Public Transport during coronavirus outbreak

A research of measures taken in Dutch and international PT

C.G. (Gerben) van der Horst - 4673417

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Preface

This report is meant for people interested in public transport during the COVID-19 pandemic. No background knowledge in the public transport field is needed to understand the report.

The conducted research can be seen as an addition to other research about COVID-19, in particular to the UITP's research on operators actions and practices (UITP, 2020 -a) and to Oxford University's research on government responses to the pandemic (Blavatnik School of Government, University of Oxford, 2020).

I want to thank my supervisors Dr. ir. A.M. Salomons and Dr. ir. Y. Yuan as well as my peers for their continuous feedback. I want to thank Pedro Peters for allowing me to take an interview with him and I want to thank Dr. ir. N. van Oort for his advice and guidance throughout the research.

Summary

During 2020's coronavirus pandemic, governments took measures to reduce the spreading of the COVID-19 virus. These measures had a major influence on everyday life and consequently on public transport as well. Public transport (PT) had a difficult position during the pandemic, because their service is essential for, amongst others, health workers. At the same time their service could be very dangerous, due to the high number of people and contact points present in public transport vehicles. This makes it interesting to know how public transport was organised during the pandemic. Leading to the research question of this report: How was public transport organized during the COVID-19 pandemic?

The goals for this research were to find data about the actions by public transport companies or actions on public transport by governments. The research consisted of an analysis on the actions by Dutch public transport companies and a general global analysis on the closing of public transport and the use of face masks, where the implementation dates for each of these measures in different countries were found. For the Dutch public transport companies, a detailed analysis of the changes to the timetable in specific phases was made. In general the companies reduced their service, due to personnel reporting sick and the amount of passengers decreasing by about 90% (Puyleart, G., 2020). Also, the physical measures were stated and the reason behind them explained. The research was conducted as objectively as possible, no opinion on any actions will be found in this report.

The changes to the timetable for every line in the network of every major Dutch PT company, for every mode of (public) transport and every defined phase, were compared very precisely to the normal timetable. These were then expressed as the relative amount of service left to be able to compare the findings between companies and to be able to compare the findings to the relative amount of passengers. The international measures were visualized on world maps for every day from January 1st up to June 1st.

The conclusion to this research gives an answer to the research question in the form of data. One of the most notable things that can be concluded from the data, is that many companies, countries and governments responded differently with both their actions and timing. People acted on their current knowledge and experts opinion, and did not know for certain what the optimal decision would be. However, within the Netherlands, the response between different companies was very similar, despite there being so much uncertainty worldwide.

The research can be used in future projects, where, for example, the actions and/or companies could be assessed or the relation between (measures in) public transport and the spreading of a virus could be investigated.

Contents

1. Introduction

In the year 2020, the world suffered from a global pandemic. This pandemic was caused by the SARS-CoV-2 virus, a virus from the family of coronaviruses. The disease caused by the virus was called Coronavirus disease 2019 (COVID-19 for short), the first signs of the virus were discovered in 2019 (Bos, R., 2020).

Due to the coronavirus outbreak, many countries have taken measures to reduce the spreading of COVID-19, such as stay-at-home requirements, school closings and/or the usage of face masks. In the Netherlands the government had chosen for a so called 'intelligent lockdown' (Rijksoverheid, 2020 - b). This means that, in the Netherlands, in general people should stay inside. They were still allowed to go outside, on the condition of keeping at least one and a half meter distance from each other and avoid gatherings of (large) groups. Companies had their own responsibility when it came to making sure this measure was obeyed. Besides that, due to the virus and the measures, the amount of passengers in public transport drastically decreased (UITP, 2020 -a). Public transport was in a crucial position, as they are an essential service to the public, but at the same time they are a potential high risk area for getting infected. This leads to the research question of this thesis: How was public transport organized during the COVID-19 pandemic?

1.1 Demarcation of the research

The research focussed on the measures taken in public transport, in particular those in the Netherlands, by Dutch public transport companies.

In the Netherlands

The following companies were analysed, which are some major public transport companies in the Netherlands: Arriva, GVB, Hermes, HTM, Nederlandse Spoorwegen (NS), Qbuzz and RET. More information about the companies and other stakeholders can be found in appendix A.

When it comes to the changes to the timetable, a distinction was made between modes of transport. Different modes of transport can't be compared (objectively) on their timetables, as different modes have different hours of operation and different operating fields. A company is considered for a mode of transport if it has at least 3 different lines for that mode. This is to exclude companies with only one or two lines, which would result in too small of a sample size to determine the relative change in service. This will be explained in more detail in the second chapter: Methodology.

Due to time constraints, not all bus companies that fit the criteria, could be considered. Also, only city bus lines could be considered, any regional bus lines were left out. Table 1 shows which companies are considered per mode of transport, for the bus: Arriva, EBS, Keolis, Qbuzz and Transdev were left out. GVB, HTM and RET were chosen, because they operate in Amsterdam, Den Haag and Rotterdam respectively, the three largest cities in the Netherlands.

Table 1: Considered companies per mode of transport

Mode of transport	Considered companies
Train	Arriva, NS
Tram	GVB, HTM, Qbuzz (U-OV), RET
Metro	GVB, RET
Bus	GVB, HTM, RET

Internationally

The research was expanded to other countries. An analysis was made on which measures were taken in certain countries across the globe. A list of analysed countries can be found in Appendix D, which countries were analysed was dependent on the data available.

More detailed maps were made about the mandatory use of face masks and operation levels in public transport. Only these measures were made into maps due to time and data constraints.

The findings of all research in the report are presented and treated as objectively as possible, no assessment was made of any actions or measures. So, no opinion on any measures will be found in this report.

1.2 Sub-goals

To answer the main research question, data was gathered from Dutch public transport companies and governments across the globe. This was done according to the following sub-goals:

In the Netherlands:
- Define distinct phases, caused by government measures and subsequent PT companies` actions
- Determine the changes made to the timetable per company per phase per mode of transport
- Determine the amount of service with respect to the normal, 2020 timetable, by analysing the frequencies and operating hours of all lines per company per mode of transport
- Determine the physical measures taken per phase.

Internationally:
- Determine (some of) the measures taken in different countries
- Determine the date of lockdown for each country
- Determine the actions on public transport per country and the date when these actions were first implemented.
- Determine the date and policy on the mandatory use of face masks per country

How the research was conducted and how the research was concluded can be read in chapter 2: Methodology. After that, chapter 3, with the results, follows. Finalizing the report are chapters 4 and 5, the discussion and the conclusion respectively.

2. Methodology

In this chapter the methodology is discussed. This was done through two major sections: The main focus and data collection section and the finalizing section about the conclusion to the research. The methodology will clearly state how the research was conducted, how the data was collected and how the research was concluded.

2.1 Main focus and data collection

The changes to the timetable and the measures taken, differ over time. Therefore, it is important to clearly define phases to which the changes and measures can be linked. Every country had its own phases, but due to the scope of this project and the goals of the research, only the phases in the Netherlands are defined. The main focus of this report is elaborated after the phases are defined, and consists of the research on the timetable changes in the Netherlands, the measures in the Netherlands and the measures in other countries.

2.1.1 Phases

Different measures were taken by public transport companies in response to government actions and advice by the Rijksinstituut voor Volksgezondheid en Milieu (RiVM). Four distinctive phases can be defined, these phases follow from major government measures (Rijksoverheid, 2020 -c) and are not directly related to the virus. However, they are indirectly related, as government measures (and relaxing of) are based on data and experts opinion off the virus. These phases are applicable to the measures taken and the changes to the timetable.

Phases of responses by public transport companies, since the first detected case in the Netherlands [February 27]:

> ➢ **Phase 1, Lockdown**: Response to intelligent lockdown [March 19 to 23 – April 28].

On the 9th of March, the government took action in the province of Noord-Brabant, issuing them to work from home. Nationwide, washing hands more frequently and avoiding handshakes was recommended. From the 13th of March, all gatherings of a hundred people or more were prohibited (Rijksoverheid, 2020 -c).
On the 16th of March, prime minister Mark Rutte announced the Dutch response to the virus outbreak. Later this response would be known as the "intelligent lockdown". The measures included: closing of the catering industry, work from home advice, closing of schools, prohibiting contact labour and prohibiting gatherings of groups with more than 3 people (excluding families). From this day, and throughout all future phases, the government told people to only use public transport if absolutely necessary and to report sick to work, even when showing very minor symptoms.

From the 19th of March the visiting of nursing homes was prohibited as well. All these measures meant that the amount of people not leaving their home on a regular day went from approximately 20% to approximately 50% and the amount of movements per person per day went from 2.3 to 1.2. (Haas, M. d., Hamersma, M. & Faber, R., 2020). The public transport sector saw a decrease of about 90% in passenger amounts (Puyleart, G., 2020). Therefore, and due to more personnel reporting sick (UITP, 2020 -b), most companies changed their timetables or introduced a new timetable on March 19 to March 23 (varying per company), where the amount of service was drastically reduced.

The government announced that the measures will at least hold to the 28th of April, and around this date a re-evaluation will take place. This caused most PT companies to also announce the special timetables to be in effect, at least up to the 28th of April.

➢ **Phase 2, Busier**: Response to increasing amounts of passengers [April 29 – May 10].

On the 21st of April, the government announced that primary schools would be partially and day-care's would be fully opened by the 11th of May. Sports were allowed per April 28, for people up to the age of 18 years old (Rijksoverheid, 2020 -c). Due to this announcement, and some general trends, some companies noticed an increasing amount of passengers. This caused them to make changes to the timetable, increasing the service.

➢ **Phase 3, Relaxing**: Response to relaxing of measures. [May 11 – May 31].

From the 11th of May some measures were relaxed: Contact labour was allowed again as well as sports for all ages. The visiting of nursing homes could gradually be increased. Also, visiting a library was allowed (Rijksoverheid, 2020 -c). Still, one and a half meter distance should be kept. The relaxing of these measures caused many companies to adjust their schedules once more, increasing the amount of service.

➢ **Phase 4, Open up**: Return to normal timetable and some everyday activity [June 1 - present].

