Appendices

Appendix 1

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

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

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

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

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

family name: Puglia
initials: MT given name: Tim
student number: 4386124
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): ★ IPD ○ DfI ★ SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ○ Honours Programme Master
specialisation / annotation: ○ Medisign ○ Tech. in Sustainable Design ○ Entrepeneurship

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

** chair: S. Hiemstra-van Mastrigt dept. / section: SDE / MF
** mentor: G. Kortuem dept. / section: SDE / IoT
2nd mentor:
organisation:
city: country:

comments (optional)

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

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

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

Procedural Checks - IDE Master Graduation

TU Delft

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair _____ date ____-____-____ signature _____

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

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

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

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

YES all 1st year master courses passed

NO missing 1st year master courses are:

name _____ date ____-____-____ signature _____

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

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

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name _____ date ____-____-____ signature _____

Initials & Name MT Puglia Student number 4386124

Title of Project Personal device for modality integration (strategy & development)

Personal Project Brief - IDE Master Graduation

TU Delft

Strategy and development of a tool for seamless modality integration

project title

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

start date 11 - 10 - 2021

16 - 05 - 2022 end date

INTRODUCTION **

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

The OV-chipcard incorporates all public transport providers on a national level into a single ecosystem. It is one that is easy to understand for the traveller as there is only one way to pay and check in/out. Just a couple of years ago the delineation between public and the private sector was clear. However, with the introduction of shared modalities the boudary is becoming fuzzy, especially due to the fact that these newcomers all use their own way of checking-in/out. Because they are not incorporated into the OV-chipcard ecosystem, the journey from door to door is becoming less seamless the more mobility providers are added to the market. This also means that there are exponentially more ways of getting to a final destination.

The Dutch government, Delft University of Technology, and the private sector are actively working on various MaaS (Mobility as a Service) apps and this graduation project will be joining the efforts. Socio-economic trends such as a continous rising population and the increase of congestion in cities require a highly efficient and improved integration of all forms of transport (public and shared). In addition, over the past decade privacy and digital securty has become a sensitive topic. When developing the personal device for modality integration, it must adhere to the legislation such as the GDPR. With the increase and continuous push of the sharing economy, integrating all forms of transport will be valuable.

This graduation project will be done together with the Seamless Personal Mobility Lab. The lab focusses on the main themes MaaS (Mobility as a service) and Seamless Travelling, both of which are fundamental pillars in the project. In the next few years, the OV-chipcard system willl change from the current Card Based Ticketing (CBT) where transactions are made locally on the card towards Account Based Ticketing (ABT) where the transactions happen per account and behind the scenes (ovpay.nl/nl/). The Lab is in close contact with various transport operators, mobility companies, government and technology developers. The relevant stakholders will be involved in the project (interviews, validation sessions, stakeholder needs, etc.).

space available for images / figures on next page

Initials & Name MT Puglia Student number 4386124

Title of Project Personal device for modality integration (strategy & development)

introduction (continued): space for images

image / figure 1: Partners of the Personal Seamless Mobility Lab

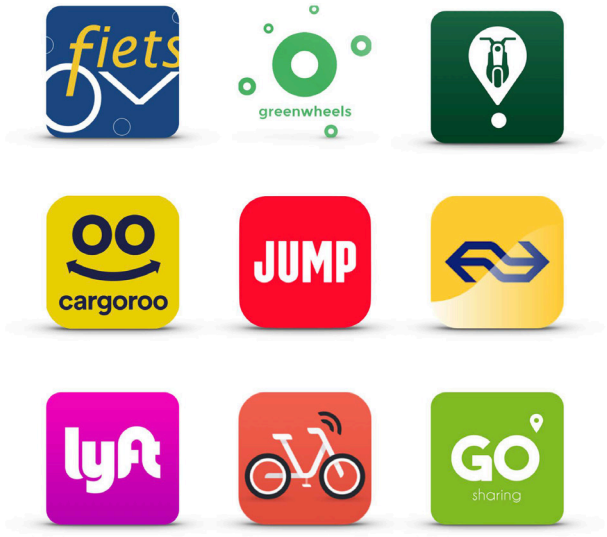


image / figure 2: Some examples of public and shared mobility providers who are not integrated.

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

There are two major problems which this graduation project will tackle. The first is that newcomers (usually shared mobility providers) are operating alone and therefore are not integrated into a single travel ecosystem. This implies that for every extra mobility service outside of the OV-chipcard ecosystem, there is a seperate and unique way in both payement and checking-in/out. It will be essential to understand the stakeholder needs, and how they can be enticed to be incorporated into a single transport ecosystem. The second main problem which this project is trying to solve, is that connections and transfers are far from being seamless. The OV-chipcard system still has too many step which decrease the feeling of seamless travel: grabbing your card to check in or out, gates at stations, unlocking the OV-bicycle, etc. This creates discomfort, creates congestion, and induces stress for travellers. To solve this problem, the enitre customer journey and the way in which we travel must be re-imagined. All aspects must be designed with the user at the center as they are the ones who must benefit the most.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

SPD: develop a design vision and a fully seamless travel experience from which a strategic roadmap including implementation steps will be constructed.
~~IPD: develop a demonstrator prototype with the aim to validate the experience of the new way of travelling.~~

This project is part of a double degree graduation assignment. The two masters IPD and SPD must both be covered and time must be (roughly) equally allocated. The two masters during the project will be incorporated in parrallel, however each of the master will have its own deliverable. For SPD this will be an extensive analysis, a vision, and finally a strategic roadmap with clear implementation steps. For IPD the final deliverable will be a demonstrator in a demo setup to validate the new experience. For both masters, the question of what exactly consitutes as' seamless' travel will be answered.

