Interreg North Sea

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ShareDiMobiHub

Requirements in Shared Mobility Data Reporting

DELIVERABLE 8.1 and 8.2

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Summary sheet

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Organisation	Abbreviation	Country
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Capital Region of Denmark	CRD	Denmark
Vestfold county	VTFK	Norway
Subpartner: Statens vegvesen	SVV	Norway
Subpartner: Tønsberg kommune	TK	Norway
Promotion of Operation Links with Integrated Services	POLIS	Belgium
City of Amsterdam	AMS	Netherlands
City of Leuven	LEU	Belgium
University of Antwerp	UAntw	Belgium
Transport Authority for the Amsterdam Region	VRA	Netherlands
Mpact	Mpact	Belgium
Autodelen.net	Auto	Belgium
City of Rotterdam	ROT	Netherlands
Hamburg University of Applied Sciences	HAW	Germany
University of Applied Sciences Utrecht	HU	Netherlands

Document history

Version	Date	Organisation	Main area of changes	Comments
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0.2	02-07-25	Hogeschool Utrecht	Major revision, results and conclusion	
0.3	14-07-25	Hogeschool Utrecht	Review	
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0.5	04-09-25	Hogeschool Utrecht	Edits based on reviews	

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1. Summary

The supply and use of shared mobility is growing in many cities and with it comes a growing amount of shared mobility data: numbers of vehicles, rides, locations but also complaints. Public authorities can learn from this data and monitor and steer the development of shared mobility. To prevent public authorities becoming overwhelmed with (raw) data, easily accessible data analysis and visualization can be helpful. This document describes the results of research on the development of an on-demand automatic reporting tool for shared mobility data. The results are also described in a comprehensive documents on data and dashboarding research for the ShareDiMobiHub-project. It is also part Workshops with public authorities revealed a demand for detailed data visualization on shared mobility such as vehicle count, rentals, parking times and complaints. A prototype for the tool has been made in cooperation with students at the University of Applied Sciences Utrecht. The target audience of the tool are municipal officers, and it was designed with flexibility on topic-choice and spatial extent in mind. The prototype tool generates tailored PDF-reports for municipal officer to aid in decision-making. The goal of online implementation of this tool was not fully met due to capacity constraints.

2. Introduction

ShareDiMobiHub (Shared & Digital Mobility Hub) is an Interreg North Sea project that aims to improve shared mobility through the use of shared mobility hubs. To achieve this, cooperation is required among all stakeholders including regional authorities, knowledge institutions and service providers.

An important focus of the project is using data to help public authorities make informed decisions. One of the ways knowledge institutions can help public authorities is by making datasets on shared mobility more accessible and understandable for local and regional authorities. This is necessary to improve monitoring and decision making. Therefore, research has been done on the most important types of shared mobility data for public authorities and how these can be presented through reporting. Currently, larger municipalities work on increasing their shared mobility data analysis capacities and standardizing their data analyses, while medium-sized or smaller municipalities mostly lack the capacity to analyse their shared mobility data in a standardized way, but rather analyse them in an ad-hoc manner mostly for yearly reporting. The possibility to use data analysis to steer the shared mobility development is used in a very limited way so far.

Initially, the goal of this deliverable was to create a working data dashboard that can automatically generate reports on demand using available data. Unfortunately, this was not achieved due to capacity constraints. The dashboard was conceptualized and prototyped. However, integration, promotion and complying with security and privacy regulations would have required significantly more time than was available. In this document, we communicate the learnings from the prototyping phase.

This document highlights the findings of this research. It draws insights from three workshops: two involved potential tool users, and the third took place during a ShareDiMobiHub-project meeting. These three separate workshops have sought to uncover the needs and preferred output of a data reporting tool on shared mobility data. Two of these workshops were specifically organized for this purpose with potential end users, while one of these workshops was organized at the bi-annual ShareDiMobiHub project meeting. This report will first discuss the results of the first two meetings, and then discuss the results of the third meeting. A summary of the results are also described in a comprehensive documents on data and dashboarding research for the ShareDiMobiHub-project.

Additionally, computer science students at the University of Applied Sciences Utrecht have built upon these findings by creating a working interactive prototype of an automatic reporting tool for shared mobility data. This tool can automatically generate reports on shared mobility use within, among others, a desired location and timeframe. In this document, this tool will be referred to as the 'data reporting tool'.

In summary, this document explores the needs for reporting on shared mobility and how a new tool can help fill in knowledge gaps, ultimately helping local authorities with managing shared mobility.

3. Document analysis

The study began with a document analysis to understand the current state of shared mobility reporting and dashboard utilization. The focus was on identifying key metrics and trends in shared mobility that are prioritized by policymakers. Annual reports from the municipalities of Amsterdam and Rotterdam were analysed and used to understand what data elements are consistently reported and how they are presented. Our goal was to identify high-priority informational needs and common reporting formats used by policy makers.

3.1. Dashboards

Baud and In 't Veld (2021), in cooperation with the municipality of Amsterdam and the Ministry of Infrastructure and Water Management, conducted research on the development of shared mobility. They concluded that gathering more detailed information from service providers is crucial to enhance shared mobility services. This led to a recommendation to develop a comprehensive dashboard dedicated to shared mobility data. While there is an abundance of data available, analysing this information is labour-intensive and requires specialized skills. A well-designed dashboard could make it easier for municipal officials to extract meaningful insights from this data.

Currently, some dashboards already exist on shared mobility data, like the CROW's[1] shared mobility dashboard (CROW, n.d.). In this dashboard, some general figures on rentals and available vehicles can be visualized and raw data over a selected time period can be downloaded. The drawback of using CROW's shared mobility dashboard is that further analysis of the data might require custom dashboards in order to combine the collected data with other datasets (Baud & In 't Veld, 2021).