From the first of June, the government issued public transport companies to return to the normal timetable. For this research it is assumed that all companies obliged and changed their service back to (nearly) 100% which allowed for a maximum occupation of 40% of the normal amount of passengers (Rijksoverheid, 2020 -e). This phase, where the government requested the change to the timetable, is inherently different from phase 1, 2 and 3, where companies acted by themselves. The catering industry, museums, (movie-) theatres, were all opened for groups up to 30 people (Rijksoverheid, 2020 -c). The government ordered people in public transport to wear face masks, more about this and the specific measures in public transport for every phase can be read in the Results part of this report. In figure 1, the defined phases can be seen on a timeline, showing that phase 1 is the longest and phase 2 the shortest.

Timeline - Phases

First case NL: February 27

Phase 1, Lockdown: March 19-23

Phase 2, Busier: April 29

Phase 3, Relaxing: May 11

Phase 4, Open up: June 1

| 27/02 | 19/03 | 09/04 | 30/04 | 21/05 |

Date (dd/mm)
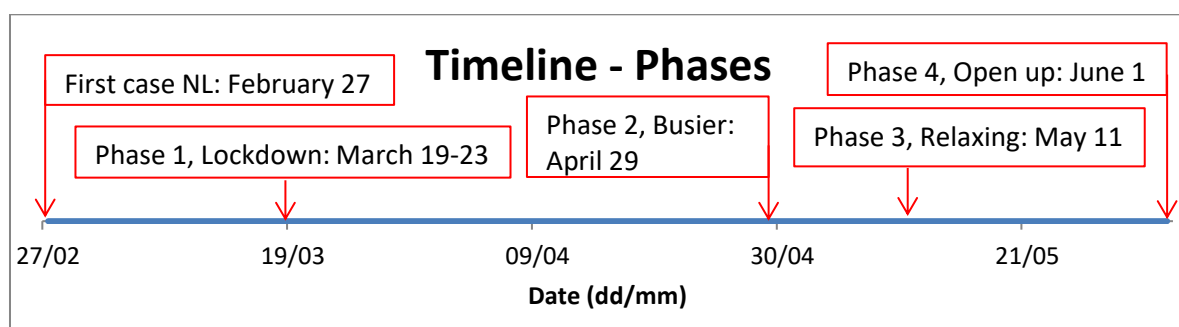
Figure 1: Timeline displaying the defined phases.

2.1.2 The timetables

To research the timetables, data was found through an online search. The same goes for the changes per phase. Most of the data comes from the timetables uploaded to the websites of respective public transport companies. The normal timetable for 2020, before the coronavirus outbreak, was found on OVinNederland wiki for all companies and modes of transport (OVinNederland, 2020).

To determine and quantify the changes to the timetable, the change in the amount of service was determined. The service of a regular weekday was analysed, including rush hour and evening services. For this a general assumption was made: Morning rush hours take from 6:30 to 9:00 and afternoon rush hours take from 16:00 to 18:30 as stated by NS (2020 -e) giving a total of 5 rush hours on a day. When a company states different rush hours, these different hours are used. To determine the amount of hours the service is provided per day, the normal timetable of 2020 was used for each company. The same goes for the evening service. This information was combined with the research on the timetable, where the frequency of every single line in every phase was found, for every mode of transport and respective companies. This frequency was multiplied with the amount of hours for which this frequency is used on a day. This calculation resulted in the total amount of lines served per day. This has been denoted as the amount of service. The amount of service was calculated per phase and for the normal timetable. To compare different companies and to compare to relative passenger amounts, the relative amount of service with respect to the old timetable was calculated, per phase. The method can be summarized by the following formula:

$$Rel.\,amount\,of\,service\,phase\,i = \frac{\sum_{n=1}^{N}(f_{n,i} * \#operating\,hours\,of\,line\,n\,in\,phase\,i)}{\sum_{n=1}^{N}(f_{n,normal} * \#operating\,hours\,of\,line\,n\,in\,normal\,timetable)}$$

Where $f_{n,I}$ stands for the frequency (amount of vehicles per hour) of line n in phase i and N stands for the total number of lines. Due to the defined phases, i can only take the values 1, 2 and 3. In phase 4, when the government issued companies to return to the normal 2020 timetable, i = normal.

The number of total operating hours in a day is the same for a lot of companies. The operations usually start around 6:00 and end around 0:00, resulting in about 17 operating hours, both before and during the pandemic. When this number does play a role, is in the case of rush hour or evening services. There, the increased rush hour or decreased evening service only last for X amount of operating hours, usually 5. In many cases, the rush hour services were removed in the adapted schedule, causing the service of 5 hours * ($f_{rush\,hour}$ – f_{normal}) to be lost in the new timetable.

An important remark here is that the relative amount of service, calculated here, does not accurately represent the actual relative amount of service, as the length of lines or the amount of stops on a line were not taken into account, due to time (feasibility) constraints. The remark can be illustrated by the following example: say a company has 3 very short lines and 3 very long lines, both of the same frequency and hours of operation. If the company reduces the frequency of the 3 short lines to 0 vehicles per hour, the service will be reduced to 50% according to the calculation. However, in reality, this percentage should be much higher, as the longer lines provide more service. The same analogy can be applied to the amount of stops on a line.

It can also been seen that a low amount of lines can give very skewed results, as the sample size would be too small to accurately say something about a relative amount of service. Therefore, the cut-off point of 3 lines or more was used.

The results are limited in accuracy as not every detail about every timetable is known. However, when a detail was known, it was taken into account. For example these details include increased services in rush hours or reduced services in evenings and for how many hours these services are used specifically. A few unspecified extra rides, not included in the schedule, are not considered. This also holds for changes made to the timetable, that were not stated or displayed on the site. Only the

timetables (schedules) are compared, so it should be noted that changes in service due to railway works or maintenance are not considered.

It is believed that due to comparing the relative amount of service, most of the errors will be very minor.

Data on the amount of passengers was found through Translink. Translink is the company behind the Dutch OV-Chipkaart and they process all transactions in public transport, in all modes (Translink, 2020). They publish only general stats about public transport, as stats from specific regions or companies would understandably be very sensitive data. Due to the availability of the data, the relative amount of passengers could only be shown compared to the relative amount of service for all modes of transport.

2.1.3 The measures
Only measures specifically taken in public transport are considered. General measures like increased hygiene, one and a half meter distance, staying at home when showing symptoms, sneezing in the elbow, etc. are not stated explicitly. These measures applied to every citizen of the Netherlands, and are not unique to public transport. An example of a measure that is not stated due to this criteria is the rule to have 4 steps between each other on the escalator. This rule follows from the 1.5 meter distance and is not unique to public transport.

The physical measures taken were found through online research and through an interview with the chairman of OV-NL: Pedro Peters. More info about OV-NL can be found in appendix A. The public transport companies collaborated with each other and with the government when taking measures (Peters., P., interview, 2020). Therefore, the measures are displayed per phase and per mode of transport and not per company. The reason for implementing a certain measure is stated as well.

2.1.4 Foreign measures
Using the responses to a survey, which was sent out by the international association of public transport (UITP), an overview was created of the measures taken in all countries that responded and how often certain measures were mentioned. (UITP, 2020 -a). The data is from the 27th of April, when some countries were still experiencing the early stages of the virus. On top of that, not every countries response to the survey is as detailed as the others, therefore not much attention was focussed on the numbers gathered from this data.

The measures on the closing of public transport as well as the use of face masks in other countries were analysed. These measures were not linked to the earlier defined phases, as these phases are defined by the Dutch public transport companies responses to government actions in the Netherlands. Instead, they were linked to the time when a country entered lockdown or issued stay-at-home advice. This data, as well as the data on the closing of public transport is available from the government response tracker (Blavatnik School of Government, University of Oxford, 2020). There, researches have categorized certain responses or measures on an ordinal scale and displayed them in timeseries format. The data for the use of face masks was found through an online search, with the UITP (UITP, 2020 -c) being a major data provider. This data was put into timeseries format and an ordinal scale was determined. All data for all maps up to the 1st of June will be included. Due to the due date of the report, this cut-off point had to be made.

2.2 Concluding the research

2.2.1 Comparison

The changes to the timetable by the Dutch public transport companies were compared per phase and per mode of transport: Train, Tram, Metro and Bus. As stated earlier in section 2.1.2, for every mode and company the relative amount of service was determined. Finally, the relative amount of service was compared to the relative amount of passengers. Due to the data about the passengers only being available for all modes of public transport, this data is only included in the comparison between all modes of transport.

Initially the measures between different companies were to be compared, but as stated in section 2.1.3, the companies collaborated resulting in the same measures for every company.

2.2.2 Conclusions

The conclusions will consist of the most notable findings from the data. This will provide an answer to the research question: How was public transport organized during the COVID-19 pandemic?

Assessing the measures taken on effectiveness was not part of this study.

The final product of this research is an overview of the found results. This overview is presented as a table and through different graphs. The international measures will be presented in a diagram and three world map visualisations were made for:

- The date of lockdown for each country
- The actions on the closing of public transport for each country
- The policy on the mandatory use of face masks for each country.

3. Results

The results to the three main parts of the research are presented in this chapter. Firstly, the results on the timetable research are elaborated per mode of transport and per company. In appendix E and figure 6 (section 3.1.5), an overview of all timetable results, in a table or graph respectively, can be found. Secondly, the measures taken in public transport in the Netherlands are stated. Finally, the measures in foreign countries are visualized.

3.1 Timetables

As stated in section 2.1.2, the companies reduced their service in phase 1. The main reason to do this was the drastic reduction in the amount of passengers. Secondary, the large amount of personnel reporting sick played a role in the reduction of the service. The increased stopping time, as investigated by Goudappel Coffeng (2020) played little to no role in the reduction of the service (Peters, P., interview, 2020).

3.1.1 Train

3.1.1.1 Arriva

Arriva made some changes to the timetable in phase 1 and some major changes on March 30 (Arriva, 2020 -a), which will be included in the changes in phase 1. These changes removed all intercity trains, and issued a one hour stop train service on all lines, which total to 19 lines. Two lines in Groningen and Leeuwarden form an exception, having a frequency of two trains per hour. Arriva made no major changes in the other phases. Compared to the normal timetable (OVinNederland, 2020), Arriva had approximately 62% of their service left in phase 1 through 3. A side note for Arriva is that their services on 'Blauwnet' are not considered, because multiple different public transport companies take part in 'Blauwnet'.

