
- Enable smooth mobility in cities

Seamless journeys
- Connect modes effectively
- Eliminate circling around for a spot
- Automate payment & (valet) parking
- Adapt advice to specific user needs

Economical benefit
- Increase car occupancy by car sharing
- Adapt charging rate to need
- Facilitate delivery operation, reduce costs
- Empower B2C connections

Figure 62.1 - Data exchange scheme for creation of value propositions around the parking ecosystem.

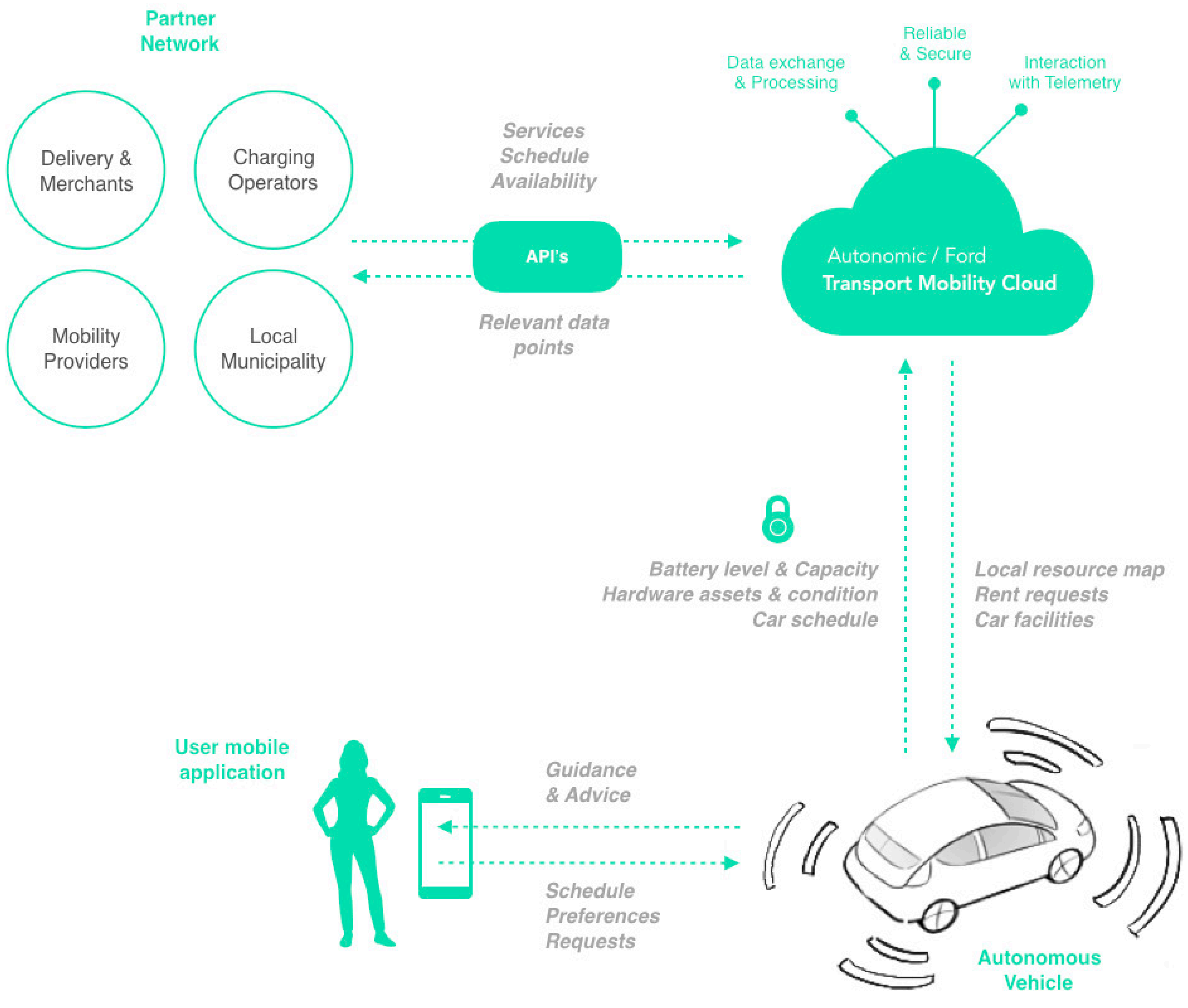


Figure 63.1 - Framework for data exchanges between user, vehicle and partners using the TMC platform.

interest and how exchanges between data could lead to value propositions. As example: if you would combine data on grid capacity with a user schedule and the vehicle battery status, a charging plan could be created that makes optimal use of the energy price (dependent on the time of the day) and the grid capacity for other cars.

The TMC enables the stakeholders to upload their data. The TMC will aggregate and translate the data into actionable insights. Key pillars for the platform are security, easy access to telemetry and processed metadata by integration of API's. This aligns with the vision of Ford to approach their business from a broader system view as Jim Hackett mentioned in 2018 (page 2).

Conclusions

Ford spoke out their interest in exploring how vehicle data could be leveraged in the TMC together with data of partner stakeholders. In the next steps a dialogue tool is explored and the future parking ecosystem is envisioned by combining technologies, stakeholders within the parking environment.

FACILITATING DIALOGUE

On page 59 it was concluded that dialogues could facilitate the exploration of data exchanges and spark ideas on value propositions. The idea of a physical maquette as dialogue tool was born, the maquette could bring perspectives together by leaving open space for interventions and using boundary objects.

Dialogue

The transition to off-street parking could be initiated by removing the current barriers and creating new incentives for users to make the transition. In this transition multiple stakeholders would involved like the parking operator, municipalities, OEM's, delivery operators, merchants and grid operators. As explored in the conceptualization, collaboration on environment design and data exchanges is key. However, stakeholders have different backgrounds, interests, assets and speak a different language. During the ITS congress[1]. TransDev mentioned how technology is not the main bottleneck, the real challenge lies in getting stakeholders aligned on how to exchange knowledge and make connections. A discussion tools could be a facilitator of open and effective conversations on the different levels of the system.

Boundary objects could form the basis for the discussion tool as they contain common references that help people from different backgrounds and perspectives to build a shared understanding of the context. The boundary objects could be physical representations of a car, a road, a charging point or even a data exchange within a maquette of a parking garage and some of the streets around it. The maquette could include 'mini-stories' around a selection of the innovations in the ecosystem presented on page 62 and 63.

[1]Blog 8, Documentation of ITS Congress insights

Figure 64.1 - Maquette as dialogue tool, it includes boundary objects and space for interpretation to explore design interventions.

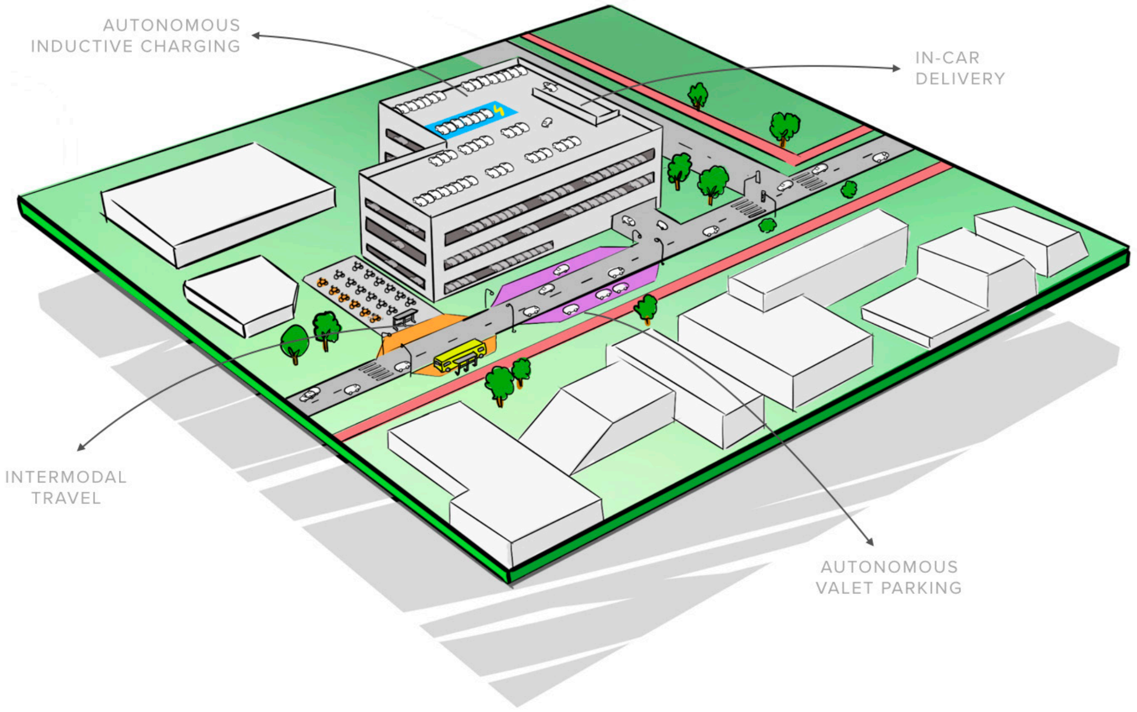


Figure 65.1 - Sketch of the maquette and the 'stories' that were chosen do elaborate in-depth.

Moving forward

The ideation brought ideas and concepts together around the parking ecosystem on page 58 and 59. It was concluded that transitioning to off-street parking takes more than an one-off solution. Enabling design interventions on different levels requires dialogue, a set of deliverables was redefined that could serve as a stepping stone for the envisioned transition.

1. Product Service Proposal

A parking product-service by Ford, that demonstrates the envisioned future based on the research learnings. Four stories are selected within this parking ecosystem and are elaborated on multiple layers of the system (page 66)

2. Maquette stakeholder dialogue tool

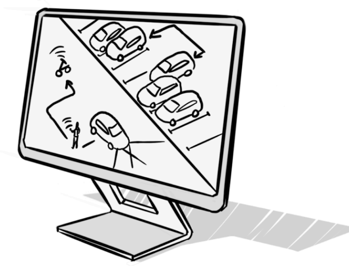
A physical maquette represents the envisioned product-service (parking ecosystem), but also leaves 'open space' for new interventions and change, as a tool that enables dialogue. The maquette will include a parking garage and a few roads and infrastructure elements around it (as described on page 64).

3. Video demonstrating the parking ecosystem

This video will start with the narrative of the research findings and conclusions that have led to the parking ecosystem. Additionally, the maquette will 'come to life' with animations showing the innovations in and around the parking garage.

1 **Report and blogs reporting the research learnings and the product-service proposal.**

2 **Maquette of the parking ecosystem including the various 'stories'.**



3 **Video concluding the key learnings and parking product service proposal.**

DECRYPTING THE LEVELS

A framework was explored that could help organising and elaborating in-depth content about the rough ideas within the ecosystem on page 59. Ford showed interest in learning more about the stakeholders in such ecosystem, their assets but especially the potential role the vehicles from Ford could have in the 'smart parking ecosystem'. The required technology and the value of vehicle and traveller data could help Ford in developing new service innovations.

In-depth stories

A selection of ideas was chosen to elaborate in-depth, they are called 'stories' within the ecosystem. One requirement for the selection was that the story should have a distinctive role of the vehicle. The following four stories were selected, a short rationale for this choice is given.

Autonomous (induction) charging

The rise of EV's comes together with increased demand for electric charging. In this story the potential of autonomous driving is explored in combination with charging, as electric vehicles demand for another approach and infrastructure than fossil fuel.

Valet parking

Enabling a seamless journey in the parking garage could support the transition to off-street parking, as defined in the vision on page 52. Autonomous valet parking is evaluated as feasible by the AV experts from the interviews.

In-car delivery

Ryan Westrom explained the value for Ford in having a partner network within smart cities to empower the servitization for their travellers. In-car delivery could support in connecting with local businesses, next to the larger collaboration with parties like Amazon. In-car delivery rethinks the potential of a vehicle as a product that enables freedom to move.

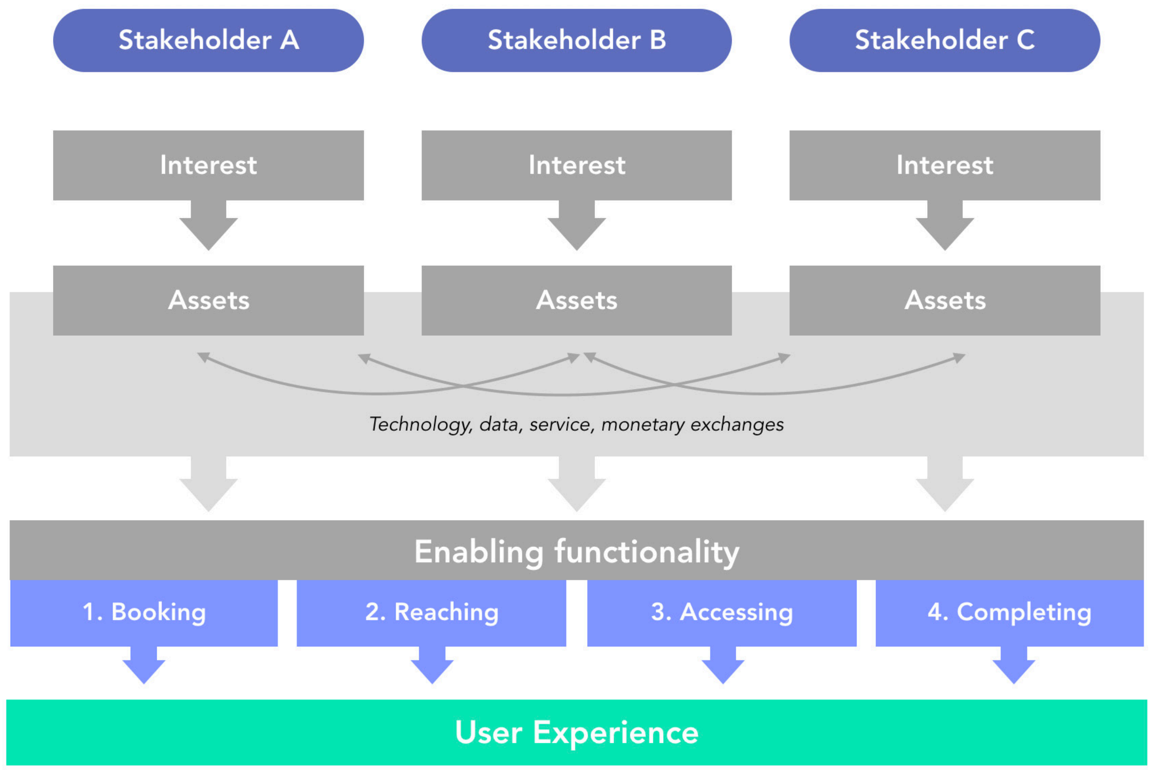


Figure 66.1 - Initial framework for organising the in-depth content of selection stories within the parking ecosystem.

