



Improve the Mobility Situation around the ArenAPoort during Events



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Preface

This project is the graduation project of my two-year study in the Master programme Design for Interaction at the Delft University of Technology. I am very glad to have such a project to finish this study journey. Combining things learned from the past two years together, this seven-month project helps me to have a good summary and reflection on the study effect, and build a clearer vision for planning my future career.

With a strong interest in the topic of smart city, I proposed this project and contacted the client and the supervisory team. Fortunately, I found the Amsterdam Municipality to sponsor me in exploring this topic and found a fancy supervisory team to guide and support my work.

First, I want to thank my supervisory team from TU Delft for giving me so much guidance, inspiration, and suggestions. Thank you, Alessandro, for challenging me with your critical thoughts, and that pushed me to form a more in-depth understanding of the project. Thank you, Suzanne, for giving suggestions and sharing professional knowledge in the design field. Thank you, Achilleas, for your critical logical thinking, and that helps me to get rid of stereotypes and consider the topic from more perspectives.

I also would like to give sincere thanks to colleagues in the Amsterdam Municipality. Boen, the client mentor, thank you for offering me this graduation opportunity, encouraging me during the whole process, and helping me to get contact with experts and target groups. Thanks to colleagues for enthusiastically sharing your insights, findings, and experience with me.

Additionally, thanks to all participants of research and design activities, including the questionnaire survey, expert interviews, target group interviews, creative sessions, and evaluation sessions. Without your participation, I would never achieve such a result.

Last but not least, I would express my sincere gratitude to my family and friends for supporting me, not only during this project but also during the whole study process at TU Delft. Support and caring from you will always be the biggest motivation for me to pursue my role in the design industry.

The process of finishing this project is a bit special. Because of the pandemic of COVID-19, I have to work remotely most of the time. It did bring some unexpected problems but also left a unique and unforgettable experience. Please enjoy the reading!

Table of Contents

Chapter 1.	Chapter 3.	Chapter 6.	Chapter 8. Discussions & Recommendations
08 Introduction	44 Design Defining	80 Final design	114 8.1 Project Review
10 1.1 Context	46 3.1 Design Goal	82 6.1 Introduction	116 8.2 Limitations
12 1.2 The OMC	47 3.2 Design Guidelines	82 6.1.1 the Application ArenAPoort	117 8.3 Recommendations
14 1.3 Project Brief		83 6.1.2 Product Positioning	118 8.3.1 Clarify the Positioning and Exploring the Best Form
	Chapter 4.	84 6.2 User Flow	119 8.3.2 A Strategy for the Future ArenAPoort
Chapter 2.	48 Ideation	85 6.3 The Designs	121 8.4 Under the Background of COVID-19
16 Research & Analysis	50 4.1 Ideation Introduction	85 6.3.1 Entrance	122 8.5 Personal Reflection
18 2.1 Research Introduction	51 4.2 Ideation Activities	86 6.3.2 Plan	
19 2.2 Current Mobility Situation	51 4.2.1 Brainstorming Session	94 6.3.3 Activities	124 Reference
19 2.2.1 Modality	53 4.2.2 Co-creation Session 1	97 6.3.4 Chat	
21 2.2.2 Time	54 4.2.3 Co-creation Session 2	97 6.3.5 Me	126 Appendices
21 2.3 Ideal Mobility Situation	56 4.3 Ideas Evaluation		
21 2.3.1 Modality Preference	56 4.3.1 First-round Evaluation		
22 2.3.2 Time Preference	56 4.3.2 Initial Ideas		
23 2.4 Reasons behind Mobility Behavior	61 4.3.3 Second-round Evaluation		
23 2.4.1 Mobility Behavior Strategy	65 4.4 Ideation Results		
23 2.4.2 Reasons behind Mobility Behavior			
27 2.4.3 Influential Factors	Chapter 5.		
28 2.4.4 Personas and User Journeys	66 Conceptualization		
38 2.5 Data Usage in Behavior Change	68 5.1 From Ideas to Concept	Chapter 7.	
38 2.5.1 Current Trials and Effects	68 5.1.1 Ideas Combination	98 Evaluation	
40 2.5.2 Potential Directions	69 5.1.2 Application	100 7.1 Methods	
41 2.6 Research Conclusions	69 5.2 Concept Developing	100 7.1.1 Evaluation Purpose	
	69 5.2.1 Structure	100 7.1.2 Participants	
	69 5.2.2 Functions	100 7.1.3 Tools	
	71 5.3 Low-fidelity Prototype	102 7.2 Evaluation with Visitors	
	75 5.4 Evaluation	102 7.2.1 Test Set-up	
	78 5.5 Conclusion and Optimization	103 7.2.2 Test Results	
		110 7.3 Evaluation with Experts	
		110 7.3.1 Test Set-up	
		110 7.3.2 Test Results	
		112 7.4 Evaluation Conclusion	

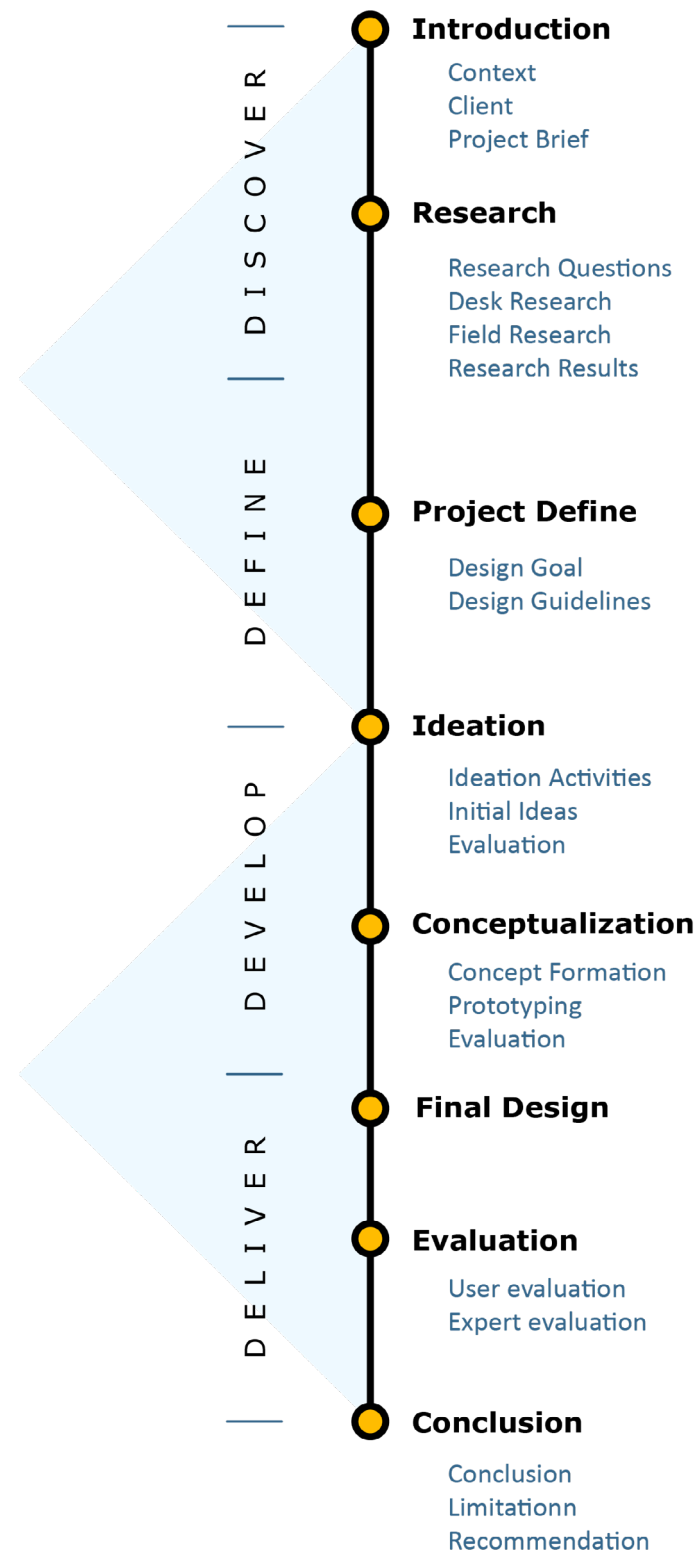


Figure. Design Flow

Executive Summary

ArenAPoort is an area in Amsterdam's Zuidoost (Southeast) district, with multiple functions including working, shopping, and entertainment. Most importantly, it is an event area with three famous venues: Johan Crujff Arena, Ziggo Dome, and AFAS Live.

Hundreds of events are held in this area every year. During the event period, mobility can always draw a concern. The Operational Mobility Center (OMC) takes charge of the mobility flows, aiming at improving the mobility situation during events in the ArenAPoort. They are now collecting traffic data to help make predictions on traffic situations of future events and to reactively take precautions. This brings the consideration of whether there are other ways of using the data, for example, making use of data to intervene in visitors' behavior.

In collaboration with the OMC, this master thesis aims to improve the mobility situation around the ArenAPoort during events by making use of data to change visitors' mobility behavior. The final outcome is an application that can help visitors to plan their event experience in the ArenAPoort.

The thesis starts with an introduction of the project background, including the context, the organization OMC, and a project brief. (Chapter 1) After figuring out the background and having the project brief, four research questions are put forward, aiming to have a deeper understanding of the context, gain an empathy with the target group, and seek for theoretical support. Several research activities were taken, including desk research and field research. (Chapter 2)

According to research results, a design goal is formulated, together with design guidelines (Chapter 3). Next, a series of co-creation sessions were performed for ideation. Based on the ideation results, 13 initial ideas are generated, and after two rounds of evaluation, ideas were summarized and integrated. (Chapter 4)

The next step is to conceptualize the ideas to a complete concept. During this process, the information structure and the user flow of the concept are defined, together with wireframes of key screens. (Chapter 5) Evaluation is conducted to assess the concept. Based on evaluation results, a final round of iteration was conducted, and the design is finalized. (Chapter 6)

Six end-users and two experts from the OMC took part in the evaluation of the final design. (Chapter 7) By summarizing and concluding evaluation results, overall conclusions of the project are drawn, together with the project limitation, future recommendation, and a personal reflection. (Chapter 8)

The project process follows the double-diamond model. (British Design Council, 2005) On the left page, a visualization of the process can be found.

Chapter 1

Introduction

This chapter will give a brief introduction of the project's context and the client. Then, the scope and the brief of the project will be addressed.

1.1 Context

Overview

ArenAPoort is an area in Amsterdam's Zuidoost (Southeast) district. As part of Amstel III, the ArenAPoort is not only an event area but also a working, shopping, and entertainment area with a regional and even national appearance. One unique deviation of this area is that it is one of the largest event and entertainment areas of the municipality of Amsterdam and the Netherlands. The large flow of visitors, 9 million annually, offers opportunities and at the same time challenges in the context of event management, accessibility, and safety.

Venues

Three main venues are situated in the ArenAPoort in close proximity to one another: Johan Cruijff Arena, Ziggo Dome, and AFAS Live. Table 1.1 shows the maximum amount of visitors that each venue attracts per event.

Johan Cruijff Arena (figure 1.2) is the main stadium of Amsterdam and the home stadium of football club AFC Ajax since its opening. It is the largest stadium in the country. The stadium will host three group stage matches and one match in the round of 16 of the UEFA Euro 2020, which is postponed to the summer of 2021. Besides,

it also hosts concerts of both international and Dutch artists, and also dance events.

Ziggo Dome is an indoor arena. It is mainly used for concerts, but it is multi-usable and can also be used for tennis and korfbal competitions or even swimming matches.

AFAS Live is a concert hall. It is specially designed for amplified music, so many artists have performed at the venue. It also hosted some song contests.

Except for three main venues, the ArenAPoort also have other groups of service providers: Pathé the cinema, hotels, retails, shopping stores, restaurants and bars in the Arena Boulevard, etc.

Venue	Capacity (Maximum number of visitors)
Johan Cruijff Arena	68,000
Ziggo Dome	17,000
AFAS Live	6,000

Table 1.1. Capacity of event venues in ArenAPoort



Figure 1.1. ArenAPoort



Figure 1.2. Johan Cruijff Arena

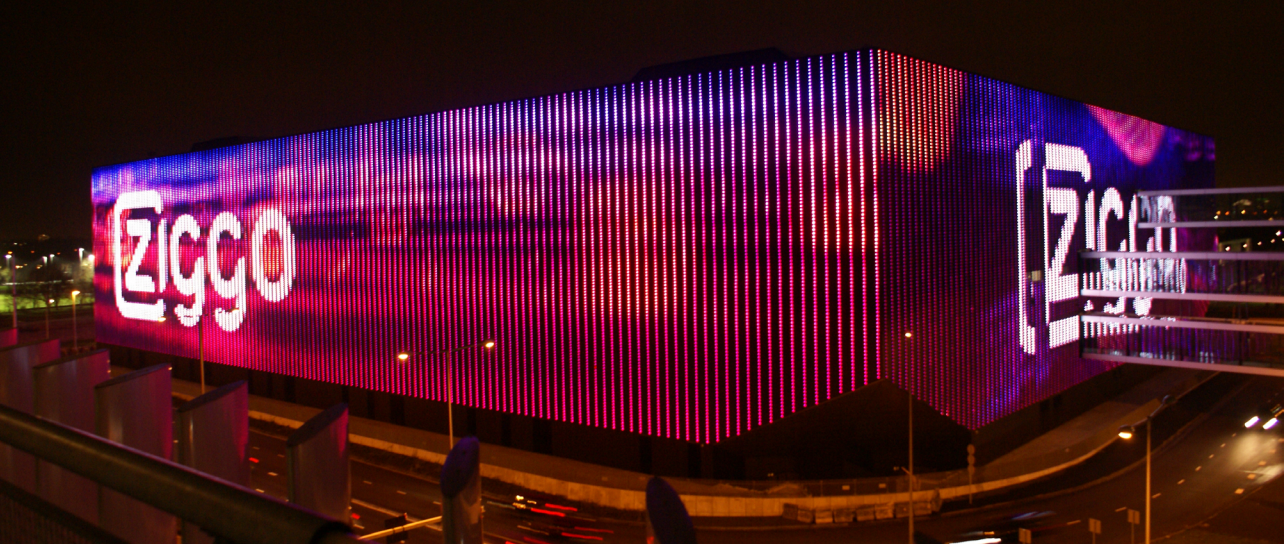


Figure 1.3. Ziggo Dome



Figure 1.4. AFAS Live

Reachability

Mobility from and to the area can be accomplished by car, public transport, bicycle, or by a combination of different transportation modes. About traveling by car, the ArenAPoort is surrounded by highway A1, A2, A9, and A10, making car traveling very easy. Regarding public transport, the area can be reached by train, by the metro, and by bus. The station Amsterdam Bijlmer ArenA and Duivendrecht are for both train

and metro, while there is a third metro station called Strandvliet. There is also a regional bus station very nearby, which makes visitors easily access by taking a bus.

Nonetheless, the mobility situation can still be unsatisfying before and after events, especially when the spectators' number is numerous. The mobility flow around the ArenAPoort is the main problem.

1.2 The OMC

The OMC (Operational Mobility System) is a multi-stakeholder organization in the ArenAPoort led by the Amsterdam Municipality. It takes charge of not only the mobility control during events but also other issues regarding this area like area development, crowd management, and communication. Improving the mobility situation during events is an important part of their work.

At the moment, what the OMC is doing on mobility management is reactively acting on the real-time situation observed via the camera system. They are also exploring more channels of mobility improvement. One objective in further development they are working on now is to be able to act in anticipation through digitalization. By collecting and analyzing mobility data, the OMC would like to be able to predict the situation both in the long term (tactical in preparation) and in the short term (operational around and during events).

Stakeholders

OMC is a multi-stakeholder organization where different stakeholders work together on the same goal. Main stakeholders in the OMC include:

- Venues: Johan Cruijff ArenA, Ziggo Dome, AFAS Live. Venues are commercial parties with the aim to make customers satisfied and come back again in the future.
- The municipality, responsible for the public space, public roads, and the overall situation.
- Police, responsible for safety.
- Public transport operators of the Dutch railways (NS) and the municipal railways (GVB), taking charge of public transport.
- Parking operators, taking charge of parking lots.
- Event organizers: fan care department of Ajax, the social media department of the KNVB (Dutch national football association), taking charge of event organizing.
- Mobility Portal (route planner), working on how to make visitors easily travel to and from the ArenAPoort with big scale public events.
- Arena Boulevards, with a lot of companies, restaurants, bars and enterprises.

Although different stakeholders have different interests, they are working on the same goal of improving the mobility situation during events in the ArenAPoort. They share information and data to have a good overview of everything, and work closely on several layers of communication.

Data

With the development of the smart city Amsterdam, the OMC is also working on making use of data to help improve the mobility around the ArenAPoort. They are collecting current and historical data to make predictions of future event mobility situations. Data they have already collected/have plans to collect includes:

- Traffic lights data.
- NDW data. In short of "Nationale Databank Wegverkeersgegevens", in English, it is the "national road traffic data database". It is open data.
- VRIs data. VRIs are traffic light installations and

they can count the number of cars that come through. There are these pressure plates on the lanes, and every time a guard drives over these pressure plates, it will count the car. The OMC now has data that is aggregated by 15 minutes.

- GVB data. GVB (Gemeente Vervoerbedrijf Amsterdam, in English: Amsterdam Municipal Transport Company) has check-in and check-out data at train and metro stations. The minimum unit of the data is every one hour.
- Pedestrian data. The municipality plans to get pedestrian data, but have not got yet.
- NS data. NS (Nederlandse Spoorwegen, in English: Dutch Railways) has train data. The municipality has a plan to make use of their data, but have not got it yet.
- Camera data. To see the traffic situation on important roads.

1.3 Project Brief

Mobility is an important part of event management. Special events such as fairs, concerts, festivals, and sporting games can cause heavy traffic pressures and bring problems like travel time extension and severe congestions. Event traffic is difficult to control as these events are temporary, and the number of visitors at a specific time can reach the maximum capacity of the infrastructure. (Stopczynski et al., n.d.). This in fact has significant negative impacts on traffic flow and safety (Eck and Montag, 2003).

The project, *Improving the Mobility Situation around the Arenapoort during Events by Using Data*, is cooperating with the OMC focusing on making use of data to change event visitors' mobility behavior and choices, so as to improve the mobility situation around the ArenAPoort during events.

Relevant to the mobility management solution that the OMC is currently working on, this project proposes a new direction. By collecting and analyzing data, the OMC would like to see

what precautions they can take to react to the potential mobility situation, while this project will focus on how to make use of data to change event visitors' mobility behavior to the way that the OMC prefers. Instead of forcing visitors to change from one behavior mode to another, this project aims at making the change spontaneously. The form of the final design remains open upon the initiation of the project. It can be either a digital platform or a physical product or anything else.

The input from the OMC shows that mobility choices generally contain two parts: modality choice and time choice. Modality choice is about which transportation the visitor takes, while time choice means when the visitor will arrive at and leave from the venue before or after the event. Data, in this case, includes both quantitative and qualitative data about the event mobility. It contains both the data that the OMC now has and the data that they would collect in the future.

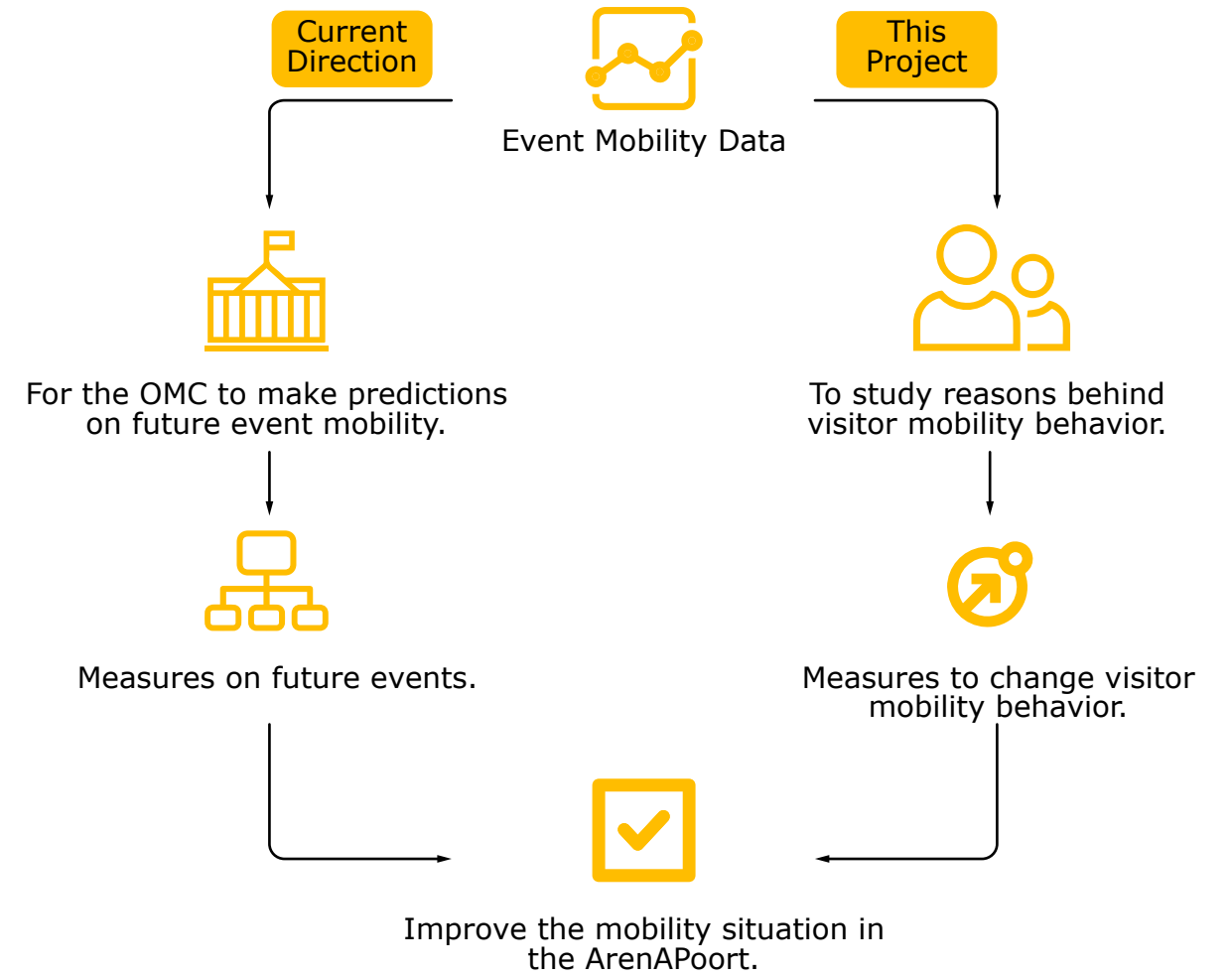


Figure 1.5. Project Scope

Chapter 2

Research & Analysis

This chapter introduces the research phase of the project. It starts with four research questions. Then the research process and findings according to each research question are introduced one by one. Finally, research conclusions are drawn as the answer to research questions, while also as the guidance to further process.



2.1 Research Questions and approach

The research was conducted for having a deeper understanding of the context and user behavior, learning relevant theoretical background, and finding potential solution directions to form guidance for the future design phase. At first, four research questions are generated:

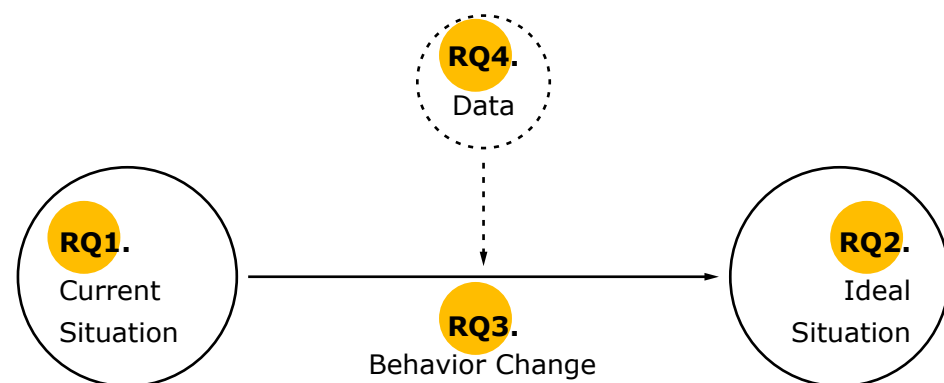


Figure 2.1. Research Structure

1. **What is the current mobility situation?**
 - a. What is the current modal split?
 - b. What problems does each modality cause?
 - c. How does the OMC manage each travel mode?
 - d. What is the current time situation?
2. **What is the ideal mobility situation?**
 - a. What is the ideal modality choice?
 - b. What is the ideal time choice?
3. **How to change visitors' modality behavior from the current one to the ideal one?**
 - a. Why do visitors behave in the current way?
 - b. What elements influence their choices?
4. **How to make use of data in this process?**
 - a. How is the OMC now making use of data?
 - b. What other ways can we make use of data?

Generally, the research approach is divided into two kinds: desk research and field research.

The desk research includes literature research and previous research results learning. The main content includes: figure out reasons for visitors' mobility behavior, look for theoretical support of the ideal mobility situation, search for methods to nudge visitor behavior by making use of data.

Approaches of the field research include expert

interviews, questionnaires, and user interviews. The output includes a list of influential factors on visitors' mobility behavior, three personas representing three typical visitor types, and corresponding journey maps to disassemble visitors' mobility behavior and experience step by step. The purpose of doing field research is to have a better understanding of the context and gain a better understanding and empathy of visitors.

2.2 Current Mobility Situation

The study of the current mobility situation in the ArenAPoort is divided into two parts: visitors' modality choices and time choices.

2.2.1 Modality

In order to learn the current modality choices in the ArenAPoort, several expert interviews were done with employees from the OMC and relevant partners, and a literature review was done on research reports made by research institutes cooperating with the OMC or Johan Cruijff Arena. As a result, the five most frequently chosen modalities are proposed: public transport, private car, taxi/Uber/kiss&ride, bicycle/scooter, and walking.

Public transport

In the context of ArenAPoort, public transport includes trains, metros, and buses. The percentage of visitors taking public transport differs in different events, but normally within a proportion of 30%-35%.

The main problems of public transport are the station choice and the resulting problem of station capacity deficiency. Most passengers

choose to use the train & metro station Bijlmer ArenA even though there are more options. The metro station Strandvliet is as near to venues as the station Bijlmer ArenA, and another train & metro station, Duivendrecht, is also within the scope of the ArenAPoort area though it is a bit farther than the other two.

Some visitors consciously choose the station Bijlmer ArenA because this station is closer to the commercial area (the ArenA Boulevard) and thus it is more attractive, while some visitors just followed the guidance of navigation tools like Google Maps and used this station without knowing the difference.

The capacity of the station Bijlmer ArenA Amsterdam is limited. During an event when a large influx comes, there will always be overcrowded in and around the station, which can cause safety problems. If the other two stations can attract more visitors, then the pressure of this station can be somewhat relieved, and the traffic situation will be better.

The OMC is working on upgrading the environment from the Duivendrecht station to the venues. Roads will be rebuilt and bushes will be grown. Hopefully, more visitors will turn to use this station.

Private car

This modality causes the biggest problem for the municipality. Normally, visitors traveling by a private car take about 55%-60% percent of all visitors, so the huge number of vehicles is a reason that makes them hard to manage.

The main problem private cars cause is the congestion on the road around the ArenAPoort before and after the event. The OMC has to make real-time monitoring on surrounding roads and give quick reactions. In the inflow, there are dynamic displays on roads to assign traffic to parking spaces nearby. In the outflow, 25 scenarios are built. If a scenario happens, the OMC will take the corresponding measures to react to the situation. Measures including control traffic lights to give some direction extra green and cooperate with Google to virtually block roads on Google maps to avoid traffic flows meet in the area.

The number of parking lots is not a problem. According to previous event data, even in an extreme situation when a triple happens, which means three venues in the ArenAPoort all have events at approximately the same time, and the visitor number reaches the maximum capacity, the number of parking lots is still sufficient.

However, the municipality still feels private cars take up too much space, and have a negative effect on sustainability.

Taxi/Uber/Kiss&ride

Normally, this modality takes less than 5% of all visitors. But it depends on event types. For example, when the BTS gave a concert in Ziggo Dome, the share of kiss&ride raised dominantly

because visitors are mainly teenagers, who need their parents to drop them off and pick them up before and after the concert.

This modality can cause chaos because taxis/ubers/cars stop wherever they like for drop-off and pick-up and cause traffic disruption. But this problem will be somewhat relieved since a designated spot for drop-off and pick-up is under construction.

Bicycle/scooter

This modality depends highly on the distance and the weather. Visitors who live close to the ArenAPoort are more preferred to take a bicycle or scooter, and they normally only take a small proportion of overall visitors. On rainy days the proportion decreases. Bicycle/scooter parking spaces are sufficient in the ArenAPoort.

Walking

Just like the previous one, this modality is also more preferred by visitors who live close to the ArenAPoort, which normally only takes a small proportion.

There are also other modalities like a plane (normally happens at big international events) and organized bus trip (for supporters of the opposite team to get organized and arrive at the venue together) Sometimes a mix happens when visitors drive a car and park it in a parking lot far away from the ArenAPoort and take public transport for last miles. But the percentage of these travel modes is small, so they are not the main focus of this study.

In summary, compared to other modalities, the proportion of event visitors who take the private car or public transport is dominantly higher. Thus, these two modalities will be the main focus of the project. For the OMC, the main problems of the private car are congestion on the road and sustainability, while the main problem of public transport is congestion in the station.

2.2.2 Time

Time can also be a crucial issue. As traffic managers in the OMC explained, for both the inflow (visitors arrive at the ArenAPoort before the event) and the outflow (visitors leave the ArenAPoort after the event), there is a peak time when the mobility situation, especially road traffic, is under heavy pressure.

For the inflow, the peak time is generally from 90 minutes before the event to the kick-off moment. For the outflow, the peak time starts when the event ends and lasts about 45 minutes.

The outflow has a shorter peak time than the inflow, but the traffic pressure is heavier. Visitors will probably come early to take some food and drinks in the area before the event starts, but when an event ends, most visitors would like to go back as soon as possible.

The OMC prefers visitors to arrive and leave at different times, and use more of the area. Visitors can do leisure, have dinner and a drink before going to the event, and stay a little bit longer in the area after the event to help relieve the congestion on all modes of transport.

2.3 Ideal Mobility Situation

In order to find out the mobility situation preferred by the OMC, several interviews with OMC members are conducted, while literature research is also done for theoretical support.

2.3.1 Modality Preference

By interviewing municipality members, the ideal pattern of visitors' modality choices have been found:

Shifting from vehicles towards public transport.

Figure 2.1 illustrated the preference rank on modalities from the municipality's point of view. As introduced before, the private car and public transport take the majority in proportion, so these two modalities will be the main focus, which means the municipality would like visitors to change from the private car to public transport. This is due to the following reasons:

The private car takes more space. Although the number of parking lots is enough, it still takes a lot of resources.

Problems caused by private cars (congestion on the road) are harder to manage than problems caused by public transport (crowd in and around the station).

Taking public transport is more sustainable and more socially efficient than taking a private car. Considering the environmental performance and carbon implications of transportation systems, we should encourage the increased use of public transportation instead of private cars. (Stojanovski, 2019)

Following guidance of the OMC.

For both private car drivers and public transport passengers, the OMC would like them to follow the guidance. Visitors familiar with the ArenAPoort area prefer to behave in the way they are used to. They tend to follow the route they normally use, instead of a more reasonable route recommended by the municipality.

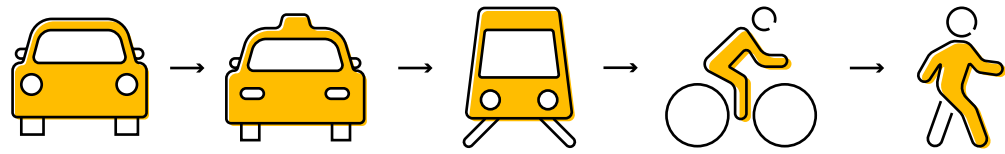


Figure 2.2. Modality preference by the OMC

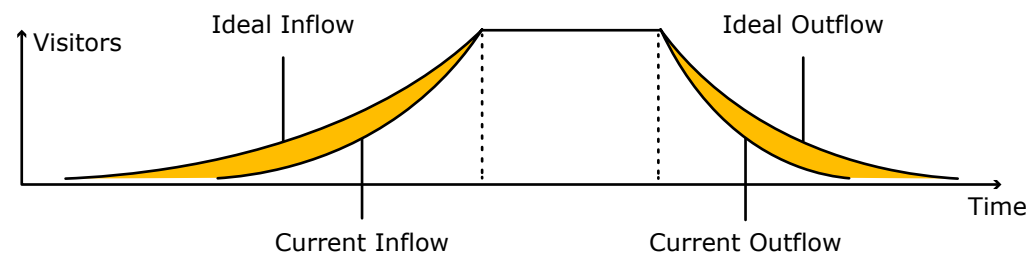


Figure 2.3. Time preference by the OMC

Besides, the OMC reacts to the real-time traffic situation on the road. Measures like closing roads and putting digital displays on roads to guide the traffic are taken. These actions are not always synchronized with navigation tools. Some visitors tend to listen to the navigation tool instead of real-time guidance on the road by the OMC.

For public transport passengers, the OMC would like some of them not to use the station Bijlmer ArenA but instead to use the other two stations in the ArenAPoort ArenA. However, there is still not an appropriate way to give this guidance. Currently, experienced visitors will turn to choose the station according to their own experience, and new visitors just follow the guidance of the navigation application.

Raise the number of occupants per vehicle.

Research shows that occupants by car fluctuate from 2.4 to 3.3, differing from event types. Generally, the events in the Johan Cruijff ArenA

have a higher average car occupant than events in Ziggo Dome and AFAS Live because the former type of visitors have a higher frequency of ArenAPoort visiting and event participation, so they already form a group to travel together.

If the number of occupants per car can be raised, the number of vehicles will be reduced, and thus the road traffic around the ArenAPoort during events will be improved.

2.3.2 Time Preference

As mentioned before, the peak time in inflow normally lasts around 90 minutes and in outflow, it lasts about 45 minutes. The municipality would like visitors to come early before the event and leave late after the event, to avoid congestion on all kinds of modalities.

Thus, they would like visitors to spend some time in the ArenAPoort area to take some activities, e.g. leisure, food & drinks, shopping, watching movies, etc.

2.4 Reasons behind Mobility Behavior

To find out reasons why visitors take the current mobility behavior instead of the ideal one, literature research on traffic strategy, a questionnaire survey with 31 participants, several interviews with different kinds of event participants were conducted. Insights obtained from these activities are concluded into three personas (representing three typical kinds of visitors) and for each persona, a journey map was made to analyze user behavior step by step.

2.4.1 Mobility Behavior Strategy

According to Xu and González's research, the main goals of urban transportation include: avoid long and unnecessary motorized travel, shift the movement of people to socially efficient modes like walking, biking, and public transit, and improve the technology and operational management of transportation services.

They divide event visitors' mobility strategy into three types: Habit, Selfish, and Altruism. The "Habit" mobility strategy means all visitors will follow their routine travel routes even if this route is more congested during the events. The "Selfish" strategy means that visitors have good knowledge of the traffic situation and each of them will choose the route with the shortest travel time. The "Altruism" strategy means visitors follow the travel route for the best-case scenario for the collectively best travel condition.

Naturally, event visitors take a mix of the Habit strategy and the Selfish strategy according to the theory "tragedy of the commons": individual users act independently according to their self-interest, behaving contrary to the common good by depleting that resources. However, the Altruism strategy can create the biggest collective benefits. Thus, motivating event visitors to take the Altruism strategy can benefit the mobility situation.

They also found out that with only a small proportion of visitors changing their mobility behavior, the collective travel time can be reduced to a great extent.

Theoretically, the mobility behavior of visitors is a mix of Habit and Selfish, while the travel mode preferred by the OMC is the Altruism one, for the biggest collective benefits.

2.4.2 Reasons behind Mobility Behavior

This section introduces the reasons for visitors' mobility behavior. The research methods include questionnaires, interviews, and online information collection.

Questionnaire

For understanding the mobility behavior of event visitors in the ArenAPoort, a questionnaire about event visitors' mobility behavior and reasons behind the behavior was designed through Google Forms. The questionnaire was distributed among the author's personal connections, with the help from the client mentor, and through the groups in the social media Facebook.

The questionnaire includes three parts. At first, participants need to give some basic information about themselves and their event experience in the ArenAPoort, for the author to study the research results by ethnographic difference. Then, they will be asked about their modality choices and the reasons behind them. After that, they will be asked about the will to take part in activities in the ArenAPoort. In the last of the questionnaire, they can leave their email addresses for further research (online interview) if they would like to.

An overall of 31 replies was collected in total. Although the participant composition is not exactly consistent with the real context, it still shows enough diversity to avoid bias. Most of the respondents are relatively young, ranging from 18 to 35 years old. About half of them come to the ArenAPoort only once a year, while the other half has a higher frequency. There is also diversity in venues and event types. When asking about their last-time experience, about half of them went to Ziggo Dome, one-third of them went to Johan Cruijff ArenA, and the last one-sixth went to AFAS Live. Two-thirds of them went to concerts, while others went to football matches of the Ajax or Netherlands national football team. Only 12.9% went to the event by him/herself. Others went together with family, friends, colleagues, or partners. A vast majority went in a group of 2 to 4 persons. The distance from the respondent's place to the venue varies from less than 10 kilometers to more than 100 kilometers.

Two-thirds of respondents went to and from the venue by public transport, while about one-fourth went by private car or taxi. When asking visitors who did not take public transport why they choose this modality, the response with the highest rank is that "it is convenient", followed by "quick", "comfortable" and "the autonomy to make travel plans". (see Figure 2.2) When asking them why they did not choose public transport, the option "because it takes too long and too many transfers" occupies the vast majority. (see Figure 2.3)

But for public transport passengers, this modality also has irreplaceable advantages. The highest ranked responses of choosing private cars are "convenient" and "cheap". Interestingly, three responses said that is because public transport is the only option for him/her, while 2 of them mentioned they take public transport because they want to drink alcohol during events. (see Figure 2.4)

About one half of visitors decide the modality between ticket purchase and the event day. Making a modality decision as soon as buying the ticket and on the event day separately takes one-fourth. (see Figure 2.5)

Except for modality choices, the questionnaire also involves some temporal issues. The inflow experience is better than the outflow experience, with the former one got an average score of 4.23 while the latter one only got a 3.45. This result is consistent with the information obtained from expert interviews, saying the outflow performs worse in mobility.

Taking other activities in the ArenAPoort before or after events is quite popular, with about two-thirds of respondents having such an experience. Visitors prefer to take activities before events instead of after events. The most frequently taken activity is food & drink, followed by shopping, watching movies, event-relevant activities, sightseeing, and work-related activities. (see Figure 2.6)

Participants showed a high acceptance to participate in activities, with only 1/31 respondents said no. When asking about what activities they might be willing to participate in, the most popular activities are taking food & drink and event-relevant activities. (see Figure 2.7) And more visitors prefer to take activities before the event than after the event.

For the complete questionnaire results, please check Appendix B.

Reasons for choosing this modality:

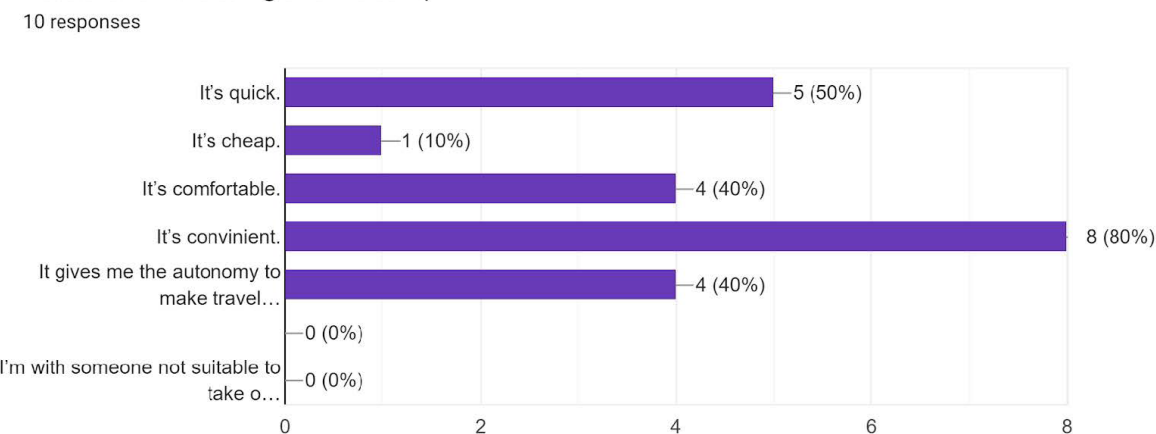


Figure 2.4. Reasons for choosing the modality other than public transport

Reasons for not choosing public transport:

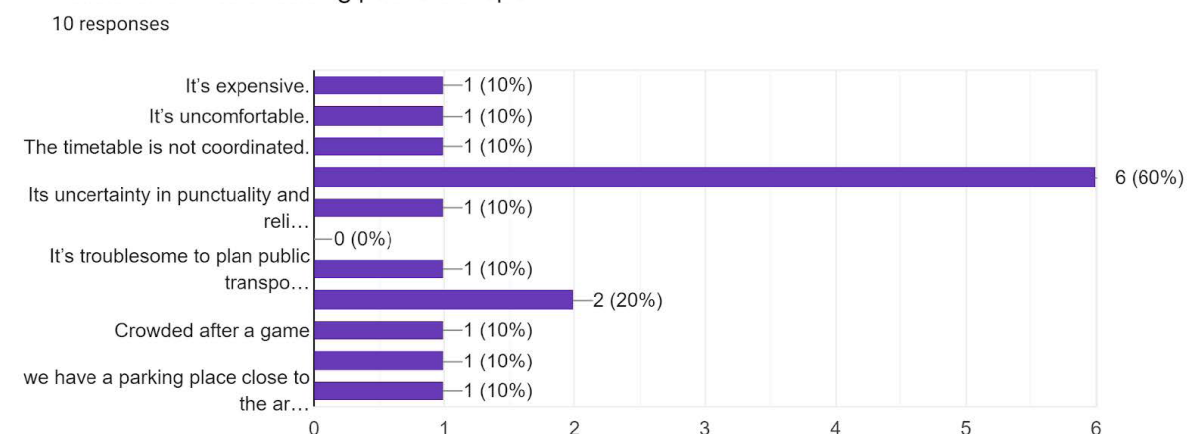


Figure 2.5. Reasons for not choosing public transport

Reasons for choosing public transport:

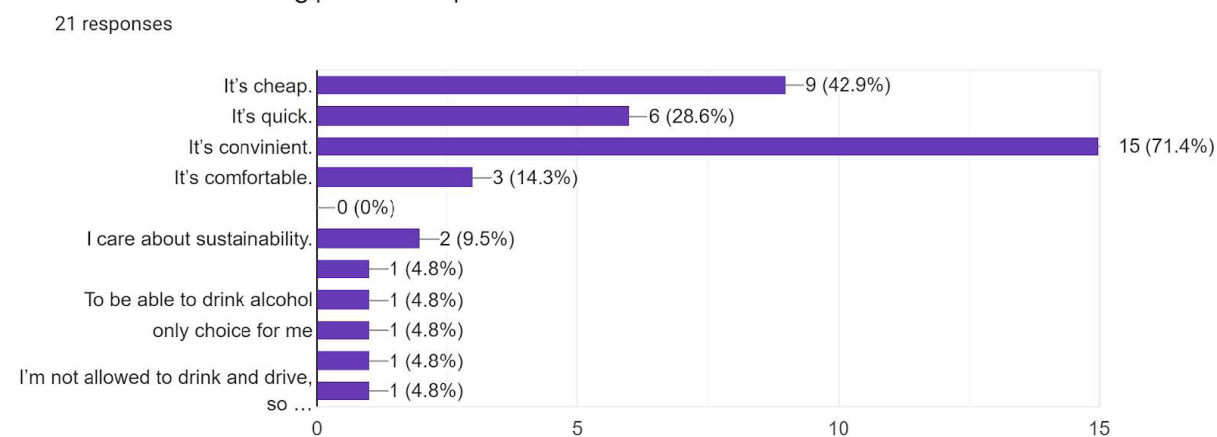


Figure 2.6. Reasons for choosing public transport

When did you decide the modality to travel to the venue?

