Opleiding Informatica & Economie

Optimizing the Customer Journey of Events

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BACHELOR THESIS

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Abstract

The customer journey of an event starts from the moment the visitor leaves the doorstep. The increased intensity of people and traffic going to one public event causes a lot of delay and annoyances. Latest innovations and technologies gather large amounts of data on real-time traffic situations, delays and crowd sizes. This thesis seeks to answer the research question: Can the customer journey of events be optimized with data? Therefore, several data sources relevant for the customer journey are reviewed in this paper. Experiments and studies done on smart mobility during events have been included as well to give insight on past experiences. In answering this question, it is hoped this research will inform readers on the possibilities of optimizing the customer journey and can be useful in further research or practice.

Preface

The completion of this bachelor thesis would not have been possible without several people. First, I would like to thank my supervisors Prof Dr. Joost Kok and Arie-Willem de Leeuw, for their support and valuable feedback. Secondly, I would like to thank HSD, KPN and PROOOST! for offering us their valuable knowledge, connections and the opportunities to provide us with the best circumstances to conduct research. Thirdly, the other five students who worked on the project together with me, with great teamwork and cooperation we were able to deliver a satisfiable project. Finally, I would like to thank my family and friends for their encouragement and support.

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Chapter 1

Introduction

Whether it is beacons, sensors, or second screens with live feedback functionalities, event technology and Big Data is changing the way we design event spaces, and inevitably how consumers experience them. Everything is going in the direction of personalisation with technology [26]. It grants event organizers access to extremely personalized information about their audiences, from the way they move around a space, to the amount of time they spend at a particular location. It allows us to ask important questions, such as are they following the event's linear path, or taking an alternative route? Which elements do they love, and which ones aren't they enjoying so much? Are these behaviours that were predicted? It ensures we're creating experiences that appeal to attendees, even if this goes against what we may have originally thought. Creating the best experience for the visitors starts right at the front door of their house. To ensure a smooth customer journey, the route to the event and back should be made as comfortable as possible. Can we use data to optimize the customer journey of events?

What is looked at in particular in this thesis is the customer journey of events and how data can help in optimizing the best experience for the customer. This bachelor thesis will keep the Volvo Ocean Race in mind as a target event which will finish in Scheveningen in 2018. If the outcome of this project proves to be useful, it is possible the results will be implemented during the event. The objective of the whole project is to provide a proof of concept of a platform which can be used during events.

1.1 Context

The Bachelor project is supported by The Hague Security Delta (with regional hubs in The Hague, Twente, and Brabant) businesses, governments, and knowledge institutions work together on innovations and knowledge in the field of cyber security, national and urban security, protection of critical infrastructure, and forensics. The Bachelor project is part of the Big Data & Security program powered by HSD and supported by several partners. The project consists of 6 students with their own research questions for these challenges and work together with public and private partners. Leiden University, KPN and Prooost have mentored the students during the project [14].

Involved organisations are: Leiden University, KPN, Prooost, Gemeente Den Haag, TU Delft, Siemens, Cocoon Risk Management, CBS and DITSS.

The safety and security of events in public areas holds many challenges for parties involved, such as the cities, event organizers, public safety professionals (police, emergency medical service, fire brigade), security guards, local residents and others[14]. Challenges include:

- Managing costs of event security (safety & security plans, efficient deployment of personnel);

- the interdependencies between actors (both in information provisioning and collaborative action);
- combining fun aspects for visitors with effective safety & security measures;
- scalability and mobility of solutions;
- added value, savings and requirements of information sharing platform for all stakeholders.

Each student covers a different aspect concerning events. As mentioned before this thesis covers the aspect of the customer journey of events, mainly looking at public transport and traffic. The missing part in the event organisation branch is a standard platform for which event organisations can customize each event according to the theme and location while keeping the standard platform in use. Currently, there is no such thing as a standard platform, event organizers often have to work from scratch to establish structure in the organisation of a new event.

Research Question

The research question deals with the domains of events, public transport, traffic management including the data which is recorded by these three domains with several sensors. Therefore, the main research question is:

Can the customer journey of events be optimized with data?

To answer the main research question, three other sub-questions are posed and answered in different chapters of this thesis:

- What kind of data is available for our research?
- Which data is useful for the optimization of the customer journey?
- What data can be used in a potential use case?

Stakeholders

This section will cover some of the main stakeholders in this project who have provided support in the process:

- **The Hague Security Delta (HSD):**
  In The Hague region alone 400 security businesses realise more than 25% of the national turnover in security and employ 13,400 people. Nationwide there is a turnover of 6 billion euros and 61,500 people are employed in the security domain. HSD has three important regional hubs with their own areas of expertise. Twente Safety & Security (TS&S) is particularly strong in nano technology, safety, radar & sensor technology and the Dutch Institute for Technology Safety & Security (DITSS), located in Brabant, in high-tech solutions and camera and sensor technology. The main focus areas of the region The Hague are: cyber security, forensics, national security, and critical infrastructure [13].
- **KPN:**
  KPN is a telecommunication company, providing internet, television and telecommunication [20]. Moreover, KPN provides IT services to businesses and government institutions. This thesis is mainly involved with the local government department of KPN. This department collaborates with partners to provide local government institutions with relevant innovative services in the field of connectivity, IT services and identity. The experience and network of KPN provide this thesis with real-time data concerning traffic and public transport during events. The provided data comes from research which has been done by KPN. In addition, KPN provides advice and feedback during the progress.

- **Prooost:**
  Prooost was founded in 2008 by Arthur PROnk and Rick van OOSTerhout, making PROOOST, which has grown to an event organisation with experience in cultural, business, sports and public events and an extensive network [25]. Their main projects are The Hague Beach Stadium and the Life I Live Festival. At events, Prooost concerns itself with the programming, permits, marketing, sponsoring, financial management and more. The experience Prooost has in the event organisation branch provides this thesis with a network to several public and private companies which are involved during an event. Furthermore, Prooost provides advice and feedback based on an empirical perspective.

1.2 Thesis Overview

In the following chapter, the method applied in the research is discussed. This covers the methods that were used during the research to gather information and get results. The third chapter discusses existing related work in this field. The related work is used continuously in the thesis as a framework and reference. In the fourth chapter, the available data and sensor technology will be discussed which are potential data sources for the research questions. The fifth chapter presents the results of the methods that have been applied. The following chapter discusses the quality of the research process, results and possible future work. Finally, the last chapter provides a conclusion based on the related work, results and discussion and give possible answers to the research questions.

Chapter 2

Methods

This chapter discusses the method which has been chosen to answer the research questions. Several techniques were used to gather information and analyze the results to reach a definitive conclusion in answering the research question, which will be a qualitative research. For this thesis, several works are reviewed and discussed. The works include scientific papers, subject related articles and projects as well. These works will form the foundation for the research and will influence the results as such. Besides literature, this research will also include a proof of concept based on the results. The results will be determined in the manner the customer journey is optimized, meaning the journey towards the event avoids the most delays, traffic jams and inconveniences for event visitors in an efficient way.

2.1 Customer Journey Analysis

To get an understanding of the customer journey the focus was on insights in three areas: mapping out and analyzing the customer journey, how understanding customer journey touch points can influence the design, and how emerging mobile channels influence the customer journey [21]. The event visitor is the customer in this case. The analysis focuses on how customers interact with multiple touch points, moving from consideration, and purchase to consumption, postpurchase and future engagement or repurchase [24]. The focus of the customer journey within this thesis did not include the entire journey however, in fact, it only covered the prepurchase phase of the customer journey. Its goal is to understand the possibilities and paths a customer may take to complete his or her journey to an event.

2.2 Data

The approach of this research is focused on the use of data to optimize the customer journey. The combination of complete near-real-time public and private data about the availability surrounding events will be looked at extensively. The research project can be divided into three steps mainly:

- **Data acquisition**
  The first step will categorize the available data, public and private. The overview of the data will give insight to all the parties involved in providing data. The categorization will also include the compatibility of the different kinds of data and systems that are being used. The challenge will also be on the link between the different kinds of data. Examples include open parking data, statistics about public events, historical traffic data and real-time traffic data.

- **Data to value**
  After the data has been categorized, there still needs to be a method in deducing the relevance of the data. This relevance can be seen as the value of the customer journey. By transforming the data into information that is useful for the project a lot of redundant data can be excluded and reduces processing time.

- **The visualization and communication of the data**
  Having deduced the relevance of the available data. It should be considered how this can be communicated and visualized to the users in an efficient way. The users include the event organizers and the visitors with each their own needs.

2.3 Interviews

To answer the research questions, employees of KPN were interviewed. These employees were interviewed on the phone or face to face. The interviews were recorded with a mobile phone and transcribed afterward. Open questions were asked to create a dialogue and allow the interviewees to elaborate on certain subjects. The interviewees had experience in creating a customer journey and providing a link between several data sources. It is expected the lessons learned from these experiences can provide this research with a clear illustration of the pitfalls and hurdles encountered in such a process.

2.4 Proof of concept

Based on the retrieved information, a proof of concept was constructed which can potentially be used as a reference for future work. The proof of concept is constructed as an application programming interface (API) in the programming language Javascript. An API is a set of software facilities that enable programmers to develop programs which interact with the software that provides the interface [31]. A good API makes it easier to develop a computer program by providing all the building blocks, which are then put together by the programmer [17]. For example, a word processor might have an application programming interface that allows a programmer to enhance and customize it.

Chapter 3

Related Work

In this chapter, some existing work that has been done in the past is discussed. These works each cover a certain aspect of the research which contributes to answering the research questions. Although research has been done concerning the customer journey and concepts have been conceived on improving this journey, they do not entirely cover the scope which has been set for this research. For this reason, the works which were reviewed, combined several aspects to achieve a better understanding of the subject and provide a foundation for the research.

The social and financial relevance of a well organized public event can have a substantial impact on a city's image [18]. Sports events can be part of a tourism product portfolio that can be leveraged to 'optimise total trade and revenue' and to 'enhance the host destinations image' according to Chalip. Increased trade, revenues and city image improvements contribute to economic and tourism impacts, which can be fostered by sports events that attract business and residents in the area [22]. Chalip connected O'Brien's suggestions to the notion of event leveraging which involves attracting sports events to an area through bidding, planning and delivering the event [12]. Chalip specifically said, 'the purpose of studying event leverage is to identify and explore event implementations that can optimize desired event outcomes' [12].

3.1 Customer Journey

As mentioned in a recent study by Lemon & Verhoef, we first want to conceptualize a customer experience as a customer's "journey" with an event over time during the whole cycle across multiple touch points [21]. The study further notes we also conceptualize the total customer experience as a dynamic process. The customer experience process flows from before the event to the event itself and finally to the post experience; it is iterative and dynamic. This process incorporates past experiences (including previous events) as well as external factors. In each stage, customers experience touch points, only some of which are under the event organizers control. This process may function as a guide to empirically examining customer experiences over time during the customer journey, as well as to empirically modeling the effects of different touch points on the customer's experience.

The scope of this research has been determined to cover the journey which only includes the route from home to the event itself and how that journey can be optimized. When we look at the Process Model for the customer journey in Figure 3.1. We can translate this back to the Prepurchase stage. Meaning all aspects of the customer's interaction prior to the event, including the recognition, search and consideration for an event. For this thesis, however, it is assumed the customer already has decided to attend the event. Based on this assumption it was determined what is needed for the optimization of the customer journey. What happens afterward in the journey, namely the purchase stage and postpurchase stage at events, was not looked into.

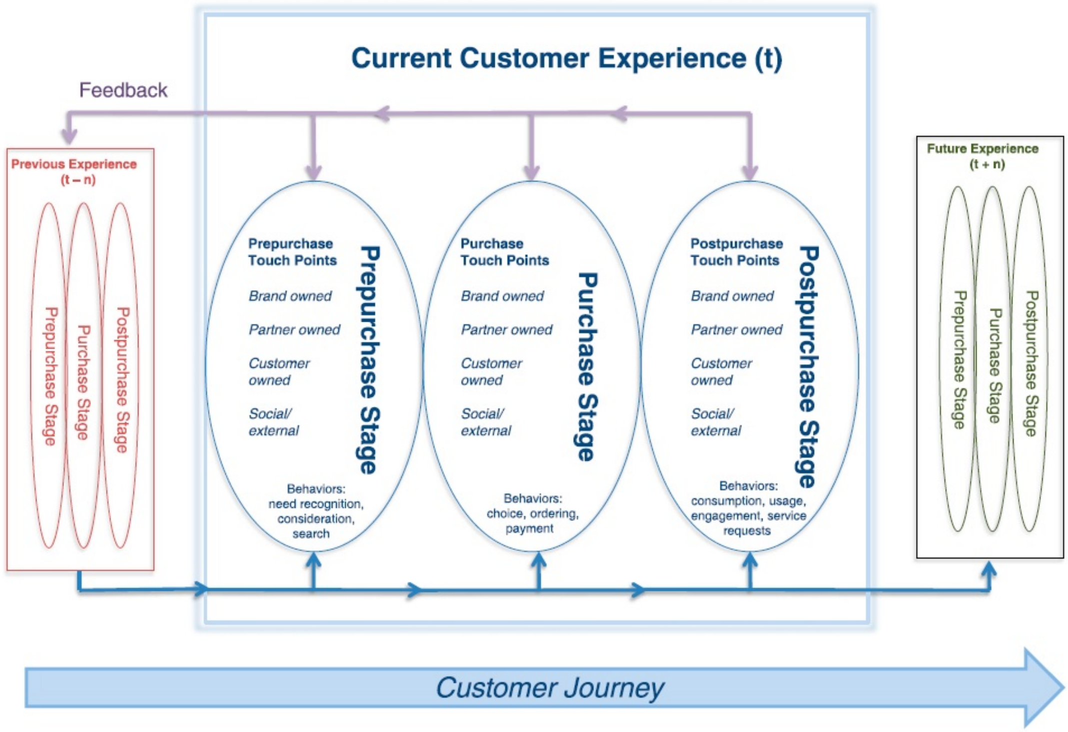

Figure 3.1: Process Model Customer Journey [21]

3.2 Eventcloud

A mobile application made by PROOOST! and Future Events which shows visitors and event organizers useful information on what is going on during an event [15]. This includes heatmaps to display the crowd and the programme of the event for example. The mobile application has been used in an experiment during the large public event Kingsnight in The Hague. The results of this experiment proved the need for such a platform in the event management field. It also serves as an information hub for several stakeholders involved in organizing an event. The research project is built on the basis provided by this application. Previous experiences with the application show the pitfalls, improvements and feedback from users. Although the application gave a slight idea of situational awareness, more data was needed to ensure a complete view of the event and surrounding areas. The application provides a platform for the customer journey feature which is intended to be added in the future.