Moreover, I&O Research, a Dutch research institute has, on behalf of the Ministry of Infrastructure and Water Management (IenW), produced a report that describes the standardization of research on shared mobility (Groenhuis, Maathuis & Wolf, 2023). Municipalities are interested in comparing their data with that of other regions and understanding additional contextual factors such as public transport availability, neighbourhood urbanization, and green spaces. Monitoring changes over time at the neighbourhood level is particularly important for municipalities. Moreover, data privacy and control are essential. The dashboard should make sensitive data only accessible to authorized stakeholders, allowing them to manage data sharing.

[1] CROW (https://www.crow.nl/) is a Dutch knowledge institute for infrastructure, public space, traffic and transport, and work and safety. It has developed a real-time dashboard on shared mobility supply in the Netherlands: https://dashboarddeelmobiliteit.nl/

3.2. Annual reports

The municipalities of Rotterdam and Amsterdam both reports on their shared mobility performances over the timespan of a year (Scheltes et al., 2023; Gemeente Amsterdam, 2022). Analysing these reports highlight the data points that policymakers prioritize and helps us understand what information should be reported on in a data dashboard or report.

Both reports commonly address topics such as the number of vehicles, distances travelled, rentals, and rental durations for internal assessment. These metrics are often compared across longer time spans, like yearly or bi-yearly totals, to analyse trends within the municipalities. Figure 1 shows an example of a factsheet.

Some topics and figures are presented in both reports although they are presented differently. For instance, while both reports include maps, they focus on different aspects. In the maps of Amsterdam, the focus is on the inventory of shared mobility and their service areas, while in Rotterdam the focus was on the origins and destinations of shared mobility itineraries.

Both reports also contain figures on the offer, use, and the total distance travelled of shared mobility. This is then typically split by vehicle type and time periods. Both reports categorize data by vehicle type, including shared cars, bicycles, and mopeds (Figure 1), with further distinctions like 'free-floating' versus 'station-based' cars. Only in the report of Rotterdam, the categories were also divided to the service provider level.

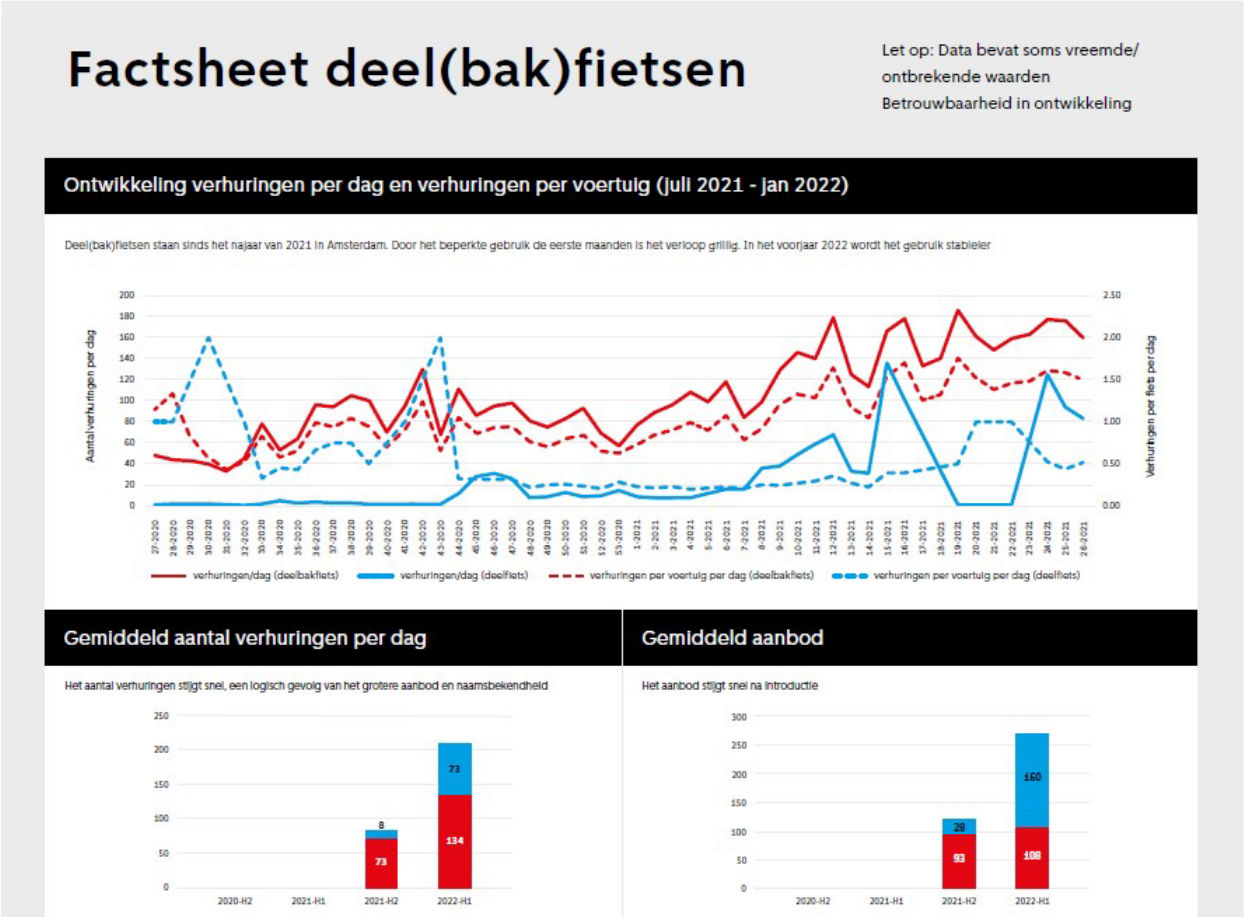

Figure 1: Factsheet on shared bicycles and cargo bikes (Gemeente Amsterdam, 2022)

Finally, both reports also had some unique topics. The municipality of Amsterdam provided a table with the expected CO_2, NO_x and PM_x emission reduction based on the shared mobility usage and they coupled the rented vehicles with train-stations nearby. The municipality of Rotterdam made the comparison to other cities in their report, compared summer and winter months, and have maps and figures on the relationship between origins and destinations of rented vehicles. The figures present in both reports can be seen in Table 1.

