Stockholms stad

Data driven regulation of Micromobility

A demonstration project with e-scooter providers in the City of Stockholm

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February 2022

Issued by: City of Stockholm

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Summary

The city of Stockholm has carried out a one year learning and demo project about data-sharing between the city administration and micro mobility providers active in Stockholm. The data-sharing uses the MDS format and the data-sharing and analyzing are mediated through the third party platform Cityscope, provided by the French company Vianova.

Six providers of e-scoooters participated in the demo project and two of the operators also added info about shared e-bikes as they introduced limited e-bike-fleets in Stockholm during the project period.

Through the project much data about the use of e-scooters was gathered. Detailed analyses were made possible via several tailored dashboards and tailor-made reports in Cityscope. Download options for sets of aggregated data also makes further analysis possible. During the demo project analysis was mainly done in Cityscope.

The city of Stockholm used the demo-project and the data sharing via Cityscope to:

- analyze e-scooter use.
- publish and share info about restrictions and recommendations (no-parking zones, speed limit zones and recommended parking spots) - primarily with the e scooter providers.
- follow how well different providers complied with the voluntary agreements between the city and the providers.
- study the effects of the restrictions and of new regulations like adding new no-parking-zones.
- compare performance KPIs with other cities and between operators, as well as to correlate complain levels at different fleet sizes.
- learn and gain experience about how to create and communicate geofences for zones with different restrictions as well as about how this can be distributed via policy APIs.
- learn about the opportunities with the MDS format and the potential to get providers to use the policy API and apply potentially variable geofences in their own systems.
- publicly publish some statistics about e-scooter fleet publicly.

Among the challenges during the demo-project was the low accuracy in the shared vehicle positions. The low accuracy makes it hard to:

- apply regulations in narrow zones.

- for the operator to technically regulate speed in zones close to areas where traveling at a low speed, or technical speed reductions, would be dangerous.
- use the data about parking violations (parking in no-parking zones) as the sole record to enforce financial penalties on the operator, as an error-margin must be adapted at the outskirts of the no parking zone.

Another challenge was incorrect status formats or not using correct vehicle statuses by some e-scooter providers.

The fact that communication of geofences in an automated and digital way is not an established procedure in Stockholm and that the available street database does not support such operations made the demo project both a challenge and a learning opportunity.

Work-arounds found in the project and long-term solutions are suggested and discussed in this report.

Data-sharing via a third party aggregator turned out to be a valuable tool to follow e-scooter operator's compliance to the voluntary agreement. The gained insights resulted in a new form of permits for renting e-scooters in Stockholm.

During 2022 the new permits will be introduced in Stockholm including a cap on fleet size for each provider and a fee that is based on fleet size. Data-sharing as in the demo-project will be one requirement to get a permit. The data-sharing is also necessary for basing the fee on fleet size.

Data-sharing via Cityscope will be continued as part of normal operations in City of Stockholm during 2022.

During 2022 the work to establish a flow between city own systems for traffic regulations and street data and the third party solution Cityscope will be continued with the aim to store the zones and policies in city own systems. A more automated ingestion of statistics about e-scooter use via API will be developed with the aim to publish more e-scooter statistics and trends for the public.

[Text]

Innehållsförteckning

1 Introduction

This report is the result of a demonstration project, exploring the role of data sharing in management of electric shared micro-mobility operators in Stockholm.

This demonstration was constructed as a learning project. The city provides geo-spatial rules and regulations (in this report sometimes called “policies”) to the operators, in order to indicate the appropriate parking and riding locations which operators should communicate to their users. The companies share data about the location and movement of devices, both for the purpose of monitoring compliance and for giving the city an insight into usage behaviour. This exchange is done via the third party platform Cityscope, provided by the French company Vianova.

The demonstration project has four main parts:

1. Collection of city needs for mobility monitoring, strategy and policy enforcement
2. Development and testing of the MDS Provider API to share historical data
3. Development and experimentation of data fetching & processing infrastructure, to provide mobility insights through a web dashboard or API
4. Digitalisation of traffic regulation communication and experimentation of geo-fencing.

Official partners in the project are City of Stockholm (Traffic administration and Environmental and Health Administration) Voi (Swedish based e-scooter provider) and Vianova (French third party platform provider). Stockholm has encouraged all micro-mobility operators active in the city to provide data via MDS and to test to implement the intended Policy API. Additional operators Bolt, Tier, Lime, Bird, and Superpedestrian have shared data for all, or part of, the project period.

The Demo project is financed by Swedish Vinnova and French BPI. The demo project was connected to the Swedish Strategic innovation programme Drive Sweden.

This report is written jointly by the City of Stockholm (Helene Carlsson and Johan Sundman) Vianova (Alexander Pazuchanics and Linus Eriksson).

2 Background

2.1 Arrival of e-scooters to Stockholm

The first e-scooter provider to launch in Stockholm was Voi in August 2018. They were soon followed by several others, and by summer 2019 Stockholm counted 11 different providers, ranging in fleet size from a few dozen to several thousand devices.

Stockholm City administration was taken by surprise by the massive “invasion” just as the rest of Europe. The City of Stockholm soon realized that the legal underpinning to handle the-scooters was very different in different countries. While some countries already had legislation in place to regulate the providers and the users, other countries such as Spain and France quickly introduced new regulations. On the other hand, Germany introduced regulations to legalize e-scooters thus paving the way for further use. In Sweden the existing regulatory environment made it tricky to regulate e-scooters in a way unique from the regulation of bicycles.

Over the years additional providers entered the market in Stockholm, some providers left Stockholm and some companies merged. Two companies also added electric bicycles in their fleet in Stockholm. As of 2021 there are 7 providers of e-scooters that officially cooperate with the City of Stockholm. In addition there are some companies that have newly launched e-scooters in Stockholm with no cooperation at all with the city. During peak season in 2021 (September) there were more than 23 000 e-scooters in Stockholm.

2.2 Shift from overnight collection to battery swap on street effects daily redistribution

While all companies in 2019 and beginning of 2020 collected their e-scooters for overnight charging, using their own staff or employing freelancing gig-workers, almost all providers now utilize on street battery swap using batteries which can be exchanged without taking the devices back to the warehouse. This practice is a result of also changing to heavier and more robust and durable vehicles which can remain outside for longer periods of time. These new operation practices have fundamentally restructured the device redistribution practices. In the early stages e-scooters was reorganized every morning when parked on the streets again in neat groups after charging over night. Parking is now more or less taken care of solely by the users. The companies only redistribute the e-scooters when they are clustering in certain areas with no scooters in other. The service teams of the providers are now primarily focused on swapping batteries and re-parking badly parked e-

scooters in a less hindering position. The shift from overnight collection to on street battery swap also means that there are many more e-scooters available for rides also in the late evenings, i.e. in periods where misuse and intoxicated riding are more likely to occur.

2.3 Price competition and subscription models

A Perfect Substitute Goods are those goods that can satisfy the same necessity in exactly the same way. A substitute good can be used in place of another. If the consumer can choose between buying one substitute good or another, she will buy the cheaper one or the one with the best marketing and advertising. Examples of perfect substitute goods are petrol, grain or vodka. E-scooters can be seen as something like a perfect goods where all the companies have similar products with almost exactly the same features and the only thing the companies compete with is presence on the market and price. The primary way to compete has therefore been the presence on the market in number of e-scooters in the streets.

It seems that the companies have tried to avoid starting a price war. But during the years in Stockholm different operators have explored different price models. Competition is intense and have periodically played out in the form of different subsidies, incentives, and pricing structures. In winter 2020-2021 Voi first introduced a monthly e-scooter ticket in Stockholm and several providers have tried to offer both day passes and monthly tickets. These tickets typically waive the unlocking fee and providing a bank of trips at a reduced rate or no cost. High volume subscriptions, allowing up to nine trips/day is in November 2021 approximately 60 percent of a full price monthly ticket for public transport. This pricing makes them a competitive price alternative for those who only use public transport for shorter trips within the operational area of the-scooters.

2.4 Possibilities to regulate e-scooters in Swedish law

In Sweden it is Transportstyrelsen (The Swedish Transport Agency) that defines different types of vehicles. Transportstyrelsen has decided that e-scooters should be regulated as bikes. From the city's point of view this has been a problem, since all regulations regarding e-scooters will also affect private owned bikes. All no parking zones has therefore been implemented on a voluntary basis with the companies and been regulated within Cityscope. Privately owned e-scooters and e-scooter companies that don't cooperate with the city has not been affected by these regulations.

When an e-scooter are in use, it's only the police that are allowed to stop the vehicle or give the driver a fine. The city has no authority over moving vehicles. So in the same way as with no parking zones,

the slow speed zones that have been implemented in Cityscope are only voluntary and only affect e-scooters that are in this project.