Initials & Name MT Puglia Student number 4386124

Title of Project Personal device for modality integration (strategy & development)

Personal Project Brief - IDE Master Graduation

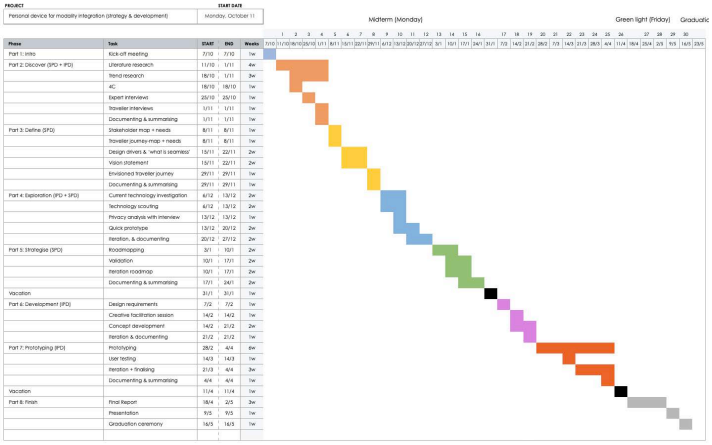
TU Delft

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 20 - 9 - 2021 6 - 5 - 2022 end date

Project planning



The project will be split up into 8 parts. Some parts combine both IPD and SPD, and some will be specifically focussed on a single master. The parts, including which master they cover, are listed below:

1. Intro
2. Discover (SPD + IPD)
3. Define (SPD)
4. Exploration (IPD + SPD)
5. Strategise (SPD)
6. Development (IPD)
7. Prototyping (IPD)
8. Finish

The graduation will be done full time. There will be two weeks of vacations in total.

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

One motivation is that I did a very small project whereby I felt that the end-result held so much value, that it would be wrong to leave it undeveloped. I believe that the mobility sector is at a critical junction where decisions and strategies made today, will have major impact on millions of travellers in the future. I have great ambitions to develop this concept in such a way that it will become part of the conversation by the people who will eventually make these decisions.

Another motivation is that this project lends itself to be spread out over two masters. As I have mentioned in my Double Degree Proposal, I'm highly interested in both the mindset of an SPD and IPD type-of-person as they are quite different. I believe that by understanding both mindsets, there can be clearer communication and better results. This graduation project will be the best example I can think of as I will be investigating the high-level strategy and constructing the implementation plan in addition to going into great detail regarding the product itself by deepdiving into specific technologies.

There are a couple of competencies which I would like to learn more about or improve. I followed the course Creative Facilitation and highly enjoyed it. This project would be the first external project in which I will apply the method taught in the course. I'm curious to see what the results will be. Another competency which I would like to explore more is sketching and drawing. I know that I'm not the best at it, and I would like to improve my skills. This will hopefully lead to better communcation with stakeholders. In addition, I want to learn in-depth knowledge on cryptographic protocols and standards as privacy and security will be an important pillar of this project. This also implies extensive knowledge on the concept of IoT and the accompanying communication technologies. My already existing knowledge in detailed prototyping with Arduino and having built a fully functioning autonomous vessel with a 6-person team, will help to develop a proper prototype to validate the experience.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Initials & Name MT Puglia Student number 4386124

Title of Project Personal device for modality integration (strategy & development)

Appendix 2

General trends

The previous section looked at specific trends, however, since the projects intends to make strategy calls into the future, it is similarly important to take multi-decadal trends into account.

Population size

The European population will grow towards almost 450 million citizens in 2026, after which it will steadily decrease. The Netherlands will likely have a population of 18,6 million citizens in 2060. The Urban Europe Strategic Research and Innovation Agenda note that: 'Some 73% of the European population was considered urbanized in 2010. In contrast with for example Asia and South America, Europe has relatively few cities with more than 1M inhabitants and a relatively high number of small and medium sized cities (SMCs). The larger urban areas are also mainly formed of amalgamated SMCs.' More importantly, CBS projects in The Netherlands that 75% of population increase is primarily in small to medium cities. These great urbanisation trens call for a flexible, adaptive, and dynamic transportation system of both leveraging the advantages of the public transportation sector and well-adapted shared mobility service providers. Not doing anything will increase congestion and pollution.

Attitude towards cars

An increasing number of cities in The Netherlands are moving towards a car-free (in Dutch 'autoluwe') city centre; Haarlem, Leiden, Delft, Amersfoort, Leeuwarden, and Amsterdam, just to name a few. The removal of cars in city centres, as pointed out by Steenbergen, calls for the development and better cooperation of shared transport service providers and micro-mobility.

