



CHALMERS
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Special Event Traffic Management
An analysis of public transit during Göteborgsvarvet
Bachelor thesis within civil engineering

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Abstract

Göteborgsvarvet was the world's second largest half marathon or marathon race in the world in 2017. Each year the event is held in the center of Gothenburg and places a great strain on the public transport system, which includes trams, buses and ferries.

The event results in many road closures throughout the city and therefore trams and buses are rerouted placing extra strain on already busy stops. Added complications include race participants collecting their race numbers across town from the race start location and the start and end of the race being in the same place. This case study examines the planning process for Göteborgsvarvet and public transit management by conducting interviews with the major organizations involved in event logistics. A survey was conducted that asked respondents about their experiences from Göteborgsvarvet 2017. General Transit Feed Specification (GTFS) data were analyzed at key public transport stops associated with the special event.

The results show that there is a clearly defined planning process for Göteborgsvarvet that is made easier by the fact that it is a reoccurring event, which can be improved upon each year. There are major disruptions to traffic but the event is held on a Saturday and residents tolerate the disruptions due to the special nature of the event. The city of Gothenburg uses the half marathon as a form of publicity and stands firmly behind the event branding. The survey shows how people experienced the disruption to public transport caused by the event. The GTFS data indicates that there are fewer trams in operation during Göteborgsvarvet in 2017 than there were on a normal Saturday, in agreement with the survey conducted.

The case study in the very end examines the social and ethical aspects associated with hosting a half marathon, including considerations given to safety planning. The study concludes that there is a functioning planning process but that improvements could be made to public transport use during the special event. This could be achieved by more thorough data analysis through surveys and traffic data.

Keywords: Göteborgsvarvet, Public transit, Special Event Traffic Management, Traffic planning, Traffic management

Special Event Traffic Management
An analysis of public transit during Göteborgsvarvet
Kandidatarbete inom Samhällsbyggnadsteknik

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Sammandrag

Göteborgsvarvet var världens näst största halvmaraton eller maraton i världen år 2017. Loppet går av stapeln varje år i centrala Göteborg och ger en mycket stor belastning på spårvagnar, bussar och färjor i kollektivtrafiken.

Evenemanget orsakar många vägvstängningar i hela staden som tvingar spårvagnarna och bussarna att bli omdirigerade, vilket ger extra belastning på redan högt belastade stopp. Andra saker som förvärrar trafiksituationen är att deltagarna måste hämta ut sina nummerlappar på andra sidan staden jämfört med var start- och målområdet är.

Denna fallstudie undersöker planeringsprocessen för Göteborgsvarvet och dess påverkan på kollektivtrafiken genom intervjuer med de större, berörda, organisationerna. En enkätundersökning genomfördes som frågade respondenterna om deras erfarenheter kring kollektivtrafiken under Göteborgsvarvet 2017. General Transit Feed Specification (GTFS) analyserades vid viktiga hållplatser i samband med Göteborgsvarvet.

Resultaten visar att det finns en tydligt definierad planeringsprocess för Göteborgsvarvet, denna planeringsprocess underlättas även utav att det är en återkommande händelse som kan förbättras varje år. Evenemanget ger stora störningar i trafiken men då det hålls på en lördag blir störningarna mindre och invånarna tolererar störningarna på grund av Göteborgsvarvets speciella karaktär. Göteborgs stad använder evenemanget som en form av publicitet och ser det som mycket bra marknadsföring för staden. Enkätundersökningen visade på hur människorna upplevde störningarna i kollektivtrafiken som orsakats av evenemanget. GTFS-data tyder på att det finns färre spårvagnar i driften under Göteborgsvarvet år 2017 än det finns på en vanlig lördag, vilket överensstämmer med enkätundersökningen.

Fallstudien granskar slutligen de sociala och etiska aspekterna kring att arrangera ett halvmaraton och inkluderar överväganden kring säkerhetsplaneringen. Studien drar slutsatsen att det finns en fungerande planeringsprocess men att förbättringar kan göras kring användningen av kollektivtrafik under evenemanget. Detta kan uppnås genom noggrannare dataanalys genom enkätundersökningar och trafikdata.

Nyckelord: Göteborgsvarvet, Kollektivtrafik, Trafikplanering kring evenemang, Trafikplanering, Trafikhantering

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Lovisa Boström, Oliver Disney, Eva Gustafsson
May, 2018

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Glossary

Botaniska Trädgården - A bus and tram stop located towards the south of the city of Gothenburg. Göteborgsvarvet starts and ends near this location.

F.H.W.A. - Federal Highway Administration is a part of the U.S. Department of Transportation to support local States and governments. F.H.W.A. are responsible for construction, maintenance and preservation of highways, bridges and tunnels.

GTFS - General Transit Feed Specification is a data format developed by Google that is used to display public transport schedules and associated geographical information as provided by city public transport agencies around the world.

Göteborgs Spårvägar - Operators of the tram system and some bus lines in Gothenburg.

Göteborgs Stad - Gothenburg Municipality.

Göteborgsvarvet - A half marathon that occurs annually in Gothenburg, Sweden.

Korsvägen - A bus and tram stop located towards the east of the city of Gothenburg. Göteborgsvarvet entrants must collect their race numbers from this location.

Svenska Mässan - The Swedish exhibition and congress center located near Korsvägen.

Trafikkontoret - Traffic office responsible for infrastructure in the municipality of Gothenburg.

Trafikverket - Swedish Transport Administration, government agency responsible for infrastructure.

Västra Götaland - A region in the southwest of Sweden where Gothenburg is the main city.

Västtrafik - Provider of public transit in the region of Västra Götaland.

1 Introduction

1.1 Background

The city of Gothenburg is characterized by recurring events such as the half marathon Göteborgsvarvet and more seldom occurring events such as the EU-Summit 2017. These events result in large groups of people in the city center, which may adversely affect surrounding traffic. This can result in primary roads and public transport being overloaded. In addition to the limited accessibility it can affect traffic safety for both road users and pedestrians.

Göteborgsvarvet with around 46,000 participants is the world's second largest half marathon or marathon race (Göteborgsvarvet, 2015). The race affects the city of Gothenburg to a very high extent as the city's public transport uses the road network, which is also in use by the runners during race time. Göteborgsvarvet also differs from many other races, in that not everyone starts at the same time, instead the start groups are spread out over 3 hours.

By creating detailed traffic plans for events in Gothenburg city, negative traffic impacts can be reduced. The goal of the marathon traffic planning is to reroute some of the event traffic to low-volume roads, thus allowing normal below-the-capacity traffic flow on primary roads in the city. Traffic planning for special events requires coordination from the municipality, traffic engineers and event planners. A plan should be provided for the calculated traffic flow and proper implementation should be ensured (Mobility, n.d.).

This study will investigate traffic planning around Göteborgsvarvet, its influence on event participants and on city residents regarding public transport. The city of Gothenburg is currently undergoing major reconstructions that further affect traffic and accessibility. This makes it particularly relevant for elegant traffic planning solutions associated with forthcoming events.

1.2 Aim

The aim of this bachelor thesis is to analyze traffic management during Göteborgsvarvet, focusing on how the event affects public transit. The thesis focuses on the planning process implemented by transport agencies in the city. Transport user's experiences of traffic services during the event, and the potential of currently existing data resources to assist in developing future traffic plans are explored.

1.3 Limitations

This study will only focus on special event traffic management regarding Göteborgsvarvet and the public transit during the event. It will only regard public transit in the city such as trams, buses and additional services for the event. These limitations are made to enable a

more thorough study of public transit and their impact. In addition, it will ensure that our thesis stays within our time frame.

2 Special Event Traffic Management

2.1 Planned special events

According to (Dunn, 2007, p.1), “A planned special event (PSE) is a public activity with a scheduled time, location and duration that may impact the normal operation of the surface transportation system due to increased travel demand and/or reduced capacity attributed to event staging.”

Since the time and place of a planned special event is known, traffic planning can be managed in advance and the need for resources can be anticipated. There is a wide range of planned special events but ultimately, they all lead to an increased travel demand. Planned special events can occur frequently such as conventions at permanent multi-use venues and less frequently such as marathons and parades. During the past years there has been a significant increase of planned special events and travel to them. These events often coincide with rush hour making it even harder than normal for travelers. Planned special events may also result in congestion and street closures during weekends.

Severe weather and major catastrophes can lead to extreme traffic demands under evacuation conditions. However, these do not represent planned special events since they occur randomly. The same goes for construction and traffic incidents which unlike planned special events only constrain travel within a single corridor. More specifically, planned special events generate trips and affect travel in all corridors serving the event venue (Skolnik, Chami, & Walker, 2008).

2.2 What is special event traffic management?

Special event traffic management is the entire planning process leading up to the planned special event as well as day of the event traffic control and coordination. It includes advanced planning, stakeholder coordination and partnership, developing a transportation management plan which includes all stakeholders, raising awareness of the event, preventing travel impacts and coordinating agency services and sharing of resources. Evaluations and implementation of evaluation results are also important aspects of traffic management according to the Federal Highway Administration (F.H.W.A., 2003).

The internet has an important role in special event traffic management for advanced planning. Through social platforms such as Facebook and Twitter it can be predicted which types of events will occur in the future. Websites and information systems can also provide information regarding road works, demonstrations and data about the city. These predictions can give an idea of the travel demand and impact of upcoming events. Thus, methods to use this type of information should be implemented by stakeholders during special event traffic management (Pereira, Rodrigues, & Ben-Akiva, 2015).

2.3 Why is it important to manage travel for planned special events?

There are a lot of reasons why managing travel for planned special events is important. Managing increased travel demand, avoiding congestion, decreasing costs and ensuring the safety of travelers are some of them. Through successfully planning a special event and thus managing increased travel demands, delays may be reduced for travelers both attending and not attending the event. This can be obtained through information about the special event and promotion of alternative routes. Ultimately, this will also decrease the risk of congestion and increase the attractiveness of the city and the event.

Traffic congestion is directly related to economic loss for businesses and trucking companies. By managing travel and planning for the special event these losses can be minimized. In addition, promoting planned special events can benefit tourism and fuel local and state economies. This is only true through successfully managing travel. A successfully planned special event may also lead to increased pride and community spirit, awareness of the community as a travel destination and increased potential to attract other special events (Latoski, Dunn Jr, Wagenblast, Randall, & Walker, 2003).

2.4 Special events typology

There are many types of planned special events. According to (Getz, 2008) these can be divided into the categories shown in the figure below.

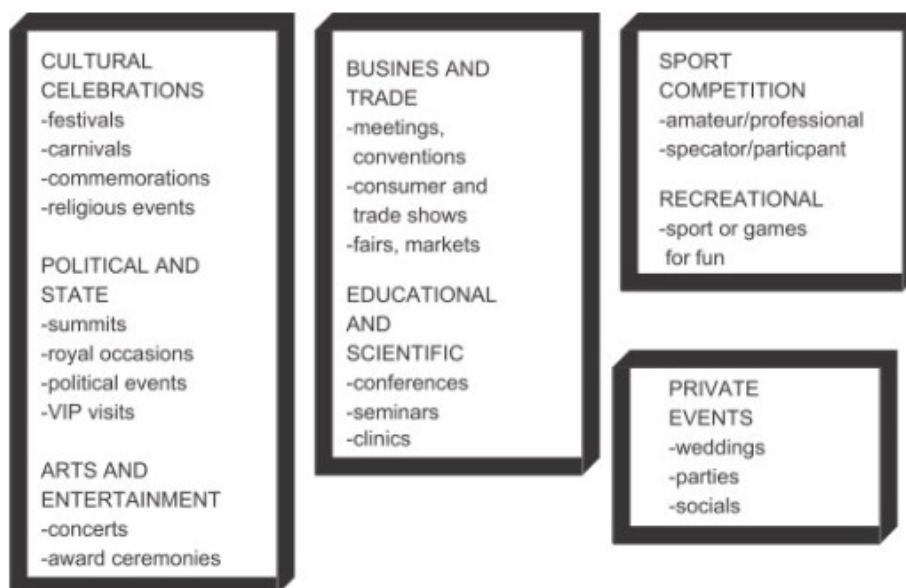


Figure 1. Types of planned special events (Getz, 2008). Reprinted with permission.

Each event type requires a unique set of plans, as different considerations need to be accounted for.

2.5 Special event considerations

When planning for special events, a variety of factors should be considered. These considerations can be researched by asking the following questions (Maricopa Country Department of Transportation, 2015). What other events are scheduled on the date of the planned event? How will the noise impact the surrounding neighborhood? Where will people park? What needs to be included in the traffic control plans, for example, do street closures block or impede access to emergency access routes, churches, schools or public transport use?

More detailed considerations may be taken for specific events. An event such as a marathon that uses city streets has the following impacting factors (Dunn, 2007): travel demand, road/site capacity, event operation, external factors and other considerations. Events held in the city center require extensive planning, weather conditions may affect the plans. Major events generate extra incoming traffic from surrounding regions. Races, parades or rallies often require temporary road closures as they represent the event venue. Event attendance including spectators may be difficult to estimate. These considerations are important as parking, access to public transport, access to neighborhoods, roads and connections may be limited.

2.6 Stages of planning for special events

The stages of planning for special events differ depending on the perspective of organizers, public transit providers or municipal traffic planners. Law enforcement agencies and traffic operators are also involved but do not participate in the planning to the same extent. The event organizers focus in the planning process should be to minimize safety, mobility and reliability impacts on traffic operations. Whereas the municipality stakeholders should focus on minimizing impacts on community quality and maximize social and economic benefits. Even though the planning process may differ the collaboration between stakeholders is of great importance.

The following is a general plan for planned special events which contains all stakeholders. The first step should be program planning where the stakeholders consider policies and regulations and infrastructure resources. A first meeting with all stakeholders should be held where this is discussed and a permit for the event needs to be approved. The event operations planning consists of a feasibility study. It should be considered if the event and traffic operations are manageable. A traffic management plan should be produced and the travel demand should be estimated. An implementation plan for preparations and day of the event activities should be established. This plan should be reviewed and tested. At this stage personnel training in preparation for the event is conducted. Day of the event activities consist of traffic management, traffic monitoring and safety monitoring. The last phase is post-event activities which includes participant evaluation, post-event debriefing and post-event reports (Latoski et al., 2003).

2.7 Traffic solutions for other marathons

This study focuses on Göteborgsvarvet but traffic planning for special events is important throughout the world. This section describes different traffic solutions for other marathons considering their different conditions.