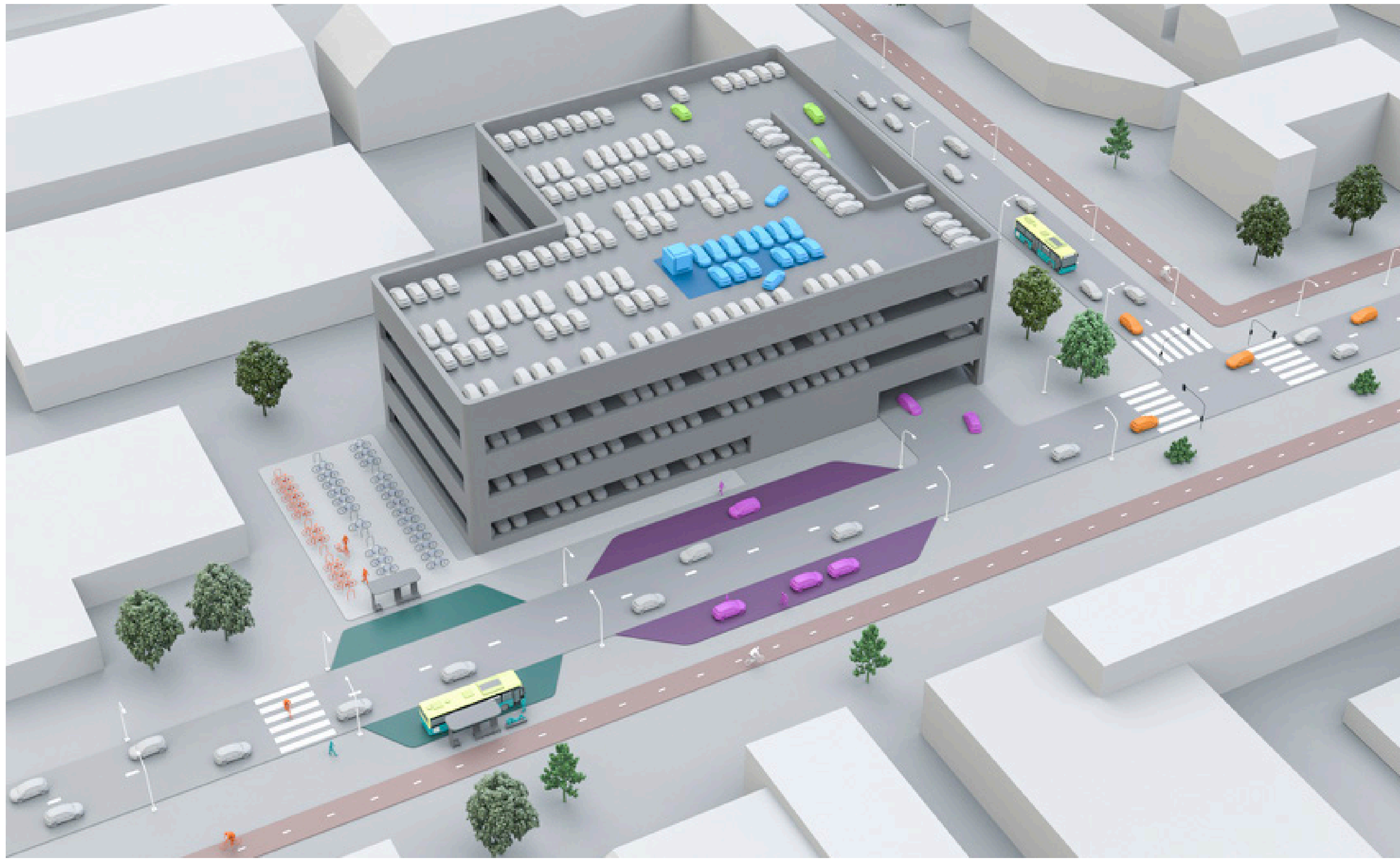


Figure 67.1 - Render of the parking ecosystem including some of the innovations from page 59.

Multimodal travel

This topic was pointed out during many of the interviews (Mobility Portal, NS, SnappCar) and was one of the main topic fields during the ITS congress. This field is especially interesting as the challenge relates closely to what the Ford Transport Mobility Cloud strives to fulfil.

Levels of the system

Each of the stories above are elaborated consistently on various levels (or perspectives). Figure 66.1 shows the initial framework that was used to organise the information. Eventually, the Business Model Kit[1] from the Board of Innovation and a table was used to organise the following levels.

Stakeholders

The main stakeholders involved in the service are identified. Obviously, there are more parties involved on the back end in real practice.

Drivers

The market, user and technology drivers are summed up that rationalise the desirability and potential of a story.

Exchanges

The Business Model Kit and table includes the exchanges between stakeholders, their concrete data points and their data sources.

Enabling functionality by high level insights

Aggregating the data points lead to high level insights that enable functionality.

User experience

Eventually, these back-end elements are translated into the experience layer. This is the content that will be visible to the end user.

[1]Business Model Innovation Kit. Website: https://www.boardofinnovation.com/tools/business-model-kit/

AUTONOMOUS (INDUCTION) CHARGING

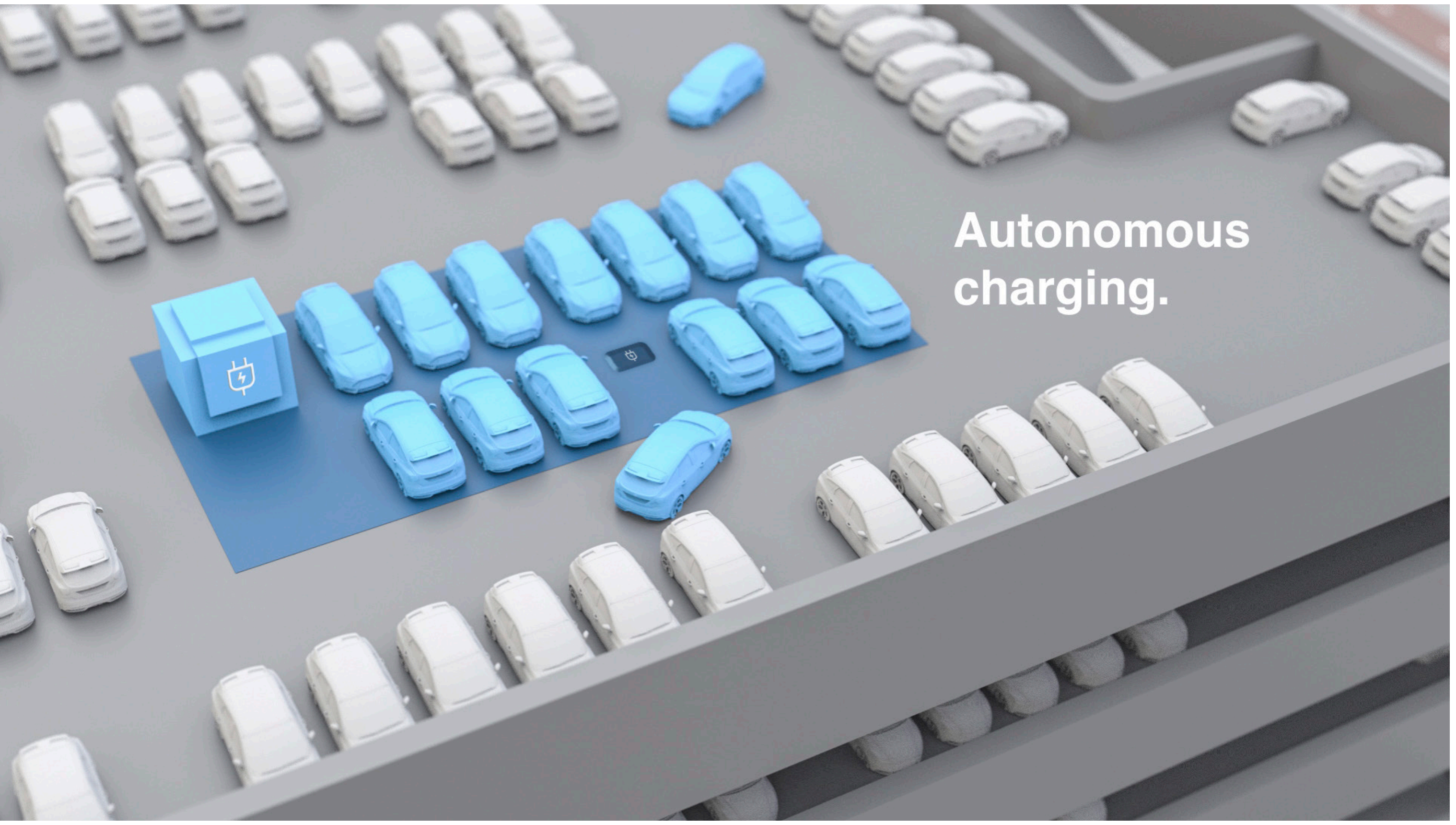
Autonomous organisation of vehicle induction charging could leverage the available grid capacity optimally without human intervention. When a car is charged, it could automatically switch with the next car in line. Dependent on the expected stay a required charging speed per car can be defined leading to a optimised charging schedule and sequence.

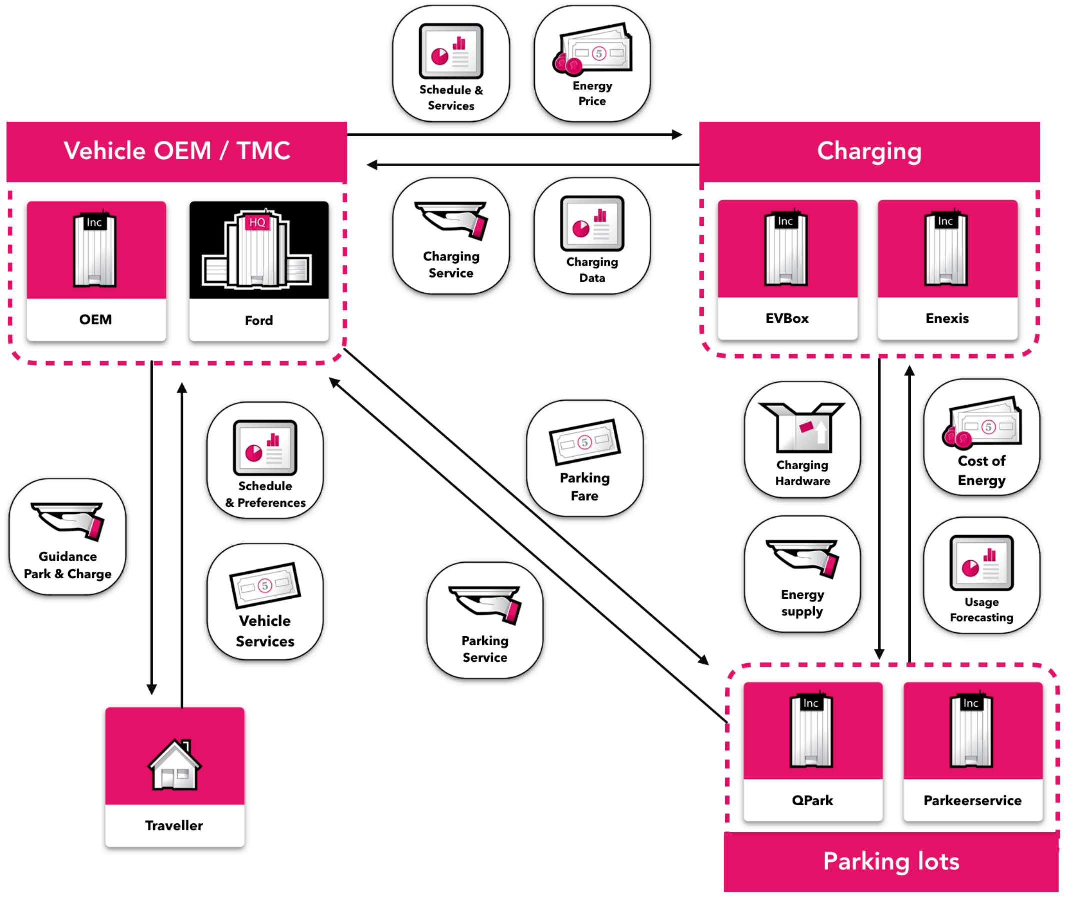
Main drivers

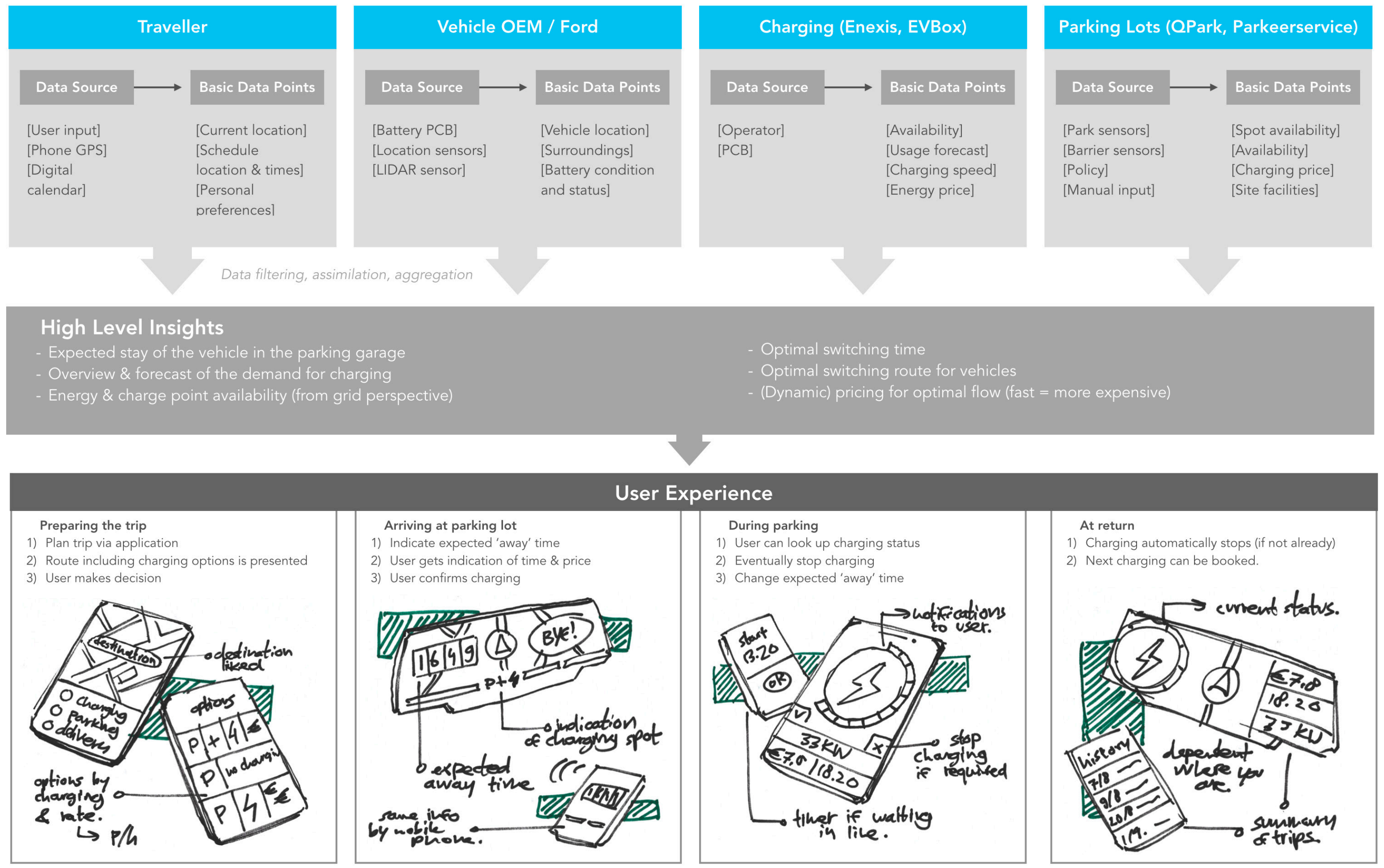
- The amount of EV's will rapidly increase, so does the demand for charging.
- Grid capacity is limited, fast charging won't be possible on large scale. Smart charging is slow charging (Evercharge, 2019)
- Cars are parked 95% of the time, this forms an opportunity for slow charging (which is cheaper and better for the energy grid and vehicle battery).
- Electric charging points for every parking spot is too expensive. (Evercharge, 2019)
- Idle time due absence of the driver leads to unused potential of charging infrastructure.

Requirements

- Scheduling system that defines the sequence and charging speed for cars based on e.g. request time, expected stay and grid capacity.
- Communication between the charging points and vehicles to enable the switch maneuver.
- Automatic payment and car identification is required for the monetary exchange with the energy service provider.
- Conventional charging points require human interaction, induction charging hardware is needed.