Demographics

Demographically speaking, some interesting trends are on the horizon as-well. CBS notes for The Netherlands that in 2030, it is expected that 4.2 million people over 65 will live in the Netherlands, 920 thousand more than now. This group will then form 23 percent of the population, now it is 19 percent. In particular, the number of people over 80 will increase, from 0.8 million now to 1.2 million in 2030. Moreover, younger ago cohorts will stay roughly the same, of decrease slightly. These younger citizens are an important demographical age group, as they are growing up with abundant technological advancements are and more like to be inclined to use new modes of transport. In addition to the older age cohorts, millennials embrace the adoption of the sharing economy the most.

Privacy

The Dutch law 'Wet Bescherming Persoonsgegevens', or in short WBP, was introduced on the first of September 2001. The law was mostly based on and inspired by the European Data Protection Guideline called 95/46/EC. This guideline was replaced in May of 2016 by the General Data Protection Regulation, or in short GDPR, or its directive code 95/46/EG, which came into effect exactly two years later. The Dutch government decided to

embrace the GDPR fully and therefore the Dutch privacy law WBP was rendered irrelevant. According to the GDPR, the first points is that the collected data must be subject to lawful, fair and transparent processing. This means that the processing must be on a legitimate purpose, be fair to not use the data for anything other than said legitimate basis and be transparent meaning that the data subjects must be informed by the data processor and be fully aware of what is done with said data. Another point is the limitation of purpose, data and storage. This means that a data processor must not ask for more personal data than is necessary. Also, when the data is no longer needed to fulfil the original intentions, the data must be deleted. Another law is that the data subject gains more
power, e.g., the data subject gains the power to ask for their information to be removed, rectified, not transferred to a third party or to lodge a complaint. In addition, the data processor now has the obligation to report a data breach within 72 hours to all affected data subjects and respond with appropriate measures. Other smaller points are important as-well. For example if the data subject is younger that 16 years old explicit consent is mandatory from a parent or legal guardian. There must be privacy by design i.e. having the best data protection using appropriate encryption the more sensitive the data subject's data is. Furthermore, employees must be aware of the data that is handled and remain ethical with the use of the data.

Appendix 3

Interview guide for mobility expert
Method: semi-structured

Research topic: Understanding the current system of shared modalities and future vision
Research question: What is seamless travel and how can it be introduced in the Dutch mobility landscape consisting of public and shared transportation modes?

Checklist for start:
I. Mention why the interviewee is selected
II. Assure interviewees of anonymity, confidentiality and TU Delft ethics, they may leave at any point
III. Explain that there are no right or wrong answers
IV. Explain who I am
V. Ask permission to tape (if necessary)
VI. Sign consent form

Introductory script:
I. Introduce the project
II. Goal overview: first drawing, then questions
III. Zijn er vragen?
IV. Briefly show the overview of the OV-map

Subtopic 1: Overview stakeholders
Opening question: Can we map out all the relevant stakeholders just like the public transportation overview?

Follow-ups/probes:
- *What are the roles (draw coloured arrows) of each stakeholder?*
- *Who holds responsibility for what?*

Subtopic 2: Hierarchy of regulation
Why are the shared mobility providers managed from this particular level of governance (OV-autoriteit, municipality, province etc.) compared to the decentralised system of public transportation?

Follow-ups/probes:
- *Why is it organised in this particular way?*
- *What benefits are there to this way of organising?*
- *What are the drawback to this way of organising?*

Subtopic 3: Current regulation
To what specific (way of) regulation from [insert relevant authority; likely municipality] are the shared mobility providers subjugated?

Follow-ups/probes:
- *Is there a concession-model like the public transportation sector?*
- *Why (not)?*
- *Why would a single tram concession work, but not a single shared moped provider?*

Subtopic 4: Demarcation under pubic transport system
Why is is opted to keep shared service providers privatised and not subsumed under the public transportation sector?

Follow-ups/probes:
- *Is the incorporation of shared modalities in the OV-chipkaart ecosystem desirable?*
- *Why (not)?*
- *What is the reason (not) to operate like the OV-fiets?*
- *Public transportation was in the same predicament, why not move the shared system forward?*

Subtopic 5: Seamless travel
What is in your eyes fully seamless travel?

Follow-ups/probes:
- *What are current obstacles/challenges to fully introduce seamless travel?*
- *What should be necessary steps to introduce seamless travel?*
- *Are the current offerings willing to fall under the seamless travel system?*
- *Why would they object?*

Appendix 4

Interview guide for shared mobility provider
Method: semi-structured

Research topic: Understanding the current system of shared modalities and future vision
Research question: What is seamless travel and how can it be introduced in the Dutch mobility landscape consisting of public and shared transportation modes?

Checklist for start:
I. Mention why the interviewee is selected
II. Assure interviewees of anonymity, confidentiality and TU Delft ethics, they may leave at any point
III. Explain that there are no right or wrong answers
IV. Explain who I am
V. Ask permission to tape (if necessary)
VI. Sign consent form

Introductory script:
I. Introduce the project
II. Are there any questions?