The Stockholm marathon is held every year with approximately 17,000 participants. The impacts this race has on public transport are less in the city center as subway and commuter trains go through tunnels below the city. The closing of streets has therefore reduced effects. During the Stockholm marathon some bus traffic is rerouted or reduced but this has a minor impact due to extra underground services being offered (Trafikförvaltningen, 2016).

In New York, where the world's largest marathon is organized, many bridges and roads are closed during the race. Event participants must follow strict guidelines of how and when they can travel to the race start at Staten Island. These guidelines are implemented as to reduce the effects of the race on transportation opportunities of ordinary people. There are also clear travel recommendations for spectators about how they can move around the city to watch the race and support the runners (New York City Marathon, 2018).

London has approximately 37,000 marathon participants every year. Near where the marathon is held in London the bus traffic must be rerouted or suspended. The underground is in use as usual but with increased traffic loads at the stations near the marathon (Transport for London, 2017).

2.8 Previous studies within special event traffic management

Through the literature review different studies regarding special event traffic management have been reviewed. There are many previous studies focusing on different areas in special event traffic management however they are mostly studies based on events held outside of Sweden. One study focuses on how to predict and visualize traffic congestions in urban environments, caused by planned special events as a part of special event traffic management (Kwoczek, Di Martino, & Nejdil, 2014). This study was considered when analyzing the traffic management during Göteborgsvarvet. One of the other studies that was reviewed focused on the predictions that can be made about public transport arrivals during special events with the use of the web and social media (Pereira et al., 2015). The public transit aspect in this study was deemed interesting when working with our thesis and is a possible aim for further studies in traffic management regarding Göteborgsvarvet.

This study focuses on traffic management during Göteborgsvarvet and its impact on public transit. To our knowledge no previous study has been conducted in this field. Pereira, Rodrigues and Ben-Akiva did conduct a study which contained the public transit aspect, but the focus was rather the use of the web as a part of the planning process. The fact that the traffic management and the impact on public transit during Göteborgsvarvet has not been studied before makes it an interesting subject. It could also be perceived as an important study

since Göteborgsvarvet is a large special event which occurs annually in the city of Gothenburg.

3 Methodology

3.1 Location and event selection

The city of Gothenburg was selected as the location for the study of a planned special event. This selection was made since we are based in Gothenburg and therefore the working process for the thesis was simplified. For instance, interviews with stakeholders in person were made possible. Being based in Gothenburg also leads to an increased knowledge of the city and possibilities for on-site studies.

Göteborgsvarvet was selected as the planned special event which this study focused on. It was selected since it was assumed to have the biggest impact on the city of Gothenburg's public transit. Göteborgsvarvet 2018 takes place on the 19th of May past the deadline for this thesis. The date of the marathon eliminated the opportunity for field studies during the day of the event. Therefore, the analysis of the impact on public transit is based on data from Västtrafik, a survey and interviews with stakeholders. Considering this, Göteborgsvarvet was still perceived as an event with the possibilities for a thorough study.

3.2 Research process and interviews

After choosing a planned special event for the study a general review of the event was conducted. This process included information about special event traffic management, the event Göteborgsvarvet and the stakeholders. Different studies regarding special event traffic management were read to gather background information and ultimately writing a literature review.

An important part of the research process was finding out who the stakeholders were. At the start of this thesis we were recommended by Claes Johansson, guest speaker at Chalmers regarding traffic, to contact Trafikkontoret since they are involved in the traffic planning in the city of Gothenburg. We also chose to contact Västtrafik knowing that they are responsible for the public transit in the city. The fact that the representatives from Göteborgsvarvet play an important role in the traffic planning was made clear through reading different studies regarding special event traffic management. Thereby a contact with representatives from Göteborgsvarvet was established. Interviews with relevant representatives from Trafikkontoret, Västtrafik and Göteborgsvarvet were later held. During our interview with Västtrafik we were also recommended to contact Göteborgs Spårvägar and thus an interview with a representative was held.

Each interview included a series of questions related to a particular stakeholder. These questions aimed to explore the role each stakeholder had in organizing Göteborgsvarvet and the effects on public transport. The feedback from the interviews was recorded manually by at least two project group members and then later compiled into a summary for this report. These interviews served as a learning basis about different organizations and the process of

coordination in order to find suitable traffic solutions. This can be compared with the literature connected to traffic planning for special events in the US.

3.3 Literature review

A literature review was completed partly based on the documents provided to us from our mentor. The aim with the literature review was partly to provide the reader with background information regarding special event traffic management. More importantly it was used to analyze the traffic management during Göteborgsvarvet by comparing the literature review with the results conducted from the interviews. The documents, which this literature review is based on, are mostly studies made in the US regarding car traffic. However, these studies described special event traffic management thoroughly and were considered as good sources for this literature review. There were difficulties finding studies regarding special event traffic management for public transit in Sweden.

3.4 Survey

A survey was compiled and distributed through Facebook. The survey contained questions regarding travel during the day of Göteborgsvarvet 2017, which was the 20th of May. The survey layout can be found in appendix A.1. The main purpose was to get an understanding of the public's view regarding the public transit during Göteborgsvarvet. The survey was distributed through Facebook to our classmates in the group "Chalmers Samhällsbyggnadsteknik 2015," to CFN, which is a female network at Chalmers, and our mentor Ivana Tasic sent it out through e-mail to some of her colleagues at Chalmers. We were able to collect 105 answers which was perceived as sufficient considering our time frame. Out of these 105 respondents 96 stated that they were affected by the marathon and therefore a compilation of these answers was made.

Since it was distributed to CFN it can be assumed that the biggest group in this survey consist of female students who reside in Gothenburg. However, the distribution of the survey to our classmates and employees at Chalmers results in answers from both males and non-students. The fact that it can be assumed that most people in this survey reside in Gothenburg will probably not be significantly misleading since according to Göteborgsvarvet most people participating in Göteborgsvarvet reside in the region Västra Götaland. In 2016 46,3% of the participants were people residing in the region Västra Götaland (Göteborgsvarvet, n.d.-b). Residents in Västra Götaland might even give a better view regarding the disruptions to public transit since they can compare it to public transit on a regular Saturday. However, the travel habits of the people who do not know the city are not represented. It will mostly affect the preferred use of transportation mode and it can be assumed that most students use public transit. Therefore, this survey is considered suitable for our thesis since our aim is to focus on public transit.

3.5 Data from Västtrafik

For this study GTFS data was received from our mentor Ivana Tasic who had received it from a contact at Västtrafik. The data represents tram use in Gothenburg during 2017. GTFS stands

for General Transit Feed Specification (Trafiklab, n.d.) and is being developed by Google to map traffic data.

The files received were in a zip, containing multiple text files that were imported into Excel. These contained information on transit agencies, stop locations, routes, trip sequences, arrival and departure times, dates, transfers and information about the traffic feed. Each one of these files was imported to a separate Excel sheet. The identification numbers for the stops Botaniska Trädgården and Korsvägen were located by searching for the stop names. The routes sheet had identification numbers for each separate tram line. The stop times were filtered by stop and tram identification numbers to show all travel for a specific tram line through a given travel node. This was done for each tram line for both Botaniska Trädgården and Korsvägen. The trip identification field was also sorted by date to only display three different time points. These time points were selected to be the day of Göteborgsvarvet 2017, as well as a Saturday one month before and after this date. The three dates were April 15th, May 20th and June 17th, 2017. The reasons for choosing these dates and time periods were that there was a lot of incomplete data in the GTFS feed and these dates surrounding the event were the most complete, within a reasonable period.

The sorted data was then transported over to a new Excel workspace. A sheet was created for each tram line for both the Botaniska Trädgården and Korsvägen stops. On each sheet the arrival and departure times were listed for the three different dates. However, the arrival and departure times were not listed for trams stopping during the rerouting period under Göteborgsvarvet. Therefore, the data was compiled into sets showing the number of trams for each line stopping at Korsvägen and Botaniska Trädgården under the periods where rerouting did not occur. This was compared with data from the same time periods on other normal Saturdays. A normal Saturday for this project is the two dates listed above due to no large scheduled events occurring. As data was missing in some cases the average between the two Saturdays was used as a comparison to the day of the event. For the time periods listed the number of additional trams present on a normal Saturday was shown. It was also thought to be interesting to consider the number of trams per hour for the given criteria. This was done by counting all the trams, stopping in both directions during the time periods that data exists for. As there were gaps in data due to rerouting on the day of Göteborgsvarvet the period of disruption was not used to calculate the number of trams per hour.

There existed multiple limitations in processing the GTFS data. The data file was exceptionally large and it couldn't be imported into Excel completely. There existed missing data because of this but it was assumed this part of the data was from the end of the year that we did not analyze. In addition to this there were many entries that were either missing or incomplete. Ideally the Saturdays before and after the event would have been analyzed but the data was too incomplete. The tram lines were chosen because they had the most complete data. During Göteborgsvarvet 2017 there were other tram lines used that stop at Korsvägen but do not exist in the data. This part of the study had to focus on trams and not other forms of public transport, such as buses because the same detail of data did not exist in the file. There was no data during the time of rerouting. There were many missing entries for the chosen

tram lines for the Saturday before and after the event. The workaround for this was to combine the two data sets and take the average value. The direction the tram was travelling in was not considered, they are counted the same. There is no way to cross check the accuracy of this data during the study. Arrival and departure times for trams do not differ, therefore it was not possible to research the delays caused by the increased traffic.

Every tram line used in this part of the study was rerouted during the middle of the day except for line 8. This line may be considered less variable as there was meant to be no listed schedule changes. According to information Västtrafik released before the event there are meant to be no changes to line 8, it goes as normal. Botaniska Trädgården and Korsvägen were chosen as they were expected to be two of the most affected stops where trams continued to run during the day of the event. Due to time limitations additional stops were not considered.

The study focuses on the GTFS data acquired as there was no data available from the Västtrafik To Go app or public transport use numbers from vehicle sensors.

4 Results

4.1 Interviews

The text in this section shows the results of the interviews with the four organizations that are primarily responsible for organizing Göteborgsvarvet, how they plan it and the effects on public transport.

4.1.1 Västtrafik

Västtrafik have been responsible for all public transit in the region of Västra Götaland since 1998. Sven-Erik Holta and Anna-Lena Lauritzen work at Västtrafik as project managers for traffic diversions during events and infrastructure developments in the Västra Götaland region. They work with all events in the region and Göteborgsvarvet is the largest of them. Sven-Erik and Anna-Lena's main aim is that the public transit passengers will be affected as little as possible by the disruptions.

Planning activities before the event

The public transit solution for Göteborgsvarvet is planned one year at a time. Planning for an event at Västtrafik usually starts when they receive information from the police that an event permit has been granted. For Göteborgsvarvet this is roughly half a year before the event takes place but for Göteborgsvarvet Västtrafik starts planning before the permit is granted since they assume that Göteborgsvarvet will occur. They also start the planning process earlier since Göteborgsvarvet is an important for the city's brand, so it is important that it functions well. The planning process begins by analyzing last year's plan for public transport and what changes need to be made because of construction work, road closures and changes in the course. Together with the event planner and Trafikkontoret they try to estimate the number of event attendees, how it will affect public transit and to establish which routes the passengers will likely take. From this information they create a plan for rerouting public transit or where extra resources are needed, with the aim that the event will impact the public transit passengers to a minimum.

At least one month before the event plans are finalized and they notify their tram and bus providers. This is necessary so that their providers can create their own event plans and provide updated information to their passengers. Information is the most important tool for Västtrafik. Releasing information in advance eases problems during the event. Information is available in their apps, 'Resoplanerare' and 'Västtrafik To Go', on their webpage and at the bus and tram stops. From experience Västtrafik has realized that even if extra buses are provided during the day of Göteborgsvarvet people tend to use their normal mode of public transit such as trams. They continue to improve traffic information methods regarding public transport to help avoid congestion around the key traffic nodes.

Planning activities during the event

During Göteborgsvarvet, Västtrafik has access to an additional 63 buses and 2 boats to ease the pressure on the provided transport. There are two main nodes in the city that are under extra pressure, these are Korsvägen and Botaniska Trädgården. All the runners must collect their race bibs at Svenska Mässan (The Swedish exhibition and congress center), which is in the proximity of Korsvägen, one third of the people do this the morning of the event. There is also extra pressure on Korsvägen as buses and trams that normally would not go through Korsvägen are rerouted there because their usual route is closed. The other stop that is majorly affected is Botaniska Trädgården as this is the station closest to the start and finish of the race.

There are 80 people employed by Västtrafik specifically for providing information to travelers during Göteborgsvarvet. They provide information to people and direct them to the most effective travel method. The amount of traffic leaders from the different traffic companies is about four times as high as on a normal day and they are there to help if any problems occur. There is also an additional service car in the city to help with vehicle problems and power cuts on the tram tracks. Västtrafik have plans for how to solve any problems that might arise and how to get the information out to passengers as quickly as possible.

In the appendix section A.2. there is a map showing trams and shuttle buses in operation during Göteborgsvarvet 2017. This was received from Sven-Erik via email after we conducted the interview. In the appendix section A.3. is a map of trams and buses normally in operation in Gothenburg, taken from Västtrafik's webpage.

Planning activities after the event

After Göteborgsvarvet, Västtrafik meets with all the organizations involved and they evaluate what went well and what didn't. They also have an evaluation meeting with their vehicle providers to see if there are things they can improve until next year.

4.1.2 Göteborgsvarvet

The second interview was with Lasse Jönsson, the course organizer for Göteborgsvarvet. He is responsible for there being a course for the runners to run on and to be the contact person for the authorities, Trafikkontoret, emergencies services and Trafikverket. He is also responsible for the race officials and has been in this role since 1999.

Planning activities before the event

The planning process begins by Göteborgsvarvet submitting an event application to the police in November. Plans are aimed to be completed in February but must be finalized by 1st April. The opinions of Trafikkontoret and police are respected in the areas that they specialize in, for example, emergency routes. During the planning stage the whole race course is in front of them on a large map. They go through the whole course and pay extra attention to specific places where special considerations are needed. An example of this is if there is ongoing construction work, then the relevant people must be contacted. Göteborgsvarvet meets at least

twice a year with the other organizations to plan the event. There is often contact by telephone and site visits if there are areas that require extra planning.

One thing that has changed a bit of the planning process before the event is that in the past runners collected their race bibs 50 meters from the race start but the building was too small. Therefore, the race number collection was moved to Svenska Mässan which was also due to better communication and the fact that Svenska Mässan provides staff for the event. The decision to do this was a financial one based on more space. However, a consequence of this move is the difficulties in transportation between Korsvägen and the race start. It is especially complicated for the runners that arrive late on the Saturday and will collect their race bibs just before the start. It can then be difficult to arrive at the start on time.