31 responses

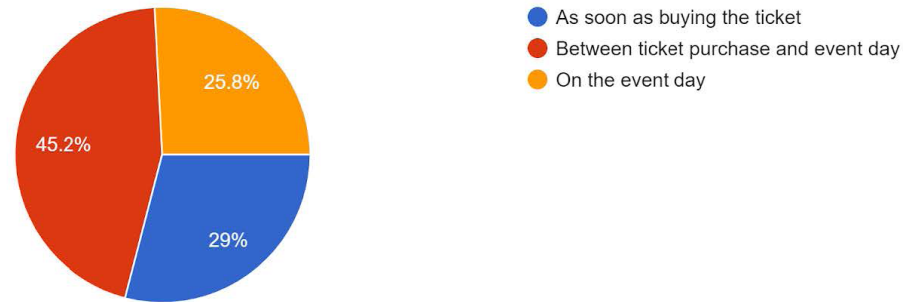


Figure 2.7. Decision-making time

What activities did you participant in in the ArenA area before or after events?

21 responses

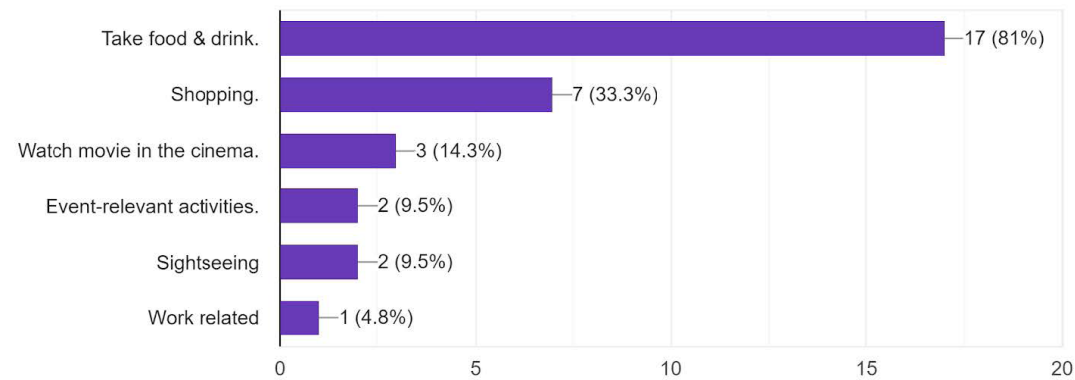


Figure 2.8. Previous activity choice

What activities you might be willing to participate in the area before or after events?

22 responses

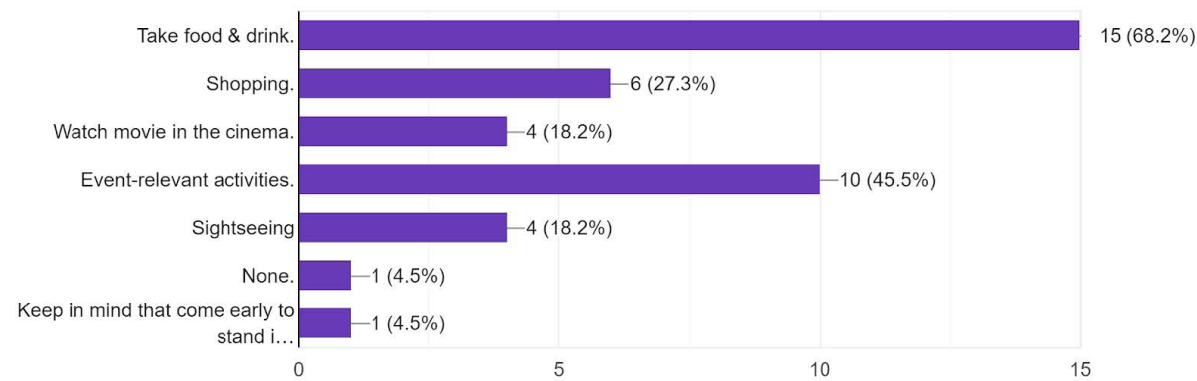


Figure 2.9. Preferred activity choice

Supplement documents

In addition to the questionnaire mentioned above, there are other surveys made by the OMC to learn visitors' opinions about the event mobility. Some survey results confirm the results obtained from the questionnaire, while we can also get some new insights from it.

When asking about which aspects of the car, taxi, and motor tour are insufficient, the most highly ranked three answers are the road network around the ArenA to the parking lot, the parking facilities around the stadium, and the parking options. For public transport takers, complaints focus on the available space on board and the facilities at and around the station.

On the return journey, the main complaints of the visitors who take a car/taxi/motorbike are the organization at the parking lot, while public transport takers mainly complain about the organization at the station.

Research also reveals a lack of information on mobility in advance. Around 34% of visitors inform themselves in advance about travel options. The website of the venue, the website of the organization, a travel app, social media, and the Mobility Portal are all frequently chosen options. Approximately 38% do not inform themselves in advance about travel options, mainly because these people were aware of the situation. Around 14% inform themselves in other ways, for example, knowledge from previous visitors.

The proportion of visitors who inform themselves in advance among public transport passengers is slightly higher than among car users, while this rate is the lowest among cyclists/pedestrians. The latter category often concerns people living closer to home who are familiar with the situation.

2.4.3 Influential Factors

Before making attempts to change visitors' behavior, we first need to know what factors influence their traffic behavior and what factors influence the overall traffic situation. From the literature review, expert interviews, and user interviews, a summary of influential factors is summarized:

Event venue

Different venues have different capacities, hold different types of events, and attract different groups of visitors.

Event type

Different types of events attract different visitor groups, and they vary in mobility behavior. For example, in an Ajax match, a large group of visitors come every two weeks and they are familiar with the area, thus they tend to take the habit of travel mode. On matches of the Netherlands national football team more visitors are from other regions outside of Amsterdam or the Noord-Holland province, they might be unfamiliar with the area, rely on guidance from navigation, and be more willing to follow the guidance from the OMC on the road.

Generally speaking, concerts visitors are less familiar with the area, because the same concert does not happen frequently in the same place. But there are other differences between visitors. Some concerts attract mainly teenagers thus the proportion of kiss & ride will be high, while some concerts attract mainly older people then the modal split of private cars will raise because older people have a higher preference for traveling by car.

Time of the day

If the event is late at night, more visitors will prefer to take private cars, because sometimes public transport does not work on certain routes at midnight. If the event is after dinner time, the inflow pressure will be relieved, because some people come early and have food before the event, so the inflow is apart.

Day of the week

At weekends, the inflow and outflow curve is flatter, because more visitors come early or stay late to have meals or watch movies in the area. On weekdays, sometimes the event traffic peak hour overlaps with the commute peak hour, which makes the situation worse.

Weather

If it's rainy or cold, more visitors will prefer to take a vehicle instead of public transport or bicycle or walking.

Distance from the venue

Research shows that the proportion of visitors using private cars among visitors from Amsterdam is dominantly lower than the average. Visitors who live close to the venue have a higher possibility to choose walking, bicycle, and public transport. As to visitors living far away from the venue, walking or riding is not feasible, while the public transport system might be too complicated, taking too many transfers or temporally too long.

This factor has an inner relation with the factor event type. For example, if the concert is a national tour also with other sessions in other cities in the Netherlands, then it will mainly attract visitors near Amsterdam. If the event is international, then visitors will come from the whole nation, or even from abroad.

2.4.4 Personas and User Journeys

To gain the empathy of event visitors, and have a deeper understanding of their mobility behavior, several interviews with event visitors in the ArenAPoort were done with different kinds of visitors.

Insights from the interviews were documented and summarized, and demonstrated in the format of personas and user journeys, as will be introduced next.

Persona

Persona is a widely used design method for representing and communicating user needs. Many benefits of this method have been proposed as compared to other approaches of communicating user information, such as improving communication about the target users within the design team and with other stakeholders, and helping designers focus on the needs of the target users. (Miaskiewicz and Kozar, 2011)

In the research process, the author chose to use the design method Persona to depict target users because the classification of event visitors in the ArenAPoort differs. The author aims to use the Persona to show the different characteristics and features of event users.

As mentioned before, events held in ArenAPoort differ a lot, while football matches and concerts can be considered as two representative types. Different types of events attract different types of visitors, and even for the same event, visitors' age, occupation, residence places, economic status, and travel mode choices vary a lot. Thus, their mobility behavior and reasons behind it are also diversified.



	Persona A	Persona B	Persona C
Modality choice	Public transport	Private car	Private car
Area familiarity	Unfamiliar	Familiar	Unfamiliar

Figure 2.10. Personas

Including all types of visitors in the research is unrealistic and unnecessary, thus, three typical types are concluded by the author, and for each type one persona was created. Personas are classified by two main features of visitor classification: modality choice and familiarity on the ArenAPoort (also can be seen as the frequency of visiting the area).

There are a few key elements that influence modality choices. Age is a key issue. Young visitors are more likely to take public transport while older visitors, especially those who travel with family, are more likely to take private cars.

As to the familiarity of the ArenAPoort, it is more relevant to the event type. Some events, for example, Ajax matches, are held regularly. Visitors come to the ArenA every two weeks, so they are probably more familiar with the ArenAPoort area and already formed their travel habits. In contrast, some events, like concerts, are irregular and the artist probably never has come to the venue before. Visitors of these events are more likely to be unfamiliar with the area and need more travel guidance.

Considering these elements, three personas are created, representing three typical kinds of visitors:

1. Concert visitors, unfamiliar with the ArenAPoort, take public transport.
2. Ajax fans, familiar with the ArenAPoort, take private cars.
3. Football fans of the Netherlands national football team, unfamiliar with the ArenAPoort, take private cars.

Several interviews were done with visitors of each classification. Insights gained are summarized in the journey map showing below.

User Journey maps

The user journey map is a visualization of an individual's behavior and experience of interacting with a product/service over time and across different channels. It can help designers to learn about the user processes, the activities the user needs to perform to achieve a certain goal, gather essential steps and stages of the user process, and the experiences accompanying them. (Endmann and Keßner, 2016)

By making use of user journey maps, the author would like to find out visitors' behaviors and experience step by step, and on each step what visitors are satisfied or unsatisfied about, to find design opportunities.

Six steps are divided in the whole travel journey chronologically:

1. Preparation (plan the travel route before departure)
2. 1st part inflow journey (from the start point to the venue parking/station)
3. 2nd part inflow journey (from the venue parking/station to the venue entrance)
4. During the event
5. 1st part outflow journey (from the venue entrance to the venue parking/station)
6. 2nd part outflow journey (from the venue parking/station to the destination)

For each journey map, the persona is given, added with some other personal information aimed at helping to make the character image richer so as to help to gain empathy. The spot of the event and users' behavior is listed. For each step, the emotion relevant to mobility is also given. Comments from visitors are listed on the journey map.

User Journey Map 1

The first user journey map is for visitors who take public transport to the ArenAPoort and are relatively unfamiliar with the area. In this journey map, comments are from four event visitors the author interviewed who meet this classification.

By analyzing visitors' comments, three main issues are drawn from it.

1. Information is insufficient. The public transport information from the event organizer is normally insufficient, and the information obtained from Google maps is not always accurate. Opportunity: Provide personalized, detailed public transport information in advance.
2. Aficionados atmosphere onboard. It is an advantage of public transport because

it extends the time visitors can immerse themselves in the event experience. Attention needs to be paid to make it more organized, to avoid negative things like drunk visitors onboard. Opportunity: Create an organized aficionados atmosphere onboard, or extend the event experience to attract more visitors.

3. Pre-event and after-event activities. Most visitors are willing to take part in activities before and after events. Before the event, the time issue is a big concern because they need to enter the venue on time. After the event, visitors have more free time, but the specific situation depends on whether the time is late, whether the weather is good or so. It is also a good solution to avoid inflow and outflow peak hours. Opportunity: Provide event-relevant activities before and/or after events, and guide visitors to take part in them.

Besides, some other issues mentioned in comments, e.g. unpredictable delay/cancel, can also influence mobility influence. But it is beyond the scope of my project and involves too many other stakeholders. Thus, these issues are not summarized in the summary.

User Journey Map 2

The second user journey map is for visitors who take a private car to the ArenAPoort and are familiar with the area. Results in the journey map are from 2 event visitors interviewed by the author and meet this classification.

By analyzing visitors' comments, three main issues are drawn from it.

1. Habit is hard to change. For this type of visitors, their rich experience does help them avoid the problems of taking a private car. But for the Municipality, it is harder to change their habit, for example, make them take public transport instead of a private car.

2. Finding positive things in negative experiences. Walking a long way from parking to the venue is a negative experience, but they can gain some positive experience like taking good food & drink in a less-crowded bar. Opportunity: When a negative experience is unavoidable, add some positive things to it.
3. Pre-event and after-event activities. This type of visitor is also willing to take part in activities, but the activity type is a bit different. They will not go sightseeing, but they would like to take event-relevant activities and take food & drink. Opportunity: Provide activities that they want.

3. Activities difference. A group of friends are more likely to have food & drink at the bar before or after the event to have a good friendship time, but a group of the family seems seldom to take this kind of event, they prefer to see this event as a part of family time. Opportunity: Recommending different activities to different visitor groups.

User Journey Map 3

The third user journey map is for visitors who take private cars to the ArenAPoort and are not familiar with the area. This type of visitor is hard to reach by the author, so results in this journey map are mainly from comments on the Internet and the questionnaire survey.

Three main issues are drawn from it.

1. Relying on guidance. This type of visitor needs to follow the navigation tools to find the route and find a parking lot. Therefore, their behavior is relatively easier to manage. But since routes recommended to them are normally conventional and popular among visitors, they will probably face heavy congestion. Opportunity: provide them better guidance, including different travel options with advantages and disadvantages marked for the users' choice.
2. Difficulty in wayfinding. A common comment is that indication of the parking lot entrance and from the parking lot to the venue is insufficient. These problems cause extra time and effort for visitors. Opportunity: Creating a better guidance system, both digitally and physically in the area.



Modality choice:
Public transport

Area familiarity:
Unfamiliar

Name Allie
Gender Female
Age 24
Occupation Student
Event Concert
Location Den Hague

Residence Dormitory with roommates
Car Ownership No
Group With friends
3 persons in total

Sensitivity
Price -----●-----
Time -----●-----
Comfort -----●-----



Spots&Behavior

Emotions

Comments



Residence

Make travel plan



1 +. Sometimes the event organizer provides traffic information.
1 -. Normally, the traffic information is too broad. Need to check Googlemaps for detailed traffic information.



Onboard

Departure/ Transfer/ Onboard



1 -. Unpredictable delay/cancel.
+/- . Crowded but tolerable.
2 +. Aficionados around can get me immersed in the event atmosphere in advance.
2 -. Dislike drunk passengers.



Station

Arrival at the station



1 -. Googlemaps cannot tell you which station is more attractive. It guides you to get off at Strandvliet, but the trail from there to the venue is long and uncharming.

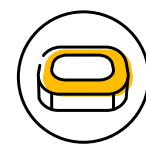


Arena Area

Pre-event Activities



3 +. Willing to take activities like buying event-relevant products, taking food&drinks, watching pre-match training.
3 +/- . Avoid take time consuming activities because need time to wait in the queue at the entrance, and willing to enter the venue on time. Especially for some events without allocated seats, you need to enter early to get the front row.



Venue

Event



+/- . Do not plan return route during event, since uncertainty in ending time, confidence in public transport system and excitement on the event itself.



Arena Area

After-event Activities



3 +/- . Plan return route after event.
3 +. If come for the first time, willing to go sightseeing and take photos at landmarks.
3 +/- . In order to avoid the crowd, take some activities after events. e.g. taking food&drinks.
3 -. If the ending time is too late, prefer to directly go back.



Station

Departure



3 -. Crowded and messy on the platform.
-. Anxious and boring during waiting time.



Onboard

Transfer/ Onboard/ Arrival



+ . After a tiring event experience, it's good to relax on the return public transport.
2 +. You can chat with aficionados. A continue of event atmosphere.
-. Uncertainty in return time, perhaps a long transfer time.
-. It's already late after events, impatient in waiting, especially if weather is terrible.

Figure 2.11. User Journey Map 1



Modality choice:
Private car

Area familiarity:
Familiar

Name Brian
Gender Male
Age 28
Occupation Engineer
Event Location Ajax match Utrecht

Residence Living alone in a rent apartment
Car Ownership Yes
Group With friends 4 persons in total

Sensitivity
Price●.....
Time●.....
Comfort●.....

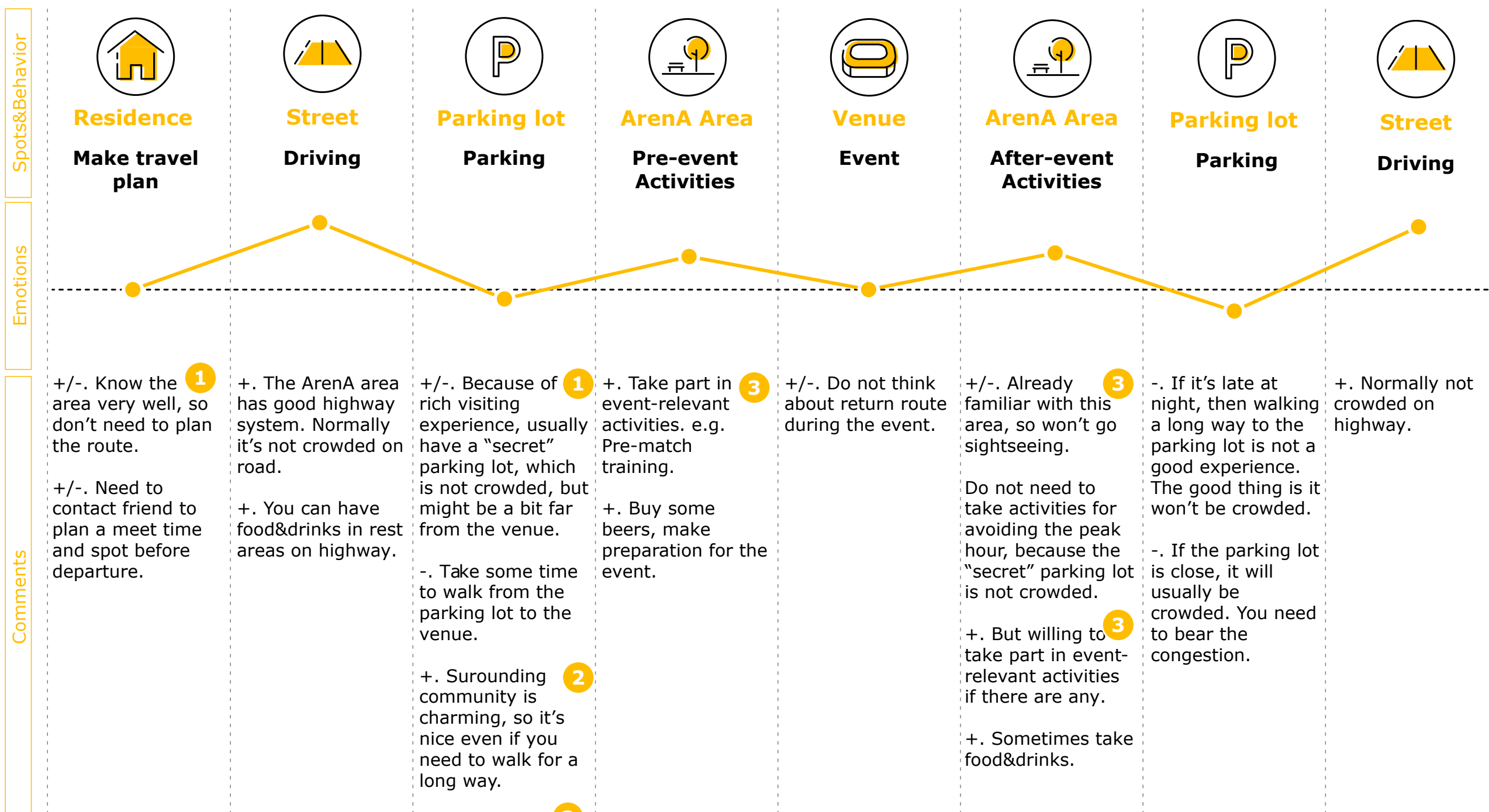


Figure 2.12. User Journey Map 2



Modality choice:
Private car

Area familiarity:
Unfamiliar

Name Clark
Gender Male
Age 39
Occupation Manager
Event KNVB matches
Location Eindhoven

Residence House with family

Car Ownership Yes

Group With family
4 persons in total

Sensitivity

Price ---●-----

Time -----●-----

Comfort -----●-----

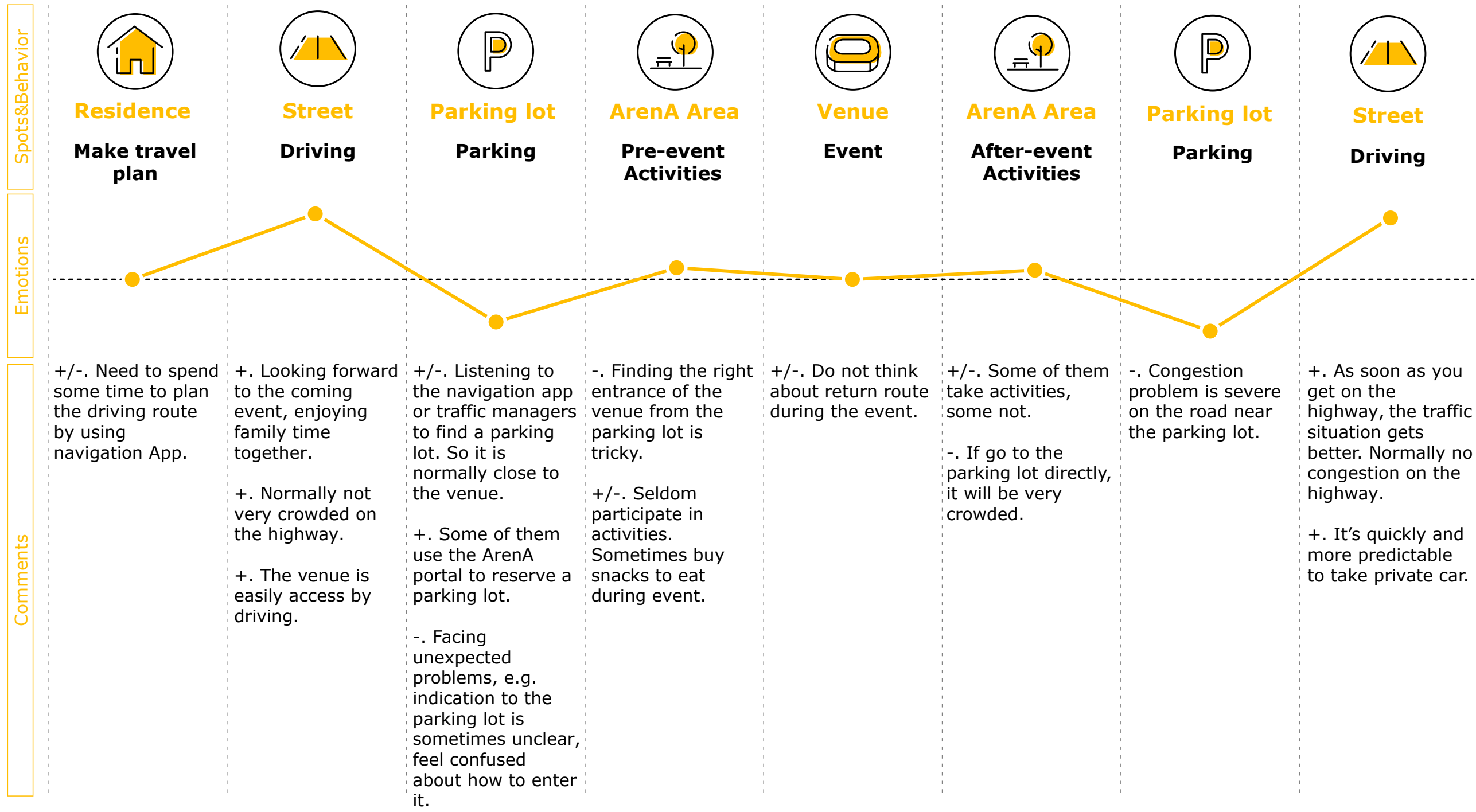
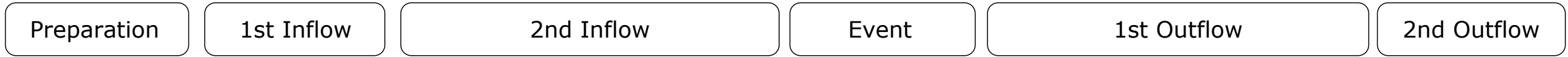


Figure 2.13. User Journey Map 3

2.5 Data Usage in Behavior Change

The OMC is now working on collecting event traffic data and making use of data to improve mobility situations in future events. A research was done about how the OMC is making use of data now, what is the effect of data usage, and what are other potentials of making use of data on mobility behavior change.

2.5.1 Current Trials and Effects

Event classification

Putting cameras on traffic intersections, utilizing picture preparing procedures, and a model for controlling traffic signals in light of data obtained from pictures of streets taken by camcorders. (Rizwan et al, 2016) This is one of the strategies that the OMC is now taking to manage the event traffic.

As mentioned before, one direction of using data to improve mobility is to analyze previous data and make predictions of the mobility situation of future events and then take responding measures. Experts in the OMC are now working on analyzing the lane data, the GVB (public transport) data, and the parking space data to reach this goal. They are also working on classifying events. By studying what elements influence visitors' behavior, experts can learn how to analyze an event in the future.

The shortage of collecting data. Events in the future are not always predictable, especially for those unconventional and irregular events. Traffic experts in the municipality pointed out that, "Because most of the artists come only once, so it is hard to find out how we can segment them in a way that makes sense." That is the reason why the model of making predictions of future events is a bit "haphazard".

This aforementioned direction is valuable but beyond the scope of this project. In this project, the focus will be making use of data to change visitors' behavior, to improve the traffic situation.

One attempt that the OMC is currently taking is the Mobility Portal.

Mobility Portal

"We change the travel behavior of the visitors by showing them the alternatives."

This sentence is one slogan of the Mobility Portal, a wide label portal made by the company BeSite cooperating with the OMC aiming at improving the mobility situation. It cooperates with platforms like the website of ArenAPoort and the application of Johan Cruijff ArenA to provide service regarding mobility to event visitors.

The steps of using it are quite easy: First, the user needs to choose the event he/she will join, and input the departure location. Then the user can choose the modality. After that, the user needs to choose a parking spot. After inputting the email address, the reservation is finished and a parking ticket will be sent to him/her.

There are three different scenarios of using the Mobility Portal, representing three phases in planning an event experience: booking a ticket, between ticket purchasing and the event day, on the event day. Currently, the peak of the user number is on the event day. But the Mobility Portal is working on bringing forward the using time slot, making visitors plan their journey earlier.

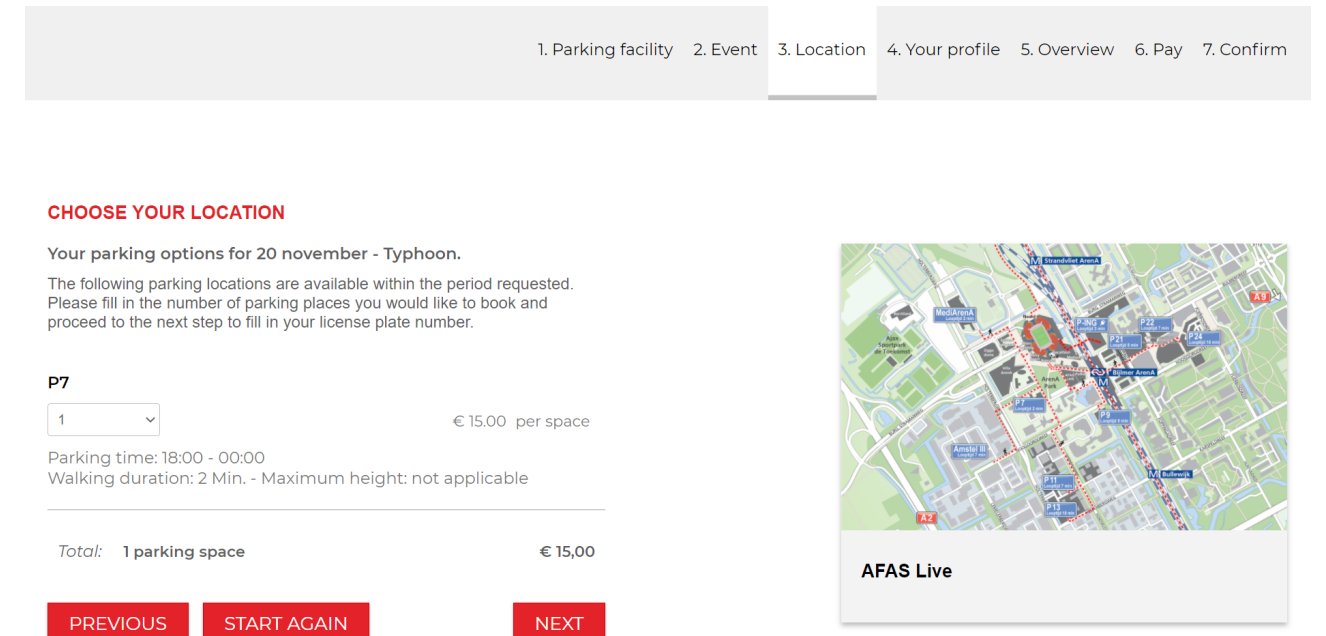


Figure 2.14. Mobility Portal on the ArenAPoort website

"For most organizers and venues, the event starts at the entrance. But for Johan Cruijff ArenA, the customer journey starts at the couch, when the audience buys the ticket for an event."

- Designer from Mobility Portal

The process of the Mobility Portal to collect and use data is very interesting. It can give visitors suggestions about the parking spot according to the data they input: where they come from. For example, if the visitor comes from the east, then he/she will get a recommendation of parking spots on the east so that he/she does not need to go across the ArenAPoort area. This helps to avoid traffic flow intersected in the area, and save time for visitors.

Another selling point of the application is the accuracy and the level of travel guidance. When the visitor makes a travel plan, it is directly from the starting point to the parking lot, instead of

navigating to the venue and then looking for a parking space nearby. Besides, the Mobility Portal can provide the last-mile trip from the parking lot/station to the seat in the venue.

The traffic data collected by the Mobility Portal will be provided to the Johan Cruijff ArenA, and to learn the mobility situation of each event.

2.5.2 Potential directions

Apart from the two solutions mentioned before, there are more ways of making use of data for mobility behavior change. Learning from the literature review, the following directions are summarized by the author.

Personalized persuasive profiles

One potential direction is to rely on the deep penetration of mobile phones to influence citizens' behavior through data-driven mobility and persuasive profiles. Anagnostopoulou introduced research that an application that can analyze visitors' behavior mode and conclude them to one profile was developed. According to the behavior mode analysis result, persuasive messages will be sent to the user to change their travel behavior. By nudging users on a personalized level, the product can change their mobility behavior and make mobility choices preferred by the researchers (choices that are more sustainable in this case.)

To be more specific, the first step is to leverage pervasive mobile sensing to uncover users' mobility patterns and use of transportation mode. After that, users' persuadability profiles are constructed by considering their personality and mobility behavior. With the use of the aforementioned information, personalized interventions are generated to nudge users to adopt sustainable transportation habits. The tool used in this intervention relies on persuasive technologies and are embedded in a route planning application for smartphones.

This approach has a certain similarity with the Mobility Portal but goes further in nudging behavior change. If we can give visitors personalized persuasive traffic suggestions, the possibility of improving their travel mode will be higher.

Travel preparation

A research done by Bauder and Freytag in 2015 reveals that helping visitors get prepared for the travel can help to direct visitor activities of less-prepared visitors temporally and spatially.

Well-prepared and not well-prepared visitors are two distinct types of tourists with specific mobility patterns. Less-prepared visitors are more likely to gather in the inner city where a crowd and congestion happens, and well-prepared visitors are more likely to separate in less-famous spots. Addressing information and recommendations to visitors might channel their activities and mobility practices during their stay. Knowledge of these specific characteristics and mobility patterns allows tourism professionals to develop and offer target-oriented services which may help to avoid overcrowding effects by fostering slight spatial deconcentration of visitor activities. In particular, online information services and signage can help to direct visitor activities of less-prepared visitors temporally and spatially.

Appropriating the findings in the context of the ArenAPoort, providing suggestions and recommendations to less-prepared visitors can help to deconcentrate them temporally and spatially to avoid overcrowding. These suggestions and recommendations can be based on former data.

2.6 Research Conclusions

According to the research activities introduced before, the research questions are explored and answered, and several design directions are found for the further step.

In summary, the private car and public transport are the two modalities that are more frequently taken by event visitors. Both modalities have their problems, but generally speaking, the OMC would like visitors to use public transport instead of the private car. Besides, the OMC also wants visitors to follow their guidance, and want the utilization of vehicles to be higher, which means more passengers in the same car. Besides, a temporal decentralization on the inflow and outflow will also help the mobility situation.

The above-mentioned are the goals of mobility change by the OMC. The research was done on the possibility of reaching each goal, here is the summary:

Changing modality choice is hard but possible.

One vision of the municipality is to make more visitors take public transport instead of private cars. However, considering the advantages and disadvantages of both modalities, the reasons for choosing the private car are solid.

The private car overperformed public transport at convenience and price. Convenience is an essential element, especially for a group of visitors traveling together, e.g. family or friends, taking a private car is more convenient than calculating timetables to take public transport. Financial is another important issue. The parking fee of a private car is normally not higher than

the public transport ticket fee of 4 people, thus for a group of visitors, taking a private car is a better choice.

In contrast, the complaints about public transport are also obvious, including comfort, convenience, stability, and time limit issues. Sometimes the carriage is overcrowded and leaves passengers no seat or even no space, which brings a negative experience in comfort. Sometimes the timetable does not suit the event arrangement, or for some visitors taking public transport will take a too long time or too many transfers. The unexpected delay or cancellation of public transport also happens, which leads to a stability problem. The time limit is also a bit concerning because many events end late at night when the trains/metros/buses are already out of service. These are all reasons for which visitors do not want to choose public transport.

However, there are also some advantages to public transport. The aficionados atmosphere onboard is an attractive factor. Visitors that have the same interests can meet together onboard and have discussions, which can extend the event experience. Besides, after attending an exciting event, relaxing onboard is more comfortable than driving a car home.

All in all, the advantages of the private car and the disadvantages of public transport objectively exist, thus motivating private car drivers to use public transport is hard. But public transport also has some unique advantages, which can be utilized to attract more visitors.

The familiarity of the ArenAPoort can improve the experience but cause difficulties in mobility behavior change. Visitors unfamiliar with the area have a higher possibility of modality change.

From the user journey maps, we can see that the second type of visitors who are familiar with the ArenAPoort, has a higher average emotion level because they already know how to avoid troubles in the travel process. Thus, making visitors get familiar with the area in advance can help to improve both the visitor's mobility experience and the mobility situation in the ArenAPoort.

However, precisely because of familiarity with the situation, this type of visitor already formed a traveling habit, which is hard to change. For example, he/she will choose to use the parking lot he/she normally uses, instead of the best one. Making them follow the guidance from the OMC is relatively hard.

Changing time choice is possible, while outflow is harder to improve.

Compared to modality change, it's easier to make visitors change the arriving and leaving time. From the questionnaire and target group interview, two conclusions can be drawn: Most visitors had the experience of participating in activities before or after events, and even more, visitors are willing to participate in activities before or after events.

The most popular activity types are event-relevant activities and taking food and drinks. Event-relevant activities include pre-match training, rehearsal, after-performance party, signing, etc. Although the percentage of visitors who took part in event-relevant activities is not high enough, there is a huge improvement opportunity. Thus, organizing more event-relevant

activities might be a good way to separate the crowd and flatten the peak-hour curve.

Visitors are more willing to take part in activities before the event than after the event. Considering the situation that at present outflow is already worse than inflow, managing the outflow congestion is much harder.

Informing visitors in advance can help with the situation.

The proportion of visitors who inform themselves about the traffic information in advance is not high, while research shows that informing visitors in advance might help with choosing a more appropriate modality. Therefore, the OMC can inform visitors about the traffic information in advance with persuasive reminders, this might help with nudging them to choose the modality more preferred by the OMC.

More ways of using and collecting data.

There are more ways of using data and collecting data. Except being used to make predictions so that the municipality can take precautionary reactions, data can also be used in changing visitors' mobility choices, for example giving them personalized persuasive reminders, and helping them in their travel preparation.

Besides, since for some irregular events, it is not easy to find out all variables and make predictions, we can also seek other ways of collecting the mobility data for the coming event.

Chapter 3

Design Defining

By synthesizing findings and insights from the previous research phase, a clearer design goal is proposed. Further explanations are added, and design guidelines are also given in this chapter.



3.1 Design Goal

After the research phase, a deeper understanding of the issue was gained by the author. Correspondingly, a clearer design goal is proposed.

Design a digital platform that can make use of data to motivate event visitors to spontaneously take the mobility choices preferred by the OMC, thus to benefit the mobility situation around the ArenAPoort during events.

A digital platform: The form of the product remains open in this stage, but the interaction should happen on digital equipment for the wide use of the Internet.

Make use of data: The final design can propose a new way of making use of data the municipality currently has or intended to collect, or it can provide a new way of helping the OMC to collect data.

Spontaneously: Instead of forcing visitors to take some mobility modes, the product should make visitors spontaneously change their behavior. It should be attractive to users and be effective in nudging behavior change.

Mobility choices preferred by the OMC: As explained in Chapter 2.3, mobility choices preferred by the OMC includes four parts: modality change from private car to public transport, time change to avoid peak hours in the inflow and the outflow, following the guidance from the OMC, and sharing vehicles to raise the utilization.

3.2 Design Guidelines

The design goal is a general guide in the design phase, while some more detailed guidelines are also needed as an additional explanation, and to be used as criteria to assess the design work.

1. **Effectiveness:** The design should be effective in changing visitors' mobility behavior to the mode preferred by the OMC, which can create the biggest benefits for the overall situation. Mobility behavior change includes modality change, time change, following guidance, and enhancing the utilization of vehicles. The effectiveness can be assessed by studying to what extent do visitors willing to do each part of mobility change.
2. **Comprehensiveness:** The design should benefit a massive group of visitors instead of only influencing one specific group for the diversity of visitor groups in the ArenAPoort. The universality and comprehensiveness can help to broaden the application scope and maximize the benefits of the design.
3. **Attractiveness:** The design should be attractive to visitors. Instead of forcing visitors to change their behavior, the design aims at making visitors willing to make use of it. Thus, the design should understand users' needs and provide them useful functions and good user experience.
4. **Implementation easiness:** The design should be easy to implement by the OMC. It can not involve too many stakeholders and propose solutions that are beyond the scope of the OMC's work. Solutions that need too many investments or resources are not appropriate either.
5. **No side-effects:** While improving the mobility situation in the ArenAPoort, the design should not cause problems in other domains. Since the OMC is a multi-stakeholder organization with a wide responsibility range far broader than mobility behavior, the design should neither harm the interests of other stakeholders like the police, entrepreneurs in the ArenA Boulevard, or the venues nor create extra work for them.
6. **Data usage:** It should effectively make use of data, with not only the data that the OMC currently has but also collecting data for future usage.

Chapter 4

Ideation

This chapter introduces the ideation phase, including three ideation activities and two rounds of evaluations. The output includes 13 initial ideas and their assessment for further development.



4.1 Ideation Introduction

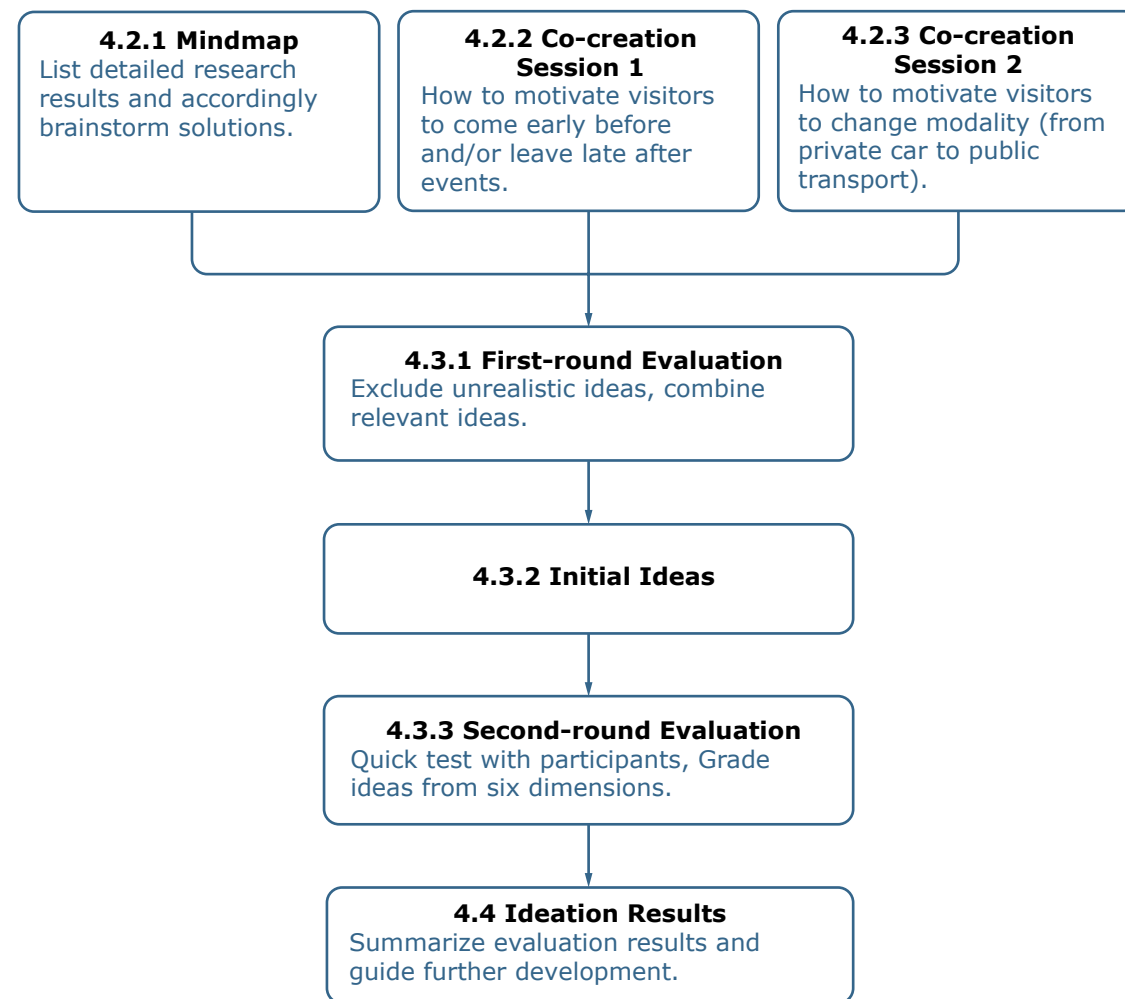


Figure 4.1. Ideation process

The ideation is based on research results, which have been introduced in previous chapters. Figure 4.1 illustrates the whole process of this stage. Generally, three ideation activities were organized. By analysing the outputs, several initial

ideas were generated. After that, two rounds of evaluation were conducted, from which the final design direction is defined.

4.2 Ideation Activities

4.2.1 Brainstorming Session

This session is the first attempt at the ideation stage. It aims at helping the author to build an overview of potential solution directions. Thus, the main expectation of the session is the diversity of ideas.

Procedure

Figure 4.2 shows the procedure of the brainstorm session.

It is conducted in the format of a mind map by using the remote collaboration tool Miro. The mindmap starts from the design goal, then it comes to two main directions: modality change and time change. For each direction, factors that make visitors take current mobility behavior instead of the preferred one are listed.

A brainstorm was conducted according to each factor. Participants proposed ideas/ solutions/ measures that can make visitors turn to take the preferred behavior.

The complete brainstorm document is in Appendix C.

Participants

Two participants took part in the brainstorm session: one fellow student and the author.

The fellow student took part in the session in the situation of totally understanding the context and situation.

Output

Abundant ideas came out. First ideas beyond the scope are excluded. Then a summarization and classification on all ideas were done, and the results are shown below. All ideas are sorted by if it is physical or digital.

Physical ideas

1. Guide passengers to use the station Strandvliet or Duivendrecht.
2. Create interactions in the station to distract visitors from the negative experience and emotions.
3. Make the aficionado atmosphere onboard more organized and avoid disorders.
4. Improve signage around the parking lot and from the parking/station to the venue.
5. Provide activities that take little time after events.
6. Provide event-relevant activities.

Digital ideas

1. Guide passengers to use the station Strandvliet or Duivendrecht.
2. Provide convenient public-transport route-planning service.
3. Provide real-time traffic information and event information.
4. Provide digital interactions to distract visitors from negative emotions of public transport.
5. Give event visitors autonomy on their travel plans.
6. Provide precise navigation to the parking lot.
7. Accurate and detailed map around the Arena area.
8. Give more traffic information upon ticket purchasing.
9. Provide information on traffic situation prediction to help them avoid congestion.
10. Tell visitors activities they can join in so they can make plans in advance.
11. Build a platform to make visitors organize activities by themselves.