At the moment, the city is starting to regulate the renting of the e-scooters. After a decision in the city council it's been made mandatory to have a permit from the city to have a business renting e-scooters in Stockholm. The traffic board has also put a limit on the number of scooters to 12 000. This regulation will start in February 2022. When the companies puts new scooters in the streets or regulate the ones already there, they are obliged to use certain so called hot spots to park the e-scooters but the users can park them wherever they like as long as they follow traffic- and parking regulations. The regulation has been taken to court but with no verdict yet.

3 Databased insights about e-scooters use

In this chapter some insights about e-scooter use based in Cityscope processing of vehicle data is presented.

Uneven distribution – focus on central areas

The availability of e-scooters is a phenomenon primarily in the inner city as well as for some spots and junctions in and to the nearby suburbs. After the plans for cap for fleet size was presented in December 2021 the concentration to the very central parts is even more exaggerated.

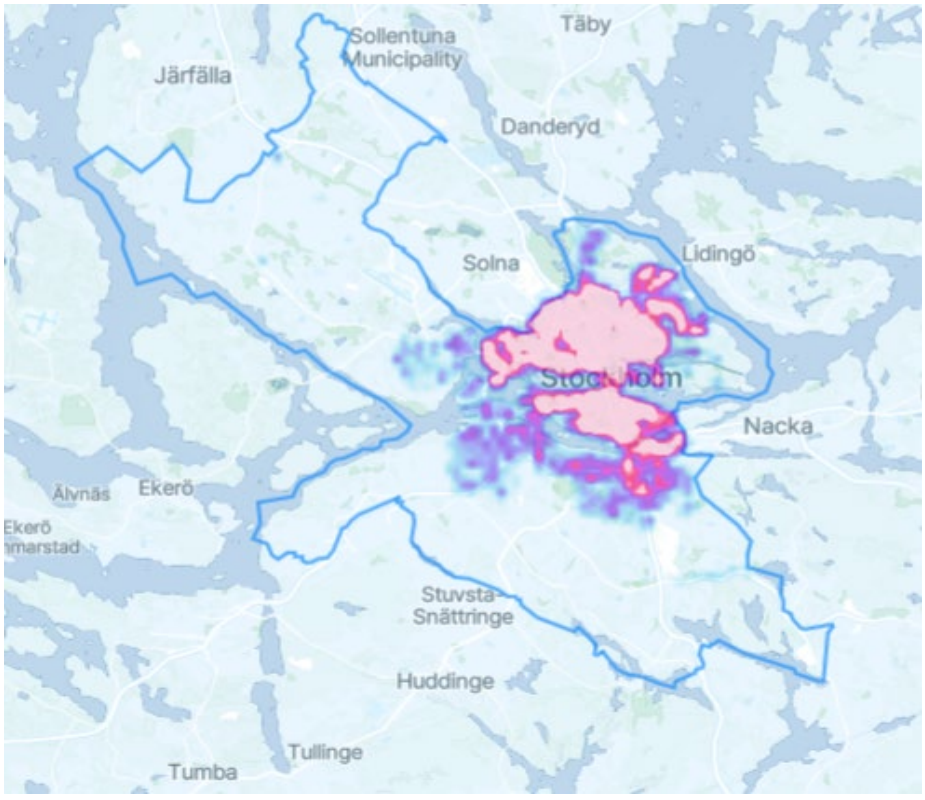

Fig 1

The map in Fig 1 shows the e-scooter geographical distribution (density) November 2021. The central parts are densely covered and some coverage are also seen in the near suburbs and along important public transport lines and junctions. In the peripheral areas there are no e-scooters.

Strong variation in fleet size and no of trips

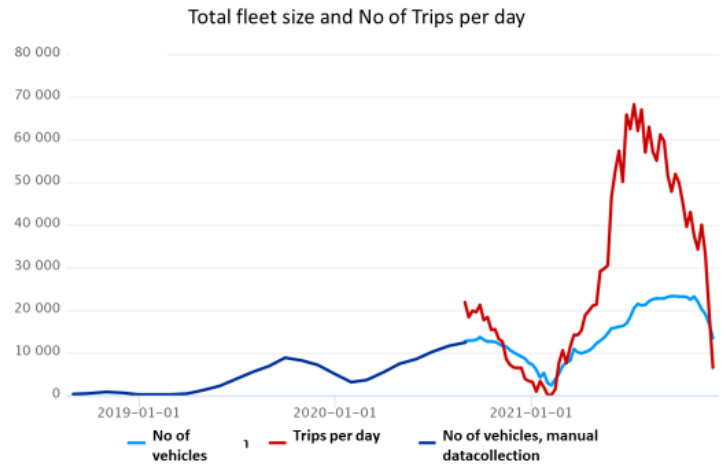

Fig 2

Fig 2 Shows that the number of e-scooters on city ground, the fleet size, is gradually increasing. It also vary over time with the smallest fleet in mid-winter and all time high in August - September. The number of trips follows approximately the same pattern although the vehicle rotation (no of trips/scooter and day in average) has increased somewhat over time. (graph from miljobarometern.se.)

Fig 3

Fig 3 *shows a screenshot from Cityscope showing variations in number of daily trips for the period December 2020 to November 2021. The graph shows that the number of trips has increased substantially last year and until beginning of December still stayed rather high.*

Distance and duration more constant during the year

Fig 4

Fig 4*Screenshot from Cityscope showing variations in trips lenghts for the period December 2020 to November 2021. The average trip lenght however do not show that strong variation over the year as do vehicle rotation, no of trips and fleet size, only in mid-winter are trip distance substantially shorter. The rest of the year the average distance stays at something around 1,7 km.*

Fig 5

Fig 5 *Screenshot from Cityscope showing variations in trip duration for the period December 2020 to November 2021. Average duration of trips follow the same pattern over the year as average distance of trips.*

Time in use is low

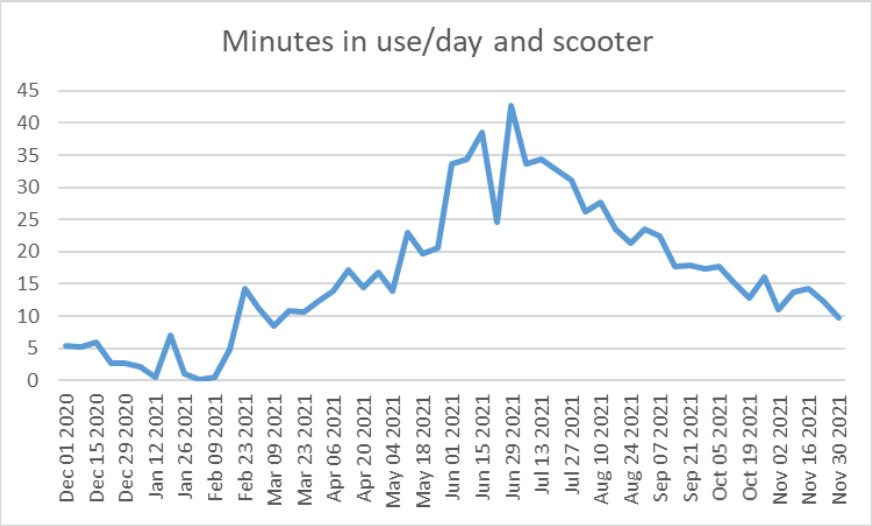

Fig 6

Fig 6 *Graph showing the variation in average time the e-scooters are in actual use/day. For the period December 2020 - November 2021 the mean time in use/day was 16 minutes. The highest use time per scooter and day is seen in the summer months and the lowest in January, most likely during periods of cold weather and snow.*

To improve vehicle rotation is central

Fig 7

Fig 7 *Screenshot from Cityscope showing variations in vehicle rotation for the period December 2020 to November 2021. Vehicle rotation shows how many times an e-scooter was hired/day. This is an important KPI to follow to measure how efficient the e-scooters are used. The graph shows that vehicle rotation is much higher in summertime, although the fleet size is also substantially larger at the same time. This fact indicates a much stronger demand for e-scooter trips in warmer months, consistent with walking and cycling*

patterns and also reflected in the much longer time in use/scooter/day

Screenshot from Cityscope showing variations in fleet availability, the average share of all devices which were available for rental compared to all devices on-street for the period December 2020 to November 2021. The average for the whole period was 88 percent. This also shows that 12 percent of the e-scooters on the streets were unavailable - either in use or out of order/out of power. The actual use time indicates that in use is the smaller portion of the unavailable time.

Cityscope indicates sub districts with high (and low) vehicle rotation

Finding space for e scooters in the city is a challenge. When organizing parking locations it is relevant to search for areas with high vehicle rotation. In areas with many scooters but low vehicle rotation it is more interesting to try to reduce the no of parked scooters. In table 1 the subdistricts with the highest average rotation are listed.