Göteborgsvarvet sends out information to the race participants before the race to encourage people to take public transport to the race or park outside the city. In addition to this Göteborgsvarvet tries to create additional parking places.

Safety planning has become an important part of planning for Göteborgsvarvet. There needs to be clear plans around safety and who makes the final decisions. The police make the decision to stop the race in times of a crisis. Göteborgsvarvet considers terror threats and discusses it with the police that have contact with the Swedish Security Service, SÄPO. Details are not given from the police other than if there is any danger. Responsibility for safety lies with the police and SÄPO. Göteborgsvarvet takes this into account when planning the race with thoughts given to situations like trucks being driven into crowds.

Planning activities during the event

During the event itself Göteborgsvarvet has little involvement with public transit. They encourage race participants to take public transit through providing free travel during the day of Göteborgsvarvet and the two days leading up to it. Göteborgsvarvet's decision to move the collection of race bibs to Svenska Mässan has put extra pressure on the Korsvägen stop. In 2017, 28% of runners collected their race number on Thursday, 44% on Friday and 28% on Saturday.

During the event there is a crisis group that is gathered in one place. Lasse Jönsson is present along with representatives from Trafikkontoret, emergency services and Sahlgrenska hospital. It is here that important decisions during the race are made.

Planning activities after the event

After the event has occurred an evaluation meeting is held not more than 10-14 days after the race. Göteborgsvarvet, Trafikkontoret and the emergency services are at this meeting. They go through the whole course step by step to see what went well and what could be improved. After the race, participants receive a survey from Göteborgsvarvet but this does not contain questions related to public transport.

The race course for Göteborgsvarvet can be seen in the illustration below. In the top left of the image is the course elevation and the key in the bottom right shows water, sport drink, sponge, health care, music, large screen and prize money stations. It also shows the kids version of Göteborgsvarvet called MiniVarvet. The map clearly shows the public transport stops called Botaniska Trädgården towards the South and Korsvägen towards the East. The start and finish for the race are shown in the South towards the Botaniska Trädgården area.

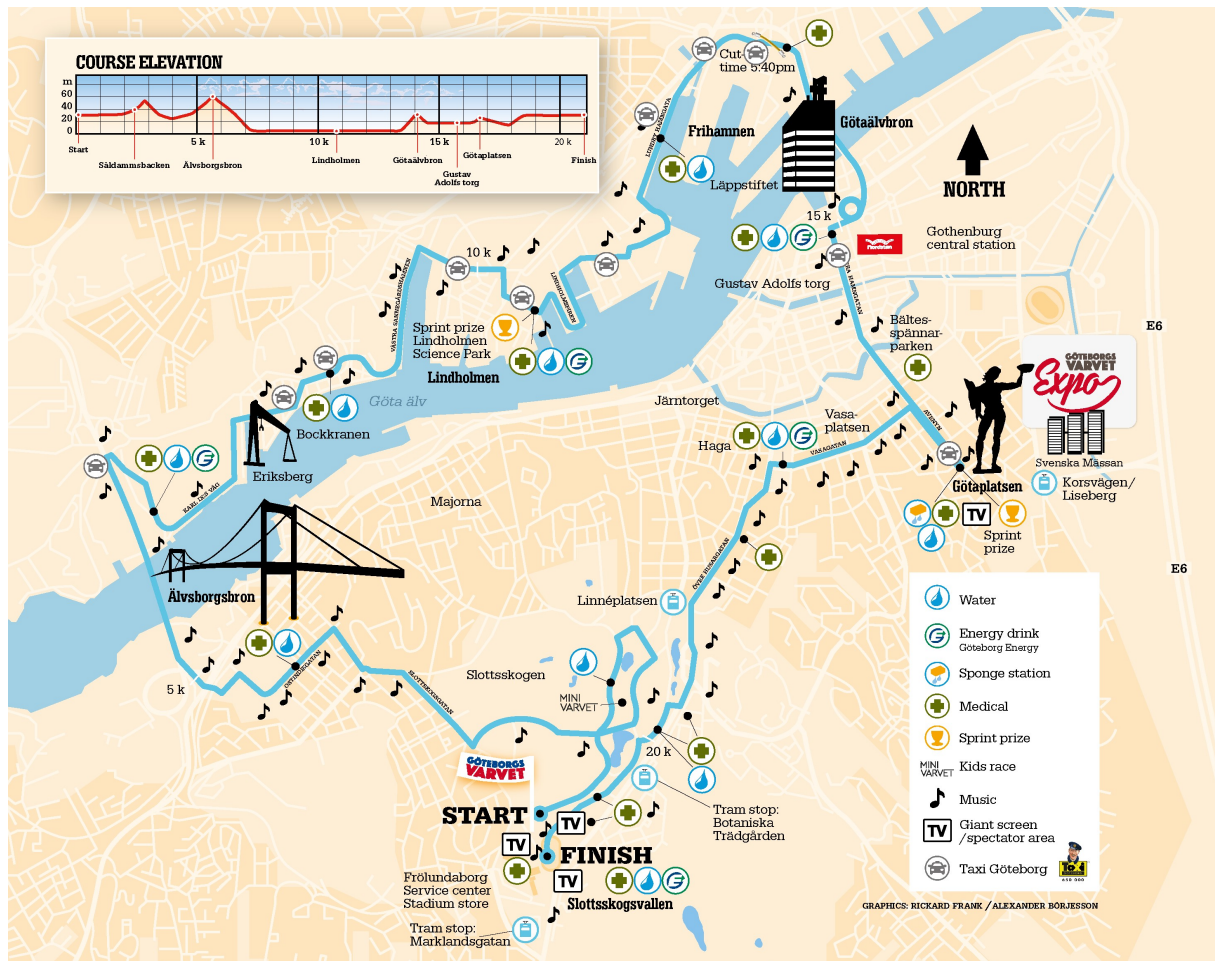


Figure 2. Map of Göteborgsvarvet 2017 showing key points of interest, course layout and important public transport stops connected with the race (Göteborgsvarvet, n.d.-a). Reprinted with permission.

4.1.3 Göteborgs Spårvägar

Göteborgs Spårvägar have provided public transit in Gothenburg by tram and bus since 1879. Anna Källtén works as a traffic planner at Göteborgs Spårvägar and together with the other traffic planners is responsible for providing a base timetable, redirecting public transit during work on the infrastructure and event transport planning.

Planning activities before the event

The coordination between Göteborgs Spårvägar and Göteborgsvarvet usually begins in February of the same year with a start-up meeting where Västrafik are also present. Changes from previous years, such as collecting race bibs from Svenska Mässan are reviewed to see

how it affects travel patterns. Closer to the event itself, traffic managers from the different transportation companies, such as Göteborgs Spårvägar, take over more responsibility. Within 2 weeks before an event, Göteborgs Spårvägar will be ready with their plans but for Göteborgsvarvet they are often ready a month beforehand.

Göteborgsvarvet is the largest individual event they plan for during the year. It is also the most complicated. Much of the planning is similar from year to year but the timetable changes based on feedback from previous years to achieve a better plan. The goal for Göteborgs Spårvägar is to establish a temporary network that works based on available tracks and travel streams.

Planning activities during the event

Göteborgsvarvet closes many streets and all tramlines in Gothenburg except line 8 have in recent years received some form of rerouting during Göteborgsvarvet. Routes may be divided into two parts as traffic through Brunnsparken is greatly reduced or new routes around Brunnsparken may be given. The main shopping street Avenyn is also closed and the traffic must be rerouted to Skånegatan and Chalmers. The rerouting causes delays, Göteborgs Spårvägar adds extra time in the timetable at the final stop to manage this situation. There are also traffic managers from Göteborgs Spårvägar positioned throughout the city, especially at critical points such as Korsvägen and Marklandsgatan to improve the flow of traffic.

Göteborgs Spårvägar takes extra safety measures during the day of Göteborgsvarvet by lowering the speed across Götaälvbron and not collecting passengers on the left turn at Marklandsgatan.

Planning activities after the event

Västtrafik holds an evaluation meeting after Göteborgsvarvet where all the traffic leaders from the different traffic companies involved, such as Göteborgs Spårvägar attend. During this meeting they discuss what went well and what can be improved for next year's race.

4.1.4 Trafikkontoret

Trafikkontoret are responsible for infrastructure in the municipality of Gothenburg. Cecilia Ljunggren and Eva-Britt Andersen work as traffic planning managers at Trafikkontoret and manage traffic planning for special events. This involves the interaction the events will have with infrastructure developments and coordinating with the police on the event permits they issue.

Planning activities before the event

Göteborgsvarvet is an event that occurs annually and there are documents from previous years to base plans on. Planning occurs throughout the year and starts directly after the evaluation meeting from the previous year's race. Trafikkontoret works with Västtrafik and Göteborgsvarvet to estimate the traffic demand for the event. Plans should be complete between March and April. Two weeks before the event they check whether the plans can be

implemented as intended. It happens that there are projects in the city that are not complete on time and these projects must be temporarily halted.

The race organizers have most of the responsibility for the race participants but Trafikkontoret assists with the logistics to provide a better experience for all road users. They also assist with the logistics for the activities that take part around the race course. The planning is difficult because most events want to be located close to the city center where most traffic is. Large infrastructure projects like Västlänken add to the complexities. Trafikkontoret have already noticed the effects from these projects and Västtrafik do not have as much redundancy in their system as they did previously. Therefore, planning is becoming increasingly difficult. It is of great importance for Trafikkontoret that the logistics around Göteborgsvarvet goes well since it is a very important brand for the city.

Trafikkontoret releases information about traffic disruptions through many different methods. These include advertising in newspapers, webpages, radio and social media. They try to reach all groups of people, car users, pedestrians, cyclists and companies. However, the race organizers have most of the responsibility for releasing this information to the race participants.

Planning activities during the event

During the race Cecilia Ljunggren or Eva-Britt Andersen work with the crisis group to support the police, race organizers and Västtrafik. The other is out on the course analyzing traffic flows.

Trafikkontoret works with Västtrafik to prioritize public transport during the race day. Where possible public transport is not rerouted and there are even extra bus lanes to the race start area. Race organizers need to take responsibility for blocking areas close to the race start to minimize illegal parking. Race officials working with traffic management responsibilities must focus on their task and not be distracted by greeting the runners.

Planning activities after the event

Trafikkontoret are present with Göteborgsvarvet, emergency services, Västtrafik and Göteborgs Spårvägar for the race evaluation meeting to discuss improvements for the future.

4.2 Survey

The survey generated 105 answers 96 stated that they were affected by the half marathon which generated further questions and 9 stated that they weren't affected which meant that they were asked no further questions. This section contains an overview of the results from the survey. For a more thorough representation of the survey results see appendix A.4 where used travel mode and reason for travel is considered.

The responses regarding the reason for travelling during the day of Göteborgsvarvet is stated below.

Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as:

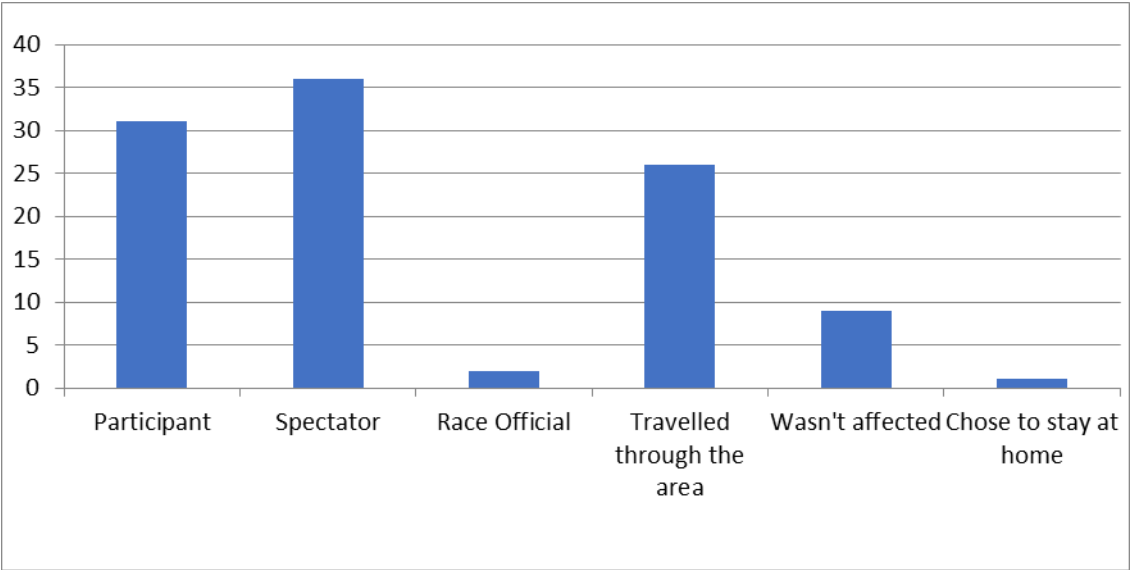


Figure 3. Bar chart showing the reason for travelling during the day of Göteborgsvarvet. Authors own copyright.

Out of these 96 who stated that they were affected by the half marathon the distribution of traffic modes used is stated below.

What was your main mode of transport during the day of Göteborgsvarvet?

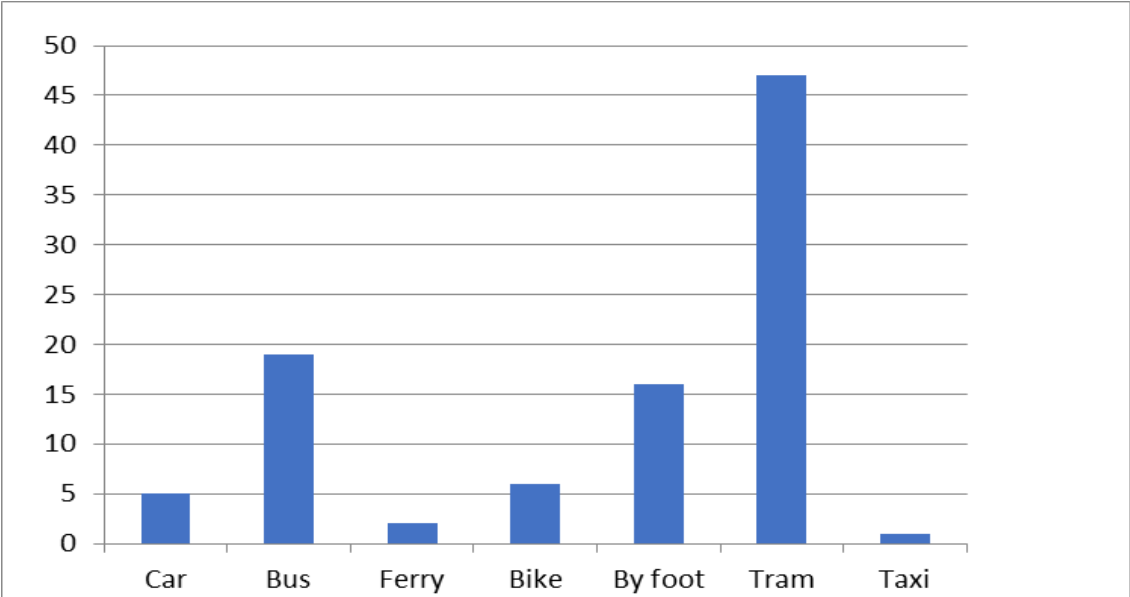


Figure 4. Bar chart showing the distribution of traffic modes used. Authors own copyright.