VALET PARKING

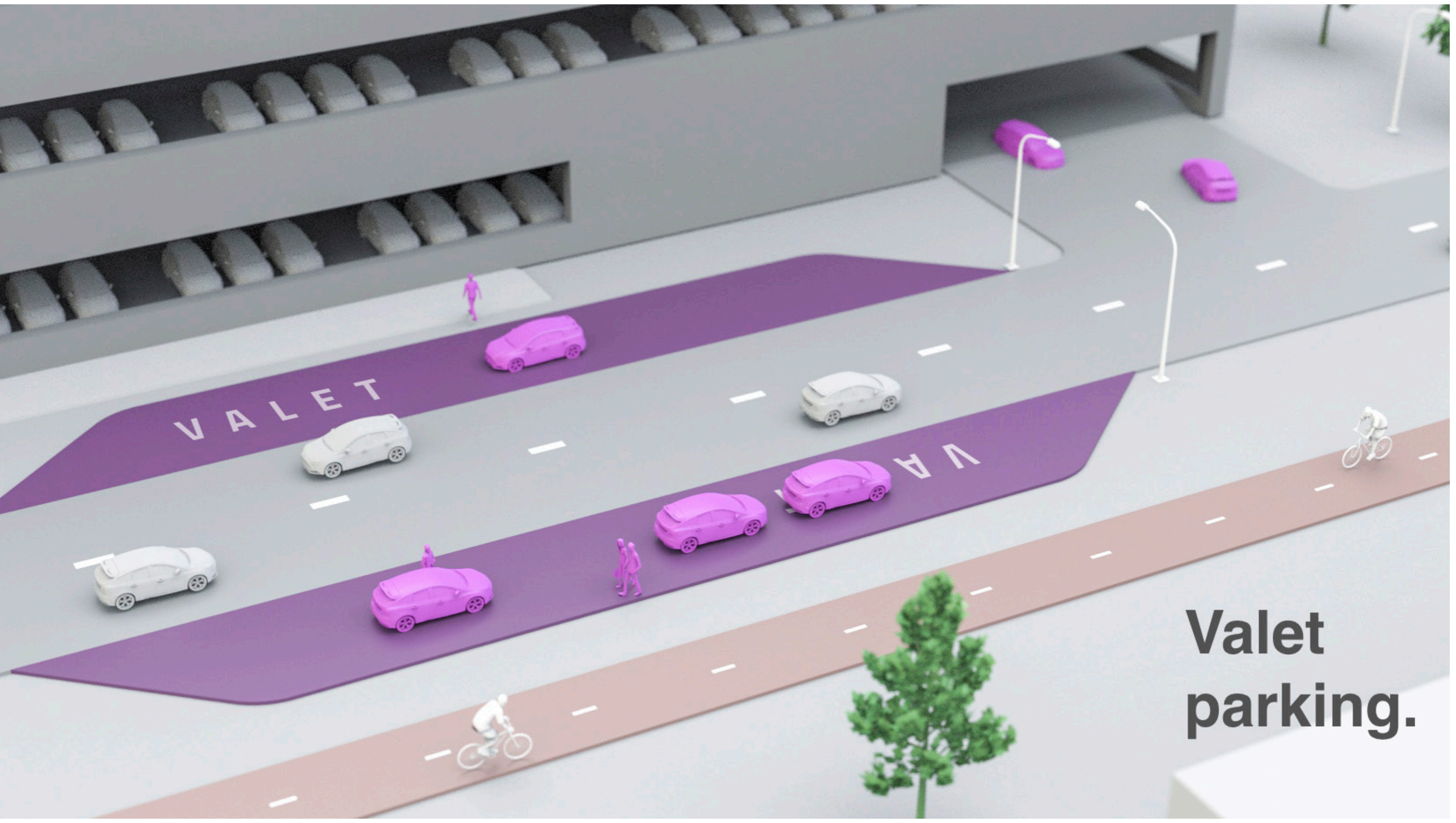
With valet parking the user can be dropped off in front of the parking lot, the vehicle will automatically find a suitable spot within the garage. This can decrease parking time for the user and enable optimal use of space for garages, by decreasing the required space between cars.

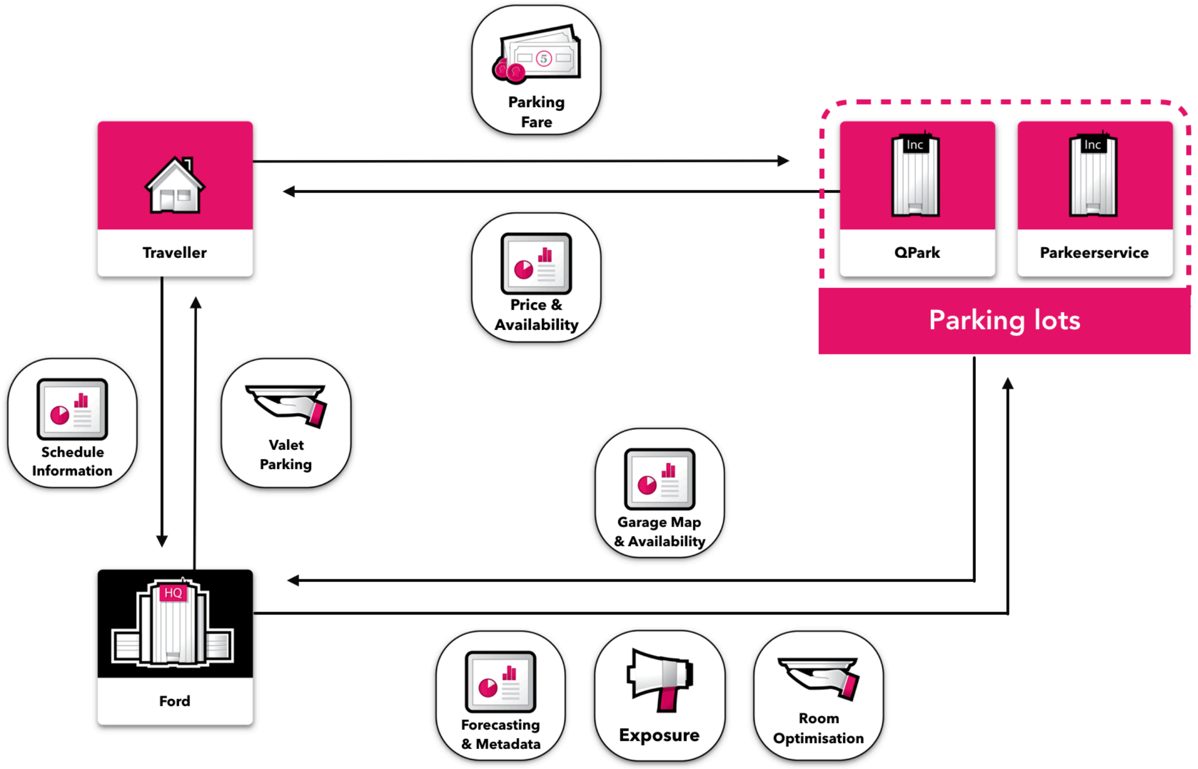
Main drivers:

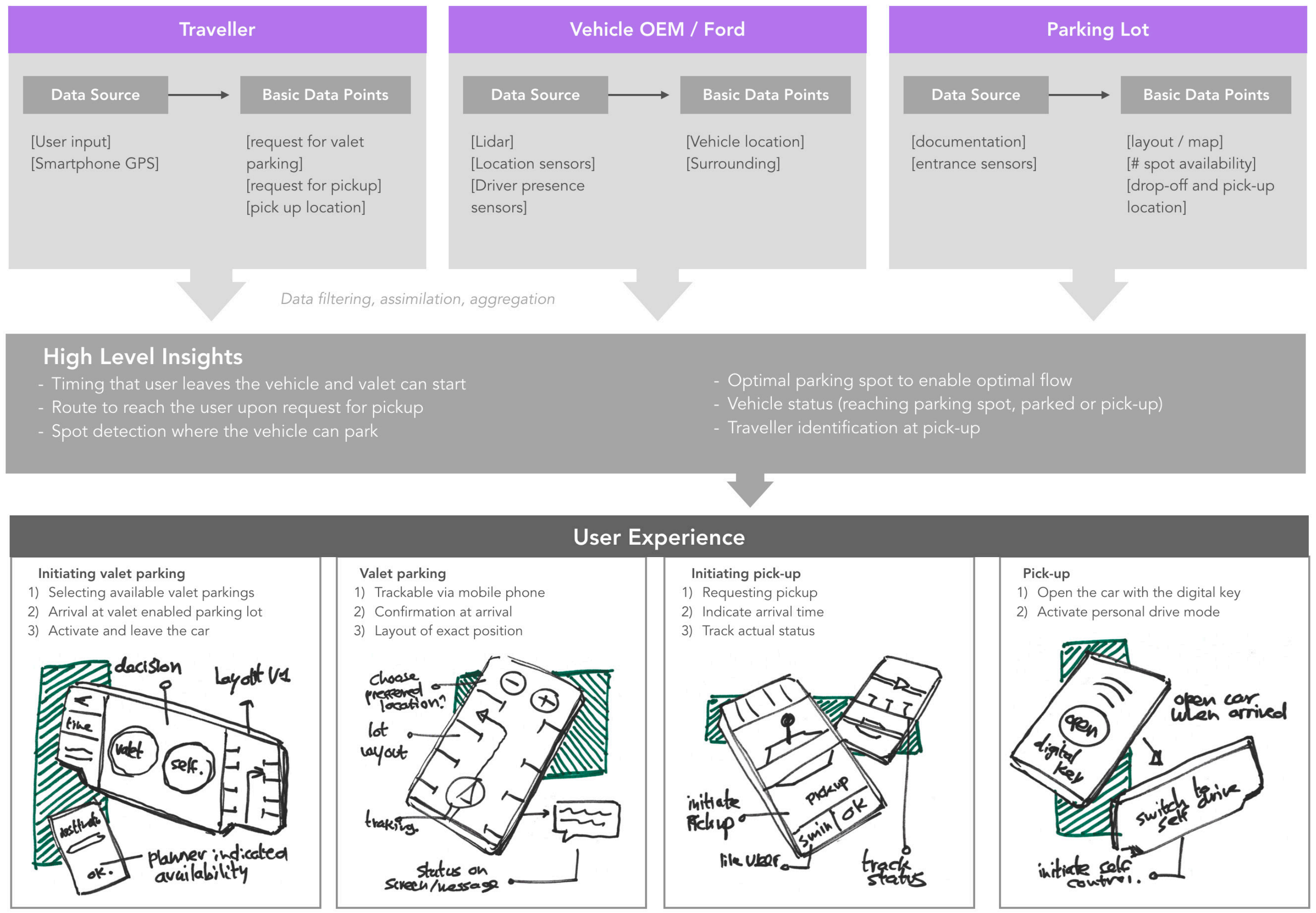
- Circling for a parking space & payment can be time consuming, valet parking could cut away this time for the traveller.
- The parking garage is a viable environment for autonomous drive, the AD system can drive more conservatively as the traveller left the car.
- Autonomous drive enables more tight parking to increasing the capacity of parking lots. This is enabled by more accurate parking manoeuvres by AD systems and as the traveller left the car at the drop off point, no space is required to open the door.
- Optimal vehicle allocation in the building is enabled based on vehicle flow models, this might lead to a faster operation than when the user decides a spot.
- Ford mentioned that people feel uncomfortable in parking lots as it is dark and may feel unsafe. Valet parking takes away this concern.
- The risk of accidents could be eliminated in full AV environments due the (conservative) AD systems.

Requirements:

- Point One Navigation mentioned how a 2D layout or map could be very beneficial for the accuracy, these could be provided by the parking lot operator.
- Humans appearing from behind a corner could be dangerous, as it is hard for AD to anticipate on this, AV only lots would help a lot.
- Automatic or digital payment systems are required as buying a ticket would increase the time.







IN-CAR DELIVERY

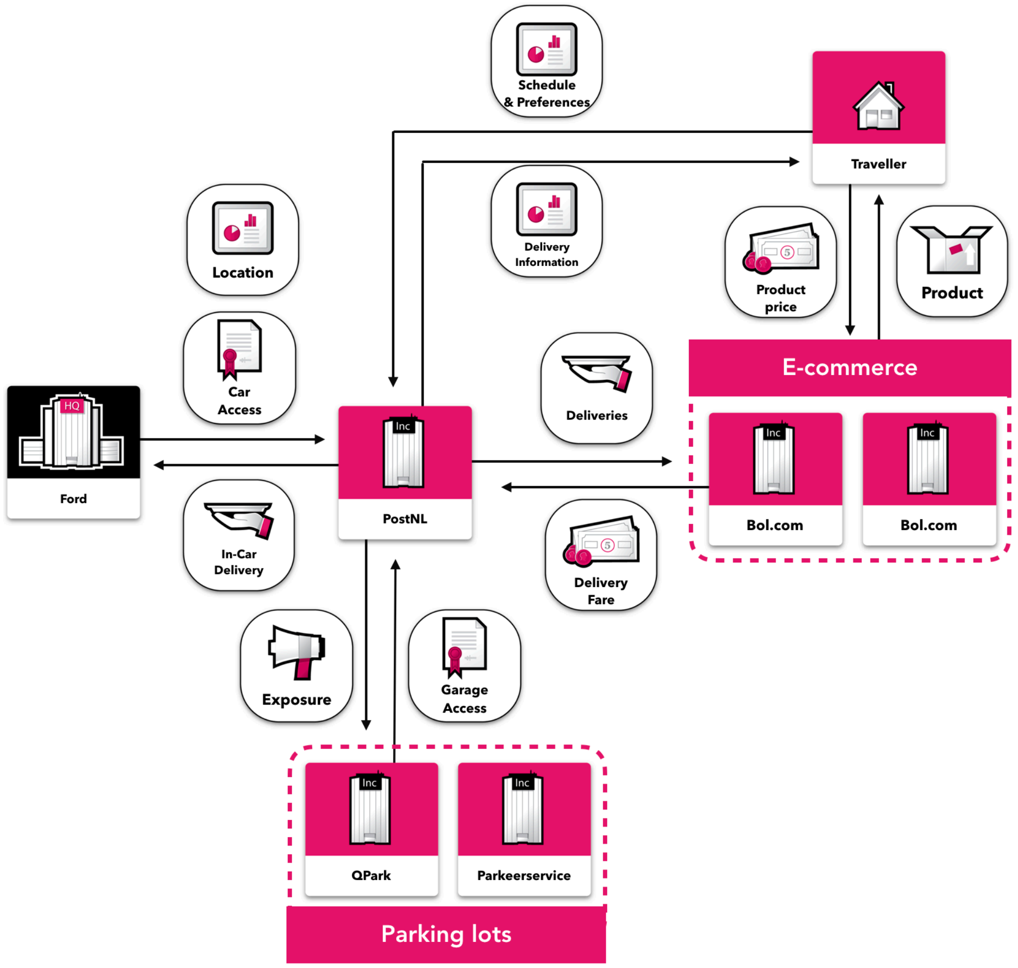
In-car delivery enables delivery operators to receive a digital access key to open the car trunk to deliver goods while the vehicle is parked. This service provides additional delivery choices for the user and could optimise the delivery operation. Parking lots could lower the delivery costs as it centralises delivery location, leading to a lower 'door-to-door' time, if deployed on large scale.

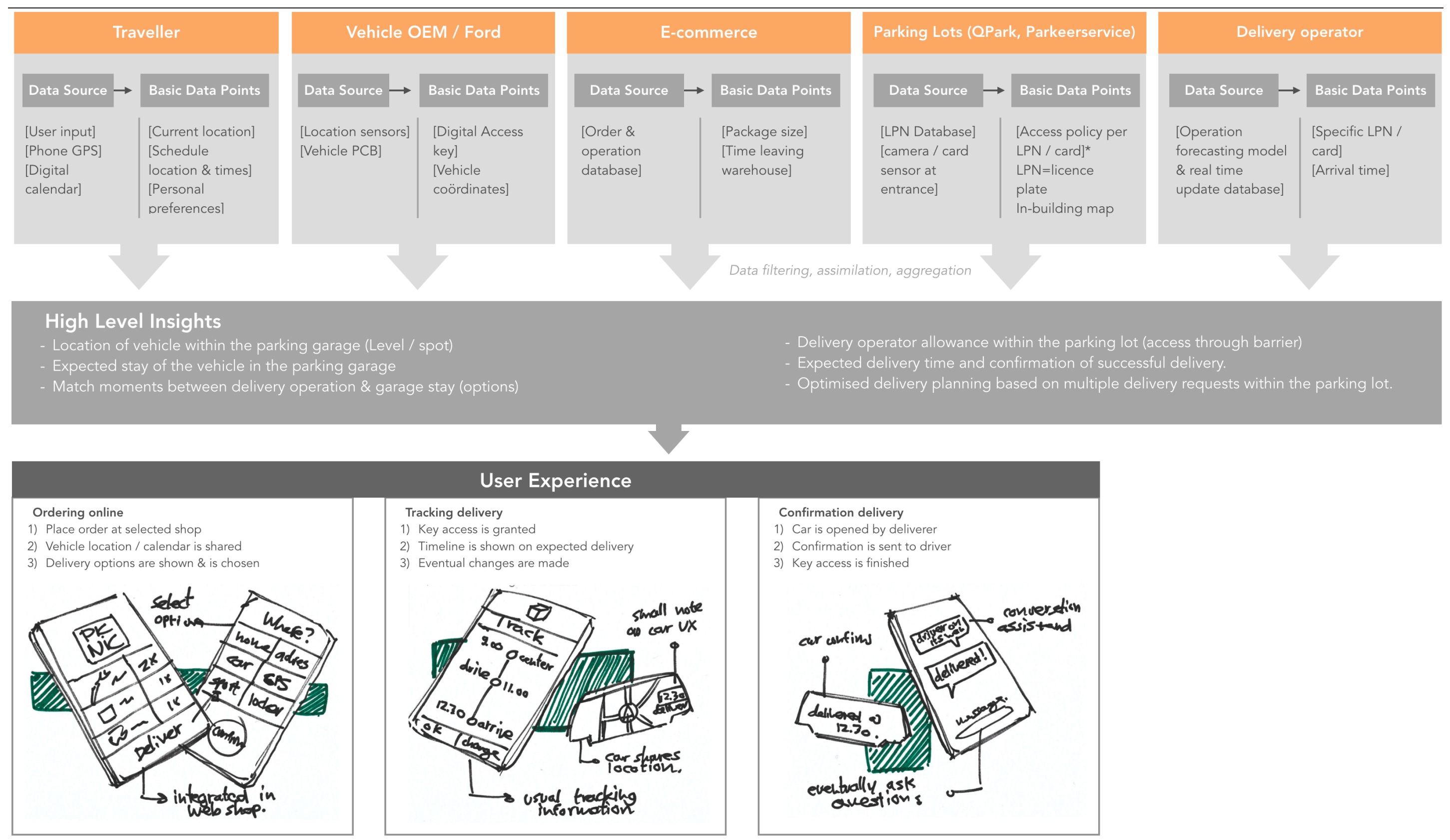
Main Drivers

- Offers additional choice for the user, PostNL explained that one of their main pillars is to provide more choice of delivery options.
- When providing people with more choice, there is a larger chance they choose an option where they are available (minimalizing the amount of 'not-home' deliveries (interview PostNL).
- The parking garage could form a large delivery center, as it is centralising many cars on a small area.
- In-car delivery is already deployed by Ford in collaboration with Amazon. However, offering in-car delivery in parking lots near shopping centers might provide opportunity for small businesses.