Subdistrict	Rotation
Stureplan Ö	3.77
Hötorgscity	3.62
Hötorget	3.43
Klara Kyrka	3.43
Östra Åsö	3.36
Östermalmstorg	3.33
Tandläkarhögskolan	3.29
S:t Eriksplan	3.25
Stureplan V	3.23

Subdistrict	Rotation
Elverket	3.23
S:t Eriksgatan	3.23
Kungsbroplan	3.21
Skvalberget	3.18
Mosebacke	3.12
Gustav Vasa Kyrka	3.09
Åsötorget	3.08
Norra Real	3.05
Centralposten	3.05
Betlehemskyrkan	3.02

Table 1

Subdistricts with the highest average vehicle rotation are listed in Table 1. *A relatively high vehicle rotation indicates that demand for e-scooters are high and also more efficiently met than in districts with lower vehicle rotation.*

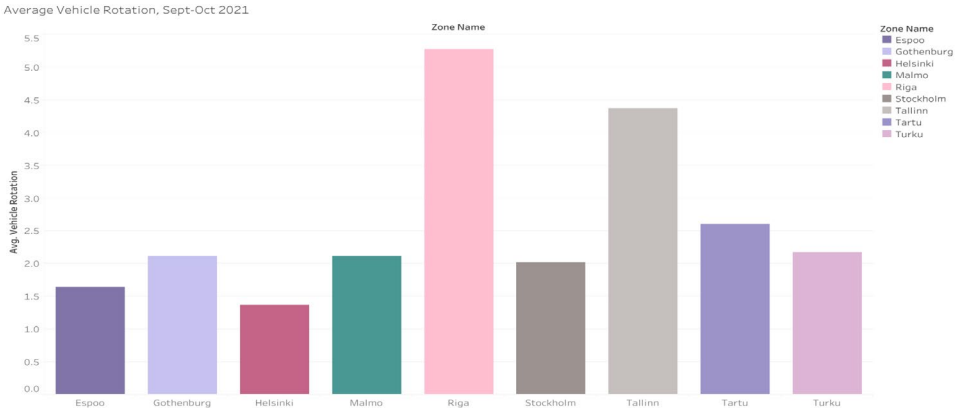

Fig 8

Fig 8 *Graph provided by Vianova comparing vehicle rotation in various Cities using Cityscope. The graph shows that the average vehicle rotation is almost twice as high in Riga and Tallin as compared to seven Swedish and Finnish cities, with an average vehicle rotation between approximately 1,5 and 2,6.*

Stockholm has a larger combined fleet of e-scooters compared to other cities with similar climate using Cityscope. The average number of trips are also higher in Stockholm compared to other cities. But the vehicle rotation is much lower than in Riga and Tallin. Stockholm is larger than the other cities but still have more e-scooters even if you adjust for size. People living in Stockholm are early adopters of new technology and almost everyone has access to a smart phone and are used to download apps. The use of different forms of bank cards are also high and the use of cash are much lower than in cities outside of Sweden. All these facts should rather support a higher vehicle rotation in Stockholm. The actual figures support the hypothesis that the number of e-scooters in Stockholm are far too high above the optimum in relation to demand and that a cap on fleet size can contribute to more efficient use.

4. Testing Cityscope in Stockholm

4.1 Incentives and regulations tested in Stockholm

In this section incentives and regulations tested in Stockholm both before and during the demo project are described.

Voluntary agreement

As mentioned before, the national law forces a uniform regulatory system of city streets that treat bicycles and e-scooters equivalently. This made it complicated to regulate e-scooters without also applying the same rules for bikes. Thus a voluntary agreement was negotiated and signed between the vice mayor for the City of Stockholm and the operators. The voluntary agreement was launched and signed by the first operators on 19 April, 2019 and has been signed by all present operators except one.

When signing the agreement the providers promised to

- educate both staff and customers about safe use and traffic regulations, speed limits and no go and no parking zones
- take responsibility for “littering” devices – violating regulations or being a hindrance for traffic or people, with special respect for disabled and blind
- inform their customers that e-scooters in pedestrian areas and sidewalks must not drive faster than 6 km/h, and if possible technically reduce the possible speed within given areas
- provide and communicate a Swedish contact point

The city on the other hand committed to

- provide dedicated spots for parking (devices are not required to park in these spots, but they are meant to better concentrate devices)

Collecting hindering e-scooters + collection fee

In the voluntary agreement e-scooter operators are committed to move e-scooters hindering or constituting a traffic jeopardy by improper parking within two hours after notification. However, the City determined that compliance was insufficient, and pursued additional steps. Thus the traffic department began to remove badly parked e-scooters in the fall 2019. The work relied on the law *1982:129 om flytt av fordon i vissa fall* allowing for the removal of improperly parked devices. It turned out to be both too expensive and too complicated to continue. The action required a truck with a driver, a civil servant employed by the city to issue the formal decision and a parking surveillance officer to issue the parking penalty. The operator was charged a penalty of 500 SEK for each collected device when the operators collected them at the city's vehicle depot. The typical daily result was approx 20 - 30 collected bikes.

The trial was conducted without additional data (before the demonstration -project with Vianova) and the collection was made more or less based on what the team in the lorry experienced on the streets. Occasionally, the action was a result of complaints about a specific e-scooter reported as hindering to the traffic department but it was soon clear that by the time the complaint had gone from the complaints desk to the lorry, the hindering e-scooter most often had already been moved. It was more efficient that the personnel in the lorry made de decisions where to go on their own The issued penalties did not by far cover the cost of the collection. Thus the collection ended after a trial of a few months.

Reporting e-scooters as hindering

The City of Stockholm has an app, "tyck till", where the public can report problems and make suggestions about the condition of streets and the environment in Stockholm. In 2020, a feature to add complaints about e-scooter parking and riding was added. In parallel, a private initiative, the app "felsparkerad", was created to allow the public to report poorly parked e-scooters, a service which gathered significant publicity. Initially also this app forwarded the complaints to city traffic administration. Now, the complaints from both apps are instead directly forwarded to the operator. The log about complaints to "tyck till" shows that the number of complaints rose to a much higher level when the number of e-scooters exceeded 20 000. There were a lot of complaints before that level but with 20 000 e-scooters it was very clear that the citizens was

tired of e-scooters standing all around. When the number of e-scooters dropped due to winter the number of complaints dropped more, suggesting that people are getting used to having e-scooters and see a drop in the number as an improvement The number of complaints correlates to the amount of scooters each company has in the street with two exceptions; both Voi and Bolt has fewer complaints than should be their share. Most of the reported problems are sent directly from the traffic departement to the company in question as long as it is possible to identify the company owning the e-scooter reported.

Moving e-scooters by parking surveillance + moving fee

In spring 2021 the traffic department started to use parking surveillance teams, patrolling the streets to supervise compliance to parking rules and paying parking fees for cars, to also rearrange badly parked e-scooters. Parking surveillance staff was given the task to repark the worst parked e-scooters in a less disturbing manner nearby to ensure better use of space for parking and for traffic flow on street, bike lanes and pedestrian areas. E-scooters are usually only moved 1-10 m by parking surveillance. The actual operator is billed a fee of 250 SEK for this “shortmove” This operation is now included among the daily tasks for the parking surveillance. The short move is in accordance with the same law as the previous long move.

To help the parking surveillance to work in a more targeted way, a report, listing the locations of large amounts of e-scooters is generated by Cityscope and forwarded to the parking surveillance team. Since it requires additional training to be allowed to move cars and scooters according to the law, not all parking attendants can do this, Some of them move e-scooters without issuing a ticket, as a service. Between 200-400 e-scooters are moved and fined every month during the season in Stockholm. It varies a bit in different areas of the city. There are no data showing why it varies, but a suggestion could be focus of the supervisors in different parking districts and individual preferences from the parking surveillance person.

Parking hotspot - tests in 2019 and 2020:

During 2019 and 2020 three different types of organized e-scooter parking - “hotspots“ were tested:

- racks with and without charging cables (5 racks)
- foliated spots (50 spots)
- “virtual” hotspots (500 spots) - only visible in provider apps, with no on-street markings

The trial was conducted together with all providers present in Stockholm. The evaluation was based on interviews with the providers and data from the companies. The results were not encouraging, with fewer than 5 percent of all trips ending in any of the hotspots. The majority of “these less than 5 percent” ended in a virtual hotspot. The racks proved to be too small and too rare, so those that were available were constantly full of devices. The foliated hotspots were according to interviews with users on the street, hard to see from a distance. Even if you know when you started your trip that there was a hotspot located at the destination it was hard finding it when yoou ended your trip. Charging racks were rarely used for charging, as they required users attaching the device cables manualy. The conclusion of the test was that there need to be some signs visible on a distance on all hotspots, that there needed to be a much larger amount of hotspots – probably around 1 000 in the inner city – and that neither companies nor users were intested in charging capabilites.