4.2.1 Disruptions

How would you rate the travel disruptions because of Göteborgsvarvet? For example, increased waiting times and delays.

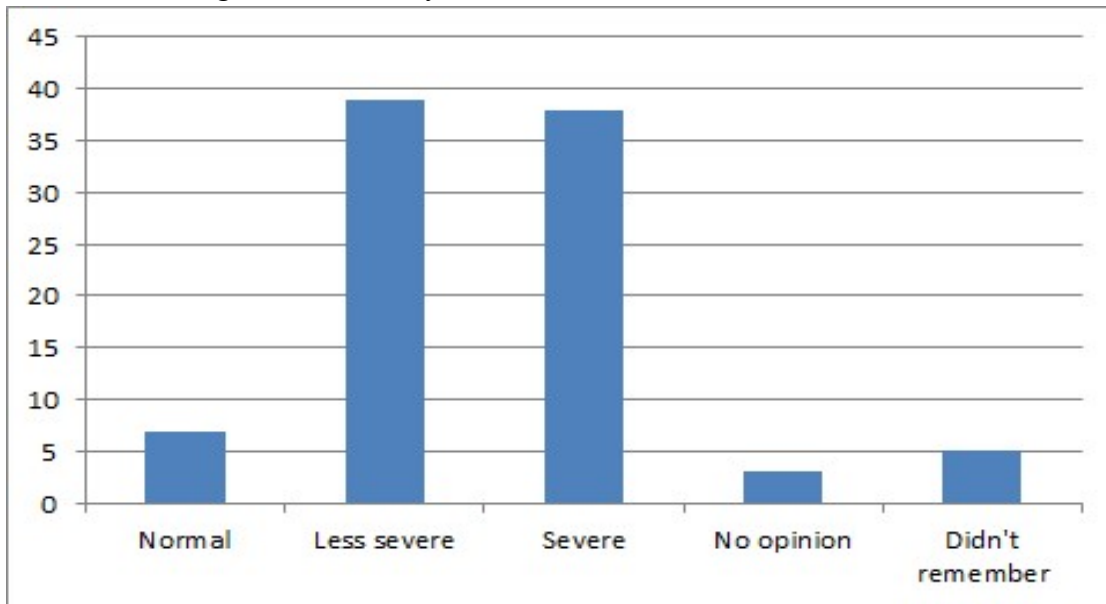


Figure 5. Bar chart showing how the respondents rated the disruptions during the day of Göteborgsvarvet. Authors own copyright.

4.2.2 Waiting times

How would you rate the advanced information about travel disruptions that you were provided with?

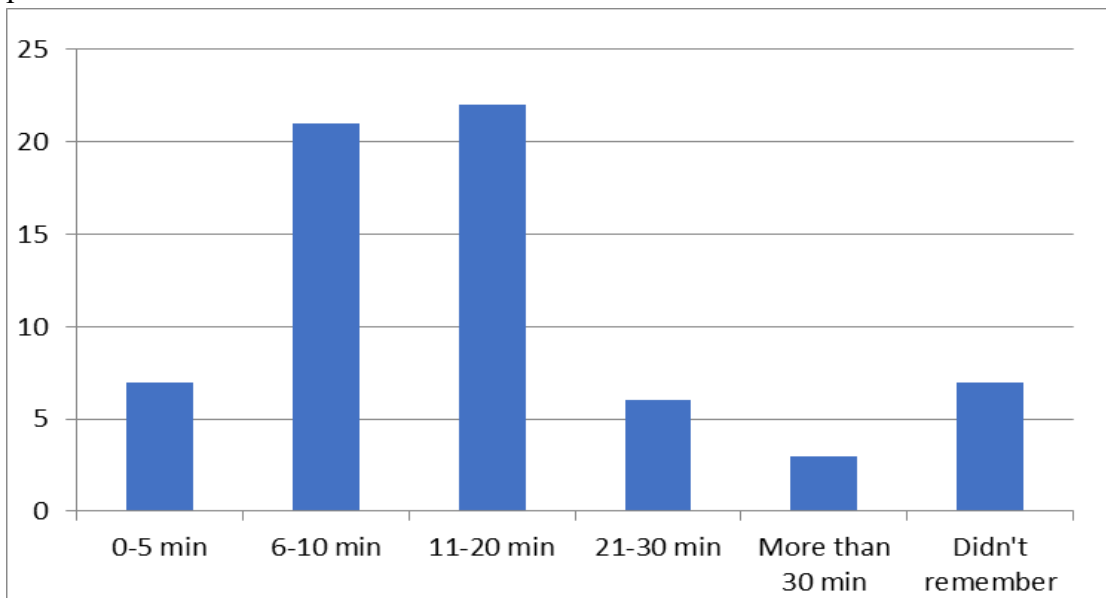


Figure 6. Bar chart showing the respondents estimated waiting times during the day of Göteborgsvarvet. Authors own copyright.

4.2.3 Information

How would you rate the advanced information about travel disruptions that you were provided with?

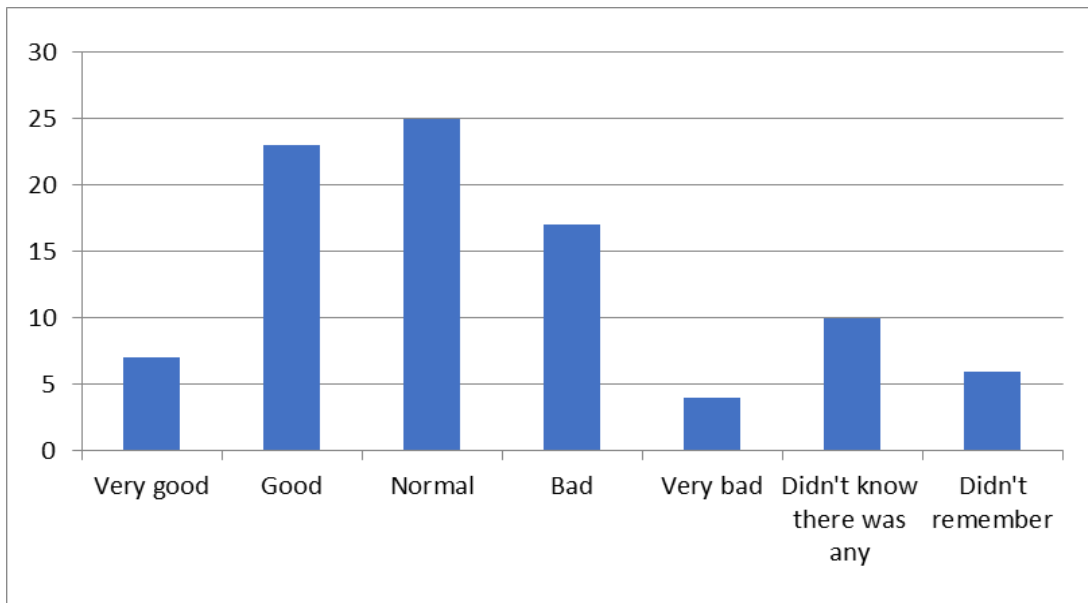


Figure 7. Bar chart showing how the respondents rated the advanced information about travel disruptions. Authors own copyright.

4.2.4 Stops

The following stations were stated when asked at which station the respondents had to wait at, given that they had to wait.

At which bus/tram stop was it?

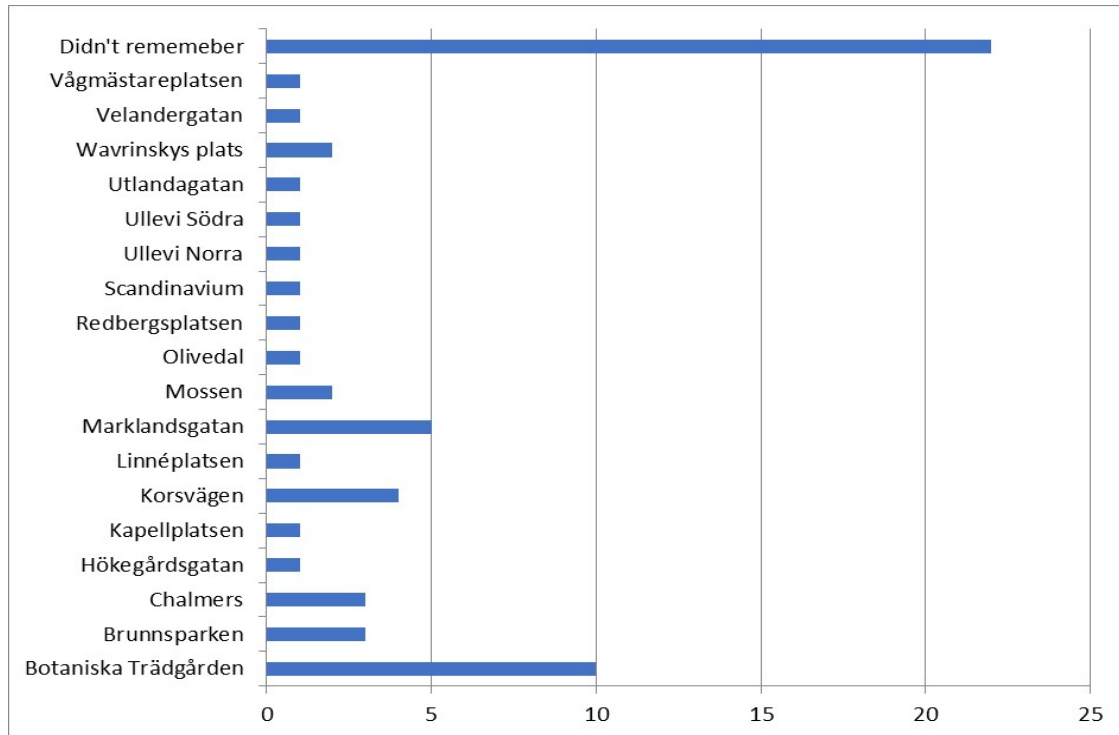


Figure 8. Bar chart showing which station the respondents had to wait at. Authors own copyright.

4.3 GTFS Data from Västtrafik

The GTFS data from Västtrafik was used to record the following results. Arrival and departure times for tram lines 2, 4, 5, 6 and 8 were recorded at the Korsvägen stop. Similarly tram lines 1, 2, 7 and 8 were recorded at the Botaniska Trädgården stop. The results show the arrival and departure times for each tram stopping at either Korsvägen or Botaniska Trädgården on the day of Göteborgsvarvet 2017, a month before and a month after. In some instances, the data is missing. During the scheduled rerouting there is no data during the times of disruption.

4.3.1 Number of trams stopping at Korsvägen and Botaniska Trädgården

In the Appendix section A.5. the results of the data collected are displayed in tables detailing the number of trams for each stop. The tables show where there was complete, partial or no data for each tram line.

In this section two bar charts are presented showing the number of trams stopping at Korsvägen and then Botaniska Trädgården during the day of Göteborgsvarvet 2017 and the

average taken from a month before the event and a month afterwards. Where there is no data displayed the data was missing. The data is split into different intervals due to the rerouting that exists.

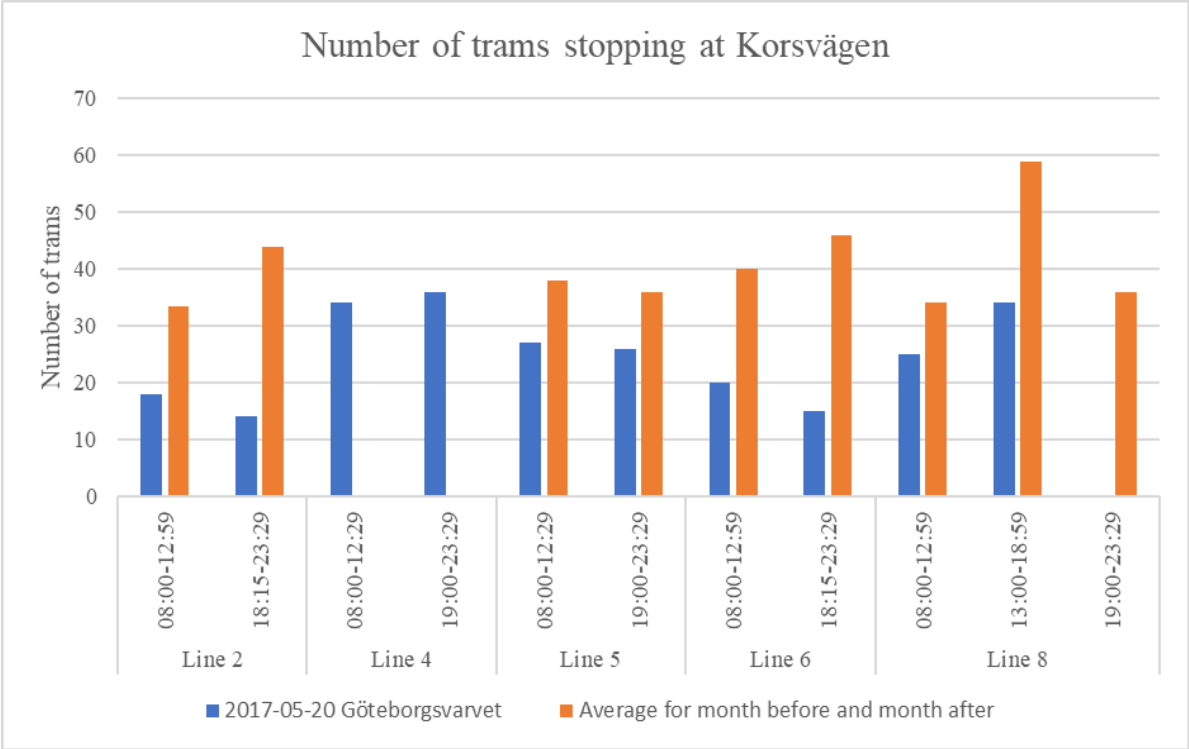


Figure 9. Bar chart showing the difference between number of trams in use during Göteborgsvarvet and the average taken from a month before and a month after the event for the stop Korsvägen. Authors own copyright.