Subtopic 1: Trajectory from idea to the street
Opening question: You had the idea for 'Brand X', what were the steps taken in order to get your bicycles on the streets?

Follow-ups/probes:
- *Who did you talk to specifically?*
- *You operate in multiple municipalities. Is the process different per municipality?*
  - *To what extent do the regulations differ?*
- *How did you select the city to offer your services?*
  - *Is is specific for favourable regulations per municipality?*
  - *Or do you adapt to the wishes of the municipality regulations with the highest potential?*
- *Why are there multiple shared service providers?*
  - *Is it good for competition?*
  - *Do you want competition?*
  - *Has the shared mobility sector innovated enough for there to be a single player?*
    - *Or are there still technological ares's that need to be explored?*
- *Is 'Brand X' economically self-sufficient?*

Subtopic 2: Interaction
Opening question: Do you make your app in-house? Who makes it?

Follow-ups/probes:
- *Most of the apps used by your competitors look and work the same. Why does everyone use the same system?*
- *Have you considered alternative ways for users to use your service?*
- *Do you wish to integrate with MaaS service providers?*
  - *Why (not)?*
  - *Are you willing to work with some and not with others?*
  - *What are the reasons for your decision?*
- *What are the current challenges of introducing MaaS?*
- *Do you feel that MaaS is the solution to integrate the entire shared mobility sector?*

Subtopic 3: Regulation (take out context map)

Opening question: The way in which the public transportation is organised is different from how shared mobility providers are organised (provide explanation); did you speak with any of these stakeholders?

Follow-ups/probes:
- *Are there higher levels of government with which you talked or must follow regulations?*
- *Did you ever consider working from higher levels of regulatory bodies (i.e. provinces, ov-authorities etc.)*
- *Why (not)?*
- *Would a single concession model be desirable?*
  - *Why (not)?*

Subtopic 4: Demarcation under pubic transport system
Opening question: Do you see yourself as a public transport service provider?

Follow-ups/probes:
- *Why (not)?*
- *Have you ever considered using the check-in method of public transportation (just like the OV-bike)?*
  - *Why (not)?*
  - *Is it desirable? What are the advantages or disadvantages of doing so?*
- *Let's assume the authorities regulate it in such a way that you must use an ov-chipkaart as a means of checking in; what would you do?*

Subtopic 5: Seamless travel
What is in your eyes fully seamless travel?

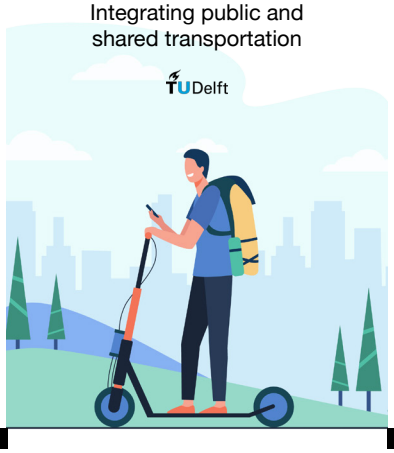
Follow-ups/probes:
- *What are current obstacles/challenges to fully introduce seamless travel?*
- *Speaking of seamless travel, how do you envision the transition between public and shared modalities?*
- *What should be necessary steps to introduce seamless travel?*

Appendix 5

Seamless travel

Integrating public and shared transportation

TU Delft



General information

Thank you for participating! For my graduation project at the Delft University of Technology, I am researching what exactly 'seamless' travel means for the traveller. Specifically, I'm focusing on the integration of public transportation (train, bus etc.) and shared transportation (shared car, shared moped etc.).

Please fill in this booklet during or right after the end of your trip. By doing so, your experiences are still fresh and provide a better image of your experiences.

Your answers will be used anonymously and serve to get a good picture of the current situation, so that I can make it better. It is therefore very important for me to learn as much as possible from you and your trip!

After you have completed the booklet, please give it back to me so that we can have a short chat about your experiences. I would like to have it back before the 8th of December.

Contact me at m.t.puglia@student.tudelft.nl

This booklet belongs to: _____

My age is: _____

I live in: _____

Instructions

You will be going on a trip of your choosing. In your trip you must use **both** a **public** and a **shared** means of transportation. You can include more means of transportation when required. Up to you. For this research, please do not use the OV-bicycle.

Example: You start at home and cycle to the station, take the train, use a shared moped to your destination, walk the last bit. This trip has 4 modes: cycle, train, moped, walking.

On the next page, you will be making a timeline. After the timeline, there will be a couple questions about your trip.

Good luck!

Timeline:

Please note down what actions you took and what you did during the trip. If relevant, include interesting thoughts. You can write or make illustrations. The timeline is all yours, so go crazy!

Examples to add: I had to run here, I checked in/out there, this thing happened unexpectedly, I listened to a podcast here, I took my phone out there etc.