The frequency of timescales varies, from daily to yearly statistics, with half-year periods most commonly used. Daily data primarily covers vehicles and rentals.

Table 1 offers an overview of the figures reported and the differences between the two cities.

Figure	Yearly report Amsterdam	Yearly report Rotterdam
Number of vehicles	**Yes, separate figures per vehicle type:** - Daily average number of vehicles per half-year	**Yes,** - Number of vehicles per half-year per vehicle type - Number of cars per quarter-year per parking type (Station based, free floating & Peer-to-peer

Distance travelled	**Yes, separate figures per vehicle type:** - Average distance travelled per half year	**Yes, per vehicle in one figure:** - Average distance per vehicle per year - Average distance per vehicle per quarter-year
Rentals	**Yes, separate figures per vehicle type:** - Average rentals per day - Average rentals per day per half-year - Average rentals per weekday - Average rentals per neighbourhood per day - Percentage of day in use per half-year	**Yes, per vehicle type in one figure:** - Average monthly rentals per vehicle per half-year - Ratio of use per vehicle in winter vs. summer months - Ratio of use per neighbourhood per year - Number of cars per quarter-you per parking type - Ratio of use per time of day
Duration	**Yes, separate figures per vehicle type:** - Average duration of the rental per half-year	**No**
Complaints	**Yes, only for mopeds** - Number of incorrectly parked moped per month - Complaints per rental per month - Complaints about alarm noise per month - Traffic violation per month - Average time to resolve per month - Number of times dispatched	**Yes, only for bicycles and mopeds** - Complaints per rental per quarter
Modal split	**No**	**Yes,** - Modal split per year
Emissions	**Yes** - Estimated emission reduction of CO_2, NO_x and PM 2.5 per year	**No**
Origin-destinations	**No**	**Yes** - Map of relations of origin destinations

Table 1: Figures present in the yearly reports for the municipalities of Amsterdam and Rotterdam (Scheltes et al., 2023; Gemeente Amsterdam, 2022)

4. Methodology

4.1. Workshops

To gather additional insights, two workshops were conducted involving municipal government officers and ShareDiMobiHub partners. The workshop participants were engaged through structured discussions and interactive tools like Mentimeter, which facilitated real-time polling and feedback collection. The workshops aimed to uncover user preferences and identify desired features in a data reporting tool for shared mobility.

The first focus group meeting that was organized with end users was held on September 26th 2023. At this meeting were two policy officers from the municipality of Amsterdam, and one government officer of the municipality of Amersfoort. The policy officers of Amsterdam are responsible for policy on shared moped and project management of smart mobility projects in the municipality. The government officer of the municipality of Amersfoort is responsible for shared mobility policy. Three researchers of the University of Applied Sciences Utrecht were also present to facilitate the focus group. There were also three partners of the ShareDiMobiHub project present out of their own interest.

The second focus group meeting that was organized with the end users was held on October 9th 2023 with three policy officers of the municipality of Rotterdam. One responsible for car sharing and shared mobility hub policy in the municipality, one responsible for general shared mobility policy and the last one responsible for the shared two-wheelers and communication with shared mobility providers. Two researchers of the University of Applied Sciences Utrecht were present to facilitate the focus group.

Next to taking notes during the discussions, data was gathered using Mentimeter surveys, which allowed participants to rate potential data visualizations and discuss their relevance to daily workflows. During the survey questions there was room for discussion on the surveyed question. After the survey there was also room for additional discussion on the user needs of a data report.

A third workshop took place during the bi-annual internal conference of ShareDiMobiHub on November 14, 2023 and was facilitated by the University of Applied Sciences Utrecht and MPact. It was attended by all partners, including governmental organizations, research institutions, and supporting partners. The group was split in several smaller groups were the groups consisted of participants from different organizations. They were presented with a fictional problem and needed to think about the data required to effectively tackle the fictional problem.

4.2. Data Reporting Tool Prototype

Qualitative data from the workshops and quantitative data from previous reports were analysed to identify recurring themes and high-priority reporting metrics. These recurring themes and metrics were then listed as requirements for the content of an automatically generated report on shared mobility for policy makers.

Using this list of requirements, computer science students from the University of Applied Sciences Utrecht developed a prototype of an automatic data reporting tool. The tool was designed to be user-friendly, allowing municipal officers to generate reports on shared mobility. It features functionalities for customized data visualization, enabling users to select parameters like timeframes and vehicle types according to their needs. It was also designed to extend on the services of the CROW-dashboard and it should be securely navigable in the browser. In the end the report has to be downloadable in pdf.

5. Results

5.1. User needs focus groups with municipal government officers

In both workshops, a Mentimeter was used to show potential data visualization options of the available data. The data visualizations did not have any real data, but rather served as an example for potential formats. Participants rated each visualization's relevance to their work on a scale from 1 to 10. Figure 2 shows and example of a Mentimeter result.