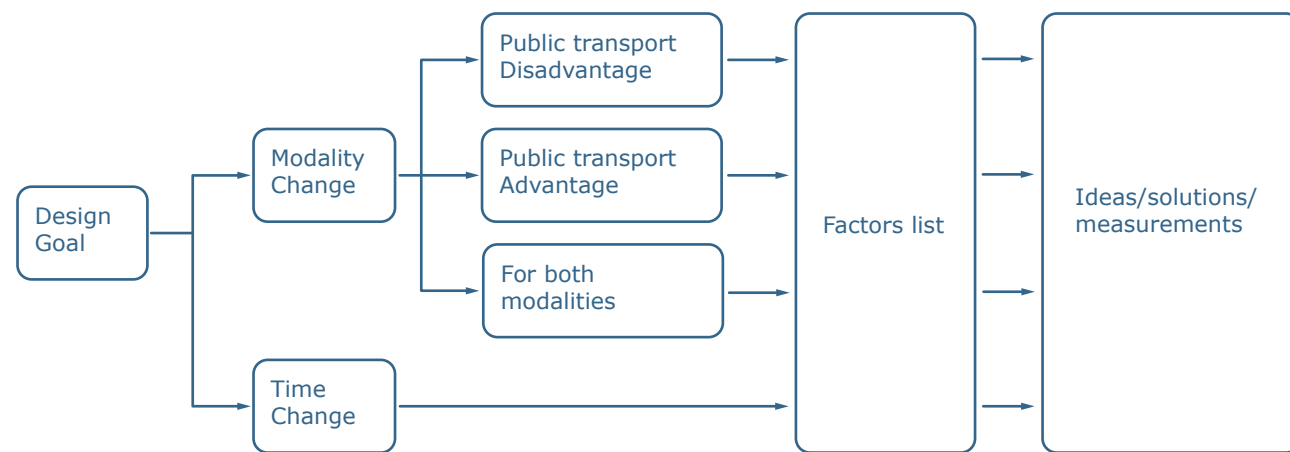


Figure 4.2. Brainstorm session procedure

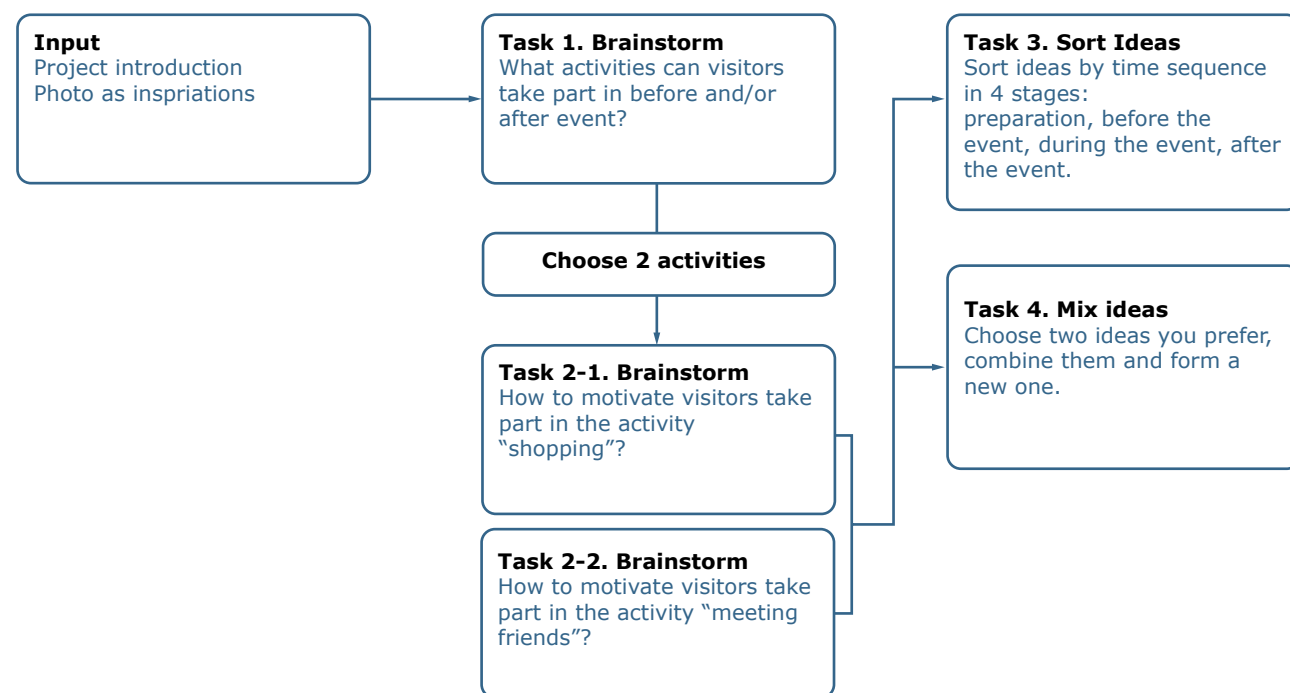


Figure 4.3. Co-creation session 1 procedure

4.2.2 Co-creation Session 1

This session focuses on the “time change”. The main expectation is to gain creative and better-considered ideas in this direction.

Procedure

The theme of this session is about motivating visitors to avoid peak hours. In order to do so, We need to find visitors to come early before and/or leave late after the event.

The session was conducted online by using the remote collaboration tool “Miro”. The setup of the meeting is shown in figure 4.3.

Participants

Three participants took part in the session, one male and two females. They are all fellow students, with an age range from 24 to 26. One of them had concert experience in the Arena area, while although the others don’t have such an experience, they have event experience at other places that can help them empathize with the context.

Three participants took part in the session:

- Participant 1: Female, 26, student, had experience in the Arenapoort (concert).
- Participant 2: Male, 24, student, no experience in the Arenapoort, but had event experience at other places.
- Participant 3: Female, 25, student, no experience in the Arenapoort, but had event experience at other places.

Output

The original session board is in Appendix D. Idea classifications and integrations were done and here are the results:

What activities can visitors take part in before or after events?

- Food & drinks
- Shopping

- Meet friends (old & new)
- Record the experience
- Sightseeing & wandering
- Past relevant event review
- Work
- Watch movie
- Relax

How to motivate visitors to take part in these activities?

1. **Physical facilities support.**
 - a. Provide lockers for saving shopping stuff.
 - b. Provide facilities for chatting.
2. **Sales strategy.**
 - a. Sell event-relevant stuff, e.g. support equipment, merch (merchandise), souvenirs/gifts.
 - b. Sell the limited version at limited time, first come first serve.
 - c. Make the shopping experience like visiting the museum.
3. **Discount encourage.**
 - a. Get a discount by ticket before/after the event.
 - b. Group discounts to motivate visitors shopping together.
 - c. Parking fee discount. Longer time shopping, lower fee.
4. **Social activities.**
 - a. Provide group activities, e.g. visitor parties, luck-draw, parkour. And provide rewards for it.
 - b. Allow visitors to organize events by themselves in the area.
 - c. Famous landmarks in the area + take photos and post them on social media.
 - d. Match with similar visitors and provide a chance to meet new friends.

The original session board is in Appendix <fixme>.

4.2.3 Co-creation Session 2

This session focuses on the “modality change” part. It aims at finding creative and better-considered ideas in this direction.

Procedure

The theme of this session is about motivating visitors to change the modality from the private car to public transport.

The setup of the meeting is shown in figure 4.4

Participants

Four participants took part in the session, with the age range from 24 to 26, and the gender range of 1 male and 3 females. All of them are fellow students. Two had event-participation

experience in the Arena area and the other two had event experience at other places.

Four participants took part in the session:

- Participant 4: Male, 25, student, had experience in the Arenapoort (football match).
- Participant 5: Female, 24, student, no experience in the Arenapoort, but had event experience at other places.
- Participant 6: Female, 25, student, no experience in the Arenapoort, but had event experience at other places.
- Participant 7: Female, 26, student, had experience in the Arenapoort (concert).

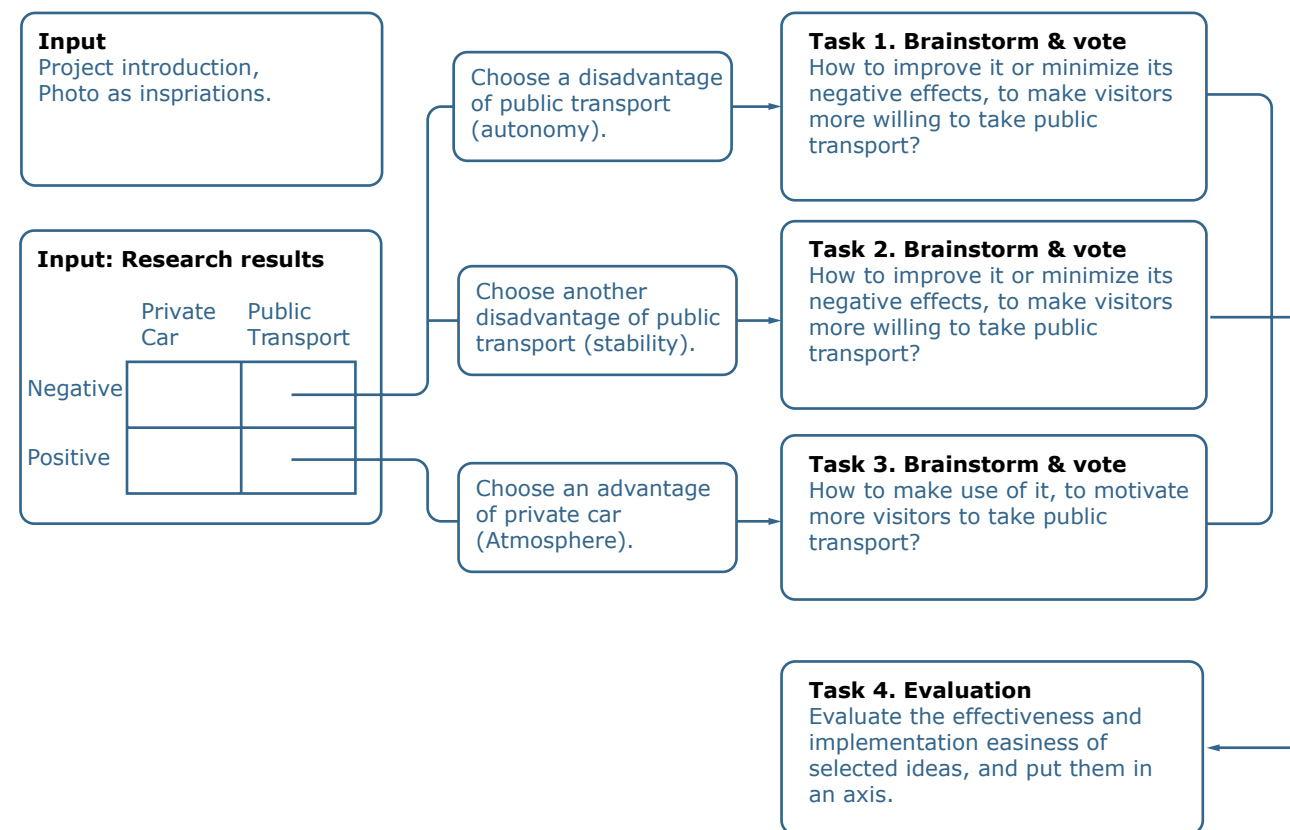


Figure 4.4. Co-creation session 2 procedure

Output

The session was conducted online by using the remote collaboration tool “Miro”.

The original session board is in Appendix E. Idea classifications and integrations were done and here are the results:

1. A better public transport system

- Provide shuttle buses from important stations (e.g. AMS Central) to the venue.
- The public transport system alters according to the event schedule.
- Provide emergency shuttle buses to solve unexpected delays/cancel.
- Provide an insured shuttle bus, make visitors feel relieved that no matter how late it is, they will be able to go back home.
- Provide flexible bicycles in the area.
- Public transport system stability insurance.

2. Extend event time

- Provide activities before or after the event, so that visitors do not need to arrive at exactly one time-point, so they won't have such a high requirement for stability.
- Provide activities around the station after the event, so people will not be bored because of waiting for a long time.

3. A better travel plan system

- Provide travel plans according to visitors' priority (time, comfort, price, etc.)
- Personification. Venue secretary to give you plan A, B, C, D...

4. Prompt response

- Provide alternative plans according to the real situation. If an unexpected delay happens, immediately give visitors alternative plans.
- Event venue live broadcast. Visitors will keep updated with the situation, and they will not miss things even if they are late.

5. Socialization

- Mutual help, to take a taxi together if an unexpected delay/cancel happened.
- Share your delay/travel experience, make it a part of your event experience.
- Leave your message/pictures/handprints, which will be shown in the area.

6. Onboard

- Limited version merchandise you can only buy on the train.
- A green (speed) channel from your home to the venue, consistent visual and guidance design.
- Distribute gifts/souvenirs on board, avoid the peak hour.
- A digital commemorative badge on your travel card, to show off on social media.
- Different trains build different teams and do competitions.

4.3 Ideas Evaluation

From ideation sessions, many wild ideas are proposed. Selections need to be done, so as to find the most suitable ideas for further development.

4.3.1 First-round Evaluation

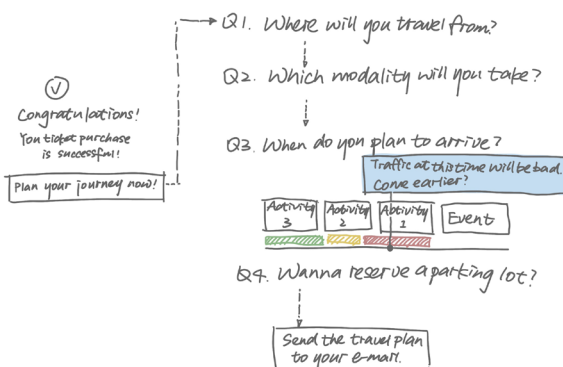
The ideas obtained in the ideation phase are abundant and valuable for further development. However, some of them are too wild to use in a real context. So the first-round evaluation was conducted. It was a self-evaluation with the purpose of excluding unrealistic ideas.

By the word “unrealistic” it means:

1. The idea is too idealistic to realize under the realistic background.
2. The idea is beyond the scope of a graduation project, e.g. it involves too many stakeholders or it can not be finished within limited time or resources.
3. The idea does not suit the current situation with COVID-19 and has difficulty in testing and evaluation.

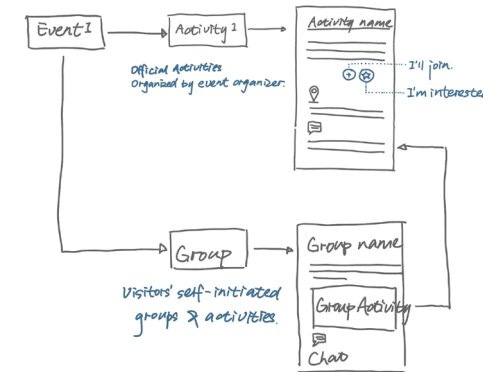
4.3.2 Initial Ideas

After the self-evaluation, ideas that meet the requirement are selected and developed, and formed 13 initial ideas. A quick sketch is done for each idea to give an intuitive introduction and texts are also given for more explanation.



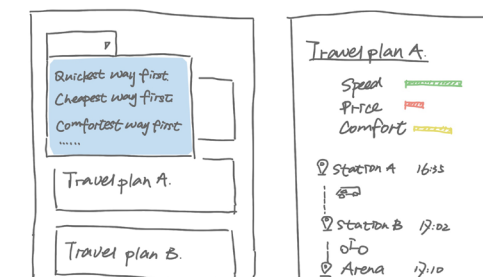
Idea 1. Make the travel plan after ticket purchasing.

- Make the travel plan as soon as buying the event ticket.
- Only need to answer a few questions to make the travel plan.
- Make reservations at the same time.
- Get recommendations on avoiding peak hours, and what activities they can take part in if they come early or stay late.
- Using previous traffic data to give guidance, and collect data for future use.



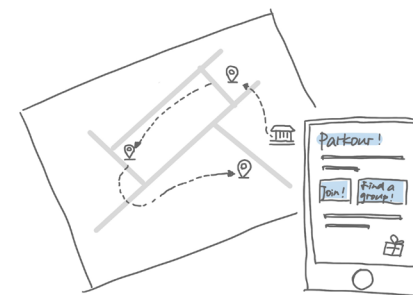
Idea 2. Activities reservation and group formation.

- A platform to see activities that this event provides.
- Choose “I’ll join” or “I’m interested” to collect the event.
- Initiate or join groups to meet new friends with the same interest.
- Initiate group activities by visitors themselves.



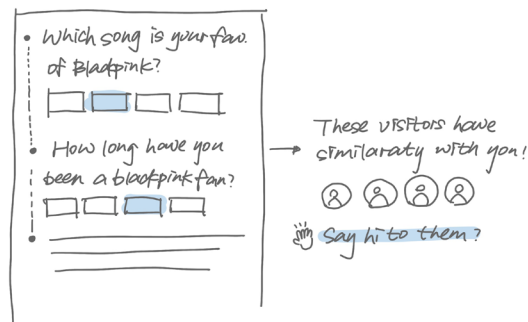
Idea 3. Choose the travel plan according to different priorities.

- When making travel plans, visitors can choose to rank all plans by different criteria, e.g. speed, price, comfort.
- For each travel plan, visitors can see its assessment on different criteria.



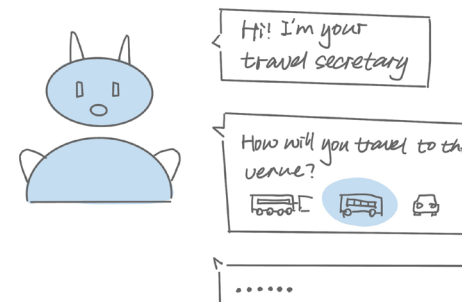
Idea 4. Parkour.

- Organize Parkour activities, to give visitors some tasks to do in the area.
- Use the event merchandise as the reward for winners.



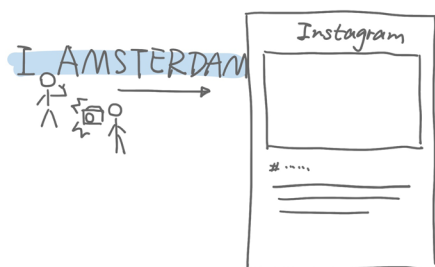
Idea 5. Match and meet similar fans.

- Answer some quick questions about the event.
- Match with visitors that have similar questions.



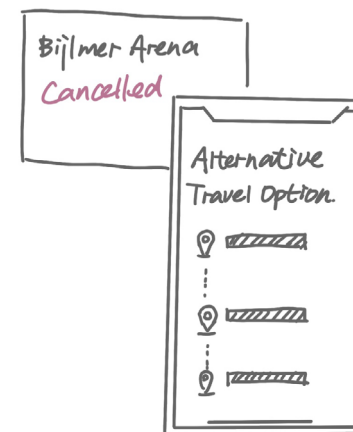
Idea 8. Personification: Travel secretary.

- Asking the visitor's travel choices, then helping him/her to do the travel plan.
- Personification character to attract visitors' interests and improve their emotional experiences.



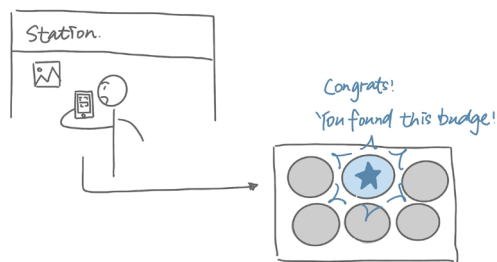
Idea 6. Landmark photo on social media.

- Take photos at landmarks in the area.
- Share the photo on social media with a hashtag.



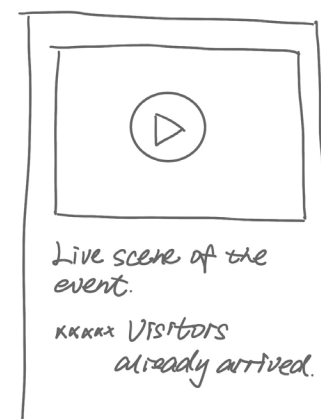
Idea 9. Quick response.

- Provide alternative travel options as soon as a delay/cancel happens.



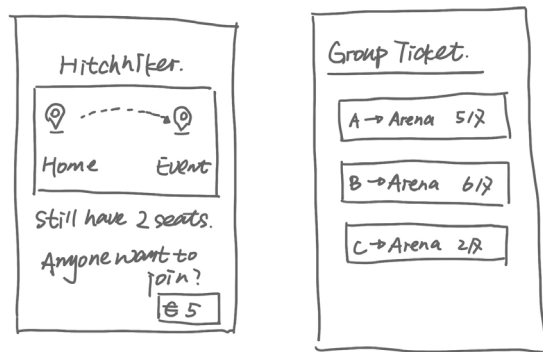
Idea 7. Find QR Code, unlock accomplishments, and get a badge in the area.

- Wander in the area everywhere and find QR code.
- Scan the QR code and unlock the relating badge (accomplishment).
- Collecting all badges to exchange a gift.



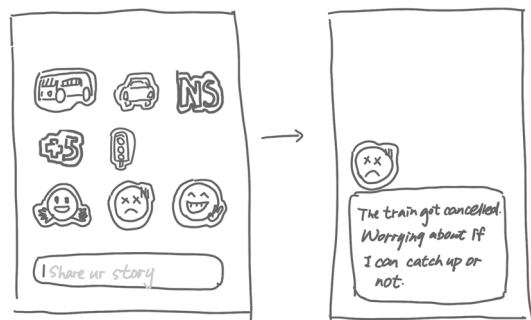
Idea 10. Event live scene.

- Show the live scene of the venue. Visitors will keep updated with the event condition.
- Visitors will not miss anything even if they are late.



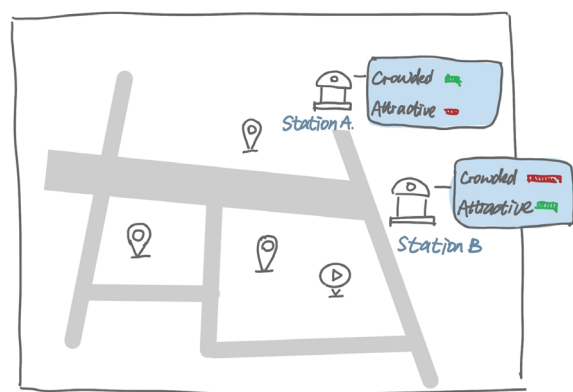
Idea 11. Mutual help group.

- Hitchhiker
- Share a taxi
- Buy group NS ticket



Idea 12. Make traffic a part of your event experience.

- Share your experience if a delay/cancel happens.



Idea 13. A detailed map of the area.

- Mark the attractive landmarks in the area
- Give detailed information like the crowdedness and attractiveness of a station, to help visitors to make the decision.

4.3.3 Second-round Evaluation

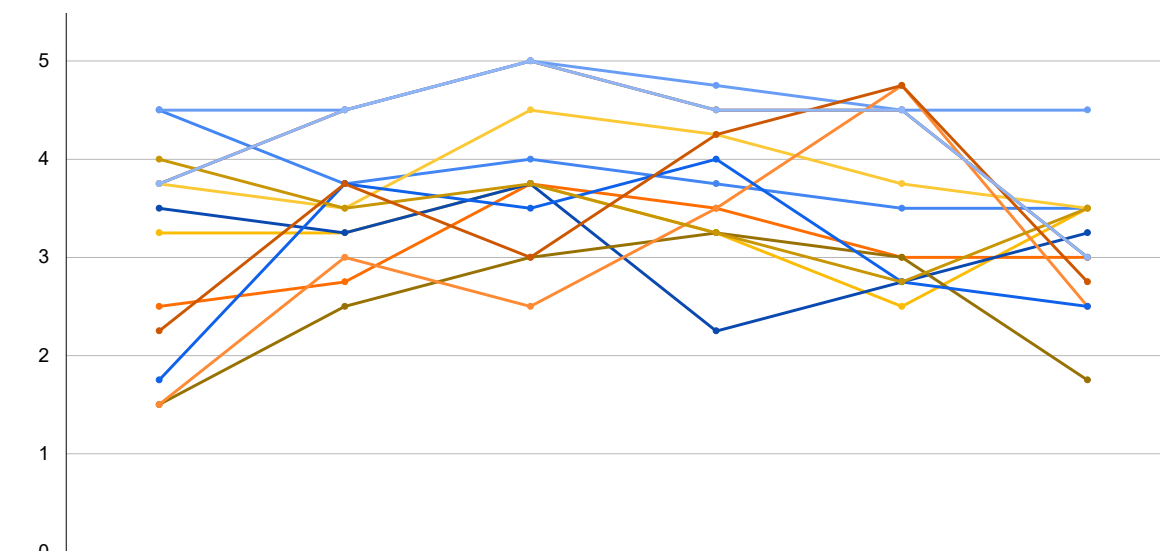
After presenting ideas, another round of evaluation was conducted. Four fellow students, with the age range from 22 to 27, participated in the evaluation session. The session was conducted individually with each participant through online meeting tools. The author presented ideas one by one, and participants were asked to give a score on a scale from 1 to 5 by six dimensions, which is corresponding to the design guidelines introduced in Chapter 3.2:

- Attractiveness: The idea should be attractive and make visitors willing to use it.
- Implementation easiness: The idea should be easy in implementation.
- No side-effect: The idea should not cause problems in other domains.
- Data usage: The idea should effectively make use of data and/or collect data for further use.

Results

The original evaluation board is in Appendix F. The quantitative results are shown in table 4.1. Besides, participants also gave many suggestions on each idea.

- Effectiveness: The idea should be effective in changing visitors' mobility behavior.
- Comprehensiveness: The idea should benefit a massive group of visitors.



	Effectiveness	Comprehensiveness	Attractiveness	Implementation	No side-effect	Data Usage
Idea 1	4.5	3.75	4	3.75	3.5	3.5
Idea 2	3.25	3.25	3.75	3.25	2.5	3.5
Idea 3	2.5	2.75	3.75	3.5	3	3
Idea 4	3.5	3.25	3.75	2.25	2.75	3.25
Idea 5	1.5	2.5	3	3.25	3	1.75
Idea 6	3.75	4.5	5	4.5	4.5	3
Idea 7	4.5	4.5	5	4.75	4.5	4.5
Idea 8	3.75	3.5	4.5	4.25	3.75	3.5
Idea 9	1.5	3	2.5	3.5	4.75	2.5
Idea 10	1.75	3.75	3.5	4	2.75	2.5
Idea 11	4	3.5	3.75	3.25	2.75	3.5
Idea 12	2.25	3.75	3	4.25	4.75	2.75
Idea 13	3.75	4.5	5	4.5	4.5	3

Table 4.1. Quantitative evaluation results

Idea 1. Make the travel plan after ticket purchasing.

Positive

- It is a good entrance to the product (from ticket purchasing).
- The user flow is quick and smooth.

Negative

- Can only change time choice instead of modality choice, unless recommending “public transport is better.”
- It’s hard to make sure that visitors will arrive exactly at the time they planned unless you give some restrictions or punishment measures.

Recommendation

- Add a strategy like “the earlier you come, the higher chance that you might reserve a parking space or the higher discount you can get for the parking fee.”
- The data should be dynamic. Give real-time reactions to the data. If too many visitors choose to come early, then the remaining need to come late.

Idea 2. Activities reservation and group formation.

Positive

- If the activity is good, then it can indeed attract some visitors.

Negative

- Each activity might only attract a small group of visitors.
- Depend on the activity type. Some activities, especially group activities, are hard to manage.

Recommendation

- Need to consider whether or not those fans who do not buy an event ticket but are interested in the activity are allowed to join.
- How to check if the self-initiated activity is good or not? If any risk happens, who should take responsibility?
- Maybe the venue should reserve places for visitors or other groups to hold activities

when constructing the area. Then groups and organizations can reserve a spot and initiate an activity.

Idea 3. Choose the travel plan according to different priorities.

Positive

- It’s convenient if you can solve everything regarding the event in one App.

Negative

- One participant said knowing the rank according to different priorities won’t change his modality choice.
- Google Maps already does a good job.
- “Comfort” is a subjective thing that can not be quantified.

Recommendation

- Consider privacy issues: visitors need to provide position information.
- Seems novice visitors will be more willing to use this function. Maybe filter and classify visitors in advance.

Idea 4. Parkour.

Positive

- It provides a chance for visitors to wander in the area.
- The OMC will know when people will come.

Negative

- It’s hard to organize a parkour activity, especially considering safety problems.
- Also depends on the weather.
- Add workload to the security team.

Recommendation

- Combine with idea 2.
- People might be willing to join such activities before the event. But after the event, they only want to have some snacks in the food bar to regain strength.
- Need to consider if visitors can join individually or need to form a group.

Idea 5. Match and meet similar fans.

Negative

- The data collected here is useless for changing visitors’ behavior.
- Social media apps like Instagram and Facebook can promote relevant strangers to you.
- Not everyone wants to socialize with others. The stranger-matching database might not be enough.
- Every time holding a new event needs a new set of matching questions.
- Hard to promise that the one you match is good by just answering a few questions.

Recommendation

- Combine with idea 2.
- It can be an additional function of a product, but not the core function.
- It also depends on the product’s positioning.

Idea 6. Landmark photo on social media.

Positive

- A good idea that can indeed attract visitors to come early or leave late, especially for those who are unfamiliar with the area.
- Put a landmark in front of the train station, maybe more people will take the train!

Negative

- Hard to predict when visitors will come.
- Might cause congestion in front of the landmark.
- It won’t take too long to take a photo, so time choice won’t change a lot.
- Post time might not be the real photo-taking time.
- Recommendation
- Ask data scientists about the technical details.
- Combine with other ideas.

Idea 7. Find QR Code, unlock accomplishments, and get a badge in the area.

Positive

- Easy and quick interaction.
- Can motivate visitors to come early and stay late, like a treasure-hunt game.

- You will know how many visitors scanned which QR Code at what time. A good way to collect data.

Recommendation

- Combine with idea 4.
- Change the QR code content according to different event types.
- Provide trivia knowledge about the event after scanning the QR code.
- Put some QR codes in the station. Visitors can only scan it if he/she takes public transport.
- Put it in less-congested spots.

Idea 8. Personification: Travel secretary.

Negative

- People might won’t come as they promised.

Recommendation

- The data should be dynamic. Give real-time reactions to the data. If too many visitors choose to come early then the remaining need to come late.
- Can be an additional concept of idea 1.
- Provide interface style choices according to event types.

Idea 9. Quick response.

Positive

- The function can improve public transport takers’ experience.

Negative

- Having this function won’t make visitors prefer to take public transport more.
- They will still worry about stability.
- This is NS’s issue. You can connect to their data, but not develop this function by yourself.
- Recommendation
- When the user chooses a travel plan, tell him/her the historical on-time rate.
- But it can only be an additional function instead of the main function.

Idea 10. Event live scene.

Positive

- The function itself is good.

Negative

- It won't change visitors' modality choices.
- The live broadcast company should provide this function, not you.

Recommendation

- Copyright issue.
- Is it only for those who buy the ticket or for anyone who wants to watch the live broadcast?
- It can be an additional function of the final product.

Idea 11. Mutual help group.

Positive

- Car sharing can help to improve traffic situations.
- Can also collect where visitors come from.

Negative

- Safety problem.
- Be an additional function.

Recommendation

- Cooperate with Uber or other car-sharing companies.
- Be a sub-function in the chat group.

- Consider how to make visitors keep their promise.

Idea 12. Make traffic a part of your event experience.

Positive

- It can collect emotion data for experience improvement.

Negative

- Its effect on changing mobility behavior is limited.

Recommendation

- Based on another App, be a part of the chat room (forum).

Idea 13. A detailed map of the area.

Positive

- Can indeed attract visitors to spend more time in the area.

Negative

- After the event is a more tricky period. If the event is in the evening then maybe a lot of spots have already closed.

Recommendation

- Add comments / scores / recommendations.
- Treat "before the event" and "after the event" differently.

4.4 Ideation Results

According to evaluation results, valuable initial ideas are selected, improvements were made according to participants' suggestions, and formed the structure of the concept, see figure 4.5.

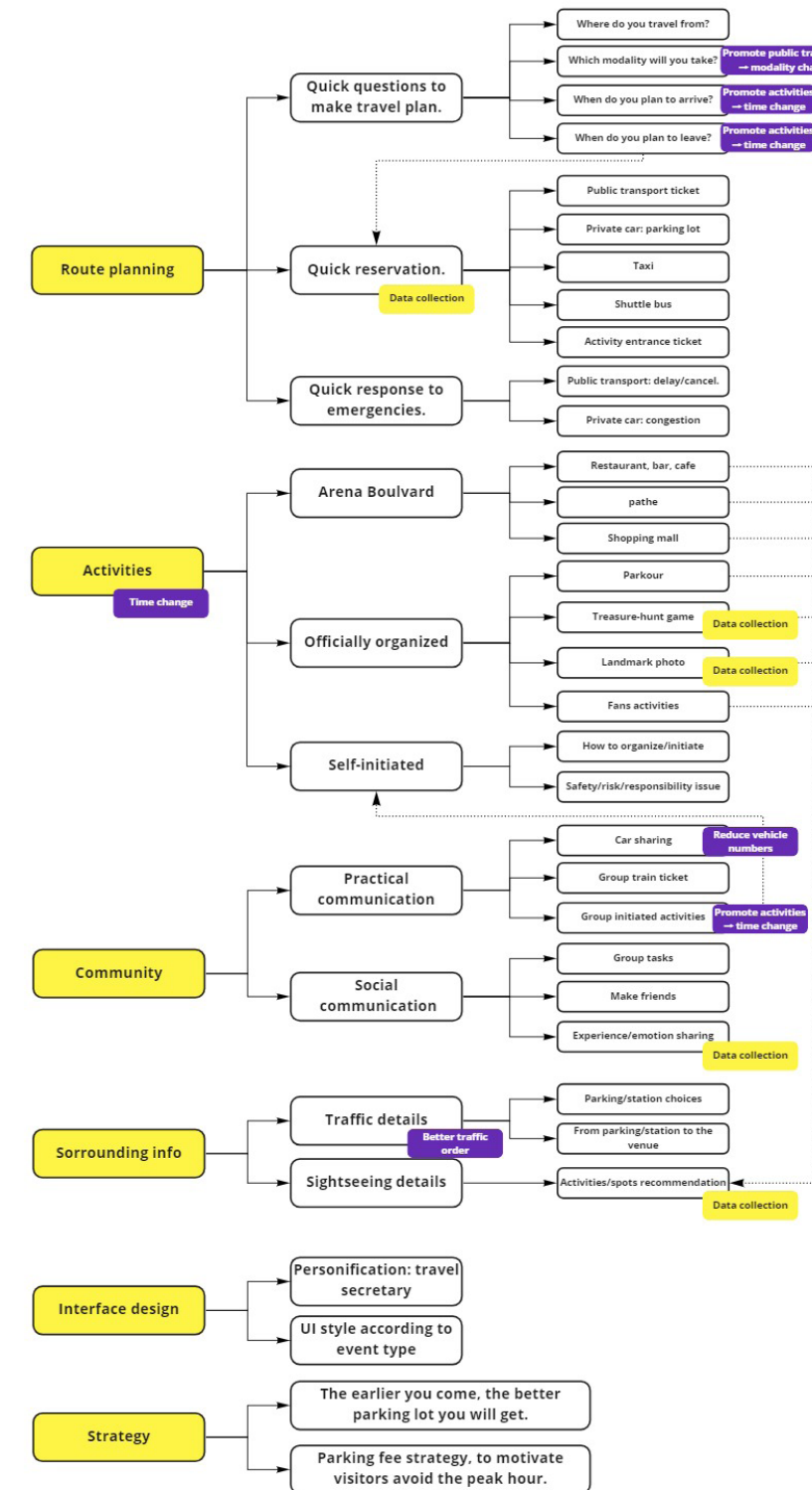


Figure 4.5. Ideation Results

Chapter 5

Conceptualization

This chapter introduces how initial ideas are integrated and developed to form the complete concept: an application aiming at changing event visitors' mobility behavior.



5.1 From Ideas to Concept

Design conceptualization is a process of generating ideas for an optimum solution to the design problem. At the start of the conceptualization, a combination of ideas is conducted. An explanation of doing combinations (instead of diving deeper in one specific direction) is needed, and a consideration of choosing the format of the product should be done.

5.1.1 Ideas Combination

By analyzing the results of the ideation phase, a decision of combining ideas was made due to the following reasons:

Although some ideas get good comments on effectiveness, none of them can be decisive in changing mobility behavior. Each idea can only have limited influence among limited groups. Thus, if going in one direction, the range and the effect of the design will be declined.

Elements that influence visitors' mobility choices are diverse and complex, and they are internally related. Figure 5.1 shows the complexity of

the elements that influence mobility behavior. For example, for making visitors change their travel time, the OMC should not only tell visitors that avoiding peak hours can benefit the traffic situation, but also give them benefits for their behavior. Besides, they also need to have something to do if they come early, thus providing activities for them to attend is necessary. A synthetic approach needs to be taken to solve the complexity behind it.

Thus, by doing a combination of all ideas, we can create a product that is relevant to not only the event relevant mobility but also the whole event experience for event visitors.

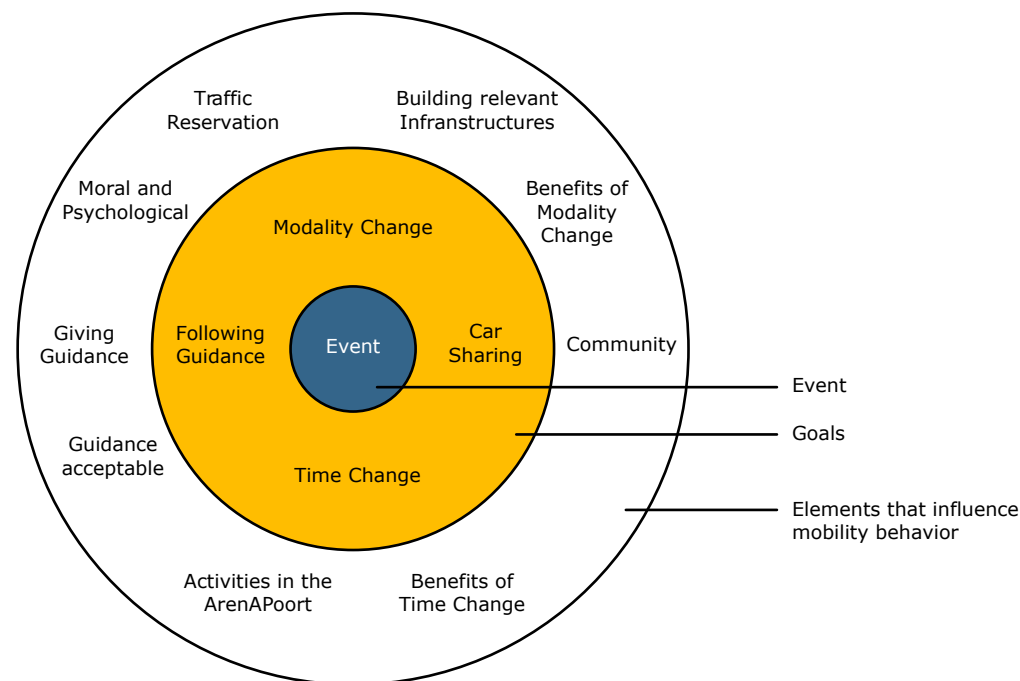


Figure 5.1. Elements influence mobility behavior

5.1.2 Application

When considering what the final product will be, there were three options for the author to choose from: an application, a web page, and a newsletter. The final decision is the application for its advantages in handling complexity, reusability, and interactivity.

Since the final product is a product with multiple functions, an application is more proper because it can carry multiple functions. In contrast, by using a webpage, users usually do not have the patience to explore all about it, not to mention a newsletter that can be easily ignored by users.

An application can make visitors use it multiple times. The interaction between the user and the product is not just a one-time thing, but can be at

any time and anywhere. The application can save the user's data so that he/she does not need to input again next time when an alternation is needed.

Besides, the application is excellent in interactivity. The newsletter is normally one-way from the sender to the user, while the application can learn visitors' behavior by studying their interactions. This can provide a new way of collecting data for the OMC.

However, how to get people to download the application can be a big problem. The most appropriate approach is promoting the application when the visitor finishes buying a ticket. Besides, by enhancing the product's irreplaceability, it can also attract more visitors.

5.2 Concept Developing

5.2.1. Structure

At the end of the previous chapter, initial ideas have already been categorized into six types: route planning, activities, community, surrounding info, interface design, and strategy. The last two are additional in product design, and the former four are about the practical functions that can be integrated into the product.

During the process of concept development, some detailed changes have been made when taking these four categories to four bottom-tabs

of the application. The "surrounding information" was divided into traffic-relevant information and activity-relevant information. In the new product structure, The former one is added in the bottom tab "Plan" and the later one is added in the bottom tab "Activities", while a new tab, "Me", is added to enable the user to see his/her event experience in the ArenAPoort. Figure 5.2 shows a reflection between the ideation summary and the bottom tabs in the iterated concept.

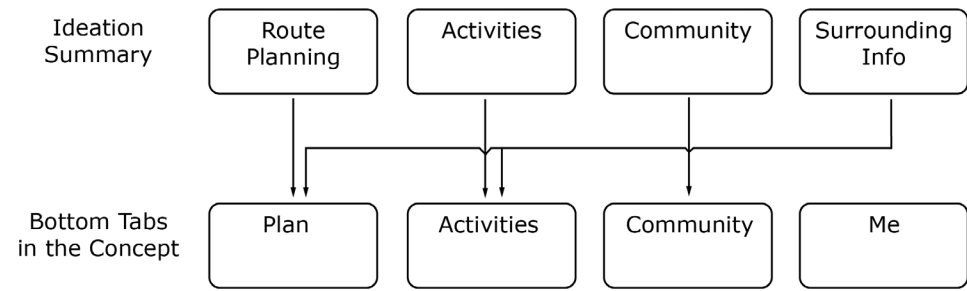


Figure 5.2. Reflection between ideation summary and bottom tabs in the integrated concept

5.2.2 Functions

Three bottom tabs in the concept embody three key functions of the product: route planning, activities, and the community.

Route Planning

After ticket purchasing, the visitor will be recommended to download this application. The most fundamental and practical function is route planning. The user needs to answer a few questions to make their travel plan. Questions include:

1. Where will you travel from?
2. Where will you go back? (default: the same as the departure place)
3. Which modality will you take?
4. When do you want to arrive?
5. When do you want to go back?
6. Which station/parking lot do you prefer?

After answering these questions, traveling options will be provided to visitors, and they can choose the best option according to their preference. After confirming the travel plan, visitors can make travel-relevant reservations. Public transport takers can reserve tickets and private car drivers can reserve parking lots. Finally, the user will get a traffic plan.

Activities

The second function is checking and joining activities. The user can check the activity list to see if there are any activities that he/she is interested in. If so, the user can check the details of the activity to decide if to join or not. He/She can add the activity to the calendar.

If the activity needs to be reserved, the user can also make a reservation through this application.

Community

Community is a set of chatting groups, where visitors of the same event can form groups and chat together. They can talk about practical things, e.g. car sharing, group forming, or do random chat and share their feelings about the event. Steps users need to take are as follows. First, they need to check the group list to find the group they would like to join, then they can see group details to decide if to join the group or not. After joining a group, users can join the group discussion, and check the group-initiated activities and decide to join or not.

The overall structure of the application is shown in figure 5.3. Three bottom tabs, plan, activity, community, leads to three main functions, and another bottom tab, "me", shows the user's event history and personal settings.

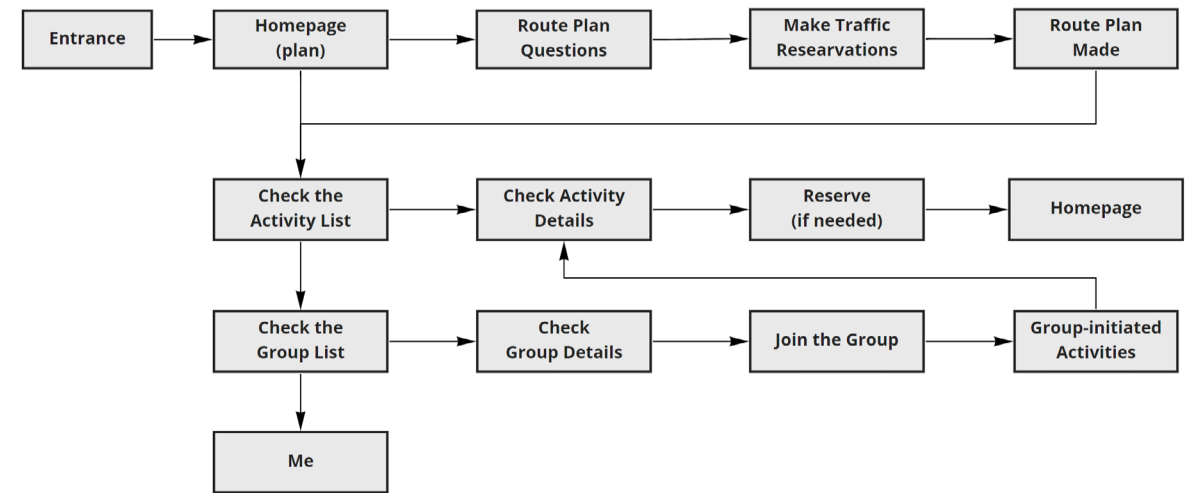


Figure 5.3. Structure

5.3 Low-fidelity Prototype

Based on the functions and the information structure introduced before, the low fidelity wireframes are sketched to show the layout and content of each screen, as well as the interaction operations between different pages.