3.1.1.2 NS

Due to a large amount of personnel reporting sick, NS reduced the rush hour service (NS, 2020 -b). This happened on March 13th, before phase 1, and resulted in a service level of 98%. Starting from phase 1 the NS issued a special basic timetable, which can be seen in appendix B. This timetable consists of mainly stop trains ('Sprinters') from the normal timetable, which serve every station twice per hour. Intercity trains are still used on lines to stations where no stop trains ran initially. Special rush hour services were generally removed as well as most international trains, night trains and all intercity direct trains. In phase 1 approximately 61% of the service was left compared to the normal timetable. In phase 2, the amount of intercity trains was increased, one intercity direct train and the night trains were put back into the timetable (NS, 2020 -c). This resulted in approximately 78% of the service in phase 2. No changes were made for phase 3. The NS have 89 lines in total, including their intercity direct lines.

3.1.1.3 Summary Trains

In figure 2 a brief summary of the result for train companies can be seen. Arriva made some changes to their timetable on the 18th of march (Arriva, 2020 -c), however these were only in a specific region and the info was not detailed enough to make an accurate calculation of the amount of service. This does mean that the graph is misrepresenting the service of Arriva between the 18th of March and the 30th of March.
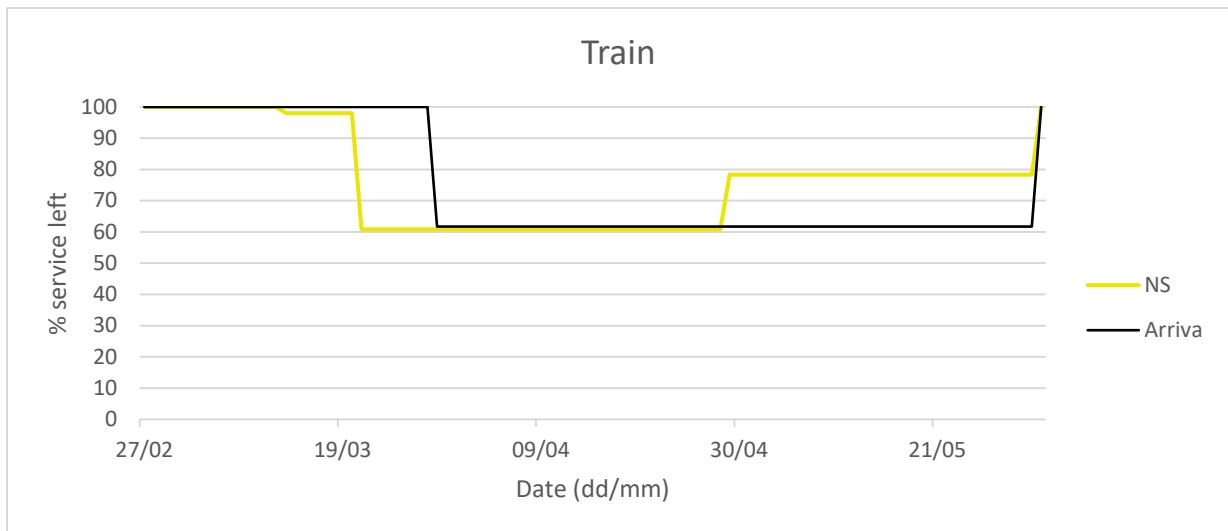
Figure 2: Relative amount of service of considered train companies

From the graph it can be seen that the adjusted timetables are very similar in the relative amount of service provided. In phase 2, NS saw an increase in the amount of passenger causing them to increase their service. Neither company made a change in phase 3.

3.1.2 Tram

3.1.2.1 GVB

In the normal timetable of 2020, GVB often has different frequencies for morning rush hour and afternoon rush hours, these differences are taken into account. GVB has special services on shopping evenings (Thursdays and Fridays, GVB, 2020 -b), these are not taken into account, so the service of the normal timetable is calculated for a regular Monday, Tuesday or Wednesday. In phase 1, the GVB reduced their tram service to four trams per hour on most lines (GVB, 2020 -d). They also removed the rush hour trams from the timetable (line 6 and 11). This resulted in approximately 49% of their service left in phase 1. In phase 2, GVB increased the frequency of lines 1, 13, 17 and 26, resulting in approximately 64% of the service compared to the normal timetable (GVB, 2020 -a). In phase 3, GVB increased the frequency of more tram lines, to match their holiday timetable. This resulted in approximately 84% of the service compared to the normal timetable. The GVB has 15 tram lines in total.

3.1.2.2 HTM

Originally, in the normal timetable, most tram lines of HTM had a frequency of 6 trams per hour (HTM, n.d.). As per March 23, HTM reduced the frequency of all tram lines, which total to 12 lines, to a frequency of 3 trams per hour and removed extra rush hour rides from the timetable (Omroepwest, 2020). This resulted in a relative service of approximately 49% compared to the normal timetable in phase 1. In phase 2 no changes were made and in phase 3 the frequency was increased to 4 trams per hour, with the exception of lines 6 and 9, those were increased to 5 trams per hour (Andriessen, K., 2020). This ultimately resulted in approximately 75% of service in phase 3.

3.1.2.3 Qbuzz (U-OV)

In the tram timetable of Qbuzz there are only three lines. Line 22, 60 and 61. Line 22 normally has a frequency of 12 trams per hour. For lines 60 and 61 this frequency is 4 trams per hour. In all phases Qbuzz adjusted the timetable to the Sunday timetable (U-OV, 2020). In this timetable line 22 is not

used and lines 60 and 61 are reduced to 2 trams per hour. This meant that the amount of service left in all phases was approximately 25% compared to the normal timetable. Line 22 is the busiest line in the network and connects, amongst others, Utrecht central station with the Utrecht Science Park. Closing line 22 was quite logical, as activities on the Science Park and university shut down as well.

3.1.2.4 RET

In phase 1, RET reduced the tram frequency to 3 trams per hour and they removed rush hour trams from the schedule, this includes line 20 (RET, 2020 -a). This resulted in a relative service of approximately 51%. In phase 2, no changes were made. In phase 3 the frequency was increased for all 10 lines, except line 21 and 24. Also line 20 started operating again, six times per hour in rush hours. This resulted in approximately 71% of the service compared to the normal timetable.

3.1.2.5 Summary Trams

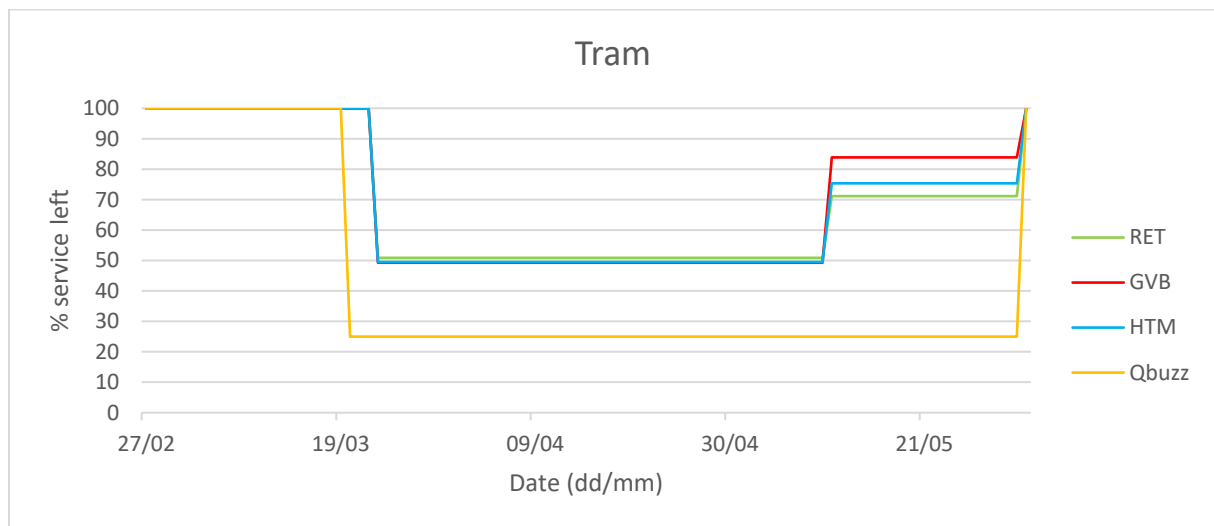In figure 3 a brief summary of the result for tram companies can be seen.

Figure 3: Relative amount of service of tram companies

Very noticeable in the graph Is the low amount of relative service from Qbuzz, while the other companies have extremely similar amounts of relative service. As stated in section 3.1.2.3, Qbuzz has only 3 tram lines, the minimum according the criteria stated in 1.1. The sample size is thus quite small, this explains why the results are so extreme and also shows that the putting a criteria on the sample size is valid. Seeing these results, the criteria could also have been adjusted to a minimum of 5 lines (more than 5 and the metro wouldn't count). However, it was kept at the minimum of 3, also to illustrate the importance of this criteria. No company made any changes in phase 2.

3.1.3 Metro

3.1.3.1 GVB Metro

As can be seen in table 2, the GVB reduced its metro services to roughly 51% compared to the normal timetable in phase 1. They increased the service to approximately 62% of the normal timetable in phase 2, and further to about 67% in phase 3.

In rush hours in the normal timetable, lines 50, 51, 53 and 54 have a frequency of 7.5 metros per hour instead. This, and other details can be seen in the timetable from the GVB transport plan, included in appendix C.

Services per hour GVB				
Line	Normal	Phase 1	Phase 2	Phase 3
M50	6	4	4	4
M51	6	0	4	4
M52	10	6	6	8
M53	6	4	4	4
M54	6	4	4	4
Percent	100%	51%	62%	67%

3.1.3.2 RET Metro

The results for the RET metro can be found in table 3. The adjusted timetable is the same in all phases, in the adjusted timetable the service is about 63% compared to the normal timetable.

Services per hour RET		
Line	Normal	Phase 1, 2, 3
A	6	4
B	6	4
C	6	4
D	6	4
E	6	4
Percent	100%	63%

In rush hours, in the normal timetable, line D has a frequency of 12 metros per hour.