The decision is made to go on a trip

Date: ____
Time: ____

Destination is reached

Time: ____

Add markers to timeline

Add the following symbols on the timeline to mark moments of importance where you experienced the following:

Use **—** for obstacles or difficulties

Use **+** where you experienced stress

Use **x** where you experienced continuity *(being in the flow)*

Use **^** where you experienced lack of control

Use ***** for parts which are well integrated

You can use more of the same symbol, as many as you like. If you find that an experience was not relevant for your journey, you can leave it out.

Tip: draw a little line between the parts that were well integrated.

General questions

How often do you use public and shared transportation?

Public: _____ Shared: _____

When would you use a shared means of transportation? Why?

_____

_____

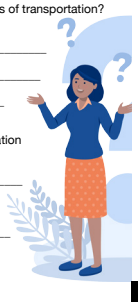
_____

When would you **not** use a shared means of transportation? Why?

_____

_____

_____



In your opinion, how is shared transportation different to public transportation?

_____

_____

_____

Almost there…

For your trip, what would you do differently the next time? Why?

_____

_____

At home and during the trip, how did you plan your journey? What did you use?

_____

_____

What was the check-in/out process like for your shared means of transportation?

_____

_____

_____

_____

How is it different to public transportation? Was the experience the same? Why (not)?

_____

_____

_____

Final questions

Do you have anything extra you would like to share?

_____

_____

_____

_____

_____

_____

_____

_____

Anything you want to say to me?

_____

_____

_____

Thank you for participating!

Please return this booklet by contacting m.t.puglia@student.tudelft.nl
You can bring it in person or send high-resolution photos.

Appendix 6

Interview guide for traveller
Method: semi-structured

Research topic: Understanding the current system of shared modalities and future vision
Research question: What is seamless travel and how can it be introduced in the Dutch mobility landscape consisting of public and shared transportation modes?

Checklist for start:
I. Mention why the interviewee is selected
II. Assure interviewees of anonymity, confidentiality and TU Delft ethics, they may leave at any point
III. Explain that there are no right or wrong answers
IV. Explain who I am
V. Ask permission to tape (if necessary)
VI. Sign consent form

Introductory script:
I. Introduce the project
II. Ask participant to think out loud
III. Are there any questions?
IV. Show sensitising tool and and explain its function
V. Start drawing

Subtopic 1: Mapping journey
Opening question: Think of a journey in which you took both a public and a shared transportation service. Can you draw your entire journey and all the steps you undertake?

Follow-ups/probes:
- *Did you plan elements in the trip beforehand?*
- *How did you plan it (e.g. phone, website, etc.)?*
- *Why did you take this modality for the first mile? Why not something else?*
- *Did you have to book it, and if so, how?*
- *What did you do during your public transportation?*
- *Why did you take this modality for the last mile? Why not something else?*
  - *Did you have to book it, and if so, how?*
- *For all modalities, how did you check in and out, and what is it like?*
- *Where there moments where you had to think ahead?*
- *How did you navigate this section?*
- *How often do you make this trip?*
  - *When was the last time?*
- *Would there be different steps when it is a special/new trip?*
- *What was your interaction like with the:*
  - *Public transportation*
  - *Shared modality*
  - *Card reader*
  - *Phone/website etc.*

Subtopic 2: Interruptions, friction and difficulties
Opening question: Can you pinpoint in your journey where you felt interruptions, frictions or difficulties?

Follow-ups/probes:
- *Any differences in mental vs physical interruptions?*

- *What triggered the interruption/friction/difficulties?*
- *How did you feel after the interruption/friction/difficulty presented itself?*
- *What was the effect of the interruption/friction/difficulties and how long did it last?*
  - *Where there any attempts to mitigate or even avoid them?*
- *Was the trip spontaneous?*
  - *Why (not)?*

Subtopic 3: Level of stress
Opening question: Using your filled-in journey map, can you draw a line depicting your stress levels?

Follow-ups/probes:
- *Why is it high/low here?*
- *Why did it (not) rise precipitously?*
- *Why did it (not) go away quickly?*
- *Any relation with the pinpoints?*

Subtopic 4: Level of continuity ('flow'; 'in the zone', 'in the groove')
Opening question: Using your filled-in journey map, can you draw a line depicting your flow levels?

Follow-ups/probes:
- *Why is it high/low here?*
- *Why did it (not) rise precipitously?*
- *Why did it (not) go away quickly?*
- *Any relation with the pinpoints?*