3.3 Sensor Networks around Public roads

A master thesis done during an internship with KPN by analyzing sensor networks around public roads [30]. The thesis discusses the developments of a 'smart city' and how this can be improved. The information provided by this thesis gives an insight on the available data concerning traffic on the public roads. Limitations and challenges are also discussed in using the sensors and their data. The extensive research done provides a source of information for the customer journey. For the most part acknowledging the fact that old technologies are still being used by the agency in control of the roadside systems. The reason being, that these technologies are still considered to be more reliable and safe than the new technologies currently available and in development. With this in mind, the thesis still explores possible applications for future work and these serve as inspiration for this research.

3.4 Visitor Connect

A concept which focuses on the Scheveningen beach area and provides a digital ecosystem for the visitors, local entrepreneurs and the government [19]. This is made possible by a connecting layer which allows several data sources to be stored and used by the stakeholders. The concept discusses the possibilities of using open data and providing it to the public through an application. It concerns an area which is of interest for the Volvo Ocean Race in particular and involves local entrepreneurs as well. The idea to involve the local businesses as data sources and be able to share these with each other can establish a good foundation to communicate and explore innovative ideas. Accordingly, the negotiations between several parties can improve and knowledge on the local area can be shared.

3.5 Beter Benutten

In the program Better Benutten, the government, regional municipalities and businesses work together to improve accessibility by road, water and rail in the busiest regions [10]. This combination of public and private parties allow for a significant amount of resources which are available in achieving the objectives. Since 2011, the measures have led to 48,000 rush hour avoidances per day. This contributes to 19% fewer delays during rush hour on Better Benutten specific projects. These results were achieved with a package of more than 350 practical, measurable actions. In 2014 it was decided to continue the program until 2017. The ministry and the regions will invest an additional 600 million euros with the aim of achieving a 10 percent improvement in travel time from door to door during rush hour in the busiest areas [10]. To achieve this, a total of about 400 projects are in progress. Therefore, the next few years, the emphasis is on measures to get travelers quickly to their destination in a smart way. This is done using a number of key themes: ITS, Cycling, Activity, Logistics, Working with employers, education / (regional) public transport, park and ride and parking, Spitsmijden, Infra-adjustments and Sustainability. Within the theme of ITS (Intelligent Transport Systems), there are several relevant subjects for this research.

The subject of Talking Traffic concerns new developments on smart mobility [11]. With the growth of smartphones, Internet of Things and cars becoming more connected than ever, a new method to generate traffic data can be created. Therefore, allowing real-time insight on traffic situations. The inter-connectivity of road traffic, signs, traffic lights and traffic centers can produce personal traffic information before the drive and during the drive. In addition to Talking Traffic, is the subject of events which aligns with the research of this thesis [9]. The objectives of this particular aspect of the ITS theme are largely the same, as they include the improvement of the journey to an event with smart personalized solutions based on real-time information in a user-friendly service.

Another key point, reviewed within the ITS theme, is the potential financial impact reducing traffic jams and delays can have. By quantifying the benefits of such a platform the relevance becomes more clear for stakeholders. As can be seen in Table 3.1 based on the fact sheet provided by Beter Benutten [8], there is a lot of potential profit which can be gained by reducing the traffic delays. The fact sheet reviews a football match at the Amsterdam Arena to determine a realistic overview of large public events. With an estimation of 35.000.000 event visitors per year, the assumption has been made 50% will travel by car. The average occupation will be 2 visitors per car. The cost of one vehicle is €9,00 when they are event visitors or passing by. Business-related vehicles have an average cost of €42,20 however, for this case only the common vehicles have been included in the calculation. Having set the objective of at least two minutes time gain per car user during large public events, the benefits are quite substantial. As a result 291.667 hours will be gained which costs €9,00 per hour. Accordingly, for a time gain of only two minutes, the potential profit will be €2.625.000 for one football match. This insight proves further the relevance of the work being done in this thesis and provides a sound business use case.

Table 3.1: Costs & Benefits of event traffic management [8]

All Events in the Netherlands		
Amount of visitors per year	100%	35.000.000
Amount of visitors by car	50%	17.500.000
Average occupation per car	2	8.750.000

Common vehicle delay costs per hour	€9
Business vehicle delay costs per hour	€42,20
Travel time gain per car user	2 min
Vehicle time gain per football event	291.667 hours
Potential Social Profit in costs	€2.625.000

3.6 PPA Zuidoost

Praktijkproef Amsterdam (PPA) is a large-scale test with the latest innovations in the car and on the road [3]. A joint initiative of the Ministry of Infrastructure and Environment, Rijkswaterstaat, the city of Amsterdam, the province of North Holland, the transport region Amsterdam, businesses and Delft University of Technology. Intelligent technology is being used in the field of traffic management on a large scale in daily traffic. Using real cars and real busy road users in the Amsterdam region. The aim of the field test is to work to a future in which cars, traffic lights, and digital information boards are connected to each other and cooperate in full. So the trial will contribute to a better flow of traffic, less congestion and a cleaner city.

Drivers almost all have a smartphone with apps for information and navigation. It is a development with opportunities, to reduce the number of traffic jams. This revolution is the background of the PPA. By now testing the ideas and techniques in practice, PPA gathers the knowledge needed to solve traffic problems in urban areas [5]. The lessons and solutions for the practical test could eventually be applicable in any city, anywhere in the world. According to PPA, traffic is like water. People always look for the fastest way to get from A to B. But, if everyone chooses the same fast track, they are still stuck together. Therefore, PPA uses the new technologies, such as intelligent traffic lights and smart apps, to spread the traffic over the Amsterdam network. So traffic is flowing better as a whole and everyone ends up better off.

PPA Zuid-Oost, in particular, is a test case done in the Zuid-Oost region of Amsterdam mainly near popular venues like the Ziggo Dome, Heineken Music Hall and the Amsterdam Arena [29]. The idea was to use intelligent technologies in traffic management during large events in the area. PPA is a complex project that requires quality knowledge, skills and insights to succeed. Collaboration is the key for this, as the road authorities joined hands but also innovative companies, and science worked closely with PPA. The trial of PPA Zuid-Oost has been during the popular concert of the Toppers for three days. Based on the results of the trial in Table 3.2 it is shown the traffic delay has been reduced by a considerable amount compared to Coldplay the week after without PPA. Given these points, this trial further emphasizes that the application of data and intelligent technology can help improve the customer journey to events.

Table 3.2: PPA Zuid-Oost fact sheet [29]

Results PPA Zuid-Oost				
Event	Toppers Day 1	Toppers Day 2	Toppers Day 3	Coldplay Day 1
Vistors	60.000∼	60.000∼	60.000∼	60.000∼
Traffic Delay	30 min	45 min	-	5 hours
Traffic Jam Length	max 4 km	max 2 km	-	>4 km

Chapter 4

Data

This chapter covers several possible data sources which can be used in traffic management, parking management and crowd management to determine an optimal customer journey. In doing so, this chapter takes up the role of providing an inventory of the potential data sources. Important to realize is the different kind of data needed for specific users. With this in mind, the data sources have been divided into Road Traffic and Public Transport data respectively. Only knowing what data currently exists in these two domains is not enough to determine what data can be used. Specifically, the challenge lies in the fact that not all data is available for usage by external or third parties. The relevance of the data must be determined as well, to establish a set of data sources which are useful in optimizing the customer journey. Furthermore, not all data sources proved to be compatible which each other as different standards and structures have been used. For this reason, the data quality is assessed on four criteria namely the availability, usability, reliability and the relevance for the customer journey. The final set of data sources eventually is utilized in providing a solid foundation for the customer journey optimization.

4.1 Road Traffic Sensor Technology

Rijkswaterstaat is part of the Ministry of Infrastructure and the Environment. The mission of Rijkswaterstaat within the government entails: "the national agency that provides dry feet, clean and sufficient water and a quick and safe flow of traffic." Therefore, Rijkswaterstaat manages a large number of sensors concerning the highways and main roads in the Netherlands. In order to gain insight into the used Sensor Technology, a strategic exploration within Rijkswaterstaat is currently running. This exploration targets all the sensors used by Rijkswaterstaat which was done by van Dam during his master thesis [30]. The primary source of information about the road traffic sensors within Rijkswaterstaat come from this exploration. The focus of this thesis, however, is especially in the sensors which can be useful for the customer journey. Sensor technology is a means to the higher goal of security, accessibility, dry feet, clean water at Rijkswaterstaat. Meaning sensor technology is secondary to this goal. A lot of old sensor technology is still being used because safety and reliability are important. New sensor technology has not proven itself yet and thus is not easily used in safety-critical objects.

4.1.1 Roadside Systems

Roadside systems can consist of different sensors and actuators. In total, Rijkswaterstaat has about 5700 roadside systems in the Netherlands. A roadside system usually has detection loops as a sensor (2-3 per roadside system). The detection loop is the most commonly used sensor technology at Rijkswaterstaat. In addition to these sensors, a roadside system has a matrix sign as an actuator. The roadside systems serve different information streams:

- Traffic Jam Protection (near-real-time). It checks continuously whether there is a traffic jam, by calculating an average. If a traffic jam is created, the matrix signs are used to reduce the speed of the traffic. This is called Automatic Incident Detection (AID).
- Minute averages (by minute basis). These are calculated and transmitted to a central system. This is used for travel times (DRIP texts), traffic information service and the ANWB (which uses this information to communicate traffic jams).
- Intensity: the number of vehicles per minute (last year). This is passed to the department statistical calculations. It used for analysis where accidents occur and whether new roads should be constructed amongst other things.

The roadside system was established in the eighties/nineties, so works with the bandwidth of that time (the network load is low). The data from roadside systems are accessed via copper wires. In the metropolitan region of The Hague and Rotterdam, Rijkswaterstaat has 1118 roadside systems, with approximately 3,400 loops.

Cameras

Cameras are used by Rijkswaterstaat to support the traffic. In total, Rijkswaterstaat has about 3,000 cameras in the Netherlands. In tunnels and fast lanes, cameras are required, and cameras are often installed at major intersections and locations where incidents often occur. The cameras stream without compression, as the traffic center should be able to quickly switch between different images. The fixed network of Rijkswaterstaat can handle the amount of data from these cameras. Currently, the average bit rate is about 11 Mbit / s per camera. In the metropolitan region of The Hague and Rotterdam, Rijkswaterstaat has 382 cameras. This does not include cameras inside tunnels because this information is not within the available data.

Weigh inMotion

Weigh in Motion are systems that can weigh trucks. In the Netherlands there are 18 Weigh inMotion systems. The system consists of several sensors: a sensor that measures the axes of a truck, three cameras that take pictures of the truck (front, rear and side) and a detection loop which determines the photo opportunity. If a truck is too heavy, it will be measured again at a fixed measuring point. Whether this system can serve the purpose of the customer journey optimization is highly unlikely.

Air Quality

Rijkswaterstaat does not measure the air quality directly. For the air quality, traffic intensities and speeds from the sensor networks are used. This data is used with models to calculate the emissions of many substances. There are no plans for the future measurement of these substances. Although the air quality is not directly interesting for the customer journey it can be important to measure the air quality during increased traffic intensity due to large public events. Consequently, discovering the impact of increased road traffic on the local environment.

Connectivity

The various sensors managed by Rijkswaterstaat produce data. There are currently few sensors connected wirelessly. Some DRIPs (Actuators) are connected wireless, but the experience is that sometimes these cannot be reached. This unavailability keeps a preference for fixed connections with a higher availability. The induction loops in the road surface are from the eighties. Rijkswaterstaat has fibreglass lines along almost all highways. The problem is that these are often long connections (e.g., between Rotterdam and Utrecht), so these cannot branch out along the way. Most sensors are connected to the networks managed by Rijkswaterstaat. The data from the sensors is collected in the different traffic control centers in the Netherlands.

4.1.2 New Technology

In the following section, relative new technologies will be discussed that are currently still in the development or experimental phase. With the ongoing development of innovative technologies like Internet of Things, new sensors on cars and data from smartphones, the possibilities of monitoring traffic and crowds have increased substantially. Therefore, a large amount of data is being registered and monitored but not used to its full potential yet as these technologies are still in the development phase. To use these technologies and apply them to the customer journey, will immediately provide an use case for further development and prove to be useful for several purposes.

Floating car data

Floating car data is a possible source of information for traffic management. This technology makes use of the Ground Positioning System (GPS) data of cars and the mobile phones of the passengers. By utilizing this data the traffic intensity, speed and traffic time can be determined of several cars in real-time [1]. At the moment, most cars use the GPS function for navigation purposes. Traffic centers can use this data to manage the traffic and respond to incidents. In the long term, the historic data that has been stored can be used to create traffic models and anticipate certain bottlenecks. Sharing this information with event organizers provides a common operational picture for both parties. As a result, the dialogue will be more efficient and ascertains misinterpretations are limited.

In-car app data

Mobile traffic apps are used every day by drivers and passengers alike. Apps like Flitsmeister, Google Maps, Tomtom Go Mobile all collect data from their users while they are navigating in the car. Like floating car data, this data can be used to determine traffic intensity, speed and most used routes for example. By combining the data inputs from multiple users, a reliable stream of information can be extracted and used for further insight on user behavior in traffic. The advantage of using in-car app data is that the input of data can be provided real-time to create a realistic illustration of the current traffic situation. Not all the app data is available for use however, as the service providers maintain their databases and require permission from the concerned companies.

Social Media

Social media can be a useful data source as well. Scraping social media like Facebook and Twitter during an accident can be helpful in understanding the situation before the emergency services have arrived. When people make a picture of a traffic jam and put it on Twitter this can be useful for the emergency services. It is presumed that people will call the emergency services first instead of posting on social media, but a slow shift is already in motion of people posting on social media first. Scraping on popular and relevant topics can provide information on the current status of a visitor. When a visitor posts a picture of a traffic jam a couple of blocks before the event, it is possible for the event organisation to get this information immediately and can act upon this. On the other hand, social media can be used by the event organizers to communicate expected traffic jams, road closure or delays to the event visitors.

4.2 Public Transport Sensor Technology

Having covered the possible data sources for road traffic, the following section will cover public transport and the relevant sources it can provide for the customer journey. The sources for public transport are mainly managed and provided by the concerned companies like Nationale Spoorwegen (NS), ProRail, HTM, Arriva, Veolia, RET and Connexxion. Generally speaking, this will require a collaboration or at least limited access to their data. There are developments within the public transport sector to implement a uniform data format called General Transit Feed Specification (GTFS) so everyone can access and utilize the data for their own purposes [23].