Requirements

- Sharing a digital key of the car requires trust from the user, as someone will access the car.
- Not all packages are suitable for In-car delivery (e.g. based on size or the need for cooling).
- The delivery operator would be helped if they know how long a car is expected to stay on a certain place.
- If the user decides to leave earlier than expected, the system and delivery operator should be able to anticipate on such changes.
- The delivery operator should be granted access to the parking lot.





MULTIMODAL TRAVEL

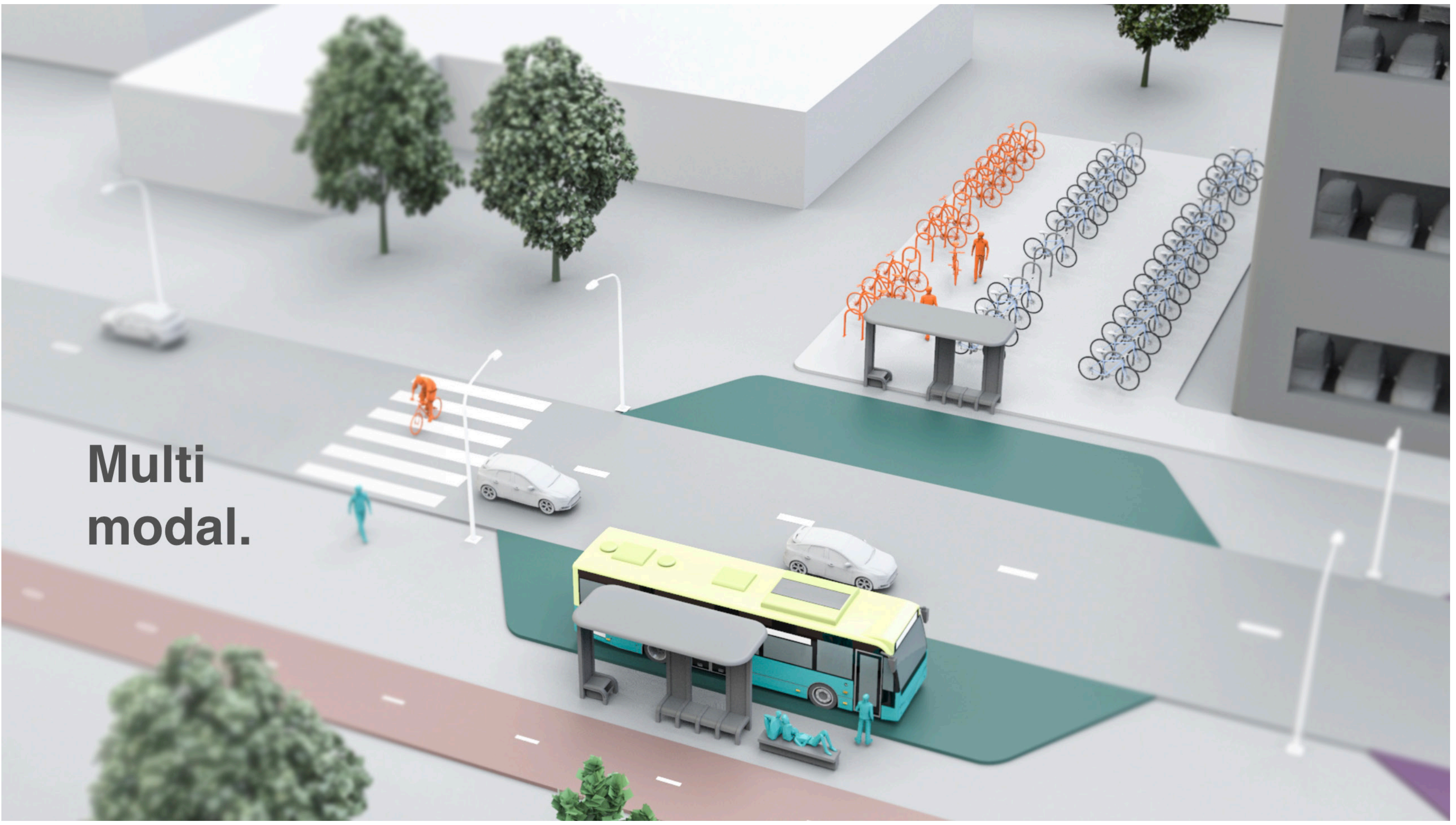
As parking lots are in many cases not on walking distance from the final destination, people may choose to park on-street. By offering seamless connections from the parking lot with other modalities for the last mile, travel comfort could be increased, and travel time and costs could be decreased.

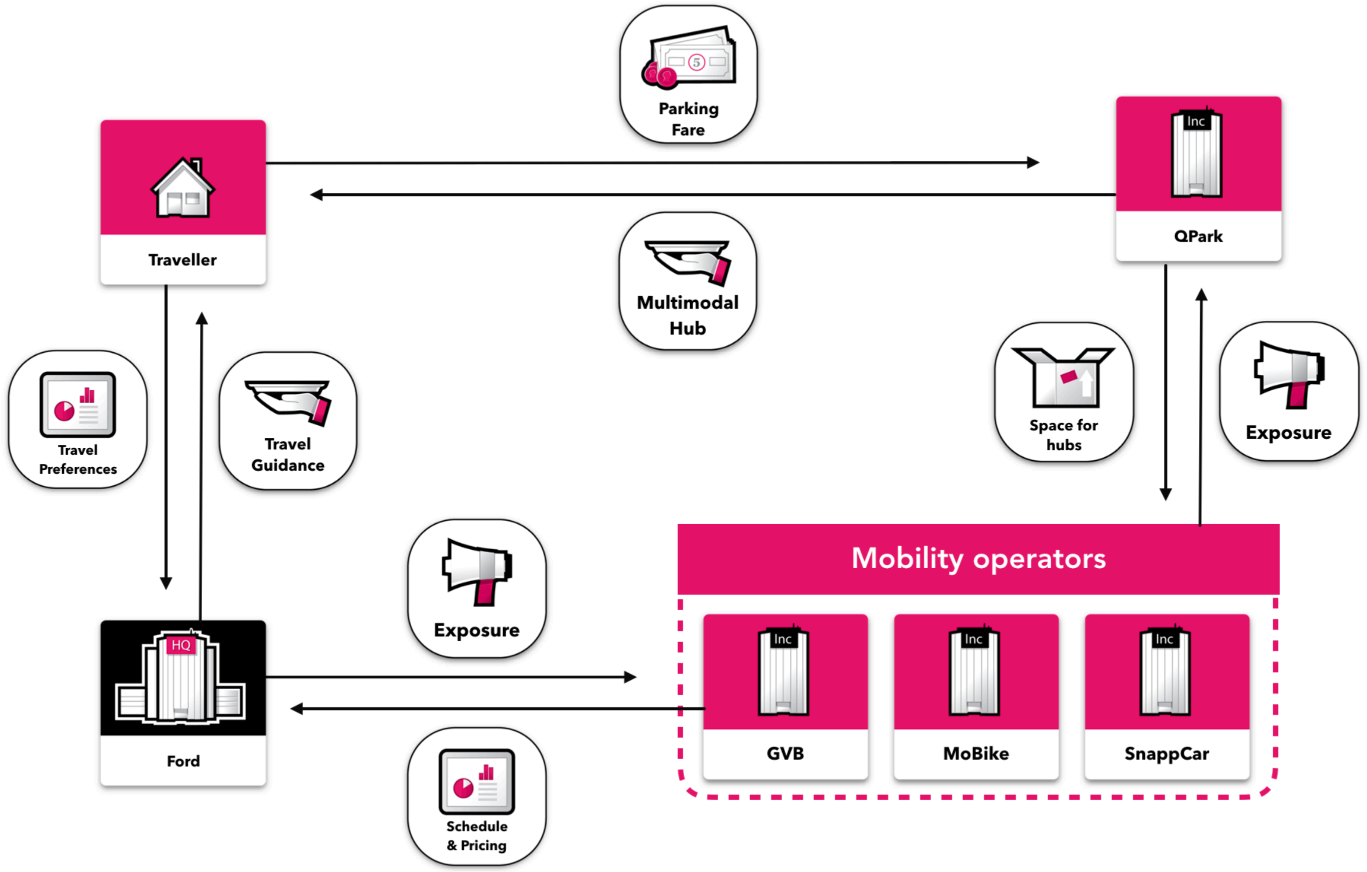
Main drivers

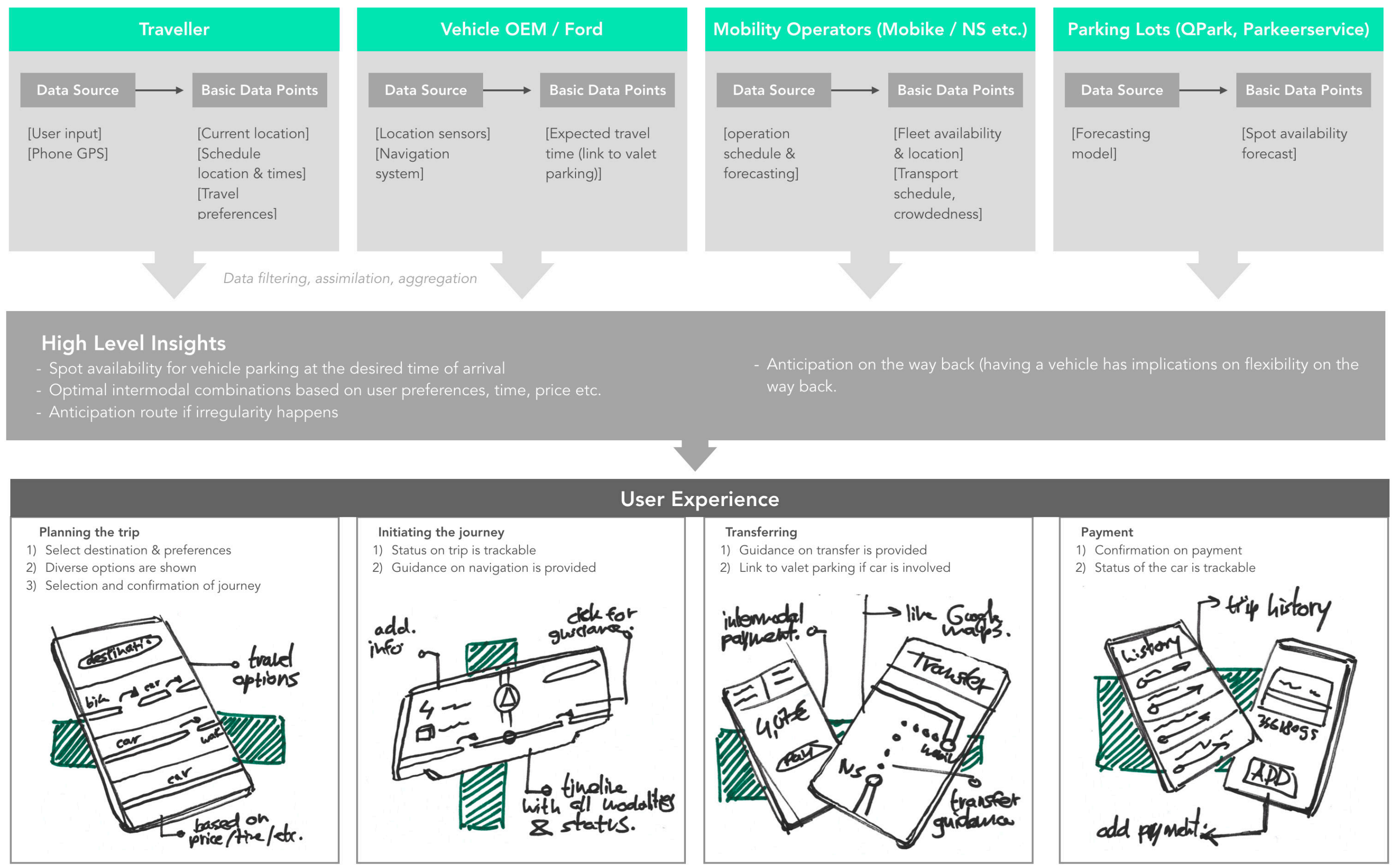
- Connecting other modalities around the parking lot could attract more people to park off-street as the parking lot facilitates the continuation of their trip.
- Municipalities like Amsterdam are investing and incentivising public- and active modes of transport, leading to a well-developed range of connecting modes.
- Planning a multimodal trip could lead to cheaper and faster travel.
- Parking lots are interesting for shared bike services and public transport operators as it might increase demand for connecting transport on these points.

Requirements

- In order to plan multimodal journeys, the mobility operators should exchange their travel schedule to analyse the best-connected routes.
- During ITS the complexity of intermodal and MaaS from a data sharing perspective was mentioned: who will own the platform? how are modalities prioritised in the system? Such platform only works when multiple modes are connected to it.
- The modes should not be placed too far from each other, as the transfer would take too much time.
- Transfer time and comfort should be taken into consideration, as it could require too much effort.







PRODUCT SERVICE

As discussed on page 68-69, the parking ecosystem could serve as a fruitful environment for product-services by Ford. These services could facilitate the traveller in his freedom to move in urban areas and eventually initiate a shift to off-street parking. Stakeholder and data mapping were done to understand the back-end. An initial direction was given on the user experience side, this part elaborates on the product service from a user perspective.

Key requirements

Some key requirements have been formulated for the development of the product service that brings together the stories presented on page 70 to 77.

- The UI development exercise within this project aims to demonstrate the potential user experience that in front of the technical back-end of stakeholder relations and exchanges. It serves as a tangible element that sparks inspiration and enables

- The product service should integrate the various selected services (in-car delivery, valet parking, autonomous charging and intermodal planning) into one platform by leveraging the existing FordPass platform.

- The user should be able to interact with the product-service both inside as outside the vehicle, serving the specific demands based on the phase of the journey (e.g. a user that would like to pre-plan his or her journey from their home).