Two of the providers (Voi and Tier) gave an incentive to users ending their trips in a hot spot, with minor positive effects. The incentive of only 5 SEK may not have been a sufficient financial incentive to reposition devices.

Speed limitation zones

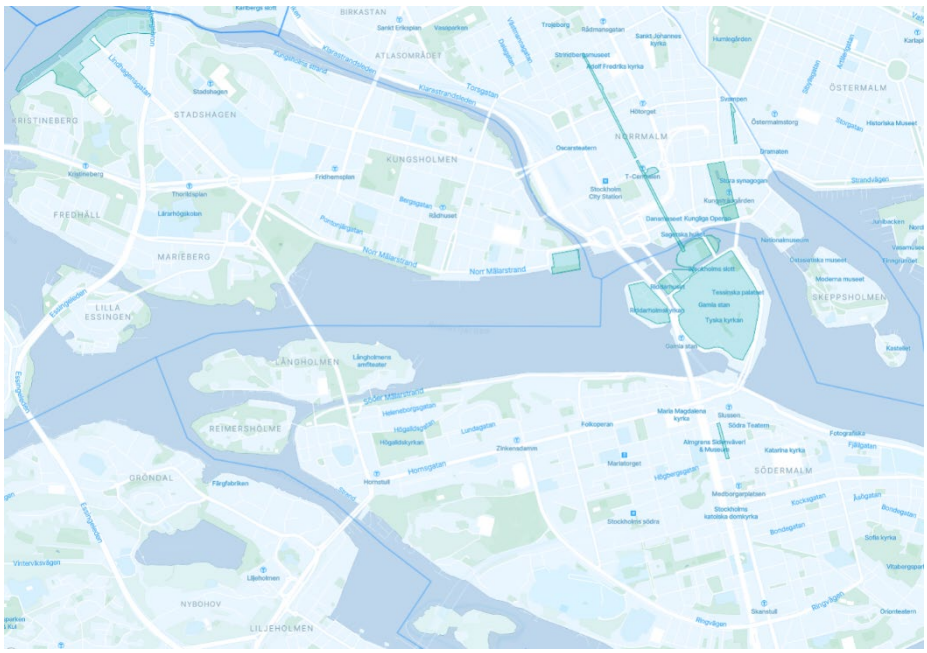

Fig 9

Fig 9 *Screen shot from Cityscope showing the zones with speed limits for e-scooters communicated via Cityscope and provided via the policy API. The zones are: Drottninggatan - the first speed reduced zone, Oldtown (except the shores), Riddarholmen (except the shore), Helgeandsholmen; Cityhall and its patio and*

park.Götgatsbacken, Sergels Torg, Kungsträdgården and Hornsbergsstrand.

No parking zones

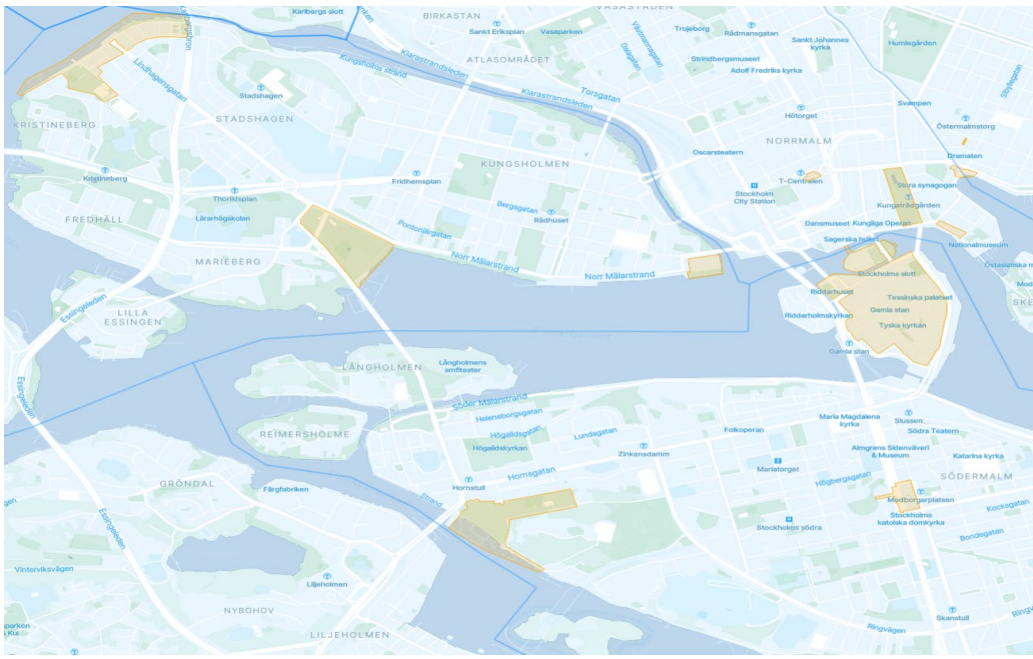

Fig 10

Fig 11 *Screen shot from Cityscope illustrating no parking zones communicated via Cityscope and in policy API. The areas in Cityscope was: Touristic spots: Oldtown and Helgeandsholmen. City Hall. Important public transit connections: Odenplan, T-centralen, Quay at Blasieholmen, at Berzelii park. Leisure areas and squares: Kungsträdgården, Hornsbergsstrand, Rålambshovsparken, parts of Tanto and Medborgarplatsen*

Parking racks for all 2021- in cooperation with two operators

Several of the e-scooter providers in 2020 and early 2021 approached the city with suggestions to provide parking racks for their own e-scooters on public ground. The solution developed in cooperation between the city and some of the big providers was racks that are company neutral allowing all e-scooters to be parked in them. The racks are provided and financed by two of the e-scooter operators and placed on the streets in Stockholm with permission from Stockholm Traffic Administration. The city decides about the exact spots to place them. Each single sided rack had place for 5e-scooters and each double sided rack had place for 10 e-scooters. Racks could be connected to larger units. Racks sufficient to store in total approx 800 e-scooters were placed at 75 spots in the inner city by the end of the summer 2021.

All of the racks are imported to Cityscope. We can see that in the period from 1 july to 30 november, approximately 300 e-scooters

has been parked within 20 meters from the racks each day. If we look at the month with most e-scooters in the streets, September, the number rises to 325 as an average per day. Those numbers should be compared to the numbers of scooters that during this period varied between 21 000 and 23 000. We can make the same conlusion this time; to be meaningful, there need to be plenty of racks and the location is extremely important. We can se that one rack is full almost all the time, while a rack just 50 meters away are almost never used. The racks need to be easy to move to anothter location, Cityscope has been very useful to use when evaluating the racks and their location. Before the coming season, there will be a discussion with the companies that own the racks about relocating them.

To come in 2022: permits + fee with conditions + cap on No of e-scooters/company

The number of preferred operators and the allowed fleet size will be limited from 2022 after using Cityscope to analyze data of e-scooter use and presence in the city carefully.

Three to five companies was seen as enough to ensure competition under market conditions but during 2022 all existing operators will be welcome under a cap of max 12 000 e-scooters in total. With 8 applications – to be allowed to operate in the city next year the companies need to have a police permit – that will give each company 1 200 e-scooters. For the largest 3 companies this means a reduction of their fleet from todays 4 000 – 6 500. For the 4 mid size companies it is about the same amount of scooters as they had last season. The smallest companies and the new company will have an increase in the number.

The maximum number of e-scooters was set to increase the vehicle rotation and the usage of each e-scooter still allowing a very high accessibility to e-scooters in all relevant areas.

Companies will be selected based on performance criterias where 6 out of 7 comes from Cityscope

1. Vehicle rotation (the total number of trips per day divided by the total average fleet size per day)
2. Market share measured as share of total trips made in Stockholm
3. Share of operational scooters for each company
4. No of e-scooters that are out of order (unavailable) more than 24 h
5. Implementation of means that makes it impossible to park the e-scooter in no parking zones
6. Not to park longer than 24 h in the same spot

7. Volume of short move penalties issued to the company

The performance of the different companies will be measured using data taken from Cityscope for the first half of 2022 and companies that does not fulfill the citys requirements will be excluded during the second half of 2022. During 2022 the possibility to do a procurement of e-scooters will be investigated with the goal to publish a request for tenders during the second half of 2022.

4.2 Collection of needs for mobility monitoring, strategy and enforcement

At an early stage in the project a workshop was held to define and prioritize use-cases for the demoproject based on the needs in City of Stockholm. The workshop resulted in prioritized use cases. Below the full list, the priority that was given to them and the status in november 2021.