Real-Time Public Transport

The exact time the train will arrive at the station is important for event visitors as they want to arrive on time at the event, avoiding any delays. To display real-time travel times of buses, trains, metros and trams the government, in collaboration with the main public transport providers, established an open source data set containing the planned schedule and information about the routes taken in GTFS format [4]. Moreover, the position of every vehicle is given within every minute including any deviations from the planned schedule. This data set allows for independent developers to create relevant applications useful for the customer journey. OVradar is one of these services which shows the current position of every vehicle in the data set on a map [2]. As a result, visitors will be able to see exactly where their train or bus is when waiting at the station. Especially the real-time aspect of this kind of application can be important during public events.

Train station sensors

NS transports 1,2 million travelers daily, this will only grow in the coming years. Besides the growth of the train tracks and trains, the train stations must be prepared as well for the expected increase in demand during large public events for example. Currently, at the six largest central stations, NS and ProRail measure the flow and intensity of the crowds on stations with counting sensors monitoring WiFi and Bluetooth signals emitted from smartphones, tablets and laptops the travelers are using [27]. At the most crowded places on the station, local counting sensors are present to measure the crowd intensity. This provides a real-time illustration of the number of people traveling via the station. The information is directly available for employees and can be applied to the customer service by redistributing resources and employees. Therefore, creating a crowd management tool to maintain an acceptable crowd intensity for all travelers. Communicating this to event organizers can allow them to take the right precautions and have a better insight on the potential amount of visitors.

Train sensors

The NS is currently starting the development of measuring the amount of free spaces in the train for passengers [28]. The idea is for passengers to be able to see, via the NS app, exactly where in the train free seats are still available. This was the result of a Hackathon specifically done for public transport. The current app shows a global indication of the crowd intensity inside the whole train. The new development allows for passengers to see exactly where these free seats are inside a train. Depending on the train station and where the train comes to a halt, most people enter the train at the front or at the back. Under those circumstances, the amount of passengers can be distributed more efficiently, by showing passengers there are still free seats available on another carriage. The measurements are done with smart sensors in the train tracks which were originally meant to measure the weight of freight trains. This information can be transferred real-time and will be linked to the NS app. Allowing train station managers to have a better perspective of incoming travelers. Additionally, by providing this information to the event organizers a better insight of the crowd intensity is possible and nearby stations and routes to the event can be prepared as such.

Following this section is an overview of all the data which has been discussed in the chapter. The data has been reviewed and graded based on a plus-minus scale. The customer journey optimization depends on reliable real-time information. If the information is incorrect, unreliable, missing, unavailable or not accessible, the customer journey can not be optimized which may lead to undesired results. Since the customer journey will need this data to function it is necessary to have insight on the quality of the aforementioned data sources.

4.3 Data overview

The data which will be generated by the earlier mentioned sensors will be determined on quality or fit for use following three criteria:

- Availability: Can the data be retrieved for use?
- Reliability: Can the data be trusted?
- Usability: Can the data be used?
- Relevance: Is the data relevant for the customer journey optimization?

The determined quality can be seen in the following table:

Data quality		
Data source	**Availability**	**Relevance**
Roadside Systems	- (Managed by Rijkswaterstaat)	+
Cameras	– (Managed by Rijkswaterstaat & private companies)	+
Weigh inMotion	- (Managed by Rijkswaterstaat)	–
Air Quality	- (Managed by Rijkswaterstaat)	–
Floating Car data	+ - (Partially open-source & privately owned)	+
In-car app data	- (Privately owned)	+
Social Media	++ (Open data)	+ -
GTFS	++ (Open-source)	+
Train station sensors	- (Managed by NS)	+
Train sensors	- (Managed by NS)	+

Data source	Reliability
Roadside Systems	++ (Traditional systems)
Cameras	++ (Real-time feeds)
Weigh inMotion	++ (Accurate scale)
Air Quality	- (Estimate)
Floating Car data	+ - (Bias of the user group)
In-car app data	+ - (Bias of the user group)
Social Media	– (Based on assumptions)
GTFS	++ (Provided by Public Transport companies)
Train station sensors	- (Estimate)
Train sensors	– (Rough Estimate)

Data source	Usability
Roadside Systems	– (Traditional connectivity)
Cameras	– (Privacy concerns)
Weigh inMotion	– (Traditional connectivity)
Air Quality	– (Traditional connectivity)
Floating Car data	+ (Data feed needed)
In-car app data	+ (Data feed needed)
Social Media	++ (Easily applicable)
GTFS	++ (Common standard)
Train station sensors	+ (Data feed needed)
Train sensors	+ (Data feed needed)

Table 4.1: Data Overview

Chapter 5

Results

In this chapter, the results of the research are presented after applying the methods that have been discussed in the previous chapter. The methods form the foundation on which the customer journey was built on. There are several scenarios possible, so this chapter will cover the three possible journeys that represent three different kinds of users each discussed in a separate section. Each user, however, will be attending the same event which will be the Volvo Ocean Race in this case.

Following the inventorization of the relevant data sources in Chapter 4, the relevant data will be extracted and passed through a database which is accessible for the customer journey API. The API will be able to process and transform the data to valuable information for both the event organizer and event visitors. Providing information on the event organizer's dashboard about real-time incidents for example and communicating information to the visitor through the event app. The result should be applicable to all kind of public events eventually. As an illustration how the customer feature will be constructed, Figure 5.1 provides an overview. The following sections will elaborate on how the constructed customer journey API will be utilized in practice by three different kinds of users. Due to the scope of the research and time constraints, not all scenarios were entirely build into working proof of concepts. For this reason, it has been decided that the Road Traffic scenario will be constructed into a working proof of concept. The other scenarios will discuss the intended use of the API in the Public Transport and Event Organization case respectively. The provided screenshots are design suggestions with the incorporation of other existing works to give a better understanding of the practical use in the customer journey, which can be used for future work.

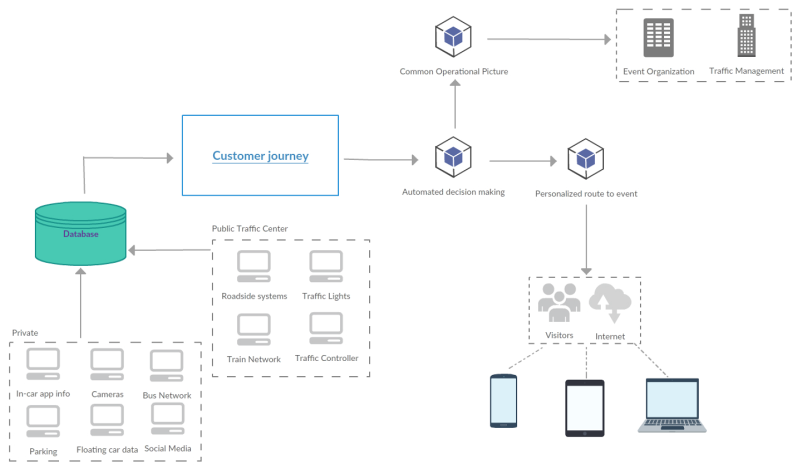

Figure 5.1: Model Customer journey feature

5.1 Road Traffic

Many visitors of the Volvo Ocean Race will come by car. For a big event like the Volvo Ocean Race, traffic intensity will definitely increase and might lead to traffic jams if the infrastructure is not prepared correctly. Henk is one of those visitors, father of three and living in Utrecht. He will be going to the event by car and has already downloaded the Volvo Ocean Race app. The Volvo Ocean Race app provides a range of traffic information services to help you avoid delays and plan your route to the event. A day before the event starts he opens the app and searches for the fastest route if he leaves at 10:00 am. The app predicts the highways will be relatively quiet. When Henk enters The Hague however, he will most likely encounter slow traffic and traffic jams. This is indicated by red lines which represent traffic jams. Especially on the roads to Scheveningen where the event will take place. Henk chooses the route which will have the least traffic consequently having him take a detour of about 15 minutes as shown in Figure 5.2. Furthermore, he chooses a parking lot which is close to the event. The app shows the available parking spaces at parking lots near the event. Henk chooses the parking lot which still has 92 spaces available and is on his route to the event. The parking lot is a few miles from the event; luckily a shuttle bus rides from the parking lot right to the entrance of the Volvo Ocean Race. On the app, Henk is able to see the schedule of the shuttle buses.

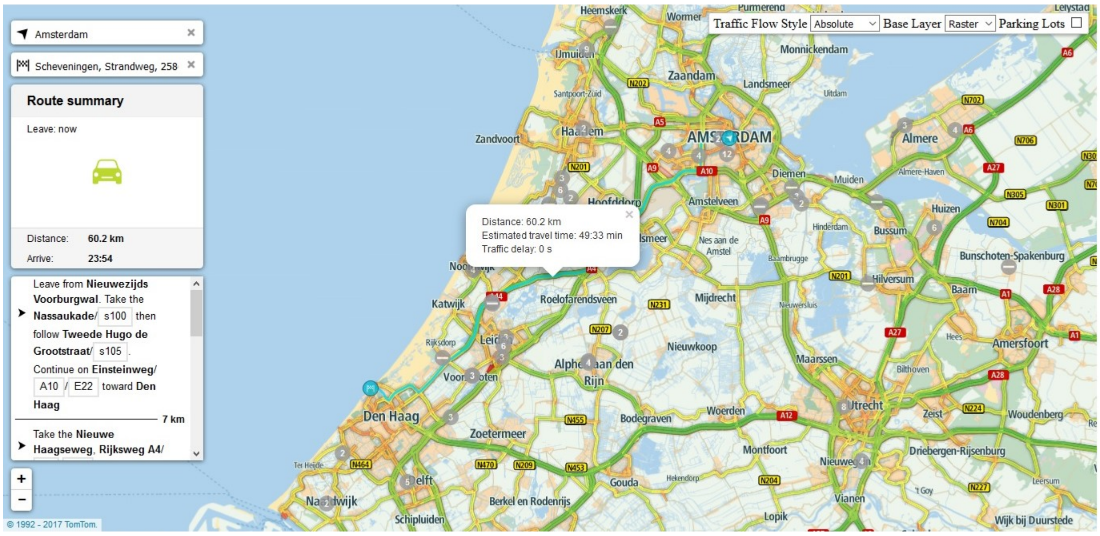

Figure 5.2: Routing map with traffic

The next day, Henk and his three children leave for the event at 10:00 am sharp. Henk opens the app again right before he drives off and sees nothing has changed on the route. After half an hour on the road, Henk receives a notification from the app. The notification says that a traffic jam has come up on the route and gives the option to calculate a new route with the minimum amount of delay. The app gives new directions and shows the amount of parking spaces still available, namely 79 (see Figure 5.3). Henk decides to take the new route as the estimated delay of the traffic jam on the original route was about thirty minutes. The alternative route requires Henk to take the next exit on the highway. The route leads Henk to a road outside of the urban area with almost no cars in sight. Passing through small villages, he can see the highway from the small road and on the highway Henk can see all the cars stuck in the traffic jam. Luckily, he bypassed this traffic jam entirely and managed to enter the city via a rarely used road. Henk arrives at the parking lot and sees that there is more than enough free spaces available like the app indicated. After the car has been parked, he opens the app and looks up the schedule of the shuttle buses. Henk and his children take the first shuttle bus and arrive at the Volvo Ocean Race event area without any delay, ensuring pleased children and a calm father.

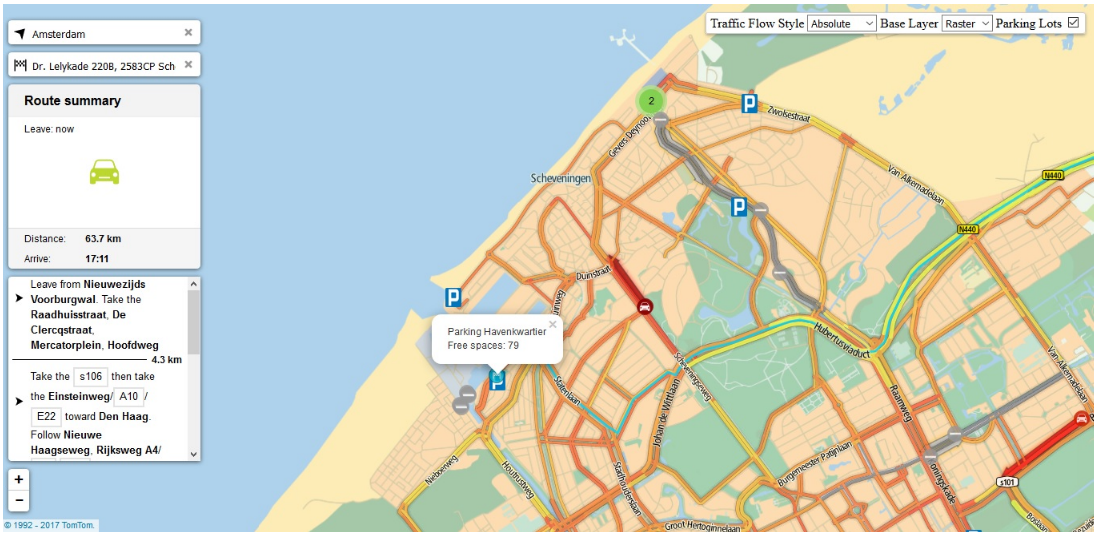

Figure 5.3: Routing map showing free parking spaces

The Road Traffic scenario has been transformed into a working proof of concept for the main features (see Appendix C). The traffic data and maps are based on the TomTom Maps Software Developer Kit (SDK) [7]. One of the reasons this SDK has been chosen is because it is open-source and available after you register at TomTom. Moreover, the years of experience of Tomtom in the navigation business ensures the routing and mapping come from a reliable source. The Maps SDK provides developers with an API library of TomTom services which can be integrated into web applications. The API's which are available, are written in Javascript and are highly customizable. The API library provides functional examples applicable to the intended customer journey [6]. The main features which have been integrated are the:

- Searching: Enables searching for an address or place and makes use of fuzzy matching algorithms. While typing the function will auto-complete with address suggestions.
- Routing: Enables planning the fastest route to a certain destination. The route will include real-time traffic data to determine the best route possible. For this reason, users will be kept up-to-date with new traffic information and get new instructions each time something happens on the route.
- Traffic Flow: Enables a layer on the map which shows a clear overview of all the traffic incidents in the Netherlands as well as the traffic intensity on the main roads. The incidents included in the layer are the congestion level, traffic jams, roadworks, blocked roads, closures.