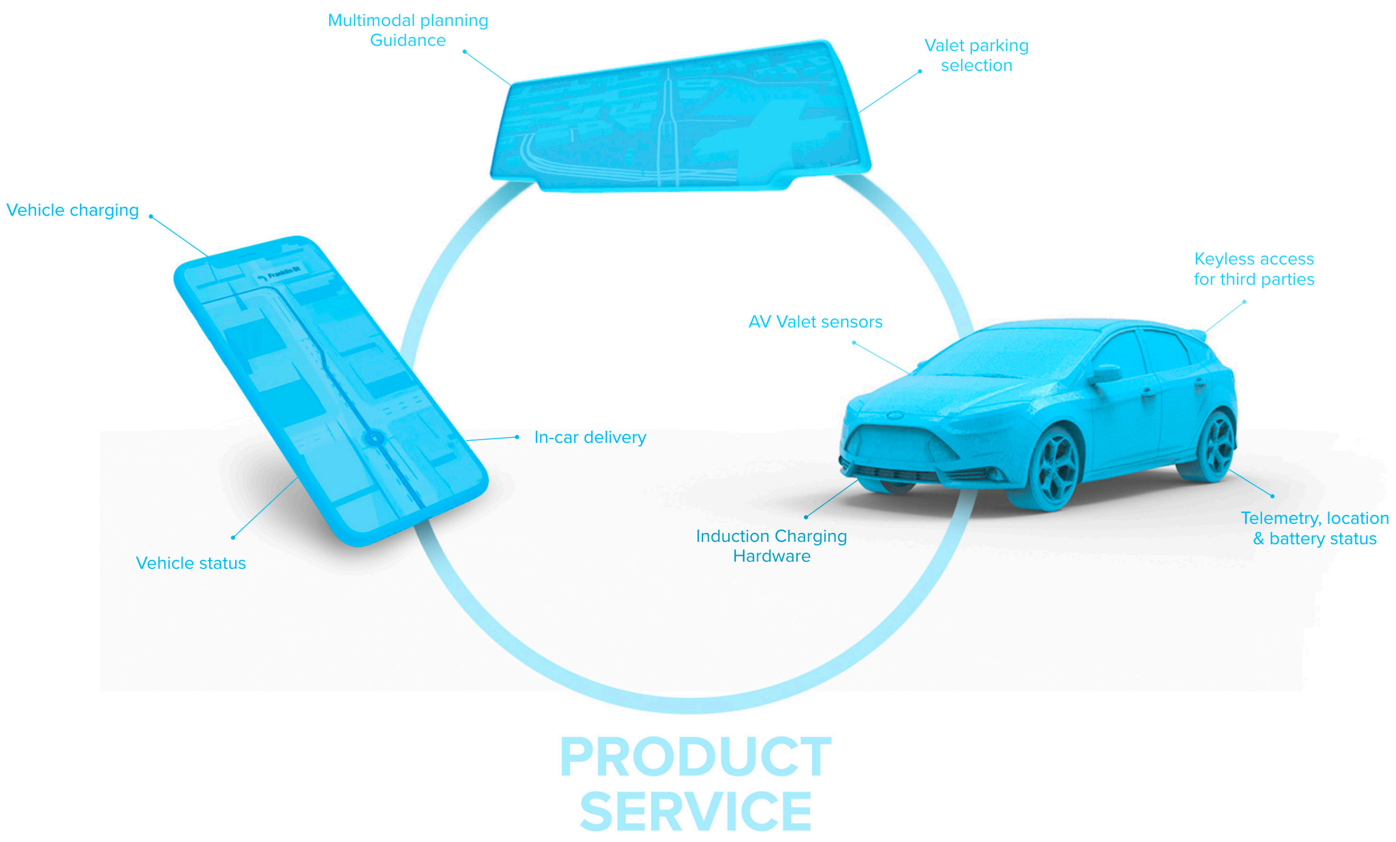


Figure 76.1 - A selection of digital, hardware and service elements within the product-service ecosystem.

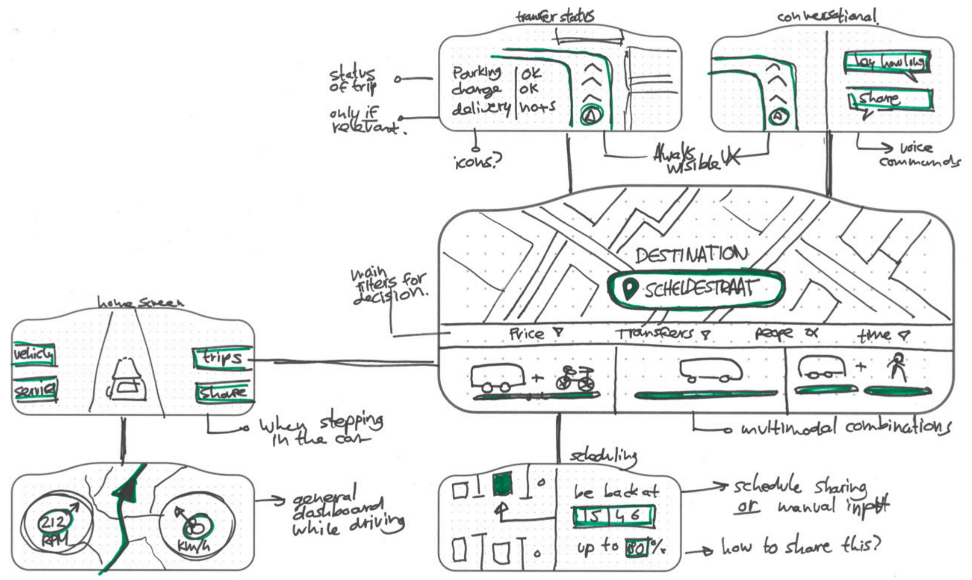


Figure 77.1 - Dashboard interface wireframes

Touchpoints

Digital interfaces are envisioned as key touchpoints of the traveller with this product services. Pages 71-77 demonstrates the very early explorations of these touchpoints, consisting digital user interfaces on both personal mobile devices and the vehicle dashboard.

Mobile Phone

The mobile phone UI is designed for the moments in the customer journey when the user is away from its car, he or she could maintain access and control to the services when desired.

Vehicle Dashboard

The dashboard UI is developed to demonstrate the interaction with the services while being inside the car.

Conclusion

The UI design aims to find a fluid transition from being outside and inside the vehicle and supporting the user in using the services. Figure 67.1 and 67.2 demonstrate early exploration of such interfaces, the functionality may differ on the phone and dashboard, as they represent a different moment in the customer journey.

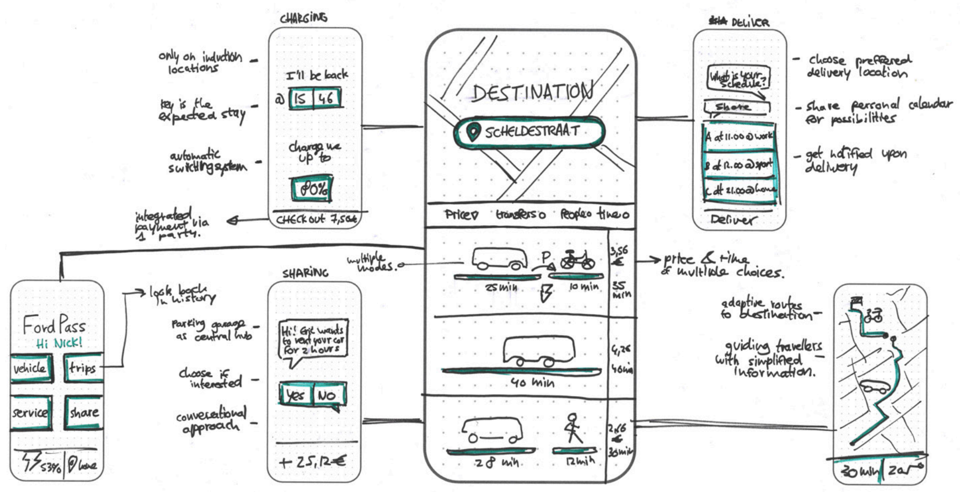


Figure 77.2 - Mobile phone interface wireframes

EXPERIENCE LAYER

A product service was designed to demonstrate how the experience layer could look like. It helped in making the functionality tangible on the front end. The experience layer consists of an interface on a mobile device and the vehicle dashboard.

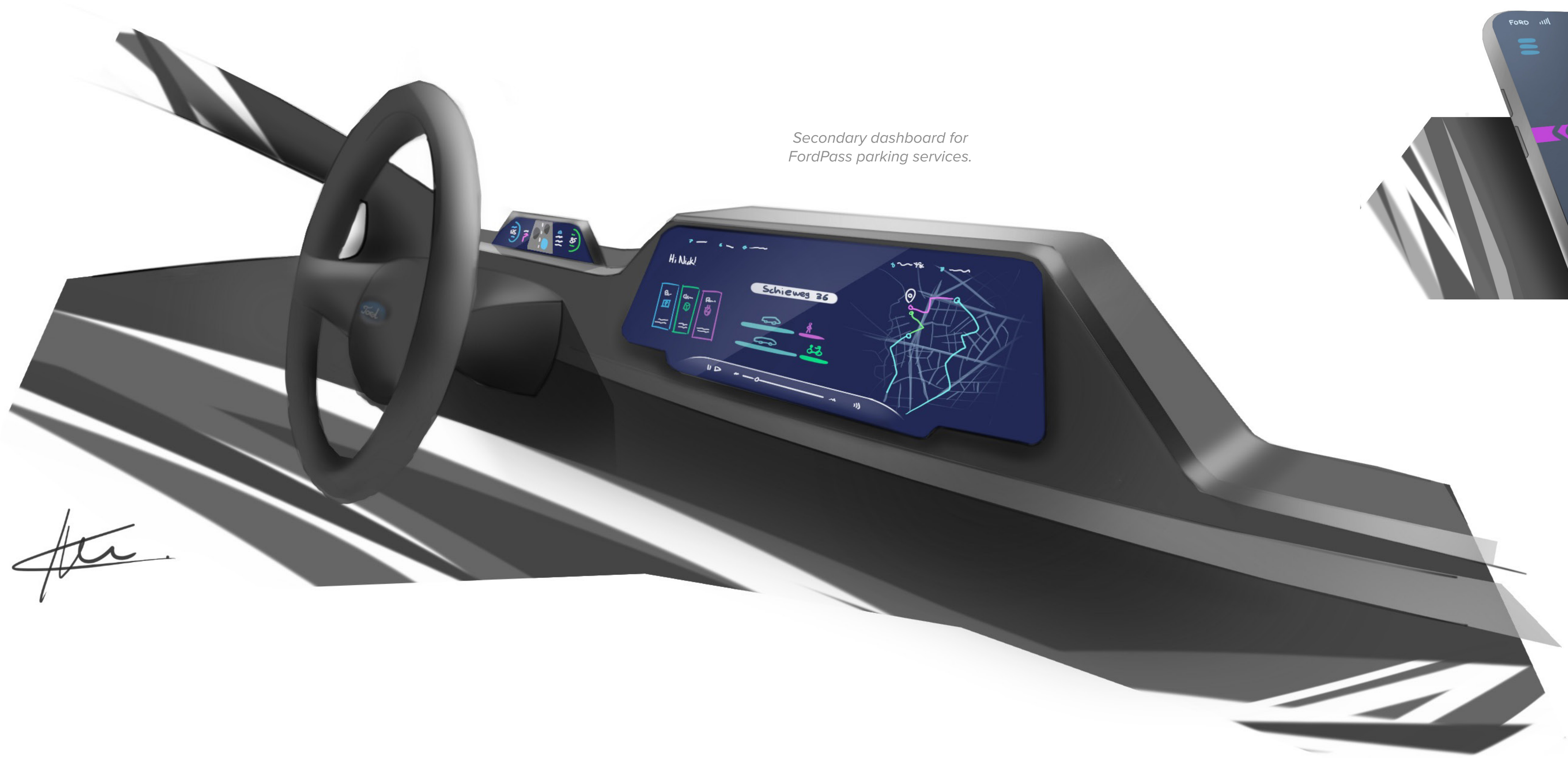
Platform integration

All services will be integrated in the existing FordPass platform. Using the existing platform seems beneficial for both the user experience (integrated services) as for the feasibility for Ford (leveraging the existing system).

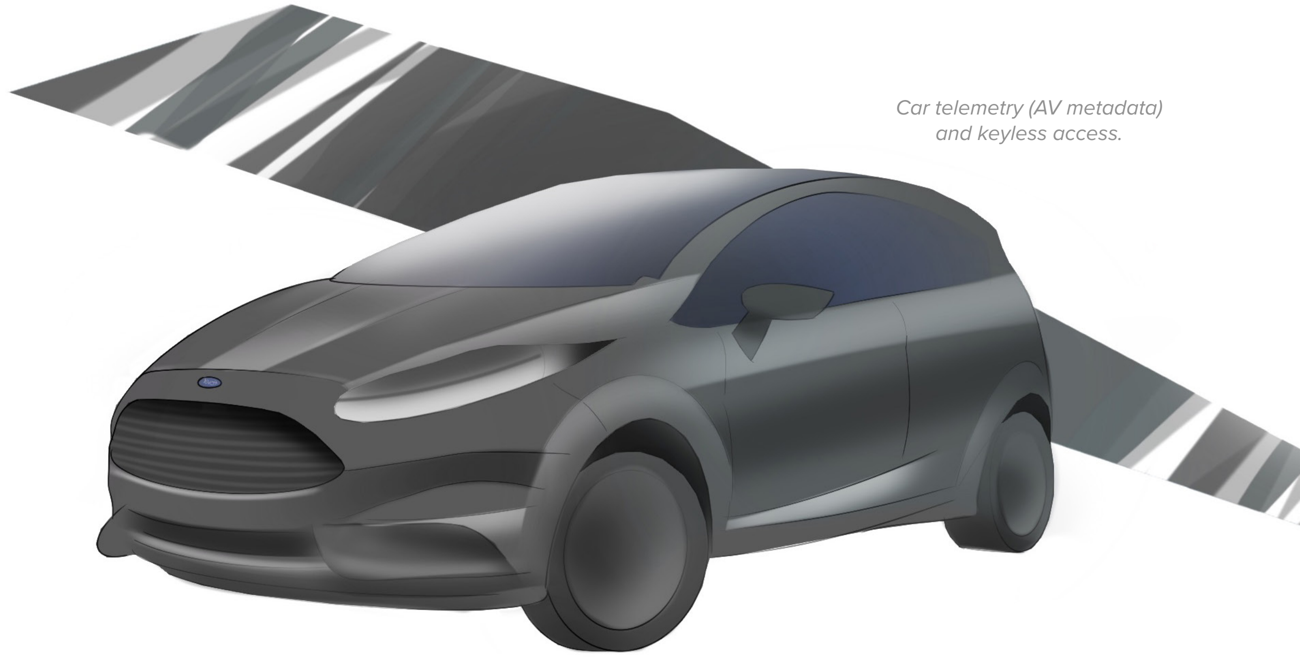
Functionality

Within the scope of this project, the services were limited to a selection of 4 stories. In the discussion (page 99) suggestions will be given on other functionalities that are evaluated as feasible, desirable and valuable for Ford and its partners.

Secondary dashboard for FordPass parking services.



Car telemetry (AV metadata) and keyless access.



Role of the vehicle

All functionality is partly enabled by vehicle telemetry or other data accessible to Ford, the basic data points are presented on page 68 - 75.

Mobile device application for access outside the car.

Next steps

These impressions have been translated to CAD and screen mock-ups in higher detail. Additionally, the maquette will provide a high-level overview of the services for an 'eagle-eye' perspective. Together they form the input for dialogues about novel services in the parking ecosystem.

MAQUETTE FOR DIALOGUE

The physical maquette of the parking ecosystem could drive dialogue and spark ideas around novel product-services by creating a common understanding on the complex context. The maquette leaves ‘open space’ for design interventions and serves as a tool a tool that enables dialogue and creative thinking by a playful, interactive and visual approach.

Requirements

The following key requirements were formulated for the maquette to serve as an effective dialogue tool.

- The maquette represents a fictional parking garage and a few roads and infrastructure elements around it (as described on page 64) to set boundaries for the topics dialogue.

- The maquette leaves ‘open’ space for interventions and change. There should be some level of interactivity to facilitate dialogue and creation.

SAP Scenes & LEGO Serious Play

The SAP Scenes[1], Business Model Kit[2] and LEGO ‘Serious Play’[3] techniques are examples of tools that support teams in creating common understanding of a context. Visual tools can support people to express their ideas. This playful, interactive and visual approach is evaluated as an effective tool drive dialogue and spark creativity process of building novel products, services and shared visions (SAP Scenes is one of the tools used by Ford Aachen and is positively evaluated).

These techniques served as inspiration for the maquette dialogue tool, participants of such sessions could create design interventions and communicate their ideas by adjusting and adding elements to the parking ecosystem ‘base maquette’[4] using tools like paper, scissors, pencils and pre-made moveable boundary objects.

As described on page 66 boundary objects contain common references that help people from different backgrounds and perspectives to build a shared

[1]SAP (2019). Storytelling tool. From: https://experience.sap.com/design-services/approach/scenes

[2]Board of Innovation (2019). Business Model Kit. From: https://www.boardofinnovation.com/tools/business-model-kit/

[3]LEGO Serious Play Tool (2015) From: https://seriousplaypro.com/2015/06/02/using-lego-serious-play-as-a-design-thinking-tool/

[4]. Base maquette refers to the maquette which does not include design interventions yet. It is the simple form of the maquette before session participants add their elements.