High priority

- Access daily, weekly, or monthly reporting of main KPIs to communicate within the city & politics - Done
- Monitor modal shift (e.g. what trips are being replaced) - Not possible within Cityscope
- Assess multimodality, interconnections between micro-mobility & public transit – only partly possible
- Visualise most used corridors and plan cycling lanes - Only partly possible because no exact trip data is shared but a workaraound was developed. The workaround visualizes relative e-scooter traffic density based on the assumption that parked scooters are a good enough indicator for traffic density.
- Create or expand parking infrastructure (mobility hubs), monitor usage & compliance - Done
- Analyse street usage, cluttered sidewalks, set no-parking zones - Done
- Set slow speed areas on pedestrianised zones - Done
- Evaluate operators performance and compliance to regulations - Done

Medium priority

- Identify general mobility needs – Not done, partly due to the fact the visualisation of important origin-destination combinations need to be improved to make the analysis easier.
- Understand how these services are being used - Done

- Asses road safety – Not done because Cityscope is not the right tool for this
- Monitor fleet distribution, assess equity and possibly set minimum distribution requirements - Done
- Get alerts for vehicle in violations and prioritize police enforcement - Done
- Manage events, communicate temporary regulations (no-parking, no-riding) & monitor compliance – No tests with short term temporary regulations was done
- Provide data-feed for open-data or services availability to the wider public- Not done to the wider public but some data are utilized to publish trends on miljobarometern.se

Low priority

- Understand who is using these services – Not done because cityscope is not the right tool, other projects will investigate this (this is also the reason for the low priority)
- Monitor fleet size limits to respect tender caps – Done even though Stockholm don't had caps during the project
- Impound or fine bikes or e-scooters incorrectly parked – Not done based on shared data. Cityscope was however used to highlight problematic areas for parking surveillance and operators.
- Collect damaged vehicles and improve services availability – Not done within the demo project
- Set & develop fees or subsidies program on the city territory or per district – No fees was set but Cityscope insights was used to elaborate the size of a cap for total number of scooters on city level.

4.3 Data-sharing Architecture and Implementation

Introduction to the Mobility Data Specification

The Mobility Data Specification (MDS) is an open standard originating with a collection of American cities in 2018 and now under the management of a non-profit: the Open Mobility Foundation. MDS data standard is meant to be bi-directional, allowing the city and the operator to communicate with one another about device statuses and events.

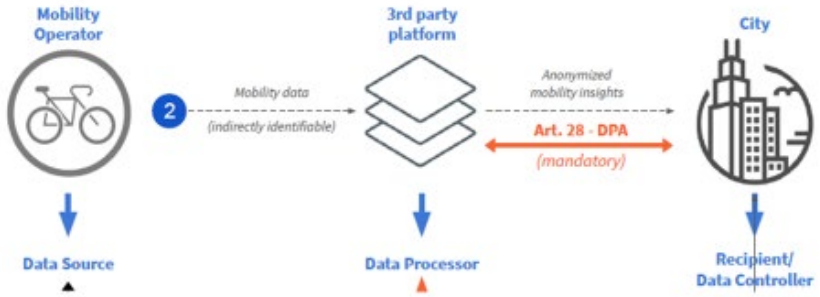

Fig 11

Fig *11 Data is shared from the different e-scooter companies (mobility providers) to Vianovas platform Cityscope and then made accessible to the city.*

Another prominent data standard in the shared mobility space is the General Bikeshare Feed Specification (GBFS). GBFS, which is also an open standard, shares information about the availability and location of devices, but does not include the same information about device statuses and events.

Actual use of Cityscope to set up regulated zones in Stockholm 2020-2021

During the trial traffic department staff experimented with setting up zones and applying different regulations in City Scope.

The regulations that was used was

- Low Speed Zone - in these zones speed must be restricted to 6km/h, governed by the positioning of the device. These areas are centered in areas of high pedestrian activity.
- No parking zone - here no e-scooters are allowed to park - only a few no parking zones were applied - some popular parks and leisure areas, and some of the most frequented pedestrian areas.

Two regulations was applied all over the city:

- That no device was permitted to remain “unavailable” for longer than 24 hours (a “max unavailable” policy).
- That no device was permitted to remain parked in a single location for longer than 72 hours (a “max parked” policy)

The zones was added to Cityscope using various methods

- drawing the borders manually in the Cityscope dashboard. The first low speed zones and some trials with no parking zones at central and clogged spots was drawn manually.
- importing GIS-coordinates of the parking rack locations - the parking rack locations were constructed as a circle consistent with the definition of the initial IPZ and imported from the operators who had initially proposed them.
- importing shoreline-protective zones. After not finding the time to do the time consuming adding of protective zones along the uneven shorelines these zones will be constructed using the shoreline-coordinates available in other maps in the city adding a buffer of 5 meters to the shore protection zone.

During this demo-project no zone coordinates were drawn outside Cityscope in any other system owned or utilized by the City. Neither were the rules imported to Cityscope in a format dowmloaded from a city owned system.

Actual use of the City regulation API by the operators

All operators received access to the Policy API in spring of 2021 though not every operator updates their policies based on the API. The reasons are several and vary by operator- in most cases, there is no direct technical connection between the systems in which the policies are created, and the way in which they are ultimately represented within the operator's app. In most cases, human intervention is still necessary, and depending on the operator this could happen at the local, regional, or even international level. Additionally, while the data was available through the API, the City was in parallel providing other streams of locations such as emails and static maps.

Over the course of the pilot, operators received access to their own version of the Cityscope dashboard, which will make the locations of new policies clearer to non-technical staff of the operators.

Integration with cityown systems – flow between the systems

As mentioned above no regulatory rules and zones were created and stored in any streetmap system owned and/or administered within the city administration. Neither were the rules and zones that the traffic department created in Cityscope imported to any city owned system as yet. The work to define how the flow of data describing the regulations shall go between city owned systems and Cityscope will be further elaborated, defined and established in 2022.

Data extracted for use as e-scooter trends to share with citizens and to ”society”

The City of Stockholm publishes trends and statistics about parameters relevant for sustainability at miljobarometern. Before this demo-project no trends about e-scooters in traffic was published. Data was collected manually once a month by traffic department but those figures were kept internal. In the beginning 2020 these monthly figures were made public on miljobarometern.

When the operators started to share data to Cityscope the city was given the opportunity to extract data on several parameters on high resolution and use them as indata to miljöbarometern. Still some hands-on work is necessary to translate between different export and import formats because a direct and automated import procedure to miljöbarometern is not in place. Nevertheless a more accurate input about e-scooters with a higher resolution is now made available to miljobarometern. No manual emails to and from individual providers is necessary. More trends regarding e-scooters are relevant to present on miljöbarometern in the future - e g trip lenght, and actual vehicle utilization. A less hands-on import feature will be tested in 2022.

5. Experiences relevant for policy and further development

5.1 The possibilities to use an already existing “standard” for data sharing

When Stockholm wanted to take action on the e-scooter situation there were two available standards for data sharing with e-scooters: MDS and GBFS. (See above).

MDS gave the city of Stockholm the opportunity, together with a third party platform and aggregator, to directly start to collect data and to try to distribute rules for the e-scooters in a format operators directly would be able to utilize in their own platforms.

MDS is initiated and gradually adopted by cities and operators to meet the increasing need to organize the micromobility situation in a smart and efficient way.

To develop a local and own format and system for receiving, sharing and analyzing e-scooter data would have been far too time consuming and also far beyond the municipal role, competence and mandate. Thus the fact that there was a standard protocol already in place gave the city of Stockholm a flying start.

MDS maturity among the e-scooter providers active in Stockholm

MDS provides a framework for how to share fleet operational data about shared vehicles. Some of the companies operating fleets in Stockholm in 2019 and 2020 had prior experience with MDS when Stockholm started this demo project, particularly those operators coming from the US. Other operators had to start from scratch. However, applying MDS also makes companies, formerly unfamiliar with MDS, more ready for an international market since the MDS standard is increasingly applied in many cities. The fact that MDS was already the most used standard most likely made the inexperienced operators more interested to adapt to it.

The standard sets out predefined parameters and terminology to use when operational data is shared (see above). However - if the companies don't stick to the defined formats and categories - or if the operation staff don't apply the categories correctly - the output - in english the analysed data - is also biased.

MDS standards are regularly updated and developed by open mobility foundation (more info here https://www.openmobilityfoundation.org/). This also introduces some challenges since all providers need to keep up with the updates.