These functions retrieve data from the extensive Tomtom database. As mentioned before, the TomTom maps on which all these functions will work can be considered reliable and detailed due to the vast experience of Tomtom in the navigation branch. In addition, the traffic data is retrieved by using floating car data generated by Tomtom users. Combining this data with other real-time traffic information can be used to construct a traffic management tool for event organizers. Currently, the parking lot function is 'hardcoded' into the API and does not represent real-time parking lots as access to parking databases were not easily granted. Although this may be true, the parking lot function is set up to incorporate a parking database. Meaning, the database will provide information on free spaces at parking lots given access has been granted. The complete overview of the route taken in the scenario can be seen in Figure 5.4.

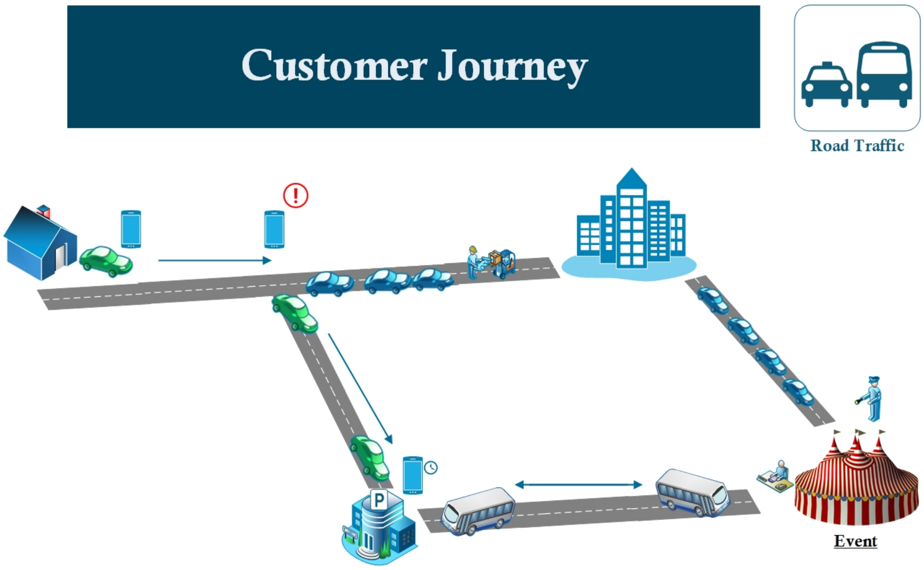

Figure 5.4: The complete route

5.2 Public Transport

Visitors of large public events can prefer public transport to cars because it allows you to avoid traffic jams and fully occupied parking lots. The downside, however, are the crowded stations, trains and buses which lead to such a large public event. Jessica is one of those visitors and would like to go the Volvo Ocean Race with her boyfriend Joris. Jessica has read a week before the event that the boats will sail past the pier at Scheveningen, but space will be limited there, so Jessica wants to go early. The pier will open at 9.30, so Jessica starts the app and enters an arrival time of 9.00 for the public transport route. They will be leaving from Rotterdam so it will take about 1 hour before they arrive at the Pier. Jessica makes sure Joris gets this route schedule (see Figure 5.6) as well by sharing it with him through the app share function. No planned delays are shown on the route and they should arrive on schedule. Besides the route, a real-time map shows the current position of all the trains, trams, buses and metros (see Figure 5.5). Moreover, any delay will also be shown on the map calculated to the second and indicated by a red, yellow or green glow based on the severeness of the delay.

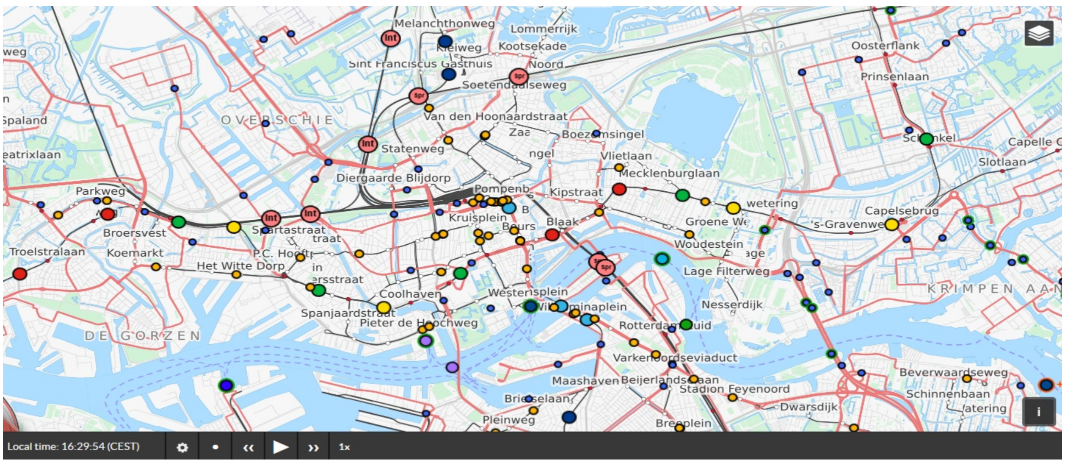

Figure 5.5: Real-Time Public Transport map [16]

The day before the event, Jessica opens the app again and enters the same information in the public transport route feature. The app shows it will take 1 hours and 30 minutes because of train tracks that have to be replaced on the route. The detour will delay Jessica and Joris by 25 minutes, so Jessica messages Joris to get up even earlier. Joris receives the message and sets his alarm at 6.30 am. Jessica does the same and plans to meet up at central station with Joris at 7:30. The next morning Jessica goes by car to the station and sees Joris has already arrived. Once the train has arrived the app shows a notification that the delay has been reduced to 10 minutes. With relief, Jessica tells this to Joris and now they know they will be well on time to have a nice view of the boats on the Pier.

Figure 5.6: The schedule of a metro line [16]

Arriving at the Hague central station shows Jessica and Joris that they are not the only ones wanting to arrive early at the Volvo Ocean Race. The event organizer has put in extra shuttle buses to alleviate the load on the public transport services. These buses leave every 30 minutes from central station to the event according to the schedule. Taking into account the extra high traffic intensity because of the Volvo Ocean Race, these scheduled times might change due to new traffic situations on route to the event. Luckily, the app provides a solution through the real-time public transport map by showing exactly where the shuttle bus is. Now Jessica and Joris do not have to decide as the app will calculate the fastest route to the event including any delays as well. The route sets Jessica and Joris on a tram straight to Scheveningen. Provided that they have arrived quite early at the Hague central station already, the crowd going to the Volvo Ocean Race have not yet grown to an alarming size. Thus, ensuring them of a pleasant journey to the event site and at the same time limiting the amount of delay.

Currently, the positions of the public transport vehicles are not based on GPS data from the concerned companies. The companies currently do not provide the service which enables third parties to get access to their GPS data. In order to still establish the 'real-time' map, another method has been used. The real-time map shown in Figure 5.5 is based on schedules provided as open data, delay times, the latest arrival time, known as GTFS feeds. The map is built and managed by geOps [16]. With this data, the position is interpolated to determine the position of the vehicle and moving it along the planned route. Including GPS data for future applications will make the public transport map more reliable and accurate to illustrate the real-time situation. In conclusion, to summarize the route taken in the scenario, Figure 5.7 shows an overview.

Figure 5.7: The complete route

5.3 Event organization

An event organization has to be up-to-date on the accessibility of its event to ensure the visitors with a pleasant journey. Martijn is the event manager for the Volvo Ocean Race and with the help of the dashboard he has a direct insight of the visitors and what route they choose. The event manager will be able to see from where the visitors will be coming from and therefore can determine the right preparations. The dashboard allows the use of filters so Martijn can choose what he wants to look at in real-time. The complete situational awareness is possible by enabling all the filters available.

A few days before the Volvo Ocean Race event will begin Martijn opens the dashboard to see whether there are any important updates coming through. Seeing no high priority notifications are shown, Martijn decides to look whether any planned delays are expected on routes towards the event. Martijn clicks on the public transport feature and retrieves information about the users of the mobile app. This information includes the desired routes the majority of the users have chosen and at what time they will arrive at the Volvo Ocean Race. The information Martijn is getting through shows him that 120.000 of the users will be coming by public transport which is 60% of the total amount of users (see Figure 5.8).

Luckily this will be easier to manage for Martijn as he can set up road blocks and DRIPS, to lead the crowd all the way from the station to the event itself. The input from users shows Martijn most of the public transport users will be arriving from The Hague Central Station. Knowing this station cannot handle the amount of people based on the app input. Thinking of the safety of the visitors, Martijn decides to order extra shuttle buses which will drive from The Hague Holland Spoor and The Hague Central Station to the event every 30 minutes. This allows the public transport companies more room to transport their passengers as well as reduce the number of delays caused by a sudden increase of passengers. Furthermore, the information received from the input of users shows at what time and place a lot of visitors will arrive. Martijn will inform the managers in charge of the stations so they can put in extra employees who can guide the visitors to the event in an orderly fashion. The dashboard also indicates a critical situation will occur at Kurhaus station because several crowd flows will come together at the same time. With this in mind, he chooses to set up temporary gates at the exits of the tram stop to make sure the increased flow of people is limited.

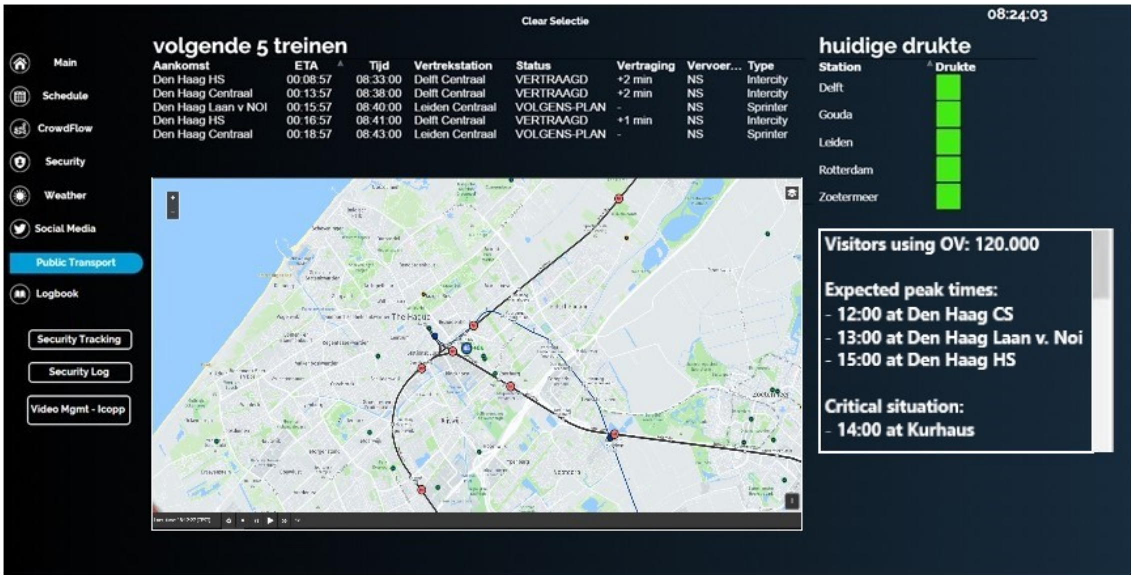

Figure 5.8: Dashboard showing Public Transport

The other 40% of the users, of which 30% decided to come by car and the remaining 10% by other means of transport, are somewhat more difficult to steer for Martijn. As this requires a lot of traffic control management to direct the cars to the optimal location for the customer as well as the event itself. On the day of the event, Martijn opens the dashboard once again choosing the Crowdflow option. Moreover, parking lots close to the event which have been chosen will be fully occupied in a short amount of time. Martijn can decide to change the car flow towards certain parking lots by altering the amount of free spaces available. Additionally, Martijn can utilize DRIPS to steer visitors by car towards a particular direction or parking lot. The app will then suggest a different parking lot to the user in which case another route will be taken and the car flow near the event will be distributed more evenly. Therefore, avoiding traffic jams and reducing delays which benefits Martijn and the visitors as well.

The dashboard shows the latest traffic incidents which happened on the main roads. Presently, no incidents have any impact on the journey to the event. The most used route to the event is shown on the map and the traffic intensity has not resulted into any traffic jams or congestions as of yet. Martijn does choose to send out a message to the app users to leave their house early so they can have a good spot at the event to see the sailboats. The ability to communicate with the potential visitors of the event who are already willing to install and use the app adds another option for Martijn to control the flow of the incoming event visitors.

Martijn notices that the parking lots of the Circus Theater and the BKS Strand have 14 and 16 free spaces available respectively. These parking lots are in the vicinity of the Volvo Ocean Race, so Martijn expects these two parking lots to be fully occupied within the next hour. For this reason, Martijn chooses to alter the information that is displayed to app users and show them that these parking lots are already fully occupied. As a result, less traffic congestion is realized, which could have been caused by long queues before the entrance of parking lots. The visitors who intended to go to these parking lot and were using the routing function on the app will receive the option to take an alternative route. The alternative route will lead them to other parking lots with a larger amount of free spaces available.

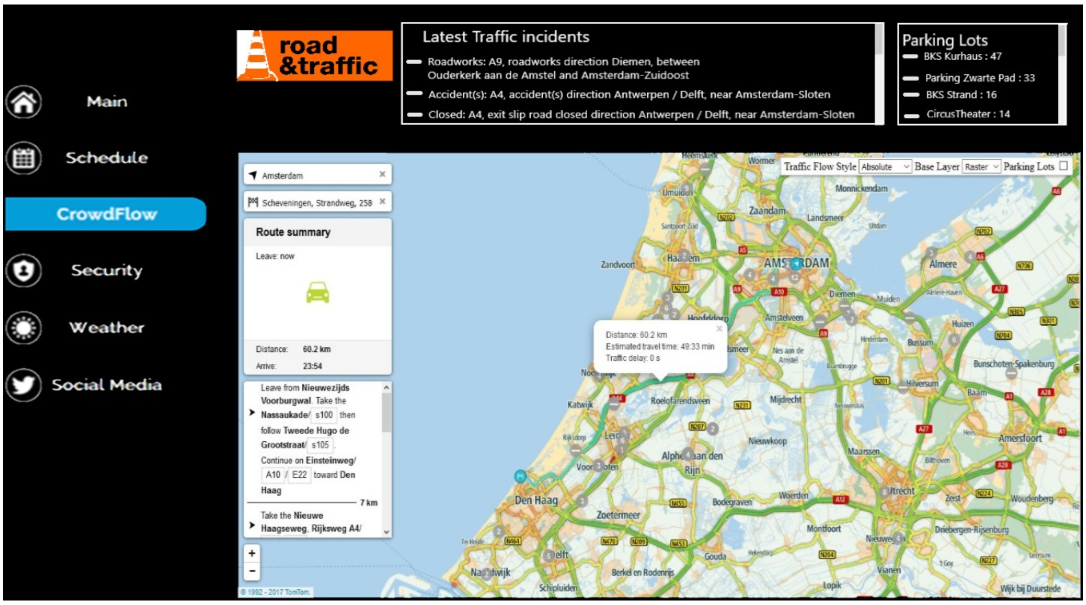

Figure 5.9: Dashboard showing Traffic Situation

Martijn cannot reach all the event visitors with just the app as not every visitor has decided to install the app prior to the event. The information Martijn receives from the dashboard, however, allows him to anticipate visitor behavior. In effect, Martijn can use the retrieved information as guidelines to determine the right set of actions to be taken. Martijn knows a lot of visitors will be searching for parking spaces near the event based on the app alone. Given these points, Martijn decides to close certain main roads to parking lots after they are occupied for up to 85%, ensuring safety for outgoing cars as well. The DRIPs available to Martijn will display the message to follow another route including parking lots with more free spaces available. Similarly to the Public transport situation, Martijn communicates the incoming flow of visitors by car to the traffic management agencies as well as emergency services to keep them up-to-date of the situation. The combination of app information with traffic management tools enables the event manager to control the flow of incoming visitors before the congestion reaches a critical situation.