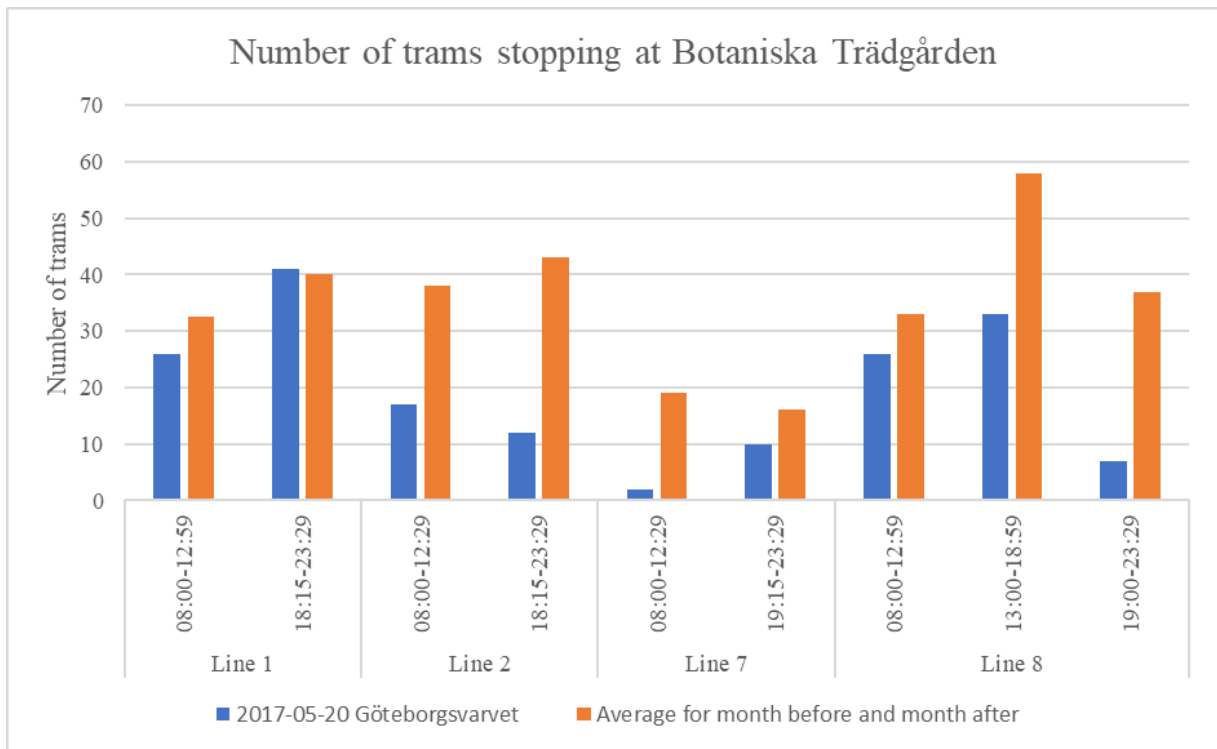


Figure 10. Bar chart showing the difference between number of trams in use during Göteborgsvarvet and the average taken from a month before and a month after the event for the stop Botaniska Trädgården. Authors own copyright.

4.3.2 Additional trams stopping at Korsvägen and Botaniska Trädgården

In this section two bar charts are presented showing the number of additional trams stopping at Korsvägen and then Botaniska Trädgården on a normal Saturday compared with the day of Göteborgsvarvet 2017. The data for a normal Saturday is taken from the average number of trams for the Saturday a month before and after the event. Where there is no data displayed the data was missing. The data is split into different intervals due to the rerouting that exists.

In all cases except one, there are more trams that stop at Korsvägen and Botaniska Trädgården on a normal Saturday than during Göteborgsvarvet.

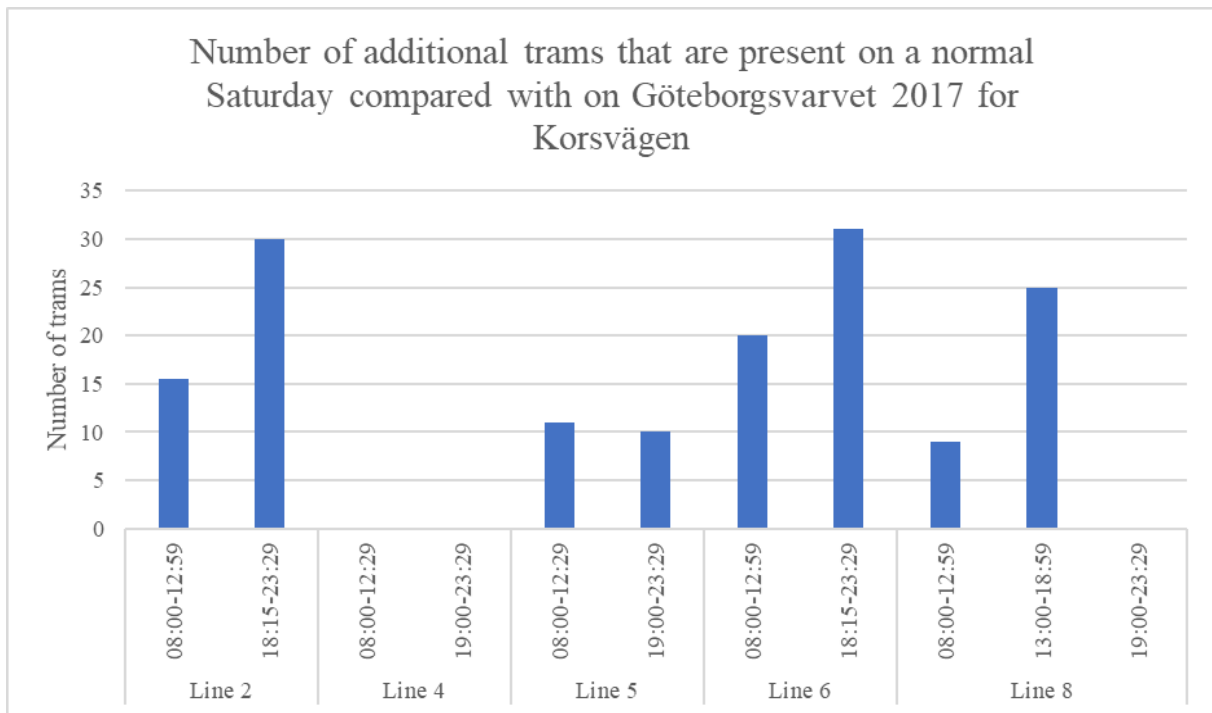


Figure 11. Bar chart showing the additional number of trams in use during a normal Saturday compared with during Göteborgsvarvet 2017 for Korsvägen. Authors own copyright.

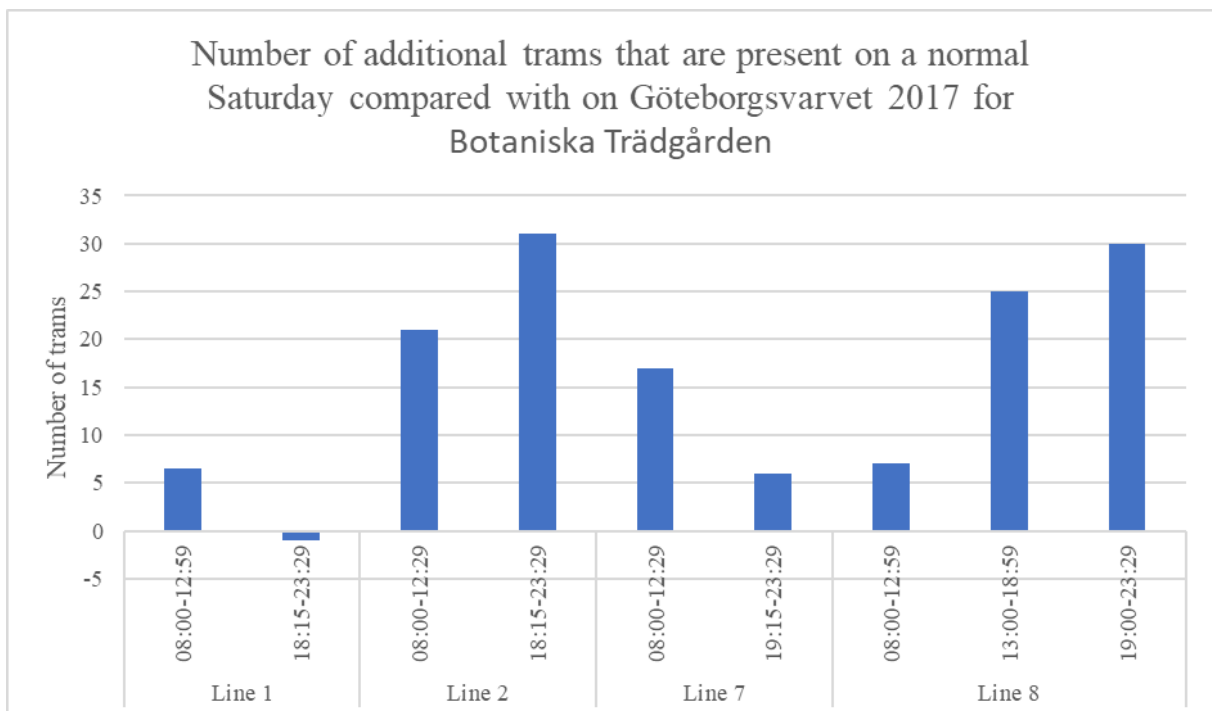


Figure 12. Bar chart showing the additional number of trams in use during a normal Saturday compared with during Göteborgsvarvet 2017 for Botaniska Trädgården. Authors own copyright.

4.3.3 Trams per hour at Korsvägen and Botaniska Trädgården

In this section two bar charts are presented for the tram stops Korsvägen and Botaniska Trädgården showing the number of trams per hour on the day of Göteborgsvarvet 2017 and on

a normal Saturday. A normal Saturday is calculated by taking the average values of a Saturday a month before and a month after the event. The data is calculated outside of rerouting times and is shown for trams travelling in both directions.

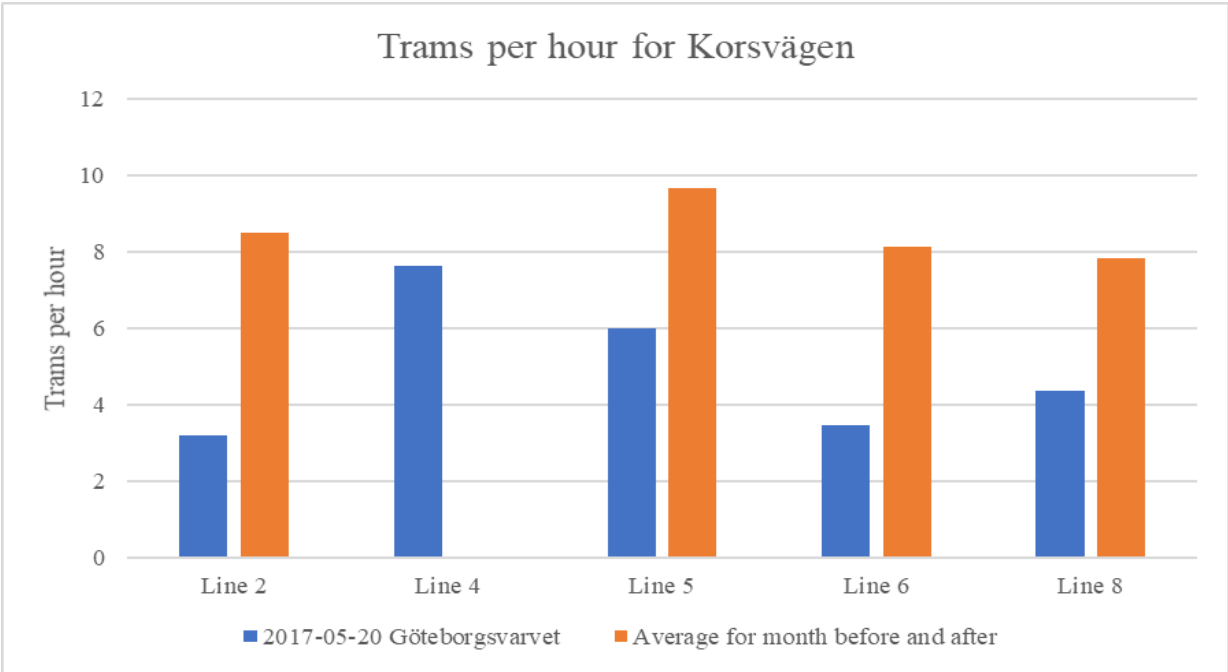


Figure 13. Bar chart showing the number of trams per hour in use during a normal Saturday compared with during Göteborgsvarvet 2017 for Korsvägen. Authors own copyright.

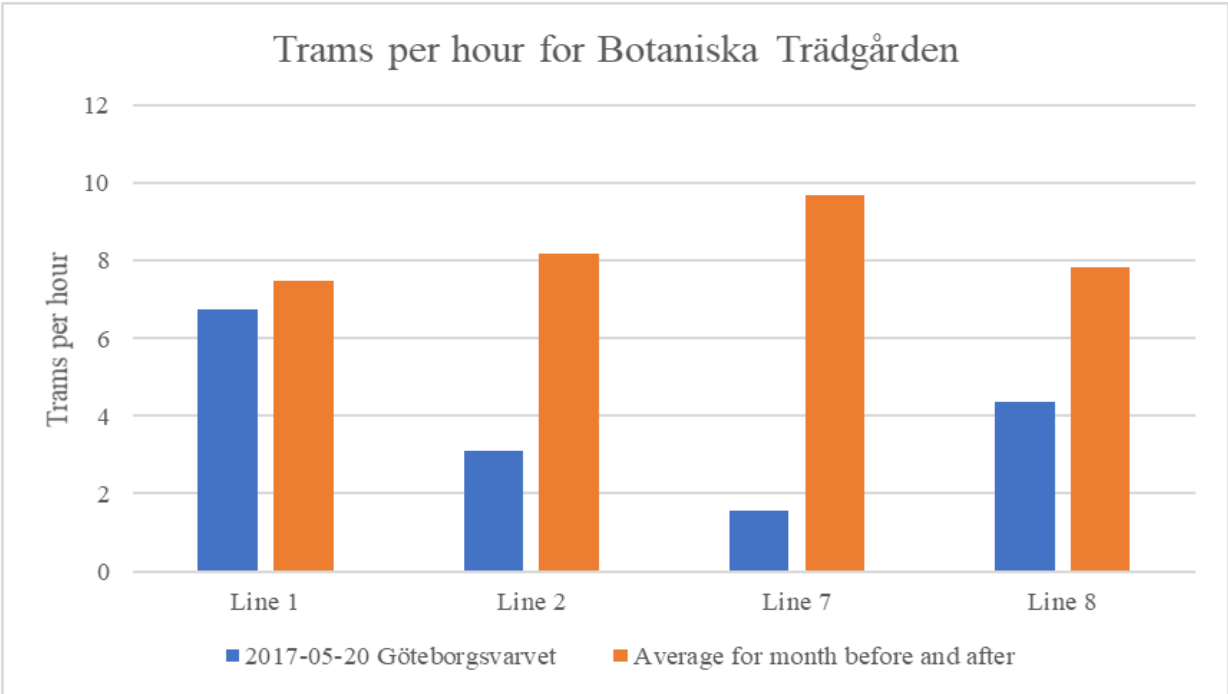


Figure 14. Bar chart showing the number of trams per hour in use during a normal Saturday compared with during Göteborgsvarvet 2017 for Botaniska Trädgården. Authors own copyright.