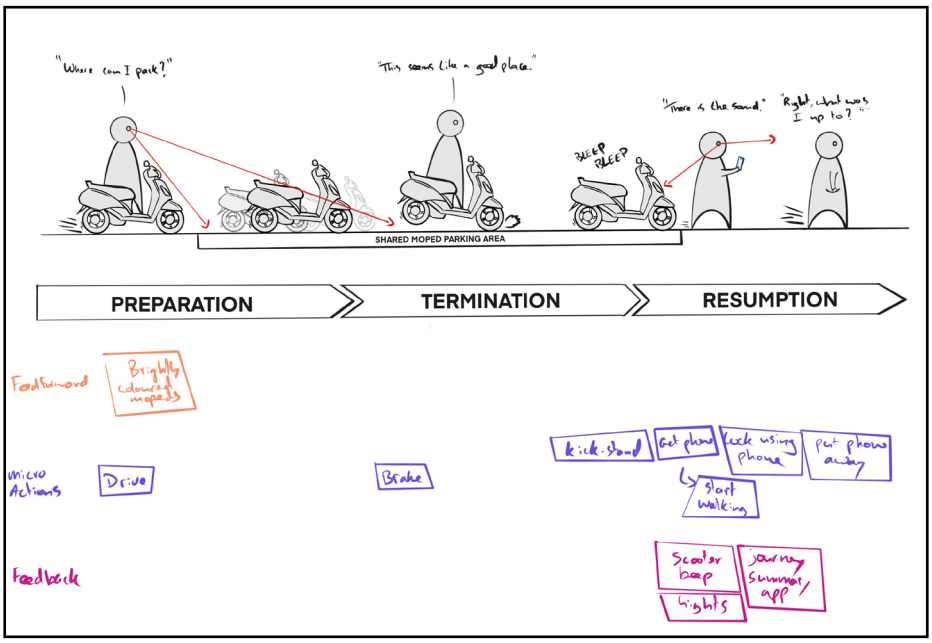
Subtopic 5: Level of control
Opening question: Using your filled-in journey map, can you draw a line depicting your experience level of control over you journey?

Follow-ups/probes:
- *Why is it high/low here?*
- *Why did it (not) rise precipitously?*
- *Why did it (not) go away quickly?*
- *Any relation with the pinpoints?*

Optional subtopic 6: Seamless travel
What is in your eyes fully seamless travel?

Follow-ups/probes:
- *Where is it lacking in your travel?*
- *Where is it already integrated in your opinion?*

Appendix 7


"Where can I park?"
"This seems like a good place."
"There is the sound."
"Right, what was I up to?"
BEEP BEEP
SHARED MOPED PARKING AREA
PREPARATION
TERMINATION
RESUMPTION
Feedforward
Brightly coloured impact
Micro Actions
Drive
Brake
kick-stand
Get phone
Fuck using phone
Put phone away
Start walking
Feedback
Scooter beep
lights
journey summary app

Appendix 8

Technical requirements

Accessibility

» Costs for the traveller
- The personal device in the reimagined concept should not be reserved for only those who can afford substantial extra costs, but must be an economically viable alternative for everyone in The Netherlands. A ballpark cost estimation for the traveller should not be substantially different to that of the costs of the current OV-chipkaart.

» Cost for the modality provider
- Modality providers, both in the shared and public sectors, are also concerned with costs. Integrating the new specific technology should not be a substantial expense.

Data quality

» Privacy
- To securely communicate between the personal device and the device mounted on a shared moped or at a terminal, full-duplex, cryptographically secured communication is required. Simply blasting your OV-card information omni-directionally is highly subject to hacking, misuse, and fraud. Not to mention the legal implications regarding the GDPR, or its directive code 95/46/EG (European Parliament, 2018).

» Security
- The information wirelessly transferred between the token and the terminal must be of sufficient bit depth to ensure that the information can be encrypted using high-quality industry standards and protocols. In addition, only minimal personal information must be used to validate the user with as much information as possible hidden away.

Interoperability

» Integration in OV-pay
- The technology must be implementable in the ABT scheme being rolled out by OV-Pay without any major software or hardware changes.
- Working in public and shared transportation
- The digital handshake must be designed in such a way that both public and shared transportation modality providers can implement the technology solution.

Performance

» Accurate positioning
- Accurate positioning is imperative for the design to properly work. The user in the reimagined scenario must have a high degree of trust that the correct individual is checked in. Imagine a scenario where two people are stepping on an OV-fiets and exit the station cycling next to each other. As a cyclist, you are now the legal ‘owner’ of that particular bicycle, and you want to be sure that user A is checked in to bicycle A, and user B is checked in to bicycle B. Therefore, at least, sub-30-centimetre accuracy is required.

» Speed
- Speed of the validation of a traveller goes hand in hand with the core design driver. Only when a traveller is mentally and physically unobstructed due to a swift digital handshake, does the concept

operate undisturbed, and thereby in a seamless manner. If, for example, a traveller has to wait only a fraction of a second for the digital handshake to occur, does the concept fail.

» Battery life
  - The product concept is a hands-off system. Something the user should forget and would never have to worry about, and only if it is forgotten does the concept produce the most value for the user. This means that the device carried by the user should last for multiple years, and therefore require ultra-low power consumption.

» Lifespan
  - The technology must at least work during the entire duration of the next generation of terminals. A good estimation is roughly one decade; the same duration of the CBT scheme of the OV-chipkaart from when it fully replaced the Strippenkaart.
  - The technology preferably is scalable meaning that in the future travellers are not restricted to solely the conceptual product proposed in this report, but have multiple options from which to choose.

Size

» Physical size personal device
  - The technologies that will be used must be able to be carried by a traveller in a non-obtrusive manner. The device should be so small that one would not mind carrying it with them until the battery runs out after many years.