Screen 0 (shown in figure 5.4) is the entrance of the application. After the visitor buys the ticket for an event, they will be recommended to download this application. On the first page, visitors need to choose the event they are going to join in.

If the application can read the ticket purchasing data, it will automatically choose the event.

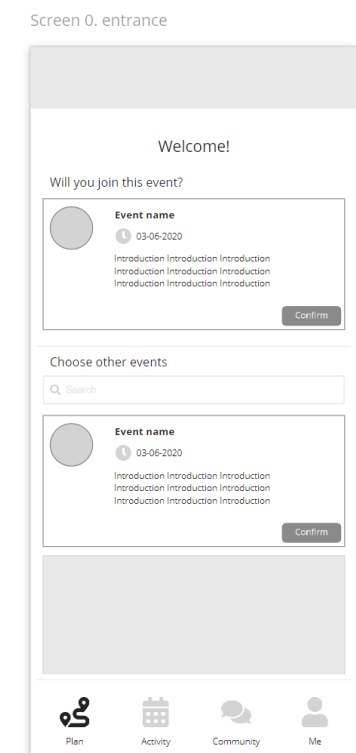


Figure 5.4. Screen 0

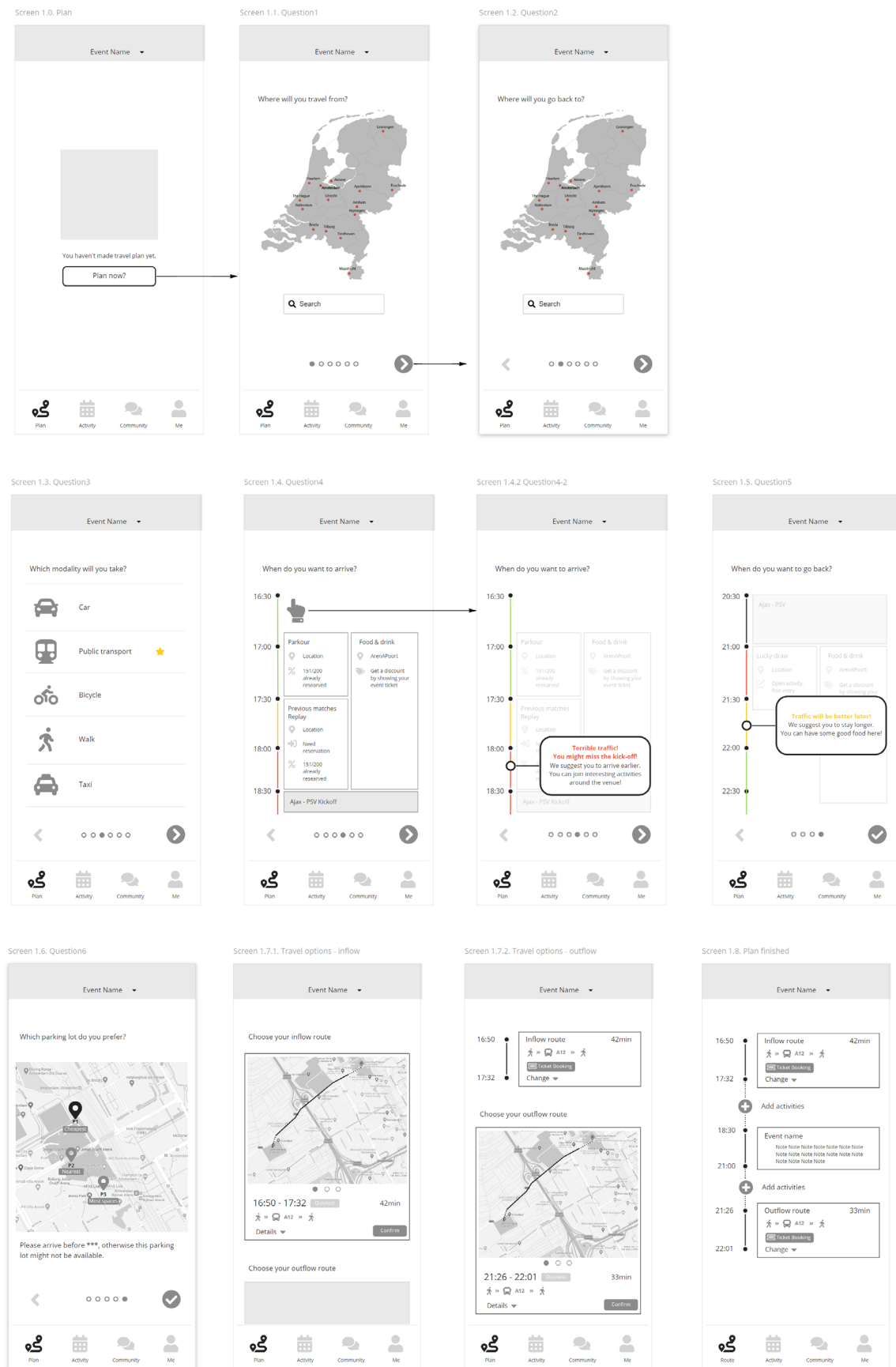


Figure 5.5. Screen 1.0 - Screen 1.8

Figure 5.5 shows the screens of the route planning process. Screen 1.0 - 1.6 are questions that the user needs to answer, while during this process the platform will give guidance to influence visitors' mobility choice to fulfill collective benefits. In screen 1.3, a star is given to the modality "public transport" to imply this modality is more recommended than others. In screen 1.4 and 1.5, different colours are used to represent the predicted traffic situation during each time. Besides, there will be a notification to prompt the traffic situation at that time period. Activities that visitors can join in are also shown on the screen to help visitors to make travel choices.

After answering questions, several traffic plans will be promoted to the user, see screen 1.7.1 and 1.7.2. The user can choose the preferred travel option, and it will be saved on the plan in the format of a timeline, as shown on screen 1.8. Users can change travel plans as they want, and can also arrange activities on the timeline.

Figure 5.6 shows the screens of activity participation. Activities are divided into three types, which are shown on the three sub-tabs: event-relevant, food & drinks, and ArenAPoort.

For the first type, event-relevant activities, an activity list will be shown, and users can choose to see details of the activity they are interested in. They can add the activity to the timeline, and make reservations if needed.

The second subtab, food & drinks, shows a list of restaurants, cafes, and bars for visitors to arrange a meal or snacks. The user can also make reservations of restaurants if needed.

The third subtab, ArenAPoort, provides users detailed information on the ArenAPoort.

Attraction spots are marked with brief introductions, so as to help visitors to do exploration in the area.

Figure 5.7 shows the "community" function of the concept. Users can check a list of groups with brief introductions, and they can also find specific groups by searching for keywords. The user can join a group, see group chat messages, and join in group-initiated activities.

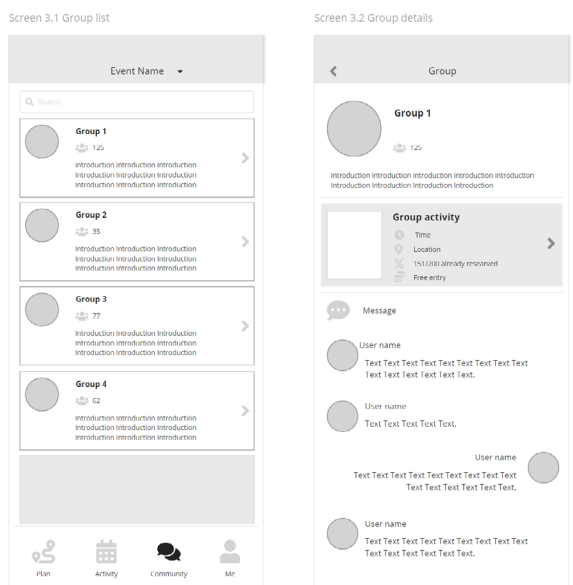
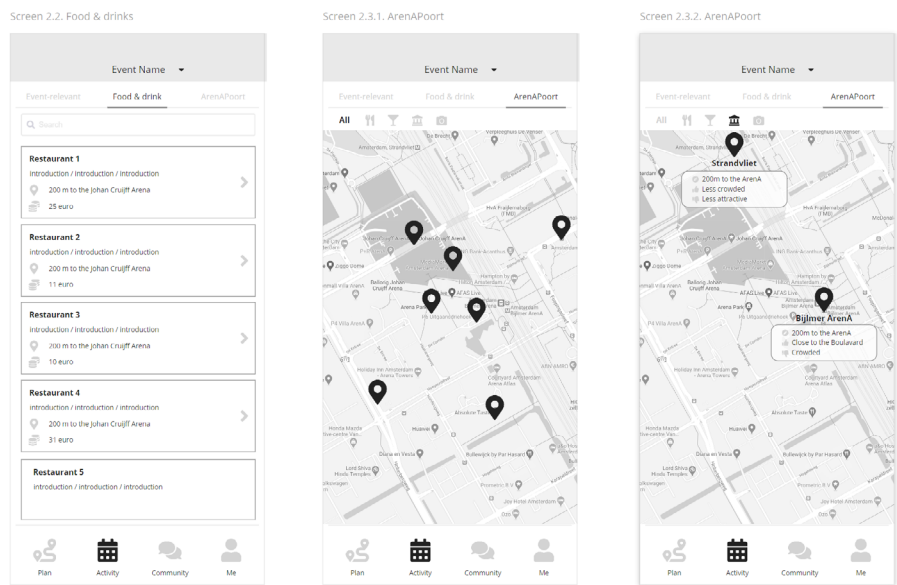
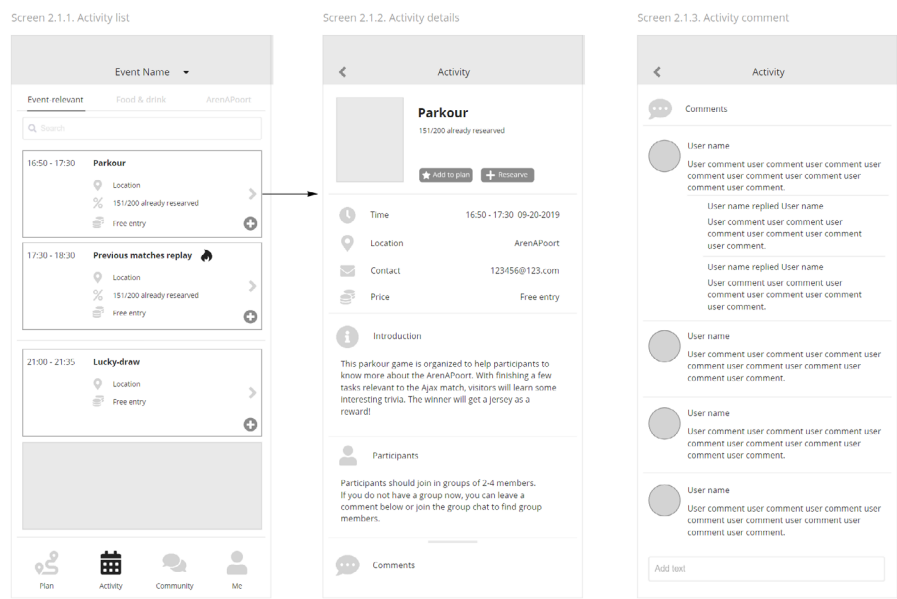


Figure 5.7. Screen 3.1 - Screen 3.2

Figure 5.6. Screen 2.1.1 - Screen 2.3.2

5.4 Evaluation

After finishing the wireframe design, an evaluation was done to see if the concept can reach the design goal. Therefore, the functionality of the concept is the main focus of this round evaluation.

The evaluation was done online by using the remote cooperation tool Miro and Google slides. The author, as the host and the manager in the test, briefly introduced the concept and then presented the main functions one by one. The participant gave a score to each function, and finally gave an overall score on his/her intention of using this application.

Participants

Four participants took part in this round of user tests, including three event visitors in the ArenAPoort with different backgrounds and a consultant from Johan Cruijff Arena, see Table 5.1.

Since different target groups are involved in different mobility changes, Test content for them is also different. Visitors who already took a more preferred modality do not need to answer questions about modality change. Table 5.2 shows the test content for each participant.

	Gender	Age	Event	Residence	Frequency	Companion	Modality	
P1	M	30	Ajax	Amsterdam	Every 2 weeks	Family	Bicycle	
P2	F	24	Concert	Delft	Once a year	Fellow students & Friends	Train	
P3	M	28	Ajax	Utrecht	About 5 times/year	About 5 times/year	Private Car	
P4	M	-	Consultant mobility & environment from Johan Cruijff Arena.					

Table 5.1. Evaluation Participants

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
P1		✓	✓	✓	✓	✓	✓
P2		✓	✓	✓	✓	✓	✓
P3	✓	✓	✓	✓	✓	✓	✓
P4	✓	✓	✓	✓	✓	✓	

Table 5.2. Test Content

Evaluation results

Participants were asked to give a score to each question on the scale from 1 to 5. A score 1 means extremely negative and a score 5 means extremely positive. Besides, they were asked to explain the reason for giving the score and share comments and suggestions to the concept.

Evaluation results are as follows, together with insights summarized from participants' comments.

Q1: (Screen 1.3) How likely will this page change your modality choice from private cars to public transport?



Insights:

1. The star on public transport does give users an intimation that public transport is more recommended than other modalities, but it is not persuasive enough to make visitors who have already decided to take a private car turn to choose public transport.
2. In order to make it more persuasive, the advantages of public transport should be listed. Participant 4 suggested that if the platform emphasized the advantages of public transport, e.g. price, speed, or sustainability, then visitors might have a higher possibility to change mobility choices.
3. Changing the sequence of options might also help to promote public transport. Putting the option "public transport" on the top and putting the option "private car" on the bottom might make more visitors choose public transport instead of private cars.

Q2: (Screen 1.4 - 1.5) How likely will this page change your arriving and leaving time?

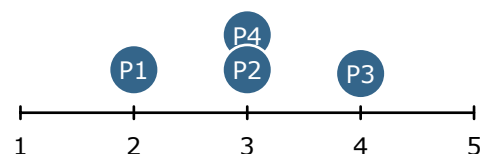


Insights:

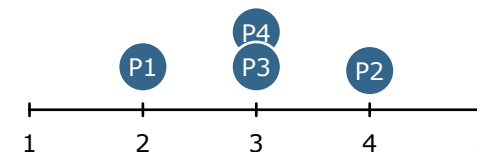
1. This function is useful in influencing visitors' time choices, especially for visitors who are not familiar with the ArenAPoort. Participant 2 said: *"I hate overcrowding on the train, so if I know when I can avoid crowds, I will definitely choose that time slot."*
2. The more familiar with the ArenAPoort, the less useful this function will be. As participant 1 mentioned: *"I go to the Arena a lot, and I know even if during the time slot when the notification is red, the traffic situation will still be acceptable to me. So I won't change my travel time."* Visitors who are familiar with the ArenAPoort prefer to listen to their experience instead of the guidance from the application.
3. The activity list can also help to make visitors stay longer before and after the event. More than one visitor mentioned that if he/she knows these activities upon scheduling travel time, the possibility of learning more about activities and participating in them will be high.

Question 3 to question 5 are about the possibility of joining games. Insights of these three questions are quite relevant, thus they will be introduced together.

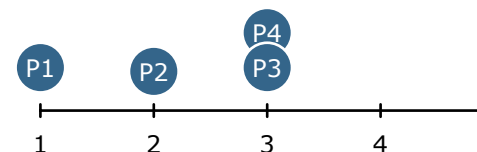
Q3: (Screen 2.1.1 - 2.1.3) How likely will you join the treasure-hunt game?



Q4: (Screen 2.1.1 - 2.1.3) How likely will you join the Parkour game?



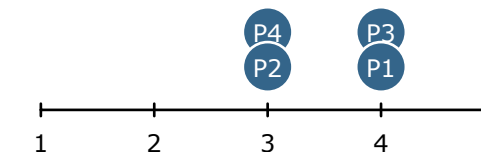
Q5: (Screen 2.1.1 - 2.1.3) How likely will you join the landmark photo-taking activities?



Insights:

1. Some typical visitor types are more interested in taking part in activities than others. These features include but are not limited to: young, coming with friends instead of families, unfamiliar with the ArenAPoort. Participant 1, who comes a lot to the Arena with families, shows a lower interest in activity participation than others.
2. Activity participation might be a one-time thing. Especially for landmark photo taking, visitors will probably only participate in their first-time visiting. For the treasure-hunt game and the parkour game, which encourages visitors to explore the ArenAPoort, visitors will also probably only take once to fulfill curiosity on the ArenAPoort.
3. Surrounding conditions can be an important consideration while designing activities. Participant 1 mentioned that some spots in the ArenAPoort are not charming for visitors, and on some time periods it can even be dangerous for visitors.

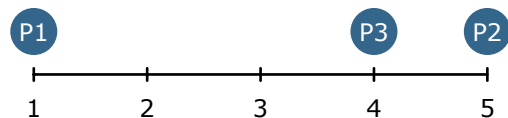
Q6: (Screen 2.1.1 - 2.1.3) How likely will you join chat groups?



Insights:

1. Irregular event visitors are more likely to join the chatting group. Participant 1 pointed out that regular event visitors like Ajax fans already have a habitual platform to share their event-relevant feelings, so they will not prefer to use this one.
2. Practical information in the community might be more popular than random chat. Both participant 2 and participant 3 indicated that they are more interested in practical information like car sharing and event-relevant information sharing.
3. Privacy can be a concern. The platform needs to make it clear who will have the access to see the chatting group information to avoid privacy disputes. Besides, if the platform would like to make use of the chatting group data, users should be informed in advance and give concern on data usage.
4. Competitive products are dominated. As participant 4 mentioned, there are already some social platforms with a huge user base, like Facebook, on which visitors can easily share their information. How to motivate visitors to use the chatting function on this product instead of other social platforms can be a big concern.

Q7: How likely will you use this application to plan your event experience?



Insights:

1. The interest in using this application in different user groups vary a lot. Participant 1 shows an indifferent interest in the application because both route planning and activity participation are not attractive to him since

he is clear about the route and travelling with families reduces his desire for activity participation. On the contrary, participant 2 finds this application quite useful for her because she needs traffic information and has the enthusiasm for activity participation.

2. The integration of ArenAPoort surrounding information is useful. Both participant 2 and participant 3 mentioned that knowing about what activities they can join in and which spots are worth exploring do help to enrich their event experience.

5.5 Conclusion and Optimization

Summarized from evaluation results and participants' suggestions, some conclusions of the conceptualization phase are drawn, which will guide the iteration and form the final design.

The concept is good, while design details need to be optimized.

Evaluation results reveal that the concept is useful in mobility behavior change. Participants also give some suggestions about details optimization. For example, on the page of choosing modality, the advantages of public transport should be emphasized, and changing the order of options can also help. On the travel time plan page, details also need to be polished, for example considering what content and text in the notification can be more effective in changing visitors' time choices.

Temporarily put aside studying the type of activities. Consider how to provide a platform between stakeholders and visitors instead.

Three types of activities proposed in the evaluation, the treasure-hunt game, the Parkour game, and the landmark photo-taking can be useful in changing mobility behavior among some visitor groups. The suggestion from the client is that put aside the study on which kind of activities can attract more visitors, but focus more on how to design a platform for stakeholders to organize activities and for visitors to be informed about these activities. Building a bridge between stakeholders and visitors is more fundamental at this stage.

Chapter 6

Final Design

The final design will be introduced in this chapter. First, a brief introduction of the product will be given, together with its position in the development strategy of the area. After that, a detailed introduction on designs of each page will be given.



6.1 Introduction

In the previous chapter, the conceptualization process and results are introduced. Accordingly, another round of iteration was conducted, and a more concrete concept was formed, that is the final design.

6.1.1 the Application ArenAPoort

The final design is an application named ArenAPoort with the target user group of event visitors in this area. It enables users to plan their trips to and from the ArenAPoort, learn about and join in activities, share event relevant information, and record their trip experience. During this process, travel mode for best collective benefits will be promoted, aiming to make visitors take a more altruistic mobility behavior.

For visitors

Visitors come to the ArenAPoort to enjoy the event. They want to make the process of making travel plans as easy as possible. This application enables visitors to make travel plans by answering six questions, which simplifies the steps and process. Traffic-relevant reservations can also be made by using this product.

Besides, visitors also would like to enrich their event experience. By using this application, visitors can find event-relevant activities, take food and drinks, explore the area, or join event-relevant discussions.

For the OMC

Four aspects of mobility behavior change expected by the OMC (the modality change, the time change, following the guidance and vehicle sharing) are all included in the final design.

In the final design, when choosing the travel modality, some design strategies are used to motivate users to choose public transport instead of private cars. When choosing the arriving and

leaving time, a notification is given to visitors to inform them about the potential congestion/crowds, together with an activity list showing what visitors can do if they come early and leave late. About following guidance, parking lots or stations that suits the visitor best will be recommended together with tags to show the advantages and disadvantages. Car sharing information can be found in the Chat part in the application.

Data Usage

The application uses data from previous events. As mentioned in the research phase, the OMC is now working on analyzing mobility data of previous events, to have better predictions on future event mobility. This knowledge gained from data analysis will also be provided to visitors in this application by giving notification when the user is making a travel plan, aiming at reminding them to change arriving and leaving time to avoid peak hours.

Besides, the product can also help with data collection. A conclusion gained on the research phase is that the event mobility situation is hard to predict because it is influenced by too many factors, especially for irregular events that have never been hosted in the ArenAPoort before. Therefore, if the OMC can collect mobility data in advance for the coming event, the prediction will be more accurate. This application asks visitors six questions about making the travel plan, which can be data resources for the OMC.

6.1.2 Product Positioning

Some parts of the application is consistent with the mobility solution that the ArenAPoort is working on currently, for example providing traffic recommendations and online reservations. But this product has a bigger ambition. By synthesizing the route planning, activity participation and chatting, the application aims at creating a one-stop event experience for visitors. Visitors can find everything about the event from this application.

There is an even bigger strategy behind this product. It is not only about event mobility management, but also about the development of the ArenAPoort area. An instance is that by promoting activities before or after the event, more visitors will stay longer in the area, and it can bring more consumptions to the area, which can help the regional development.

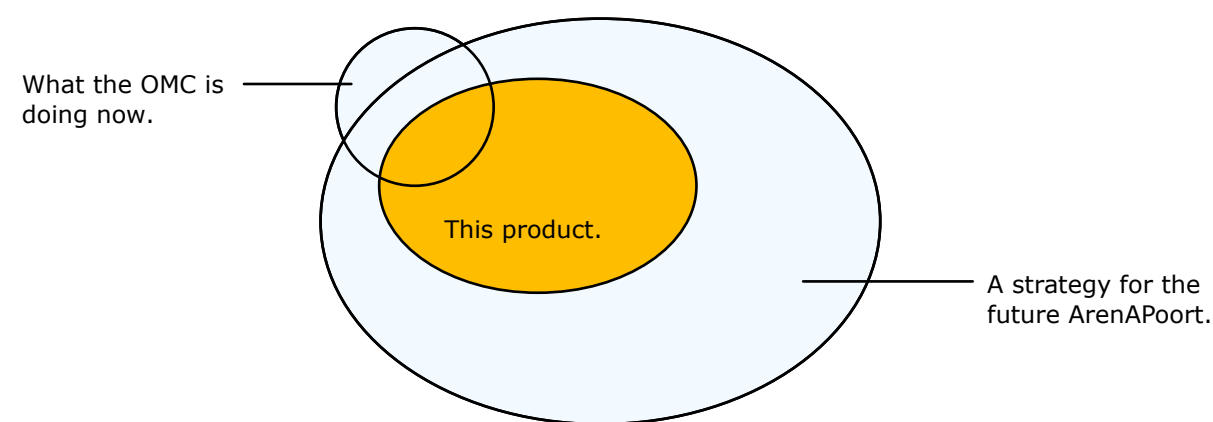


Figure 6.1. Product positioning

6.2 User Flow

There are three main functions of the application: plan, activities, and chat. Based on the main functions and considering the using habits of users, the product structure and the user flow are defined, see figure 6.1.

By using the “plan” function, users can make travel plans and reservations to and from the event venue. By using the “activities” function, users can check the activity list and plan their time in the ArenAPoort area before and after the event. By using the “chat” function, visitors can talk about everything relevant to the event.

The core page of the application is a plan on the format of a timeline, listing all actions that the user will take regarding the event, including the inflow and outflow route, activities the user is going to join in, and the event itself. It is a summary of the visitors’ event experience from the start to the end.

The user can use this application in advance for planning. On the event day, the application will be used as a guide on the event experience. It will work as a calendar to check plans and details, and also as a certificate for reservation and entry.

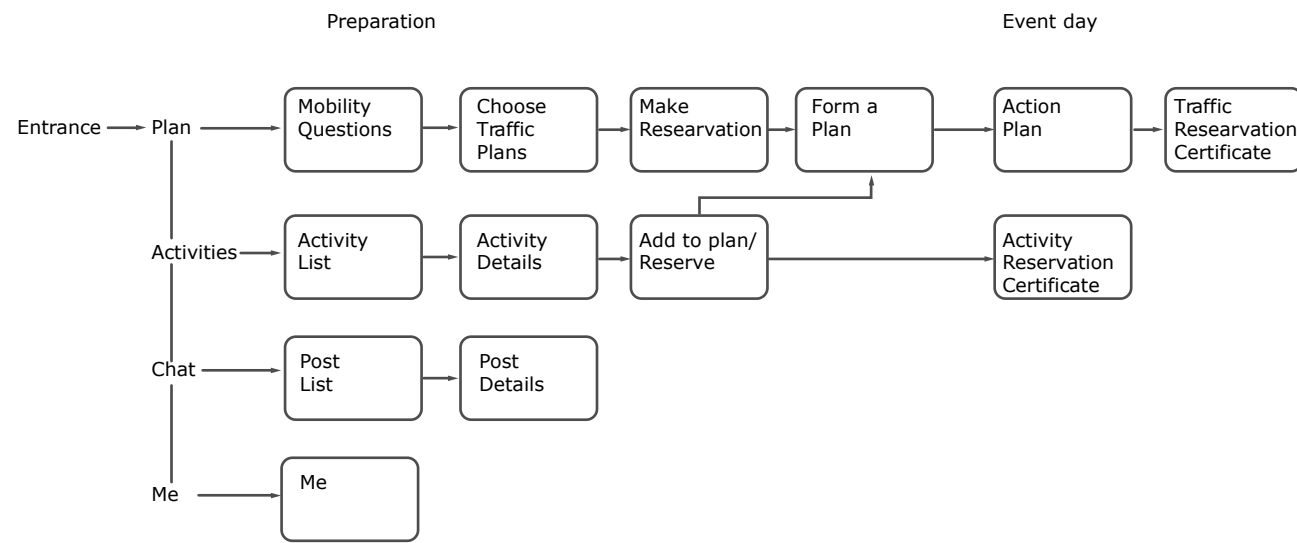


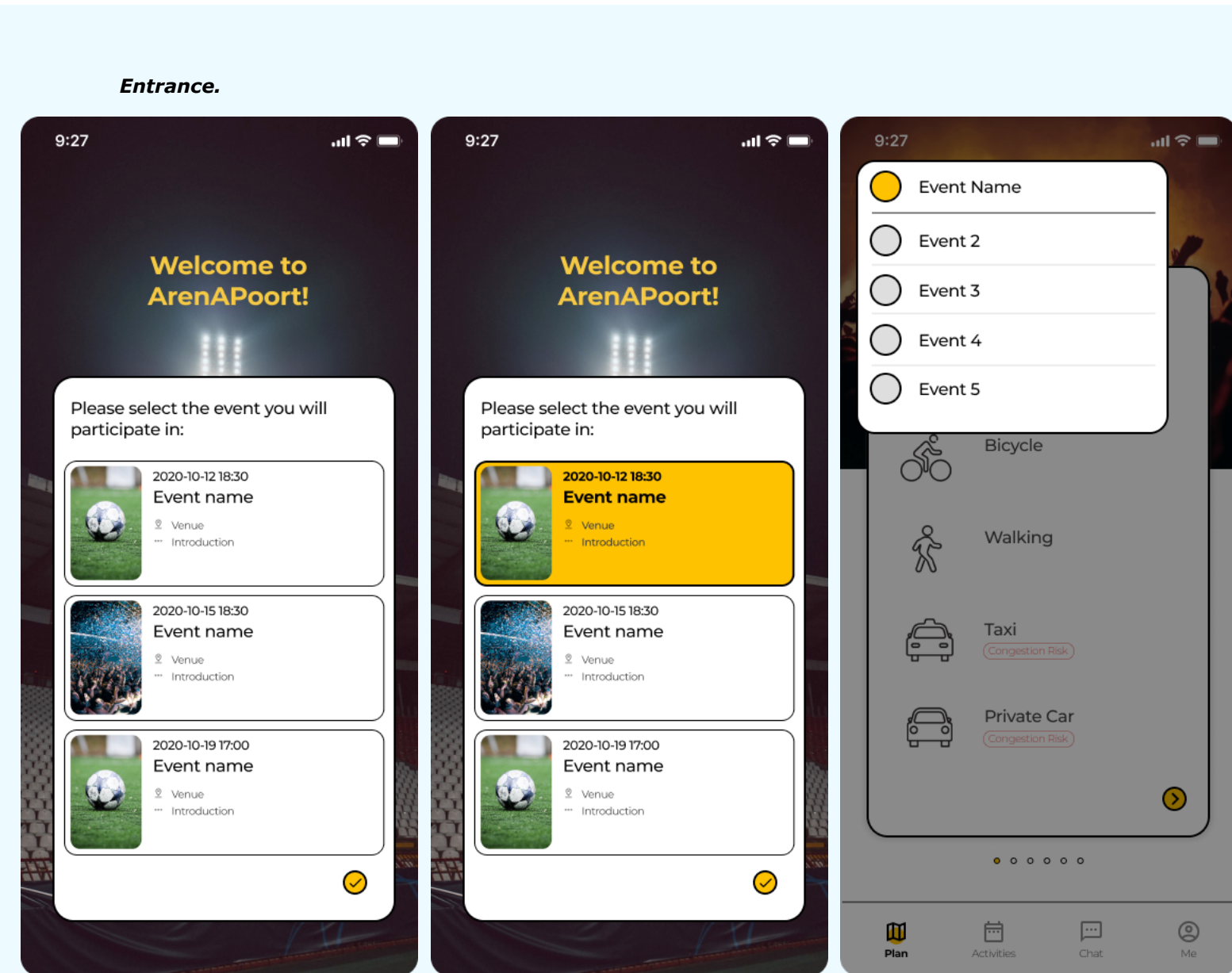
Figure 6.2. User flow

6.3 The Designs

6.3.1 Entrance

After ticket purchasing, visitors will be recommended to download this application. The first using step is to choose the event the user is going to join. If the application is authorized to read the ticket-sellers' data, then this choice will be automatically made and this step will be skipped.

After choosing the event, the operation of changing the choice remains possible. The user can use the drop-down list to choose other events. This is designed for the situation when the user makes a mistake of choosing, or the user has more than one planned event at the ArenAPoort, or other potential conditions that need to switch between events.



6.3.2 Plan

“Plan” is the most fundamental function of the application. It includes two parts: traffic planning and activity planning.

The traffic plan is the first task that the user will be guided to do upon starting to use the application, for that only by defining the arrival and leaving time, other activities in the ArenAPoort can be planned. Users only need to answer six questions that are unavoidable in making a travel plan:

1. How will you travel to the event?
2. Where will you travel from before the event?
3. When do you plan to arrive?
4. Where will you go back to after the event?
5. When do you plan to leave?
6. Which parking lot/station do you prefer? (according to modality choice in Question 1)

Six dots are shown under the question board to show the progress so that the user will be clear on how many steps they still need to go through to finish the traffic plan. This design will avoid the abandonment of using because of unclarity on the progress.

Question 1. How will you travel to the event?

Modality is the first question that the user needs to answer because it is the most fundamental one. The five most frequently chosen modalities are provided as options of this question: public transport, bicycle, walking, taxi, private car.

Basically, modality options preferred by the OMC are listed higher as research suggests that the order of options can influence choices. Researches reveal the benefits to being first or early in a sequence because people tend to choose the first option provided to them. (Coney, 1977) Thus, options “public transport”, “walking” and “bicycle” are listed high, while “taxi” and “private car” are on the bottom of the list.

The frequency of choosing also influences the order of options. “Bicycle” and “walking” are the most preferred modality, but these two modalities are highly limited by factors like distance and weather, thus the proportion of visitors who take these modalities is relatively low. “Public transport” is a modality that is acceptable to the municipality while having a wide range of use, thus it is on the top of the options list.

Tags are given on each modality to give a brief introduction and suggest its advantage and disadvantage, differentiated by different colors. The color green means advantages and the color red means disadvantages. For “public transport”, its advantages, price and sustainability, are emphasized, while for “taxi” and “private car”, the disadvantage of “congestion risk” is shown. This helps imply visitors to choose public transport instead of a private car.

Question 2. Where will you travel from before the event?

Users need to input their starting point of the inflow journey. They can search by inputting the name or the postcode of the spot. Cooperating with the third party stakeholder like Google Maps and using their API will be a good choice to realize this function.

Question 3. When do you plan to arrive?

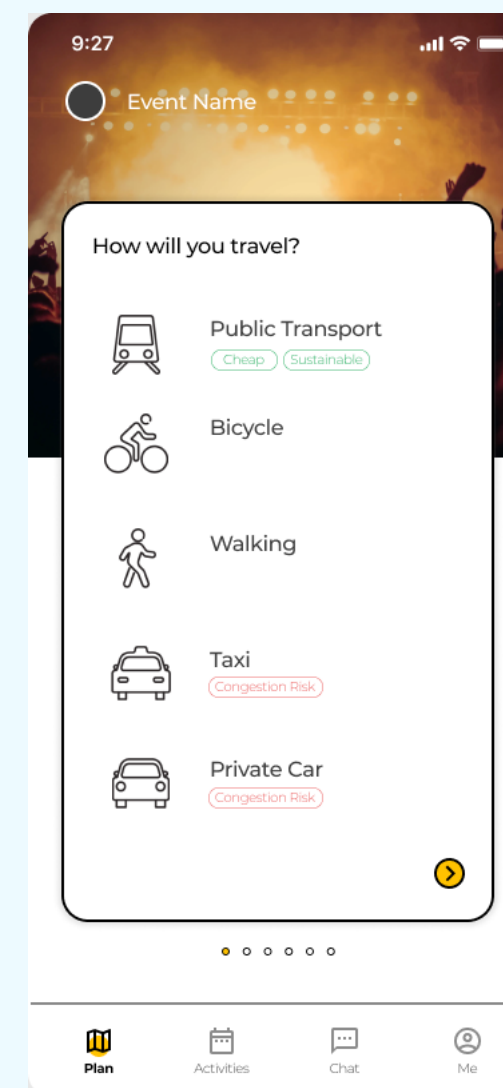
On this page, users need to drag the dot on the timeline to choose the arrival time.

Activities are shown on the timeline in the format of cards, together with an introduction to each activity. Showing the activity list aims at making visitors know the existence of abundance activities upon making the travel plan, to motivate them to arrive early and join activities.

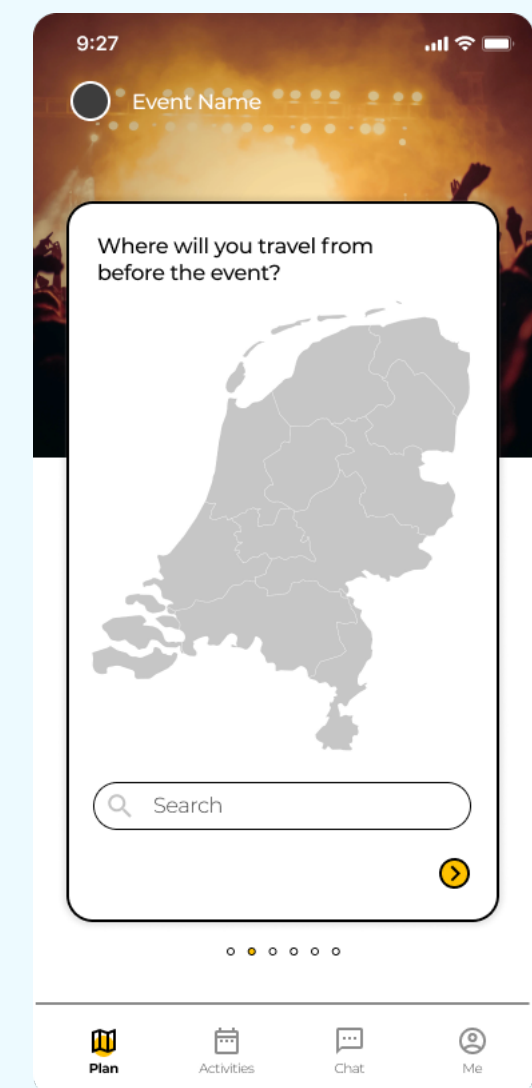
From previous event data, the OMC will make predictions about when the traffic situation around the ArenAPoort will be heavy. If the visitors are notified of this traffic information, some of them might change their time plan to avoid the peak hour. Thus, when the user drags the dot down to choose the arrival time, a notification will emerge, and the color of the dot changes correspondingly. If the arrival time is too close to the event kick-off, and according to previous data, the traffic situation will be terrible at that time, then the dot will be red, and the notification will strongly suggest the user arrive

earlier. If the traffic situation is a bit heavy, the dot will become orange, and the notification will mildly suggest the user arrive earlier. If the user chooses a time that the traffic situation is good, according to previous data, then the dot will be green, and the notification will recognize and praise the user’s behavior.

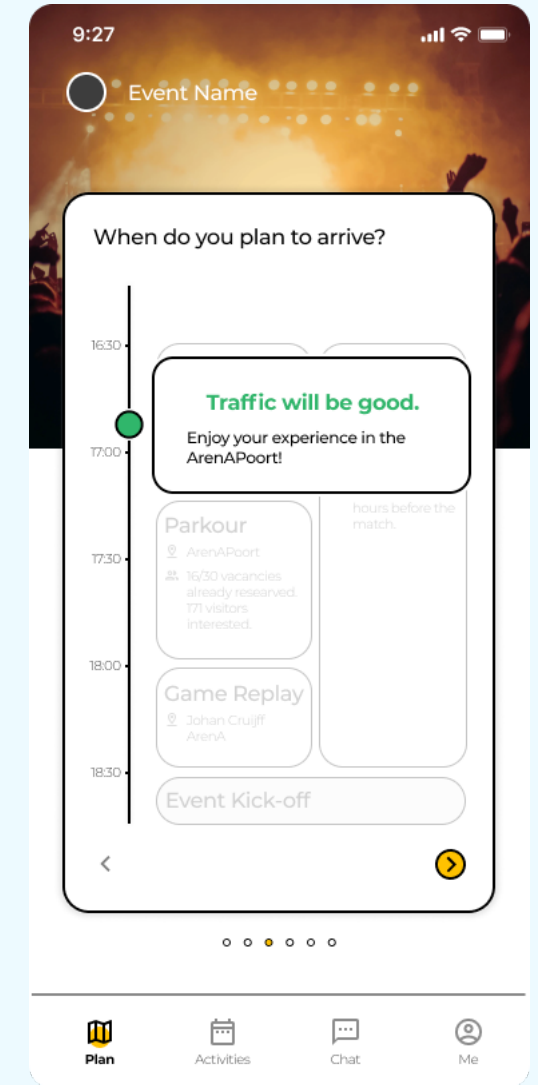
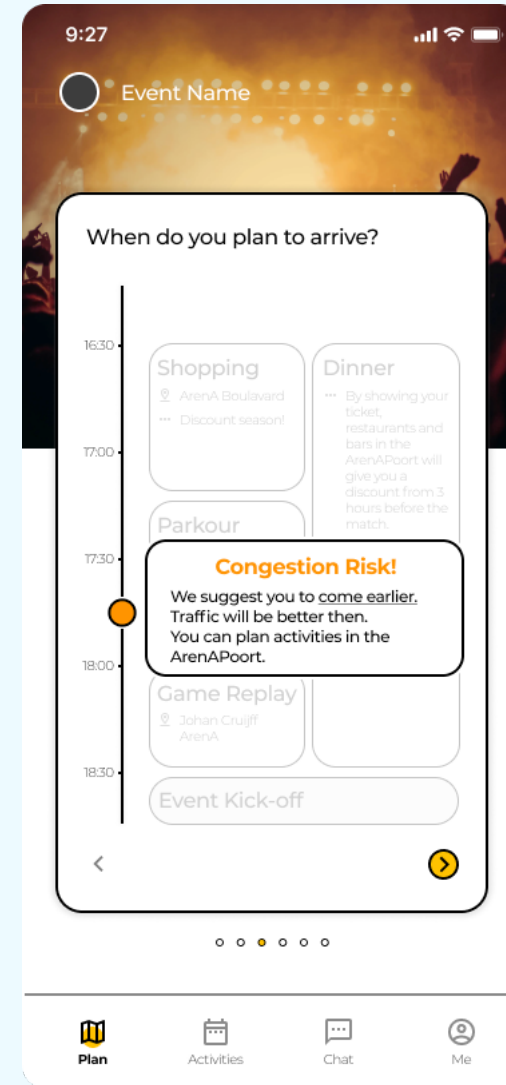
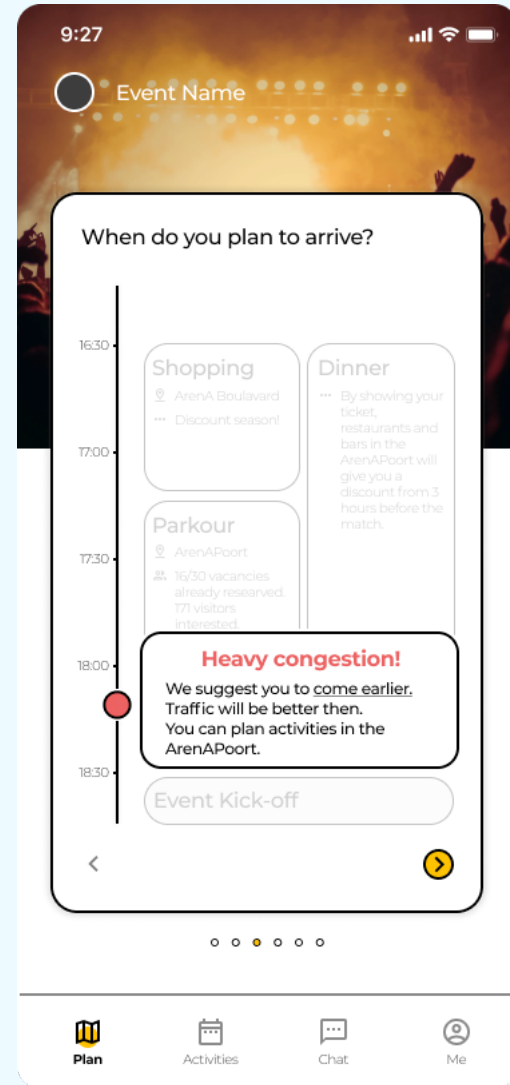
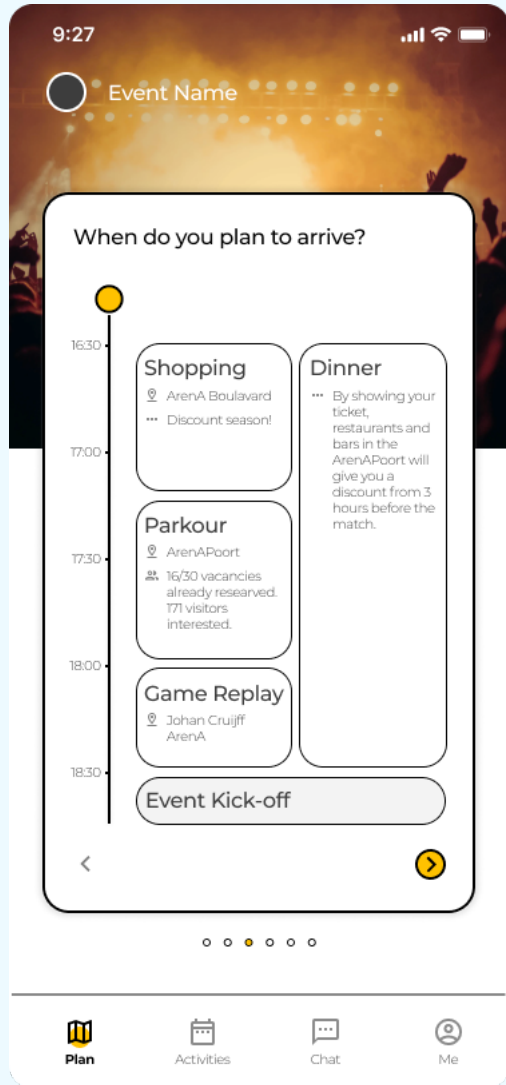
Question 1.