Challenges with the MDS met during the demo in Stockholm

- Vehicle status mapping may be incorrect- for example vehicles taken into service would still show up as being in the public fleet. **Suggested workaround**: Manually identifying workshops and warehouses and remove e-scooters located in those spots from analytics
- Operator's internal systems do not always "map" to the correct statuses within MDS, leading data to be incorrectly reported. **Suggested workaround:** Regularly check for input to the Cityscope platform that doesn't comply with standard statuses and then inform both provider and city about non-compliance to standard formats, or abnormalities in the reported data.
- Some initial hesitation among both city administration and national authorities to work with a standard "not invented here". A national process to define digital protocols for e g street data is ongoing. But this process had no output to directly use to help organize the e-scooter situation 2020-2021. **Recommendations:** Use the opportunity to work with an already existing standard as a learning process. The skills gained among city employees during the test gives a lot of experience. Participation in a global data standard community increases the ability to adapt the city's own system to a more modern data sharing environment. It also gives a deeper understanding and personal experiences about new possibilities for traffic analyses in a world with connected vehicles. Also make sure to utilize the gained insights as input in a national standardization process

5.2 Experiences from communicating geofences for speed-limits, and other regulations through open APIs

The MDS protocol makes it possible to communicate a number of pre-set rule types - and to add city-parameters to these rule types. For exampel a rule can be "no parking" - and city parameters can be the area (eg zone borders) where no-parking applies and the timeframe where the no-parking policy applies to the individual area.

Use the demo-project to learn how to share policies in predefined dataformats and as open APIs

Challenges with the MDS Policy API met during the demo in Stockholm

- The city owned system to store and update street data is old and document based. A modernisation is ongoing but is partly slowed down while awaiting new national standards for digital street data to be predefined.

Recommendation: Use the Cityscope platform as the place to store and update zones and policies regarding e-scooters until city systems are developed to be able to fulfil the role as the primary source of the set of policies and zones applying for the e-scooters. Use MDS standard unless some other best practice comes up that is more relevant to the city to use.

- City is gradually shifting to presenting street data on maps and as open data, but still various street info is stored as pdfs or pictures of maps or as tables of street addresses.

  Recommendation: Work with standard GIS-formats to be able to import/export for exampel zone-borders, parking spots etc between Cityscope and different city owned systems and share via open APIs. When features are complex, rely on geodata experts to produce complex shapes (for example, boundaries around shorelines) to avoid manual work.

- No “automated” data interchange between city database for street data (LV database) and Cityscope is set up for the time being.

  Recommendation: Begin by working with manual imports and exports between Cityscope and city owned system and open data platform. After that, publish policies and zones as open data on the Stockholm open data portal so that they can be utilized directly by operators. Strive to make them available also to providers of other applications, e g trip planners, map resources and by developers of new guidance systems.

- Communication of geofences in an automated and digital way is not an established procedure in Stockholm. Existing geofence zones for non-shared mobility uses, e g LEV-zone, have been static over time. In addition, the vehicles in concern, i e heavy trucks banned in the LEV-zone, were neither connected nor hosting navigators developed to respond to geofence systems. Some individual auto manufacturers equipped their vehicle navigator systems in some vehicles with geofences based on pictures of maps illustrating the zones shared on city web or via mail in personal communication with city staff. As long as geofenced areas are static this is a possible workaround, If zones will be more dynamic, and even more if they may be temporary adjusted, due to events or road maintenance etcetera, or variable over time, this will most likely result in outdated info in the navigators in the vehicles with the current method of hands-on updates.

  Recommendations: Use the test-project and further work with Cityscope to gather insights and best practices for a more ambitious attempt to provide and update geofences for various protection purposes as open data. Feed national process to define

standards for road data and geofencing with relevant learnings. Stay updated and adjust to upcoming national and international standards and protocols when appropriate. Follow - and when appropriate contribute - to the development of MDS via OMF Continue to participate in exchanges on geofencing development (including the OMF).

5.3 Insights about the role of e-scooters in the traffic system

Covers a minor parts of all trips in Stockholm

The Cityscope platform enables a rich analysis of parking and riding behaviour of shared e-scooter and users (and a potential for the same analysing of shared bicycles). However, the devices make up a relatively small number of the total trips taken in the city, both because of the relatively small fleet size (compared to public transport capacity and private car and bike usage) and because of the relatively small service areas.

Less details about other traffic modes

For other traffic modes the data at hand and the type of analyses that can be made of travel patterns are far less detailed and less sophisticated. Because these vehicles are not connected, or the city does not have access to use data. Usage assessment instead needs to rely on visual traffic counts, data collection from sensors, etc. Thus it is hard to give a realistic picture of the share and role or importance of e-scooters in the total traffic system in Stockholm.

Some combination with bike data is possible

However, by using data from manual biannual counts of bicycle and e-scooter rides, the following can be concluded: Shared e-scooter have increased over time both in absolute figures and as a share of commute trips (trips happening during typical commute hours). This characteristic was probably exaggerated by the Pandemic, as riders turned away from public transport and travelled to different destinations outside of the office. E-scooter share of “total bicycle traffic” (bicycle and e-scooters) in the inner city is not neglectable. During the time we have had shared e-scooters in Stockholm both the traffic volume as such and the e-scooter share is increasing.

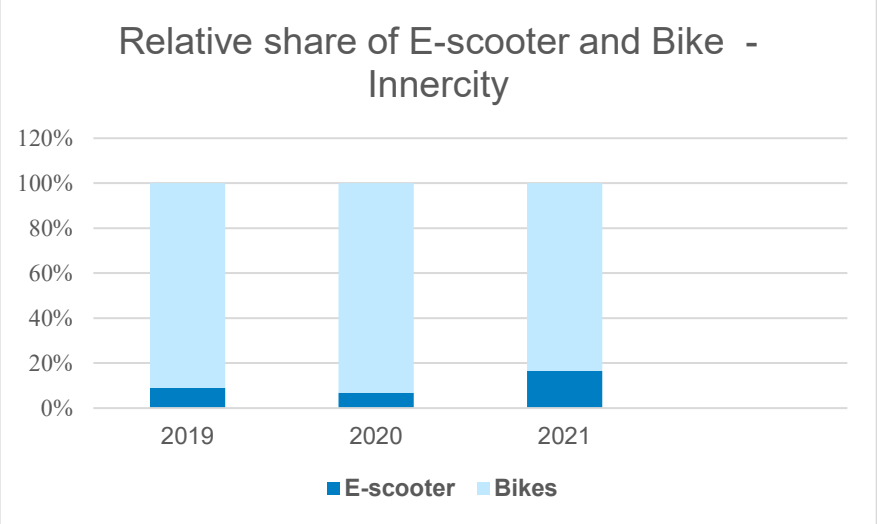

Fig 12

Fig 12 Diagram showing the distribution between e-scooters and bikes during the manual counting of bike traffic to the inner city. The e-scooter share is increasing and reached in 2021 every sixth "bike".

Probably more leasure and visitors trips than daily commuting

Another conclusion that can be made is that e-scooter use does not show a decrease in daily usage during July, the dominant holiday month in Sweden. This fact is in contrast to the July dips shown for both motor traffic and bicycling. This characteristic might be a signal that e-scooter use for commuting is less important than other modes, or that the possible loss of e-scooter commuters during holiday months are instead compensated for with pleasure rides of local stockholmers as well as visitors.

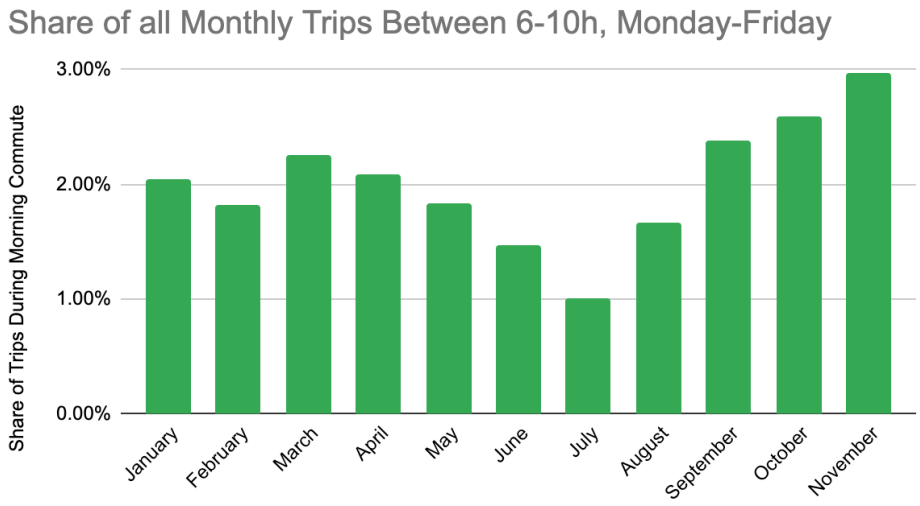

Fig 13

Fig 13*Share of E-scooter trips that take place in "morning commute- hours" is relatively low. But the dip in July might be interpreted as an indication that some limited use for commuting purposes exists.*