Martijn will be busy during the event, so he will not be able to monitor the dashboard the whole time, similarly for some of his assistants. Therefore the dashboard can determine whether actions should be taken or not given the data which has been received. The dashboard is preprocessed with a predictive model for traffic and public transport situations. As a result, the dashboard will be able to analyze current real-time situations in traffic. For instance, predicting where a congestion could form on the main road. Based on the analysis the model will provide the user with a certain amount of best actions to take in solving the predicted problems at hand. These predicted situations will be so-called 'triggers' and notify Martijn for potential problems. The automatization of the dashboard and analysis of the data allows Martijn to do more actionable work instead of monitoring all the time. Coupled with the ability to prevent traffic congestion from happening and reducing delays to a minimum based on predictions which Martijn would not always have determined from the data at hand. The ultimate decision will be left in the hands of Martijn. After Martijn has received the push-notification he can decide to act upon this or determine that this trigger does not warrant any action. Accordingly, the predictive analysis can provide Martijn with another dimension of insights on the situational awareness during events. The data generated during the event can be stored and used for further evaluations as well.

Chapter 6

Discussion

This chapter will discuss the results mentioned in the previous chapter and the contribution these results have for further research. The limitations and pitfalls that have been encountered will be mentioned as well. Additionally, potential future work which still can be done will be suggested. As mentioned in Chapter 1, the research question is: **Can the customer journey of events be optimized with data?** Furthermore, three subquestions have been mentioned contributing to the main research question, namely:

- What kind of data is available for our research?
- Which data is useful for the optimization of the customer journey?
- What data can be used in a potential use case?

The inventorization and reviewing of the potential data sources in Chapter 4 enabled us to answer the subquestions. The overview of the data gives a clear illustration of several tools currently used in traffic and public transport management. The extensive amount of possibilities does not immediately mean the data is available for use in a business use case. The inventorization teaches us that the current supply of traffic and public transport data is segmented and managed by several private and public parties. Moreover, open data is not a certainty with private parties in particular. The more data is being used, the better, to get an accurate view of real-time situations. Therefore, an important aspect of the customer journey optimization is the ability to combine several data sources to create a reliable output. Open data on traffic situations, currently provided by companies, does not provide an entirely independent source however. The TomTom Maps SDK which has been used in constructing the customer journey API uses the traffic flow data from floating car data generated by Tomtom service users and partners. Therefore, the view on traffic situations is still limited to the accuracy this floating car data can deliver. The addition of more data sources can provide a solution for that. As a result, negotiations should establish an agreement between several parties to be able to retrieve the data that is needed.

The public transport sector is making more strides in that sense. Currently, more companies are implementing a standard data format called General Transit Feed Specification (GTFS) to be able to share and communicate with the same kind of data. The GTFS data is open source as well so independent developers can utilize it for their own purposes. Thus, avoiding the potential bias visible in the traffic data as the independent companies provide their own data. Contrary to the traffic sector the heterogeneous data sources from the public transport companies are easy to merge because of the common data standard. The uniform data format also makes sure it can be easily implemented and integrated into third party applications. One of these applications is used as an example in the scenario and further elaborates on the potential this kind of data can have for event management. Sharing this data also allows parties outside the sector to be able to have more insight on the inner workings of the public transport. The combination of the independent companies' data ensures a reliable output which will contribute to the accuracy of the customer journey.

As mentioned in Chapter 2, related work, interviews and an analysis of the customer journey were used in constructing the results. The related work included literature studies done on customer journeys and events. Additionally, works were discussed and reviewed on the particular subjects of the customer journey, smart mobility and event management. The literature studies provided this research with a scientific structure from the beginning. Especially in defining the problem and establishing a better understanding of the scientific perspective on this subject. The customer journey analysis has been done by analyzing previous works and the lessons which were learned. The projects Beter Benutten and PPA Zuid-Oost in that regard provide a realistic picture of the feasibility of such a project on a large scale. Therefore, the scoping and possibilities were narrowed down as the findings from these projects showed not everyone is willing enough to cooperate and share their valuable data. This decision caused the proof of concept to be constructed based on open data, with the option of adding new (private) data sources in the future.

The interviews add another valuable source of information for the research as hands-on knowledge was shared on working with the customer journey. The first interview was an employee who worked on the PPA Zuid-Oost project on behalf of KPN in a consortium which was then established between private and public companies. The companies who participated in the experiment did not receive any financial compensation for their input. For that reason, a lot of companies initially left the project as they did not deem the experiment to be beneficial for them. The remaining companies however considered the experiment an opportunity worth their time and resources. Regardless, the challenge was for all the companies to combine their data and resources to construct a common operational picture. The different infrastructures and standards used by each company even within the public sector meant a lot of consolidation was needed. The notion that several companies considered this worthwhile shows the relevance of this research as it aligns almost entirely with the intended purpose of the experiment. Where the experiment showed the results can be considerably influenced with the utilization of data. The second interview emphasized the importance of visualizing the customer journey for stakeholders as well as event visitors; this influenced the results to not only be a proof of concept usable as an experiment but providing a scenario as well. The scenarios serve the purpose of understanding the intended practical use for the optimization of the customer journey. In doing so, the scenarios describe the potential of using data in optimizing the customer journey and therefore answer the research question as to the effectiveness of using data in that process.

The underlying objective was to come up with a certain proof of concept which was able to provide a potential use case for the Volvo Ocean Race. During the review of data it was also considered whether it immediately could be used in a proof of concept and experiment during a real-time event. The proof of concept currently provided by the results can be seen as a foundation to build on and still needs work to be fully functional in a real-time environment. The limited options and design can be improved on with the work of a team of professional developers. Despite the technologies and possibilities which have been mentioned in the previous chapter, only a part of them were realized into a working proof of concept. For the future, a predictive model making use of machine learning can be an interesting component to include in the system so the system can learn from historic data automatically and provide event organizers with valuable information. Another option not considered in the results is the possibility of the application deciding for visitors what the best means of transport will be on route to an event. Therein lies also a limitation of the results and the impact it can have as the proof of concept has not been able to perform at a real event to see the real-time effect of such an application. As such, further steps which can be taken in that regard must include a test case for the customer journey feature to measure and experience the relevance of such a feature.

Furthermore, the integration with other features of the Eventcloud and the event app is necessary to let the system work as a functional event management platform. The insight this research provides, can emphasize the importance of such a feature in future event management tools. The integration of the customer journey feature with the other functionalities was not fully taken into account. Consequently, for further development, this must be implemented to provide users with an entirely functional app and event management dashboard. Enabling an event platform which can be provided as a service. The event management as a service model can be delivered by city municipalities to attract more public to their city as this service will reduce the workload of the event organization. As a result, providing extra means of income for the economy of a city as well as provide a podium for the municipality to display the city to a new public.

Along with the technical limitations for the constructed customer journey API. There is still an aspect left outside of the scope of this research which still can be important for future research. Notably, the customer's preferences, for this thesis the preferences of the customer, the event visitor, have not been researched as this covers another part of the project done by a separate student on the willingness of app users. It is interesting however to look into the needs of event visitors to determine what they find relevant in optimizing the customer journey. In the long run, this information can enhance the success of the customer journey feature as it will be catered more to the needs of the intended users. Therefore, it is suggested to conduct a thorough customer analysis including surveys in the process, before releasing the app officially. Nonetheless, it is highly recommended to present potential customers with a proof of concept or prototype which enables them to understand the intended purpose of the application. Given that the prototype is liked by potential customers and stakeholders see an opportunity to deliver an unique service to event organizations, the platform could be applicable to several public events. In that case, the platform should be customizable and event organizers can personalize the platform to their needs with the features they want.

Despite certain limitations acknowledged in the research, there remains a significant contribution to the further development of customer journey analysis and event management tools. The research established the need for such a platform in the current event management landscape. Confirming the lack of a generic platform capable of processing heterogeneous data sources. The knowledge that currently a lot of event organizations will build events almost from scratch every time a new one will occur exhibits the waste of time and resources. In that sense, the results offer a solution to this gap in the market and can provide event organizations and city municipalities with an efficient infrastructure to build on. The ability to combine real-time data sources and presenting a personalized traffic or public transport solution is unique within one application. Moreover, event organizations gain new insight on situations which were not fully visible in the past.

Chapter 7

Conclusion

As demonstrated by the scenarios, data is able to influence the customer journey of event visitors. The purpose of this research thesis was to determine whether the customer journey could be optimized by using data. Subsequently meaning the customer journey of event visitors are optimized when delays in public transport and road traffic are reduced or avoided altogether on route to an event. In answering the research question, several options have been looked into to deliver a desirable result. For this reason, subquestions were set up to build the results in clear segments. Namely, determining relevant data, knowing how to transform this data into knowledge which can be applied to real-time situations, visualizing and communicating this knowledge to the users. The research for this thesis has been done with a framework in mind established by the method which was decided beforehand. By starting with potential data sources which could be used for the customer journey optimization, it showed a better insight on the current possibilities in the field of traffic, parking and public transport management. Showing that a lot of data being measured right now is not used to its full potential. Especially the traffic systems managed by Rijkswaterstaat demonstrated difficulty in applying this in a new platform. Namely, because traditional connectivity and structures which are being used can date from the eighties. This was noticeable in other projects as well like the aforementioned PPA Zuid-Oost and Beter Benutten. The traditional traffic and public transport companies do not have the flexibility to alter their systems and infrastructures in such a way third parties can make use of their tools.

Thus, narrowing down the scope of the customer journey as to what can be measured right now or in the near future. With newer technologies allowing more flexible applications and better connectivity to implement in a third party platform. Regardless, knowing the data being measured and generated in this field is not enough as the relevance and quality of the data must be determined as well. In doing so, the data was assessed and graded on the reliability, usability, availability and relevance to the customer journey. The results from this assessment further stipulated that new technologies have a better connectivity, resulting in positive grading on the usability and availability criteria. In contrast to the more traditional technologies the reliability of the new technology data leaves much to be desired as accurate data on real-time situations either come from a singular group or are based on rough estimates. Therefore the need of merging the data sources arises to create a reliable situational awareness.

With the knowledge of the relevant data for the customer journey optimization the next step was to determine the method of conveying this data to event visitors and organizers. In the scenarios discussed in Chapter 5 several use cases for the data have been mentioned when applied to a real-time event. The scenarios prove the potential influence data can have on the customer journey and how it can be used to optimize the journey of visitors prior to the event itself. The results were not tested in a real-time environment however, which will be the necessary next step after this research to evaluate the influence of such a platform. Nonetheless, the results show a promising purpose for the customer journey within event management and can be used as a foundation.

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Appendix A

Interview Praktijkproef Amsterdam Zuid-Oost (KPN)

Interview gehouden op 23 maart 2017

Allereerst, weet u al iets over het project?
"Ja en Nee, in algemene kern volgens mij wel. Een aantal mensen zijn bezig met een stukje verdieping op mobiliteitsvraagstukken, dacht ik. Misschien moet je ze even aanvullen."

Ik ben bezig met de customer journey van evenementen. Hoe we de bereikbaarheid daarvan kunnen verbeteren, de mobiliteit. En het project waar u bij betrokken was, PPA Zuidoost, vind ik wel goed aansluiten bij mijn onderzoek. En daar zou ik wel meer over willen weten.

Kunt u mij vertellen wat u zelf doet?
"Ik werk eigenlijk op een afdeling waar ik de naam niet precies van weet. Meestal ziet er iets in van integrated en solution. We worden over het algemeen opgesteld voor grotere klant projecten. De regels varieren per jaar volgens mij is dat nu 2.5 miljoen maar dat is ook een keertje 10 miljoen geweest. En waar zeg maar veel verschillende diensten van KPN moeten worden ondergebracht in n klantoplossing en over het algemeen is mijn rol solution architect of solution manager. Dan word ik vaak betrokken bij klantvragen waar we niet gelijk het antwoord op kennen. En ik heb behoorlijk wat ervaring op het gebied van telefonie en netwerken en veel te maken met IT dienstverlening. Dat is mooi want, dan zit je altijd op de plek waar de lastige vragen zijn en belangen groot zijn en waar je ons bedrijf in al zijn ouderwetse volwassenheid soms kunt zien en ziet worstelen met de toekomst of het heden. Dat is een mooie plek om te werken, soms heel frusterend maar meestal hartstikke leuk."

Dus u bent veel bezig geweest met integreren en koppelen.
"Ja, zeg maar de baantjes waar ik mee bezig ben geweest, is in de directie dus de operatie. Als service manager hielpen we bedrijven met jonge outsourcing projecten. In de jaren 90 hebben we met name in de industrie veel outsourcing projecten gedaan. Daarbij ben ik met name met DSM, Philips, ASML, XP en klanten als ING betrokken geweest. De grotere klantspecifieke dienstverlening over de keten heen. Je ziet met KPN dat ze dat ook proberen te doen de afgelopen jaren. Dat is tot op zekere hoogte gelukt, maar niet helemaal."