3.1.3.3 Summary Metro's

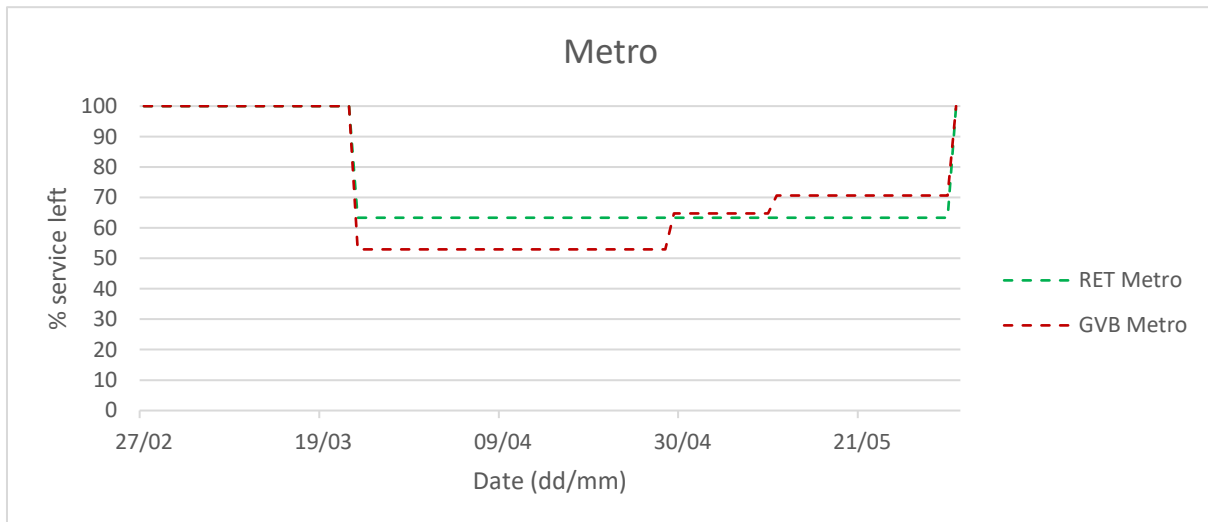In figure 4 a brief summary of the result for metro companies can be seen.

From the graph it can be seen that both companies had a very similar relative amount of service. While the GVB changed its service in every phase, the RET kept its service constant in phase 2 and 3.

3.1.4 Bus

3.1.4.1 GVB

GVB made changes to their bus service levels on the 23rd and 30th of March. They removed some rush hour services and decreased the frequency of their lines to either 4 or 2 busses per hour, dependent on the line (GVB, 2020 -d). This reduction resulted in approximately 61% service in phase 1. Since the 4th of May, most bus lines increased their service and rush hour lines 222 and 248 started riding again (GVB, 2020 -a). This resulted in approximately 81% service compared to the normal timetable. No other changes were made to the bus timetable before June. The GVB has 8 rush hour lines and 27 normal lines for the city bus.

3.1.4.2 HTM

On the 23rd of March HTM reduced their bus services to about 41% compared to the normal timetable, by decreasing the frequency of their bus lines to 2 busses per hour for all 10 bus lines. They also removed their 2 rush hour lines from the service. HTM actually reduced their services already on the 16th of March, however this reduction was not calculated as it was quickly overwritten on the 23rd. Because the level of service between the 16th and the 23rd of March was not calculated, the values for these days are incorrectly displayed in the graph. In phase 2 they made no changes and in phase 3 they increased the frequency to 4 busses per hour and 8 busses per hour for line 25. This resulted in a relative amount of service of roughly 91% in phase 3.

3.1.4.3 RET

RET reduced their bus services on the 23rd of March, where all lines, which total to 35 lines, had either 2 or 3 busses per hour. Quickly thereafter on the 30th of March they made some slight adjustments to that reduction (RET, 2020 -c), resulting in approximately 68% of the service compared to the normal timetable, throughout most of phase 1. They made no changes to the timetable in phase 2 and 3.

3.1.4.4 Summary Busses

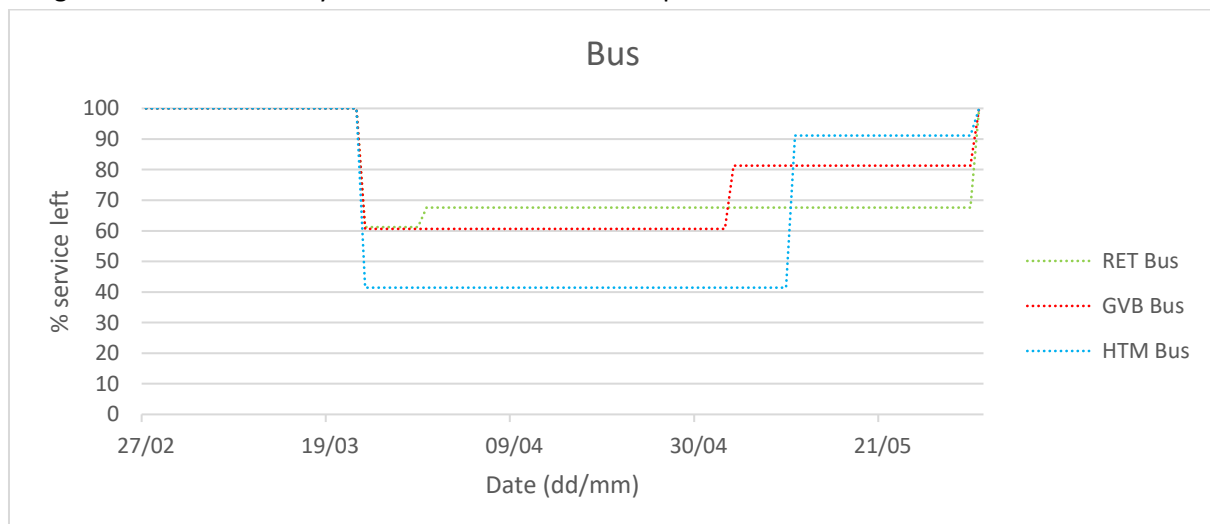In figure 5 a brief summary of the result for metro companies can be seen.

Figure 5: Relative amount of service of considered bus companies.

Not much stands out in figure 5. HTM had a greater reduction of their services in phase 1 and 2. However, they also have the least amount of city bus lines from the three analysed companies.
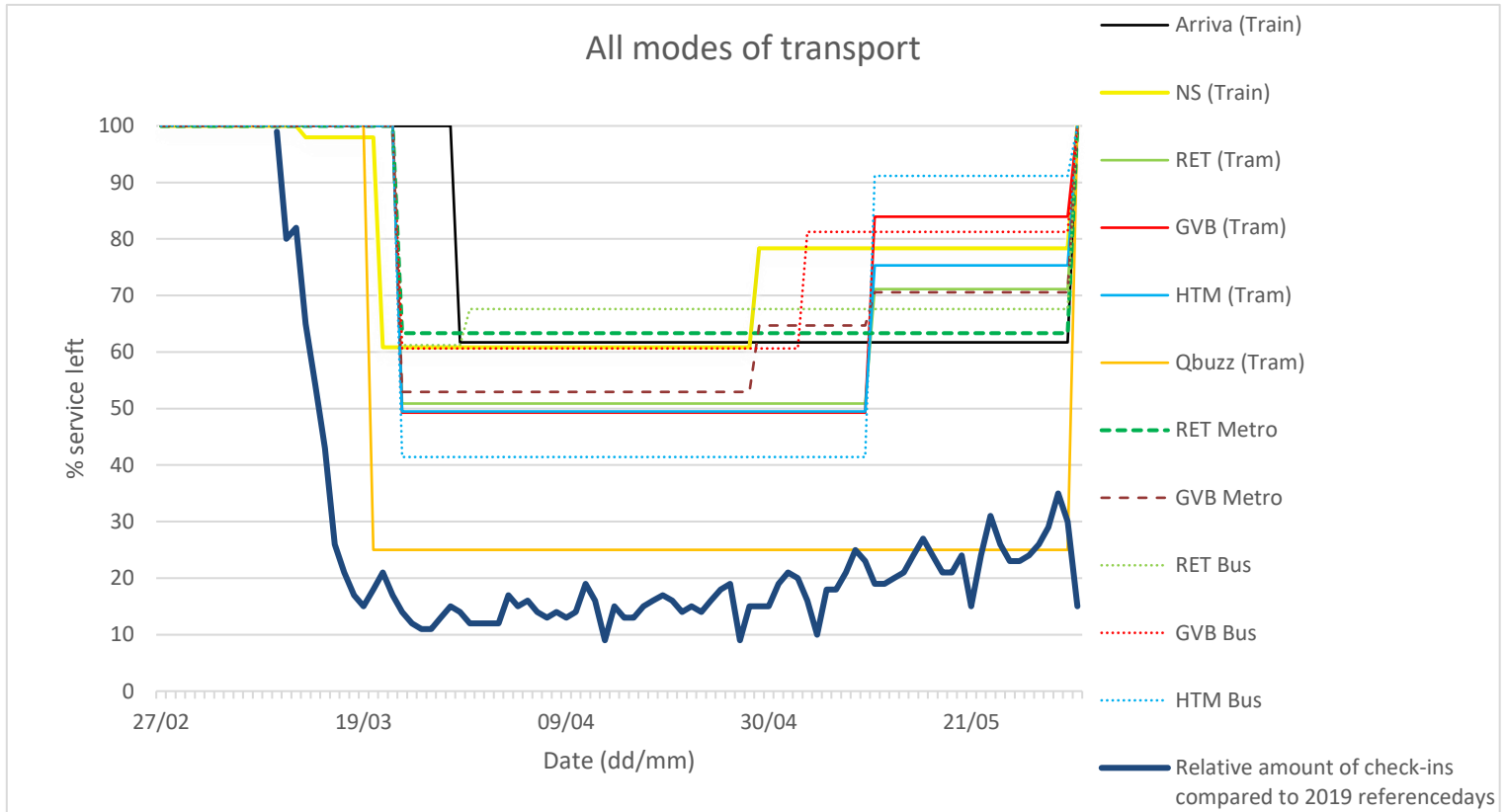
3.1.5 Summary all modes of transport

Figure 6: Relative amount of services of all companies and the relative amount of passengers compared to 2019 referencedays.