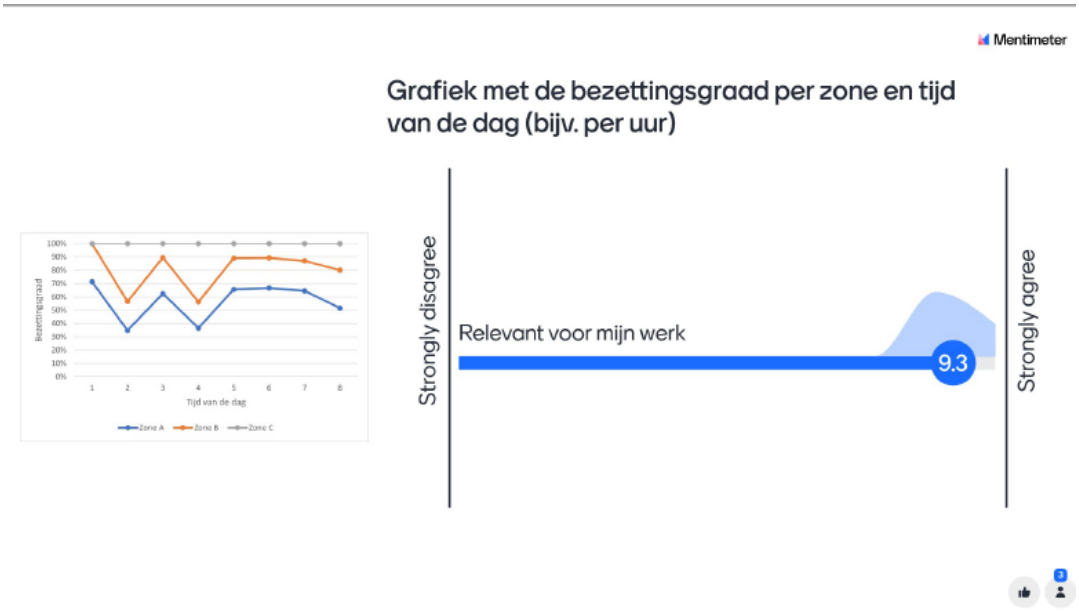

Figure 2: Mentimeter question if a graph with the occupancy rate per zone and time of day is relevant to the policy officers work activities on a scale of 1 to 10

Table 2 provides the average participant scores for each visual representation. It shows the potential visualization in both workshops in descending order of the total average score given by the participants.

Potential visualization	Rating workshop 1	Rating workshop 2	Average
Graph with the occupation rate per hub and per time of day	8	9.3	8.7
Total rentals per vehicle-type barchart	7.3	9	8.2
Graph with occupation per vehicle type per hub	No input	8	8
Graph of rentals per time of day	7.7	No input	7.7
Netto rentals/arrivals per hub	No input	7.7	7.7
Histogram with the average parking time per hub per vehicle	7.3	7.3	7.3
A map with the average parking time per hub	7.7	6.3	7
Average parking time at various occupation rates per hub	No input	7	7
Graph with rentals per time of day per hub	7.3	6.3	6.8
Graph with average parking time per time of day (i.e. hourly)	5.2	7	6.1
A map with the average occupation rate per hub	3	7	5
Stacked bar chart with the ratio of vehicle-types per hub	3	No input	3

Table 2: Scores given in the workshops per Mentimeter question

5.1.1. Results per question

Both workshops identified the graph showing hub occupation per time of day as most relevant. While the CROW dashboard currently provides the maximum occupancy in the hub per day, this does not mean much to the government officers. Instead, it would be more interesting to be able to visualize peak times

of the day. This can be used to tackle idle vehicles and start working with maximum vehicle parking in hubs. It is also relevant on a seasonal scale. For instance, the comparison between the use of shared vehicles in both summer and winter. This data can be used to be more effective in steering the vehicles in accordance with the demand. In this potential visualization the variable is occupation 'rate', however the total number of vehicles would also be very useful.

A bar chart for the total rentals per vehicle-type were also deemed very useful, although some changes were suggested. Besides vehicle types, there are also multiple service providers for the same vehicle types that could be split. Currently the CROW-dashboard provides this data in a table, however a bar chart would be more attractive and readable. Perhaps besides splitting by vehicle type, a split could also be made between the various business models, for instance free floating, station based and zone-floating. It would be nice if these numbers could be compared over time, like between seasons, months, or compared to the same time last year. Finally, the total number of rentals over time is very interesting, more interesting than per vehicle type.

Regarding the rentals per time of day, more insight is desired than is currently provided by the CROW-dashboard or the service providers. A daily or weekly timescale would be useful, and for the largest municipalities, an hourly timescale could even be useful.

The parking time per hub is mostly useful for comparing it with other hubs for spreading and steering the vehicles based on this data. It would be best if the service-areas that providers offer could be used in the analysis. Parking time and occupancy rate can also be compared to gain useful insights. A map is visually appealing and can give insights very quickly.

The comparison of rentals per time of day split by hubs was deemed most useful as a means of comparing various hubs. However, comparing it by time of day might be a bit too specific and will get a lot of information when comparing multiple hubs. This feature would be a nice to have, but not immediately necessary.

Finally, the comparison of vehicle types per hub were not deemed very relevant, as it the vehicle types supplied at a hub are often following municipal policy.

5.1.2. Open discussion

After the Mentimeter questions, an open discussion was held in both workshops to discuss the usefulness of the reporting tool, what it should contain, and some additional suggestions.

The tool would be useful for frequent reporting. Every year a report is made by the municipality, however this is done by their own in-house knowledge and work. This tool could support with creating this report. The reports could become more important in the future, as with the growth of shared mobility, more monitoring is required.

The most important topic for municipalities is the reduction of congestion, and increased accessibility and public space. Environmental gains are nice, but not the most important reason for the uptake of shared mobility. An important topic to municipalities is the complaints on shared mobility vehicles in the public space, which is often present in shared mobility reports. These complaints are collected by the service providers and the municipalities.

The comparison between hubs in the same municipality is a very important topic. The municipality of Rotterdam has even built their own small dashboard in which they compare neighbourhoods for additional insights. They would value if there could be a ranking based on the data, for instance a top 10 hubs with the most rentals or the most growth. Also, the heatmaps of the shared mobility are often used for determining potential locations of new hubs. It would be nice if it was also possible to include public transportation in the report. To see if there is a link between the accessibility by public transport and the usage of a hub.

