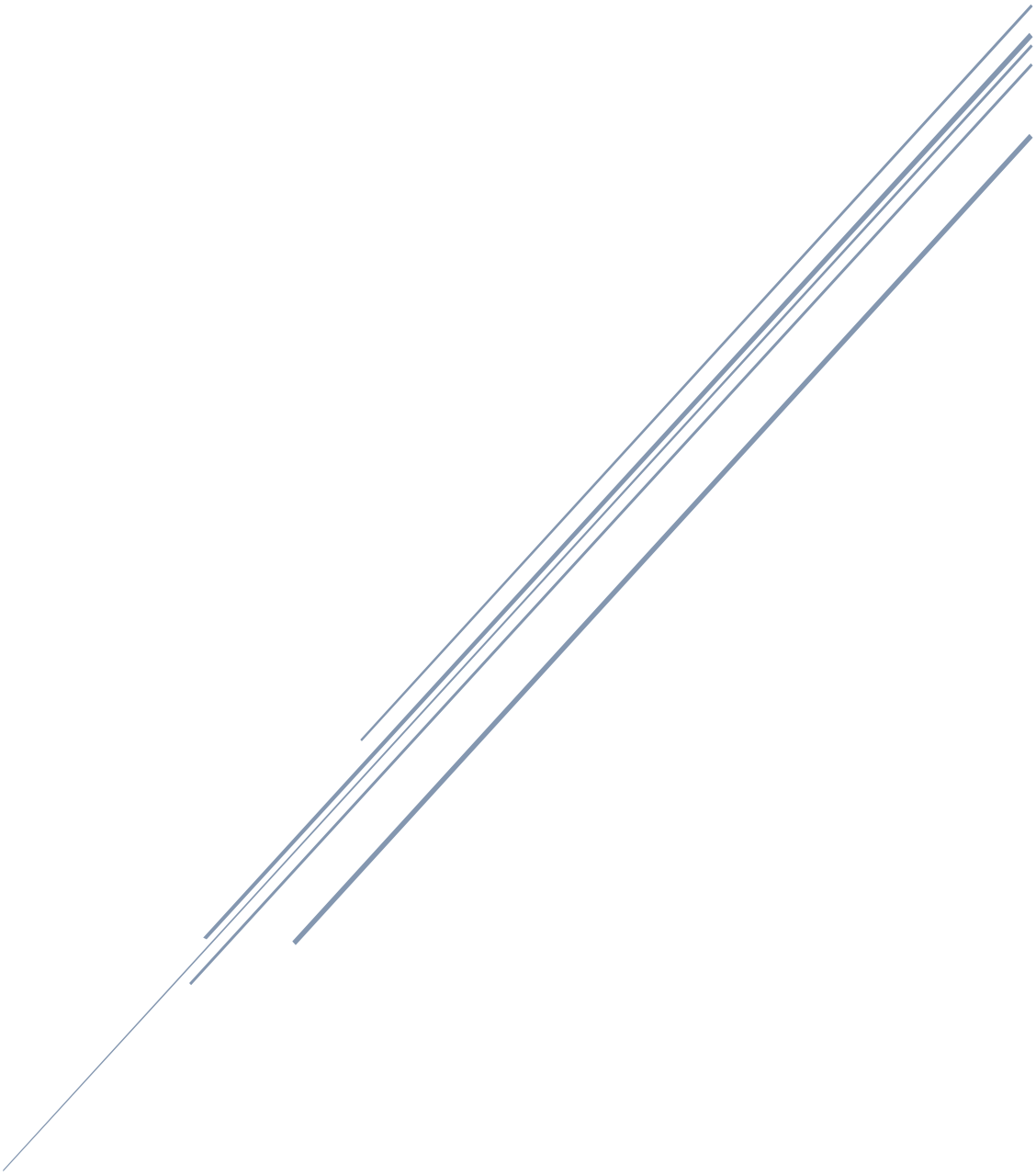
Development and implementation of mapping tools – SURFLOGH WP4

Report – 2022-04-19



City of Borås

Summary

The WP4 work package within the SURFLOGH project aims to deliver easy to use methods for mapping of freight flows. The tools are the supposed to function as a basis for data collection and data analysis, as well as tools to model the primary innovations.