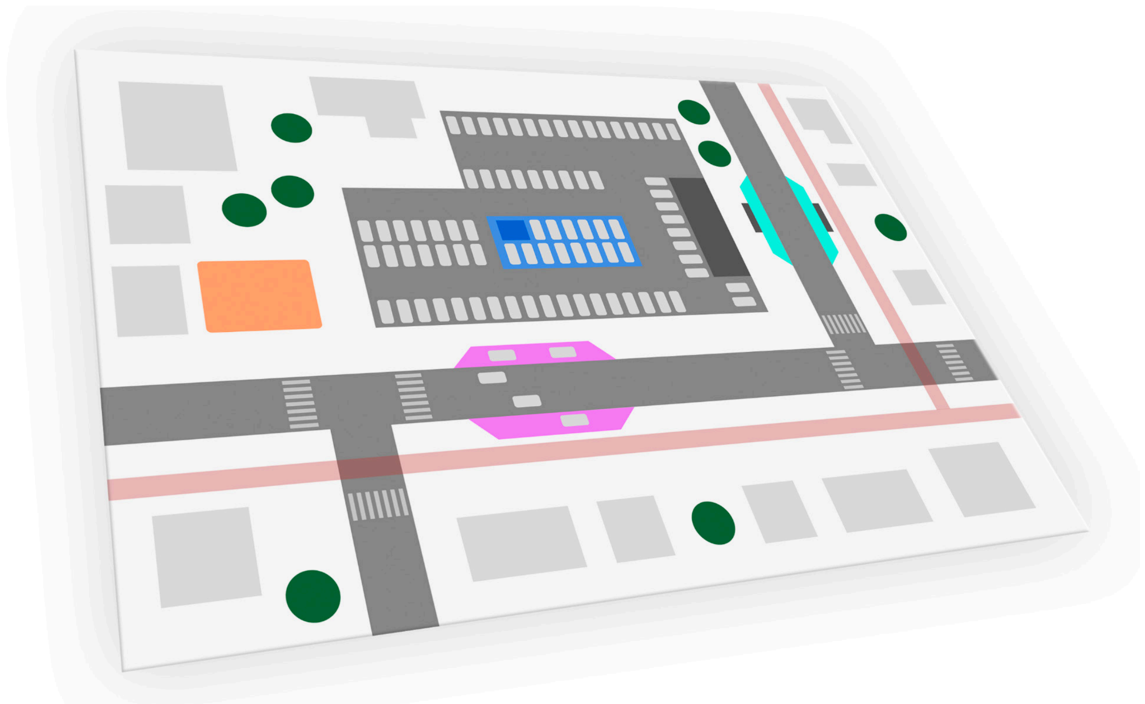


Figure 80.1 - Maquette 2D Layout with a selection of the stories included.

Figure 81.1 - Early maquette construction work in progress

understanding of the context. Moveable elements elements of the selected stories in this maquette such as cars, an induction charging area, an intermodal ‘transferium’, a delivery operator van and valet parking drop-off points. Bright colour paper or wooden pieces are used to emphasise the four different stories within the maquett, for example:

Purple: Valet drop-off and hop-on points
Orange: Bus of the in-car delivery operator
Blue: Autonomous induction charging area
Green: Intermodal travel transferium

Additional colours could be used for other stories

Data sharing

Basic data points are represented by coloured wooden coins, they can be exchanged between participants of the session. Exercises around ‘conversational prototyping’ (page 60-61) could be conducted with help of these coins.

Validation

The maquette was initially validated with a session with a small group of students and the learnings from this experiment were used to shape a second creative session at Aachen, the validation insights can be found on page 97.

Figure 81.2 - Will mechanical parking lots cease to exists when AV valet parking will be widely adopted?

Figure 81.3 - How about the parking problem for for micromobility, in terms of sidewalk polution?

PART E
PROPOSAL

This part presents the final concept proposal, this part includes the user experience design visualisations, the final maquette presentation, the final parking ecosystem visualisations and a Service Blueprint.

"The evolution of the environment is not only needed but is going to happen. For instance, you waste more time today trying to find a parking place than being stuck in traffic. Now, that's just [about] trying to match the open parking place with where the car needs to go, which is going to help fuel efficiency, whether it's electric or gas. It's a "smart vehicle, smart environment, smart world"."

Jim Hackett (2018) - CEO @ Ford Motor Company

PROPOSAL

This part presents the final proposal as the result of the research- and design phase. To rationalize the direction, a brief recap is given on the process steps supported by a simplified process tree of the project (page 85). Additionally, an introduction is given on the proposal elements.

How we got here

The thesis set out to explore design methodologies for a future context to generate user and market insights and translate them into a product-service concept which allows Ford to *sense and seize*[1] upon future European urban areas. Additionally, the project aimed to provide a tangible vision for the European market in 2030-35 and form a stepping stone for far-future concept development considering the commercial interest of Ford.

[1]Berkeley (2019) - Sensing and seizing. From: https://cmr.berkeley.edu/blog/2016/8/dynamic-capabilities/

The scope of the project started with a very open-ended challenge: exploring the shifting mobility landscape and designing an autonomous mobility concept to improve liveability. In order to take on this challenge three research questions were formulated (page 19) to research urban liveability, the mobility paradigm shift and the characteristics and trends of the European market. To answer these questions expert interviews, urban observations and desk research was conducted. The results were continuously documented in blogs.

The research was followed by the synthesis, ideation and concept phase where the open-ended challenge was converged by focussing on the transition to off-street parking in Amsterdam, as it was identified as a rich opportunity space from the research findings and the Ford Aachen team expressed interest in this space (especially in the data and dialogue field).

Final proposal

The proposal consists of three interrelated parts:

1) A product service proposal that consists of a selection of 4 parking ecosystem innovations. These were elaborated on various system levels like functionality, stakeholder relations, basic data points and user experience and are envisioned to be part of the FordPass ecosystem. The multiple system levels were organised in a framework to provide an accessible overview (page 66-75).

2) A maquette dialogue tool that enables dialogue between people from various backgrounds by creating common ground with boundary objects (102-103). The maquette aims to explore opportunities in the parking ecosystem that are enabled by emerging technologies like AD and electrified mobility. This tool was validated positively with a first test group of students, the results of the validation with the Ford team can be found via the link on page 102.

3) A report and video that brings together the main research findings and reflections on design methodologies for far-future contexts. The video serves as an 'easy-to-share' deliverable and provides a simplified narrative of the thesis findings and outcome.

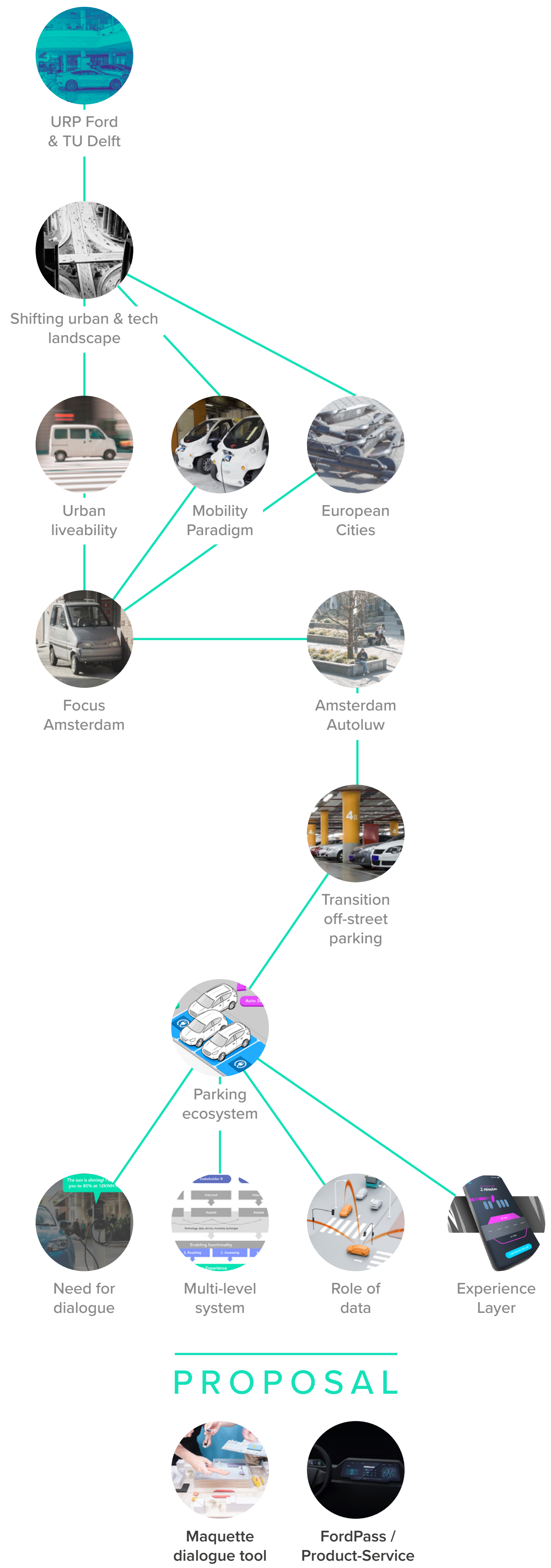


Figure 85.1 - Simplified process tree of this thesis project.

PRODUCT-SERVICE OVERVIEW

Each of the stories within the parking ecosystem product-service was approached individually (page 70-77). From there, steps were made towards the integration of these services by leveraging the existing FordPass platform. This part provides two diagrams that visualizes the relations between a set of components and stakeholders of the service.

Framework for services

An initial overview of the stakeholder ecosystem in relation to the Ford Mobility Cloud, user and vehicle was shown in figure 63.1, an new diagram created that elaborates on the experience level (figure below).

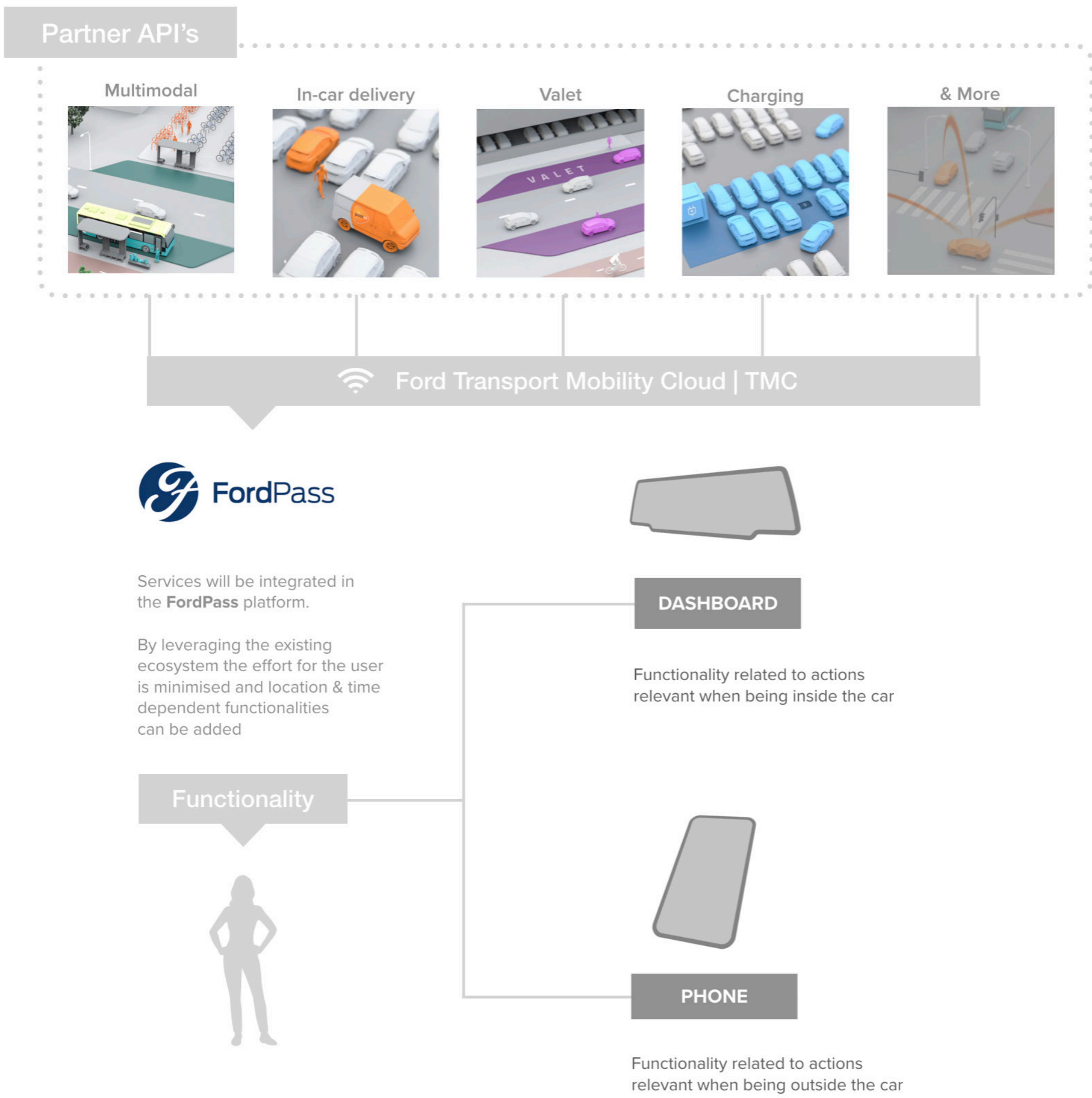


Figure 86.1 - Framework for data exchanges between user, vehicle and partners using the TMC platform.

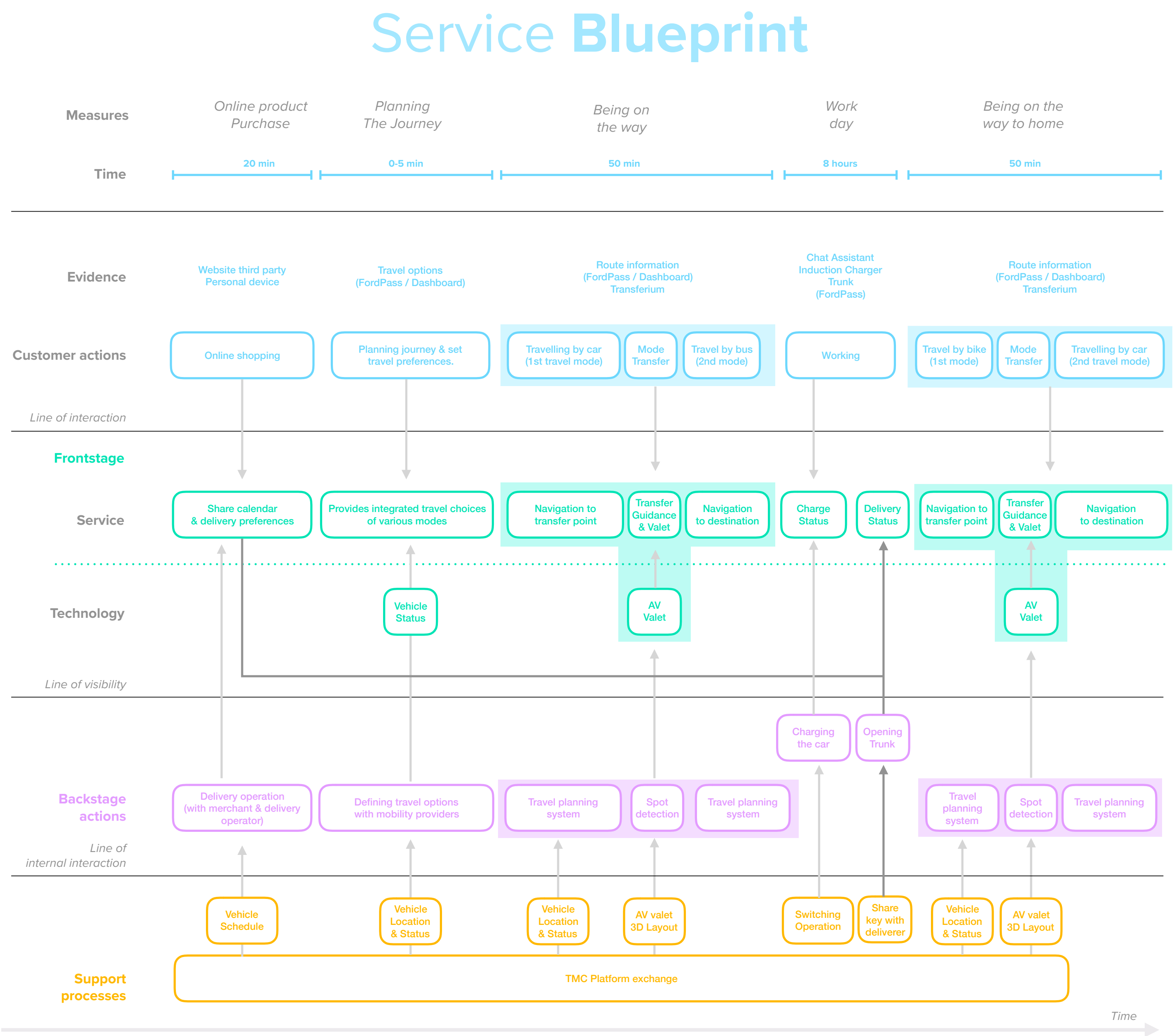


Figure 87.1 - Service Blue Print, based on the methodology by Nielsen Norman Group. Source: https://www.nngroup.com/articles/service-blueprints-definition/

Service Blueprint

The Service Blueprint approach was created as described by the Nielson Norman Group[1]. Their websites describes the methodology:

"Blueprinting is an ideal approach to experiences that are omnichannel, involve multiple touchpoints, or require a cross functional effort".