4.3.4 Additional vehicles

Through contact with Sven-Erik from Västtrafik the following information was provided in March 2018 about extra resources that were provided during Göteborgsvarvet 2017.

Traffic supervisors	42
Extra busses	63
Information providers	80
Boats	2
Service vehicles	1

4.4 Parking for participants

Göteborgsvarvet recommends that participants travel to the race start with public transit, bicycle or by foot but they also provide guidelines for people traveling by car (Göteborgsvarvet, n.d.-c). People arriving by car are recommended to park in the central parts of Gothenburg (Nordstan, Heden, Focus, Gårda, Ullevi, Liseberg and Järntorget) and then take the tram to the start as it is difficult to find parking close to the race start. There are also some parking spots in the industrial area in Högsbo. From here people can access the bus that goes to Marklandsgatan. If race participants need to collect their number bibs before the start, Göteborgsvarvet recommends that they park at Åby Arena that has 1200 parking spots available. They should then take the bus to Svenska Mässan to collect their number bib and then travel by bus or tram to the start. After the race there are buses that return to Åby Arena. In previous years people have also been able to park at Volvo IP but this is unfortunately not an option during 2018.

For people traveling by bus or recreational vehicles it is recommended to park at Valhalla IP, which is between Ullevi and Scandinavium and from there travel with public transit. This parking is open from Friday at 6 pm until noon Sunday. There is bicycle parking available close to the race start.

5 Social and ethical aspects

Special events play an increasingly important role in society and therefore social and ethical aspects are considered.

5.1 Safety planning

The interviews that were conducted highlighted that safety surrounding Göteborgsvarvet is an important issue. The organizers of Göteborgsvarvet have detailed unpublished plans based on several different scenarios. There is a clearly defined decision process, a list of responsibilities, roles and methods of communication.

The decision process is defined into three categories, situation overview, decision making and how to communicate the decision. The situation overview asks the decision maker to analyze what has happened, who is affected and the consequences short and long term. The decision making describes if a decision is needed, can it be made with the current information or if it is worthwhile to wait for more information before deciding. The decision is then communicated by following the documentation and spreading the information to those that need to have it.

The crisis group handling document lists seven main roles. These include chief of staff, decision maker, secretary, communication coordinator, logistics and service and support. For each role it is clearly defined what their responsibilities are, what they are meant to do during race day and a checklist.

During the race the main method of communication is by radio. In 2017 four radio channels were used and each one was reserved for different functions. Each organization involved in running the event listens to their assigned radio channels. The crisis handling group is involved in all channels and can communicate with the relevant party. For example, one radio channel is reserved for health care stations around the course.

The document then addresses in more detail a plan for how communication should occur in the event of a crisis. This includes sections on general advice, a media handling plan and who is responsible for each decision. To aid the information flow on the day of the event there are clearly written scripts for different scenarios that may occur. The document also includes a contact list for everybody involved with the event.

5.2 Health

Göteborgsvarvet is an event that requires physical activity to complete. The race requires a person to physically move themselves 21km to complete the course. In most cases people will prepare for the race by involving themselves in physical activity and health benefits can start to occur before the event is even held. Whilst those with preexisting heart conditions should be careful, overall there exists substantial health benefits. Encouraging physical activity by holding a reoccurring event such as Göteborgsvarvet where many of the race entrants are

from the same region as the event is held, may have long lasting positive health impacts for a regions physical health.

In a report on health and marathon running (Predel, 2014) it is discussed the benefits and drawbacks of training for and running a marathon. The author says that even though participating in endurance events delivers beneficial health effects such as life expectancy the strain on the cardiopulmonary system is very high. Long term effects on middle aged runners may cause adverse effects if excessive endurance training occurs. It is recommended that these athletes have regular checkups and although further studies are needed they should perhaps focus on half marathons instead.

The health benefits of physical activity are numerous. According to (Warburton, Nicol, & Bredin, 2006) physical activity can reduce risk of cardiovascular disease, diabetes mellitus, cancer (colon and breast), obesity, hypertension, bone and joint diseases (osteoporosis and osteoarthritis), and depression. The report shows that a small increase in physical activity can result in large gains in health. The authors say that there appears to be a graded linear relation between volume of physical activity and health. However, there are the greatest improvements in health for those least physically active.

5.3 Financial factors

Each year Göteborgsvarvet has over 60,000 runners entered into the race each paying between 625-895 SEK (Göteborgsvarvet, 2017). The event for 2018 is also sponsored by three main partners and several smaller ones. These are the main sources of income for the race organizers.

Organizing an event on the scale of Göteborgsvarvet takes a lot of planning and resources. Race participants may use the city's public transport for free during race day and the two days before. In our interview with Lasse Jönsson from Göteborgsvarvet he said that each year the race organizers pay a fee to Västtrafik to cover costs.

Hosting a marathon may provide a significant boost to a city's economy if they are organized efficiently and effectively (Papanikos, 2015). It depends greatly on the stakeholder's ability to capitalize on the publicity of the event. There may be benefits to individual entrepreneurs or companies that own hotels, restaurants and shops that have an increased demand for services due to the influx of participants and spectators. An analysis of the 2012 Boston marathon was conducted, which was expected to have 26,700 runners and 500,000 spectators (Boston Athletic Association, 2012). This event was expected to bring in \$137,5 million dollars in the form of fundraising for charities, runner and spectator spending and sponsorships amongst other revenue streams. It is also the largest publicity event that Boston offers.

5.4 Disruption to residents

The half marathon in Gothenburg causes great disruption to residents in the form of road closures, re-routing of public transport and increased traffic. The marathon is held on a

Saturday, which reduces disruption to the working week. On the weekend people generally have more free time and the disruption is not as critical.

From the results of the interviews and survey the consensus is that the residents in Gothenburg are reasonably tolerant of the disruption. They feel the excitement of having such a prestigious and entertaining event in the center of the city outweighs the disruption to their normal routines. Many residents are either participating in the event, spectating the event or not greatly affected.

Less tolerant groups of people may include the disabled, elderly or those with young children. Feedback was received that overcrowding on public transport can make it exceptionally difficult for these groups of people to have the desired access they require. At present there appears to be no clear solution on how to accommodate these groups of people that require extra space for pushchairs, wheelchairs or access to disabled areas, without causing further delays. The staggered starting times of the race are aimed at reducing this disruption but the feedback is that it remains a large problem.

6 Discussion and analysis

6.1 Interviews

The interviews provide a similar view of how Göteborgsvarvet is planned and how it is managed during the day of the event. Göteborgsvarvet's planning follows many of the same principles presented by the FHWA in their handbooks. The FHWA mentions increased travel demand, avoiding congestion and ensuring the safety of travelers as important aspects in managing the event. These are all topics discussed by the stakeholders interviewed for this study. Västtrafik discussed how they focus on managing increased travel demand during Göteborgsvarvet and their coordination with traffic operators to reduce the impact the event has on people that are not interested in the event.

The interviews have shown an understanding for stakeholder coordination which the FHWA describes as a crucial part of event management. In appendix A.6 there is an illustration detailing the coordination that exists between the different organizations involved in planning Göteborgsvarvet. Some of the interview questions were repeated to the different stakeholders and similar answers were received. Therefore, it appears that they have a good collaboration, coordination and management when planning for Göteborgsvarvet.

One aspect that several of the people interviewed raised is that Göteborgsvarvet is an important event for the city and affects the attractiveness of the city, it is part of the city's brand. Therefore, it is important for the city of Gothenburg and Trafikkontoret to work with Göteborgsvarvet so that the event functions well. It is also important because it promotes the city of Gothenburg and a well-functioning event reflects positively on the city. The Federal Highway Administration mentions the importance of managing special events as a way of increasing the attractiveness of the city and appears Gothenburg has understood this.

The general plan for how to organize a planned special event according to Latoski et al. is very similar to the planning stages for Göteborgsvarvet. However, Göteborgsvarvet's planning process can be streamlined as it is a reoccurring event that the city knows take place. The first step for organizing an event, according to Latoski et al. is program planning where they must consider policies, regulations and infrastructure resources. For Göteborgsvarvet this is already clear since it is a reoccurring event and only updating plans from previous years is needed. Göteborgsvarvet applies for a permit from the police but Västtrafik and the other stakeholders will start their preparations before this permit is approved due to the reoccurring nature of the event. The permit application for Göteborgsvarvet is submitted to the police in November and the first meetings are held between Göteborgsvarvet and Västtrafik approximately half a year before the event. Trafikkontoret's planning process for Göteborgsvarvet is ongoing throughout the year and the traffic operators for Västtrafik, such as Göteborgs Spårvägar, are involved from February the same year as the event. The traffic demand is estimated by Västtrafik, Göteborgsvarvet and Trafikkontoret during the second stage of the event operations planning. The third stage for all the stakeholders according to

Latoski et al is the implementation of activities. This planning stage is straightforward since plans from previous years are reviewed. During the day of the event, most of the work surrounding public transit is carried out by the traffic leaders from the different traffic operators. There is also a crisis group monitoring the safety during the event that is assembled with people from Göteborgsvarvet, Trafikkontoret, emergency services and Sahlgrenska hospital. An evaluation meeting is held between 10 to 14 days after the event where Göteborgsvarvet, Trafikkontoret, Västtrafik, Göteborgs Spårvägar and the Emergency services are present and discuss improvements for next year's event.

Interviewing the police may be interesting to gain a deeper understanding of the safety aspects surrounding Göteborgsvarvet. This could provide a clearer view the planning process regarding safety and their social and ethical affects.

6.2 Survey

The participants in the survey were expected to be mostly students, which may have an impact on chosen mode of transport during the day of Göteborgsvarvet. It was expected that most people answering the survey travelled by tram, bus or foot as this is quite typical for students. A difference between chosen mode of transport was distinguished by the fact that 48 out of 96 people stated that they travelled with tram and 18 out of 96 people stated that they travelled by bus. This is obviously affected by where people live and the number of trams or buses running that day. The place of residency was not included in the survey, so no conclusion can be made from this perspective. Through the GTFS data it was made clear that there are less trams running during the day of Göteborgsvarvet than on a normal Saturday. However, the only information provided to us regarding buses is the fact that there are 63 extra buses during this day. This study does not contain information regarding which routes these extra buses take or how many times per hour they are operated. This makes it difficult to discuss the reasons why most people chose to travel with tram. Nevertheless, it was presented during the interview with Västtrafik that it was difficult to motivate the public transit travelers to use the extra buses provided for the day of Göteborgsvarvet. People would rather use the public transit options which they normally use. This could be one of the reasons why most people chose to travel with tram. It must be considered that the survey only contains 96 answers regarding chosen mode of transport and therefore it might not give a correct representation.

Most participants in this study were either participants in the marathon or spectators. 31 out of 96 stated that they were participants and 36 out of 96 stated that they were spectators. This could be explained by the fact that a person may be more willing to answer a survey if they have a closer connection to it. Participating or spectating the event may lead to this. It might also be considered that people try not to travel during the day of Göteborgsvarvet since they are aware of the disruptions during the day of Göteborgsvarvet. In the survey one respondent answered that they stayed home due to the severe traffic disruptions. However, 26 out of 96 people stated that they travelled through the area which is unavoidable since people still have to work or carry out errands.

6.2.1 Disruptions

The majority of the respondents stated that they regarded the traffic disruptions during the day of Göteborgsvarvet as either severe or less severe. This gives the perception that most people in Gothenburg find the traffic disruptions during Göteborgsvarvet to be quite significant. This was not unexpected since it was made clear during the interviews that Göteborgsvarvet is a complicated event which causes a lot of traffic disruptions. Göteborgs Spårvägar mentioned that many streets are closed during this day and that all tram lines except one is therefore rerouted. This further emphasises that the traffic disruptions are in fact significant. Göteborgs Spårvägar also mentioned that they try to minimize the delays by adding extra time in the timetable at the final stop. This means that there will still be delays between stops but the trams are able to start the next travel journey on time. This will not reduce the disruptions but rather through reduced delays give the public the idea that there are less traffic disruptions. Trafikkontoret stated that they try make sure that no construction work is carried out during the day of Göteborgsvarvet, which given the disruptions due to Göteborgsvarvet is of great importance.

34 out of 48 respondents who travelled with tram during the day of Göteborgsvarvet and 16 out of 18 who travelled with bus stated that they regarded the traffic disruptions as severe/less severe. This was slightly unexpected knowing that almost all tram lines are rerouted and that extra buses are provided during this day. This result might indicate that the traffic disruptions are greater for buses. However, since there are quite few respondents and the fact that the answers are based on the respondent's opinion, it is difficult to make this conclusion. Trafikkontoret mentioned that they provide extra bus lanes to the start area of the race which should ease the disruptions. However, factors such as congestion at stops contribute to disruptions. Trafikkontoret do put in effort to minimize the traffic disruptions but ultimately there are so many people travelling during the day of Göteborgsvarvet that significant disruptions are unavoidable.

6.2.2 Waiting times

Most of the respondents in the survey answered that they had to wait either 11-20 minutes or 6-10 minutes at stops during the day of Göteborgsvarvet. 6-10 minutes might be considered as a normal waiting time during a Saturday. Out of the 22 respondents who had to wait 11-20 minutes 21 stated that they regarded the traffic disruptions as severe/less severe. Since there were also 6 respondents stating that they had to wait 21-30 minutes and 3 respondents stating that they had to more than 30 minutes we can make the conclusion that the waiting times were longer than on a normal Saturday. There was not a significant difference for waiting times between trams and buses.