The methods developed for mapping goods are quite different among the project partners, which emanates from the various characteristics of the cases respectively, and the models and methods developed and used for mapping of freight flows are generally based on either/both traffic data or surveys/interviews and manual monitoring.

Qualitative and quantitative data have different areas of use, where quantitative data generally includes information on traffic flows and vehicle types, and qualitative data includes certain specific details of delivery patterns (and prerequisites for delivery) as well as the types goods, carriers etc. Examples of gathering quantitative data are use of cameras, involvement of students to count vehicles, collaboration with logistics service providers involved to use their corporate data, and examples of gathering qualitative data are consultation with /interviews with / questionnaires for retailers, consultation/interviews with real estate owners, interviews with residents / people on the street.

Below is an overview of the different mapping methods used by the project partners:

Groningen: Interviews with shop owners, cooperation and data gathering from a logistics provider, and video recording of a street

Mechelen: Use of ANPR (road monitoring) and OBU (on board unit) data, development of trade of tools (Rebel with a cause) in cooperation with stakeholders.

Edinburgh: Shipment and route information

Borås: Detailed freight “log books” in cooperation with retailers, as well as interviews, utilization of results from similar freight analysis.

Drenthe: Questionnaires for retailers (before, during, and after the pilot), manual observation of trucks and deliveries

The first step of the mapping process is to clearly define the information needed need from a policy and a business case perspective, and to have a clear link to the problem/solution case.

Focus may be environmental targets (often policy related), but economic targets as well (related to the business model of the companies involved). It´s important to formulate clear data expectations, and also to identify possible data that could be gathered (quantitative/qualitative, goods traffic flows, specific information regarding deliveries etc.).

Initial information, dialogue and interviews with the businesses in the area of interest helps to create awareness of the problem/situation and further commitment to participate in the process.

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1 Introduction

The WP4 work package aims to deliver easy to use methods for mapping of freight flows. The tools are the supposed to function as a basis for data collection and data analysis, as well as tools to model the primary innovations. The tools also intends to help to define the (quantified) starting points for the development of urban logistics hubs and the effects of various business models.

The mapping tools have been used for baseline figures, mid-term reviews, case studies and mid-term reviews to quantify the effects of various innovations on urban freight flows and aims to be an easy-to-use standardization for analysis and mapping of freight flows. Each participant has been responsible to establish a working team, and to customize adequate mapping tools for their own region and to develop new modules for the innovations. For the development of innovation modules, working groups have cooperated with logistics entrepreneurs for the necessary input and consultation.

2 Overview of different approaches

The methods developed for mapping goods are quite different among the project partners, which emanates from the various characteristics of the cases respectively.

The models and methods developed and used for mapping of freight flows are based on either/both traffic data or surveys/interviews and manual monitoring. The various focus and methodologies could be generally divided between analysis based on traffic monitoring on different levels, and specific data collection for freight transports.

2.1 Analysis based on traffic monitoring

Traffic monitoring/measurement and freight analysis based on general traffic- and vehicle data (performed by Groningen, Mechelen) means that certain data regarding freight traffic in an area could be obtained from monitoring by using equipment that registers vehicle movements and also includes a relevant method of vehicle recognition.

The data sources could range from single cameras installed on single streets or street segments, where observations have to be analyzed manually, to makro level data collection systems on national roads with automatic recognition of number plates.

By identifying vehicles entering and leaving certain areas, as well as passing through certain points, its possible to obtain data beyond just the number of vehicles, such as:

- Distances
- Time spent in the area (may enable to separate goods deliveries/pickups from parking)
- Velocity

Based on the number plates, vehicle types can be identified from national vehicle registers, and also possibly areas of use (ie if registered for professional use within freight/logistics). The data is then anonymized when compiled, by removing the number plate information.

2.2 Analysis based on specific freight data

In order to obtain further details of the shipments (ie goods types, volumes, terms and conditions etc.) different types of manual registration/monitoring and/or interviews are generally required.

This kind of data has been collected by Borås, Drenthe, Groningen, Sestran, and may include registration of:

- Goods type
- Goods volumes
- Load carrier (parcel, pallet, roller cage etc.)
- Time of delivery
- Transport company performing the delivery
- Vehicle used for delivery
- Specific terms and conditions (ie time window, courier/express, refrigerated etc.)

The data may be obtained manually by individual registration of deliveries and shipments (common when working with goods receivers), as well as from business systems (freight forwarders).