It supported in creating the relations between the customer journey, their actions and the related service components.

Conclusion

The creation of both diagrams supported in mapping the presence of the different stories across a typical customer office day and their relations. As described on page 78, the user should be able to interact with the product-service both inside as outside the vehicle serving specific demands based on the phase of the journey. The Blueprint supported in identifying those demands and required back-end processes to make it work.

[1]Nielsen Norman Group (2019) From: https://www.nngroup.com/articles/service-blueprints-definition/

USER INTERFACES

A vehicle (font) interior was designed and modelled and digital interfaces are designed to demonstrate how the interaction between the user could look like.

EXPERIENCE LAYER

In-car delivery, intermodal travel, charging and valet parking are integrated into the existing FordPass ecosystem. Leveraging the platform enables the user to access the services via one platform, which that can be accessed both inside and outside the car.

Dashboard

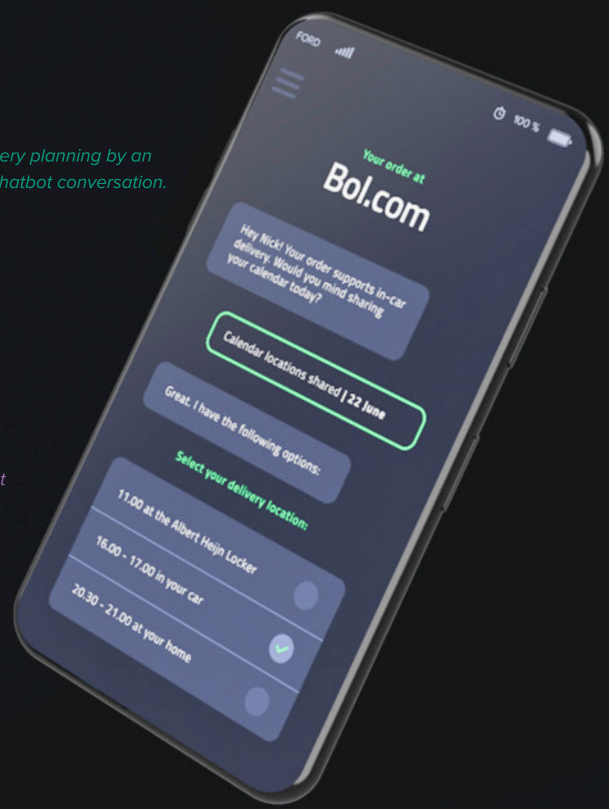
The FordPass parking services can be accessed on the secondary screen within the vehicle dashboard. No distraction is caused during driving, as the essential driving information is shown on a smaller screen behind the steering wheel.

Phone

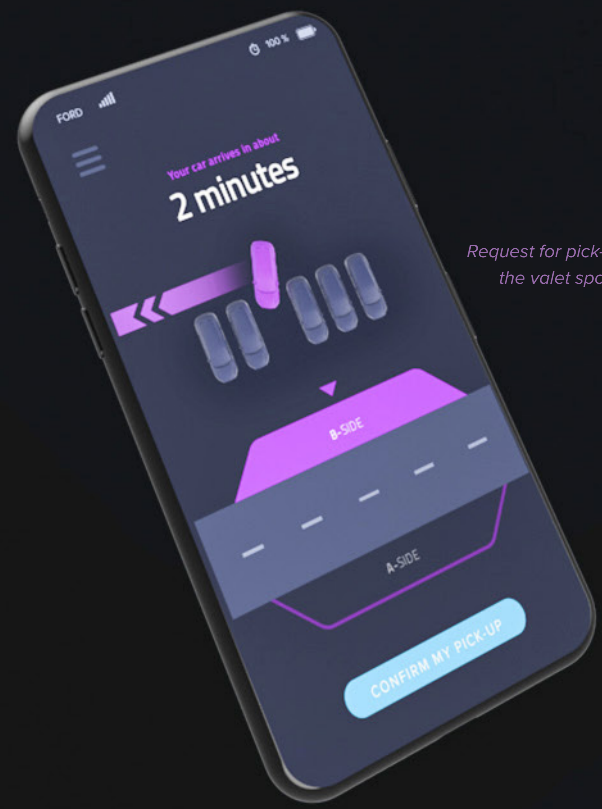
Services can also be accessed by the user's personal device, think of checking the charging status, planning an in-car delivery or requesting pick-up when the car is in a parking garage. The personal device serves as the extension of the car interface.

Intermodal travel planning guidance.

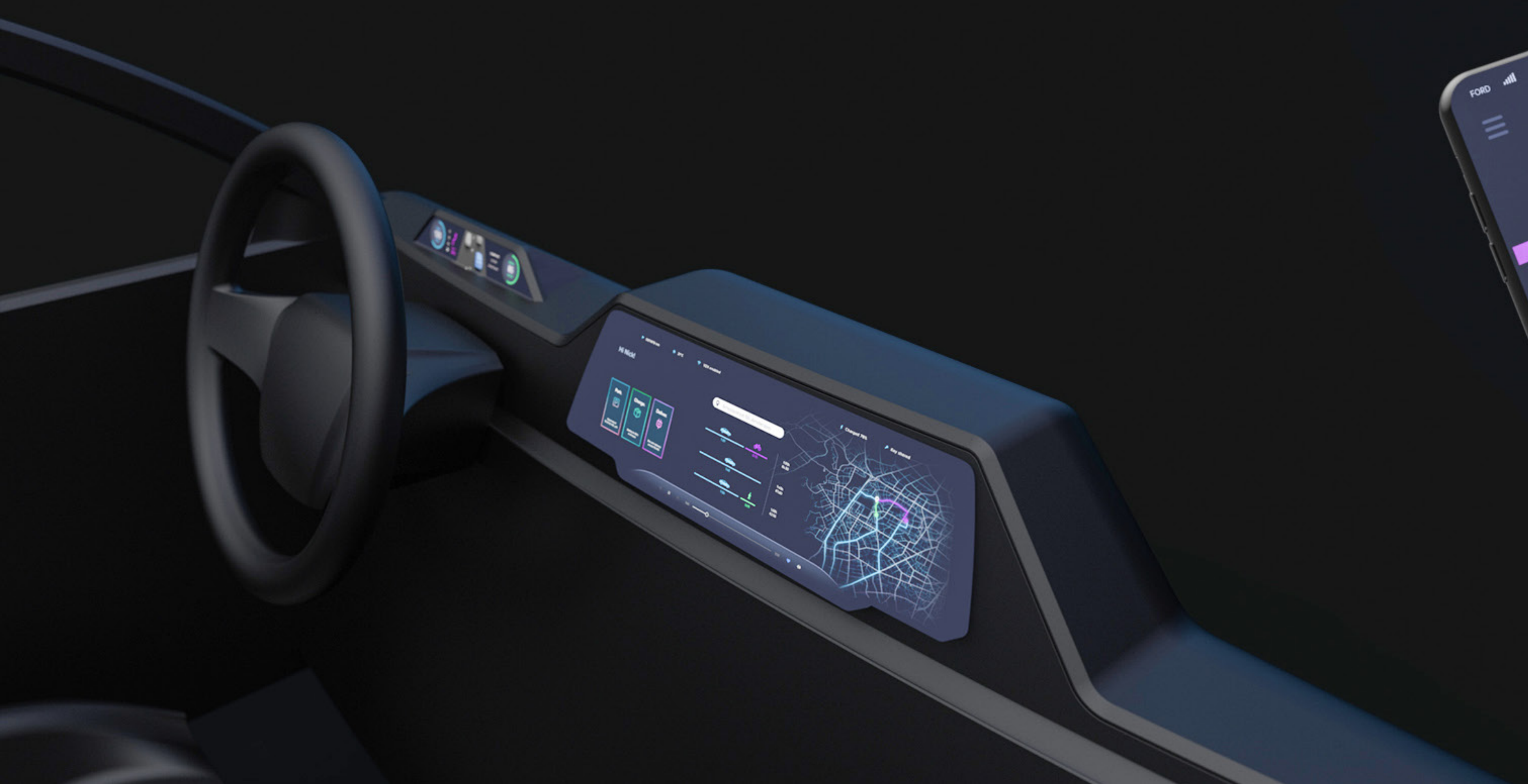
Spot selection for autonomous induction charging



In-car delivery planning by an humanised chatbot conversation.



Request for pick-up at the valet spot.



FUNCTIONALITY

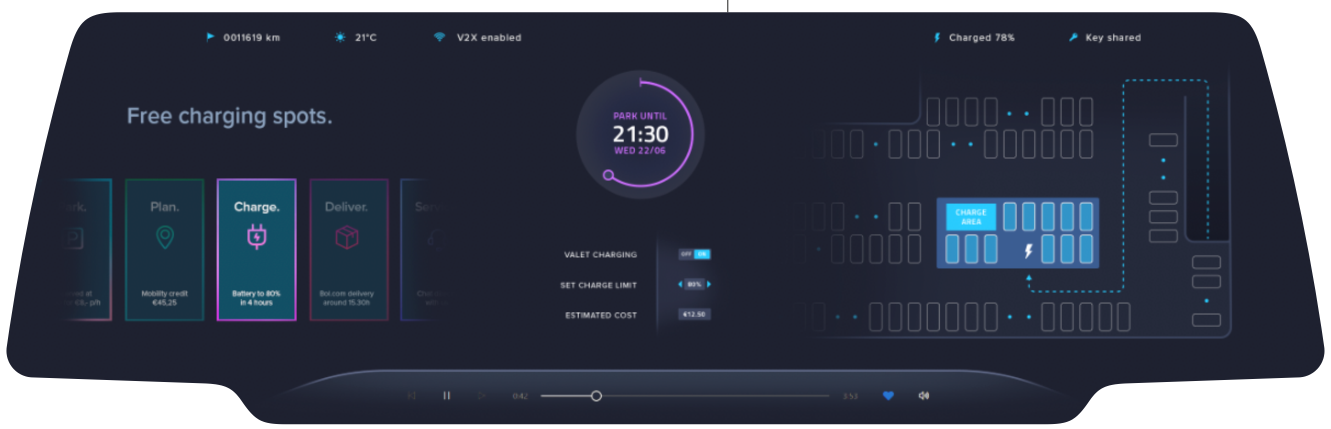
In both the in-car dashboard as the mobile application 'Service Tiles' are envisioned. This page highlights some of the core interface functionalities.

Steering wheel dashboard

The dashboard behind the steering wheel only shows primary / essential functions that are relevant while driving to prevent distraction.

Center dashboard

The dashboard behind the steering wheel only shows primary / essential functions that are relevant while driving to prevent distraction.



Park.

- Parking location layout to reduce anxiety for valet
- Compare pricing between parking lots
- Integration with plan & charge tile

Plan.

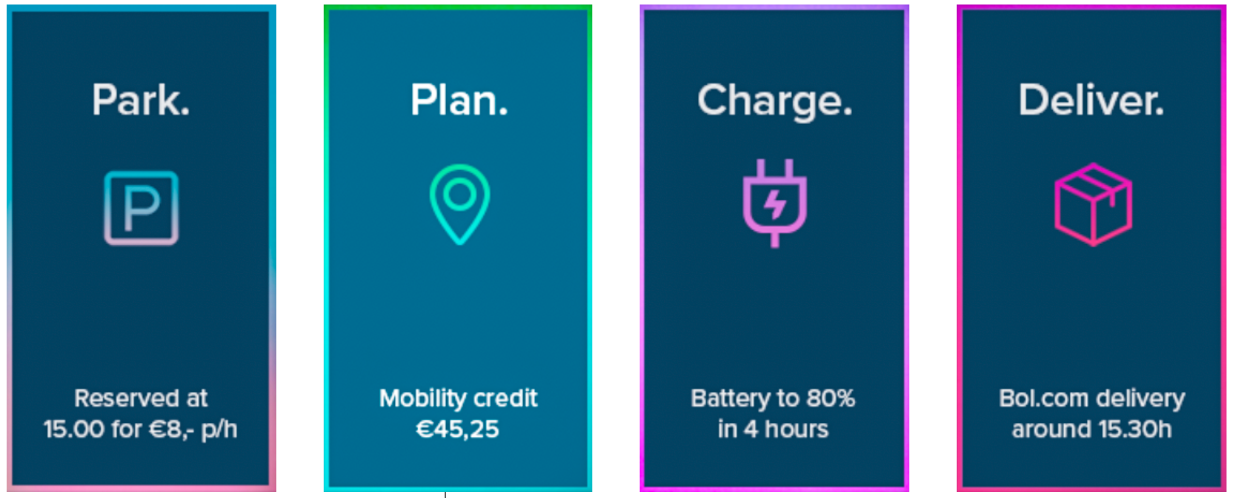
- Planning intermodal trips
- Anticipation when schedules change
- Overview of facilities for each route option

Charge.

- Reserve charging spot / wait in line
- Define schedule for optimal charging speed
- Compare pricing based on charging speed

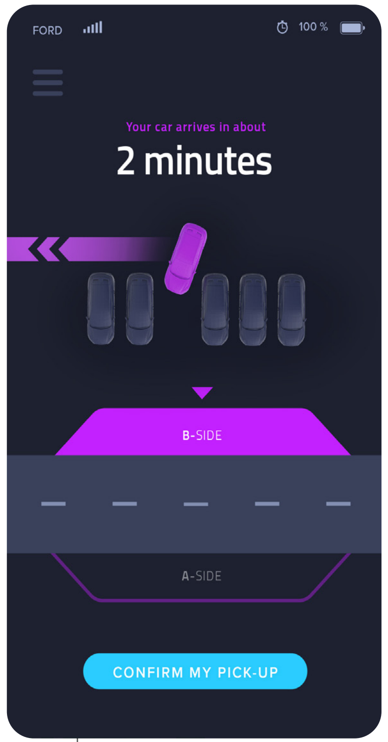
Deliver.

- Compare and choose delivery options
- Manage sharing of the digital vehicle key
- Set preferences for vehicle behaviour for delivery.



FordPass Service Tiles

The current FordPass ecosystem categorizes its functionality in a tab system. This proposal extends this system by using larger tiles to create space for a brief dynamic notifications.



Park

- Look-up the status of the valet parking
- Request for valet pick-up
- Manage parking fare payment

Plan

- Plan trips beforehand
- Look into travel history
- Manage payments and mobility budget

Charge.

- Reserve charging spots in advance.
- Manage payment of electricity
- Set charging preferences (max. level, speed)

Deliver.