Question 2.



Question 3. (Private Car)



Question 3. (Public Transport)

Overcrowded!
We suggest you to **come earlier** to avoid the crowd. You can plan activities in the ArenAPoort.

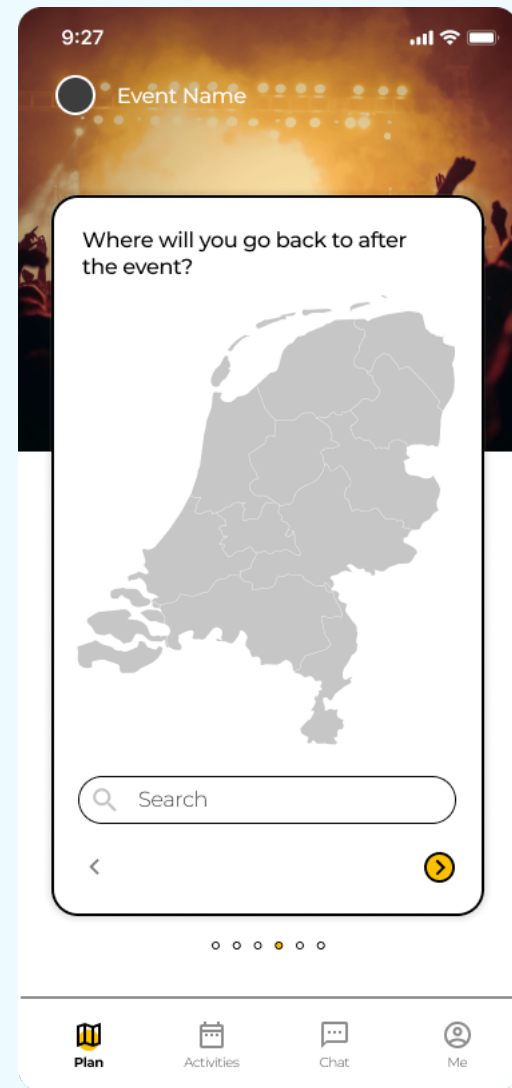
Crowd on board!
We suggest you to **come earlier** to avoid the crowd. You can plan activities in the ArenAPoort.

Traffic will be good.
Enjoy your experience in the ArenAPoort!

Question 4. Where will you go back to after the event?

This question is similar to Question 2 but at the outflow. There will be a default status that shows the same location as the user input in Question 2, so if the user comes from and goes back to the same place, he/she does not need to input the spot again. But if the outflow destination is different from the inflow starting point, the user can also input it manually.

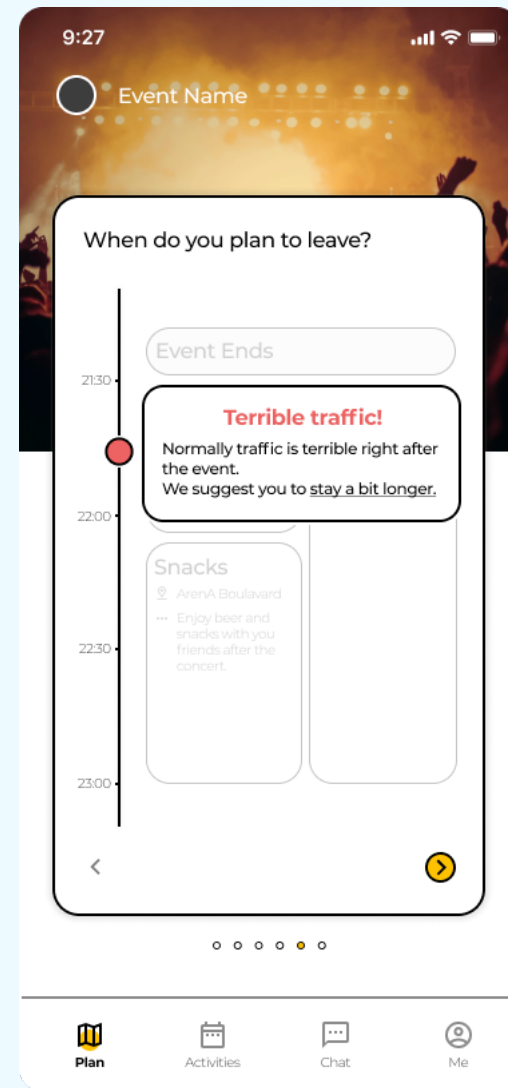
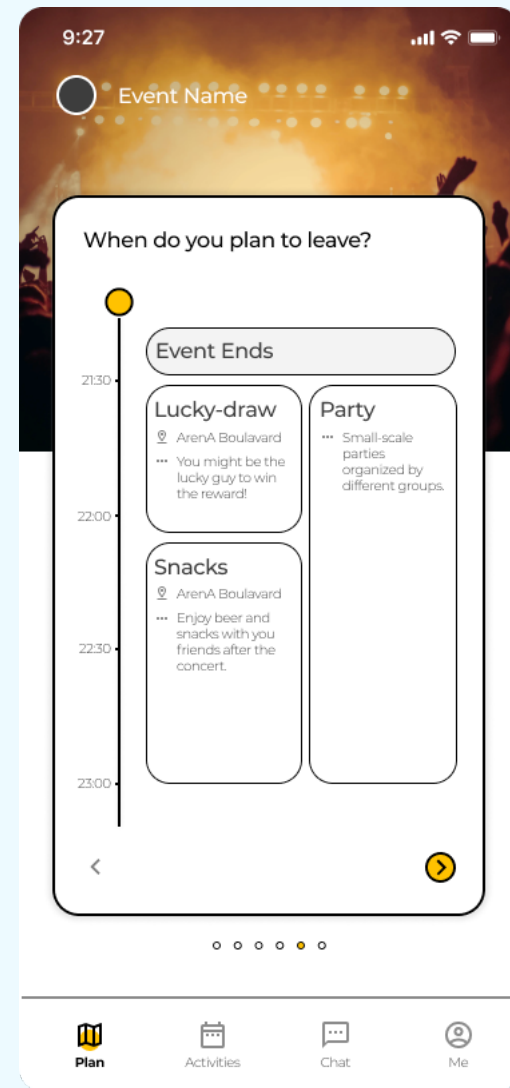
Question 4.



Question 5. When do you plan to leave?

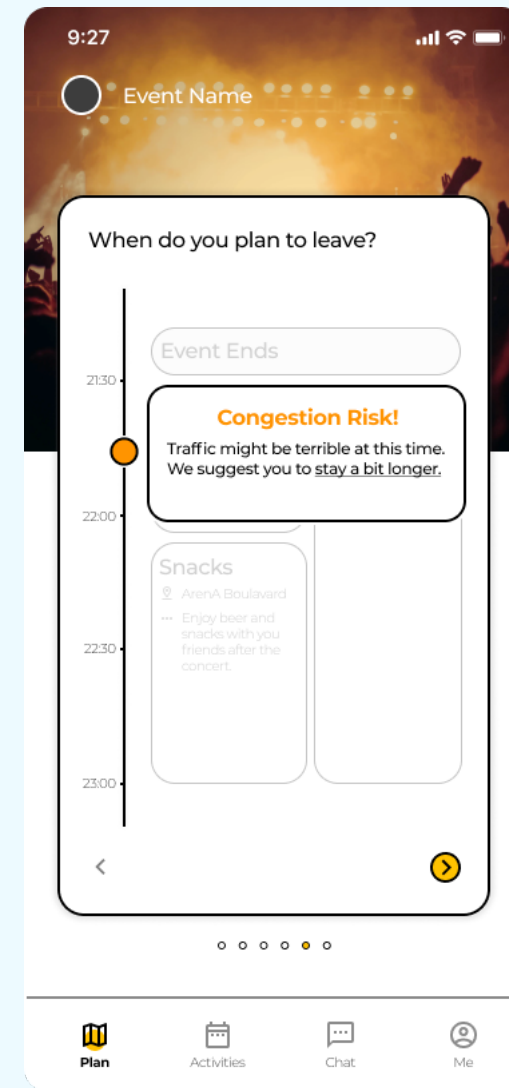
This page is similar to the page of Question 3, while the text of the notification shows some difference.

Question 5. (Private Car)

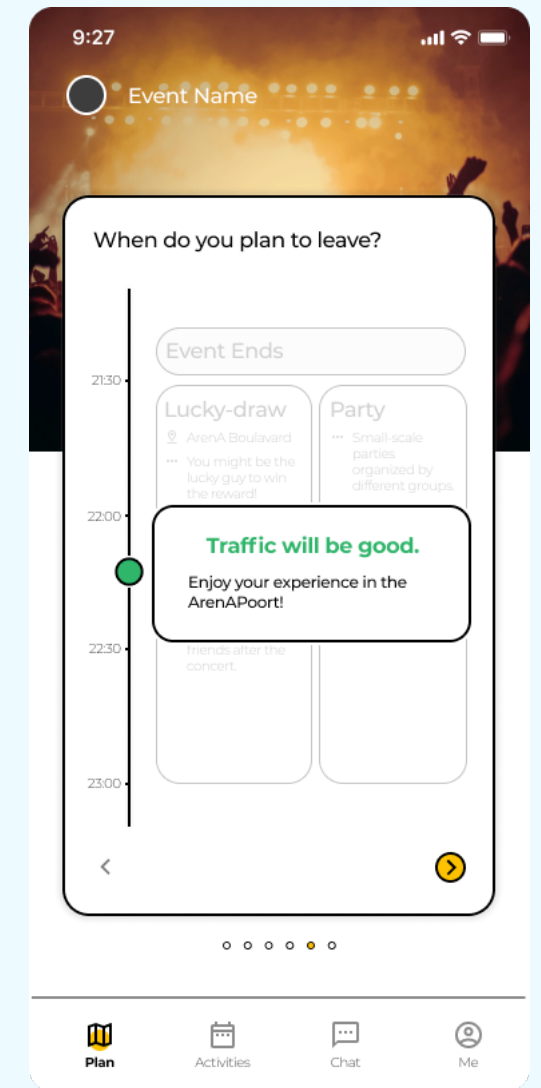


Question 5. (Public Transport)

Crowded on board!
Normally it is very crowded onboard right after the event. We suggest you to stay a bit longer.



Crowded Risk.
It might be crowded onboard at this time. We suggest you to stay a bit longer.



Traffic will be good.
Enjoy your experience in the ArenAPoort!

Question 6. Which parking lot/ station do you prefer?

For private car drivers/takers, the last question is about the parking lot choice. Several options will be recommended to the user, based on his/her inflow starting point and outflow destination. For example, visitors from the north side of the ArenAPoort will be recommended parking lots on the north side to avoid car flow intersections around the area. Once the user chooses a parking lot, more details of the chosen one will be shown, together with the notification reminding the user to arrive on time.

For public transport takers, the last question is about the station choice. As mentioned before, there are three train/metro stations and several bus stations in the ArenAPoort area. The OMC wants visitors to use less-crowded stations (e.g. Strandvliet) than more crowded stations (e.g. Bijlmer Arena). Thus, tags in different colors are added to show the advantages and disadvantages of each station, to help visitors make the travel decision.

Plan

After choosing the inflow and outflow route, the plan page will show up in the format of a timeline with actions that the user is going to take on the event day, including the inflow and outflow travel plan and the event. There will be a "plus" button with the text "Add plans" in between, for the user to add activities in the plan.

Each behavior will be shown as a card with briefly key information. If the user would like to check

details or make adjustments on the travel plan, he/she only needs to tap on the regarding card to make changes.

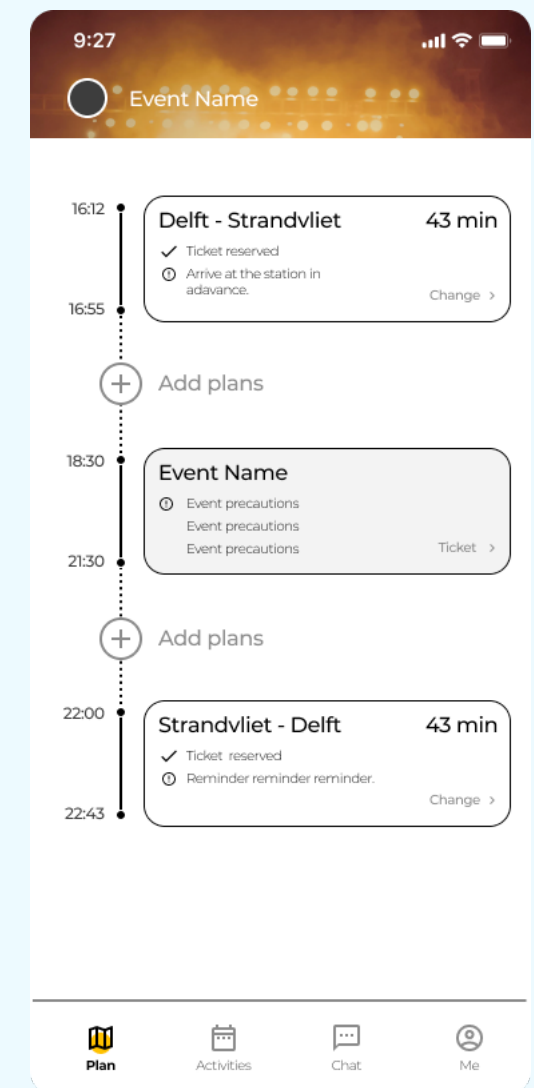
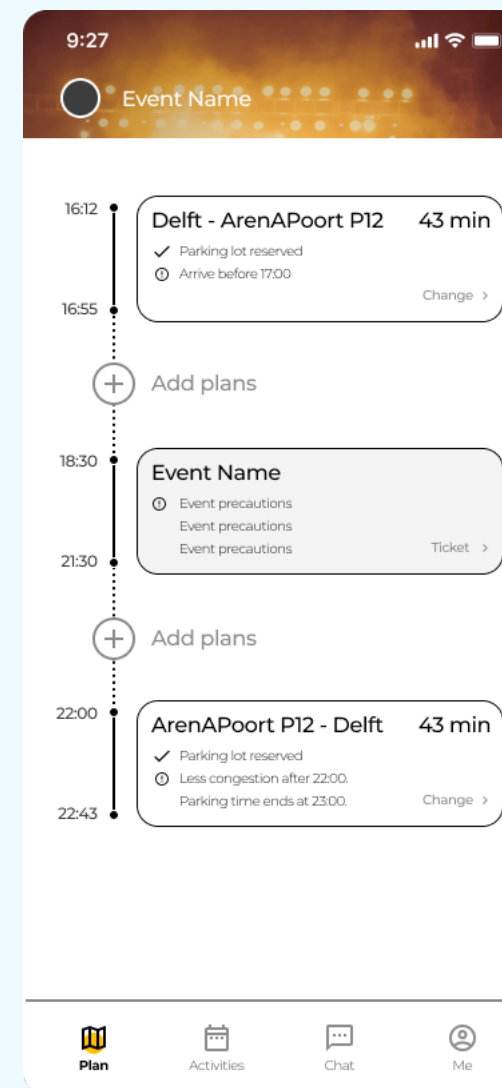
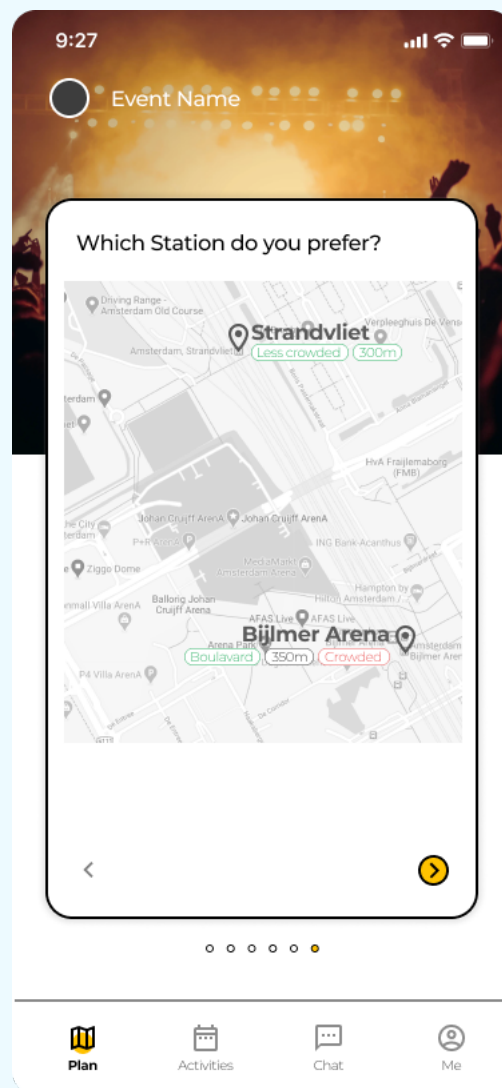
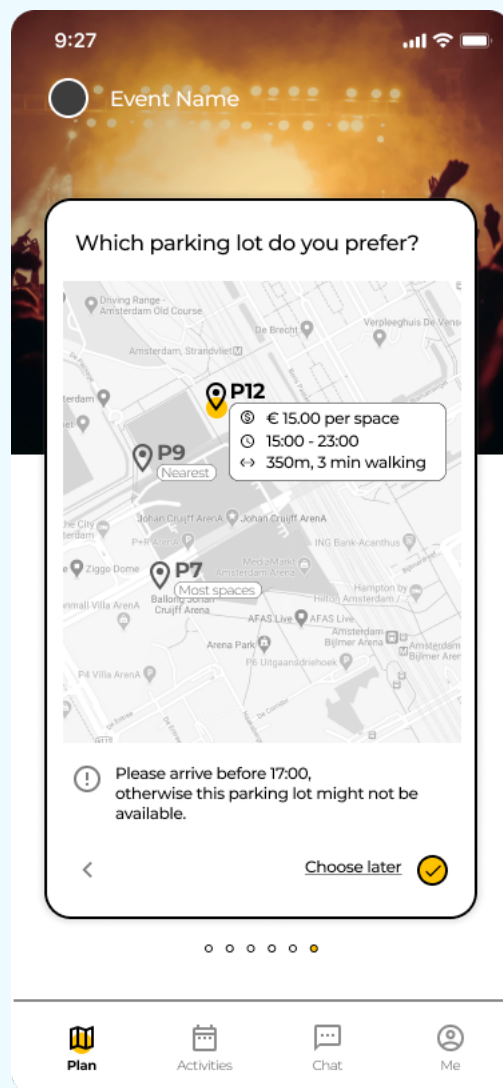
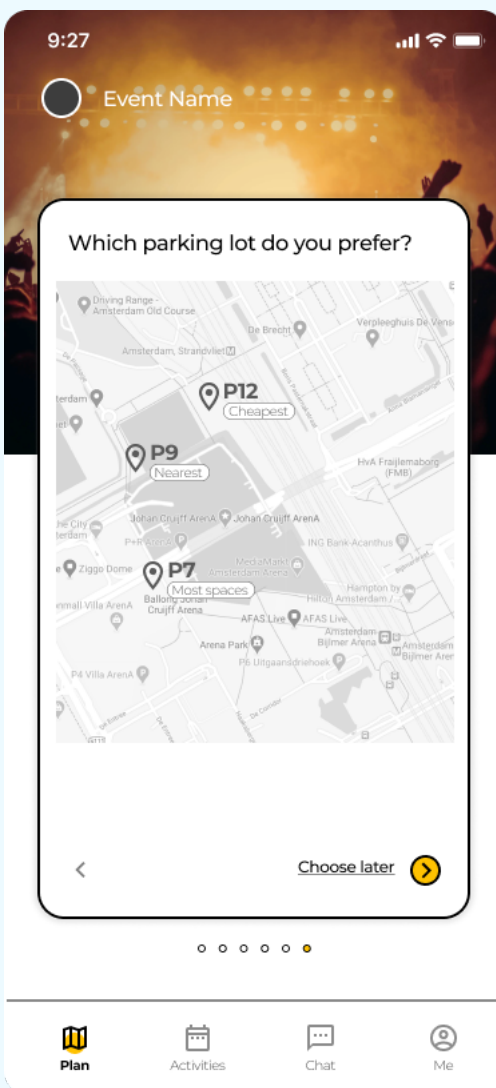
The plan page is the core page of the application. It includes all actions regarding the event: the event itself, the traffic information, and the additional activities that the visitor can take part in in the ArenAPoort. On the event day, the plan page can work as a calendar to guide the visitor's actions.

Question 6. (Private Car)

Question 6. (Public Transport)

Plan. (Private Car)

Plan. (Public Transport)



6.3.3 Activities

Once tapping on the bottom-tab “Activities”, the user will come to this page. Three sub tabs are put on the top: Event relevant, Food & Drinks, and ArenAPoort, representing three kinds of activities that a visitor can take part in before and after the event.

Event-relevant

Under this sub-tab, users can find one-time or irregular activities relevant to the event. They can be activities directly relevant to the event. For example, if the event is an Ajax football match, then the event relevant activity can be a replay of previous Ajax matches or a football fan party after the match. This kind of activity also includes activities organized for event spectators, although they might not be directly relevant to the event. For example, visitors with tickets can get a discount in the shopping mall nearby. It can not only avoid peak hours on traffic but also bring extra income to the ArenAPoort. Besides, the OMC can organize some activities to make visitors explore the ArenAPoort area, such as a Parkour game.

Activities are listed on the format of cards, with a poster, a title, the time, and some brief introduction. If the user is interested in one activity, then he/she can tap on the activity card to check the details. Details include the activity’s time, location, vacancy, organizer, price, and other relevant information that the user might be willing to know, together with a more detailed introduction. Users can also comment on the activity and reply to others' comments.

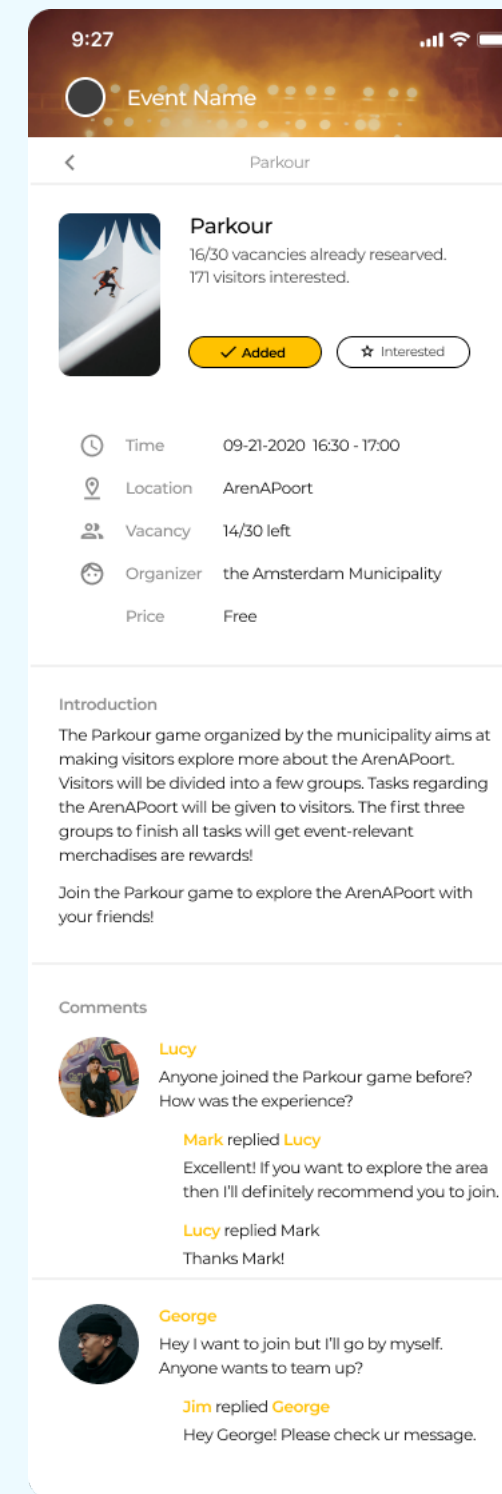
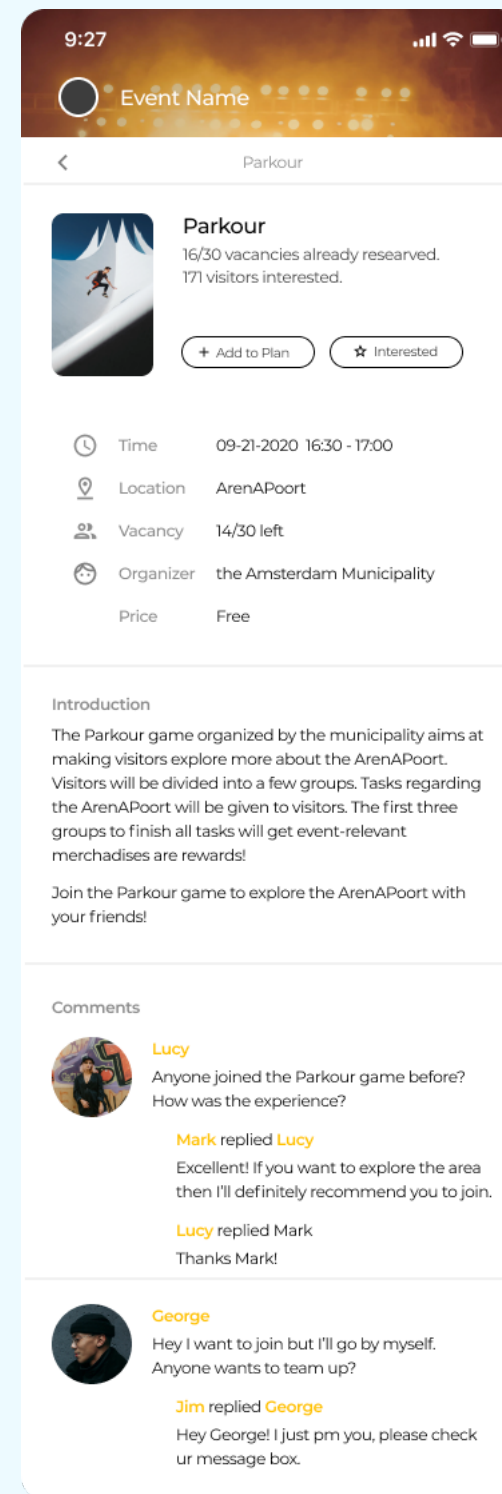
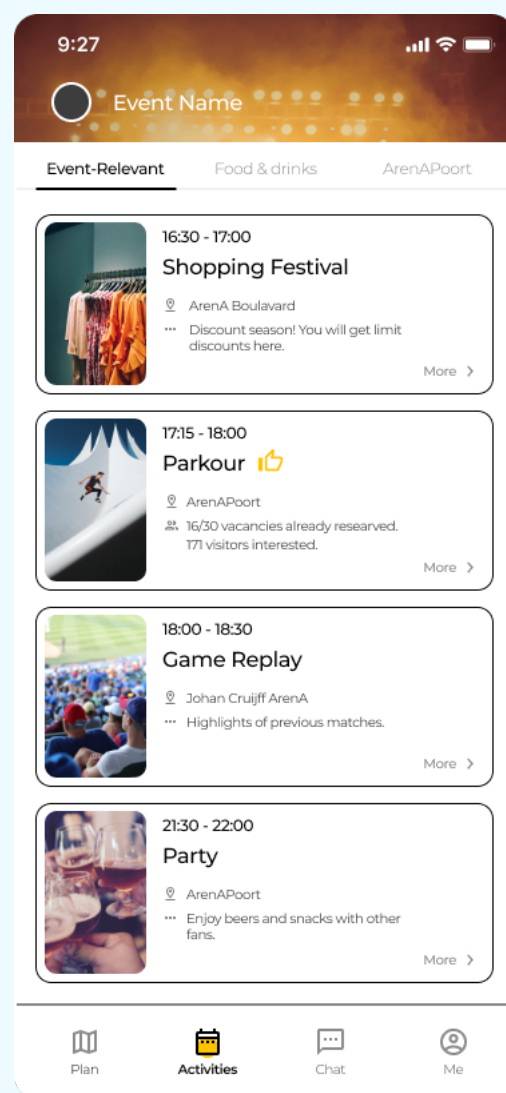
By tapping the “Add to Plan” button, the activity will be added to the timeline on the plan page, and be given an “Added” tag on the activity list. By tapping the “Interested” button, the activity will be marked with a star and shown on the top of the activity list. If the activity needs to be reserved, the user can also make a reservation on this page.

As for the initiation of event-relevant activities,

considering the diversity of event-relevant activities, stakeholders like the venue, the event organizer, the enterprises in the ArenAPoort, or the OMC can initiate such an event-relevant activity. After being checked by the OMC, these activities can be posted on the application for visitors to participate in.

All in all, providing event-relevant activities is like building a bridge between stakeholders and visitors. It can not only enrich visitors’ event experience but also bring benefits to the stakeholders.

Event relevant activities



Food & Drinks

Under this sub-tab, restaurants and bars where visitors can have a meal or snacks are listed. This sub-tab becomes an independent one for two reasons. One is that food & drinks are not event-relevant since restaurants and bars exist even if there is no event there. Another reason is that taking food & drinks is one of the most frequently taken activities by event visitors.

Just like event-relevant activities, on this page, restaurants and bars are also listed on the format of cards. On each card, basic information like the restaurant/bar's name, the average price, the

location, and a brief introduction will be given. The user can tap on the card to check its details. If a reservation is needed, the user can also reserve through the details page. Considering the number of restaurants and bars is huge in the ArenAPoort, a search bar is added for the user to search by keywords.

ArenAPoort

This page is a detailed map of the ArenAPoort area. Attractive spots like landmarks are marked on the map. The purpose of this map is to arouse visitors' curiosity about the ArenAPoort and make them willing to explore the area.

6.3.4 Chat

This page is a post-board for visitors to communicate with each other. The reason for using the format of posts instead of chatting groups (as in the last version of concept) is to make users clear that the chat information is public and can be used for the OMC.

Users can post everything about the event, from practical information like car-sharing and surrounding exploration to random chat about the event. They can add hashtags to their posts to enhance the possibility of getting a reply. Users

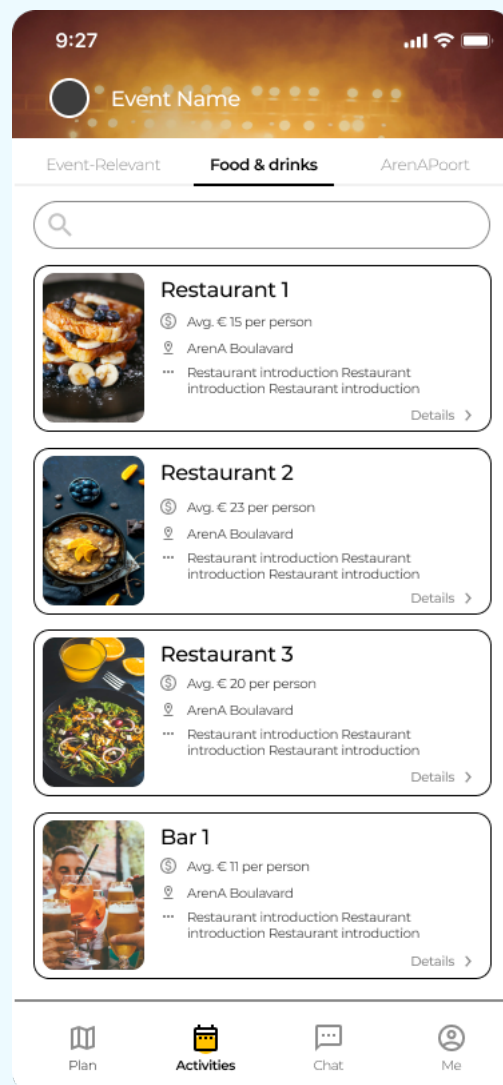
can also search by keywords to find the topic they are interested in.

6.3.5 Me

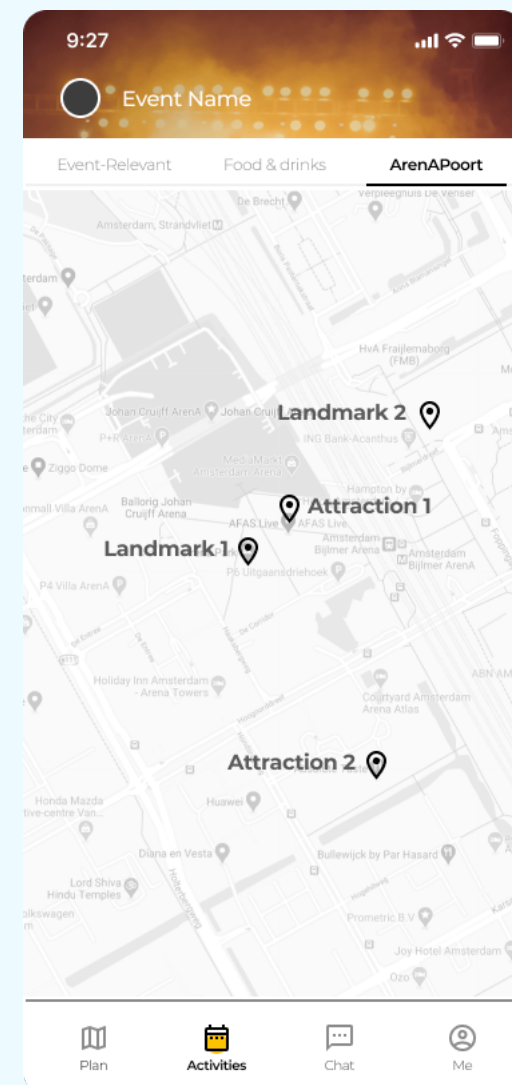
This page is the personal homepage of the user. On this page, the user can find all information about his / her event experience at the ArenAPoort, including the event experience, the activity participation, the post history, and replies.

Experience the prototype: <https://www.figma.com/proto/MgzbmQjvJHRiWcePL7TQA9/ArenAPoort-Prototype?node-id=65%3A0&scaling=scale-down>

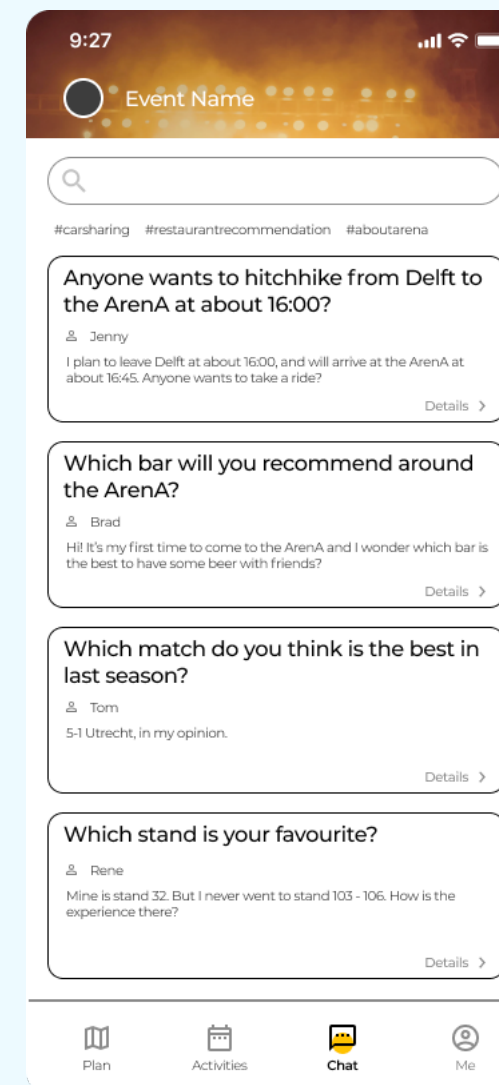
Food & Drinks



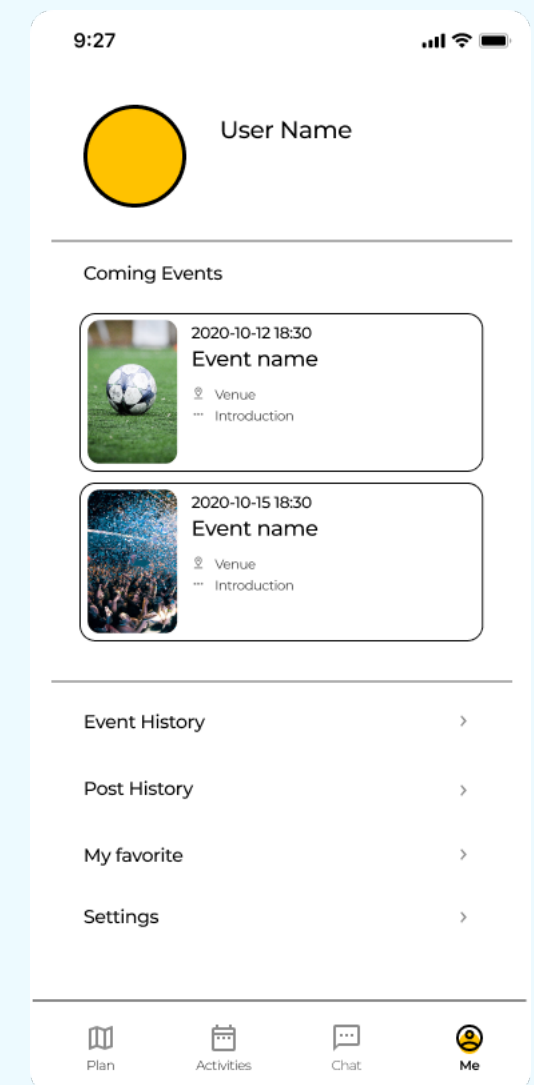
ArenAPoort



Chat



Me



Chapter 7

Evaluation

This chapter introduces the evaluation session of the final design with six users (ArenAPoort event visitors) and two experts (OMC members). The method, process, and results of evaluation sessions will be introduced. After summarizing and clarifying users' and experts' comments, an evaluation conclusion will be drawn.



7.1 Methods

7.1.1 Evaluation Purpose

Evaluation is to produce an unbiased appraisal of a program's benefit. (C. Spiel, 2001) In the evaluation phase, the main purpose is to check if the final design meets the design goal: Design a digital platform that can make use of data to motivate event visitors to spontaneously take the mobility choices preferred by the OMC, thus to benefit the mobility situation around the ArenAPoort during events.

In summary, four key elements are included in the evaluation:

1. **Effectiveness:** Whether the design can effectively change event visitors' mobility behavior (to the way preferred by the OMC). To be detailed, mobility behavior change includes four parts: modality change (mainly from private cars to public transport), time change (come early before the event and/or stay late after the event), car-sharing to reduce vehicle numbers, and follow guidance from the OMC.
2. **Spontaneity:** Whether the visitor will spontaneously use this application.
3. **Usability and User Experience:** Does this application bring a good experience and perform well in usability?
4. **Data usage and collection:** Does this product make good use of the data that the OMC already has, and help to collect data that is

useful for further use?

7.1.2 Participants

Two types of participants are involved in the evaluation: users (event visitors in the ArenAPoort) and experts (OMC members). (See Table 6.1)

Three types of visitors are recruited, divided by their familiarity with the ArenAPoort and their modality choice, corresponding to three personas created in the research phase (see 2.4.4). Six visitors are recruited in total, two for each type. Visitors are recruited through the author's personal connections. Test content with visitors includes effectiveness, spontaneity, usability, and user experience.

Two OMC members are invited to the evaluation session, with their roles respectively are the traffic advisor and the data scientist. Test content with OMC members includes effectiveness, data usage, and collection.

7.1.3 Tools

All test sessions (each ranges from 30 to 60 minutes) were conducted individually with participants via the online meeting tool Zoom. Sessions were all recorded with informed consent from participants. The prototype used in the session was created via the online prototyping tool Figma. Participants got access to the prototype via a link.

	Gender	Persona A	Persona B	Persona C	Expert	Content
P1	M	●				Effectiveness, Spontaneity, Usability and user experience.
P2	F	●				
P3	M		●			
P4	M		●			
P5	M			●		
P6	F			●		
P7	M				●	Effectiveness, Data usage.
P8	M				●	

Table 7.1. Evaluation Participants

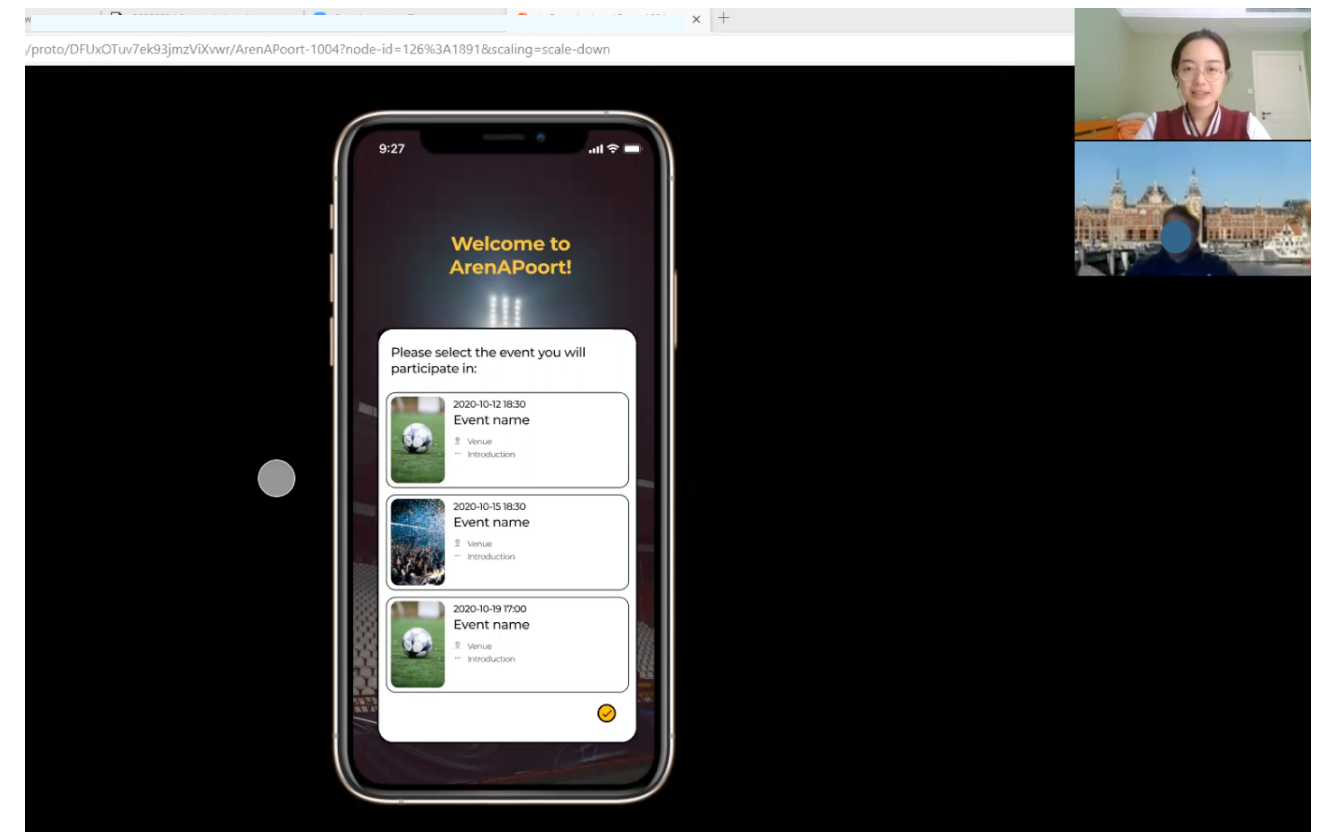


Figure 7.1. A screenshot of Evaluation Session

7.2 Evaluation with Visitors

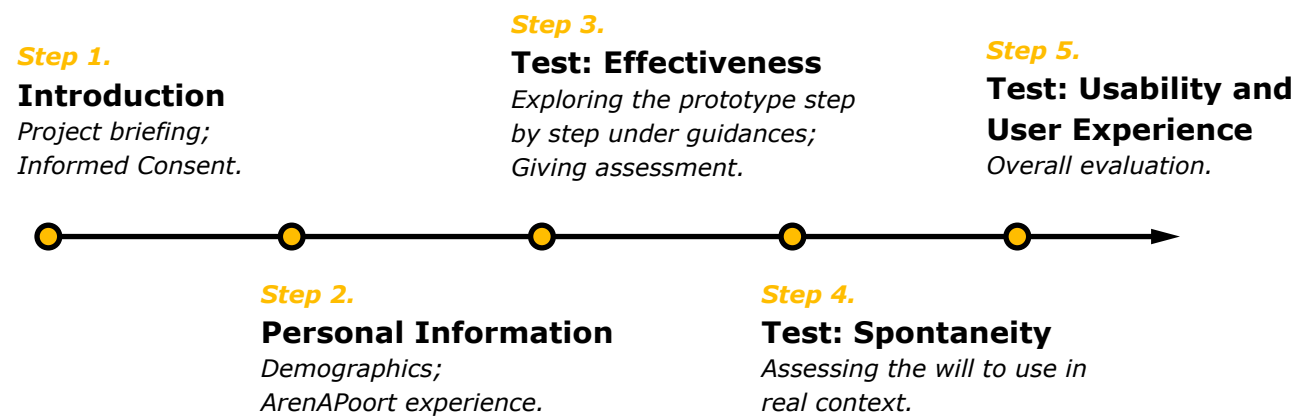


Figure 7.2. Procedure of the evaluation session

7.2.1 Test Set-up

Figure 7.2 shows the procedure of the evaluation session with visitors. Five steps are taken in total.