6.2.3 Information

During the interview with Västtrafik they emphasized the resources and focus they put into the distribution of information regarding public transit during Göteborgsvarvet. They do this through their app, web page and through 80 information providers who are working during the day of the event. 7 respondents stated that the advanced information regarding traffic

disruptions was very good, 23 stated that it was good and 25 stated that advanced information was normal. This is a majority compared with the 4 respondents who stated that the advanced information was very bad, the 17 who stated that it was bad and the 10 respondents who stated that they didn't know there was any information. Out of the respondents who stated that the information was very good or good, most respondents still considered the traffic disruptions to be severe or less severe. It can still be assumed that the advanced information does in fact reduce the traffic disruptions since people are able to plan their travel in advance, which is something Trafikkontoret mentioned as a tool to minimize traffic disruptions. The fact that the respondents still consider the traffic disruptions to be severe or less severe is not unexpected considering the rerouting and road closures. Planning travel options may reduce the impact but avoiding traffic disruptions this day may be considered almost impossible.

Trafikkontoret, Västtrafik and Göteborgsvarvet all mentioned that they provide information regarding public transit travel during the day of Göteborgsvarvet. Trafikkontoret considered it to be mostly Göteborgsvarvet's responsibility since they are responsible for the event. As previously mentioned in section 2.3 providing information is an important part of special event management and it can reduce congestion and economic loss. Therefore, it is important that all the above continue to improve the distribution of information since there were still some respondents who regarded the information as very bad or bad.

6.2.4 Stops

The stops where survey respondents answered that they had to wait a longer time were Botaniska Trädgården, Marklandsgatan and Korsvägen. It was expected to receive these responses since Västtrafik regarded these as the most affected stops. Botaniska Trädgården and Marklandsgatan are the stops closest to the start so the majority of the participants will arrive at these stations making them congested. Korsvägen was considered a problematic stop since most buses and trams go by Korsvägen and in addition there is rerouting to Korsvägen during the day of the event. The fact that the collection of number bibs for the race is at Svenska Mässan further adds to the waiting times at Korsvägen. Västtrafik considers this collection to be problematic however, it was a financial decision made by Göteborgsvarvet. They are aware of the consequences but still consider it to be the best option. Given the current conditions, waiting times at these stops can be expected to continue being significant.

6.2.5 Improvements for further studies

As mentioned in the method section there were limitations in the target group and the number of received answers. For further studies within this subject, improvements could be made in the compilation and distribution of a survey. Given a longer time frame more responses could be collected and compiled to receive a more qualitative result. If possible, the study should be conducted before, during and after the event allowing for a survey to be sent out directly after the event has been held. This would probably result in more reliable results since people are more likely to remember a trip they took two days ago compared to a trip they took almost a year ago. It is also important to remember that this survey is partly based on the respondent's perception such as in the survey question regarding how the respondent perceived the traffic disruptions. The aim with the survey was to gain an understanding of the general perception

regarding traffic disruptions, which was achieved. If the aim is to obtain the actual waiting times at stops, a collection of data or a field study needs to be conducted. Further if the goal is to achieve an assessment regarding traffic disruptions field studies and comparisons to disruptions during other events need to be conducted.

6.3 GTFS data from Västtrafik

6.3.1 Number of trams

At the Korsvägen stop results have been provided for 5 different tram lines. However, for tram line 4 there is a lack of data to make a comparison. Line 8 can be regarded as a constant as there was no rerouting during the day of Göteborgsvarvet 2017. There is clear data up until 18:59 that shows more trams are present on a normal Saturday than the Saturday of Göteborgsvarvet 2017. This is reflected in the results for lines 2, 5 and 6, where throughout the day, excluding the period of rerouting there are a greater number of trams on a normal Saturday.

At the Botaniska Trädgården stop there are results for four different tram lines. Line 8 was not rerouted as mentioned above. At all periods of time for the day of Göteborgsvarvet 2017 compared with a normal Saturday, there were a greater number of trams on a normal Saturday. This was also true for lines 1, 2 and 7 except between 18:15 and 23:29 for line 1 where there was a single extra tram during the day of Göteborgsvarvet 2017.

In both the above cases there existed times when there were upwards of 30 additional trams in just over a 5-hour period. The Korsvägen stop was more greatly affected in the period afternoon to evening than during the morning. The Botaniska Trädgården stop had higher levels of disruption later in the day for lines 2 and 8 but earlier on in the day for lines 1 and 7.

6.3.2 Trams per hour

In all cases except for line 4 at Korsvägen where data was missing, there were a greater number of trams per hour on a normal Saturday than the Saturday of Göteborgsvarvet 2017 for the stops Korsvägen and Botaniska Trädgården. These results showed the number of trams per hour during normal operating hours for trams on a Saturday. The data was compressed during periods of rerouting as there was no access to this data. Tram line 8 that is not rerouted indicates similar results for both stops and therefore this data compression appeared acceptable.

The compiled results reinforce the idea that there are less trams in operation during Göteborgsvarvet than on a normal Saturday. On a normal Saturday there are approximately 8 trams per hour in operation for each tram line, with no differentiation given to the trams direction of travel. There is a wide variation in trams per hour for the Saturday of Göteborgsvarvet 2017 ranging from below a total of 2 per hour to just under 8. The average of 8 for a normal Saturday is not reached by any tram line during Göteborgsvarvet 2017. Consideration should be given to time intervals chosen for these results where there may be

less busy periods in the early morning or late at night that affect the average trams per hour. Times used in this study ranged from 06:07 until 23:58.

6.3.3 Integrity of GTFS data

This data clearly indicates that there are more trams in operation on a normal Saturday than during Göteborgsvarvet 2017. Initially this was an unexpected result as it was assumed from the interviews that extra public transport services would be provided for the event. However, feedback from the survey indicated that whilst trams travelled relatively freely between stops there were long delays at the stops themselves. This was due to overcrowding on the transport services and the time spent waiting for passengers to load and unload. Therefore, the results seem valid and whilst there is a lack of data to compare this to the results were very clear. Public transport is heavily disrupted during Göteborgsvarvet.

It was indicated from the interviews that extra transport services are provided for Göteborgsvarvet. Upon review extra tram services were never mentioned but there are instead extra buses, trains and boats. It can be expected that even though there are a reduced number of trams in operation during Göteborgsvarvet, that the extra transport services provided, namely buses may offset some of the traffic load. The two tram stops analyzed were also two that are expected to be most heavily affected by Göteborgsvarvet. The results may differ for other less populated stops in the city.

As mentioned in the method there were many limitations analyzing this GTFS data. These limitations must be taken into consideration when reviewing the results. The data for these two tram stops consistently showed that there are a reduced number of trams in operation during the event. However, the limitations listed may have affected the result gathering process such as in cases where there was missing data or partial data.

6.3.4 Further studies for GTFS data and Göteborgsvarvet

There are many improvements that could be done to improve the GTFS data results gathered in this report. More than one year of results would be analyzed but there was no access to this data. Different tram stops and tram lines could be researched. An interesting study could be to compare these two busy travel nodes to others around the city and analyze the area of influence that the event has. It might be expected that the disruption is greatest around Korsvägen, the race start and the city center and gradually decreases as distance from these points increases.

This part of the study only focused on the tram lines that there was data for. Other forms of public transport such as buses were not analyzed. As there are extra buses provided it would be interesting to compare the influence these have during the event.

Public transport delays caused by Göteborgsvarvet may also be interesting to research. Arrival and departure times for trams were listed as the same in the data set that was provided. In the future these may be listed as different and then a comparison of delays at stops could be performed.

In this study there was no access to passenger numbers for public transport. Ideally the results could be compared to passenger numbers, public transport capacities and delays caused by Göteborgsvarvet.

6.3.5 Improvements using GTFS data

The data can be used to show that there are less trams in operation around key travel nodes during Göteborgsvarvet 2017. In the information that was provided and researched there is advice about the expected disruption to travel. During the interview with Västtrafik they said that it was difficult to get people to take buses instead of trams. A possible way to improve the situation could be to release advance information that directs people to take a bus if there is a choice.

The GTFS data can be used in many ways to manage traffic disruption during Göteborgsvarvet. A study was conducted that lists applications in which this type of data can be used (Antrim & Barbeau, 2013). A combination of these tools could be integrated with the Västtrafik To Go travel application to provide a more visual experience for the end user. For example, real time transit information displayed on google maps via the mobile application may enable end users to make smarter transit choices. If this is combined with traffic disruption notifications through the app then transit disruptions may be reduced. Trip planning may improve with access to increased real time visual aids.

6.4 Parking

Parking in the city exists during Göteborgsvarvet but due to the number of event participants and spectators, alternate transport methods are recommended. Traveling by car to Göteborgsvarvet is very difficult due to road closures and lack of parking access near the race start. Park and ride services are provided from areas outside of the city center. There is available parking in the city's parking houses but even then, another mode of transportation is required to reach the race start. It is recommended to avoid traveling by car through the city during Göteborgsvarvet. Even though some people travel by car to Göteborgsvarvet the demand on public transport remains as there is no available parking close to the race start.

7 Conclusion

During Göteborgsvarvet 2017 there was a severe impact on public transport in Gothenburg. This was shown in all parts of this case study, interviews, survey and the GTFS data. However, the feedback received was that residents are tolerant of the disruptions for this special event and the city uses Göteborgsvarvet as a branding tool. The current traffic management model is one that works but there remains room for improvement.

Plans for Göteborgsvarvet are created by all the different organizations involved and coordination between the agencies appears good. The event is one that occurs annually and therefore plans can often be reused one year to the next with improvements added. Plans are made well in advance of the event and may even begin even before the permit is granted. The planning process for Göteborgsvarvet has strong similarities to the literature reviewed written by The Federal Highway Administration.

The survey was useful to gather feedback from all those affected by the event and not just those participating. The survey conducted for this report gives an overview of how people experienced public transport during the day of Göteborgsvarvet 2017. The survey reflected responses of mainly students that found there to be disruptions caused to public transport, primarily around the stops Botaniska Trädgården, Marklandsgatan and Korsvägen. Most respondents in the survey used trams with the next largest group using buses. Whilst many respondents thought information about traffic disruptions was adequate or good there were still those that lacked information.

The GTFS data showed that for Göteborgsvarvet 2017 there were less trams in operation during the event than on other Saturdays a month before and after for the stops Korsvägen and Botaniska Trädgården. This information was combined with the responses from the other parts of this case study and was explained due to overcrowding and rerouting during Göteborgsvarvet. Trams had to wait a long time at these stops as passengers collected their race numbers near Korsvägen and travelled to and from the race at Botaniska Trädgården. Large parts of the city are closed during the race and trams are rerouted through Korsvägen also adding to the increased traffic. Only information about tram usage was gathered in this case study as there was no access to other public transport methods, the results for buses may differ.

The planning process for Göteborgsvarvet functions well but there are clearly still severe disruptions to public transport. There are people that lack information about traffic disruptions and an overloading of trams compared with buses. Therefore, improvements can still be made to information released to better manage the traffic flow. To aid this process more complete GTFS data including delays at stops could be used in combination with sensors counting the total of passengers using public transport. Further improvements could be made through field studies at key tram stops during special events and more complete surveys after the event.

This case study could be expanded to analyze the effects on alternative modes of transport such as cars and bicycles.