Wat is de rol van KPN binnen PPA Zuidoost?
"Ja apart, in Nederland als het over mobiliteit gaat zijn een aantal tafels waar je aangesloten moet zien te raken. Één daarvan voor mij is Konekt, dat is een soort platform, voor de mobiliteitsbranche waar kennis gedeeld wordt. Daar blijkt KPN ook een belangrijke sponsor van te zijn. Die tafels zijn er en daar worden worden sessies gehouden. En wij raakten zeg maar de hoek van

Rijkswaterstaat vooral, met mensen die regelmatig naar die sessies toegaan. Toen werd de vraag gesteld van wie wilt er deelnemen aan het vervolg van PPA Zuidoost fase 1 project. Er werd toen geevalueerd voor PPA Zuidoost fase 2, want met name bij fase 1 was er veel geld op te halen subsidie geld. Toen kwamen er regels, dat PPA Zuidoost fase 2 geen overheidgeld krijgt. Daardoor was gelijk het hok leeg. Er zaten uiteindelijk nog een aantal partijen die PPA fase 2 test gedaan hebben; eigenlijk een coalitie van degene die niet wegliepen toen er werd gezegd er is geen geld te verdienen. Ik maak nog wel is een grapje dat we te laat waren met onze vluchtreactie. Toen hebben we gezegd: op zichzelf is de omgeving van de Amsterdam Arena dermate interessant om experimenten op te doen. Dus toen bleven er een aantal partijen over."

Uit het evaluatierapport bleek dat zeker de helft van partijen waren gestopt nadat er bleek dat er geen gezonde business case was.
"Ja dat klopt, de grotere partijen die actief zijn in het domein die waren gestopt, want er kwam geen finaciele vergoeding aan te pas. Terwijl er toch een hoop eisen aan het experiment werden gesteld. Dat hebben we later naar onze eigen hand toegedraaid. Dat was voor ons gewoon interessant, we wilden graag kennismaken met het domein. Je kunt nu zeggen dat het een logische stap was maar dat kon je toen nog niet zeggen. We wilden toetreding tot het domein. Domein van mobiliteit, we waren die tijd bezig in Eindhoven met smart city experimenten. We hebben toen één kilometer stad in beeld bebracht en dan kom je ongeveer 30 infrastructuren tegen die veel te maken hebben met mobiliteit. Zoals meetlussen, camera, scanner, verkeerregelaar installaties. Wat ik er van leerde was, dat het zo onlogisch in elkaar zit omdat er heel aspect gericht gewerkt wordt. Zeker vanuit de gemeente, is het één versnipperd landschap dat per definitie suboptimaal is. Zo is mijn interesse voor mobiliteit gewekt en zijn wij aangeschoven bij die tafels. Er werd toen niet nee geroepen, maar we kregen toen het vraagstuk wat gaan we met PPA doen en als je van een afstand kijkt, kun je zeggen dat het past bij twee andere dingen die begonnen toentertijd. Ene kant Talking Traffic en de andere smart mobility schiphol. En discussies die op de achtergrond spelen, met name technologie, ga je op het mobiliteitslandschap mee met de vrij standaard 3G toepassen of ga je daar met 4G proberen een positie te verwerven om straks met 5G die hele sector aan je bedrijf te hangen. Dus er speelden ook wel strategische belangen van KPN in de verte een rol"

Voor KPN bleek het toch wel handig om mee te doen.
"Ja, precies je moet op een moment toetreden en je ziet dat er handel uitkomt vanuit smart mobility schiphol en mobiliteit als een service. Dat zie je dan allemaal en wat is nou het moment dat je gaat toetreden tot zo'n domein. Hoe doe je dat op een manier wat niet veel geld kost en dat je er wat van leert. PPA Zuidoost fase 2 is daar een mooi voorbeeld van. Achteraf bleek het wel revolutionair, namelijk met de partijen die er zaten iedereen in zijn kracht te brengen. Manier van experiment doen met de Toppers was een aparte manier van werken met zowel publieke als private partijen die samenwerken. Ook op basis van een soort gelijkheid. Iedereen zat er in met een onbrekend stukje van de puzzel. Brandmakers was een vreemde partji, social media, daar hadden we niet over nagedacht, maar was uiteindelijk fantastisch het bereik wat ze daarmee hadden was gewoon goed. En dat ze concepten hadden als klantenservice 3.0 voor evenementbezoeker gaf een hele andere context en inzicht tot standpunten. Doordat Bemobile en Flitsmeister aanhaakten hadden we gelijk een heel groot bereik, waardoor je nieuwe data terugkreeg wat je eerder niet had. Me meetlussen rond die kruispunten kon je niet zo een mooi beeld maken als wij bij elkaar konden creeren. Daarnaast de consolidatie van de drie verkeerscentrales van gemeente Amsterdam, Provincie Noord-Holland en Rijkswaterstaat, wat heel uniek was om te consolideren in n beeld en daarnaast nog floating car data toe te voegen van BeMobile en Flitsmeister, kreeg je heel een mooi actueel plaatje zoals dat precies aan de hand was wat eerder niet in die mate mogelijk was. In de concept evaluatie staat dat ze de vergelijking maken met 15 mei met de Toppers en de week erop Coldplay. Waar er te zien was dat zonder het systeem er een maximale wachtijd van 5 uur en bij de Toppers met het systeem 30 minuten. Dat is voor mij het belangrijkste plaatje en dat is gelijk het verkoop argument om verkeersmanagement als een soort service aan te bieden, dat het werkt. Dat vond ik een hoopvolle conclusie, dat je best veel invloed kunt hebben op het verkeer.

In dit geval evenementverkeer, maar ik zie dit verkeer als een voorbeeld van drukke situaties in de toekomst, piekmomenten, daar kun je dingen uit leren die je generiek kan toepassen op een stad of ergens anders. Dit was mooi en hoopvol in de zin dat je ondanks dat je met onbekende partijen hebt samengewerkt als Flitsmeister, BeMobile, Brandmakers en partijen uit het domein als DAT mobility en Technolution. Wat was nou het USP(unique selling point) van KPN. Geen andere partij in de markt zou het voor elkaar hebben gekregen om de netwerken van de gemeente Amsterdam, Provincie Noord-Holland en Rijkswaterstaat aan mekaar te knopen. Dat was echt de USP die KPN heeft, het vertrouwen in de markt. Het concept was in 5 minuten bedacht maar we zijn er 5 maanden mee bezig geweest om die VPNs aan elkaar te knopen. Daar hebben we antieke technologien voor de dag moeten halen, de VPN technologie die ze gebruikte waren oud en rudimentair, Rijkswaterstaat met name. Om dat werkend te krijgen is een vak apart, wat je zou denken als je al gestandaardiseerd bent op verkeerscentrales zoals de gemeente Amsterdam, Provincie Noord-Holland en Rijkswaterstaat en gebruik maken van een zelfde platform, MobiMaestro. Dat je daar makkelijk een geconsolideerd beeld van kunnen maken, dat is evident. Toch kunnen ze geen geconsolideerd beeld van maken omdat de connecitiveitlaag met name allemaal maatwerk is. Allemaal aparte standaarden zijn."

Dat was dus een uitdaging, om te koppelen.
"Ja, dat bleek uiteindelijk een veel grotere uitdaging om te koppelen, dan we dachten van te voren. We dachten drie VPN consolideren waar gaat het nou over met gestandaardiseerde protocollen zou je zo klaar zijn. Dus niet, dat was wel een leerpunt. Die ons ook als KPN een unieke positie geeft want gaan wel met alle klanten in gesprek en kregen het uiteindelijk voor elkaar."

Dat is ook een punt waar we met ons project naar kijken. Het standaardiseren van een platform want het blijkt dat het ontbreek.
"Omdat iedereen zijn eigen standaarden heeft. Zoals MobiMaestro een presentatielaag voor verkeersmanagement centrale en dan nog zo veel diversiteiten. Misschien is dat ook wel logisch want je hebt natuurlijk met heel veel generaties technologie te maken in de wegkant. Dit zien we ook bij smart city, uiteindelijkt is het best lastig voor de overheid om bijvoorbeeld de energie agenda voor elkaar te krijgen over de openbare verlichting. Omdat die energiemasten voor 40 jaar geplaatst worden. Als je dan tussen nu en 2025 de energieagenda wilt doorvoeren moet je versneld gaan investeren in LED. Dat bied mooie kansen voor KPN om door middel van LoRa en LED, het proces te versnellen. Alleen de structuren bij de overheid staan dit soort dingen niet toe."

Ze hebben moeite met aanpassen dus.
"Volgens mij kost geld niks tegenwoordig. Stel ik wil 40000 lantaarnpalen, maak er LEDs van en bedenk een oplossing met LoRa en sensoren zodat je het als een dienst kunt verkopen, dan maak je al een hele grote stap. Die is nodig en is ook gepland, we hebben in Parijs al een handtekening onder gezet. Uiteindelijk is het heel moeilijk om de structuren, standaarden de dogmas waar je last van hebt in de sector, om die te overwinnen. Dat zie je met die onderliggende technologie, connectiviteit die nu langs de wegkant staat voor mobiliteits toepassingen. Die zijn allemaal aspect gericht opgezet en zijn nooit bedacht voor consolidatie en gevangen in de standaarden die ze bedacht hebben. Uit de jaren dat die wegkantsystemen ontstonden. Een mooi leerpunt was ook het besef. Een paar uur voordat de Toppers gingen optreden besloot Amsterdam om hun verkeerscentrale te upgraden."

Dat kwam niet goed uit op dat moment.
"Het besef dat het misschien belangrijk is voor zo'n moment. Dat was wel mooi, op dat moment hadden we niet precies door wat er allemaal gebeurde. We konden alleen het beeld van Amsterdam niet goed zien. Toen we gingen nabellen waren ze blijkbaar bezig met een upgrade wat ze met wat paniek wel konden terugdraaien. Anders had je er echt niks aan gehad en dan had je een half jaar voorbereiding voor niks gedaan. Het besef en de relevantie ontbreekt."

Het consortium bestaat uit publieke en private partijen. Botste die vaak met elkaar

tijdens het indien van het voorstel of de gesprekken?
Nee, wat dat betreft hebben we met Technolution een goede woordvoerder gehad die al lang in het domein zit en veel met innovatie bezig is geweest. Die heeft gelijk vanaf dag 1 best wel wat bijzondere voorwaarden aan de samenwerking gesteld. Bijvoorbeeld de overheid komt met één geconsolideerd beeld naar het consortium toe. Wij gaan niet met elke partij afzonderlijk in gesprek bijvoorbeeld. Dat zijn wel lifesavers geweest en hij heeft toch echt op basis van pure gelijkheid met elkaar gediscusseerd. Dat is wel uniek want uiteindelijk er is nooit iets op papier gezet qua overeenkomsten. Er waren allerlei wensen en eisen in het begin van de overheden waar partijen zich aan moesten houden. Waar nooit handtekeningen zijn gezet maar wel samen hebben gewerkt."

Op basis van vertrouwen eigenlijk.
"Ja, op basis van vertrouwen en ook op basis van gelijkheid. Dit was oncomfortabel soms voor partijen, maar ook uniek. Je kunt toch tot kennisverwerking en technologie komen zonder dat je daar dichttimmerende contracten voor tekent. Waarschijnlijk hadden we het dan ook doodgemaakt. Volgens mij zit het al aan vernieuwing en innovatie verbonden, zeker als je er niet voor wilt betalen dan moet je de partijen naar hun kracht krijgen. Volgens mij is dat ook gelukt met de project organisatie."

Vanuit het rapport komt het niet echt naar voren, maar zijn de evenementenorganisaties er veel bij betrokken geweest.
"Ja, Brandmakers die zit dichtbij twee kanten, bij Mojo de evenementenorganisatie en dichtbij social media Facebook etc. Dus die hebben een unieke posities als het gaat om evenementen. Daar hebben we overigens een hele goede relatie mee gehad. Livecrowd is toentertijd geboren en daar zijn ze nu groot mee op de markt. Mojo die financieert hun in de Livecrowd ontwikkeling. "

Livecrowd was vooral een service naar de bezoekers toe zoals ik had begrepen.
"Klopt, zo zijn er nu ook microtransacties mogelijk via Whatsapp. Ze zijn bezig om social media in te kunnen zetten voor evenementbezoekers. Op die manier verzamelen ze ook data die bruikbaar kan zijn. Dat is dan weer moeilijk voor KPN want wij willen eigenlijk nooit aan de inhoud van de boodschap zitten. Dus daarmee is hij complementair en schuurt het ook een beetje. Maar we zijn tegenpolen waar KPN privacy en security hoog in het vaandel hebben zitten zit Brandmakers heel erg op het randje van alles weten en kunnen. Die zit heel erg aan de data kant en in zo'n experiment heel erg nuttig. Ik vind eigenlijk als KPN dat we meer met dat soort partijen zouden moeten samenwerken."

Alle data die beschikbaar was gekomen. Hoe was het combineren van deze data?
"Ja en nee, dan moeten we het domein een beetje afbakenen. Je combineert natuurlijk een aantal domeinen door elkaar heen, het traditionele verkeersregel instrumentarium, wat we daar deden was MobiMaestro combineren in één geconsolideerd beeld. Daar lag vooral de uitdaging in het koppelen van de onderliggende netwerken, meer een technische uitdaging. Dat leverde één geconsolideerd beeld op, losse monitoren werden andere beelden geschapen. Jouw vraag doelt meer op kun je dat in één omgeving tonen? Dat is uiteindelijk niet gebeurd want dat zijn veelal losse schermen geweest met een datafeed van Flitsmeiser of BeMobile. Zo waren er aantal schermen die samen één beeld gaven maar, er was niet een common operational picture op één werkstation."

Dat was wel het doel had ik begrepen, maar dat is niet volledig gelukt als ik het zo hoor.
"Nee dat is niet volledig fysiek bereikt, uiteindelijk heb je wel een aantal beeldscherm aan elkaar gekregen om zo een totaal beeld te kunnen krijgen. Maar het was niet echt geintegreerd in één oplossing, dat was even te kostbaar. "

En tijdens de proef hoe is dat gegaan , hoe werden er dan beslissingen gemaakt voor het verkeer?
"Daar was een verkeersmanager namens het consortium en die had dan eigenlijk de complete

vrijheid om scenario's aan te vragen. Uiteindelijk gingen we op de verkeerscentrale over of dat nou werd toegestaan of niet. Daar was toen ook wat discussie over. Met name als je de bijlage van het evaluatierapport leest dan zie je ook de inzetmaatregelen voor het verkeer, zoals wegkruisen een DRIP boodschap aanpassen. Dat is goed beoordeeld en aantal keer ook bekritiseerd, daarbij moet je jezelf realiseren dat het een soort strijd is tussen verkeersmanagements en goeroes. Dus een beetje een hanengevecht, waarbij Rijkswaterstaat niet wil horen dat je uit floating car data en social media veel betere besluiten kan maken dan zij vandaag de dag kunnen met hun data bronnen. Dus daar zit gewoon concurrentie in het model en logisch ook, laat ze voorgoed beconcurreren. Maar ik weet niet of je daar ook een conclusie aan kan verbinden of het zoveel beter of zoveel slechter is. Dan zou je eigenlijk dat weekend daarop precies hebben moeten evalueren om de bezoekerspiek en de manier van reizen, dat je die scenario's goed naast elkaar zet en het moment dat je maatregelen inzet wat uiteindelijk tot maximale wachttijd van vijf en een half uur bij Coldplay die niet is opgetreden bij de Toppers. Het kan zijn dat het aan een hele andere reden ligt zoals een ongeluk op een belangrijk punt of wegwerkzaamheden. Uiteindelijk zal je moeten weten of de kwaliteit van maatregelen ook zoveel beter was. Dat weekend van de Toppers, dat het resultaat eerder al zo was."