The CROW Dashboard Deelmobiliteit is an important tool for municipal officers working with shared mobility in the Netherlands (see Figure 3). It is used mostly to monitor neighbourhood hubs. This is done by tracking shared mobility usage, hub occupancy, and parking times on daily or weekly timescales. This is done because shared mobility vehicles must be relocated by the service providers after four days of being stationary, according to municipal permits. The municipality of Amsterdam also analyses historical data, with a particular interest in cargo bike usage, while Rotterdam operates a simple dashboard derived from CROW-data. Amersfoort uses this information for hub creation and communication with service providers.

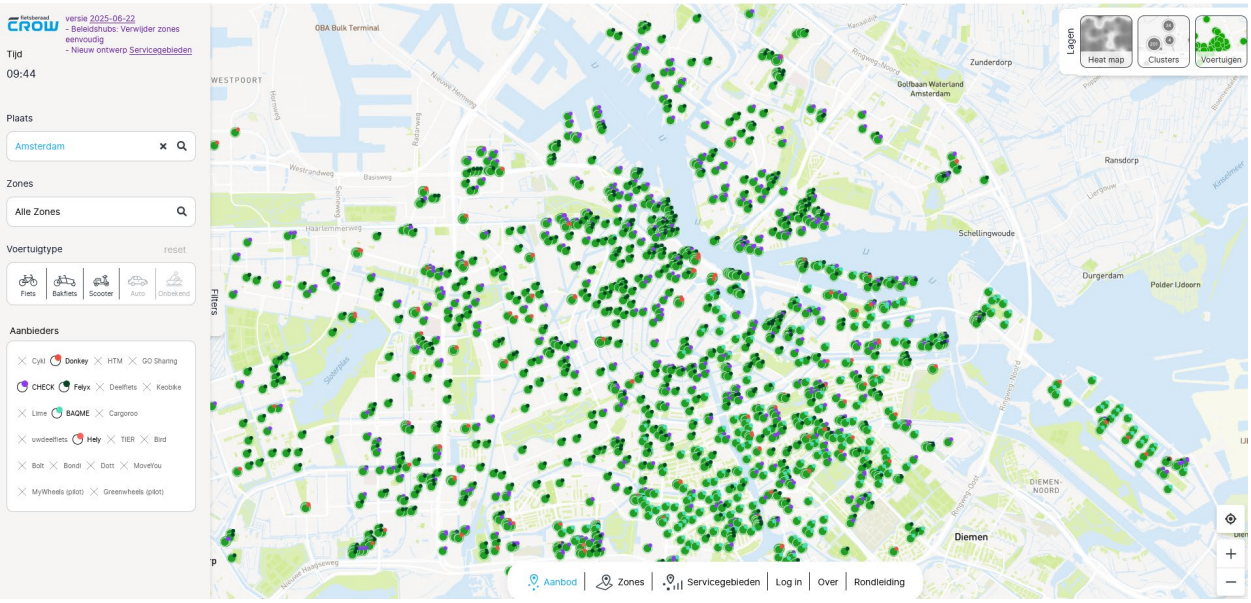

Figure 3: Example of the visualization of the locations of shared two-wheelers in Amsterdam in the CROW Dashboard Deelmobiliteit

5.2. Data requirements analysis with ShareDiMobiHub internal partners

The third workshop in which the ShareDiMobiHub partners (governmental organizations, research and knowledge institutions) discussed about the data required to effectively tackle a fictional problem, also delivered interesting insights: Notable takeaways from the discussions include the perception that the most useful data is typically sourced from mobility operators or municipalities, with occasional reliance on public transport operators. Open-source alternatives such as social media or data scraping are mentioned only infrequently. Additionally, shared mobility use and origin-destination patterns emerge as highly sought-after data points. Moreover, the desired data encompasses a blend of geodata and user/usage data, in some cases also in combination with qualitative data.

5.3. Reporting tool prototype

Taking into consideration the input from the document analysis and workshops, we propose some key features to include in a shared mobility data reporting tool. The tool should offer flexibility, allowing users to select various topics, timescales, and other options to generate tailored reports that meet specific user needs without overwhelming them with information. The front-end and back-end code can be found on Github (Github, 2024a, Github, 2024b).

5.3.1. Front-end design

Taking the workshops, document analysis and reports into consideration, it becomes evident that more insight in shared mobility through dashboards and reports is required (Baud & in 't Veld, 2021; Groenhuis, Maathuis & Wolf, 2023). The main topics identified to include in the reporting tool are:

- Number of vehicles
- Distance travelled
- Rentals

Complaints were also covered in both reports and workshops. Unfortunately, there is no consistent database on complaints, which are therefore hard to quantify. Complaints are thus not included in the reporting tool.

The CROW-dashboard allows municipal officers to draw their own hubs on the map in which data is collected and aggregated for that area. The reporting tool prototype also uses these hubs as an input. Besides the hubs, neighborhoods as defined by the CBS (CBS, 2023) are also included so that comparisons on a neighborhood level can be done. This was also done in both reports, and was deemed desirable by the workshop participants. Comparison can be done on

- neighbourhood level and
- hub level.

The tool allows the selections of preferred reporting periods, automatically providing warnings if selected periods exceed data availability or the selected period is too short. This should avoid generating incomplete reports or reports with missing data.

Taking into consideration all the elements mentioned, the front-end was developed and is shown in Figure 4.