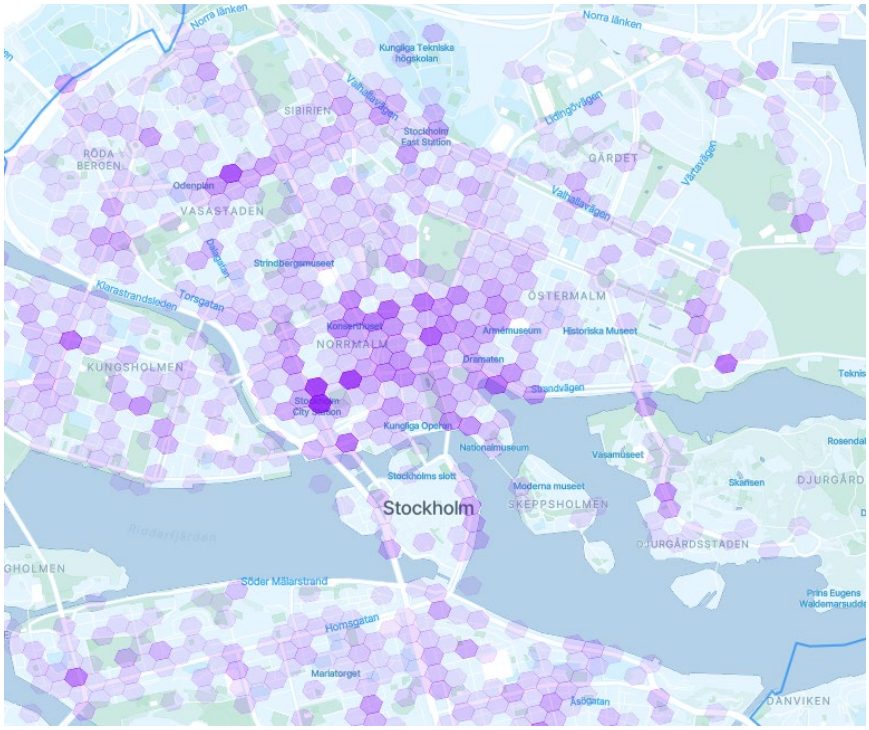

Fig 14

Fig 14 *During morning commute hours, trip endings show higher concentrations close to public transport junctions and in the very most central office districts than the same analysis covering trips for all week and all days (example July 2021).*

5.4 Support to take informed decisions

The city of Stockholm has been elaborating with different parking zones, with speed limitation areas, and no go areas.

Below are some use cases and the experiences gained during the demo project.

Speed reduction on Drottninggatan

Drottninggatan is a pedestrian area with intersections where e-scooters (and other vehicles) can arrive in “normal” speed

This was the first low speed zone applied in Stockholm. Operators gradually applied a technical regulation of e-scooter speed in the zone with speed limits on the device.

After a while the initial speed limit zone was split in several zones leaving enough space to cross the pedestrian street at normal speed, without speed reduction at the intersections. This was the result of some incidents when e-scooter riders crossed the pedestrian street in high speed and the vehicle abruptly corrected the speed

Speed reduction at Götgatspuckeln

Götgatspuckeln is a “reclaimed” street formerly for cars and bikes

on the street and pedestrians on the sidewalks. For several years it has been a mixed traffic area although with priority for pedestrians. It is also part of one of the most important bike-arterials in Stockholm and a street with a lot of morning-deliveries to shops, restaurants and bars along the “pedestrian” street. The street is also in direct connection to the public transport hub Slussen - one of the most intense PT-transport junctions in central Stockholm connecting two of three subway arterials and numerous buslines.

Götgatspuckeln now has several dedicated bike and e-scooter parking spots, cafes and restaurants growing out on the sidewalks in summertime and is usually crowded with pedestrians during business hours.

Speed limits were applied in this area rather early during this demo project. However it turned out that despite the low speed rule occasionally it was still possible to ride e-scooters on high speed in the zone due the GPS inaccuracy. As with any speed based geofence, it remains difficult to assess velocity using historical data points, but the policy is still communicated to all operators.

Workaround: The zone had to be drawn broader than the actual street to fully apply to the-scooters riding on the street. Here this was an acceptable solution due to the fact that the whole zone is lined by buildings and thus the broader area with limited speed is not a problem since it only expands to adjacent buildings not to e g a bike lane nearby.

Speed reduction at Sergels Torg

Sergels torg is a central square in Stockholm

As a response to a police request to the city, Sergels torg was made a speed limited zone. This is because police had an increasing problem with criminal actors escaping on e-scooters in that area.

Speed reduction and no parking at Hornsbergsstrand

Hornsbergsstrand is a newly refurbished district. It has a very popular seaside walk and open air bath and leasure spots attracting visitors from large parts of Stockholm, especially in summer. The area is not very accessible by car. For those arriving by public transport there is a short walk to reach the quais and the waterfront.

Thus e-scooters have become a very popular means to go there. This situation led to complaints from the inhabitants. Also aggressive and reckless driving to show off was an increasing problem on the seaside “catwalk”. The ultimate misuse was youngsters riding the-scooters on high speed over the quay jumping with the-scooter into the water, repeating this over and over with new-scooters. The-scooter jumping into the water was filmed and published on social media.

Upon request from both inhabitants and from the police both no parking zones and speed limit restrictions were applied in a zone covering the blocks closest to the waterfront. This reduced both the

misuse of driving the e-scooters into the water, and the aggressive driving. However the problem of the immense many parked e-scooters clogging the sidewalks was only partly solved and partly moved to just outside the zone border.

This taught the city that the heavy introduction of no parking zones is not the solution it will only move the problem to another spot, see the map below for a sample distribution of devices around the periphery of the no parking zone (and several no parking violations)

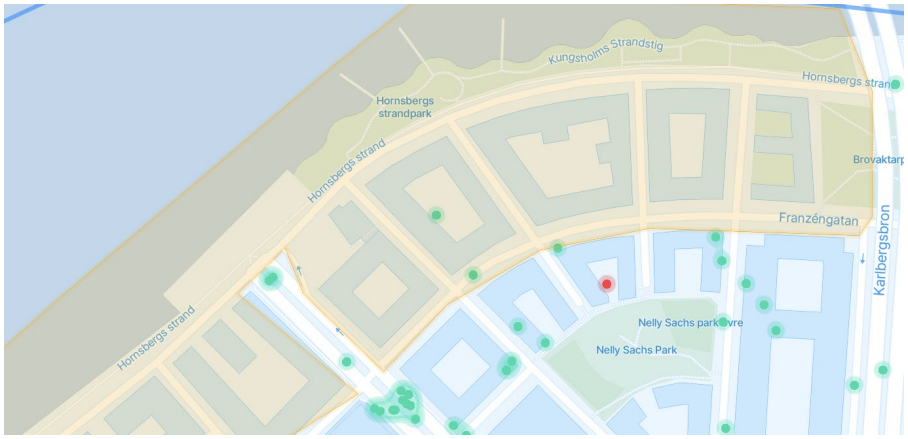

Fig 15

Fig 15 *The yellow area indicates the no parking zone at Hornsbergsstrand. The green dots just outside the zone shows that the no parking zone cleaned up the area in the zone but just moved the scooter parking just outside the border.*

To come in 2022 permits with conditions to fulfil + fee + cap on no of vehicles/company

The number of preferred operators and the allowed fleet size will be limited from 2022 after using Cityscope to analyse data of e-scooter use and presence in the city carefully.

5.5 Accuracy of GPS and experience from trying defencing on real cases

GPS signals from the vehicles tend to be rather inaccurate, a function of the use of the hardware on devices. Errors vary depending on the operator, typically approximately 5-10 meters but up to 20 meters depending on the hardware and the surrounding environment

The GPS inaccuracy is partly due to the physical surroundings - which are extra challenging on narrow streets with high buildings. “GPS wandering” can occur, with the signal bouncing between the walls of high buildings in narrow streets.

GPS positioning can also struggle to distinguish vertical levels which may cause errors in multilevel intersections; at/under bridges etc.

The vehicle position data provided to Cityscope is based solely on the GPS-logs of MDS, which themselves originate with the device. However it seems that operators also combine vehicle positions with phone-positions based on information collected through the operator's app while the vehicle is in use, since the trip is started and ended by using a phone-app. Phone-based positions are more accurate and allow for additional triangulation. Thus operators' systems likely have more accurate positions than they forward to Cityscape via MDS.

The high inaccuracy makes it hard to:

- apply regulations in very narrow zones
- Regulate a speed limit in close proximity to areas where traveling at a low speed would be dangerous.
- Use the data about parking violations (parking in no-parking zones) as the sole record to enforce financial penalties on the operator, as an error-margin must be adapted at the outskirts of the no parking zone.

Challenges with GPS and accuracy of the positioning system

"GPS wandering" because bouncing between the walls of high buildings in narrow streets **Applied solution**: applying speed limitation zone broader than the actual street i e so that it covers also the high buildings along the speed reduced street.