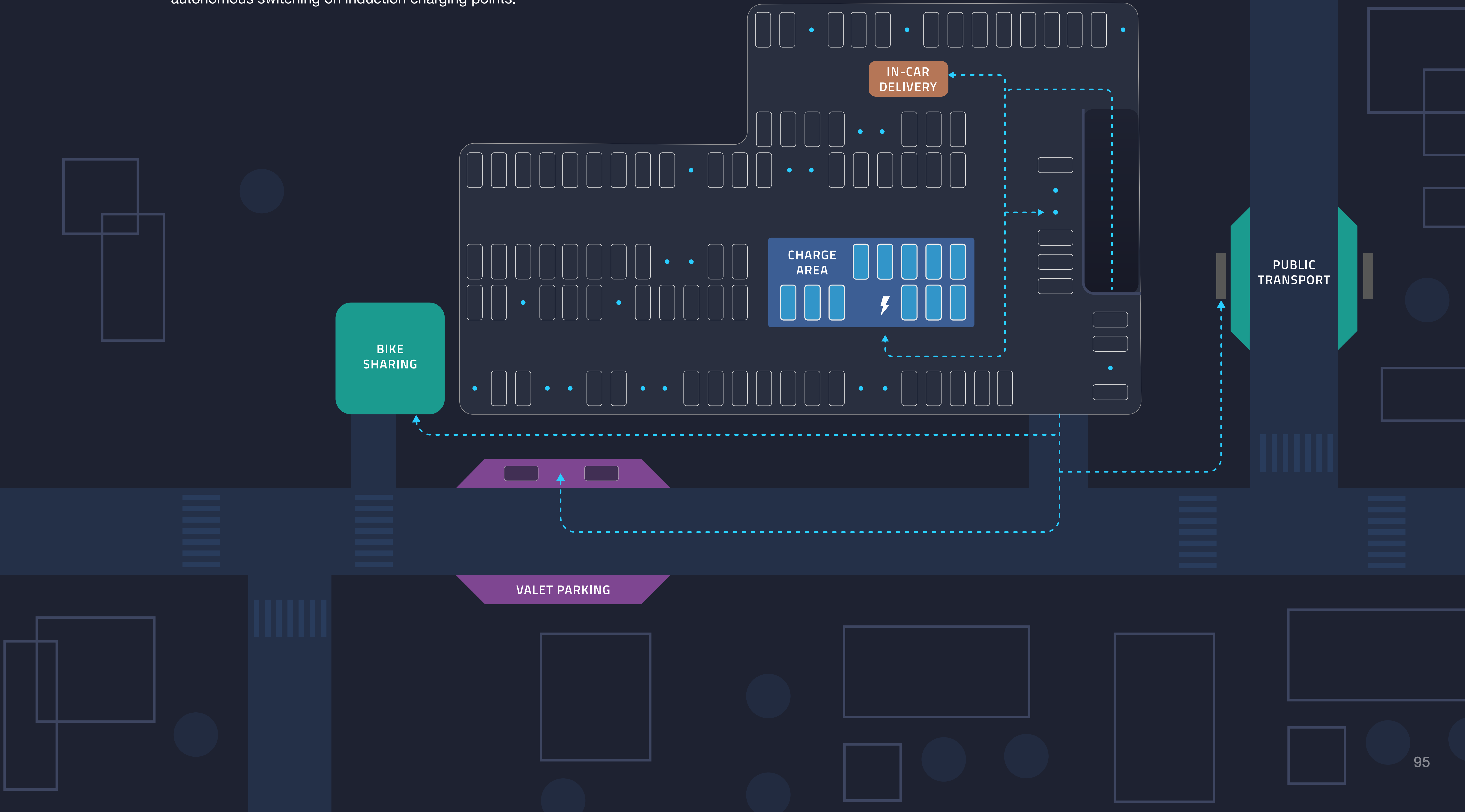
- Plan trips beforehand
- Look into travel history
- Manage payments and mobility budget

Mobile device

Users can access their vehicle from their personal device. Think of scenario's like requesting a pick-up, managing electric charging or their in-car delivery.

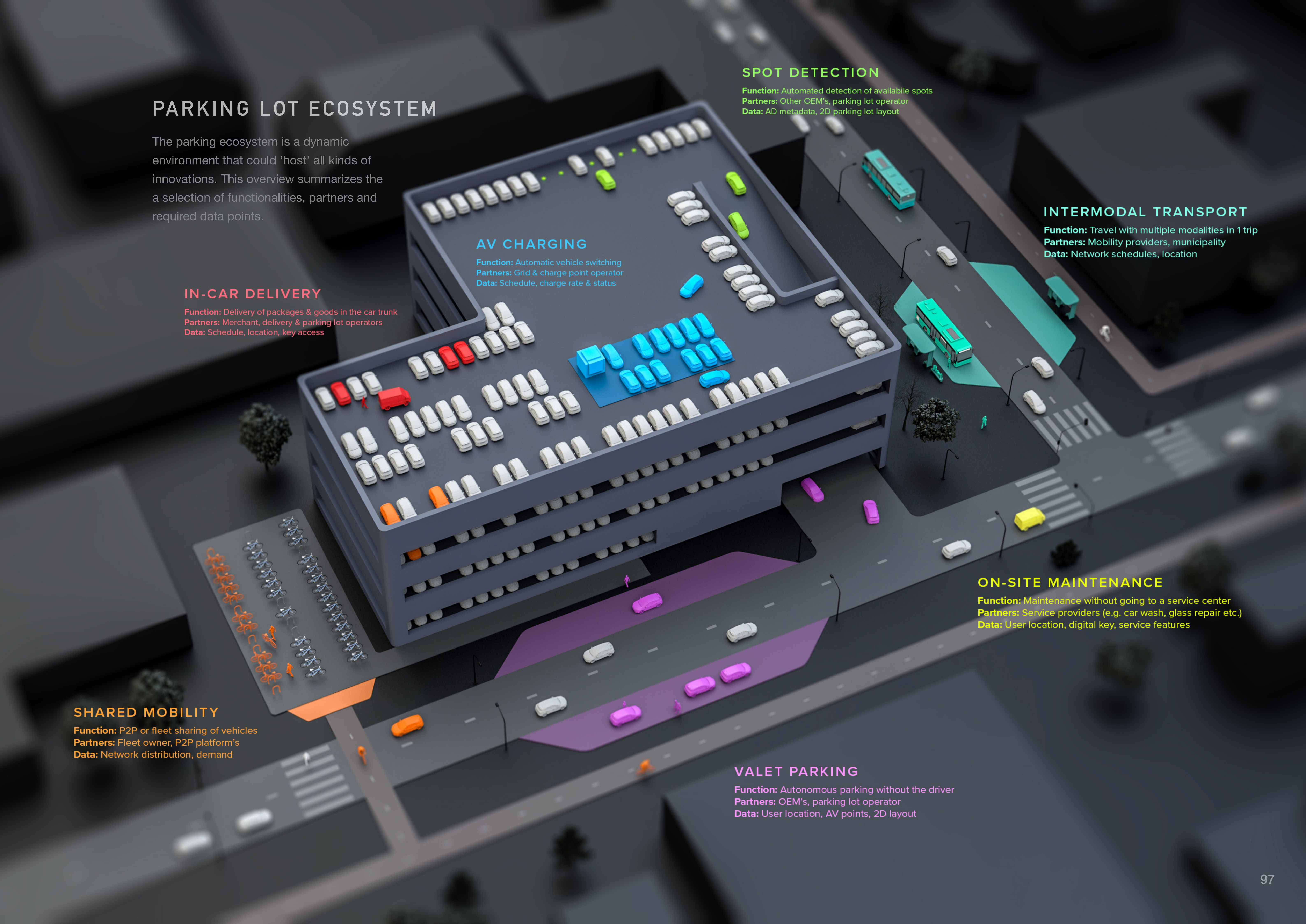
SCENARIO OVERVIEW

This map represents the various stories within the parking ecosystem. The bike sharing and public transport enable intermodal transport, the valet parking spots serve as drop-off spots for travellers. The charge area facilitates the autonomous switching on induction charging points.



PARKING LOT ECOSYSTEM

The parking ecosystem is a dynamic environment that could 'host' all kinds of innovations. This overview summarizes the a selection of functionalities, partners and required data points.



MAQUETTE DIALOGUE TOOL

The final maquette provides an basic parking environment with open room for design interventions. Almost all elements are moveable if desired during a creative session to support the dialogue.

LET'S TALK & CREATE!

Most objects are moveable, additional objects can be added to the scene and coins can be exchanged that represent data, services or monetary assets.

MAQUETTE DIALOGUE TOOL

The previous pages showed the 'base' maquette, followed by it being in use by participants of a pilot creative session. The maquette aims to support people in explaining and visualising their thoughts and ideas and enable them in the collaborative design process of interventions. The tool could enable dialogue for teams within Ford, but could also serve as a tool between multiple stakeholders. Two pilots are conducted to validate the tool for further iterations.

Session setup

The maquette offers a simplified physical representation of a fictional parking environment on a 1:200 scale (created with reference dimensions[1]). The maquette could serve for a variety of session protocols and dialogues., as the most elements are rearrangeable and additions can be made with paper and wooden elements (figure 102.1 & 103.1).

[1]TU Delft (2019) Minor Stedenbouw in de Delta. From: https://ocw.tudelft.nl/course-readings/parkeren/

Figure 102.1 - The tool invites people to create new elements.

How it works

Within the scope of the project, the following session setup was elaborated: a group of 4-5 people receive a session brief with information about the context and a problem or opportunity around a parking lot context. They are asked to collaborate on a proposal that takes into account multiple levels like functionality, stakeholder relations, data exchanges, environment layout and user experience. Pre-coloured elements like a road side lane (e.g. for hop-on and hopp-off), coins (e.g. data or service exchanges) and rectangles (specified areas like induction charging) can be used as boundary objects during the sessions. Dependent on the session setup, these elements can have a predefined meaning or are left open for own interpretation. Coloured paper can be cut in desired shapes and text and icons can be added to communicate interventions.

Figure 102.2 - Most elements of the maquette are moveable like the cars and the upper deck of the maquette. This open space aims to support creative thinking.

Figure 103.1 - Dependent on the session protocol coloured coins, cars and side lanes can be provided to participants to support their dialogue.

Validation

Pilot sessions were conducted around the selection of four parking lot innovations: in-car delivery, induction charging, valet parking and intermodal travel. The initial validation took place with a group of four students from IDE. They are very limited in their knowledge on the subject but the session provided interesting insights in how to setup such sessions to enable dialogue most effectively:

• If the session is short (+/- 20 minutes), it is important to provide clear guidelines on what is asked from the participants and the meaning of the colours and shapes on figure 103.1.

• In case of a longer session (40 minutes or more), a more open-ended approach is suitable. More diverse and in-depth results can be expected as there is more room for interpretation and elaboration.

• A point to consider is whether specific roles are assigned to the participants. Participants could represent specific stakeholders that are relavant to the brief, the conversational prototyping method might be used to decrypt data exchanges. Another approach is to put the participants in the role of the designers of the system.

Figure 103.2 - Miniature people, bikes and cars on a 1:200 scale.

Validation at Ford Aachen

The learnings and session protocol from the maquette session at Ford Aachen can be found via the QR code below.

PART F

CONCLUSION

Figure 104.1 - The long bright street is Market Street in San Francisco. During the interview Warren Logan mentioned an initiative to close around 3 kilometres of this street for cars. Will the transition to off-street parking become a global trend?

This part concludes the main research findings and reflects on the applied methodologies, the proposal and the limitations. The report will be concluded with recommendations and a personal reflection on the project.

While the delivery operators may see the Agenda Amsterdam Autoluw as a challenge, it also creates opportunity for them. Decreasing the amount of parking spots creates room for loading and unloading spots. As municipality we aim to listen to the interest of all city stakeholders.

Evelien van der Molen - Process Manager Agenda Amsterdam Autoluw - 2018

CONCLUSION

This part concludes the main research findings and reflects on the applied methodologies, the proposal and the limitations. The report will be concluded with recommendations and a personal reflection on the project.

Main findings

Looking back, these are the three main thesis findings that shaped the final proposal:

Key finding 1: ***Trend of decreasing the number of (parked) cars in cities.*** *(Part B)*

A European wide trend is found across cities who aim to decrease of the amount of cars in city centers to increase liveability by creating more room for people and a safer and healthier environment. Amsterdam Autoluw has served as key reference throughout this project. Recently the 'The Mobiliteitsalliantie'[1] emphasised the need for parking hubs outside the city in their "Mobility Plan for 2030".

[1]Mobiliteitsalliantie (2019) The plan is a collaborative effort by various city stakeholders and industry parties, they published the "Deltaplan Mobiliteit 2030". From: https://mobiliteitsalliantie.nl/wp-content/uploads/2019/06/Deltaplan-digi.pdf

Key finding 2: ***Novel business models emerge as vehicles become connected and electrified.*** *(Part B)*

As cars are increasingly capable of communicating with infrastructure and third parties (e.g. service providers), new business models emerge around topics like EV charging, goods delivery, vehicle sharing and intermodal travel (more info on page 32-33). The parking lot environment is evaluated as a rich context for sensing and seizing opportunities around the servitization of Ford.

Key finding 3: ***Transitioning to off-street parking requires dialogue.*** *(Part C)*

The transition to off-street parking is a complex challenge that involves change across multiple levels (page 48-51). It requires a socio-technical system view instead of a one-off solution. This was confirmed by multiple urban mobility stakeholders and Prof. R. Price explained how such a transition can only take place when both public as private organizations collaborate and interact by dialogue.

Discussion

An interesting conflict could be noticed in the urban mobility field: while municipalities across Europe strive to decrease the number of cars in their cities, the automotive industry is proposing novel propositions that offer additional comfort, function and convenience when using a car. This project strived to find alignment with the very likely future context in European cities (Amsterdam in specific) where reaching- and parking in city centers will be more challenging due new policy and street design.

The design vision of this project aims to make Ford enabler of the transition to off-street parking. This vision closely relates to the core value of Ford, inclusiveness, as democratising streets does not only consider car users but liveability for city habitants in general. Additionally, this direction could be of commercial interest as it explores opportunities around the servitization of Ford's business. The context may extend the purpose of cars when parked.

Ford's vision on its future is reflected in a quote by Jim Hackett in 2018 about the need for a broader system view (page 2). This project aimed to practice such broader system view and strived to look further than one-off solutions, it provides an initial framework where information is organised about the complex network of stakeholders and their specific interests, assets and relations.

During the ITS Congress (blog 8) parties like Siemens, Transdev, Tomtom and the Municipality of Rotterdam all specifically expressed the need for intensified collaboration on data exchanges between city stakeholders to move on in urban smart mobility. Transdev CTO Manu Lageirse mentioned that the largest challenges is not getting technology to work, but in getting stakeholders on the same page.

In the final week of the project, an interview with Evelien van der Molen from the municipality of Amsterdam was conducted (blog 10). As Process Manager of the 'Agenda Amsterdam Autoluw' her expertise field is very closely related this project. Without disclosing the thesis outcome before the interview, she mentioned how the municipality is seeking to make off-street parking more attractive and that finding a balance of interest between the city stakeholders requires continuous dialogue. The ITS Congress and the interview with Evelien van der Molen reconfirmed the essence of key finding 1, 2 and 3 on page 106.

The conversational prototyping method was evaluated as an effective tool to decrypt data exchanges that enable functionality by humanising a technical exchange (page 60-61). A framework was created to organise and interrelate levels like data sources, points, functionality and user experience.

Inspired by the Transition Design practice and the need for dialogue, a maquette tool was created. This tool explores a novel way to conduct both internal as external dialogues by creating common ground with a simplified representation of the parking ecosystem. The maquette leaves open space for design interventions and facilitates dialogue on data exchanges and innovations. The initial validation was positively evaluated (page 102-103).

A product service is proposed as extension of the FordPass ecosystem and provides a tangible vision on how Ford could implement servitization around parking ecosystems from a user perspective. It demonstrates how a complex back-end could interact on the front stage with Ford customers.

Recommendations & limitations

The proposal provides Ford with insights and a tool that could be used directly. There are however a number of recommendations that could support further iteration of the proposal, as the validation remained quite limited during the project duration.

- The maquette tool and the product service proposal could be iterated by organising a diversity of creative sessions and practical pilots with stakeholders and end-users to gather best practices on where the proposal serves most effectively.
- Several interviewees expressed their interest in exchanging thoughts with Ford on urban mobility (a.o. Municipality of Amsterdam, the Faculty of Architecture, Klup and PostNL). This could be of value as Ford emphasized the need to develop partner ecosystems within cities. The tool could be used to enable the dialogue.
- Within the scope of this thesis a selection of four innovations was elaborated. As shown on page 97, there might be many more additional proposals around vehicle sharing, maintenance and V2G that could be a fit to the FordPass parking ecosystem.
- The platform approach with FordPass may have ethical considerations to take into account. Especially as it becomes increasingly important for receiving functionality. What if they do not want to share data? Are users in control of their own decisions as intelligent systems could make decisions on the back-end?
- The thesis specifically focussed on Amsterdam as reference for other European cities where similar policy and trends can be recognized like Madrid, Copenhagen, Hamburg and Paris. Each city may have different implications around urban mobility that are essential to take into account when scaling the servitization around the parking.

Personal reflection

This project provided the opportunity to learn from a large number of experts and to experience the context by global observational research. I got to practice system 'design', instead of designing a one-off solution. This was challenging but truly a valuable extension of the skills I learned at IDE.

My key personal learning from this project is to participate in the context I am designing for, some of the most important insights and inspirations were found by simply looking around in the context and not being afraid to reach out to people. It turned out that most people are happy to share their knowledge! Thank you for reading this report.

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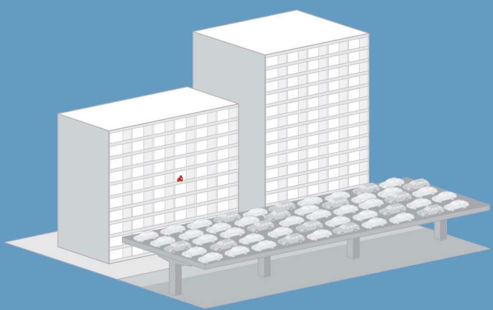
THANK YOU FOR READING!

MORE INFO

The Principles for the Living Street of Tomorrow by Ford Greenfield Labs and Gehl Studio have been a major inspiration throughout the project.
More information on: **www.ourlivingstreets.com**