» Physical size terminal
  - Physical size at the terminal side is of less importance. Nevertheless, the technology should be able to fit inside any form of sharable modality or terminal in public transportation.

Appendix 9

Test structure interaction prototyping

In short, there will be four phases, each operating a specific scenario as described above. A summary of each phase is given below.

Part A

Phase one
- Explanation and goal of the test
- The interviewer demonstrates both modality prototypes

Phase two (no token)
- Non-seamless scenario by the user (practice)
- Non-seamless scenario by the user (baseline)
- Non-seamless scenario by the user including a question (cognitive load test)

Phase three (token present)
- Seamless scenario by the user (practice)
- Seamless scenario by the user (baseline)
- Seamless scenario by the user including a question (cognitive load test)

Part B

Phase four
- Seamless scenario by the user (shared additional indicators)
  - Gate: addition of beep and light
  - Scooter: addition of beep and light
- Seamless scenario by the user (unique additional dynamic indicators)
  - Gate: adaptive light
  - Scooter: name on display
- Seamless scenario by the user (UWB additional indicators)
  - Token: light
- (Optional) A combination of additional indicators as per participants' request

Part A focuses on the experience between the current system and the fully seamless system, whereas part B focuses on the addition of possible indicators to find the optimum balance.

Part A:

Phase one:
In phase one, the interviewer introduces the project, explains what is required from the user, notifies the participant that the test will be filmed, and asks the participant to sign a consent form. Having completed the mandatory aspects of the prototyping tests, the interviewer proceeds by demonstrating both prototypes in the non-seamless state for the participant to get acquainted with the setup.

Phase two:
In phase two, the participant is asked to perform solo what has just been shown by the interviewer. This test is mainly for the participant to get comfortable using both prototypes: it acts as a practice round. This is necessary as, for example, the BLDC motor makes a bit of noise which

could lead to undesired interference in future interactions. The participants are then asked to redo the test for a baseline experience. Having achieved a baseline experience, the participant is asked yet again to repeat what has just been done, only in this case the participant is asked a question to induce a cognitive load. This is done to mimic a real-life scenario in which a participant may have to interrupt a conversation upon presenting an OV-chipkaart to the card reader as it requires significant cognitive effort—as was the case during the full travel observation study. After having conducted the test, the participant is questioned about the level of seamlessness experienced in the non-seamless scenario.

Phase three:
In phase three, the participant is first handed a necklace with a little microcontroller which imitates the wireless token. It is not functional as the interviewer from this point onwards manually opens and closes the gate, or initiates or cuts the power to the motor in the scooter. The gate remains open, and the scooter remains powered as long as the participant is carrying the token. Similarly to phase two, the participant first must get acquainted by doing a practice run and a second run to get a baseline experience. In the third run, the participant is once again asked a question to induce a cognitive load. After having conducted all three tests, the participant is questioned about the level of seamlessness experienced in the seamless scenario in addition to how it compares to the non-seamless i.e. current scenario. Naturally, if the participants want to continuously explore the scenario, by for example giving back the necklace, in turn closing the gate or cutting power to the motor in the scooter (which is done remotely by the interviewer), they are free to do so.

Phases two and three will be switched in the order of questioning for every new test subject. This is done to mitigate anchoring effects and biases resulting from the test structure in which the non-seamless scenario always precedes the seamless scenario. After phase two (or three), there will be a short break for the participant to get some (mental) rests and to get ready for part B.

Part B:

Phase four:
Phase four focuses on finding a balance between levels of seamlessness and the number of indicators. There are three setups which can be tested. The first is a shared indicator between the gate and the scooter. Upon the participant having seamlessly checked in, a small light will blink and the buzzer will sound. These are the same indicators as the non-seamless state, only in this case the gate is always open and the scooter is always turned on. The second test adds different indicators. For the gate, this is an adaptive light which increases in length as the participant gets closer and for the scooter, this is the name of the participant displayed on the scooter. Finally in the third test, only the PKES + UWB token will display an indicator light. The gate and scooter will operate without any indicators. Optionally, if the participant points out that they would prefer a combination, they are welcome to test it as well.

Appendix 10

Physical form gate concepts

Concept A: Horizontal escalator

The first concept is based on a treadmill. The underlying reasoning is a solution to the 'inverted feedback' given by a working gate; not closing indicates that the system is working. This is contradistinctive when compared to the scooter; where physical movement is seen as feedback indicating that the system is working. Therefore, introducing a continuously rolling treadmill mimics the physical movement of the scooter. Upon not having a token, or if something goes wrong, does the treadmill stop. It could even be reversed, prohibiting a fare-dodger from entering the station. The reversal of the treadmill could be seen as a gate. Drawbacks are: (1) still fare-dodgeable and (2) requires a more complex (and expensive) design. Advantages of the horizontal escalator are (1) open design, (2) no gate necessary, (3) physical movement as positive feedback, (4) does not require extra space, (4) simplistic and unobtrusive design, (5) sense of speed.