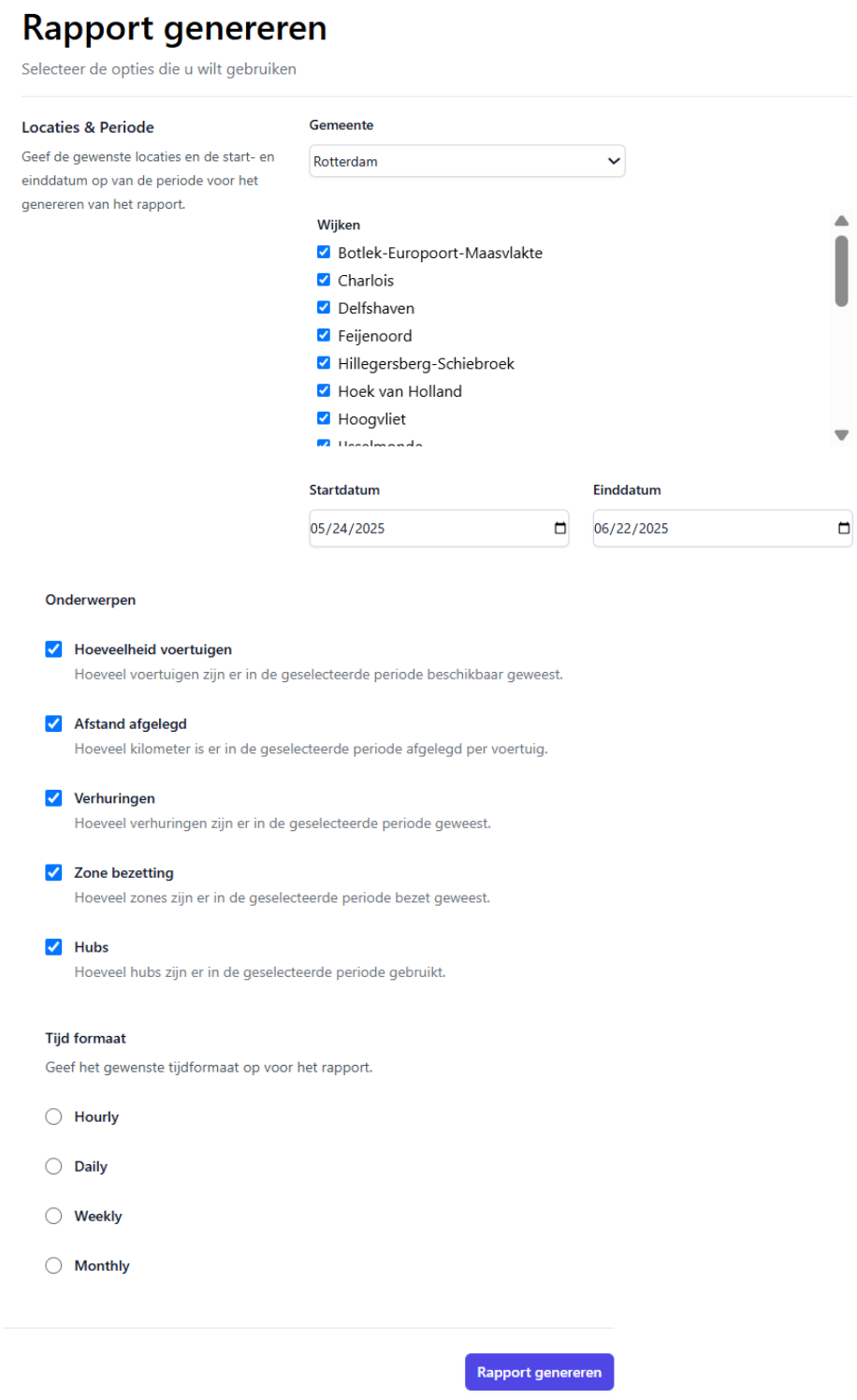

Figure 4: Web-interface with options for the report generator

Since the tool is using sensitive data, which is only to be used by the municipalities, the front-end also requires authentication from the user. The authentication window to access the web-interface can be seen in Figure 5.

Figure 5: Authentication screen for getting access to the reporting tool

5.3.2. Report contents

Users are able to generate PDF-reports for ease of access and distribution. Therefore, the user that generates the report in the front-end needs valid credentials. However, the generated PDF-file can be saved and shared freely within the legal terms of the data-providers. The figures used in the report are based on the options selected in the front-end.

The report's first page highlights key statistics with an infographic, focusing on simple, easily readable data points. Figure 6 gives an impression of what the infographic looks like.