Included in figure 6 are the relative amount of check-ins compared to 2019 reference days, which were adjusted to match 2020 weekends and holidays (Translink, 2020). Note that the check-in data starts from the 9th of March and not from the 27th of February, like the rest of the graph. As can be seen in the graph the relative amount of service from all companies and all modes of transport stayed above the relative amount in total passengers for all phases. This indicates that there was always sufficient service for the demand on average, however it is not for certain that this is the case for every mode of transport and company individually, as it is unknown what the passenger demand was per company and mode of transport. The one exception was the tram service by Qbuzz, however as mentioned in section 2.1.2.5, the sample size for the tram service by Qbuzz is the smallest, being only three lines.

3.2 Measures

Within OV-NL all measures were taken in accordance with all public transport companies in the Netherlands and the Nationaal Openbaar Vervoer Beraad (NOVB). The measures were discussed with all directors of all companies and government officials, in meetings where the secretary of state was the chairman. The companies have said from the beginning that they are no experts on the virus and thus will follow advise from experts and the Outbreak Management Team (OMT) when taking measures. The companies worked together on the measures with the aim to make all measures unambiguous between different companies, all sending a similar message to their passengers. This collaboration between the companies was not only on directorial level, but also on a communicational and logistic level. Logistic level meaning how is it going with absenteeism, measures and buitengewoon opsporingsambtenaren (boa's) (Peters, P., interview, 2020).

Phase 1

- Conductors no longer walked around and checked tickets in trains, trams and metro's (NS, 2020 -f).
    - ➢ This measure is to prevent contact between employees and passengers
- The door by the driver was no longer used in any vehicles.
    - ➢ This measure is to avoid contact with the driver, for busses this meant that only the back door could be used to get on or off the bus. Public transport companies were not happy with this measure, however it was deemed necessary for protection of the bus driver. The companies started development of a screen to protect the bus driver and allow the front door to be used again, however due to many complications, including traffic safety regulations, this screen has yet to be completed (Peters, P., interview, 2020)
- The front row of seats was not available in busses
    - ➢ This measure is to avoid contact with the bus driver
- The doors on metro's and trams opened automatically always
    - ➢ Avoid physical contact with the push button. The doors on busses are opened by the driver and were opened by the driver, before the virus outbreak.
- Closing of physical ticket sales by the driver.
    - ➢ This measure is to limit contact between employees and passengers and is only applicable to trams and busses, because in metro's or trains the driver never sold tickets in the first place.
- Only use public transport if absolutely necessary
    - ➢ This measures is to prevent overcrowding in public transport.

The one and a half meter distance rules had to be obeyed by the entire country. For public transport this meant that people should not sit close to each other and give enough space when passing. People had to keep more distance and couldn't get on or off the vehicle together. Consequently the stopping times increased, mainly for trams and busses, from 30 seconds to 2 minutes, according to a calculation by Goudappel Coffeng (2020).

Phase 2 and 3

- In phase 2 and 3 there were no changes to the previous measures and all remained in effect.

Phase 4

- In phase 4, the wearing of face masks became mandatory in public transport. Not wearing a face mask could result in a €95,- fine (Rijksoverheid, 2020 -d).
    - ➢ This measures was found necessary to reduce the spreading of the virus, while allowing more usage of public transport. The public transport companies would've liked to see medical face masks for their employees, Pedro stated during the interview, but understand that healthcare workers were prioritized.

The Dutch government promised public the transport companies full compensation for any additional costs made due to taking measures and for the loss of income. Therefore, costs did not play a role in taking the measures. Companies hope that all measure can be lifted after the virus has left society, excluding the potential screen for the bus driver. The screen can also increase the safety of the bus driver and help with incidents after the pandemic (Peters, P., interview, 2020).

3.3 Foreign measures

The foreign measures consist of an overview of the different measures taken in different countries per April 27, found in the response to a survey sent out by the UITP. Besides this overview, three world map were made with visualisations of the measures taken on: Stay at home requirements (Lockdown), the closing of public transport and the mandatory usage of face masks.

3.3.1 Different measures

The UITP has 100 members, of which 49 responded to their survey (UITP, 2020 -a). Some countries responded more elaborate than others. Similar measures were counted in each countries response, summarized in figure 7. Appendix D contains a list of all countries that responded and which measures where mentioned in their response. Also included is the stay-at-home requirement according to the government response tracker (Blavatnik School of Government, University of Oxford, 2020), more about that requirement can be read in section 3.3.2.1 of this report.

Measures taken in 49 countries per April 27

Values shown: 25, 20, 6, 6, 5, 4, 4, 3, 2, 1, 1, 1, 2, 1

Legend:
- General Measures: cleaning vehicles, social distance, isolation if showing symptoms, sneeze in arm
- Adapted schedule, reducing services
- Temperature checks for everybody
- Face masks obligated for everybody
- Complete Shutdown of all public transport
- Amount of seats limited inside the vehicle
- Lock the front door of PT vehicles or block the way to the driver
- Only essential workers allowed on PT, they have to carry proof
- Temperature checks for staff only
- Face masks obligated for staff only
- Use of an app to track proximity with others
- No cases of the virus
- No information on measures as of yet
- No measures taken

Figure 7: Measures taken 49 countries per April 27

It has to be noted that a complete shutdown of all public transport automatically implies that no other measures were taken in that country. For face masks and temperature checks: when they are obligated for everybody, this includes the staff as well. Due to the previously stated origin of the data, not much thought should be put into the numbers, rather more attention should be paid to the different measures. Interestingly, some measures were taken in other countries that were not taken in the Netherlands, like temperature checks or the use of an app. And while the Dutch government encouraged people to only use public transport if absolutely necessary, it was never obligated to carry proof.

3.3.2 World map
3.3.2.1 Lockdown
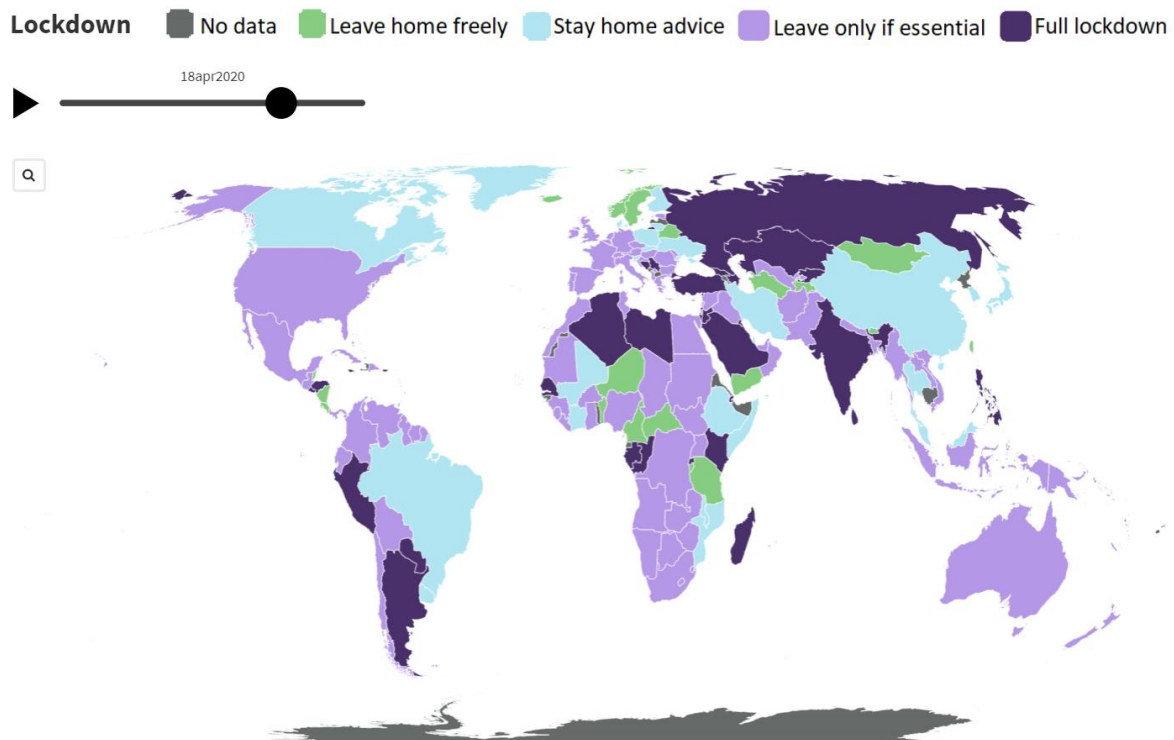
Source: <u>Blavatnik School of Government, University of Oxford, Radcliffe Observatory Quarter</u> • Data from 28 May 2020. Individual countries may be several days older

Figure 8: Screenshot of the world map visualisation 'Lockdown' on the 18th of April.

Figure 8 shows the lockdown world map on the 18th of April. The 18th of April was chosen, as this day was the peak in worldwide lockdowns. The legend contains 5 categories, including the 'No data' category. The categories were predetermined by the data source (GitHub, 2020), thus the definitions are defined by the source as well. These definitions are stated in table 4.

Table 4: Overview of used terms in legend and underlying meaning of the stay-at-home data.

Index	Legend label	Oxford definition (GitHub, 2020)
-1	No data	Blank
0	Leave home freely	No measures
1	Stay home advice	Recommend not leaving house
2	Leave only if essential	Require not leaving house with exceptions for daily exercise, grocery shopping and 'essential' trips
3	Full lockdown	Require not leaving house with minimal exceptions (eg. only allowed to leave once a week, or only one person can leave at a time, etc.)

The labels were chosen so that they fit nicely above the map. Also, 'No measures' might give a false indication of what is actually meant, namely no measures with respect to stay-at-home advice. But measures certainly could be in effect, just no stay-at-home measures.

The full visualisation can be found here: https://www.youtube.com/watch?v=k3qvQXZQrB0. All visualisations were made with software from Flourish (Flourish, 2020). In the visualisation it can be seen that China and Asia in general were first to enter lockdown, after some time Europe, North- and South-America followed, and then, a bit later Africa and Australia entered lockdown as well.