- Positions via MDS have lower accuracy than the positions in operators own system and apps **Possible solution:** work via OMF to develop requirements in MDS and thus push operators to improve their vehicle position outputs and improve device hardware
- Narrow regulation zones not possible, due to low accuracy. Example: Speed limits on a sidewalk directly adjacent to a bike lane partly applied also to the bike lane - this caused abrupt speed reduction for the e-scooters - also on the bike lane) **Intermediate solution** - do not apply speed reduction zones directly adjacent to bike lanes, streets or intersections of speed limited pedestrian areas. **Possible better long term-solution:** operators to improve their positioning systems and their vehicle position outputs so that regulations can be applied in narrow zones and in zones e g in close connection to bike lanes etc. Additionally explore other solutions to protect sidewalks etcetera (for example video analytics).
- Speed limits can be dangerous when speed reduced areas are crossed by streets/bike lanes. A pedestrian street was regulated to max 6km/h. E-scooter riders came in high speed to cross the pedestrian street. This caused an abrupt speed reduction and incidents. **Intermediate solution** - remove

speed restrictions around intersections in speed limitation zones. **Better long term solution**: work with operators to have them regulate speed smoother when entering a zone with speed limits in order to avoid a disruptive experience.

- Vehicle positioning inaccuracy limits the reliability of the violation logs as true enough to directly serve as the base for billing the operators for non-compliant parking. To bill for violating parking rules the parking surveillance still must be used. However lists of vehicles violating the rules can be extracted from the systems and used as a guidance for the parking surveillance where to find these vehicles. Theoretically an error-margin could be added sorting out vehicles closer than a certain distance from the zone border to make sure to not bill also vehicles outside the zone. **Suggested solution**: Use of the violation logs as a guidance to problematic areas the current parking violation report serves the parking surveillance well enough. It can also be used by the operators to observe places where the need for them to improve their own surveillance is high.

5.6 More ways city of Stockholm made use of e-scooter position data in Cityscope

To select preferred parking locations.

In summer 2021 the operators Voi and Tier launched an initiative to place parking racks on sidewalks and other public spaces in the inner city for parking-scooters of all brands. This was made in cooperation with the traffic department of the city of Stockholm. The locations for the-scooter racks were selected based on info from Cityscope. In many cases it was not possible, due to requirements on accessibility and the need of space for passing by, to place the racks exactly where e-scooters are often parked but in close vicinity.

Even though there are now some 75 places with e-scooter racks they are not seldom half empty while the-scooters are parked nearby but not in a rack.

5.7 Explore and get insights to how data sharing can be done in compliance to GDPR

One of the first issues that had to be solved was the question of data sharing and protecting third parties like the users or the companies. All data are cleaned before added to Cityscope and the e-scooters are given random names with each trip so it will be impossible to follow a single scooter over the day. No primary user data are included in the information sent from the companies to Cityscope but secondary data are still available. Even though only aggregated trips can be seen in Cityscope, you can still see the location of single scooters but this was by the data protection and data security officers officer to be of lesser significance to protect.

The major part of data protection has not been in regard to the customers but to the companies. A lot of company sensitive data are available. It is very easy to see how many scooters a company has, how many trips and between which locations. For a competitor this data would make it very easy to evaluate a company or move your own scooters to the companys primary locations. It was therefore deemed necessary to protect this information from persons and organisations outside of the project. This has been a great hindrance, since it made it impossible to share data with students or scientist for research among other outside of the project.

There is growing literature on the most appropriate ways to use mobility data while still protecting data. Vianova maintains a GDPR statement regarding its approach to data handling and the Open Mobility Foundation has similarly developed a document articulating its approach to handling data in a GDPR appropriate way.

6 Recommendations to other cities

In the previous sections we have described our learnings so far from the demo-project. Below we summarize our learnings as recommendations to other cities and to our selves and our city administration, but also to policy-makers, micromobility operators, a wider geo-fencing and mobility community as well as to authorities to learn from.

6.1 Policy recommendations

- Since the regulatory framework differs strongly between countries you can not copy policy-strategies and regulations directly from other countries, policies in Sweden must work with Swedish law.
- Voluntary agreement were a possibility Stockholm tested, partly as a result of lacking regulatory tools. The result is not satisfying. For 2022 Stockholm strives to use stronger methods, with permits accompanied by different formal conditions for the provider to comply with to keep the permission. In 2023 the number of operators getting a permission might be restricted further and the requirements to receive a permit still higher.
- Aim to introduce policies and incentives that optimize fleet size to actual need. Vehicle rotation shall be high while availability in close vicinity to users shall be “good enough”. Use data about vehicle use and rotation to get ideas about optimal fleet size and relevant locations.

- If public space is scarce and crowded, focus organized parking to areas where rotation is high - indicating here the e-scooters really respond to a need and the use is high.
- Do ensure competition between operators - by allowing several operators in the city, but limit the number of operators to ensure that a sufficient number of operators can reach a large enough fleet size without exceeding the city's desired cap for total e-scooter fleet.
- If fleet sizes are to be capped, do not set too low caps since that will make it hard to operate the service with reasonably good revenue to ensure good local operations.
- If working with parking racks let them be open for all brands - avoid brand specific hubs on public ground.
- Try to invent incentives that encourage fleet availability in all neighborhoods where a user base can be expected - thus ensuring justice and equity.
- Encourage providers to strongly incentivize/penalize correct behavior/misuse and bad parking among their user base.
- Encourage operators to require end of trip photo or similar to control correct parking.
- Use performance criteria, use pattern and violation of rules as base for giving permits.
- Constantly evaluate effect of current regulations and incentives to optimize e-scooter use to those needs that give most benefits both for user and society.

6.2 Recommendations regarding data sharing

- If you want to introduce any performance based requirements on mobility operators the follow up via data sharing can be a very valuable tool.
- Aggregating and analyzing data is an immense amount of work requiring appropriate skills and platform capacity. The use of a third party platform who aggregates data and creates insights is probably the most efficient way to receive actionable insights. It gave the City of Stockholm a lot of insights and experience we could not have gathered ourselves.
- An aggregating actor operating in many cities can use scale to increase output per effort. An experienced actor is more likely to observe and detect incorrect data

6.3 Recommendations when working with a third party platform for data sharing and analyzing

- Active cooperation enhances both the third party service - and the skills in the city administration.
- By working with a third party player active in many different cities Stockholm also was able to get experience and insights from other cities.
- Involve manager and developer of the city owned and street maps and street and regulation databases, traffic analysts and data analysts as well as and permission department in the use and analysing of e-scooter data.
- Ensure enough internal staff resources (time to participate) to make use of, and learn from, the data analysing possibilities.
- Use the opportunity to improve skills in the workforce by practical work with new systems.
- Make sure to use the data analysing possibilities to follow effect on regulations, new zones etcetera.
- A lot of additional and tailor-made analysing can be done by downloading data sets for further treatment by city staff - but you need to secure time among qualified analysts for the task.
- identify contacts within the organization to support GIS needs and interchange of policy boarders geofencing areas etcetera between city systems and platform system.
- always use your policy api as the source of information about updates. This to establish and maintain the policy API as the one and only source for complete and updated info about e-scooter zones and policies. If you distribute zones and regulations by other means in parallell it will be very hard to establish the desired workflow, i e that the operators always use the updated rules and zones from the updated API.
- require a non personal mailbox checked at least daily for notifying operators about updates.
- establish also some public maps, for citizens, road users and media etc in your city. This map shall highlight the zones of relevance and always be updated with the latest policies and zones. The map can either be provided and published by the used third party platform, or created by the city. It should be published publicly.
- set up a regular weekly or biweekly report following a selection of KPIs relevant for the operations in your city. Use the reports to

feed those concerned in the city administration as well as to following performance and how regulations are met or violated.

- use relevant KPIs regarding compliance and performance also as regular feedback to the operators in the city.
- for analytical and strategic decisions create a more detailed analysis once or twice a year to follow how the e-scooter use is developing.
- if possible use the same system or platform and standards if shared bikes and shared e-bikes are in town.
- cooperate with similar cities and neighbouring municipalities to inspire and share smartness and ideas about how to follow, regulate, and analyse micro mobility in smart and efficient ways. This will also be helpful for the providers thus streamlining systems, data communication formats and required KPIs. This also makes it easier for suppliers to comply in different cities and increases the chances to get correct data from providers.
- be realistic when it comes to geofencing opportunities. Take inaccuracy into account.
- do regular and structurized on-site auditing, to verify what you see in your control and analyzing platform corresponds with what you see on the streets.
- use complementary methods and data to get answers on questions like what would have been the alternative to the e-scooter trip if the e-scooters had not been around and to compare relative share of different transport modes.
- use complementary methods to keep track of accidents, incidents and injuries with e-scooters.
- investigate whether automatic bicycle counters, that also might be present in the city, also register e-scooters or if they can be adjusted to do that, and in that case to distinguish e-scooters from bicycles.
- remember that data sharing like this never includes private e-scooters, since they are not connected to the operators systems.