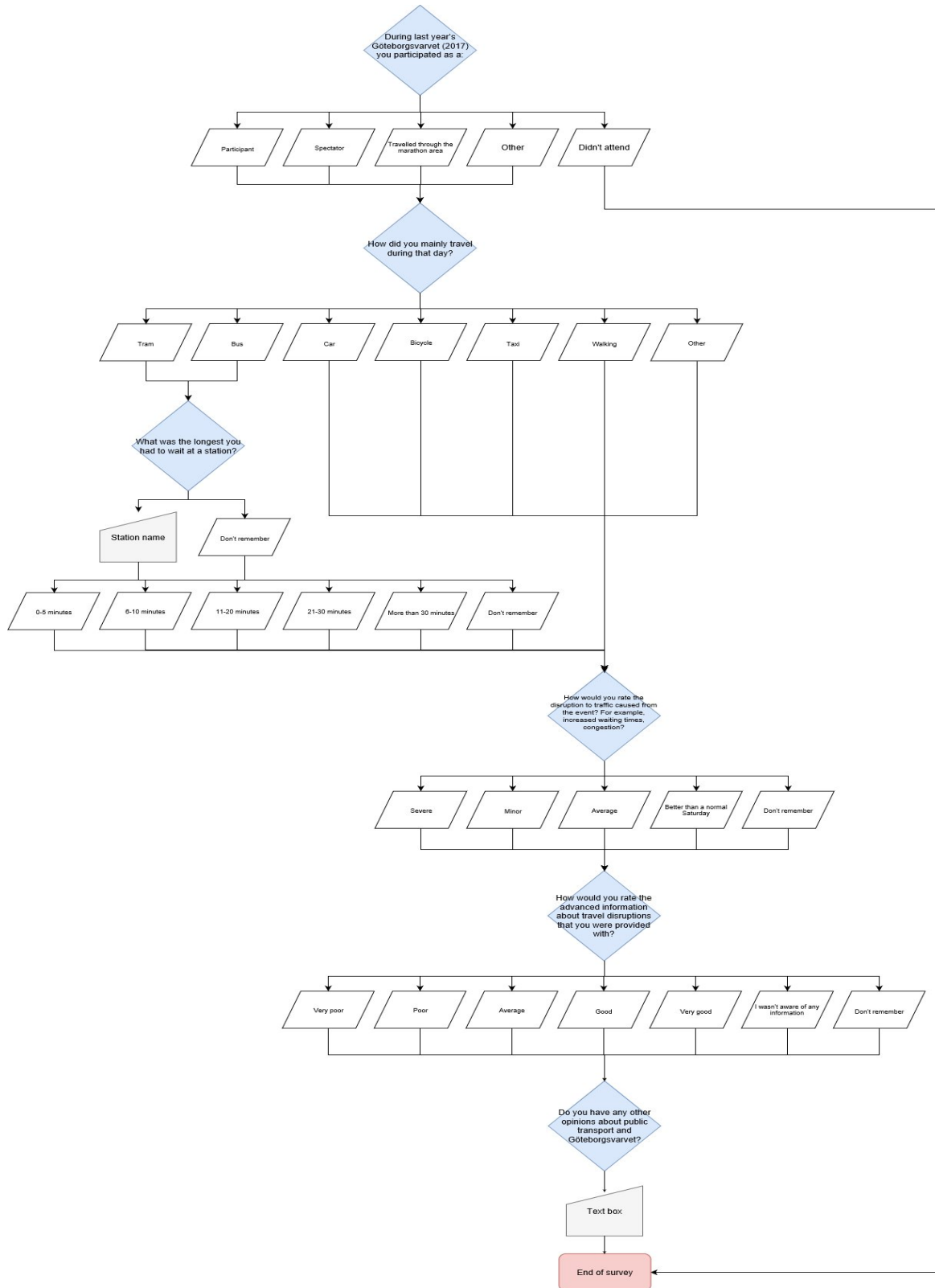
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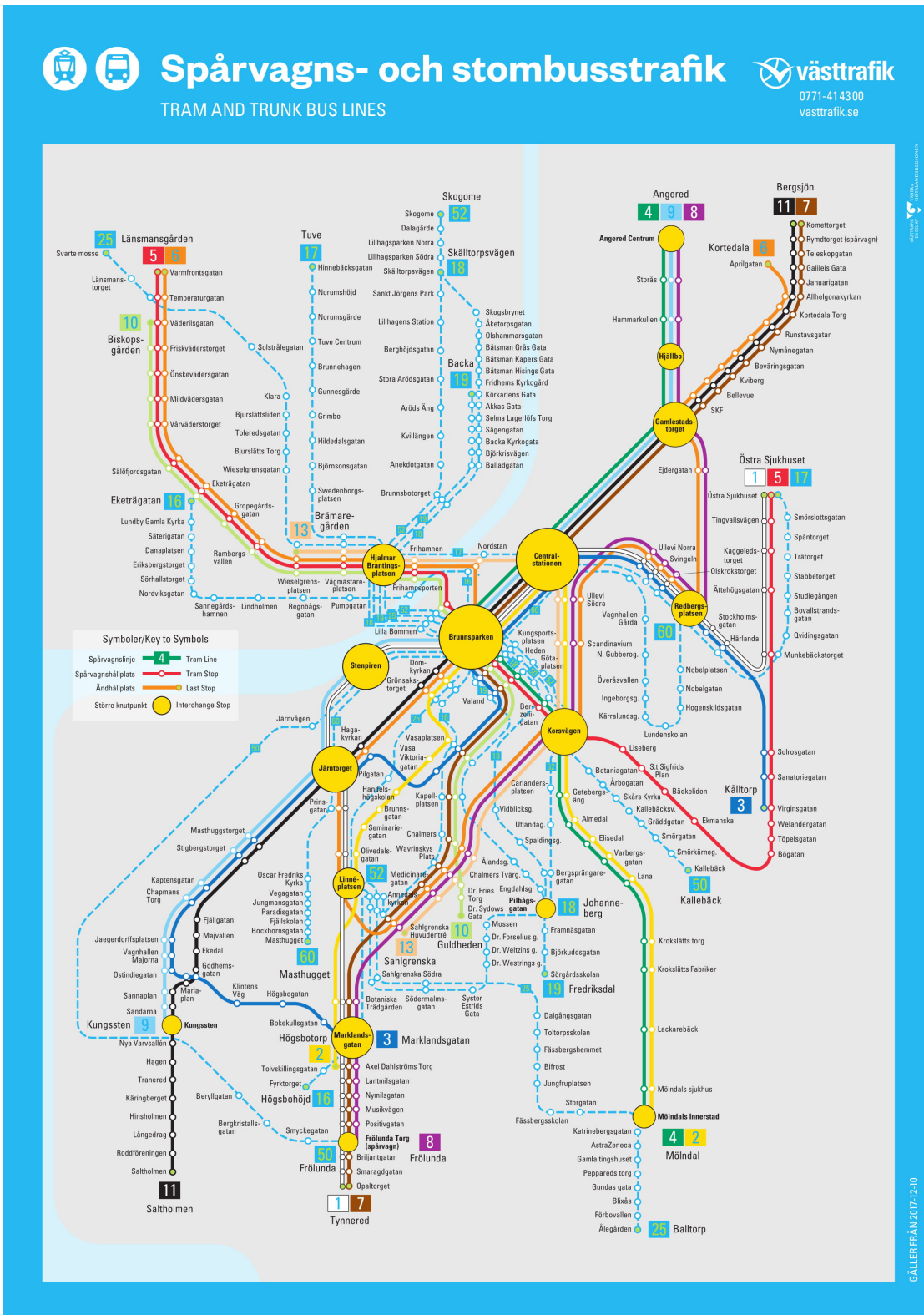
Appendix

A.1 Survey questions and design



An illustration showing the Google survey questions and layout

A.3 Bus and tram routes during a normal day in Gothenburg



A map showing buses and trams in Gothenburg. The maps shows tram lines, bus lines, stops, last stops and interchanges (Västtrafik, n.d.).

A.4 Data collected from the survey

Disruptions

There were 38 responders stating that the disruptions were severe and for these responses the distribution of traffic modes used is stated below:

Tram	18
Bus	8
By foot	6
Bike	3
Car	2
Taxi	1

There were 39 responders stating that the disruptions were less severe and for these responses the distribution of traffic modes is stated below:

Tram	16
Bus	8
By foot	6
Bike	4
Car	3
Ferry	2

There were 7 responders stating that the disruptions were normal and for these responses the distribution of traffic modes is stated below:

Tram	4
Bus	1
Bike	1
By foot	1

There were 3 responders stating that they had no opinion regarding the disruptions and 4 responders stating that they didn't remember.

Waiting times

There were 6 respondents stating that they had to wait 21-30 minutes. For these responses the respondents answer to the question "*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*" and the distribution of traffic modes used is stated below:

Participant	2	Tram	4
Spectator	2	Bus	2
Travelled through the area	2		

All the respondents who had to wait 21-30 minutes considered the traffic disruptions to be severe. The stations they had to wait at was different for all four of them that remembered, one respondent mentioned Botaniska Trädgården another respondent mentioned Brunnsparken, one had to wait at both the central station and Lindholmen and the last person had to get off at Scandinavium and walk to Korsvägen.

There were 22 respondents stating that they had to wait 11-20 minutes. For these responses the respondents answer to the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” and the distribution of traffic modes used is stated below:

Participant	9	Tram	16
Spectator	7	Bus	6
Travelled through the area	5		
Race official	1		

10 of the respondents who had to wait 11-20 minutes considered the traffic disruptions to be severe, 11 considered them as less severe and one respondent considered them as normal.

They also stated the following regarding which station they had to wait at:

Botaniska Trädgården	3
Korsvägen	4
Mossen	2
Marklandsgatan	2

The following stations were mentioned one time by different respondents; Welandergatan, Vågmästareplatsen, Linnéplatsen, Chalmers, Ullevi Södra and Brunnsparken. The rest of the respondents did not remember.

There were 21 respondents stating that they had to wait 6-10 minutes. For these responses the respondents answer to the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” and the distribution of traffic modes used is stated below:

Participant	8	Tram	16
Spectator	9	Bus	5
Travelled through the area	4		

The 21 respondents who waited 6-10 minutes considered the traffic disruptions in the following way:

Severe	5
Less severe	6
Didn't remember	2
Normal	2
No opinion	6

Regarding which station they had to wait at 6 respondents mentioned Botaniska Trädgården and 6 respondents didn't remember. The following stations were also mentioned one time by

different respondents; Almedal, Korsvägen, Brunnsparken, Chalmers, Kapellplatsen, Marklandsgatan, Olivedal, Redbergsplatsen, Scandinavium and Utlandagatan.

There were 7 respondents stating that they had to wait 0-5 minutes. For these responses the respondents answer to the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” and the distribution of traffic modes used is stated below:

Participant	3	Tram	6
Spectator	2	Bus	1
Travelled through the area	1		
Race official	1		

3 of the respondents who waited 0-5 minutes considered the traffic disruptions to be less severe. The following was also mentioned one time by different respondents; severe, normal, no opinion and didn't remember. Regarding which station they had to wait at 2 mentioned Marklandsgatan, 3 didn't remember and Wavrinskys plats and Ullevi Norra was mentioned one time each.

There were also 7 respondents who stated that they didn't remember how long they had to wait and 3 respondents that stated that they had to wait more than 30 minutes.

Information

There were 23 responders stating that the advanced information about travel disruptions were good. These respondents answered the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” in the following way:

Spectator	8
Participant	9
Travelled through the area	4
Chose to stay at home	1
Race official	1

These respondents also stated the following regarding traffic disruptions:

Severe	7
Less severe	11
Normal	3
No opinion	1
Didn't remember	1

There were 25 responders stating that the advanced information about travel disruptions were normal. These respondents answered the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” in the following way:

Spectator	7
Participant	7

Travelled through the area 11

These respondents also stated the following regarding traffic disruptions:

Severe	11
Less severe	13
Normal	1

There were 17 responders stating that the advanced information about travel disruptions were bad. These respondents answered the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” in the following way:

Spectator	8
Participant	4
Travelled through the area	4
Race official	1

These respondents also stated the following regarding traffic disruptions:

Severe	12
Less severe	2
Normal	1
Didn't remember	2

There were 10 responders stating that they didn't know there was any information regarding the travel disruptions. These respondents answered the question “*Did you travel through Gothenburg during Göteborgsvarvet on the 20th of May 2017 as*” in the following way:

Spectator	7
Participant	1
Travelled through the area	2

These respondents also stated the following regarding traffic disruptions:

Severe	3
Less severe	5
Normal	1
Didn't remember	1

There were also 7 responders stating that the information was very good, 4 stating that it was very bad and 5 stating that they didn't remember.

A.5 GTFS tram data collected

Line 2, Korsvägen

On the day of Göteborgsvarvet there is scheduled rerouting of line 2 between 13:00 and 18:15. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	18	36	31
18:15-23:29	14	44	44

Line 4, Korsvägen

On the day of Göteborgsvarvet there is scheduled rerouting of line 4 between 12:30 and 19:00. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:29	34	No data	No data
19:00-23:29	36	No data	No data

Line 5, Korsvägen

On the day of Göteborgsvarvet there is scheduled rerouting of line 5 between 12:30 and 19:00. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:29	27	No data	38
19:00-23:29	26	No data	36

Line 6, Korsvägen

On the day of Göteborgsvarvet there is scheduled rerouting of line 6 between 13:00 and 18:15. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	20	40	Partial data
18:15-23:29	15	46	Partial data

Line 8, Korsvägen

On the day of Göteborgsvarvet there are no scheduled rerouting of line 8. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20	2017-04-15	2017-06-17

	Göteborgsvarvet	Month before	Month after
08:00-12:59	25	34	Partial data
13:00-18:59	34	59	Partial data
19:00-23:29	Partial data	36	Partial data

Line 1, Botaniska Trädgården

On the day of Göteborgsvarvet there is scheduled rerouting of line 1 between 13:00 and 18:15. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	26	39	26
18:15-23:29	41	45	35

Line 2, Botaniska Trädgården

On the day of Göteborgsvarvet there is scheduled rerouting of line 2 between 13:00 and 18:15. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	17	34	42
18:15-23:29	12	43	43

Line 7, Botaniska Trädgården

On the day of Göteborgsvarvet there is scheduled rerouting of line 7 between 12:30 and 19:15. The number of trams stopping before and after this time is shown in the table below.

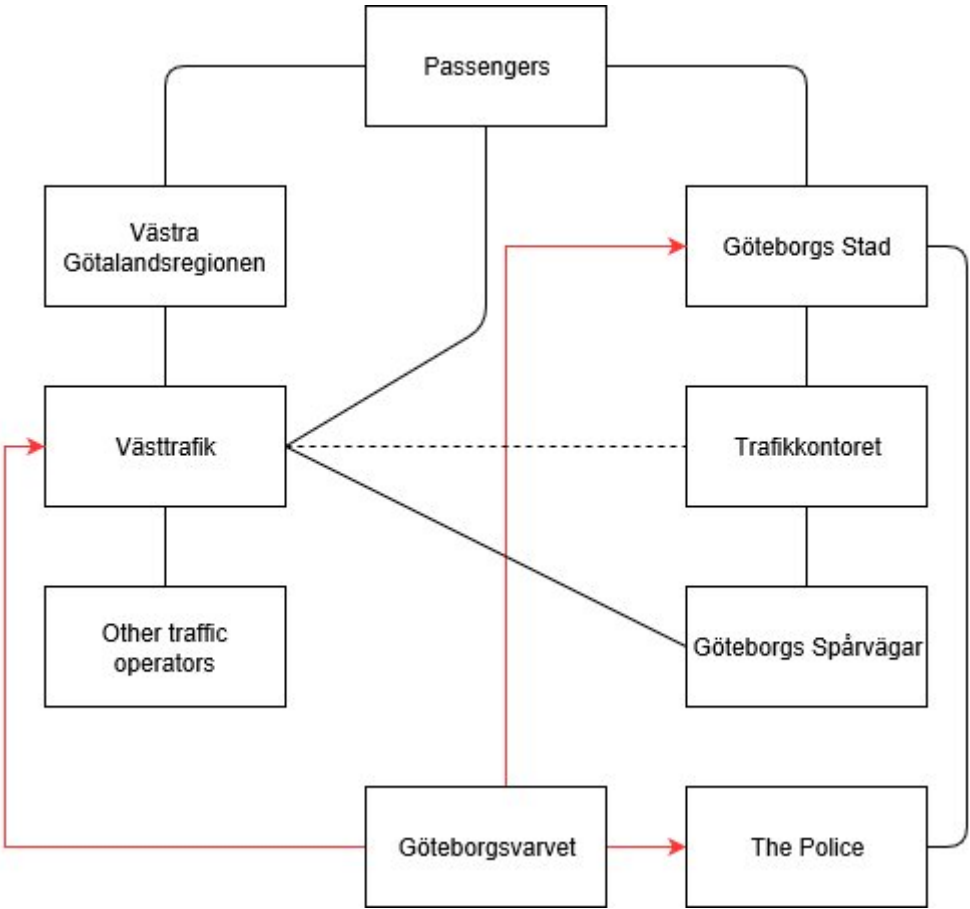
	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	2	No data	19
19:15-23:29	10	No data	16

Line 8, Botaniska Trädgården

On the day of Göteborgsvarvet there no scheduled rerouting of line 8. The number of trams stopping before and after this time is shown in the table below.

	2017-05-20 Göteborgsvarvet	2017-04-15 Month before	2017-06-17 Month after
08:00-12:59	26	33	Partial data
13:00-18:59	33	58	Partial data
19:00-23:29	7	37	Partial data

A.6 Organization



An illustration over how the different organizations are connected during Göteborgsvarvet