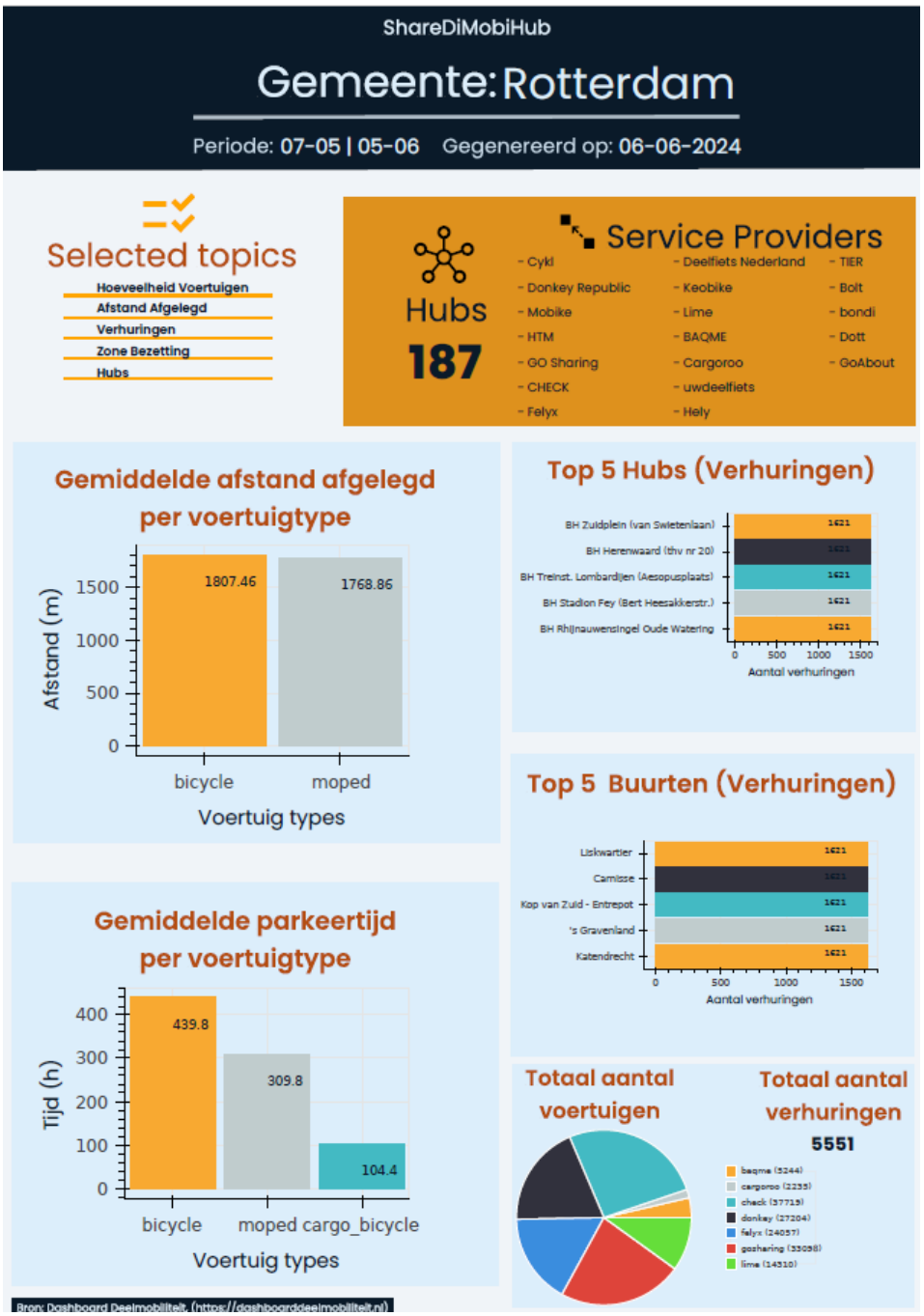

Figure 6: Front-page layout of the automatically generated report

Then there are multiple pages with figures with a short description of each figure. Depending on the chosen topics and other selected variables, certain figures will be present in the report. All of the topics and related figures can be found in Appendix A.

6. Conclusion

In conclusion, this document discusses the role of accessible and comprehensive data on shared mobility. Through the document analysis and workshops, essential features have been identified for a shared mobility report. These insights are also used to set requirements for data dashboards and automatic reporting tools, which should allow flexibility in topic choice and spatial extent to aid municipal officers in decision-making.

There were also challenges, as the goal of a functional automatic on-demand reporting tool was not met. Full integration, promotion, and compliance with security and privacy regulations turned out to be more challenging than expected and prevented the realization of this tool. It is therefore recommended to think thoroughly about the target group, the collaborative partners who offer the data, data-sharing agreements, and the long-term maintenance of such a tool.

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8. The ShareDiMobiHub Consortium

The consortium of ShareDiMobiHub consists of 13 partners and 4 subpartners with multidisciplinary and complementary competencies. This includes European cities and regions, universities, network partners and transport operators.

For further information please visit https://www.interregnorthsea.eu/sharedimobihub

9. Appendix

Appendix A: Table of figures that are generated with the selection of check-boxes in the front-end

Figures		Topics					Split by		
	Always	Number of vehicles	Rentals	Distance covered	Parking time	Hub	Vehicle type	Service provider	Neighbourhoods
Total number of hubs	■								
Number of service providers	■								
Selected topics in the front-end	■								
Total number of vehicles by vehicle type	■								
Total number of rentals by vehicle type	■								
Avergae distance travelled by shared vehicles by vehicle type	■								
Average parking time by vehicle type	■								
Top 5 hubs by rentals	■								
Top 5 neighbourhoods by rentals	■								
Graph of the number of vehicles in the municipality, total and per vehicle type with timesteps for the selected period		■					■		
Graph of the number of vehicles in the municipality, total and per service provider with timesteps for the selected period		■						■	
Graph of the number of rentals in the municipality, total and per vehicle type with timesteps for the selected period			■				■		
Graph of the number of rentals in the municipality, total and per service provider with timesteps for the selected period			■					■	
Bar chart for the average rentals per hour of the day			■						
A horizontal bar chart of the average distance covered by vehicle type.				■			■		

A horizontal bar chart of the average distance covered by service provider.				■				■	
A horizontal bar chart of the average parking time by vehicle type					■		■		
A horizontal bar chart of the average parking time by service provider					■			■	
A vertical bar chart of the distance covered with time steps of half a year				■					
A vertical bar chart of the distance covered with time steps of months				■					
A vertical bar chart of the average parking time with time steps of half a year					■				
A vertical bar chart of the average parking time with time steps of months					■				
Map with the selected neighbourhoods and labels									■
Graph of the number of vehicles in the municipality and the selected neighbourhoods for the selected period		■							■
Graph of the rentals in the municipality and the selected neighbourhoods for the selected period			■						■
Bar chart of the rentals in the selected neighbourhoods per day of the week			■						■
Vertical multi-bar chart with the average parking duration by neighbourhood per half a year					■				■
Vertical multi-bar chart with the average parking duration by neighbourhood per month					■				■
Vertical multi-bar chart with the average distance covered by neighbourhood per half a year				■					■
Vertical multi-bar chart with the average distance covered by neighbourhood per month				■					■
Map with the selected hubs and labels						■			
Graph with the average maximum occupation of the hub for the selected time period by total and vehicle type						■	■		
Graph with the average maximum occupation of the hub for the selected time period by total and by service provider						■		■	
Graph with the average occupation of the hub per hour and a line of the maximum occupation allowed in hub by total and by vehicle type						■	■		
Graph with the average occupation of the hub per hour and a line of the maximum occupation allowed in hub by total and by service provider						■		■	
Graph with the average occupation of the hub per hour of day with a line per day of the week						■			
Average occupation per hub						■			
Vertical multi-bar chart with parking time per hub					■	■			
Vertical multi-bar chart with distance covered per hub				■		■			
Multi-bar chart with percentage of time above maximum occupation per hub						■			