First, the author gives a brief introduction about the project and the test, informs the participant about privacy issues, and gets their consent. Then, the author will learn basic information about the participant, including the demographics and event experience in the ArenAPoort.

Step 3 is a test of effectiveness. Before the test, the author describes a scenario for participants to emerge in the context. Then, the author will guide the participant to use the application step by step. Some questions regarding effectiveness in changing mobility choices will be asked on key steps. For each question, the participant is asked to give a score from 1 to 5, and give an additional explanation on the score.

Figure 7.3 shows the process of exploring the application, with key steps specially marked when the participant should give a score and explain his/her opinion.

Step 4 is a test of spontaneity. Getting rid of the scenario in the last step, this part is for testing if the visitor will be willing to use the application spontaneously in the real context. Thus, test questions include the possibility of the participant to use this application in the real context, the possibility of the participant to use each part of the application, what parts the participant likes or dislikes about the application.

The last part is the usability and user experience test. The question list is based on the system usability scale (SUS) designed by John Brooke which is now widely used to assess usability. (Brooke, J. 1986)

A little change is made in applying the SUS. In the original SUS, measurements of usability include effectiveness, efficiency, and satisfaction. In this test, the effectiveness part is deleted to avoid a repeat with step 3: effectiveness test. Thus, the focuses of this step are on the application's efficiency and satisfaction.

For the complete user test set-up document, please check Appendix G.

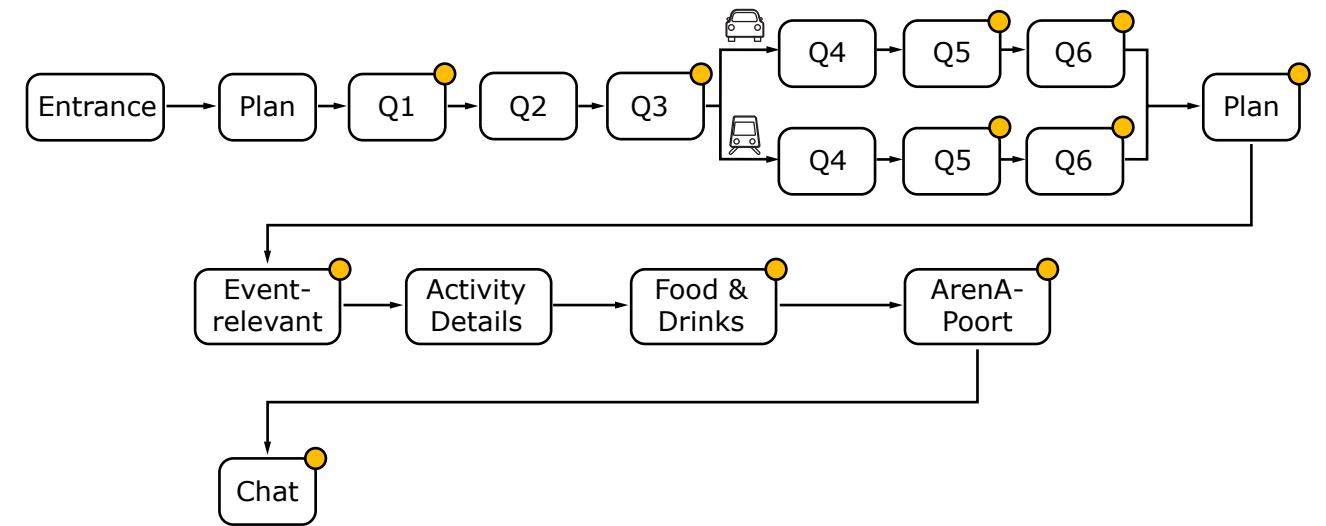


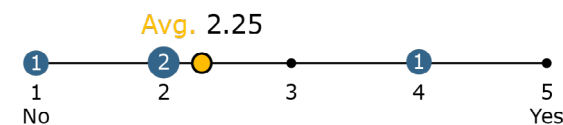
Figure 7.3. Process of exploring the application

7.2.2 Test Results

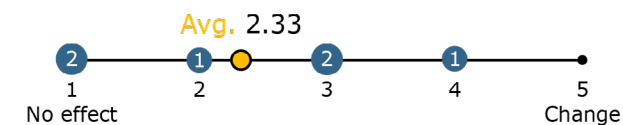
The test results will be shown in three parts, corresponding with the test set-up: effectiveness, spontaneity, usability and user experience.

Effectiveness

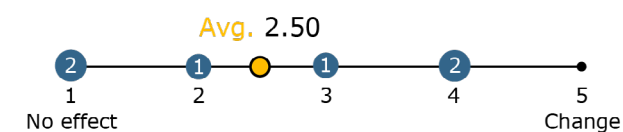
For private car takers: How likely will you turn to other modalities instead of a private car? (4 responses)



To what extent does the order of options influence your modality choice? (6 responses)



To what extent do tags influence your modality choice? (6 responses)



Designs on this page can affect the modality choice, but only for limited group type.

“People will hesitate only if they have more than one choice.”

- Participant 6

From test results, we can see that the trial to change private car takers to use public transport is not very successful. Participants revealed the reason why they do not want to change modality. If they are determined to take a private car, for example, if they have got used to taking a private car everywhere, then they will not change to take public transport.

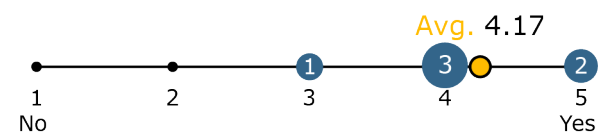
But the designs do have some effect. For those visitors who are hesitating between different modalities, the design of this page, including the order of options and tags in different colors, can influence their choices, because the design implies that public transport is a better modality.

Tags can give more information.

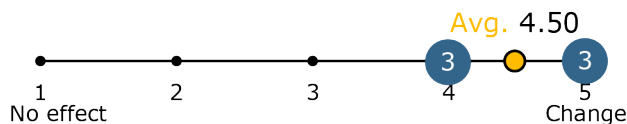
One participant mentioned that the content on tags now is not detailed enough. Words like “cheap” or “sustainable” are not enough for making choices. If tags can give more information about the time you will need to spend by choosing this modality and the price you will need to pay, then it can be more convincing and can influence visitors’ choices.

But it needs to change the order of the route planning questions. Thus, the whole structure of making route plans need to be reconsidered.

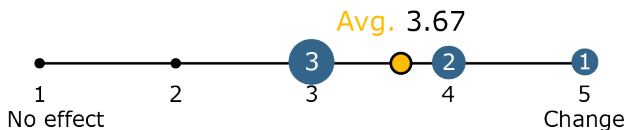
How likely will you change your arrival time by seeing this page?
(6 responses)



To what extent does the notification change your arrival time choice?
(6 responses)



To what extent does the activity list change your arrival time choice?
(6 responses)



This page works well in changing arrival time. Traffic situation prediction is more effective in changing time choice than the activity list.

“I hate being trapped in a traffic jam. If I know how to avoid it, I’ll do it” - Participant 5

Participants gave positive feedback on the attempt to change their arrival time during making the travel plan. The effect of notification got a 4.50/5 in influencing visitors’ arrival time.

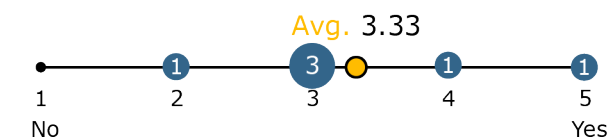
This reveals that another way of making use of data is effective. Now the OMC only uses previous data to make predictions of the mobility situation of future events. However, they can also provide this information to visitors to influence their behavior.

The score of the activity list is a bit lower. Participants said that compared to what activities they can join in, they care more about the traffic situation. Only after deciding the arrival time and finding an interval in between will they care about what they can do to fill the time gap, unless the activity is a must-go.

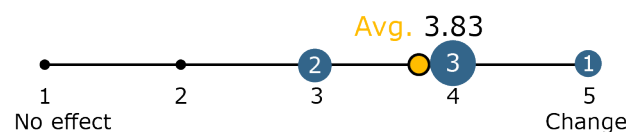
Time change depends on many objective factors.

Participants pointed out that whether they are going to change the arrival time depends not only on the traffic situation and activity list shown on this page but also on other objective factors. For example, if the event is on a working day, then visitors have to go to the venue after work. In this situation, they will not be able to come earlier even if they would like to.

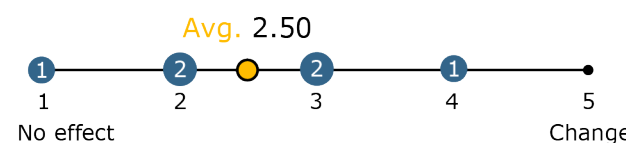
How likely will you change your leaving time by seeing this page?
(6 responses)



To what extent does the notification change your leaving time choice?
(6 responses)



To what extent does the activity list change your leaving time choice?
(6 responses)



Visitors are less willing to change the outflow time than inflow time.

“Anyhow, I want to go home as soon as possible.”
- Participant 6

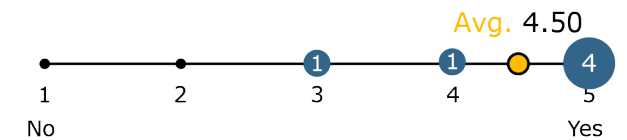
Participants show a lower will to stay in the area longer after the event (3.33/5) than come earlier before the event (4.17/5). Multiple reasons lead to this result. One is that watching a match/concert is tiring, and visitors only want to go home to take a rest after that. Another is that if the event ends late at night, and the next day is the working day, visitors need to go home as early as possible to prepare for the work/study on the next day. This conclusion also accords to research results.

However, some quick activities are worth an attempt.

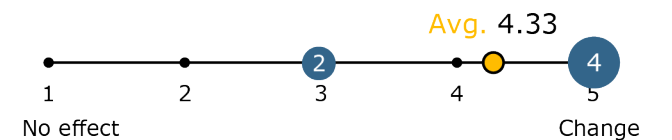
Although visitors show a relatively low willingness to attend activities after the event, some of them also named a few activities they would like to join. Participant 1 recalled his event experience in Italy and suggested the ArenAPoort build street vendors and provide visitors some barbecue or snacks after the event, which fulfill visitors’ physiological needs of replenishing energy while attracting them to stay a bit longer as the OMC wished.

Besides, the outflow peak hour lasts no longer than 45 minutes, so the traffic pressure will be relieved as long as the activity can occupy visitors for a short time. Therefore, the OMC can study visitors’ needs, and provide activities that meet their needs and will not take a long time.

How likely will you choose the parking lot / station the municipality recommends?
(6 responses)



To what extent does the tag influence/help your parking lot / station choice?
(6 responses)



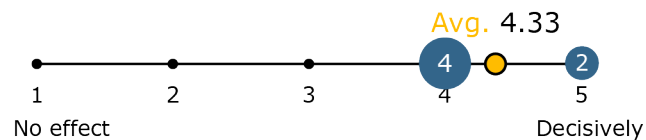
Visitors unfamiliar with the ArenAPoort have a higher chance to listen to the parking/station recommendation from the OMC.

“I already know the area very well, so the parking lot choice depends on my plan. If I’m going to have dinner first, then I’ll choose the parking close to the restaurant.”

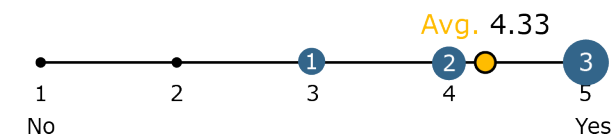
- Participant 3

All four participants unfamiliar with the ArenAPoort (participants 1, 2, 5, 6) gave the highest score on choosing the parking/station according to the recommendation of the application, and they all think tags of each choice can help them to make the decision. However, participants 3 and 4, who are familiar with the ArenAPoort, tend to listen to their own experience and habits, since their knowledge is enough for them to make the best choice.

To what extent do you think the plan can help your traffic experience?
(6 responses)



By seeing this page, how likely will you add activities to the travel plan?
(6 responses)

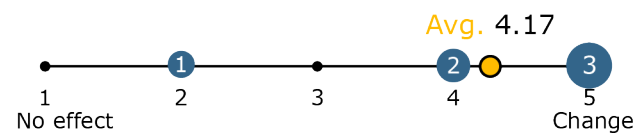


Showing the action plan in the format of a timeline is good.

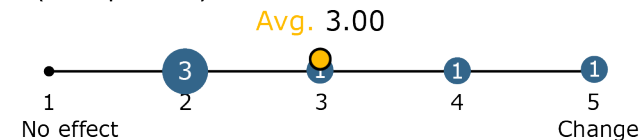
When asking about “Do you think the plan can help your traffic experience”, participants gave a score of 4.33/5. Comments are that the plan is shown in a clear and concise way, thus it can help them to have a clear overview of action points on the event day.

By leaving the space between the inflow/outflow and the event in the timeline and adding an icon to motivate visitors to “add plans”, visitors will be motivated to check the activity list and add plans.

To what extent do the activity cards motivate you to explore the event detail?
(6 responses)



To what extent does the “recommend” icon motivate you to explore the activity details?
(6 responses)

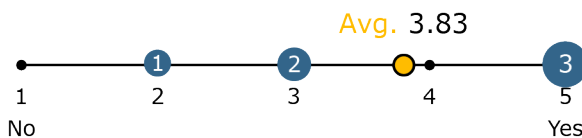


This page can help visitors on checking the activity list. Normally visitors are clear what kind of activities they are interested in.

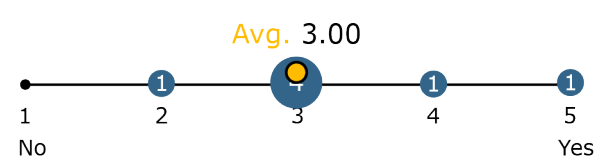
Participants generally gave a positive remark on the design of this page, saying key information of the activities is shown, which can help them to make the choice.

However, the design of the recommendation icon does not play an important role. Most participants indicate that they already know what activities they will be interested in, and will not be changed by this recommendation icon. Only one participant expressed that this icon can help him to know which activity is popular, and with a strong curiosity, he will be interested in this popular one.

To what extent are you interested in practical posts (post 1 & 2)?
(6 responses)



To what extent are you interested in random-chat posts (post 3 & 4)?
(6 responses)



Visitors are more interested in practical information.

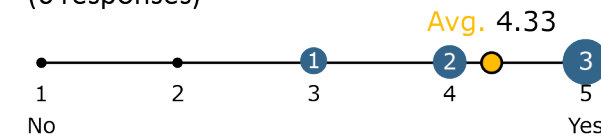
The score of interest in practical posts (3.83/5) outperformed that of random-chat posts (3.00/5). Visitors are more interested in practical posts.

Inspect the words.

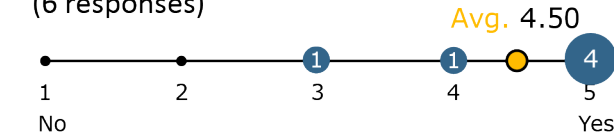
Participant 3 reminded the author to mind the situation if fans of the opponent team download this application and leave hate posts. An inspection of posts is needed to keep the community healthy and proper.

Spontaneity

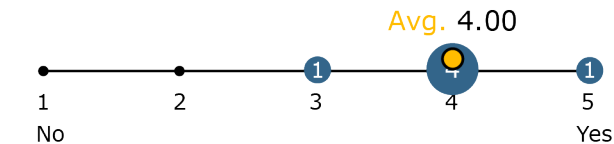
How likely will you use it to plan your event traffic?
(6 responses)



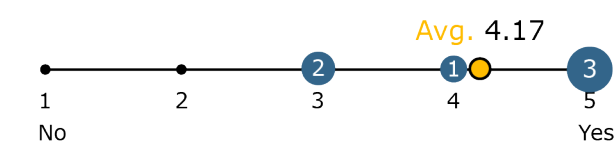
How likely will you use it to check event-relevant activities, if you are going to an event?
(6 responses)



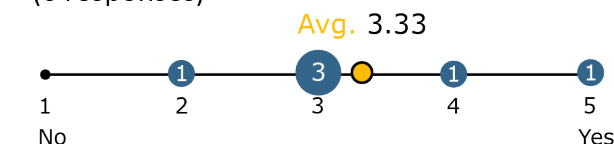
How likely will you use it to check restaurants and bars, if you are going to an event?
(6 responses)



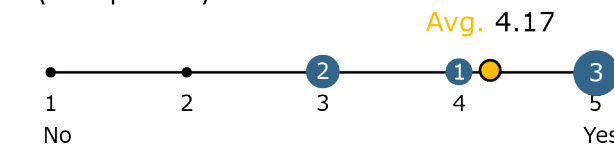
How likely will you use it to check landmarks and tourist attractions, if you are going to an event?
(6 responses)



How likely will you read, reply or write posts?
(6 responses)



How likely will you use this application, if you are going to an event in the ArenAPoort?
(6 responses)



Route Plan

“Google maps already did a good job in route planning, but I’ll give this app a try because it can tell me when a traffic jam happens”

- Participant 5

Visitors show a high interest in using this application to do route planning. They think the process of answering six questions to get a travel plan is quick and efficient. Another frequently mentioned reason is the function to notify the predicted traffic situation, which can be crucial in deciding travel time according to participants’ comments.

Activity Participation

Activity participation relies on prerequisites like the day of the week, the time of the day, weather, etc. If conditions permit, most visitors are willing to take part in activities.

“None of these activities presented on the prototype can attract me as much as watching football players training before the match”.

- Participant 3

The most popular activity type is event-relevant (4.50/5). However, we need to mind that the specific activities that each visitor interested in are different, although they can all be summed up to the “event-relevant” category. For example, one participant mentioned that the only activity he would like to join is pre-match training or pre-match press conference. There is no possibility for him to participate in other kinds of activities.

Having food and drinks in the ArenAPoort is another frequently-joined activity type. Participants expressed that just showing a list of restaurants and bars is not enough. They would like to see the remarks on the restaurant/bar from real customers. Travel/booking facilitators like TripAdvisor or Google maps already did very well in this domain, thus participants suggested us to cooperate with them and link to their data in

the application. Besides, it also has the potential to be a good means of commercialization by advertising restaurants/bars which would like to promote themselves.

Just like event-relevant activities, the willingness for visitors to use the page ArenAPoort to check nearby tourist attractions also depends on if the visitor has spare time before or after the event. If so, most visitors would like to check this page and find something to fill the time gap for themselves. The degree of interest is relatively high among visitors who are not familiar with the ArenAPoort and young visitors who are enthusiastic about exploring new spots.

Chat

As an additional function of this application, the “chat” function can attract some visitors and bring users. However, most participants said that they would only read posts instead of replying or writing posts. One participant said he might write posts only if it is necessary, for example transferring tickets.

Overall

The overall possibility of using this application is 4.33/5. Most participants expressed a high interest in trying it. Generally speaking, the notification of predicted traffic situation on answering questions about arrival time and leaving time gets the most praise.

The author also gets some suggestions and recommendations from visitors:

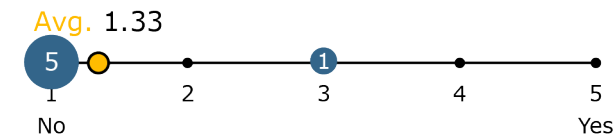
One participant expressed his strong interest in the service provided by this application, but also strongly unwilling to download a new application. In his point of view, this function can be provided to him through a web page after he bought the event ticket. If you want visitors to download this application, then you need to provide more things, for example, real-time traffic information, and navigation from spot to spot.

Other participants also suggested adding other new functions. If this product can provide a “one-stop” event experience, which means providing all things relevant to the event and visitors do not need to jump between different apps and web pages on making an event plan, then it will be more attractive. It would be even better if the application can provide a ticket purchasing service, then visitors do not need to go to use other applications at all.

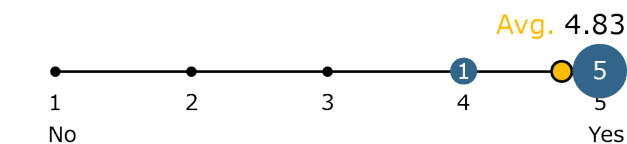
Participant 3, as a representative of frequently coming visitors, also gave a suggestion from his perspective. “If I come here a lot, can the application learn my use behavior and make smart recommendations on travel and activity arrangement?” This suggestion also proposed a design direction for the application. If this application can learn user preference, it can not only provide a better personalized recommendation to users but also build a database and have better learning on user behavior. A positive closed loop will be formed and benefits both the user and the OMC.

Useability and User Experience

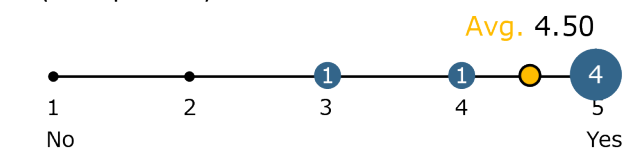
I found the system unnecessarily complex. (6 responses)



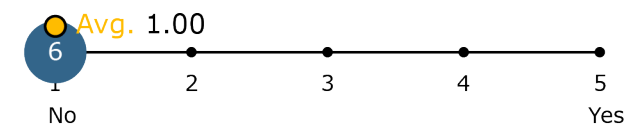
I thought the system was easy to use. (6 responses)



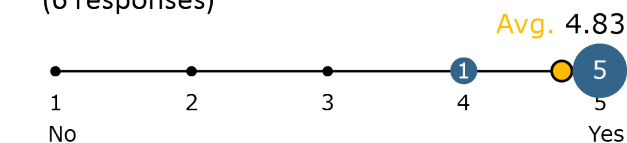
I found the various functions in this application were well integrated. (6 responses)



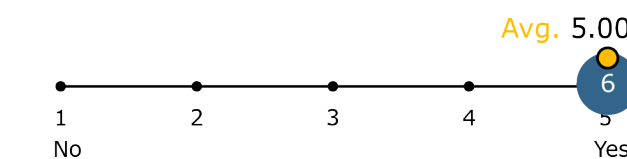
I thought there was too much inconsistency in this application. (6 responses)



I would imagine that most people would learn to use this application very quickly. (6 responses)



I felt very confident using the application. (6 responses)



Generally, participants give a high remark on usability and user experience. The most frequently mentioned positive elements are the quick user flow and precise interface visual design.

However, there are also elements remaining to be improved:

Page Arrival time and Leaving time

When users come to the page of arrival time (route planning question 3) and leaving time (route planning question 5), some of them feel lost, since there are too many elements on this page: a time bar, a time dot, cards of activities, and a notification showing up once dragging the time dot to choose the time. Some users can not quickly figure out elements on the page, and can not immediately get what he/she should do. The design of this page should be optimized to emphasize the focus: the timeline.

Besides, one of six participants had problems in finding a way to choose the time. Probably adding a novice guide animation to guide users about the interaction of dragging down the time dot can help with the situation.

Problems in prototyping

Participants also found some problems in the prototype. On the page route plan question 3 and route plan question 5, there is a timeline on which participants can drag the dot and choose the arrival time. The designed interaction is to drag the dot to choose the time, but in the prototype, the realized interaction is to click/tap on the dot to choose the time. The level of realization of interactions should be improved.

The user test was conducted under the guidance of the author, however, after adding activities in the plan, some participants want to go back to the plan page to check it on the timeline. However, due to the complexity of prototyping, the author did not make this page, which made some participants a bit disappointed.

7.3 Evaluation with Experts

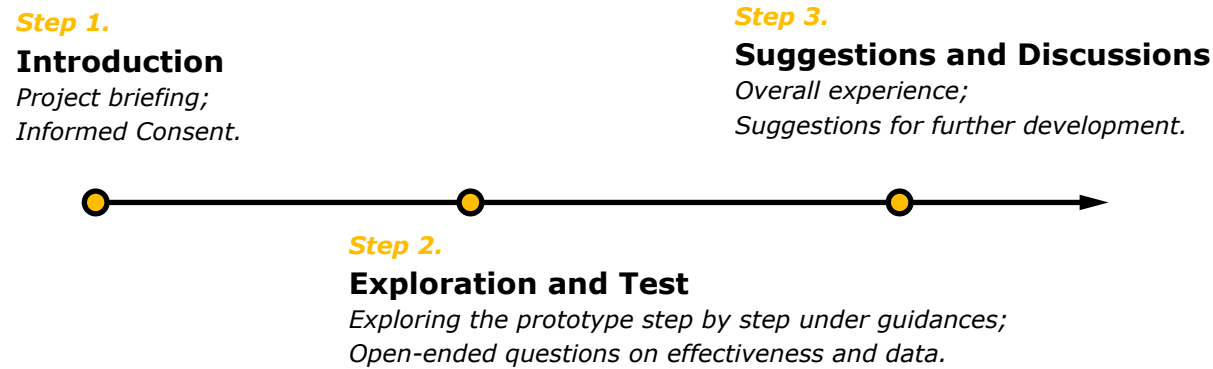


Figure 7.4. Procedure of the evaluation session

7.3.1 Test Set-up

The evaluation test with experts has a higher level of openness. Instead of checking details, the purpose of expert evaluation sessions is to check the effectiveness of this application in changing mobility behavior and in making use of data, and looking for constructive suggestions from experts.

Three steps are taken in the session. First, the author will give participants an introduction on the project and on the evaluation session, and get their informed consent in taking a record. Then, participants will explore the application under the guidance of the author. During this process, after exploring each function, the participants will be asked some open-ended questions about this function, when they can give their opinions. After exploring the whole product, the participant will be invited to share his/her opinion on the application. Figure 7.4 shows the process of the evaluation session.

For the complete evaluation session set-up sheet, please check the Appendix H.

7.3.2 Test Results

This application proposed a new way of making use of data.

It's very useful to have a warning when it might be busy or crowded. Personally, I think I might change the time to come to the event, but probably I would still leave immediately after the event. Just a guess but I think most people would just go home immediately and not stay after the event. Before the event, you can go there to have dinner or something. I think the leaving time will be harder.

It can be useful in collecting data, but the usefulness is highly dependent on the user's amount. Data collected might be biased.

By collecting data about users' traffic choices, the product gives a good insight into where people will come from, when they will arrive, and how they will travel. These data can be very useful to the OMC.

For useful data to be collected, there have to be a lot of people to use this app, otherwise the data might not be representable. Besides, some visitor

groups, like young men, are more used to using mobile phones and downloading new apps. Thus, the data may be biased for collecting too much data from some user groups and insufficient data for other groups.

Considering the privacy issue of data collecting.

Some visitors might not be willing to input their starting point, destination, travel time, and modality choice, while some visitors might only like to input data for planning their trip, but do not want to upload data for study by the platform. Thus, it is important to get users' consent about data collecting and using.

Activities can help visitors to change time choices.

Participants gave a high appraisal of the function of providing activity lists. If the OMC only tells visitors to come earlier, visitors need to find what to do by themselves. No with all the different kinds of activities listed, there will be a high possibility that everyone can find something to do. If there are a lot of things going on, and visitors know about it, they will be more willing to come earlier to avoid congestion and also find something nice to do.

Cooperating with already existing service providers.

Some functions, like navigation or restaurant recommendations, have already there in other service providers like Google maps. Cooperating with these stakeholders will be more effective compared to building these databases by ourselves.

7.4 Evaluation Conclusion

In summary, the final design reached the design goal: Design a digital platform that can make use of data to motivate event visitors to spontaneously take the mobility choices preferred by the OMC, thus to benefit the mobility situation around the ArenAPoort during events.

Take the mobility choices preferred by the OMC: Modality choice is hard to change, but by using this design, visitors who are hesitating between different modalities will be more willing to choose public transport. The goal of the time change is achieved by informing visitors about the predicted traffic situation on different time slots, and by providing visitors a list of activities to tell them what they can do. About following guidance, visitors who are unfamiliar with the ArenAPoort will be more willing to listen to the recommendations from the OMC, while the effect of influencing frequent coming visitors is not dominant. Encouraging visitors to share cars is feasible, but how many visitors will use this function still needs more tests to verify.

Data usage: The application does propose an effective new way of using data (informing visitors about the potential traffic situation), and this approach can change visitors' time choices. It is also a new way of collecting data, but the effect depends on the number of users. Besides, privacy issues on data collection also need a better consideration.

Spontaneously: Most participants show a high willingness in using this application. Generally, what they like most are travel planning and checking event-relevant activities.

Usability and User experience: Participants give a high assessment of the usability and user

experience of the application. The efficiency, satisfaction, consistency, and integration of this application are good. But novice guides on some specific pages and the quality of the prototype can still be improved.

Effectiveness	
Modality Change	●
Time Change	●
Following Guidance	●
Vehicle Sharing	○
Data Usage	
Data Using	●
Data Collection	○
Spontaneity	●
Usability and User Experience	●

● Reached
● Partly Reached
○ More study needed

Table 7.2. Evaluation Conclusion

Chapter 8

Discussion & Recommendation

In this chapter, the author will discuss how the project can contribute to the real context, together with the limitations in the project process. Recommendations on the further development of this concept and on future strategies of the OMC will be given, especially under the special circumstance of the COVID-19 pandemic. At last, the author will give a personal reflection on the overall project process.



8.1 Project Review

According to the evaluation results mentioned in the previous chapter, the final design reaches the design goal. Furthermore, this project also verifies some theoretical conclusions that can be used not only in this product, but also in other trials of improving the mobility situation by the OMC, and even universally in the event mobility management field.

Different types of behavior change.

The modality change only applies to visitors who are hesitating between different modalities, while others who already have a fixed travel mode will not easily change their habits. By promoting the advantages of the preferred modality (public transport in this case), this visitor group might change to choose this one.

The time change is easier and has a wider range of acceptance. Informing visitors about the potential risks of terrible traffic can effectively change their time choices. But it should meet the prerequisite that external factors (time, day, weather, etc) will not restrict the time choices. Changing outflow time is harder but possible if a good consideration is given on the activity type.

Mobility behavior change among different visitor groups

Some characteristics define visitors' mobility preferences. For example, visitors with a lower familiarity with the area have a higher possibility of following the guidance. Visitors who travel with family have a lower willingness in activity participation. Young visitors are more willing to explore new spots and activities.

More ways of using and collecting data

The current usage of data is mainly on the OMC's side. But data can not only be used for the OMC to reactively take measures to handle the traffic flow but also can be used for visitors to avoid negative traffic experience. It has been verified to be effective that by knowing predicted traffic situations, some visitors will accordingly change their travel time to avoid a negative experience.

Besides, using the application itself is also a way for the OMC to collect data. By answering six questions in route planning, visitors provide their mobility information about the starting point, the destination, the modality, and the time choices. Although it has a risk of bias, this approach can help the OMC on visitor behavior data collection.

Rules in activity organization.

Popular activities in the inflow and the outflow are different. Visitors are willing to participate in time-consuming but interesting activities, while after the event they only want to go home as soon as possible. Thus, time-consuming activities are more proper to be organized before the event.

The activity organizer/provider should consider visitors' needs when providing activities. For example, after participating in an event, visitors might be exhausted, thus providing some snacks to them at that time is appropriate.

8.2 Limitations

This project also has some limitations in research, design process, and final evaluation.

Limitation on research and design phase due to COVID-19

Because of the COVID-19 pandemic, events are canceled from April to August 2020 in the Netherlands. It increased the difficulty for the author to involve users in the research and design phase.

Instead of distributing questionnaires on the event day in the ArenAPoort, the author has to do it online through personal networks and social media. Participants in interviews and design sessions are also recruited from personal networks and from the help of the client mentor, instead of random recruitment in the real context which can bring more diversity.

This leads to a significantly high proportion of visitors in persona A and the lack of visitors in persona C. The author can only search on the Internet for visitors who meet the characteristics of persona C and find their remarks. The limitation in participant composition can bring some bias and make the author neglect the needs of one specific visitor group.

Besides, cancellation of events also made it impossible to adopt some design methods like the observation of users' behavior. Attempts to make up this defect include making use of online information, but it is hard to say if it can achieve the same effect.

Limitation on the final design

The final design emphasized on presenting the concept instead of launching a complete product in real life. It focuses on common situations instead of having a thorough consideration of all potential situations and fulfilling the diversity of the real context. Thus, more considerations need to be given on the details in the final design.

In the current design, the five most frequently

used modality choices are presented: public transport, bicycle, walking, taxi, and private car. However, there are other travel modes beyond these five options, including kiss & ride, P+R (Park and Ride), etc. Besides, the final design default visitors to take the same modality on the inflow and the outflow, which is not always the truth. An instance is that some teenagers come to the venue by public transport with their friends before the event, while after the event their parents drive here to pick them up.

Although the proportion of visitors taking modalities mentioned above is relatively low, we still need to consider their needs if we want to make this product beneficial to all visitors.

Evaluation on a large scale in the real context is needed.

Evaluation sessions were conducted remotely through the online meeting tool Zoom. Although a scenario is depicted to help the participant get emerged, it still can not be as authentic as doing the evaluation in the real context. Evaluation online might cause missing the latent and tacit information behind the participant's words because what people say is not always correspondent to what they do. Besides, the scale of 6 participants in the evaluation phase is small, compared to tens of thousands of visitors to each event. Thus, doing user tests with a large scale of visitors in the real context can be helpful to the project.

Besides, designing an application is not just about useful functions, smooth user flow, and fancy interface. It also involves market needs, commercial values, etc. The product should also be tested with other relevant stakeholders like restaurants and bars in the ArenAPoort, the venues, and enterprises, to see if it can also bring benefits to them thus win their support and collaboration.

8.3 Recommendations

There are also recommendations on the further development of the product, and also on how the knowledge gained from this project can benefit the OMC to perform better in event mobility management.

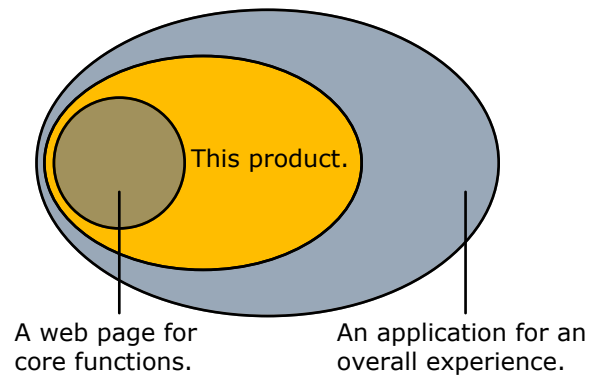


Figure 8.1. Product positioning and form choice

8.3.1 Clarify the Positioning and Exploring the Best Form

The discussion on the product's form is an important topic in the evaluation phase. One participant showed strong resistance in downloading an application and suggested to change it into a web page. Reasons for choosing to use the application, as explained in Chapter 5.1.2, are advantages in handling complexity, reusability, and interactivity. The final design is a product for visitors to plan not only the route, but also other event relevant issues to enrich the event experience, and the interaction between the product and users can be at any time and anywhere.

Besides, an application has a higher potential in the iteration. It can be expanded to include all issues about event participation, from the ticket purchasing, to the event experience planning, and the practical information like navigation and entrance voucher on the event day. An application also has the potential for serialization. The core behind the application is easy - making

travel plans, checking activity lists, and talking about the event. It has high reusability in other venues. If the other venues are interested in this application then they can also make use of it and promote it to a wider range.

However, the web page has assuredly some advantages that the application can not compare with. Visitors do not need to download an application from the App Store / Google Play. Instead, they can just open the web page on the browser after the ticket purchase. The convenience in accessibility can increase the number of users.

In summary, the form of the product depends on its positioning. If the product just provides the core function, route planning, then a webpage is more appropriate. If the product is not only about route planning, but also provides other information and service, then making an application is a better choice. The OMC should give a thorough consideration and choose the form according to the expected positioning of this product.

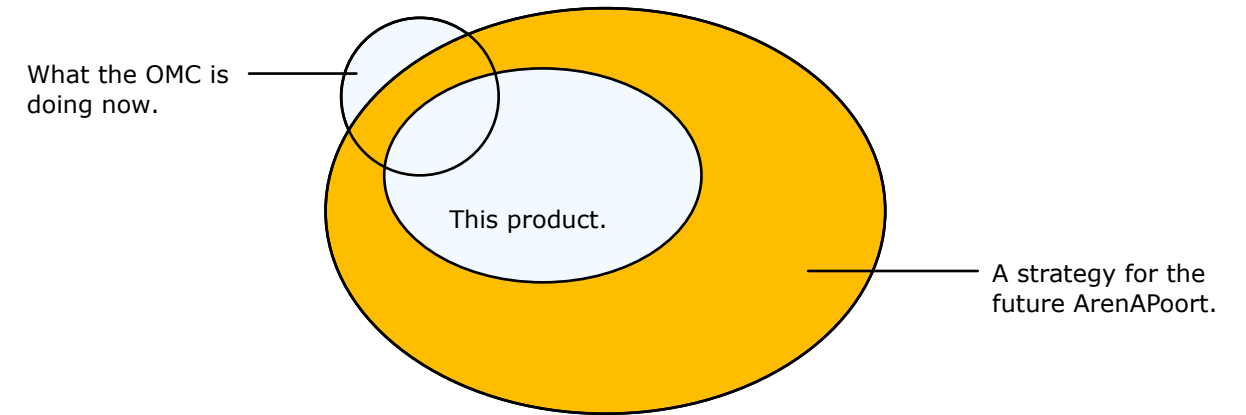


Figure 8.2. A strategy for the future ArenAPoort

8.3.2 A Strategy for the Future ArenAPoort

As mentioned in the product positioning part, this product is a part of the event mobility management strategy. The strategy can analyse variables of event visitors, give them profiles, and provide guidelines on how to change their mobility behavior.

Priority

Mobility management is not always the most important thing in managing an event. In some intense football matches, the possibility of having fights and violence after the match is high. Thus the OMC would prefer visitors to leave the area as soon as possible, even being congested on roads, than let them stay longer to avoid congestion. In these events, safety is the issue that needs more concern than mobility. Thus, the strategy should define the priorities in event management.

External factors

If the event is on the workday evening, visitors probably have to come directly from work, which leaves no possibility for them to come earlier. If the event ends too late at night, nothing would be more attractive than going home as soon as possible when the event ends. Thus, when

making the schedule of events, external factors like the time and the day should be considered.

Activity

Activity is an important part of the strategy. In the design phase, the in-depth study on activity types is suspended for that it is too broad and deviates from the main focus of this project. But a lot of inspirations are gained during the project process, which can contribute to the strategizing of organizing activities.

Several conclusions are drawn about activity organization, which can be embryonic of activity organization theory. Activities that are popular in inflow and outflow are different. In the inflow, visitors normally have a longer spare time for time-consuming activities, while in the outflow visitors are less willing to spend time. Visitors unfamiliar with the area have a higher possibility of joining area exploration activities. The OMC can make a study on what kinds of activities are more popular during a specific time in a specific event.

The activity organization can be related to area planning. An idea of visitors initiating activities by themselves was proposed in the ideation phase. Venues or the ArenAPoort can reserve some places for visitors to organize activities when building the area/venue.

Organizing activities can be relevant to commercialization strategies. If a restaurant wants to promote itself, advertising can be done in the application, which can bring income to the OMC.

Personas

When studying event visitors' behavior in the ArenAPoort, one tricky thing is the diversity of visitors. Different events attract different kinds of visitors, and even for the same event, visitor group types also vary a lot. Three personas are proposed in this project, distinguished by the familiarity with the area and the modality choice. Even within the same persona, visitors' behavior is not consistent either, for that behavior can be influenced by many other factors.

As the OMC is working on finding out variables that influence event traffic situations, a parallel study can be done on variables that influence event visitors' mobility choices. Figuring out these variables and building personas can help with the study of visitors' behavior, and figure out how to provide the best ways to influence it.

Machine Learning

The application can learn from users' preferences, and do smart, personalized recommendations aiming at changing their mobility behavior and providing them a better event experience. It can also help the OMC to build user profiles and give a better classification of visitors.

In summary, event (mobility) management is a complex issue that includes many elements. The OMC can cooperate with other stakeholders to form a wider strategy in order to respond to different situations.

8.4 Under the Background of COVID-19

COVID-19 changes many people's lives in 2020. Under this circumstance, organizing events face more restrictions. Big events are all canceled from March to August in the Netherlands. From September, holding events are allowed again, but under the control of the crowd to avoid gatherings.

As of the author finishing this report (October 2020), the Johan Cruijff Arena still holds strict rules in event visitor management. Grandstand seats are designated to visitors without independent choice to keep the social distance. Visitors are designated the time slot to arrive and to leave. In the inflow, there are four time-slots in total and each lasts 15 minutes. On the event day, the visitor needs to report their health conditions through a website of the ArenaA, (see figure 8.3.)

otherwise, he/she will not be informed about the seat and time slot information, thus will not be allowed to join the event.

There are some common points between the measures of the ArenaA and the product in this project. They both include time management and spot/location management. The difference is that the designation from the ArenaA is mandatory and the behavior change of this product is spontaneous. With some alterations, this product can be appropriated to be used as the management platform for the ArenaA.

The epidemic pushed the digitalization of event visitor management. Maybe it can bring an opportunity for visitors to get used to managing their event experience in advance online.

Corona-enquête Johan Cruijff ArenaA

Naam / Name:

Corona-vragen / Corona-questions:

a. Had je in de afgelopen 24 uur een of meerdere klachten die kunnen duiden op corona, zoals hoesten, verkoudheidsklachten, verhoging of koorts, benauwdheid en reuk- en/of smaakverlies? / Did you have one or more of these complaints in the past 24 hours: A cough, a nose cold, a fever from 38 degrees, shortness of breath or loss of smell and/or taste?

Ja / Yes
 Nee / No

b. Heb je op dit moment een huisgenoot met koorts en/of benauwdheidsklachten? / Do you currently have a roommate with a fever and / or shortness of breath?

Ja / Yes
 Nee / No

c. Heb je het nieuwe coronavirus gehad en is dit de afgelopen 7 dagen vastgesteld (in een lab)? / Did you have the coronavirus and has it been diagnosed in the past 7 days (in a laboratory)?

Ja / Yes
 Nee / No

d. Heb je een huisgenoot / gezinslid met het nieuwe coronavirus en heb je in de afgelopen 14 dagen contact met hem/haar gehad terwijl hij/zij nog klachten had? / Do you have a roommate / family member with the new coronavirus and have you had contact with him / her in the past 14 days while he / she still had complaints?

Ja / Yes
 Nee / No

e. Ben je in quarantaine omdat je direct contact hebt gehad met iemand bij wie het nieuwe coronavirus is vastgesteld? / Are you in quarantine because you had direct contact with someone who has been diagnosed with the new coronavirus?

Ja / Yes
 Nee / No

Figure 8.3. Reporting health condition online

8.5 Personal Reflection

The graduation project is the first time for me to independently finish such a complete and complex work. Looking back to the journey of the past seven months, I am surprised by the amount of work I have done and the role I have taken. I worked as a user researcher to find users' needs, as a business owner to represent the benefits of the OMC, as a product manager to control the project progress and project direction, as a user experience designer to define the interactions with the product, and as a user interface designer to make the visual design. The complex work enhanced my comprehensive ability as a designer.

I also learned a lot from this project. The first one is the importance of making timely decisions. At the beginning phase, three weeks were spent on adjusting the assignment, which led to an extension of the research phase. During the design process, sometimes I hesitated too much between different directions. I could have been more determined in the decision-making process.

Another lesson learned is the importance of documenting. At the start of the project, I have not formed a good habit of recording and

organizing materials, which lead to difficulties in research report writing. As the project went on, a good habit was gradually developed and helped me in the final deliverables writing.

It is a precious opportunity to work with an organization and solve problems in real life. During the project process, close contact was kept with eight employees from the OMC (the Amsterdam Municipality and the Johan Cruijff ArenA, specifically). Working with colleagues from different backgrounds indeed increased the difficulty of communication, but also prompted me to think in different ways.