Concept B: Curved guidance

The second concept is based on hiding the gate by obstructing it by the gate itself. One of the drawbacks repeatedly pointed out by participants was the possibility of the gate closing and either hitting them or causing the participant to swerve unexpectedly. It is understood that the more one is used to the system by repetitive use, the less they would worry about it. Nonetheless, the effect of the unlikely possibility of the gate closing should be mitigated. An assumption is made that because the participants were able to see the gate, they would think about it closing. Therefore, a design is made in which the gate itself is hidden from the product itself by curving the design. When the shape is carefully chosen, the gate is able to act as a wall of the walking path when the traveller is checked-in correctly, and transforms into a gate when extended if the traveller is not check-in correctly. Drawbacks are: (1) it takes up more space and (2) there is still a gate present. Advantages are: (1) semi-open design, (2) mitigated gate-effect, and (3) can still be used in legacy mode.

Concept C: Revolving door

The concept of the revolving door is based on the idea of the traveller being more actively guided. If the traveller is carrying a token, the 'gate' basically acts as a standard revolving door. If the gate is not present, the traveller is not able to exit on the other side and is consequently taken by the revolving door to the entrance of the door. Drawbacks are: (1) lower levels of control, (2) requires a more complex (and expensive) design, (3) only works with 1 person at a time, possibly adding congestion, and (4) takes up more space. Advantages are: (1) no interaction with a gate, and (2) physical movement as positive feedback.

Appendix 11

Design requirements

Performance

As far as functional performance goes, this is covered in the technical design requirements. These requirements also include privacy, data security, and wireless connectivity. During the interaction prototyping test, it was concluded that an indicator light must be included on the token itself for the traveller to determine if they are checked in and that everything is in working condition. Furthermore, the battery in the token will run out at some point requiring the user to take action. Under the principles of proper seamless design, a traveller should never be stuck at a modality because the battery has suddenly run out causing high levels of stress and uncertainty. Therefore an indication or notification of the battery status is required. How it is implemented is still undecided.

Environment

The token will likely not be handled with care i.e. it will be thrown in a bag life in a small space which might get dusty or wet. Therefore environmental requirements are formulated. The token must be dust and splash-water proof under the IP65 rating i.e. full protection against dust and other particulates, including a vacuum seal, tested against continuous airflow and protection against low-pressure jets (6.3 mm) of directed water from any angle (limited ingress permitted with no harmful effects).

Life in service

The OV-chipkaart is currently 11 years in circulation since it fully replaced the Strippenkaart in 2011. The life in service of the token will be derived from this benchmark and therefore the life in service is a minimum of ten years—this only applies for the electronics being functional, not the battery.

Maintenance

The token must hold a CR2032 battery. In addition, the user must be able to replace the battery since it will not last the full 10 years of life in service. How the battery can be replaced is still left undecided.

Target product costs

The OV-chipkaart is currently sold for 7,5 EUROS. This number will be used as a benchmark, however, it will likely be more expensive since the token is technologically much more complex. The token must be made as cheap as possible. In the end, the token is not there to make money, only to provide the best possible travel experience.

Quantity

There were roughly 14.4 million OV-chipkaarten in circulation in 2018. The estimated number of units to be produced is set at a humble one million. Still, being in the range of millions requires careful considerations regarding material, production techniques and optimisations.

Size and weight

A big consideration is the size and weight. A traveller must carry the token without being constantly reminded about it; it must be unobtrusive. This implies that the token must be as small and light as possible without constraining functional product qualities.

Aesthetic, appearance and finish

This category holds the most freedom for the designer and is based on subjective interpretations. The presented visual characteristics of the design should be tangent to the fundamental intention of the product. Materials such as (plexi-)glass, simplistic colour schemes, and smooth surface finishes are desired.

Materials

Good connectivity and wireless capabilities are essential. Therefore the materials should not induce a Faraday cage around the token. Conductive metals as the enclosure material must be avoided.

Ergonomics

The category ergonomics implies what requirements the observation, understanding, handling, operation, and the like place on the product. Classical physical ergonomics is not of interest as the product in most of its lifetime is not touched or handled and is probably residing in some pocket or bag somewhere. Cognitive ergonomics is another field which is of importance. The consensus of the creative session was that everybody likely has a different preference as to where to store the token. The physical form must be designed in such a way that the flexibility of where to store the token is maximised; the physical shape should be able to adapt to the wishes of the traveller instead of the traveller having to adapt to the physical aspects of the token.

Quality and reliability

The token must at the very least beat the operational stability of the current OV-chipkaart. This would imply being operational 99,99% of the time. If in any case, the system malfunctions, or if the battery happens to run out and the user forgot to replace it, it could be desirable to implement a redundant check-in method. For example, the current OV-chipkaart could be built-in as an extra option.

Standards

If in the end the decision is made to include a legacy OV-chipkaart in the new token, the dimension will be dictated by international standards. The current chip in the OV-chipkaart is the Infineon SLE 77 which is based on the ISO/IEC 14443 specification. One essential component in the standardisation is the coil design. This cannot be altered and thereby means that the token will be similarly sized, apart from thickness, to a regular credit or debit card. If however it is decided that the token will not

implement a redundant card-shaped backup, the physical form is left fully open.