3.3.2.2 Close Public Transport
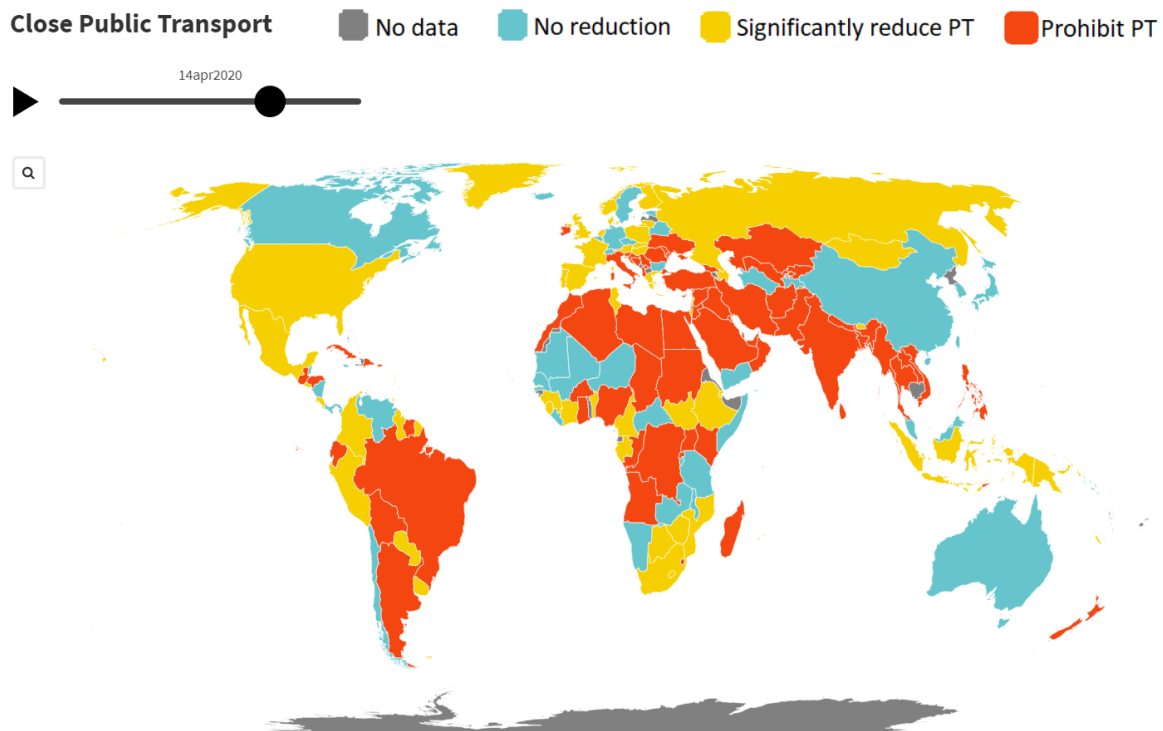
Source: Blavatnik School of Government, University of Oxford, Radcliffe Observatory Quarter • Data from 28 May 2020. Individual countries may be several days older

Figure 9: Screenshot of the world map visualisation 'Close Public Transport' on the 14th of April.

Figure 9 shows the 'Close Public Transport' visualisation on the 14th of April. This date was chosen, because the 14th of April had the most closing measures worldwide. As this visualisation was also made with the data from the Oxford Government Response Tracker, the definitions are from Oxford as well, these can be found in table 5.

Table 5: Overview of used terms in legend and underlying meaning of the Close Public Transport data.

Index	Legend label	Oxford definition (GitHub, 2020)
-1	No data	Blank
0	No reduction	No measures
1	Significantly reduce PT	Recommend closing (or significantly reduce volume/route/means of transport available)
2	Prohibit PT	Require closing (or prohibit most citizens from using it)

Once again, the legend was made to fit nicely above the map. 'No measures' was changed to 'No reduction' as 'No measures' might be misleading, governments had certainly taken measures, just no measures with respect to the closing or reduction of public transport. One thing to note with this visualisation is that there are major differences between countries when It comes to how advanced public transport (network) is. This might've played a role in the decision making of governments.

The full visualisation can be found here: https://www.youtube.com/watch?v=dA2eDdFVwqs&t=70s. From this it can be seen that the general pattern is similar to the lockdown visualisation, but that there is more randomness. Especially in Europe, multiple countries didn't reduce public transport, or only did so briefly, even when countries demanded their citizens to only leave their home for essential trips.

3.3.2.3 Mandatory Face masks in public transport
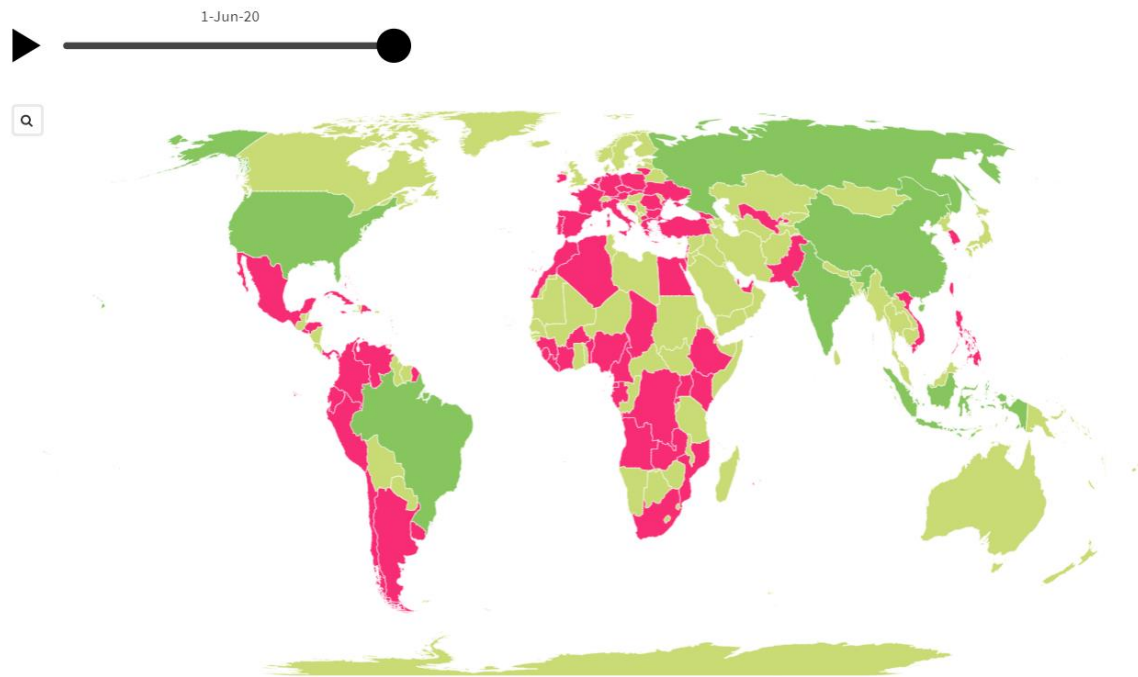
Source: UITP, Aljazeera, Wikipedia

Figure 10: Screenshot of visualisation 'Mandatory Face Mask', June 1 (UITP, 2020 -c) (Aljazeera, 2020)(Wikipedia, 2020).

The 1st of June was chosen for the date of the visualisation in figure 10, because on this date the most countries made face masks mandatory. Table 6 shows the meaning of labels in the legend. The visualisation can be found here: https://www.youtube.com/watch?v=wUOSeEuX-E8.

Table 6: Overview of the used terms in the legend and their meaning.

Index	Legend label	Meaning
0	Not mandatory / No data	Face masks are not mandatory or no data is available
1	Only in city / province(s)	Face masks are mandatory in PT, only in one or some cities or province(s)
2	Nationwide	Mandatory face masks in PT in the entire country

Not mandatory and no data were put into one category, because it was impossible to research every country in the world to make sure face masks were not mandatory. On the contrary, when face masks are mandatory, this information can more easily be found.

Mandatory face masks actually means mandatory mouth coverings, as there are some countries where covering the face with, for example, a scarf was also allowed. Moreover, it has to be noted that although governments made face masks mandatory, this didn't mean people always wore them. Sometimes due to masks being unavailable, sometimes due to a lack of enforcement of the rules.

It also has to be noted that in certain central Asian countries, like Saudi Arabia or Afghanistan, the wearing of face coverings amongst women was already commonplace before the coronavirus. In line with the previous note is that in some Asian countries, like China, Japan and Malaysia the wearing of facemasks was already commonplace before the coronavirus. In for example Japan, the government didn't have to make the wearing of face masks compulsory, as the general public already was wearing masks in (busy) public places.

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4. Discussion

The limitations of the research are presented throughout the report. This chapter will provide an overview of the most important discussion points from the report.

Timetables

As stated prior, in section 2.1.2, the calculated relative amount of service does not accurately represent the relative amount of service. This is due to the fact that the length of the lines and the amount of stops were not taken into account. It is believed that by applying the same method to every company, these errors should not play a huge role. Besides that, also not all details about the service are known, some companies could have not made all information about the changes to the timetable public.

A rough estimation of the accuracy on the relative amount of service would be +/- 3%. Due to previously stated reasons, this accuracy is highly dependent on the absolute amount of services in the timetable, which in turn comes down to the amount of lines. On the one hand more lines means a larger sample size, which helps with the accuracy when estimating the amount of service with the method used. On the other hand, more lines means more possible unknowns and details, which could in theory accumulate to a large error. However, it is more likely that the errors do not accumulate, but rather cancel each other, because the details include increased services as well as decreased services.

Foreign measures

As mentioned in section 3.3.1, from the responses to the survey by the UITP, no objective conclusion can be drawn, as this data is incomplete. Therefore the choice was made to not use the numbers, but to limit this part of the research to the different measures.

The maps about the closing of public transport and the lockdown were made using data from the Blavatnik School of Government and University of Oxford. This data is believed to be reliable. The data was updated daily by the source providers, the used dataset was last updated on the 10th of June, cut-off at the 1st of June for the maps.

The map about the face masks, however, was made with data from multiple sources. Major data providers were the UITP, Aljazeera and Wikipedia. When a country makes the use of masks mandatory, this will be known to the public and have a high probability of being reported and found through the online research. However, when a country doesn't make the use of masks mandatory and maybe only recommends them, this has a lower probability of being found. Therefore the categories in the map were chosen binary, either mandatory use of masks or not. The research was very thorough, but some countries might have still been missed, and especially with the dates there are some inconsistencies between different sources. On top of that, some countries have even different dates within them, as provinces (or states) are able to make their own choices and make masks mandatory or not. When this was the case, the date where the first province or city made masks mandatory was used.