Overall, this project not only let me make use of what I learned during the design study of past years but also brought me a lot of new things. I enjoyed working with the supervisory team and colleagues from the OMC, and I believe this project will have a deep influence on my future career as a designer.

References

Anagnostopoulou, E., Urbančič, J., Bothos, E., Magoutas, B., Bradesko, L., Schrammel, J., & Mentzas, G. (2020). From mobility patterns to behavioural change: leveraging travel behaviour and personality profiles to nudge for sustainable transportation. *Journal of Intelligent Information Systems*, 54(1), 157-178.

Bangor, Aaron, Kortum, Philip T. and Miller, James T. (2008). "An Empirical Evaluation of the System Usability Scale". *International Journal of Human-Computer Interaction*. 24 (6): 574–594.

Bauder, M., & Freytag, T. (2015). Visitor mobility in the city and the effects of travel preparation. *Tourism Geographies*, 17(5), 682-700.

Bland, D. "Agile coaching tip – What is an empathy map?" 21 April 2016.

Brooke, J. (1986). *System usability scale (SUS): a quick-and-dirty method of system evaluation user information*. Reading, UK: Digital Equipment Co Ltd, 43.

Coney, K. (1977). Order bias: The special case of letter preference. *Public Opinion Quarterly*, 41, 385– 388.

Council, D. (2005). A study of the design process. *Eleven lessons: Managing design in eleven global brands*.

Eagle, N., Pentland, A., Lazer, D., 2009. Inferring social network structure using mobile phone data. *Proc. Natl. Acad. Sci. (PNAS)* 106 (36), 15274–15278.

Eck, R. W., & Montag, D. A. (2003). Traffic effects of fairs and festivals on low-volume roads. *Transportation research record*, 1819(1), 260-264.

Endmann, A., & Keßner, D. (2016). *User Journey Mapping—A Method in User Experience Design*.

i-com, 15(1), 105-110.

Find a parking area for your visit to the ArenAPoort. (2020) Retrieved from <https://www.parkerenarenapoort.nl/en/booking/locationgroup.html>

Gemeente Amsterdam. (n.d.). *Gebiedsagenda Amstel III 2016-2019*.

Linda, S. T. E. G. (2003). Can public transport compete with the private car?. *latss Research*, 27(2), 27-35.

Miaskiewicz, T., & Kozar, K. A. (2011). Personas and user-centered design: How can personas benefit product design processes?. *Design studies*, 32(5), 417-430.

Tanis, J. (2016). *Mobility Management for events in ArenAPoort*.

Phithakkitnukoon, S., Horanont, T., Lorenzo, G.D., Shibasaki, R., Ratti, C., 2010. Activity-aware Map: Identifying Human Daily Activity Pattern using Mobile Phone Data. MIT-Senseable City Lab, Boston.

Rizwan, P., Suresh, K., & Babu, M. R. (2016, October). Real-time smart traffic management system for smart cities by using Internet of Things and big data. In *2016 international conference on emerging technological trends (ICETT)* (pp. 1-7). IEEE.

Smelser, N. J., & Baltes, P. B. (Eds.). (2001). *International encyclopedia of the social & behavioral sciences* (Vol. 11). Amsterdam: Elsevier.

Stojanovski, T. (2019). Urban form and mobility choices: informing about sustainable travel alternatives, carbon emissions and energy use from transportation in Swedish Neighbourhoods. *Sustainability*, 11(2), 548.

Stopczynski, A., Larsen, J.E., Lehmann, S., Dynowski, L., Fuentes, M., Participatory Bluetooth sensing: a method for acquiring spatio-temporal data about participant mobility and interactions at large scale events. In *Pervasive Computing and Communications Workshops (PERCOM Workshops)*, IEEE, March 2013, San Diego, CA, 242–247.

Visiting ArenAPoort. (2020) Retrieved from <https://www.arenadistrict.nl/visiting>

Xu, Y., & González, M. C. (2017). Collective benefits in traffic during mega events via the use of information technologies. *Journal of The Royal Society Interface*, 14(129), 20161041.

Appendices

Appendix A	Expert interview notes	128
Appendix B	Questionnaire results	143
Appendix C	Brainstorm Session	150
Appendix D	Co-creation Session 1 Board	152
Appendix E	Co-creation Session 2 Board	154
Appendix F	Ideation Evaluation	156
Appendix G	Evaluation Sheet (Visitors)	158
Appendix H	Evaluation Sheet (OMC members)	164
Appendix I	Project Brief	167

Expert Interview 1

Participant role: Strategic designer in Amsterdam Municipality

Date: 05-01-2020

Comments:

- Scope down now. Focus on the problematic behavior: How to make private car-drivers change their behavior to other modality?
- (Also need to find reasons to support this scope down: is this one of the big problems to the OMC)
- OMC modality preference: walk > bicycle > public transport > shared car > private car. Thus, letting private car drivers change to other modality is a valuable topic.
- Then comes the problem: You need to know why private car drivers choose to take private cars instead of other modality. You need to find reasons behind their behavior.
- How to get access to these private car drivers to find out the motivation behind their choice? What is a sizable group to get insight?

Expert Interview 2

Participant role: Traffic tactics advisor in Amsterdam Municipality

Date: 05-14-2020

Different modalities have their own problems.

Problems of private cars:

- Normally, parking lots are enough. (Borrow some parking lots in the nearby business area)
- Ingress and egress are the biggest problems.
- Ingress: Assign traffic to parking spaces.
- Egress: Need to leave the area in about 4 or 5 quarters. Especially when we have a triple, we get 10,000 to 12,000 vehicles. Crowded on the road.
- People listen to the navigation instead of the traffic displays.

Problems of public transport:

- For now public transport during events is not sufficient for the event situation. Especially the Egress. Because the Ingress spread over about 2-3 hours, but the Egress is in one hour.

- Get congested in or around the train station. Dangerous. We control the amount of people inside the station. It's easier to manage them outside.
- Most visitors use Bijlmer Arena. Just a small percentage of the people use Duivendrecht and Strandvliet. Strandvliet is not attractive.

Problems of Taxis:

- Special places for taxis in the area.
- A bigger problem is Uber-like taxis, because they can't use the facility we have for taxis (TTO taxis). They can pick up people everywhere. So we have an agreement with Uber, your pick-up point must be at that location.
- Uber is growing. We don't have enough space for Uber-like taxis as pick-up spots.

Problems of kiss & ride:

- Don't have a place for a kiss & ride. (events like BTS, have a lot of kiss & ride)
- Kids come by train and go back by kiss & ride.
- They stop wherever they like, causing a traffic disruption, and then leave as nothing happened.
- If we reserve an area for a kiss & ride, it costs money because there need to be traffic managers there. People need to pay one euro, but they don't want to pay.

Factors that influence mobility choice:

- Type of events.

Ajax, dutch championship. Visitors are familiar with the Arena, they will listen to their experience instead of display guidance.

Dutch national team, or concerts, visitors are from all over the country, they are easier to manage because they don't know the area that well, they listen to the advice better.

- Visitors from far away are more likely to take private cars. Because events usually end late, they probably won't get the second train. People take private cars because it's easier.
- Weather. In Ajax games (more Amsterdam fans), if the weather is good, a lot of visitors come with metro, bike, motor. Totally different than rainy and cold days, then we get a lot of cars in Ajax games.

Current intervention

- Ingress: Dynamic displays to assign traffic to parking spaces. (Problem: People listen to navigation instead of looking at displays)

- Egress: Send them outside of the area in about 4-5 quarters. Block roads so the intersections stay free. Make them don't meet, because they have to wait for the other if they meet.
- Use 25 scenarios. If situations happen, we can turn on measurements so we can act on the situation all the time.
- Digital dynamic displays, change the text real time.
- Control of traffic lights, give some direction extra green.
- Cooperate with Google. Virtual block roads on Google maps. Trying to do the same with Apple maps and Tum Tum.
- Plan: use other roads, other traffic lights.
- Put out traffic managers, spread the congestion.
- Train station: upgrade the environment from Duivendrecht train station to the arena. The road would be better, the bushes would be grown. Hopefully people will use that more.

Current data we use:

- Camera, to see important roads.
- A floating car data, Google data, to see how busy the roads are.
- Check-in, check-out data at the stations, so we know how many people are coming and going with public transport. (in progress)
- Parking space data. Some are manual, to know how many parking lots left. (working on change it to automatic counting system)

Ingress and Egress are different.

- Ingress is manageable.
- Egress is on the fly.
- Ziggo Dome and AFAS, events between 10,000 and 30,000. small OMC.
- Arena, >30,000. big OMC.

Influences of residents:

- We've been conducting traffic management for 3, 4 years now, people eventually know that during events, it's better not to go that direction.
- Ingress not too much, we don't block roads, just give some directions extra green. When it's busy, it influences residents.
- Egress we block roads. But Egress is most likely around 9,10,11 o'clock, everybody is already home.

Expert Interview 3

Participant role: Behavioral Scientist in Amsterdam Municipality

Date: 05-17-2020

General methods of behavior research:

1. Qualitative research. Target group, do interviews about them, why do they choose one modality over the others.
2. Questionnaire. Based on the reasons you already have. If you want a bigger target group.
3. Make a customer journey from the beginning to the end. What do people experience when they take different modalities? Then you can see what are the highlights of the journey, what is nice, what is discomfort. Then discuss the results.
4. To find out what components are most important for people's choice.
5. 80 behavior influence techniques you can implement. 85% of behavior decisions are subconsciously. They don't make a very rational decision. So a lot of influence techniques you can put on your intervention.
6. In the beginning, just diving into your target group to see what motivates them, why do they feel that way about certain mobility.

How to do test:

1. Go to the public space, write down how people are behaving, and the way you want them to behave.
2. Questionnaire. Ask them their self important measures about behaviors. Less effective.
3. Long-term effect track.
4. How many parking lots are full? How many people are from the train? Ask the Arena who sells the ticket.
5. Make it as easy as possible. After they buy tickets, a poll to ask them how they are going to go to the Arena, then collect information while giving advice.

Expert Interview 4

Participant role: Consultant Mobility & Environment at Johan Cruijff Arena

Date: 05-18-2020

Stakeholders:

- Venue: JCArena, Ziggo Dome, AFAS Live. Simultaneously events, share information and share data, to have a good overview of everything. Work closely on several layers of communication. Commercial party. Their interest is to make customers satisfied and come back to the venue again in the future.
- Municipality, responsible for the public space, public roads
- Police
- Public transport operators of the Dutch railways and the municipal railways GVB.
- Parking operators
- Event organizers: fan care department of Ajax, the social media department of the KNVB (Dutch national football association)
- Mobility Portal (route planner), how to travel to and from the JCArena with big scale public events
- Arena Boulevards, with a lot of companies, food and drink venues.
- Work together on area developments, crowd management, measures, communications.

Kinds of events in the Johan Cruyff Arena:

- home of Ajax
- the Dutch national team
- concerts
- dance events

Current transport situation:

- 60-65% of visitors come by car.
- 30-35% by public transport.
- 0-5% by bicycle or being dropped-off or taxi or other transportation.
- (average we see with Ajax matches.)

Transport situation about the Arena area:

- Arena well known for its roads, surrounded by national motorways A1, A10, A9, A2.
- A good connection with public transport. A regional bus station very nearby, big train station, connects to the subway/metro network of Amsterdam.

Preferred view on the modality:

- Public transport is being used more efficiently. We would like to see a shift from vehicles towards public transport.

- Currently, most people come at the same time to the area. No real spread in arrival times or departure times. We would really like to improve.
- We prefer people come to the area spread over time and use more of the area, leisure, food and drinks, have dinner and a drink before going to the event. After the concert, stay a little bit longer in the area, helping the congestion on all modes of transport.
- Challenge: the public transport hubs like the Bijlmer ArenA station are limited now on the capacity of passengers they can process during a specific time.
- An improvement on the train station itself is needed. And the platforms.
- Currently, there is only one access point towards the platforms. You can improve it by adding other access points to the platforms. So you can divide the influx of the outflow.

How to make people stay longer after events:

- Let the metro network run 24-7. At least prolong the timetable of the metro. It will improve the area's attractiveness for people to stay longer after events.

Why do people take private cars:

- If you are with 2-3 people, it's cheaper to go by car. Parking costs are like 25 euros per car. No increase in the price of parking but they should decrease prices of public transport.
- Public transport is already quite crowded. People would prefer space around them. People prefer being in a traffic jam than being in a overcrowded, busy train/bus/metro.

Research:

- A collaboration research between the Municipality and the Arena. A company to do it.
- They literally go around each parking facility, counting the number of vehicles.
- Ingress, on each car they check how many people are inside. Ajax game, 2.3 people on average in each car. Concert, 3.4 people.
- Questionnaires. Ask people how they come here, how people perceive the access of the area, what their motivation to choose their modality, what's the biggest hassle they come across so we could improve our services.

Characteristics of visitors who take private cars:

- When we have a late match, people prefer to take private cars.
- If you live far away, come here to a late match, you are not able to go back by public transport. So public transport is not an option because of the timetables.
- The comfort of their own car.

- Cheaper than public transport.
- Some people hate public transport because it's always running late or trains failing. Bad experience or impression.
- A status thing. If you come by car you are more luxurious.
- It's quicker.

Factors that influence mobility choice:

- The time of the day. If it's an early match (6:30), people come directly from their work, have laptops with them. The use of public transport is a little bit higher.
- Type of the day. Workday/weekend.
- Time of year. Nice weather, a lot of bicycles or scooters. When it's cold, the use of public transport and vehicles is rising.
- Type of events. Base of Ajax fans and Dutch national team fans are different.
 - Dutch national team events are more of a family event, a lot of families come with children. A lot more people inside one car.
 - Ajax game people come with friends. They like to have a beer before the match and go by public transport then they can drink beer.
 - BTS, teen idol. A lot of kisses & rides. Also it's normally in the evening. They come by public transport, but when it ends, it's already dark outside, so they're being picked up. A different modal split for the inflow versus the outflow.

Managing different types of transport:

- Kiss & ride is difficult to manage, especially parents picking up kids, children don't have battery left, this makes parents anxious, so they will not follow regulations of traffic managers. Difficult target group. Pick-up spots can be different from drop-off points.
- Don't have a pickup, drop off point for large groups now.
- North to the arena, a smart mobility hub is being built. Dynamic in the usage of the hub. Not only for parking, but also for bus parking, taxi pickup dropoff, kiss & ride for parents.
- Taxi. Two kinds. Uber-like taxi and normal taxi. Normal taxis just stand in line and wait.
- Problem of Uber-like taxi. Drop-off wherever the passenger wants to, because Uber has a rating system. Although we do have some agreements with Uber on specifically pickup points.

- But in the outflow, they do have a designated area where they can pick up their customers, and this does work. If you order an Uber, there's only one pickup place and it's shown on your mobile phone. But still some customers contact the driver saying, you are going to pick me up there.
- talk to the taxi team of Amsterdam. (and also the public transport team?)

How do you do research?

- A company.
- We also have a survey. If you use our Wifi, then you accept that we use your email for the purpose of a survey. A lot of questions on the customer journey. Inflow and outflow covered in the survey, give the grade of how we are doing in that part.
- Also a survey for people who use the mobility portal for parking (to reserve parking place). Survey about how they experience in the process of booking a ticket. Also give them personalized information with the route to travel. How they feel on the inflow and outflow journey.
- We would like people to come back to the stadium again, so we would like to provide them with a good experience from when they leave their home to when they go back to their home.
- Open questions to give us suggestions. More traffic managers, more trains. Anything we haven't thought already?
- Balance between good service and reasonable investment.

Expert Interview 5

Participant role: Data scientist in the Amsterdam Municipality

Date: 05-19-2020

Work Content for Municipality

- I'm from the transport and public space department.
- Make a crowding calendar, a crowding monitor.
- Crowding modeling for Johan Crujff Arena, information with different modalities.
- I started with parking. Also traffic lights, NDW data, Mitchell data warehouse, probably public transport data from GVB, and also plan to get pedestrian data.

(NDW data: nationale databank wegverkeersgegevens, national road traffic data database, open data.)
- CTO is working on traffic light information to keep it up to date.
- *** working on GVB data.

About working on the model

- Before the intern started, I made a model for parking.
- *** is working on traffic lights.
- *** is working on GVB data.
- Main working purpose: use computer science stuff to see if we can improve the model. Classification problems. Make a model for a specific traffic light, then extrapolate it to the road network, then put it on the map. Map it through the CMA (Amsterdam Traffic Model), make these traffic lights to the Amsterdam Traffic model network, plot these predictions on a map.
- Linear model. A baseline congestion, irregular parking congestion given a specific season, time of the day, day of the week. e.g. Monday morning at nine o'clock during summer, they expect to see a certain congestion. This is what we call the baseline.
- Then think of some other variables. One thing is offices. Events. How long before the event, sometimes steep inflow before the event. A steeper outflow after the event. Everybody leaves at the same time.
- We have some data about model split during events, but these are not complete.
- *** said, for some events, they asked how are you planning to travel to the event, and then they updated the event list with this information. Here are some estimates about how many people come by car or other modalities.

What are the characteristics that have predicted value?

- This is what I think is a bit haphazard in the current model, and that's what *** is working on his project: to have a better classification of the events.
- Current event classification: If it's in the Johan Cruyff Arena, or if it's an Ajax game, or it's an Ajax open day, international matches from the Dutch national soccer team, other events in the Arena, and also a model for the Ziggo Dome events, AFAS events, (and one more). These are separate models.
- They assume them to be roughly the same in behavior, but this assumption is not correct. I think the model predicts reasonably, but you could have different kinds of groups. e.g. If a famous 50s female singer came to have a concert, or a pop star like Justin Bieber came, they would attract completely different crowds, and also completely different modalities. (Thus one main problem of the current model is that, for the same kinds of events, like for concerts, there might still be a huge difference in mobility behavior, because the artists are different.)
- *** is looking into how can we model this, how can we separate this. Because most of the artists came only once. So how can we segment them in a way that makes sense. (How can we make predictions for those artists who come for the first time.) The model is a bit haphazard. For Ajax matches, it predicts really well because these

matches are the same. But for those events that do not happen regularly, it's hard to make predictions.

- I've only focused on parking. And now we are extending a model with others, like traffic lights information, GVB information.
- For some specific events it's hard to manage because there are so many cars coming at once. One example is the Stalker's (?) concert for instance. Then it's just really crowded in terms of parking. So you can imagine that *** is looking for ways to stimulate people to use other modalities, which would be better.

How will you make use of the model?

- For people to think about what events are important, and how we should change, what can we do to change, traffic managers will know what conditions are high risk so they may prioritize these, e.g. to see which direction has the most terrible congestion, then give more green on traffic lights.
- If you want to take precaution measures, then you first need to know when this congestion will happen, and that's what we are trying to do.
- Be aware that the direction is also important. Because for some events, you get more people from the east, and sometimes you get more people from south. Where they enter the city, and the parking garage also makes a big deal. If more people are from the south, then you need to direct them also to the north.

Random ideas

- If you could find a way to separate people, to separate the outflow. e.g. After a football match, let someone that is good but not that good to give a performance, then some visitors will leave and some visitors will stay longer.
- Encore helps to split the outflow a little bit.
- During dinner time, the inflow is also less difficult. Some people have dinner at home and then come, but also many people come early and have food in the area. Whereas when they go on weekend morning, they come all at once. So if you can let people do not all come at the same time.

Expert Interview 6

Participant role: Data science intern in the Amsterdam Municipality

Date: 05-27-2020

Data we have

- VRIs data. Cars on intersections and lanes.

- Only the data for cars and taxis. For car lanes, it's every car that passes over the thing that counts. There is no distinction between cars and taxis. But you might be able to find that in the taxi data.
- But not for buses, because buses have their own lanes, so they have a different counter.
- *** is working with GVB data. (trams and metros) That's also aggregated data but I know that it's possible to see how many people travel and which station they check-in and check-out.
- At some point, the taxi data will also be available. I'm not sure if that's ready yet, but I know *** was planning to get that as well.
- At some point they'd like to have data from OV fiets, that's the bicycles that you can rent at the stations.
- And probably trains data from NS. But not available yet.

Working process

- First, make a baseline. I also have events data, about 1100 events of the past three years.
- Then I took out all events data from the VRI data. Then I made a baseline (an average) for every day of the week. So we can see for each day, how busy it is when there's no event?
- Then I took VRI data from all events. With some machine learning, I'm trying to predict how busy it will be at certain junctions.
- So we have historical data, so we see for different junctions around the event times we see big peaks of traffic intensity, so a lot of cars will pass through and maybe there's even congestion. We are trying to predict those.
- In the background of coronavirus, We trained a model on a part of the data, and then we use another part for validation so that we try to predict an event that's already taken place and then we can see how close it is to the real data.
- I'm now finalizing the model and trying to visualize everything with graphs and a map of Amsterdam. Then the Municipality will decide if it's reliable and if they are going to use it. Then we need to go to the traffic management department.

Traffic situation

- From 15 mins to 45 mins after the event, there's the biggest peak. Then it goes like a normal curve (Gaussian curve), flats out. Everyone tries to leave the venue, and for 30-45 minutes there will be really busy. We are trying to map at what junctions these cars go, which direction will they go, and what's the ratio.

- Before events: On weekends, it's a more flat curve, some people come early to have meals or watch movies. It's way more steady. On weekdays, 4-6 is the rush hour, sometimes it's hard to distinguish between rush hour and visitors for events.
- It also depends on how many visitors because normal soccer games have 50,000 visitors, but some concerts have only 5,000 people.
- Weather can also be a characteristic. Average day temperature and the precipitation. That's aggregated by the hour. It will impact people's decisions.

Suggestion

- Before you motivate people to change modality, you would have to know where people come from. Sometimes a lot of visitors come from Groningen, sometimes a lot from Zeeland. It's hard to say beforehand. That's why we are trying to get data from the event venues or ticket sales, so that they might know the age group and where people are from so that we can give a better prediction.

Expert Interview 7

Participant role: Data science intern in the Amsterdam Municipality

Date: 06-17-2020

GVB data.

- Data comes from OV check machines, including data of the number of people entering & exiting a station at each station, the location (latitude and longitude) of each station.
- Data is split by the unit of daily and hourly. The smallest time unit of GVB data is one-hour. Not possible to split that down anymore.
- Working on predicting how many people will come from which station, how many people will arrive at which station. Stations that people are mostly arriving at and leaving from. Knowing the number of visitors using one particular route.
- Start with machine learning, then deep learning approach, neuro-based.

How visitors behave depends on:

- The type of the event. Football matches (championship, national teams, Ajax), music events (round performance in the Netherlands, only happens in Amsterdam), comedies, working events, training.
 - if it's a national round, then it might attract more visitors around Amsterdam, and if it only happens in Amsterdam, then visitors will come from nationwide.
 - Some events attract more older people, some events attract more younger people. Older people are more likely to drive a car.

- The time of the day
- Where do people come from before the event and where do they would like to go after the event, maybe tourist spots.
- The type of people who come to the event
- Demography, composition, origin of people who come to the event.
- Weather.

Get enough variables of the whole picture, and the combination and interaction of the variables, then it will be very predictive.

A mix of modality

Hypothesis: most of them arrive by car, and park at some place that can get much cheaper parking.

Mobility is not always the most important thing in event management.

- In the past, some football matches caused fights and criminal damage. So in some events, the highest priority is to avoid a large crowd of people on the street. For other events the most important thing is the congestion on the roads.
- All these things might happen, but for each event, which of these things are more likely to happen? Although the violence, the fight can cause big damages, it only happens once every ten years. But for congestion on the road, it happens everytime.

A strategy

“I think what would be best would be like, let’s say, a strategy which is able to react to realtime data, have a number of different priorities, then it would have a number of different solutions for each priority. I think that would be the best approach to take. “

Border of congestion

“We have data to say it’s more congested or less congested, but we don’t have data to say if the congestion is too high. We don’t have the data to say, okay this is the border that congestion will cause a problem. So as to the congestions of crowds. We don’t have the data to say okay now it will be a problem to us. “

Expert Interview 8

Participant role: Account manager and adviser at Besite, the company made Mobility Portal

Date: 08-04-2020

The proportion of visitors use Mobility Portal.

- A growing line of users. Generally 35% - 45% visitors use Mobility Portal.

- Ajax matches visitors don’t use it that much, they come every two weeks, they know their way.
- For people who come to concerts, this might be the first time they come to the Johan Crujff ArenA, they are less experienced in how to come, then they use the Mobility Portal for more advice and information.

Mobility Portal usage.

- Mobility Portal is a wide label portal, website of Johan Crujff ArenA, and also the application. People don’t download applications easily anymore. So we put it in the website and application of the Johan Crujff ArenA, and also other applications like Zwarte Cross.
- Marketing is important, that is what the Johan Crujff ArenA use: social media, newsletters, to get people to the mobility portal.
- Some other events at other locations also use the Mobility Portal.
- Arenapoort.com
- <https://www.johancrujffarena.nl/en/bezoek-de-arena/naar-de-arena/>
- <https://www.parkerenarenapoort.nl/en/booking/locationgroup.html>

Reduce the traffic jams on the road during the peak hours.

- Survey, we got good results.
- We give suggestions of the parking spot. If the visitor comes from the east then he/she will get the recommendation of parking spots on the east. The visitor doesn't need to go across the Area.
- “We guide them directly to the parking lot. It will be better if you use the mobility portal instead of doing it on your own searching by Google Maps.”
- Also give the advice of the last mile trip, from the parking lot to the venue.

Product logic

- Three phases: booking a ticket, between ticket purchasing and the event day, on the event day. Currently the product is mainly used on the event day.
- Clear, fast booking of traveling tickets in advance.
- Now because of the COVID-19, visitors come on different time slots, so need to add a time slot regulation on the mobility portal.
- Input the event, the location of departure. Then you can choose the modality, and book a hotel.
- Based on the departure spot, you can choose a parking spot.
- Input the email address, to contact visitors. Reserve and get the parking ticket.

- Phase two is a bit different. It will suggest the visitor which modality is the best.
- People will see the whole trip. Not only the trip from the starting point to the parking lot, but also from the parking lot to the venue.
- Use APIs to cooperate with booking, google maps.

Other modalities

- Route and parking
- P+R
- Plane

How the Mobility Portal used the data that was collected from visitors?

- A dashboard, with the number and the proportion of visitors take different modalities. Weather, Temperature. Where these visitors are from. (created by Johan Cruijff ArenA)

“For most organizers and venues, the event starts at the entrance. But for Johan Cruijff ArenA, the customer journey starts at the couch, when the audience buys the ticket for an event.”

Questionnaire: Mobility situation around Amsterdam ArenA area during events

Hi! I'm Yu, a TU Delft student majoring in Design for interaction.

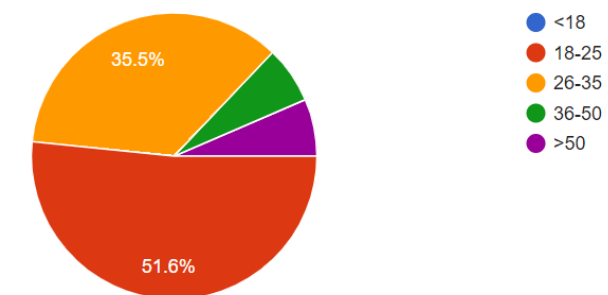
I'm now conducting a project with the Amsterdam Municipality to improve the traffic situation around the Arena area during events.

If you have ever participated in events in the Arena area (including Johan Cruijff Arena, Ziggo Dome, AFAS Live), please fill out this questionnaire to share your experience and thoughts. It contains 15-17 questions and will take about 5 minutes.

Thanks!

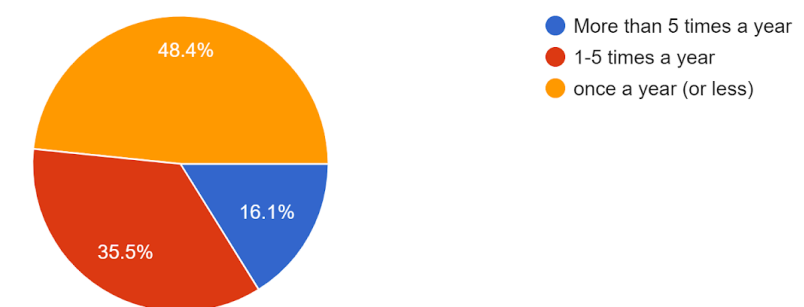
How old are you?

31 responses



How often do you visit the Amsterdam ArenA area? (Johan Cruijff Arena, Ziggo Dome, AFAS Live)

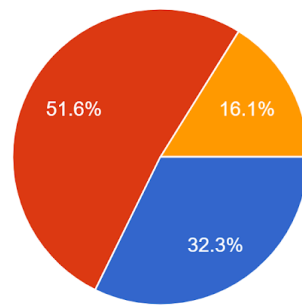
31 responses



Last-time experience

Which venue was the event in?

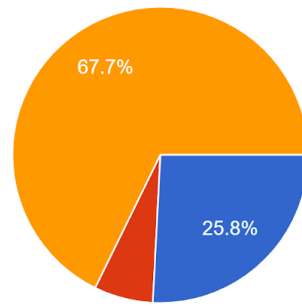
31 responses



- Johan Crujfff Arena
- Ziggo Dome
- AFAS Live

Which type was the event?

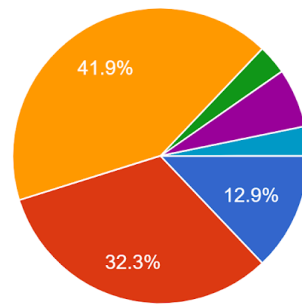
31 responses



- Football match of Ajax
- Football match of Netherlands national football team
- Concert

With whom did you travel to the venue?

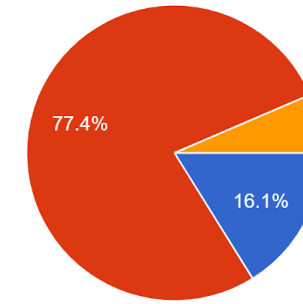
31 responses



- By myself
- With family
- With friends
- With colleagues
- With family and friends
- My partner

What was your group size when traveled to the venue?

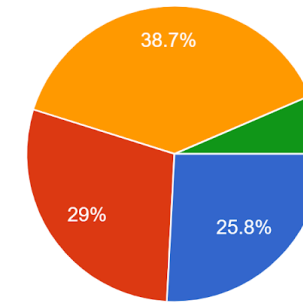
31 responses



- By myself
- A group of 2-4
- A group with more than 4 people

What is the distance from your place to the venue?

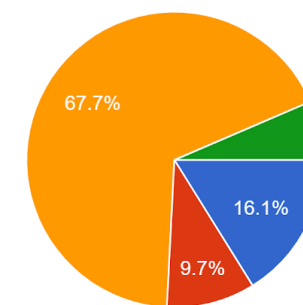
31 responses



- Less than 10 km
- 10-30 km
- 30-100 km
- More than 100 km

How did you travel to the venue?

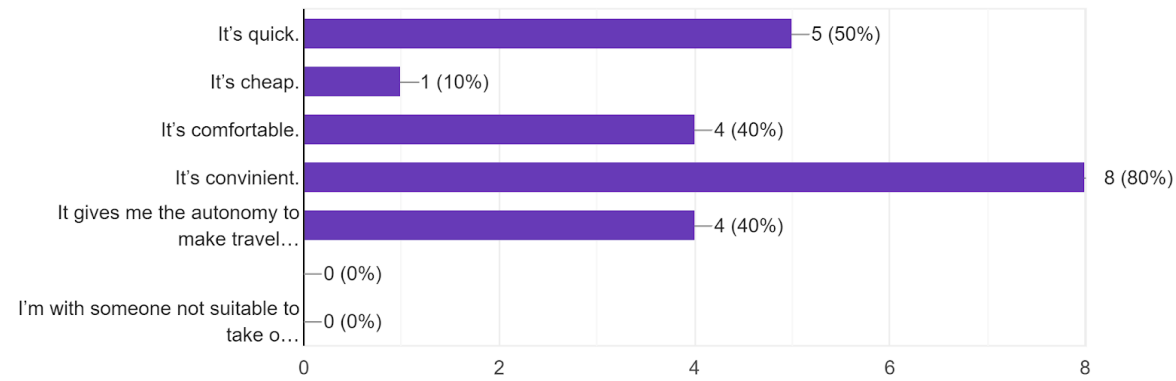
31 responses



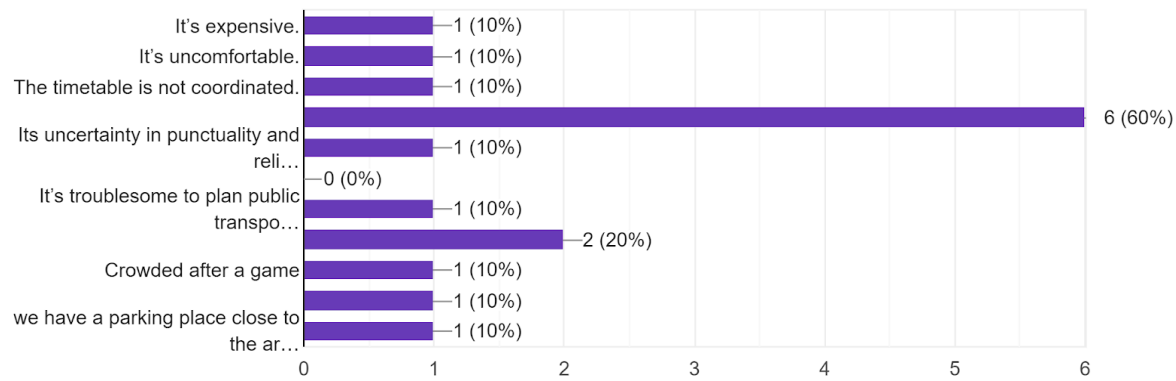
- Private Car
- Taxi/Uber
- Public Transport (train, metro, bus, etc.)
- Bicycle/Scooter

Mobility choice reasons

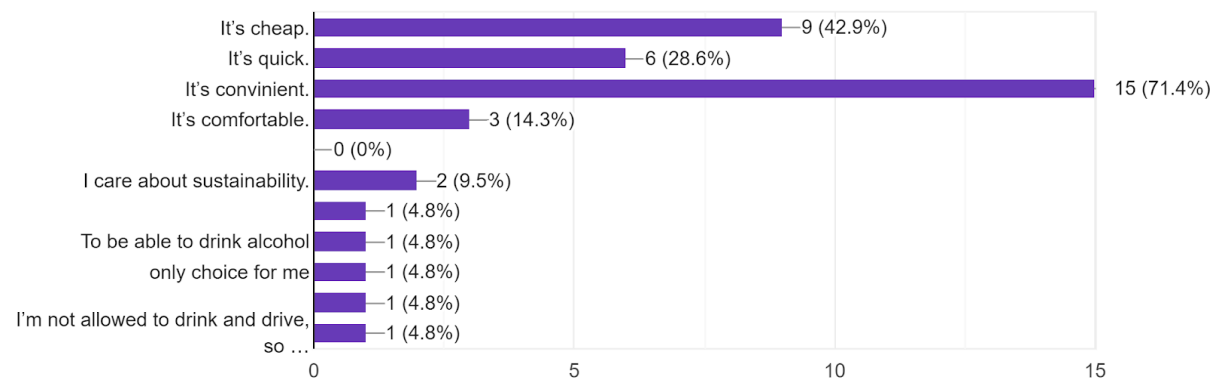
Reasons for choosing this modality:
10 responses



Reasons for not choosing public transport :
10 responses

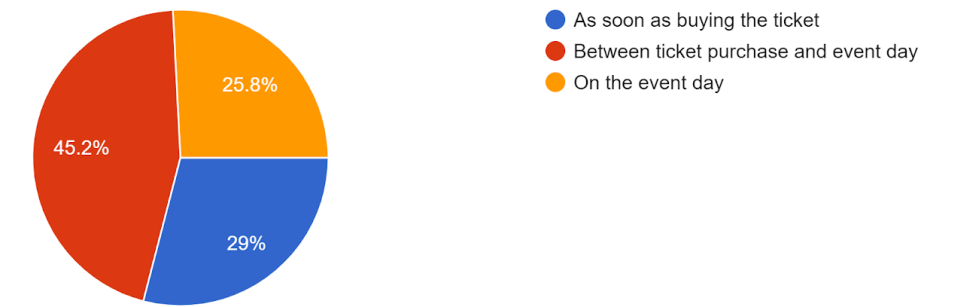


Reasons for choosing public transport:
21 responses

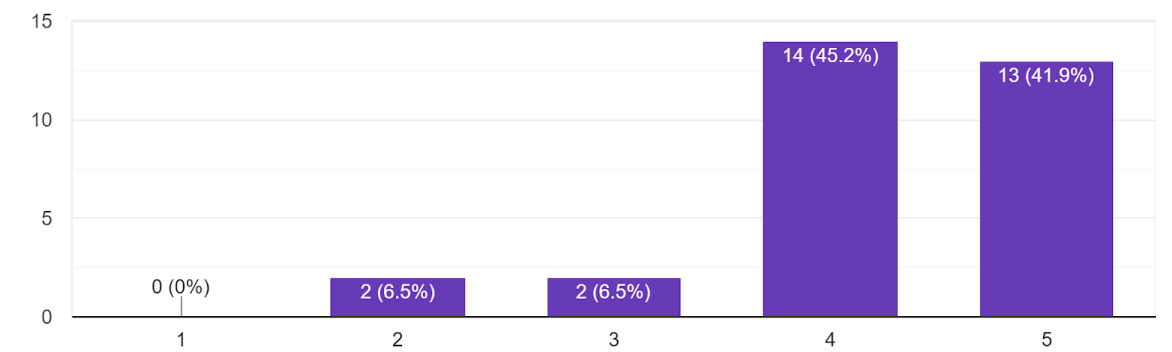


Mobility experience

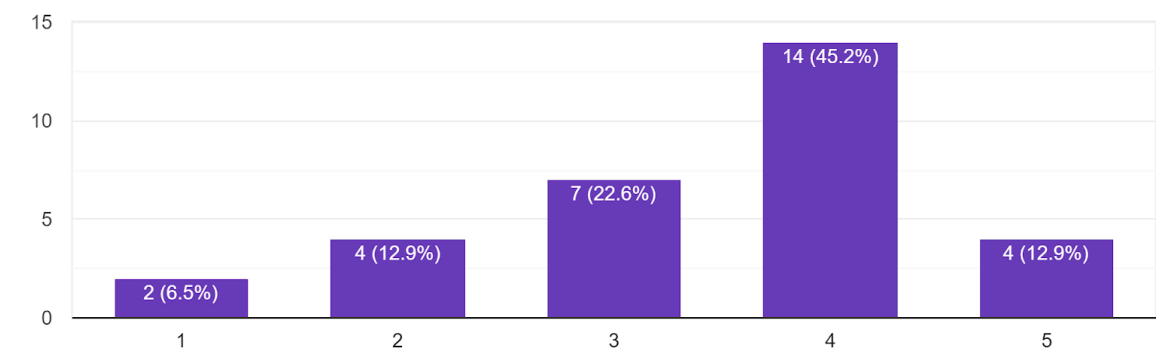
When did you decide the modality to travel to the venue?
31 responses



How was the mobility experience on your way travel to the venue before the event?
31 responses

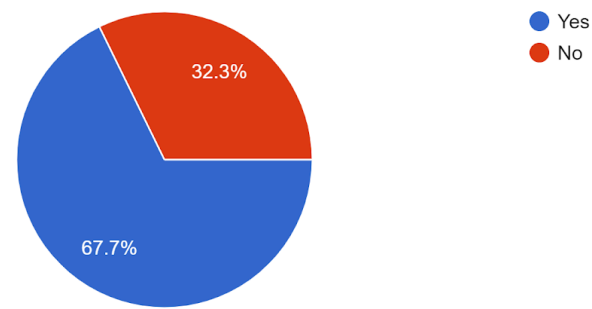


How was the mobility experience on your way to go back from the venue after the event?
31 responses



In all your visiting experiences, have you ever had other activities in the ArenaA area before or after taking part in events?

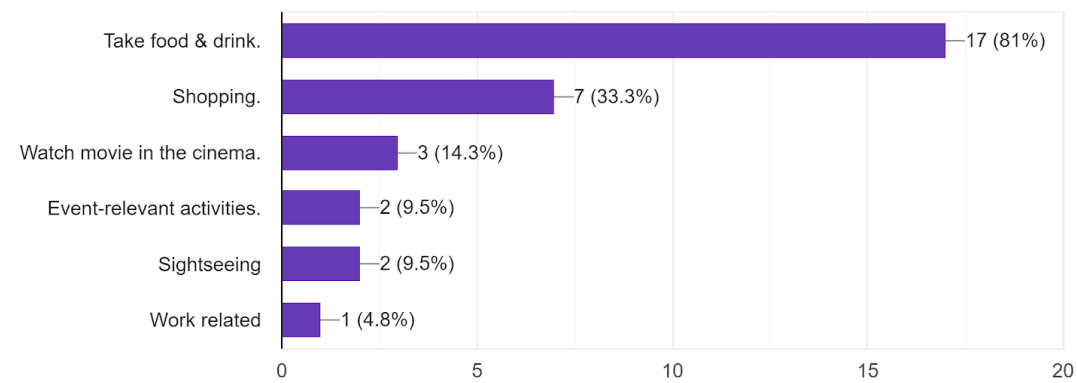
31 responses



Activity participation

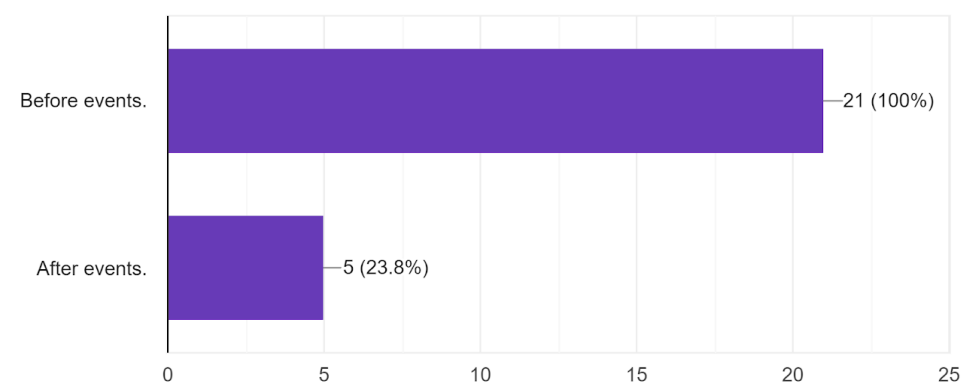
What activities did you participant in in the ArenaA area before or after events?

21 responses



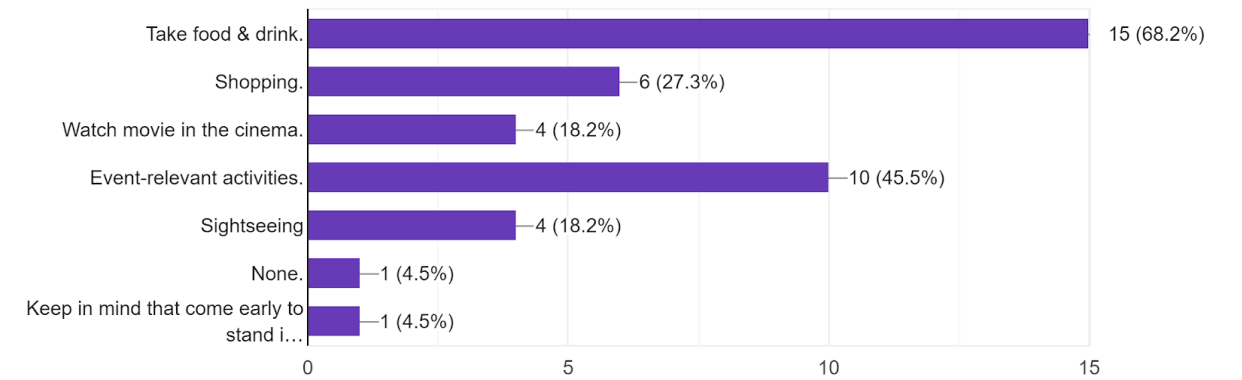
What's the time of the activity?