Appendix B: Wokshop handout of 'Fictional scenario's for data-dashboard needs'

Description of your case

Emerald City, with a population of approximately 1 million inhabitants, holds significant importance as both a business and political hub. It boasts an extensive network of yellow brick roads leading to its heart and a well-organized public transportation system. This system comprises 60 bus and tram lines, four metro lines, and an extensive S-train (S-bahn/tog/trein) network.

Over the last two years, the city has faced a significant surge in shared mobility providers, including free-floating shared car services, as well as shared e-scooter and e-bike providers, inundating the city with their vehicles. This influx has presented new challenges: micro mobility vehicles are often haphazardly parked, obstructing cycling paths, blocking the entrances to S-train stations, and impeding pedestrian walkways. Free-floating cars are frequently left in prohibited parking areas.

In response to these challenges, Emerald City's administration has allocated a portion of its budget to establish mobility hubs. These hubs will feature designated drop-off zones for shared e-scooters and e-bikes, as well as dedicated parking spaces for shared cars. However, the budget for this initiative is limited to the creation of just ten hubs. Alderwoman Mrs. Gale, responsible for mobility in Emerald City, aims to develop these infrastructure hubs in areas where the problems of improper vehicle parking are most acute and where the potential for hub usage is the highest.

What data do you require to suggest 10 priority locations to the alderwomen for potential development into mobility hubs?

Data Requirements

Make a list of all the essential data elements required to address the issue in your case study.

Once you've compiled your initial "longlist" of data elements, take a moment to select the data that should be included in your final selection of the top five essential data requirements. Mark these crucial data elements with an "X" to signify their importance.

Data requirements	**Top 5**

Description of your case

The scenery of Rivendell is stunning. The town itself is situated along the banks of the river Bruinen, with three smaller settlements located in the surrounding hills. The entire valley is home to approximately 30,000 inhabitants.

To reduce private car ownership, the municipality has established five mobility hubs within the town and one hub in each of the surrounding settlements. These hubs are strategically located at public transport stops to ensure a seamless multimodal transportation experience. At these hubs, you will always find one or more station-based shared cars and free-floating e-bikes, complete with designated drop-off zones. In an effort to encourage the adoption of these modes of transportation, Rivendell offers its citizens a 30% discount on the first ten rides with the shared e-bikes and provides €25 of credit to new users of the car-sharing scheme.

However, despite these efforts, there are some doubts about the scheme's success. Residents living near certain hubs have informed the municipality that some of the shared cars remain unused for days. Additionally, one of the town's hubs has experienced reports of vandalism towards its infrastructure, including theft of some bikes and damage to an information screen. Furthermore, the e-bike operator faces a challenge as residents from the hillside settlements use the shared bikes to travel downhill to the town but rely on public transport for their return journey in the evening. This has resulted in an oversupply of e-bikes downhill and a shortage of shared bikes uphill, posing a logistical challenge for the bike operator.

In light of these concerns, the municipality aims to evaluate the effectiveness of the mobility hub network by comparing hub locations. There are no restrictions on potential changes: new hubs can be opened, existing ones can be relocated, or some may even be closed. What specific data does the Rivendell administration require to make an informed decision regarding the mobility hub network?

Data Requirements

Make a list of all the essential data elements required to address the issue in your case study.

Once you've compiled your initial "longlist" of data elements, take a moment to select the data that should be included in your final selection of the top five essential data requirements. Mark these crucial data elements with an "X" to signify their importance.

Data requirements	**Top 5**

Description of your case

Beauxbatons, with approximately 300,000 inhabitants, is a city where multiple train lines intersect at the central station, making it easily accessible by public transport. Despite its relatively modest size compared to other European cities, it is home to a large and renowned university. The main campus is situated just outside the city center, approximately a 10-minute bus ride on average. Consequently, a significant number of students commute into the city daily via the central station, relying on buses to reach the campus.

However, the last leg of this journey, between the station and the campus, has become increasingly frustrating. Most classes begin at 9 in the morning, causing a surge of students to arrive at the central station and attempt to catch the bus to campus simultaneously, typically between 8:15 and 8:45. This has led to overcrowding at the buses, longer waiting times at the central station, and buses being unable to pick up additional passengers along the route due to being at full capacity. Additionally, buses are often stuck in traffic during rush hour, further extending the commute time. The same problem is encountered by travelers in the evening, but in the opposite direction.

In response to these challenges, the city has implemented three temporary micro-mobility hubs at the central station and three at the campus. These hubs offer shared e-scooters, e-bikes, and e-mopeds. Analog pillars and signage have been installed at the hubs to enhance the visibility of this alternative to taking the bus. The city aims to assess the impact of this temporary measure, with the possibility of making these hubs permanent if successful. What specific data do you need to evaluate the success of these temporary mobility hubs?

Data Requirements

Make a list of all the essential data elements required to address the issue in your case study.

Once you've compiled your initial "longlist" of data elements, take a moment to select the data that should be included in your final selection of the top five essential data requirements. Mark these crucial data elements with an "X" to signify their importance.

Data requirements	Top 5