5. Conclusion

This chapter contains the conclusion to the research. The conclusion to this research will be an answer to the research question: How was public transport organized during the COVID-19 pandemic?

In the Netherlands

During the COIVD-19 pandemic, public transport companies made changes to their timetable. They reduced their service, mainly to make up for the large decrease in passenger amounts. The changes in relative amounts of service are very similar between the companies and modes of transport. From figure 6 it can be seen that the relative amount of passengers was below the relative amount of service for all phases for all companies. Only Qbuzz' tram service forms an exception. This exception is explained in more detail in chapter 4: Discussion.

Many measures were taken to reduce the spreading of the virus. Most interestingly, all companies cooperated and took the same measures. The decisions were made in meetings where government parties and healthcare experts were present. Some of the measures include: automatic opening of doors, wearing of face masks and measures to avoid contact with the driver.

Internationally

In other countries some different measures were taken than in the Netherlands, including temperature checks, the use of an app to track proximity to others and the obligation to carry proof of an essential trip when using public transport. There are also countries where public transport was completely shut down.

On the visualisations behind figures 8, 9 and 10 it can be seen that the lockdown measures and the measures on the closing of public transport follow a similar pattern. From East-Asia to Europe, North- and South-America and finally to Australia and Africa. Interestingly, the visualisation behind figure 10, about the mandatory use of face masks, shows a very different pattern. There, after China, South-America, Eastern Europe and some countries in Africa are the first to make face masks mandatory.

6. Recommendations

It is recommended to use the research for further research. This research can be used as a learning experience on public transport during the COVID-19 pandemic.

As for further research, topics or points of interest could be:

- Assess the actions by the public transport companies with regards to safety, efficiency and comfort indicators.
- Asses and compare the different modes of public transport with regards to safety, efficiency and comfort during the pandemic.
- Search for a relation between the use (or closing) of public transport and the spreading of the virus either finding a relation to the number of cases or the spreading factor.
- Asses the effects of wearing face masks by analysing data about when they were implemented and how the virus spread.
- Use data and knowledge to create a protocol for public transport to follow in future pandemic scenario's.
- Asses the effects of each measure and determine which measures are most effective in reducing the spreading of the virus in public transport.
- Simply use the findings to gain insight in the responses, other countries might be interested in the Dutch measures in public transport, which can be found in this report.

References

Aljazeera. (June 3, 2020). Which countries have made wearing face masks compulsory? Retrieved June 3, 2020, from: https://www.aljazeera.com/news/2020/04/countries-wearing-face-masks-compulsory-200423094510867.html

Andriessen, K. (May 6, 2020). HTM laat trams en bussen vanaf 11 mei vaker rijden. *Den Haag Centraal.* Retrieved May 13, 2020, from: https://www.denhaagcentraal.net/den-haag-in-tijden-van-corona/htm-laat-trams-en-bussen-vanaf-11-mei-vaker-rijden/

Arriva. (May 2020 -a). Aanpassingen dienstverlening Arriva. Retrieved May 2, 2020, from: https://www.arriva.nl/a/aanpassingen-dienstverlening-arriva-corona.htm

Arriva. (2020 -b). Arriva Nederland. Retrieved April 23, 2020, from: https://www.arriva.nl/meer-arriva/over-arriva-4/arriva-nederland.htm

Arriva. (2020 -c). Aanvullend aangepaste dienstregeling voor Arriva Limburg Trein Zuid naar aanleiding van RIVM maatregelen. Retrieved May 1, 2020, from: https://www.arriva.nl/a/aanvullend-aangepaste-dienstregeling-voor-arriva-limburg-trein-zuid-naar-aanleiding-van-rivm-maatregelen.htm#:~:text=Vanaf%20woensdag%2018%20maart%20rijden,zoals%20b.v.%20lijn%20621)%20vervallen.

Arriva. (December 2019). Dienstregeling Friesland. Retrieved May 2, 2020, from: https://www.arriva.nl/friesland-en-waddeneilanden/reisinformatie/dienstregeling.htm

Bos, R. (April 3, 2020). Dit betekenen de termen rond het coronavirus. Retrieved May 30, 2020, from: https://www.quest.nl/maatschappij/a32029143/sars-cov-2-covid-19-uitleg-termen-coronavirus/

Blavatnik School of Government, University of Oxford. (May 25, 2020). Coronavirus government response tracker. [updated] Retrieved May 30, 2020, from: https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker

Flourish. (2020). Beautiful, easy, powerful data visualisation & storytelling. Retrieved June 9, 2020, from: https://flourish.studio/

GitHub. (May 22, 2020). Codebook for the Oxford Covid-19 Government Response Tracker. Retrieved June 5, 2020, from: https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md

Goudappel Coffeng (April 29, 2020). Trams en bussen staan vier keer zo lang stil in anderhalvemeter-maatschappij. Retrieved may 15, 2020, from: https://www.goudappel.nl/actueel/trams-en-bussen-staan-vier-keer-zo-lang-stil-in-anderhalvemeter-maatschappij/

GVB. (2020 -a). Aangepaste dienstverlening en dienstregeling. Retrieved April 15, May 2 and May 11 from: https://www.gvb.nl/klantenservice/nieuws/aangepaste-dienstverlening-en-dienstregeling

GVB. (2018). GVB Vervoerplan 2020. Retrieved May 4, 2020, from: https://www.hierden-bosch.nl/ori/170210-Concept%20Vervoerplan%202020.pdf

GVB. (May 2020 -b). Lijnen. Retrieved May 4, 2020, from: https://reisinfo.gvb.nl/nl/lijnen

GVB. (2020 -c). Reis veilig en sociaal. Retrieved April 23, 2020, from: https://www.gvb.nl/

GVB. (March 20, 2020 -d). Vanaf 23 maart nieuwe wijzigingen in onze dienstverlening. Retrieved May 4, 2020, from: https://over.gvb.nl/nieuws/nieuwe-wijzigingen-in-onze-dienstverlening/

Haas, M. d., Hamersma, M. & Faber, R. (April 20, 2020). *Mobiliteit en de coronacrisis.* Retrieved April 29, 2020, from Kennisinstituut voor Mobiliteitsbeleid (KiM): https://www.kimnet.nl/publicaties/rapporten/2020/04/20/mobiliteit-en-de-coronacrisis.

Hermes. (2020). Over Hermes. Retrieved April 23, 2020, from: https://www.hermes.nl/nl/over-hermes

HTM. (2020 -a). Ons vervoer. Retrieved April 23, 2020, from: https://www.htm.nl/over-htm/ons-vervoer

HTM. (2020 -b).

HTM. (n.d.). Haltevertrektijden. Retrieved, May 13, 2020, from: https://www.htm.nl/haltevertrektijden

Keolis. (2020). Ons verhaal. Retrieved April 23, 2020, from: https://www.keolis.nl/

Krabbendam, V. (March 20, 2020). Zo passen OV-bedrijven hun dienstregelingen aan vanwege de coronacrisis. Retrieved May 12 from: https://www.ovpro.nl/management/2020/03/20/zo-passen-ov-bedrijven-hun-dienstregelingen-aan-vanwege-de-coronacrisis/

NS. (March 21 2020 -a). Basisdienstregeling volgens plan van start. Retrieved May 10, 2020, from: https://nieuws.ns.nl/basisdienstregeling-volgens-plan-van-start/

NS. (March 13 2020 -b). NS neemt maatregelen tegen verspreiding coronavirus. Retrieved April 15, 2020, from: https://nieuws.ns.nl/ns-neemt-maatregelen-tegen-verspreiding-corona-virus/

NS. (April 17, 2020 -c). NS: Versteviging basisdienstregeling met extra intercity's. Retrieved May 1, 2020, from: https://nieuws.ns.nl/ns-versteviging-speciale-basisdienstregeling-met-extra-intercitys/

NS. (2020 -d). Over NS. Retrieved April 23, 2020, from: https://www.ns.nl/over-ns

NS. (2020 -e). Dal Voordeel. Retrieved May 19, 2020, from: https://www.ns.nl/abonnementen/dal-voordeel.html

NS. (March 13, 2020 -f). NS neemt maatregelen tegen verspreiding coronavirus. Retrieved April 20, 2020, from: https://www.ns.nl/uitgelicht/interessant-voor-u/corona.html

Omroepwest. (March 18, 2020). HTM laat nog minder bussen en trams rijden. Retrieved May 13, 2020, from: https://www.omroepwest.nl/nieuws/4011398/HTM-laat-nog-minder-bussen-en-trams-rijden

OVinNederland. (January 2020). Dienstregeling 2020. Retrieved May 2, 2020, from: https://wiki.ovinnederland.nl/wiki/Dienstregeling_2020

OVNL. (2020). Onze leden. Retrieved April 23, 2020, from: https://www.ov-nl.nl/onze-leden/

Peters, P. (2020). Interview

Puylaert, G. (April 3, 2020). Nieuw overleg invulling corona-maatregelen. Retrieved May 30, 2020, from: https://www.ovmagazine.nl/2020/04/nieuw-overleg-over-corona-aanpak-in-ov-1533/

Qbuzz. (2020). Regio's. Retrieved April 23, 2020, from: https://www.qbuzz.nl/regios

RET. (May 2020 -a). Maatregelen corona. Retrieved May 5, 2020, from: https://www.ret.nl/home/reizen/dienstregeling/maatregelen-corona.html

RET. (2020 -b). Over RET. Retrieved April 23, 2020, from: https://corporate.ret.nl/over-ret

RET. (April 1, 2020 -c). Nieuwe aanpassingen dienstregeling. Retrieved June 10, 2020, from: https://corporate.ret.nl/nieuws/nieuwe-aanpassingen-dienstregeling

Rijksoverheid. (2020 -a). Openbaar vervoer en het coronavirus. Retrieved April 23, 2020, from: https://www.rijksoverheid.nl/onderwerpen/openbaar-vervoer

Rijksoverheid. (2020 -b). Nederlandse aanpak en maatregelen tegen het coronavirus. Retrieved may 14, 2020, from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/nederlandse-maatregelen-tegen-het-coronavirus

Rijksoverheid. (2020 -c). 30 Documenten over Coronavirus COVID-19, gefilterd op Mediatekst. Retrieved May 30, 2020, from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/documenten?type=Mediatekst

Rijksoverheid. (2020 -d). Veelgestelde vragen over het coronavirus en het openbaar vervoer. Retrieved June 9, 2020, from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/verkeer-openbaar-vervoer-grensstreek/openbaar-vervoer

Rijksoverheid. (May 19, 2020 -e). Letterlijke tekst persconferentie minister president Rutte en minister De Jonge na afloop van crisisberaad kabinet (19-5-2020). Retrieved May 25, 2020, from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/documenten/mediateksten/2020/05/19/letterlijke-tekst-persconferentie-minister-president-rutte-en-minister-de-jonge-na-afloop-van-crisisberaad-kabinet

RIVM. (2020). Veelgestelde vragen over het coronavirus, het openbaar vervoer en dagelijks leven. Retrieved April 29, 2020, from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/openbaar-en-dagelijks-leven

Transdev. (2020). Maak kennis met Transdev. Retrieved April 23, 2020, from: https://www.transdev.nl/nl/over-ons/maak-kennis-met-transdev

Translink. (2020). Bibliotheek. Retrieved June 6, 2020, from: https://www.translink.nl/library

UITP (29 April 2020 -a). Management of virus outbreaks in public transport. International Association of Public Transport

UITP (February 2020 -b). Management of COVID-19 factsheet guidelines for public transport operators. International Association of Public Transport.