Ja dus toch meerwaarde heeft opgeleverd.
"Ja dan zou je eigenlijk nog veel meer data en onderzoek naar moeten doen. Je ziet daar eigenlijk ook de versnipperdheid zoals die langs de weg gebeurd. We hadden gehoord dat het was gelukt en een paar dagen kwamen we elkaar tegen in het kader van Talking traffic. Dan werd ik bijna gekust door Technolution dat het was gelukt, omdat het hun verwachtingen had overtroffen. Het inzicht dat zij hadden over het gebied en mate van controle die zij konden uitoefenen was groot. Vanuit verkeersmanagement perspectief hadden wij daarvoor gehoord vanuit Flitsmeister dat zei 60.000 mensen geraakt hadden en Brandmakers hun doel had bereikt. Daarmee zag je alle losse aspecten mee terug. Dat was mooi, ik was al blij dat het platform werkte die middag. De versnipperdheid wat voor mij heel moeilijk is, wat ook te zien is in de evaluatie. In december hebben ze de evaluatie gepubliceerd en we waren in mei bezig. De tijd van de evaluatie is waarschijnlijk meer geweest dan de tijd die we hebben besteed aan het bedenken en het voorbereiden van die pilot. Dat is apart toch, in een los-vast verband hebben we in zo'n twee sessies bedacht wat we gingen doen en uiteindelijk is daar verder uitwerking van geworden. Toen hebben we het gedaan, en vervolgens zijn we een half jaar bezig geweest met evalueren. We schrijven het wel mooi op, maar uiteindelijk halen we er volgens mij niet uit wat je uit had kunnen halen."

Want uiteindelijk stond in het rapport dat het moeilijk was te kwantificeren of het daadwerkelijk kwam door de toepassing van de proef dat het goed is gegaan
"Nee precies, dat het ook gewoon puur toeval was is ook mogelijk. Wat ik wel zie is een toegenomen geloof bij de overheid in dit soort proeven en dit is het nieuwe vervolg. Ik zie dat er nu afspraken zijn met een vervolg erop en dat heet dan common operational picture. Dat wordt ook betaald, dat is eigenlijk de opvolger van deze proef in een permanente oplossing. Dus een vervolg in ieder geval."

Afgelopen vrijdag ben ik bij een conferentie geweest van Beter Benutten. Waar het inderdaad ook over de bereikbaarheid ging van evenement. Daarbij waren er toch wel een aantal partijen die met hun eigen ideeen kwamen en hoe ze dat aanpakken.
"DatMobility en BeMobile zijn dat toevallig, dat is ook een collega van mij. We hebben samen Talking Traffic gedaan en zijn nu bezig met andere mobiliteitsdingen bezig, proberen groot te worden in mobiliteit. We zien het as a service model, het consolideren van Nederland, grote wegprojecten of rondom steden. Verkeersmanagement als een service kunt leveren."

Ja natuurlijk mooi als je het kan toepassen op meerdere steden.
"Wat ik zelf zit te denken is dat heel Nederland volstaat met verkeerscentrales, waar heel veel domme mensen naar heel veel televisies zitten te kijken. Als je gaat naar Amsterdam bijvoorbeeld, waar er eigenlijk een fysieke plek is waar ze verkeer besturen. Maar je hebt een paar straten verderop net zoiets en daar doen ze het openbaar vervoer mee. Allemaal vergelijkbare

puntoplossingen die nooit geconsolideerd zullen worden als je die structuren in stand houdt zoals ze nu zijn. Dan is verkeersmanagement als een service bijvoorbeeld een verbetering, we gaan het meer generiek doen, we gaan smart city-achtige doelen nastreven ermee. Daarmee kantel je het een beetje."

"Dus meer automizeren en ook generieker. Maar nog iets om over na te denken is het smart city light in eindhoven waar ik te maken heb gekregen met het meest slimme openbare verlichting in de wereld dat staat in Nederland. Maar dat heeft een beperking, het is hartstikke slim, maar kan je er uiteindelijk niet veel meer mee dan als het donker is light aanzetten. Wat ik eigenlijk zou willen dat als er zeg maar brand is dat de openbare verlichting jou wijst wat de heengaande route van ambulance is en dat ie rood wit en blauw van elkaar scheid. Als iemand zijn nek breekt op straat en die roept help dat je dat ook herkent vanuit de slimme verlichting en dat je dat belicht en ondersteunt. Nou dat soort scenario's tegelijkertijd is de allerslimste openbare verlichting op dit moment, niet toe in staat. En in hoeverre is zoiets toepasbaar in bijvoorbeeld Amsterdam, ja niet. Het is gewoon maatwerk iedere keer. Het ontbreekt eigenlijk aan generieke regels die je kan toepassen of het nou gaat over meerdere scenario's over openbare verlichting of meerdere scenario's op meerdere plekken in mobiliteits land dan is het toch iedere keer maat werk. Dan streven we nu naar objectivering, dus het is goed dat ze met Beter Benutten en Talking Traffic een stabilisering proberen af te dwingen voor de VRI architecturen, dus verkeersregelinstallaties. Dat helpt wel maar daarmee zijn die regels nog niet generiek. Het wordt wel steeds meer generiek maar nog steeds niet universeel toepasbaar op een willekeurig grid van Nederland. "

Om het echt open te breken dan zouden er meer mogelijkheden zijn om te testen
"Dat denk ik ja, dan zou je meer moeten objectiveren. PPA Zuid-Oost fase 2 was gericht op Zuid-Oost en niet op Pinkpop om maar wat te noemen en als daar ook straks 3 dagen met evenement bezoekers te maken hebt en met het wegennet dat daartoe leid en het openbaar vervoer wat er ook is. Is pinkpop niet anders dan de Toppers alleen is het een andere locatie. Waarschijnlijk is de kennis die je hebt opgedaan voor de toppers ook heel goed toepasbaar voor pinkpop. Zo zijn heel veel van die regels voor verkeersmanagement universeel, dat wat ze graag willen zien. Want dat betekent voor een heleboel mensen dat er geen brood meer op de plank komt. Voor al die verkeersanalisten en verkeersadviseurs. Als je dat in generieke regels vangt met je meetgegevens dan manage je het verkeer. Dan heb je die hele generatie van bestuurders niet meer nodig als je gemobiliseerde voertuigen hebt. Daar liggen dus grote kansen voor verkeersmanagement als een service. Voor het meer generiek, objectief en abstract oplossen van problemen en dan in regels vangen. Of je dan nog verkeersmanagers nodig hebt."

"Tijdje terug ben ik gaan kijken bij de verkeerscentrale van Den Haag. Die hebben zo'n 20 beeldschermen aan de gevel hangen en daar zitten gewoon 2-3 man daar permanent naar te kijken. Ze hebben het plan om nog 150 kruisingen van camera's te voorzien. Hoe wil je dat dan gaan doen, een grotere ruimte nemen nog een muur vol gooien met schermen. Dat is zo een zinloze manier van afstand kunnen zien terwijl het niet meer is dan dat. Uiteindelijk is dat een eindeloze route om dat zeg maar op die manier doen. Als je niet van beeldinterpretatie of alarmering erop zit waardoor jouw aandacht getrokken wordt naar die situatie waar het ook relevant is."
Alleen het in de gaten houden van alles wordt al lastig dan.
"Dan heb je daarnaast nog een HTM controleroom, ongetwijfeld ook één apart voor de metro uit Rotterdam die in hetzelfde gebied rijdt en nog een paar voor de politie. Particuliere alarm centrales met camerabeelden en iedereen is daar druk mee maar die structuren belemmeren dat er voortgang geboekt wordt."

Daardoor wordt het toch lastig om meer richting de toekomst voor te bereiden. Ook omdat de technologien blijven ontwikkelen.
"Ja de uitdaging is om de bestaande structuren te overwinnen wat we ook bij PPA gezien hebben. Het simpele feit dat de overheid zich geen rol neemt in het consolideren van die drie bestuurslagen, de stad, provincie en het Rijk, dat wij opgezadeld raken met een geconsolideerd beeld maken

terwijl er nota bene een Beter Benutten project loopt. Een overheid die innovatief wilt zijn in Nederland en toch komen we niet zo ver dat je zegt va:n kom op jullie maken het dermate universeel zodat het beeld geconsolideerd kan worden. Dat is zo een evidente logische keuze eigenlijk, maar toch doen we het niet."

Dat is toch een van de lessen die KPN heeft geleerd van PPA.
"Ja, dat je een logische plek in zo een ecosysteem kan verwerven. Dat is ons later met Talking Traffic ook daadwerkelijk gelukt. Daar hebben we daadwerkelijk gewoon een positie en daar gaan aan de slag met een data service hub als een soort neutrale verbinder, verder ontwikkelde positie dan bij PPA Zuid-Oost. Daar hebben we geleerd dat de neutraliteit in zo een domein en dat de overheid die graag ziet. Daarin zie je dat we verder dat domein ingroeien. Daar ook een strategisch relevante positie in nemen als het ons lukt om Talking Traffic op tijd in te leveren."

Appendix B

Interview Customer Journey (KPN)

Interview gehouden op 10 april 2017

Wij zijn vanuit de universiteit bezig voor publieke evenementen, daarvoor willen wij een platform creëren en we zijn met een groep van 6 studenten met ieder zijn eigen aspect. Mijn aspect is de customer journey, hoe je van deur tot deur zo soepel mogelijk eigenlijk bij het evenement komt. Dan ga ik kijken naar het verkeer hoe je dat kunt sturen of het openbaar vervoer, hoe je dat zo makkelijk mogelijk kan maken.

"Ja dat sluit wel helemaal aan denk ik, ook op hetgeen wat ik zo dadelijk ga laten zien. Ik heb toen een project gedaan voor de customer journey. Daarbij kwamen de rollen aan bod die er bij betrokken waren. De organisator, de burgemeester, de veiligheidsdiensten en dergelijke, politie, meldkamer. Zo heb ik een aantal doelgroepen en vanuit elke doelgroep kan je een redenatie maken waar ze geinteresseerd in zijn. Een organisator is denk ik meer geinteresseerd in hoeveel bezoeker op welk moment op welke plekken er zijn maar dat kan ook handig zijn voor ambulance personeel. Inzicht krijgen in het weer, in de file en met NS, treinen en misschien parkeren. Eigenlijk moet je het helemaal uitschrijven."

Ja ik heb een overzicht welke data ik nodig heb van welke partijen. Nu ben ik vooral bezig met hoe ik dat ga vertalen naar een API of app zodat het specifieker wordt voor de evenementorganisatie of de bezoekers. Hoe ik dat ga laten zien, er was ook veel open data beschikbaar wat je gelijk kan gebruiken.

"De file, en KNMI dat zijn denk ik wel dingen die van belang zijn voor zo'n evenement. Voor schiphol hebben we iets anders gedaan. Daar hebben we een storyboard gemaakt. Iemand die op reis gaat, achter zijn laptop een reis boekt en inlogt met zijn Facebook. Krijgt dan direct een gepersonaliseerde aanbieding in dit geval een koptelefoon. Als je dan 's ochtends naar Schiphol toe reist krijgt hij de data beschikbaar over files en of hij eerder moet vertrekken of niet of beter met de trein kan gaan. Op weg naar schiphol kunnen de masten signaleren dat hij vlak bij schiphol is en bij welke parkeervakken hij het best kan parkeren omdat P1 of P2 volstaan. Tegenwoordig kunnen ze aangeven op P3 op die rij is er nog plek. Inchecken is dan ook mogelijk en dat kan dan allemaal vanuit n Schiphol app. Dat hij ook automatisch een push-bericht krijgt van balie 5 als hij zijn bagage moet inchecken. Je hebt tegenwoordig ook kleine sensoren die op bagage zitten zodat je je eigen bagage in de gaten kan houden waar die blijft. Of die inderdaad op het karretje ligt en niet in een ander vliegtuig. Je kan iets zeggen over de drukte van een rij, dat je een half uur in de rij moet staan terwijl je beter een half uurtje kan wachten. Die aanbieding heeft hij dan gekocht en kan hij ophalen in zo een shopping wall waarbij je met een bepaalde code opengaat waar die koptelefoon klaar ligt. Vanuit horeca kan je special aanbiedingen doen van kortingen op koffie of lunch."

Voor evenementen is dat ook mooi, om mensen bij een druk plein de andere kant op te sturen door ergens anders een aanbieding te doen.

"Vanuit de service van het Schiphol krijg je bij vertraging gratis het Financieel Dagblad of iets dergelijks op je smartphone. Bij aankomst kan je kijken of je koffer aankomt en hoelang dat nog duurt en dat je weer terug loopt naar je auto toe dat je een herinnering krijgt waar die staat en de bus die je eventueel naar de parkeergarage moet brengen. Dit was dus vanuit marketing hoe willen we bij schiphol binnenkomen, dit zijn onze ideeën maar hoe kijkt schiphol er tegenaan. Toen we dit presenteerde bij de directie van schiphol was de reactie: 90% procent wat hier in staat willen zij mee aan de slag gaan. Je ziet het bij heel veel verschillende organisatie of het nou bij overheid is, gemeentes of publiek ze zijn er eigenlijk allemaal wel mee bezig maar er is niet één totaaloplossing. Zo een evenementen dashboard zou je dan heel makkelijk kunnen ombouwen tot zoiets voor een schiphol."

Dat is inderdaad ook het idee dat het platform niet specifiek voor de Volco Ocean Race is maar ook voor meerdere evenementen te gebruiken is.

"Voor de Volvo Ocean Race zou je het nog groter kunnen maken om als het aanslaat het jaar daarop elke landingsplaats, de stad het verplicht moet gaan gebruiken. Dat is voor KPN wel interessant, kan gewoon via de cloud omgeving van KPN maakt niet uit waar die applicatie draait want overal is breedband. Zo een platform kan je ook helemaal ombouwen voor de Nijmeegse vierdaagse. Voor de lopers, rondliggende gemeente, burgemeesters, organisator. Dus er zijn genoeg mogelijkheden."