Since it´s not generally possible to obtain the details above from all transport companies operating in an area, manual registration is the most relevant approach to obtain a complete overview at present.

3 Mapping tools and methodologies – descriptions of each case

3.1 Groningen

3.1.1 General

Within the pilot, three different transport operations based on cargo bikes and small electric distribution vehicles have been tested, on the extent to which they are suitable to apply in practice.

Those are:

1. Express ride. This is a separate journey from A to B. This involves driving, loading, transporting, unloading and continuing to the following address.

2. Express route. Several items are picked up at one address after which they are driven out in one route.

3. Hub model. This involves a collection route (items are picked up at multiple addresses, sorted and then driven out as efficiently as possible).

Focus for the Groningen approach has been on the end receivers of the goods, and to engage as many as possible in the city center of Groningen. The pilot area was the city center within the canals, and the targeted businesses were small and medium shops as well as offices. Data was mainly collected prior to the pilot activity, and the results were used in the development of the service.

3.1.2 Elements of the study

A pre study was performed in cooperation with the university of Groningen and carried out as a bachelor thesis. The methods used within the thesis work were:

A. Interviews with the shop owners

B. Data gathering from a logistic transport provider

C. Video recordings of the Oude Kijk in 't Jatstraat

3.1.3 Interviews with shop owners

Representatives from 50 shops participated in the interviews and the questions used were according to the following:

1. Background information (ie. the type of store, opening hours, choice of the location and implementation of the sidewalk were asked).

2. Organization of logistic distribution (ie network organizations, central distribution and incidental distribution)

3. Ordering procedure (ie This includes how many days the shop owners need to wait before an order is delivered, the duration of delivery time, the available storage area, how many days a shop can serve its customers without a new delivery, and what shop owners think can be improved in the ordering procedure)

4. Delivery characteristics (ie number of deliveries per week, time of deliveries, preferred time of deliveries, vehicle types, and preferred vehicle types)

Type voertuig	Aandeel in het totaal aantal ritten
 Bestelauto < 3,5 ton	17%
 Lichte vrachtauto 3,5 -7 ton	14%
 Vrachtauto 7-18 ton	44%
 Trekker-oplegger >18 ton	25%

5. Freight characteristics (ie type of shop, type of deliveries, freight volumes and weights, and requirements for transporting the freight such as fragile etc.)

6. Unloading procedure (ie unloading devices, available storage area of the shops, and procedure and requirements when receiving freights)

7. Bundling of freights (ie corporation between shops or bundling the delivery of packages with the loading of waste and recycling material)

8. Nuisance (ie factors involving the trucks; noise, cooling, traffic jams, blocking terrace and shop windows, reducing the accessibility of shops, emissions and unsafe situations.

9. Solutions (ie time windows, logistic decoupling points (consolidation centers), street management, efficient logistic routes, increase of parking spaces and uniform regulations with respect to emissions)

3.1.4 Data gathering from a logistic transport provider

The data from the logistic transport provider was split up in the scheduling and routing of the truck driver, and in the requirements, wishes and concerns of the logistic transport provider. The questions used in this part of the analysis were:

1. The background information (ie type of vehicle, times the provider works and the reason of working for KoopmansTransmission)

2. Organization of the logistic distribution, (ie the logistic distribution within Koopmans Transmission, logistic distribution in the city, functions of the chauffeur and positive and negative sides of the organization).

3. The characteristics of the delivery, (ie quantities, durations, vehicle type and important aspects of the deliveries).