UITP (4 June 2020 -c). Post-lockdown mobility. International Association of Public Transport.

U-OV. (March 20, 2020). Laatste updates coronavirus: aangepaste dienstregeling. Retrieved May 13, 2020, from: https://www.u-ov.info/meer-qbuzz/nieuws/XnHZ_xEAACIAEZrH/laatste-updates-coronavirus-aangepaste-dienstregeling

Wikipedia. (2020). Face masks during the COVID-19 pandemic. Retrieved June 4, 2020, from: https://en.wikipedia.org/wiki/Face_masks_during_the_COVID-19_pandemic#cite_note-237

Appendix A

Table 7: Stakeholders

Stakeholder	Description
PT providers (suppliers)	
RET	Mainly active in and around Rotterdam, RET provides bus, tram and metro services. RET covers mostly urban transport. (RET, 2020 -b)
GVB	Mainly active in and around Amsterdam, GVB provides bus, tram and metro services aswell a ferry. GVB covers mostly urban transport. (GVB, 2020 -c)
HTM	Mainly active in and around The Hague, HTM provides bus and tram services. HTM covers mostly urban transport. (HTM, 2020 -a)
Hermes (Breng/Bravo)	Hermes is active in and around Arnhem and Nijmegen. They provide bus services and one train connection (Arnhem-Doetinchem) under the brand name Breng. Besides Arnhem and Nijmegen, Hermes also provides bus services in Noord-Brabant (together with Arriva) under the brand name Bravo. (Hermes, 2020)
Arriva Nederland	Arriva provides train services in the North, East and South (Limburg) of the Netherlands. Arriva also provides a lot of bus services throughout the Netherlands, e.g. in the province of Friesland, Gelderland, Limburg and Noord-Brabant. Arriva Group is a large company, which is also active for multiple services, in multiple countries across Europe. (Arriva, 2020 -b)
NS	NS provides most of and is mainly focussed on the train services in the Netherlands. (NS, 2020 -d)
Keolis	Keolis provides bus services in the Veluwe, Midden-Overijssel and Twente regions aswell as the cities of Utrecht and Almere. The company previously went by the name 'Synthus', which is still used in some areas. Keolis provides some train services originating from Zwolle. (Keolis, 2020)
Qbuzz	Active in the province and city Groningen, Drenthe and Utrecht. Qbuzz covers mostly regional transport (busses). In the city of Utrecht they provide tram services aswell, albeit under the brand name U-OV. Recently, Qbuzz is also active in the Molenlanden region, between Dordrecht and Gorinchem. (Qbuzz, 2020)
Transdev	Transdev owns Connexxion which in turn owns Hermes, Connexxion covers mostly regional bus transport in the following provinces: Zeeland, Noord-Holland, Flevoland. (Transdev, 2020)
EBS	EBS provides regional bus transport in the province of Zuid-Holland. (EBS, 2020)
Others	
OVNL	OVNL is an association representing the following public transport companies: Arriva, EBS, GVB, HTM, Keolis, NS, Qbuzz, RET, Transdev. Where these companies are otherwise competing, under OVNL they can collaborate. In the current crisis collaboration can be very important, which makes OVNL an important stakeholder. (OVNL, 2020)
Ministerie van Infrastructuur en Waterstaat.	The ' Ministerie van Infrastructuur en Waterstaat' is the government department concerning public transport. The government wants people to obey their measures, but also needs health workers to be able to get to their jobs. (Rijksoverheid, 2020)
Ministerie van Volksgezondheid, Welzijn en Sport	The ' Ministerie van Volksgezondheid, Welzijn en Sport' is the government department concerning public health. The government cares about the well-being of the citizens and is thus an important stakeholder in the current situation, when it comes to obeying the measures. (Rijksoverheid, 2020 -a)
Rijksinstituut voor Volksgezondheid en Milieu (RiVM)	The RIVM conducts research and collects data on the virus. They also advise the government via the Outbreak Management Team, which is a team that consists of multiple experts from multiple disciplines and some government officials, including the prime-minister. (RIVM, 2020)

Travelers (demand)	Travelers using the services of public transport companies are a stakeholder, as they are affected by the actions of public transport companies.

Speciale Basisdienstregeling
Geldig vanaf zaterdag 21 maart

Legenda

━━━━ Hier rijden **Intercity's en/of Sprinters**

━━━━ Hier rijden **alleen Sprinters**

━━━━ **Internationale treinen** rijden volgens een aangepaste dienstregeling

━━━━ Hier is **geen treinverkeer**

┄┄┄┄ Overige vervoerders

Verder geldt:
- Vanaf ieder station in Nederland rijden, in alle richtingen, twee treinen per uur.
- Alleen vanaf stations waar nu één keer per uur, per richting, een trein vertrekt, blijft dit zo.
- Nachttreinen rijden niet.
- Check kort voor vertrek je reis in de NS-app of de Reisplanner.

Figure 11: Special basic timetable (NS, 2020 -a).

Appendix C

Metro

| Modaliteit | Lijn | Standaard of Zomer | Werkdag | | | | | |
			Vroege Ochtend	Ochtendspits	Ochtend Dal	Middag Dal	Middagspits	Avond
M	50	STANDAARD	10	8	10	10	8	12
M		ZOMER	10	10	10	10	10	12
M	51	STANDAARD	10	8	10	10	8	12
M		ZOMER	10	10	10	10	10	12
M	52	STANDAARD	6	6	6	6	6	7,5
M		ZOMER	6	6	6	6	6	7,5
M	53	STANDAARD	10	8	10	10	8	12
M		ZOMER	10	10	10	10	10	12
M	54	STANDAARD	10	8	10	10	8	12
M		ZOMER	10	10	10	10	10	12

Figure 12: GVB Vervoerplan 2020. (GVB, 2018)

Appendix D

Table 8 (1/2): List of countries that responded to UITP survey and the measures included in their response.

Country	Oxford stay-at-home requirement on April 27	Measures taken (UITP, 2020 -a)					Note
Argentina	2	2	3				
Australia	2	3					
Austria	2	4	5				
Bahrain	1	6					
Belgium	2	6	5				
Brazil	1	7					
Canada	1	5					
Colombia	2	0					
Chile	2	9					
China	1	4	10	2	6	5	
Czechia	1	2					
Denmark	1	2					
Egypt	2	0					
France	2	5					
Georgia	3	1					
Germany	2	4	5	2	3		
Hong Kong	2	4	10	2			
Hungary	2	11	5				
Indonesia	2	3	2	10			
Iran	1	3	5	12	10	2	
Ireland	1	13	5	2			Rail transport not reduced
Italy	2	2	5	11	3		Masks only obligated if 1m distance isn't possible
Japan	1	4	2				
Latvia	-1	5					Same schedule, change in pricing -> Health workers free, others pay
Lebanon	2	1					
Malaysia	1	2					
Malawi	1	5					Increased prices PT as result of loss in passengers
Morocco	2	13	2				
Netherlands	2	5	2	3			
New Zealand	2	13	5				
Philippines	3	1					
Poland	1	5	3	11			
Portugal	2	6					
Romania	2	5					
Russia	3	2	14				Change in pricing
Singapore	2	2	3	4	10	15	Mask only obligated if showing respiratory symptoms
South Korea	0	3					
Spain	2	5	2	3			
Sweden	0	3	2				
Switzerland	1	2	11				
Taiwan	0	2	3				
Thailand	1	2	14	10	3		
Turkey	2	2					Free PT for health workers
UAE	2	5	2				Metro and tram complete shutdown
USA	2	3	2	5			Differences between states
UK	2	5	2				
Ukraine	0	1					max. 10 passengers allowed per vehicle
Vietnam	2	1					

Table 8 (2/2): List of countries that responded to UITP survey and the measures included in their response.

Measures list	Taken (#)
No information on measures as of yet	2
Complete Shutdown of all public transport	5
General Measures: cleaning vehicles, social distance, isolation if showing symptoms, sneeze in arm	25
Face masks obligated for everybody	6
Adapted schedule, reducing services	20
Amount of seats limited inside the vehicle	4
No measures taken	1
No cases of the virus	1
Temperature checks for everybody	6
Lock the front door of PT vehicles or block the way to the driver	4
Face masks obligated for staff only	1
Only essential workers allowed on PT, they have to carry proof	3
Temperature checks for staff only	2
Use of an app to track proximity with others	1

Appendix E

Table 9: Overview of the timetable results

Relative amount of service left , with respect to the normal, 2020 timetable [%]			
Company	Phase 1	Phase 2	Phase 3
Train			
Arriva	62 %	62 %	62 %
NS	61 %	78 %	78 %
Tram			
GVB	49 %	64 %	84 %
HTM	49 %	49 %	75 %
Qbuzz (U-OV)	25 %	25 %	25 %
RET	54 %	54 %	72 %
Metro			
GVB	53 %	65 %	71 %
RET	63 %	63 %	63 %
Bus			
GVB	61%	81%	81%
HTM	41%	41%	91%
RET	68%	68%	68%