Ik heb iemand gesproken die betrokken was bij PPA Zuid-Oost. Daar hebben ze een proef gedaan hoe ze de mensen kunnen sturen met floating car data en wegkantsystemen. Daarmee hebben ze naar de bezoekers en ook de organisatie dat proberen te sturen en hebben ze toch gezien dat het van anderhalf uur vertraging naar drie kwartier of zelfs een half uur vertraging ging. Op die manier probeer ik dan ook te kijken om de customer journey te verbeteren.

"Je moet wel creatief nadenken voor een customer journey, ik ben daar zelf niet zo goed in, maar in de huid kruipen van die bepaalde rol. Maar daarvoor is het goed dat we er nu al mee bezig zijn, we willen ook proberen met een bepaald prototype al te kunnen inzetten voor Sail in Den Helder in juni. Wel kortdag maar zo een dashboard moet ook groeien, je moet ergens mee beginnen en dan steeds iets toevoegen, soort trial and error."

Bij ons is ook het plan om van de zomer in ieder geval bij een kleiner evenement te proberen.

"Ja, om het te perfectioneren zo dat je uiteindelijk een mooie oplossing hebt met de Volvo Ocean Race. Bij KPN zijn we ook bezig om situational awareness grafisch te maken in real-time daar is veel interesse vanuit de veiligheidsdiensten. Als je inzichtelijk kan maken waar bepaalde personen zich bevinden aan de hand van sensoren en dat op een kaart kan plotten met de beweging er bij maar ook in de hele omgeving kan afscannen welke media de lucht in gaan, Twitter of Facebook dan kan je daar wel een analyse overdoen. Als er ergens een crisis zich voordoet dan zal je zien dat er veel meer berichten verstuurd zullen worden. Dat zijn wel dingen waar wij mee bezig wat ook weer gecombineerd kan worden hiermee. Vooral het real-time aspect is daarin belangrijk, zoals de NS data en de file data dat moet eigenlijk real-time. Is er ook iemand die het technisch allemaal uitdenkt?"

Ja we hebben nog een andere student en die is bezig met de architectuur van het platform en hoe al onze stukje bij elkaar gaan passen.

"Daar heb je een API platform voor nodig een database die daar onder hangt en de database moet wel veel rekencapaciteit hebben. Dus dat moet geen SQL database zijn maar een real-time database. Dan ga je snel naar een Oracle of een SAP naartoe maar die zijn vreselijk duur. Maar je hebt rekencapaciteit nodig als je het allemaal wilt processen. De verschillende bronnen kun je dan aan laten sluiten op het API platform. Die managed alle APIs. Je hebt veel APIs nodig die samen een geheel maakt."

Hebben jullie bij een customer journey onderzoek gaan naar de klanten of bezoekers?

"Nee, dat hebben we zelf met een team uitgedacht. Een bezoek bij dance event hebben wij bedacht wat wil je dan allemaal op je smartphone krijgen. Je moet het uittekenen en uitschrijven zodat je er een uiteindelijk een verhaal van kan maken. Zoals het schiphol verhaal bijvoorbeeld."

Appendix C

Customer Journey API

```
<!DOCTYPE html>
<html class="use-all-space">
<head>
    <meta charset="UTF-8">
    <title>TomTom JavaScript SDK - Map with traffic</title>
    <meta name="viewport" content="width=device-width, initial-scale=1,maximum-scale
        =1,user-scalable=no" />
    <link rel="stylesheet" type="text/css" href="map.css" />
    <link rel="stylesheet" type="text/css" href="elements.css" />
    <script type="text/javascript" src="tomtom.min.js"></script>
        <script type="text/javascript" src="AnimatedMarker.js"></script>
</head>
<body class="use-all-space">
    <div class="map-container use-all-space">
        <div id="map" class="use-all-space"></div>

        <div class="tomtom-example-inputsWrapper">
            <label for="trafficStyle">Traffic Flow Style</label>
            <select id="trafficStyle" name="trafficStyle" onchange="
                updateTrafficFlowStyle()" autocomplete="off">
                <option value="absolute" selected="selected">Absolute</option>
                <option value="relative">Relative</option>
                <option value="relative-delay">Delay Only</option>
            </select>
            <label for="baseLayer">Base Layer</label>
            <select id="baseLayer" name="baseLayer" autocomplete="off">
            </select>
            <label for="parkLayer">Parking Lots</label>
            <input type="checkbox" name="parkLayer" id="parkLayer" >
            </select>
        </div>
    </div>
    <script>

        var map = tomtom.map("map", {
            key: "HjclGGk1F5BnuA1IicuWLRH4kg6qQa2v",
            source: ["raster", "vector"],
            glyphsUrl: "https://api.tomtom.com/maps-sdk-js/glyphs/v1/{fontstack}/{
                range}.pbf",
            spriteUrl: "https://api.tomtom.com/maps-sdk-js/sprites/v1/sprite",
            traffic: { style: "s3", key: "lHCqIYHZDR5SzZSCGEaui2k5AMZAb0P0" },
            trafficFlow: { key: "TbtbAs7NQtpDGWZq2UtzXMCe5F5DO1xS" },
            center: [52.370216, 4.895168],
            zoom: 10
        });

        function getOptions() {
            return { trafficStyle: document.getElementById('trafficStyle').value };
```

```
    }

    function isFlowLayer(layer) {
        return layer._url && layer._url.indexOf('flow') !== -1 && layer._url.
            indexOf('tile') !== -1;
    }

    function updateTrafficFlowStyle() {
        var selectedOptions = getOptions();
        map.eachLayer(function (layer) {
            if (isFlowLayer(layer)) {
                layer.options.style = selectedOptions.trafficStyle;
                layer.redraw();
            }
        });
    }

    function updateBaseLayer() {
        var baseLayers = map.getBaseLayers();
        if (this.value === 'raster') {
            map.addLayer(baseLayers.raster);
            map.removeLayer(baseLayers.vector);
        } else if (this.value === 'vector') {
            map.addLayer(baseLayers.vector);
            map.removeLayer(baseLayers.raster);
        }
    }

    document.getElementById('trafficStyle').onchange = updateTrafficFlowStyle;
    document.getElementById('baseLayer').onchange = updateBaseLayer;

    (function initializeTileSwitcher() {
        var select = document.getElementById('baseLayer');
        var layers = map.getBaseLayers();

        function newOption(value, label, selected) {
            var option = document.createElement('option');
            option.value = value;
            option.text = label;
            if (selected) {
                option.selected = 'selected'
            }
            return option;
        }

        layers.raster && select.appendChild(newOption('raster', 'Raster', true)
            );
        layers.vector && select.appendChild(newOption('vector', 'Vector'));
    })();

    var instructionMarker, groupMarkersLayer;

    // Setting TomTom keys
    tomtom.routingKey("PEB2AeRVU7XKquxmaHxk88tMW2IFqkJx");
    tomtom.searchKey("bVEDtkXH05RJRXqjBCG9M4BWxIXVlp2B");

    // Creating map
    map.zoomControl.setPosition('bottomleft');

    // Adding route-inputs widget
    var routeInputsInstance = tomtom.routeInputs().addTo(map);

    // Adding route-on-map widget
    var routeOnMapView = tomtom.routeOnMap({
        onEachFeature: bindPopups,
        generalMarker: {
            draggable: true,
```

```
            zIndexOffset: 10
        },
        serviceOptions: {
            instructionsType: 'tagged',
            traffic : true
        }
    }).addTo(map);

    // Creating route summary widget
    var routeSummaryInstance = tomtom.routeSummary({
        size: [240, 230],
        position: 'topleft'
    }).addTo(map);

     // Connecting the route widget with the route summary widget
    routeOnMapView.on(routeOnMapView.Event.RouteChanged, function (eventObject)
         {
        routeSummaryInstance.updateSummaryData(eventObject.object);
    });

    function buildPopupMessage(summary) {
        return [
            "Distance: " + tomtom.unitFormatConverter.formatDistance(summary.
                lengthInMeters),
            "Estimated travel time: " + tomtom.unitFormatConverter.formatTime(
                summary.travelTimeInSeconds),
            "Traffic delay: " + tomtom.unitFormatConverter.formatTime(summary.
                trafficDelayInSeconds)
        ].join("<br/>");
    }

    function bindPopups(feature, layer) {
        layer.on('mouseover', function (e) {
            L.popup()
                .setLatLng(e.latlng)
                .setContent(buildPopupMessage(feature.properties.summary))
                .openOn(map);
        });
    }
    // Adding route-instructions widget
    var routeInstructionsInstance = tomtom.routeInstructions({
        size: [240, 230],
        position: 'topleft',
        instructionGroupsCollapsed: true
    }).addTo(map);

    // Connecting route-inputs with route-on-map widget
    routeInputsInstance.on(routeInputsInstance.Event.LocationsFound, function (
        eventObject) {
        routeOnMapView.draw(eventObject.points);
    });
    routeInputsInstance.on(routeInputsInstance.Event.LocationsCleared, function
         (eventObject) {
        routeInstructionsInstance.hide();
        routeOnMapView.draw(eventObject.points);
    });

    // Connecting route-on-map with route-instructions widget
    routeOnMapView.on(routeOnMapView.Event.RouteChanged, function (eventObject)
         {
        routeInstructionsInstance.updateGuidanceData(eventObject.instructions);
    });

    // Update search inputs when the user change the route dragging the markers
         over the map
    routeOnMapView.on(routeOnMapView.Event.MarkerDragEnd, function (eventObject
        ) {
```

```
        var location = (eventObject.markerIndex === 0) ? routeInputsInstance.
            searchBoxes[0] :
                routeInputsInstance.searchBoxes.slice(-1)[0];
        location.setResultData(eventObject.object);
    });

    // Focus a instruction step in the map when the use select it on the route-
        instructions widget
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionClickedSelect, function (eventObject) {
        map.setView({lat: eventObject.point.latitude, lon: eventObject.point.
            longitude}, 14);
    });

    // Focus a instructions group in the map when the use select it on the
        route-instructions widget
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionGroupClickedExpand, function (eventObject) {
        zoomToPoints(eventObject.points);
    });
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionGroupClickedCollapse, function (eventObject) {
        zoomToPoints(eventObject.points);
    });

    // Show popups over the points in the map when the use move the cursor over
         the instruction steps
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionHoverOn, function (eventObject) {
        var position = {
            lat: eventObject.point.latitude,
            lon: eventObject.point.longitude
        };
        instructionMarker = tomtom.L.marker(position, {
            icon: tomtom.L.icon({
                iconUrl: 'img/instruction_marker.svg',
                iconSize: tomtom.L.Browser.retina ? [34, 34] : [20, 20],
                iconAnchor: tomtom.L.Browser.retina ? [17, 17] : [10, 10]
            }),
            zIndexOffset: 100
        });
        map.addLayer(instructionMarker);
        tomtom.L.popup({autoPan: false, maxWidth: 150}).setLatLng(position)
                .setContent(eventObject.message.toString()).openOn(map);
    });
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionHoverOff, function () {
        map.removeLayer(instructionMarker);
        instructionMarker = undefined;
        map.closePopup();
    });

    // Hightlight all the steps of a group in the map when the use move the
        cursor over an instructions group
    routeInstructionsInstance.on(routeInstructionsInstance.Event.
        InstructionGroupHoverOn, function (eventObject) {
        var markersForGroup = eventObject.points.map(function (instruction) {
            return tomtom.L.marker({
                lat: instruction.latitude,
                lon: instruction.longitude
            }, {
                icon: tomtom.L.icon({
                    iconUrl: 'img/instruction_marker.svg',
                    iconSize: tomtom.L.Browser.retina ? [25, 25] : [15, 15],
                    iconAnchor: tomtom.L.Browser.retina ? [13, 13] : [7, 7]
                }),
                zIndexOffset: 100
```

```
                });
            });
            groupMarkersLayer = tomtom.L.layerGroup(markersForGroup);
            map.addLayer(groupMarkersLayer);
        });
        routeInstructionsInstance.on(routeInstructionsInstance.Event.
            InstructionGroupHoverOff, function () {
            map.removeLayer(groupMarkersLayer);
        });

        function zoomToPoints(points) {
            var latLons = points.map(function (point) {
                return tomtom.L.latLng(point.latitude, point.longitude)
            });
            map.fitBounds(tomtom.L.latLngBounds(latLons));
        }
        document.getElementById('parkLayer').onchange = placemarker;


        var addressPoints = [
            [52.1140945, 4.2839097, "BKS Parking Zwarte Pad <br> Free spaces: 25"],
            [52.1121422, 4.2817601, "BKS Parking Kurhaus <br> Free spaces: 47"],
            [52.1133348, 4.2934083, "BKS Parking Strand <br> Free spaces: 68"],
            [52.1005834, 4.2616855, "Parkeerterrein Noordelijk Havenhoofd <br> Free
                 spaces: 36"],
            [52.1065612, 4.2923337, "Parking Scheveningen <br> Free spaces: 21"],
            [52.095143, 4.266404, "Parking Havenkwartier <br> Free spaces: 79"],
            [52.0782715, 4.3042792, "Q-Park Torengarage <br> Free spaces: 44"],
            [52.0760949, 4.3076692, "Q-Park City Parking <br> Free spaces: 16"],
            [52.0762327, 4.3126413, "Q-Park Bijenkorf <br> Free spaces: 23"],
            [52.0810186, 4.3282382, "Q-Park New Babylon <br> Free spaces: 44"],
            [52.0755975, 4.3159065, "Q-Park Veerkaden <br> Free spaces: 18"],
            [52.0639443, 4.3004287, "Q-Park Haagse Markt <br> Free spaces: 37"],
            [52.069245, 4.3264166, "Q-Park Laakhaven <br> Free spaces: 12"],
            [52.0846997, 4.3174972, "APCOA Parking Malieveld <br> Free spaces: 32"
                ],
            [52.0753739, 4.3088904, "Q-Park Grote Markt <br> Free spaces: 28"],


        ];

        var markerOptions = {
            icon: tomtom.L.icon({
                iconUrl: "img/icon1.png",
                iconSize: [20, 24],
                iconAnchor: [10, 4]
            })
        };


        // Placing markers
        function placemarker() {
            var markers = tomtom.L.markerClusterGroup();
            addressPoints.forEach(function (point) {
                var title = point[2],
                    marker = tomtom.L.marker(new tomtom.L.LatLng(point[0], point
                        [1]), markerOptions, {title: title});
                marker.bindPopup(title);
                markers.addLayer(marker);
            });
            map.addLayer(markers);
        }

    </script>
</body>
</html>
```