21 responses



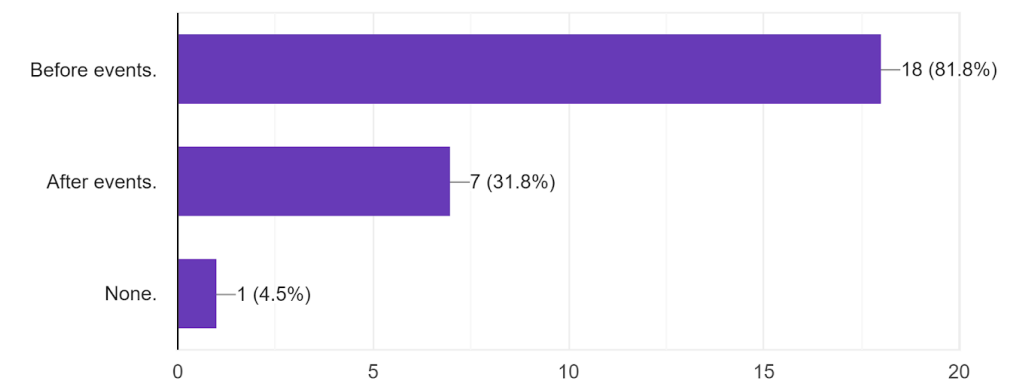
What activities you might be willing to participate in the area before or after events?

22 responses



What time you might be willing to participate in activities?

22 responses



If you would like to take part in further research (a quick online interview), please leave your email address here. That will be really helpful to me!

Improve mobility situation around the Arena area during events



Assignment

"Design an intervention to change event visitors' mobility choices by using data."

Design goal

Mobility change



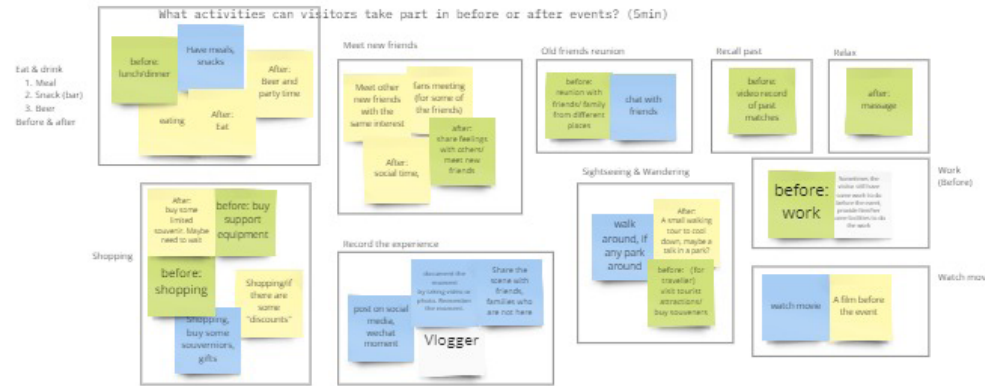
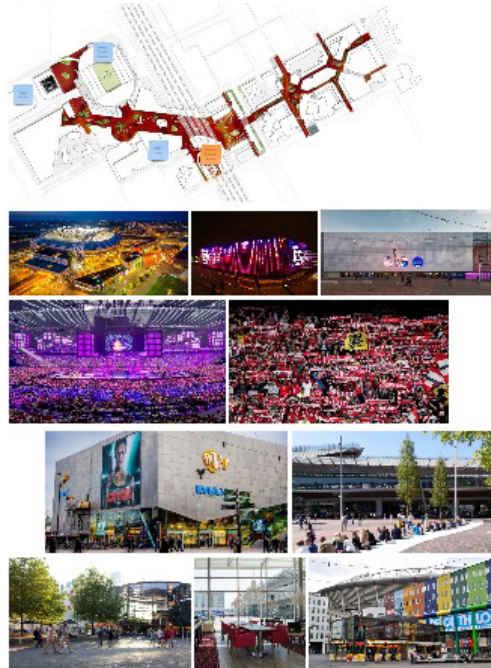
Time change



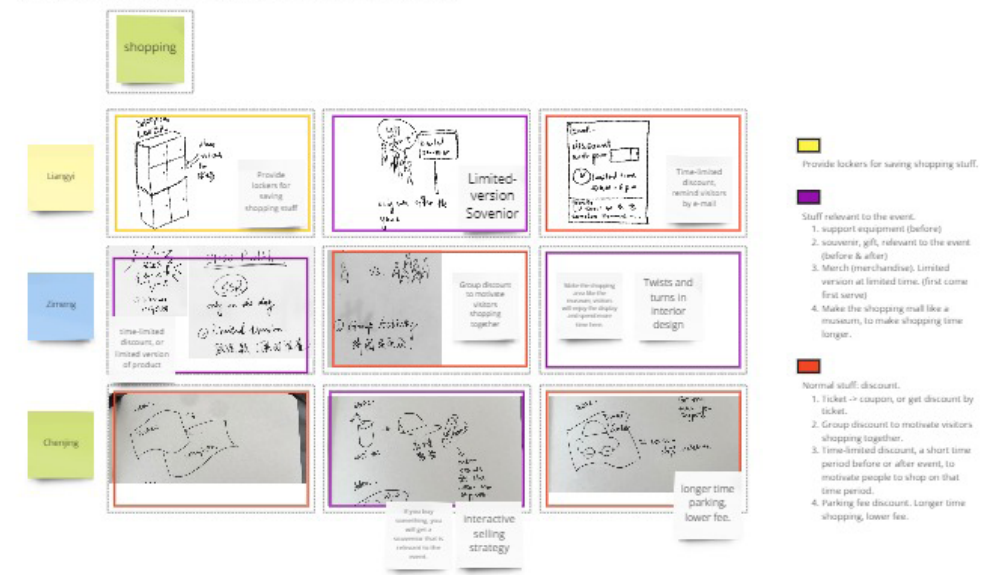
Design goal

To motivate event visitors come early before events and/or stay late after events.

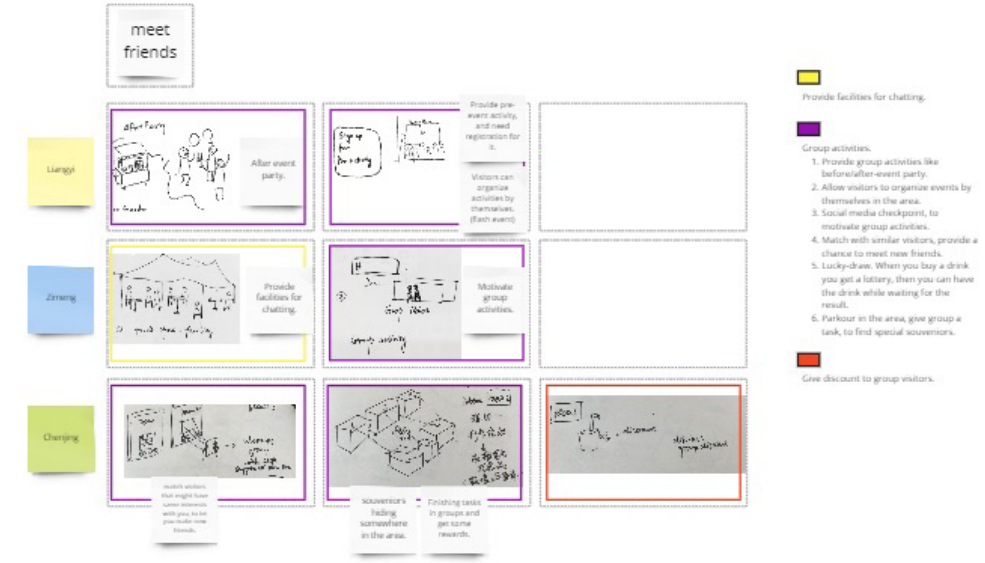
Imageboard



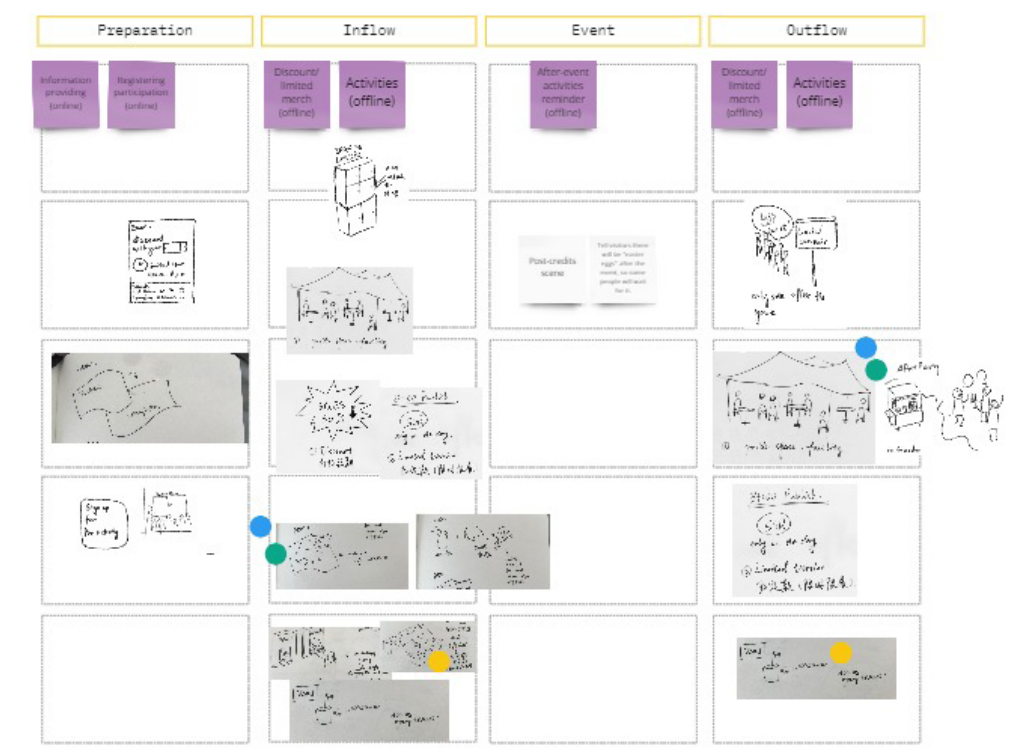
Choose an activity. How to motivate visitors to take part in this activity? (5min)



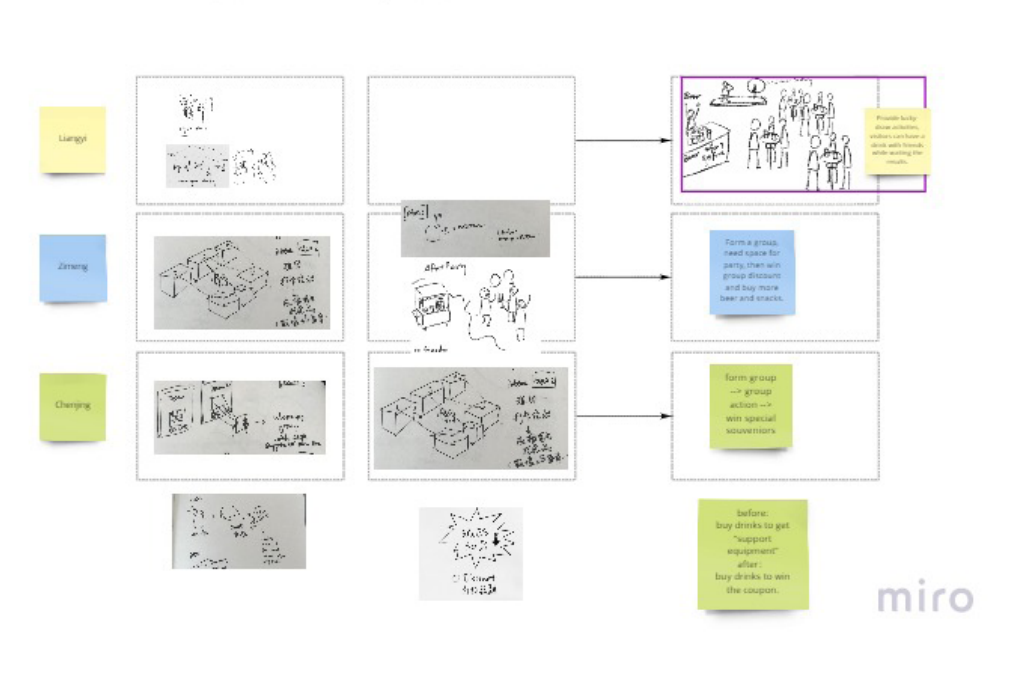
Choose an activity. How to motivate visitors to take part in this activity? (5min)



Sort concepts according to time phase.



Combine two chosen concepts, to form a new concept. (3min)



Assignment

"Design an intervention to change event visitors' mobility choices by using data."

Direction

Modality change



Time change



Design goal

To motivate more event visitors to take public transport instead of private car.

Imageboard



Research Results

Private Car Public transport



Voting

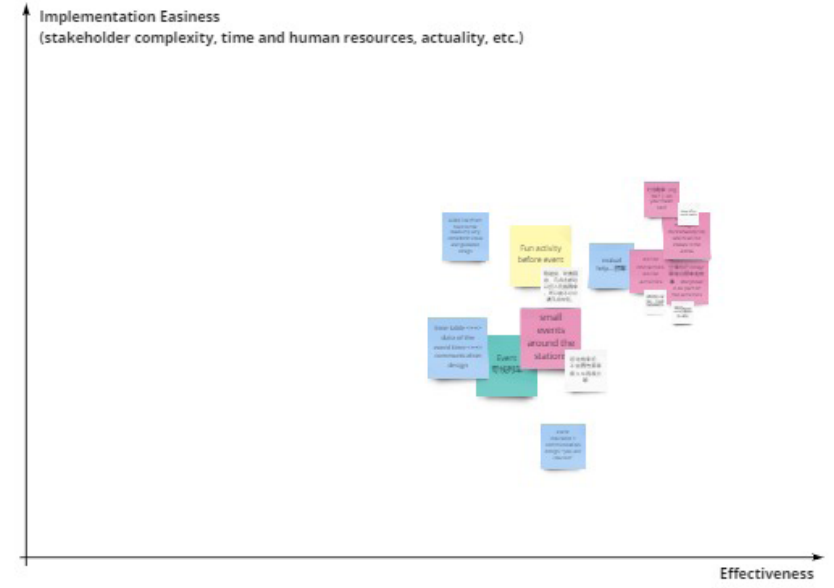
- Cheng
- Mei Mei Mei
- Xiaodi
- Sun

Which one is more effective in attracting visitors to take public transport?

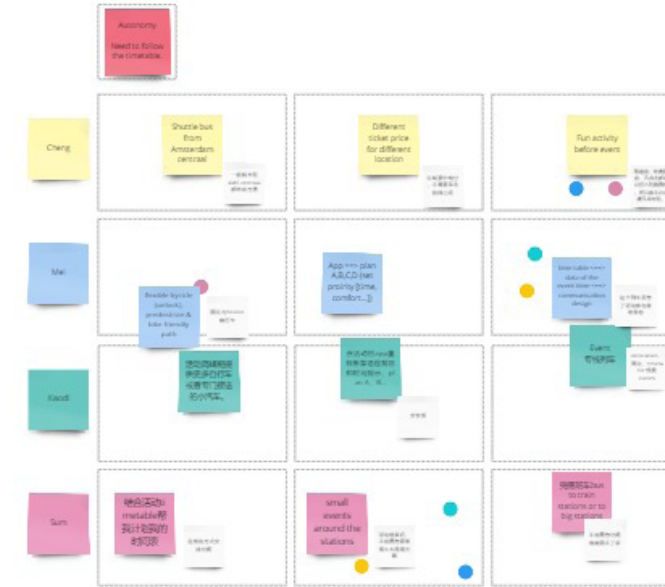
Which two are more crucial?

Assessment

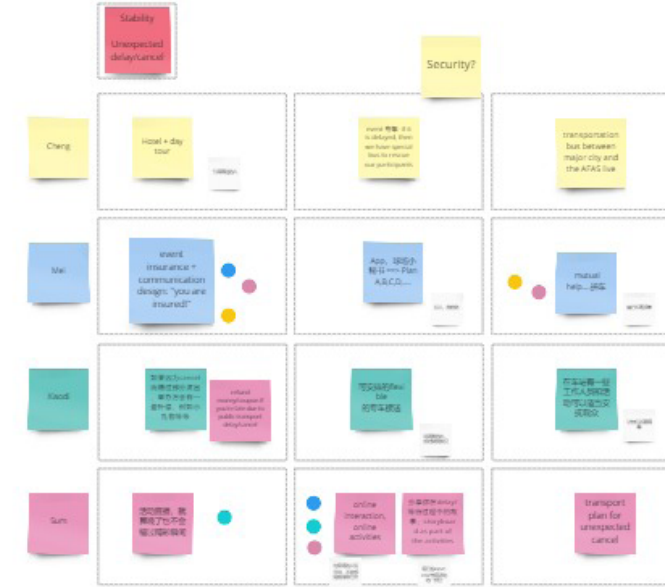
Put concepts in the axis, and explain the reason.



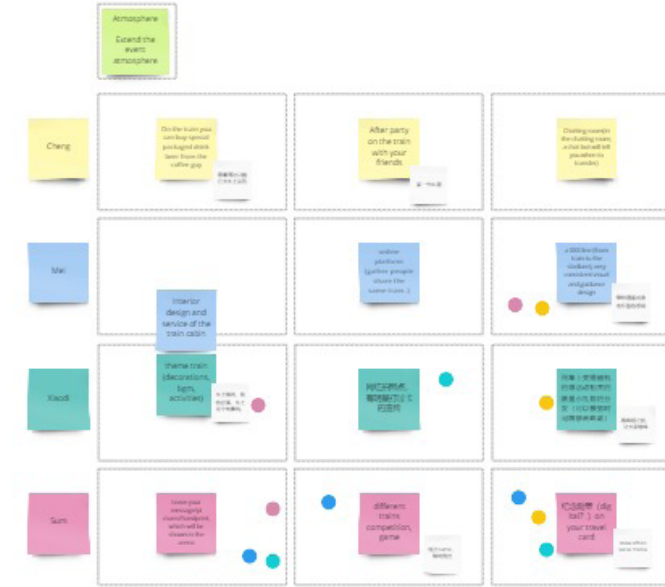
Choose a disadvantage of public transport. How to improve it, or minimize its negative effects, so that people are more willing to take public transport? (5 min)



Choose another disadvantage of public transport. How to improve it, or minimize its negative effects, so that people are more willing to take public transport? (5 min)



Choose an advantage of public transport. How to make use of it, to motivate more visitors to take public transport? (5 min)



Idea 1. Make the travel plan after ticket purchasing.

	1	2	3	4	5
Effectiveness				●	●
Comprehensiveness			●	●	●
Attractiveness			●	●	●
Implementation easiness			●	●	●
No side-effect			●	●	●
Data usage		●		●	●

1 reservation
2 plan the activities

good experience
Quick user flow

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 2. Activities reservation and group formation

	1	2	3	4	5
Effectiveness			●	●	●
Comprehensiveness		●	●	●	●
Attractiveness		●	●	●	●
Implementation easiness		●	●	●	●
No side-effect		●	●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 3. Choose travel plan according to different priorities

	1	2	3	4	5
Effectiveness	●	●	●	●	●
Comprehensiveness	●	●	●	●	●
Attractiveness	●	●	●	●	●
Implementation easiness	●	●	●	●	●
No side-effect	●	●	●	●	●
Data usage	●	●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 4. Parkour

	1	2	3	4	5
Effectiveness			●	●	●
Comprehensiveness		●	●	●	●
Attractiveness		●	●	●	●
Implementation easiness		●	●	●	●
No side-effect		●	●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 5. Match and meet similar fans

	1	2	3	4	5
Effectiveness	●	●	●	●	●
Comprehensiveness	●	●	●	●	●
Attractiveness	●	●	●	●	●
Implementation easiness	●	●	●	●	●
No side-effect	●	●	●	●	●
Data usage	●	●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 6. Landmark photo on social media

	1	2	3	4	5
Effectiveness		●	●	●	●
Comprehensiveness		●	●	●	●
Attractiveness		●	●	●	●
Implementation easiness		●	●	●	●
No side-effect		●	●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 7. Find QR Code, unlock accomplishment and get badge in the area

	1	2	3	4	5
Effectiveness			●	●	●
Comprehensiveness			●	●	●
Attractiveness			●	●	●
Implementation easiness			●	●	●
No side-effect			●	●	●
Data usage			●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 8. Personification: Travel secretary

	1	2	3	4	5
Effectiveness			●	●	●
Comprehensiveness			●	●	●
Attractiveness			●	●	●
Implementation easiness			●	●	●
No side-effect			●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 9. Quick response

	1	2	3	4	5
Effectiveness	●	●	●	●	●
Comprehensiveness	●	●	●	●	●
Attractiveness	●	●	●	●	●
Implementation easiness	●	●	●	●	●
No side-effect	●	●	●	●	●
Data usage	●	●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 10. Event live scene

	1	2	3	4	5
Effectiveness	●	●	●	●	●
Comprehensiveness	●	●	●	●	●
Attractiveness	●	●	●	●	●
Implementation easiness	●	●	●	●	●
No side-effect	●	●	●	●	●
Data usage	●	●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 11. Mutual help group

	1	2	3	4	5
Effectiveness		●	●	●	●
Comprehensiveness		●	●	●	●
Attractiveness		●	●	●	●
Implementation easiness		●	●	●	●
No side-effect		●	●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 12. Make traffic a part of your event experience.

	1	2	3	4	5
Effectiveness	●	●	●	●	●
Comprehensiveness	●	●	●	●	●
Attractiveness	●	●	●	●	●
Implementation easiness	●	●	●	●	●
No side-effect	●	●	●	●	●
Data usage	●	●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Idea 13. A detailed map of the area

	1	2	3	4	5
Effectiveness			●	●	●
Comprehensiveness		●	●	●	●
Attractiveness		●	●	●	●
Implementation easiness		●	●	●	●
No side-effect		●	●	●	●
Data usage		●	●	●	●

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

1. reservation
2. plan the activities

Final design evaluation (Visitors)

Step 1. Introduction and consent

Hi ***! Thank you for coming to the user test today. This user test is for my graduation project at TU Delft about improving the mobility situation around the ArenAPoort during events. The user test process will be recorded as necessary and authentic research material of my project. The record will only be used for the researcher's study and will not be spread to others. You as the user test participant will be anonymous in any public or published work. Before the user test starts, is it okay if I take a record of this test?

Step 2. Personal Information

First of all, I need to know some basic information about you and your event experience in the ArenAPoort.

1. (Name)
2. (Gender)
3. How old are you?
4. What is your occupation?
5. Where do you live?
6. What is your frequency of visiting the ArenAPoort?
7. With whom do you usually go to the event?
8. How do you normally travel to and from the ArenAPoort for attending events?
9. Why do you choose this transport?
10. When do you normally arrive at the ArenAPoort before the event?
11. Why do you arrive at this time?
12. When do you normally leave the ArenAPoort after the event?
13. Why do you leave at this time?
14. Do you participate in activities in the ArenAPoort before or after the event? If so, which kind do you participate in?
15. Why do you (not) participate in activities?

Step 3. Test: Effectiveness

Now, please imagine the scenario:

You bought a ticket for an event at the ArenAPoort. After ticket purchasing, the website recommended you to download an application called "ArenAPoort", saying you can make a good plan for your event experience. You are curious about this application so you downloaded it. Now you are exploring this application.

<Page. Entrance>

Please choose the event you are going to join.

<Page. Make travel plan>

Please click the "start to plan" button to do the route planning.

<Page. Route plan Question 1>

Please choose the modality you prefer.

Question	Score	Comment
(If the participant usually take the private car) How likely will you turn to other modalities instead of a private car? (effectiveness)	1 - 2 - 3 - 4 - 5 No Yes	
To what extent does the order of options influence your modality choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	
To what extent do tags influence your modality choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	

<Page. Route plan Question 2>

Please choose the inflow starting point.

<Page. Route plan Question 3>

Please choose the arrival time.

Question	Score	Comment
How likely will you change your arrival time by seeing this page? (effectiveness)	1 - 2 - 3 - 4 - 5 No Yes	
To what extent does the notification change your arrival time choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	
To what extent does the activity list change your arrival time choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	

<Page. Route plan Question 4>

Please choose the outflow destination.

<Page. Route plan Question 5>

Please choose the leaving time.

Question	Score	Comment
----------	-------	---------

How likely will you change your leaving time by seeing this page? (effectiveness)	1 - 2 - 3 - 4 - 5 No Yes	
To what extent does the notification change your leaving time choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	
To what extent does the activity list change your leaving time choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	

<Page. Route plan Question 6>

Please choose the parking lot/station.

Question	Score	Comment
(if private car) How likely will you choose the parking lot the municipality recommends? (effectiveness)	1 - 2 - 3 - 4 - 5 No Yes	
(if private car) To what extent does the tag influence/help your parking lot choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	
(if public transport) To what extent does the tag influence/help your station choice? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	

<Page. Plan>

After answering six route-planning choices, you get a travel plan like this.

Question	Score	Comment
To what extent do you think the plan can help your traffic experience? (effectiveness)	1 - 2 - 3 - 4 - 5 No influence decisively	
By seeing this page, how likely will you add activities to the travel plan? (effectiveness)	1 - 2 - 3 - 4 - 5 No Yes	

<Page. Event-relevant activities>

Now according to the plan, you have some spare time before or after the event. You would like to find some things to do around the venue. So you check the activity list to find some activities to join.

Question	Score	Comment
To what extent do the activity cards motivate you to explore the event detail? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	
To what extent does the "recommend" icon motivate you to explore the activity details? (effectiveness)	1 - 2 - 3 - 4 - 5 No effect Totally change	

<Page. Food & Drinks>

Please click the sub-tab "Food & Drinks".

<Page. ArenAPoort>

Please click on the sub-tab "ArenAPoort".

<Page. Chat>

Please click on the bottom tab "Chat".

Question	Score	Comment
To what extent are you interested in practical posts (post 1 & 2)? (effectiveness)	1 - 2 - 3 - 4 - 5 No at all Very interested	
To what extent are you interested in random-chat posts (post 3 & 4)? (effectiveness)	1 - 2 - 3 - 4 - 5 No at all Very interested	

Step 4. Test: Spontaneity

Just now, you experienced all the content of the application under the scenario I created. In the following, I would like to know your opinion about the product.

Question	Score	Comment
<Page. Plan> How likely will you use it to plan your event traffic? (spontaneity)	1 - 2 - 3 - 4 - 5 No Yes	
<Page. Event-relevant>	1 - 2 - 3 - 4 - 5	

How likely will you use it to check event-relevant activities, if you are going to an event? (spontaneity)	No	Yes	
<Page. Food & Drinks> How likely will you use it to check restaurants and bars, if you are going to an event? (spontaneity)	1 - 2 - 3 - 4 - 5 No	Yes	
<Page. ArenAPoort> How likely will you use it to check landmarks and tourist attractions, if you are going to an event? (spontaneity)	1 - 2 - 3 - 4 - 5 No	Yes	
<Page. Chat> How likely will you read, reply or write posts? (effectiveness)	1 - 2 - 3 - 4 - 5 No	Yes	
<Page. Overall> How likely will you use this application, if you are going to an event at the ArenAPoort? (effectiveness)	1 - 2 - 3 - 4 - 5 No	Yes	
What parts do you like about the application?			
What parts do you dislike about the application?			

Step 5. Test: Usability and User Experience

In the last part of the test today, I would like to know about your experience of using this application.

Question	Score	Comment
I found the application unnecessarily complex.	1 - 2 - 3 - 4 - 5 Disagree Agree	
I thought the application was easy to use.	1 - 2 - 3 - 4 - 5 Disagree Agree	
I found the various functions in this application were well integrated.	1 - 2 - 3 - 4 - 5 Disagree Agree	

I thought there was too much inconsistency in this application.	1 - 2 - 3 - 4 - 5 Disagree Agree	
I would imagine that most people would learn to use this application very quickly.	1 - 2 - 3 - 4 - 5 Disagree Agree	
I felt very confident using the application.	1 - 2 - 3 - 4 - 5 Disagree Agree	

That is all of the test today. Thanks for coming!

Final design evaluation (Experts)

Step 1. Introduction and consent

Hi ***! Thank you for coming to the evaluation session today. This session is for my graduation project at TU Delft about improving the mobility situation around the ArenAPoort during events.

The evaluation process will be recorded as necessary and authentic research material of my project. The record will only be used for the researcher's study and will not be spread to others. You as the user test participant will be anonymous in any public or published work. Before the user test starts, is it okay if I take a record of this test?

Step 2. Exploration and Test

Before the Evaluation starts, let me give a brief introduction of the final design.

In previous research, I learned that there are mainly two things that the municipality want about visitors' mobility behavior: those who take private cars turn to use public transport, and time changes.

The final design of my project is an application for event visitors to plan their event journey. Event visitors can use it to know more information about the event, so as to have a better event experience.

For the municipality, this application can help to promote the mobility behavior they prefer, while helping them to collect data about the coming event in advance.

I sent the link of the prototype to you through the chat. You can experience the prototype while I give an introduction of each page. After that I will ask you some questions and gain your opinions.

Can you please share your screen so that I can see your interactions with the prototype?

So there are three main functions of this application, please experience them separately.

The first one is about mobility planning.

<Page. Entrance>

On this page you can choose the event you are going to join in.

<Page. Make travel plan>

Please click the "start to plan" button to do the route planning.

<Page. Route plan Question 1>

Please choose the modality you prefer.

<Page. Route plan Question 2>

Please choose the inflow starting point.

<Page. Route plan Question 3>

Please choose the arrival time.

<Page. Route plan Question 4>

Please choose the outflow destination.

<Page. Route plan Question 5>

Please choose the leaving time.

<Page. Route plan Question 6>

Please choose the parking lot/station.

<Page. Plan>

After answering six route-planning choices, you get a travel plan like this.

Above is the process of making the travel plan.

Here are a few questions that I would like to know your opinion:

1. One aim of this function is to collect data of visitors about where they come from, which modality they will take, when they will arrive and when they will leave. Do you think this application can successfully collect these data, and do you think these data can be useful for the municipality?
2. During the process of making travel plans, there are some designs for nudging visitors to take the mobility choices that the municipality wants. For example, when asking them about the modality choices, public transport is ranking on the top and private cars are at the bottom. And when asking about the leaving and arriving time, there will be a notification to remind the visitors about the traffic situation, and there is an activity list to tell them what they can do around the venue if they choose to come early or stay late. To what extent do you think these designs can make visitors take the mobility behavior that the municipality prefers?

<Page. Event-relevant activities>

Now according to the plan, you have some spare time before or after the event. You would like to find some things to do around the venue. So you check the activity list to find some activities to join.

<Page. Food & Drinks>

Please click the sub-tab "Food & Drinks".

<Page. ArenAPoort>

Please click on the sub-tab "ArenAPoort".

This is the function of "activities".

1. Do you think the data of activity participation can be useful to the municipality?
2. Do you think telling visitors activities before or after the event can change event visitors' time choices?

<Page. Chat>

Please click on the bottom tab "Chat".

One additional function to attract visitors to use this application.

Do you think the data/information on the posts can be helpful to the municipality?

Step 3. Test: Suggestions and discussions

How about the overall feeling of this application?

What do you like about the application?

What do you not like about the application?

Do you have other suggestions or remarks?

That is all of the functions. Do you have other questions, comments or suggestions for me?

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	<u>Liu</u>	4102	Your master programme (only select the options that apply to you):
initials	_____	given name	IDE master(s): <input type="radio"/> IPD <input checked="" type="radio"/> Dfl <input type="radio"/> SPD
student number	<u>4831179</u>	_____	2 nd non-IDE master: _____
street & no.	_____	_____	individual programme: _____ (give date of approval)
zipcode & city	_____	_____	honours programme: <input type="radio"/> Honours Programme Master
country	_____	_____	specialisation / annotation: <input type="radio"/> Medisign
phone	_____	_____	<input type="radio"/> Tech. in Sustainable Design
email	_____	_____	<input type="radio"/> Entrepreneurship

SUPERVISORY TEAM **

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

** chair	<u>Alessandro Bozzon</u>	dept. / section:	<u>DE, HCAI</u>
** mentor	<u>Hiemstra-van Mastrigt, S.</u>	dept. / section:	<u>DE, MD</u>
2 nd mentor	<u>Boen Groothoff</u>	organisation:	<u>Amsterdam Municipality</u>
		city:	<u>Amsterdam</u> country: <u>the Netherlands</u>

comments (optional) Prof. Bozzon and Dr. Hiemstra-van Mastrigt are from the same department, but their experience and expertise is complementary. Dr. Achilleas Psyllidis will also be a mentor of the project.

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.

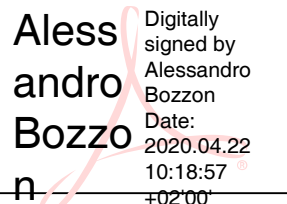


Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.



APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Alessandro Bozzon date 22 - 04 - 2020 signature 

Alessandro Bozzon
Digitally signed by Alessandro Bozzon
Date: 2020.04.22 10:18:57 +02'00'

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: 18 EC

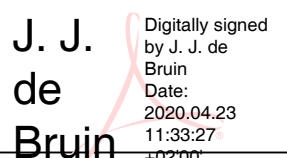
Of which, taking the conditional requirements into account, can be part of the exam programme 15 EC

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

WM1136TU (Written English for Technologists 1)

YES all 1st year master courses passed

NO missing 1st year master courses are:

name J. J. de Bruin, SPA-IO date 23 - 04 - 2020 signature 

J. J. de Bruin
Digitally signed by J. J. de Bruin
Date: 2020.04.23 11:33:27 +02'00'

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**

- a third mentor is not allowed, the mentor can act as advisor

comments

name Monique von Morgen date 11 - 05 - 2020 signature _____

A tool to find "reality" behind visitor mobility choices during events 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 06 - 04 - 2020 25 - 08 - 2020 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, ...).

Context
More than 100 events are held in the Johan Cruijff Arena area every year, including around 30 events with more than 50,000 visitors. During events, traffic issues can always draw a concern. Event visitors' mobility choices, including modality choices (which transportation means to choose) and time choices (when to arrive at/leave from the Arena area), are important for studying traffic problems. The Operational Mobility Center (OMC) takes charge of the mobility flows. They aim at improving the traffic situation during events around the Arena area. In order to do so, they are now working on collecting traffic data during events, and use it to make predictions about the future situation. Once the prediction is made, the OMC can take precaution measurements to prepare for the potential traffic situation. Another way to tackle this issue is to change visitors' mobility behavior to the way the OMC wants. In order to do so, we need to find out what is important to their mobility behavior, e.g. what factors influence visitors' mobility choices, and what are psychological motivations behind it. By doing so, the OMC can find the opportunity areas for designing interventions to change visitors' mobility choices. This direction will be the focus of this project.

Stakeholders
1. OMC (Operational Mobility Center) representing Amsterdam Municipality, taking charge of public transportation, parking garages, traffic control, police, venues, hosts, etc. The interests of the OMC is to improve the traffic situation around the Arena Area during events.
2. Visitors: come to the event in the "best" way (by their own definition).
3. Event organizer (e.g. UEFA) might be involved in designing the final concept. Their interests are visitors' safety and events' punctuality.

Opportunities
1. The OMC is now working on this issue and already collected some data.
2. This project will be totally conducted online, which is proper considering the current situation of the epidemic outbreak.

Limitations
There are many visitors to each event and they vary a lot. During the research and design process, efforts need to paid to tackle the complexity and build a clear whole map.

space available for images / figures on next page

introduction (continued): space for images

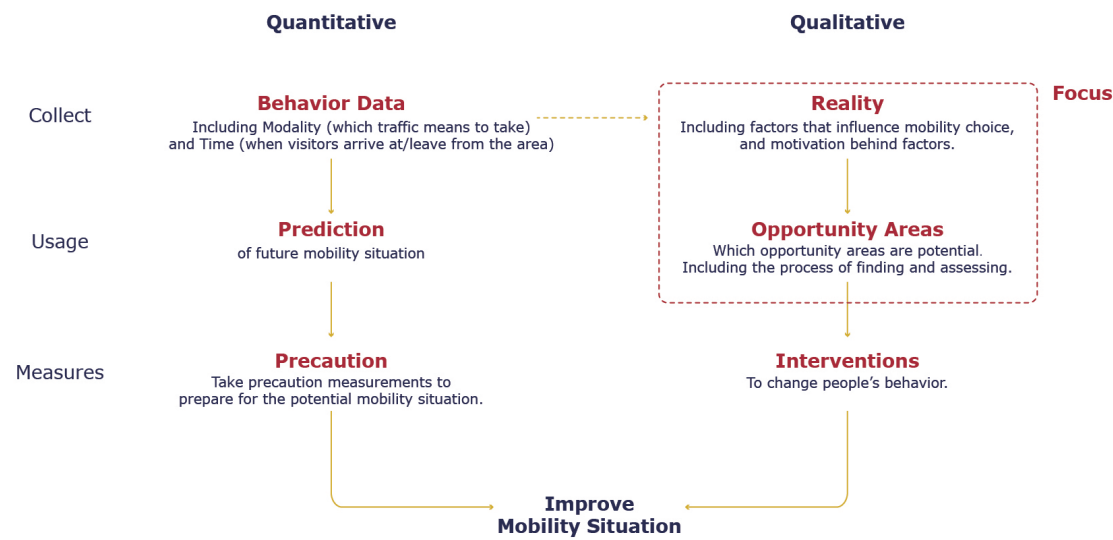


image / figure 1: the position of this project in the whole picture

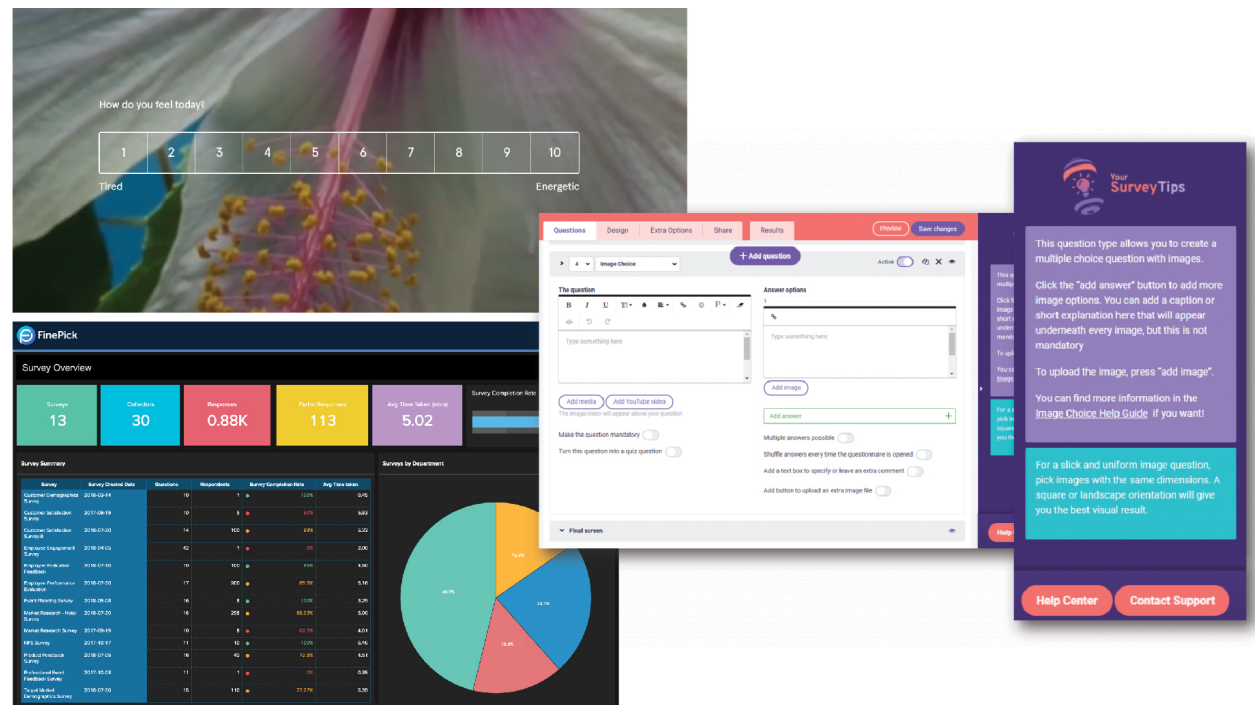


image / figure 2: Current online research tool

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.

In order to find opportunity areas to change visitors' mobility behaviors, we first need to know what influence visitors' mobility choices. Thus, we need to analyze factors that influence visitors' mobility choices, and also psychological motivations behind it. e.g. the factor might be the price of public transportation, and the motivation might be the sensitivity to price and personal financial status. Finding these "reality" behind visitors' behaviors is important for finding opportunity areas.

There are many methods to do research on human behavior. For example, observation and ethnographies are usually used to collect qualitative data about personal behaviors, while data extracting are usually used to take large-scale quantitative data. Which method is proper for finding "reality" is also important for the whole picture.

For the purpose of knowing the opportunity areas, what data we need to collect? What method can be used to collect these data? These questions should get answered by conducting this project.

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.

Design an online tool that can help the OMC to find opportunity areas to change visitors' mobility behavior and improve the mobility situation around the Arena Area during events. The end-users of the tool are visitors.

There are many kinds of data that are relevant to human behavior. One is quantitative data about how many people take what kind of transportation at what time - that is what the OMC is collecting now. There are also qualitative data about why people choose to take this mobility choice. That can help the OMC to find out what influences visitors' behaviors, and where are opportunity areas for them to design interventions.

This project will focus on qualitative data findings. Two main questions will be answered: In order to find opportunity areas, what kind of data should be collected? How to collect these data?

Based on the answers to these two questions, an online tool will be designed for the OMC to collect these data. The end-user of this tool will be visitors. There are two requirements for the tool: 1. The tool can help the OMC to collect data they need for opportunity-area finding; 2. The tool should be appealing that visitors should be willing to take part in the research.

The positioning of this tool is for the OMC to take long-term use. During the design process, I will choose a specific context to assess the tool with small-scale visitors within the target group. The final design will be a digital tool used online. One reason is that online methods can save human resources, and another reason is considering the current situation of the epidemic outbreak, the online method is more insured.

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 6 - 4 - 2020 25 - 8 - 2020 end date

Calendar Week	3.09	3.10	4.01	4.02	4.03	4.04	4.05	4.06	4.07	4.08	4.09	4.10	4.11	5.01	5.02	5.03	5.04	5.05	5.06	5.07	5.08
Project Week	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Project Week	4/6-4/12	4/13-4/19	4/20-4/26	4/27-5/3	5/4-5/10	5/11-5/17	5/18-5/24	5/25-5/31	6/1-6/7	6/8-6/14	6/15-6/21	6/22-6/28	6/29-7/5	7/6-7/12	7/13-7/19	7/20-7/26	7/27-8/2	8/3-8/9	8/10-8/16	8/17-8/23	8/24-8/30
Coaching	Kick-off								Mid-term								Greenlight				Graduation
1. Discover																					
Benchmark finding	Online Research																				
What data to collect?	Literature, Expert Interview, Session																				
How to collect?				Literature, Expert Interview, Session																	
Doing research online.				Literature																	
Carrier of the final design.				Literature, Expert																	
2. Define																					
Conclude results							Reasoning & Workshop														
Design Goal and Criteria																					
Direction Finding																					
3. Develop																					
Ideation & Evaluation																					
Iteration & Evaluation																					
Final Design and Prototyping																					
Test & Evaluation																					
4. Deliver																					
Feedback Analysis																					
Conclusion, Recommendation																					
Final Report																					
Presentation																					

Research questions:

1. What data need to be collected in order to find opportunity areas?
 - a. What are the influential factors and motivations behind human behaviors?
 - b. In order to find out these influential factors and motivations, what data should be collected?
 - c. In the specific context of mobility choice, what data should be collected to find out "reality" behind visitors' mobility behavior?
2. How to collect these data?
 - a. Classification of data-collection methods and their advantages and disadvantages.
 - b. Details of the implementation of research methods: When you do a research on visitors, what questions do you need to ask them so as to get the information you want?
3. Doing research online
 - a. Principles of doing research online.
 - b. How to motivate people to take part in it?
4. What's the proper carrier of the final design?
 - a. Will it be a web? an app? a survey? a digital game?
 - b. Comparing: Which way can easily collect data? Which way will attract visitors to take part in?

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.

Motivation:

1. Education background. I majored in transportation design in the bachelor study, though it focused mainly on exterior and interior styling of vehicles, I also learned some basic knowledge about the transportation system and mobility behavior. This project is a good chance to combine my bachelor's and master's education background.
2. Relevant personal experience. As a football fan, I had some experience as a football match spectator and I realized the importance to improve the traffic situation around the stadium during events. This project can let me consider this problem in a manager's view.
3. Personal interests in behavior study. I took the elective course "Environmental Psychology" at Leiden University from which I learned some basic behavior research methods. I would like to apply this knowledge to my graduation project.
4. A great chance to cooperate with the Amsterdam Municipality. As I have a strong interest in the topic "smart city", it is a valuable chance to cooperate with the Municipality and solve practical problems.

Ambitions:

1. To have an in-depth understanding of the "reality" behind data. Data is a crucial issue in the building of the smart city while finding the in-depth reasons behind it is an important part of understanding data.
2. To develop interdisciplinary competence by studying on the boundary of data science and sociology.
3. Broaden competence in facing complex situation.

FINAL COMMENTS

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