4. The client characteristics (ie type of clients, procedure of ordering, and positive and negative aspects of clients).

5. The freight characteristics (ie type, aspects and weight of freights).

6. The unloading procedure (ie unloading devices, receiving methods and unavailability of clients).

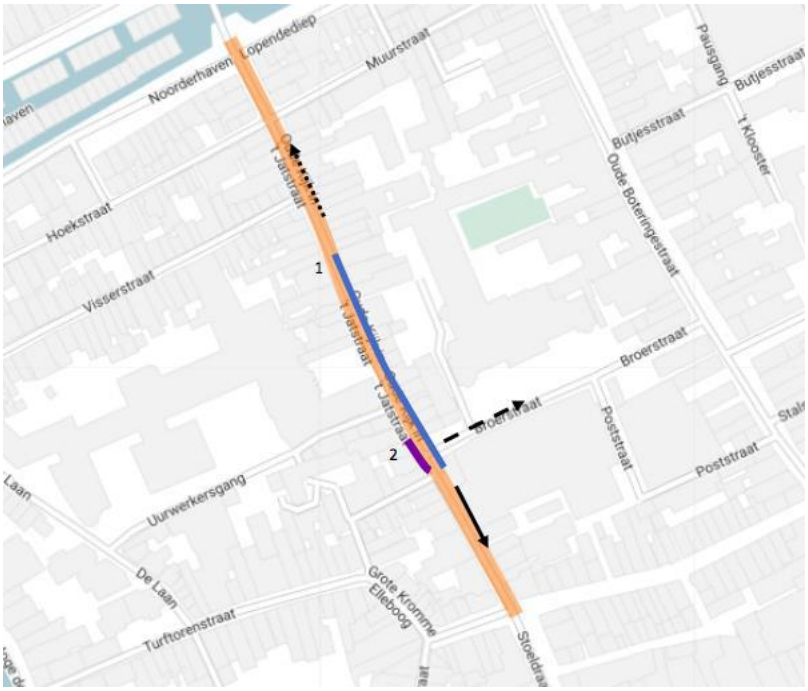
7. The retour flows (ie bundling of emballage and the organization of the retour flows with quantities and weights etc).

8. Nuisances Multiple nuisances were ranked and specific nuisances for the Oude Kijk in ‘t Jatstraat and for the city were discussed

9. The solutions. Similar to the shop owners, the logistic transport providers could select the solutions to be possible, plausible or negative and the possibilities for a consolidation centers were discussed

3.1.5 Video recordings of the Oude Kijk in ‘t Jatstraat

Cameras were installed at two spots in the Oude Kijk in ‘t Jatstraat (se map below)



The objective of the video recordings was to collect information about the vehicles entering and stopping in the Oude Kijk in ‘t Jatstraat. This includes information about motor vehicles that drive into the street, and the vehicles that have a destination in the street which actually park there. The camera started filming when a vehicle passed, and cameras were placed in two spots on the street for three days. When all images were collected the numbers of vehicles could be counted. With this information, peak times, company sectors the vehicles belong to and common parking places could be derived.

From the images, following properties could be derived and documented:

1. Number of vehicles passing the street

In this category, the vehicle type, organization or company of the vehicle, the time, the duration and the destination were documented. The logistic transport devices were divided into four main vehicles; the van (lighter than 3,5 ton), the small truck (3,7-7 ton), the truck (7-18 ton) and the trailer (heavier than 18 ton). The destination of the vehicles coming from the outer city could be the Oude Kijk in ‘t Jatstraat, straight ahead towards the center, or towards the Broertstraat, to pursue to the left. For the vehicles coming from the inner city, the destinations could be towards the outer city, following the Oude Kijk in ‘t Jatstraat or towards the Broerstraat. Likewise, vehicles can originate from the Broerstraat and depart either towards the inner city or the outer city.

2. Number of vehicles that park in the street

Similar to the latter, in this category, the vehicle type, organization or company of the vehicle, the time, the duration and the destination were documented. The vehicle types were divided into scooters, cars, vans, small trucks, trucks and trailers and the organizations or companies of the vehicles could be documented. The parkings could be done on the sidewalk, half on the sidewalk and on the street. Additionally, the duration of the parking and destination were documented.

3.1.5 Cargo bike delivery data

The cargo bike distribution (Go-Fast city logistics) was monitored continuously, and the following data was collected montly:

* Number of zero-emission stops
* Zero-emission kilometer
* Co2 emissions saved (calculation with a conventionval distribution van as reference)

3.1.6 Reflections

When reflecting on the data gathering methods, some aspects may be discussed which could change the data. The video recordings were captured on six different days with different times hence the time periods cannot be compared to find one specific peak day and peak time. From both camera stands, only a part of the street is captured, so there might have been other vehicles parked in the street which were not shown on the recordings. The standard deviation of the delivery volume and durations are relatively high, and with more samples the average volume of deliveries would become more accurate.

A lesson learnt from the data mapping was that a successful approach was to make personal visits to the businesses, to describe the concept, and get direct input from the different stakeholders, This increased the awareness of the adressed problems and made the perception of the pilot to be less of a ”forced” solution.

3.2 Mechelen

3.2.1 General

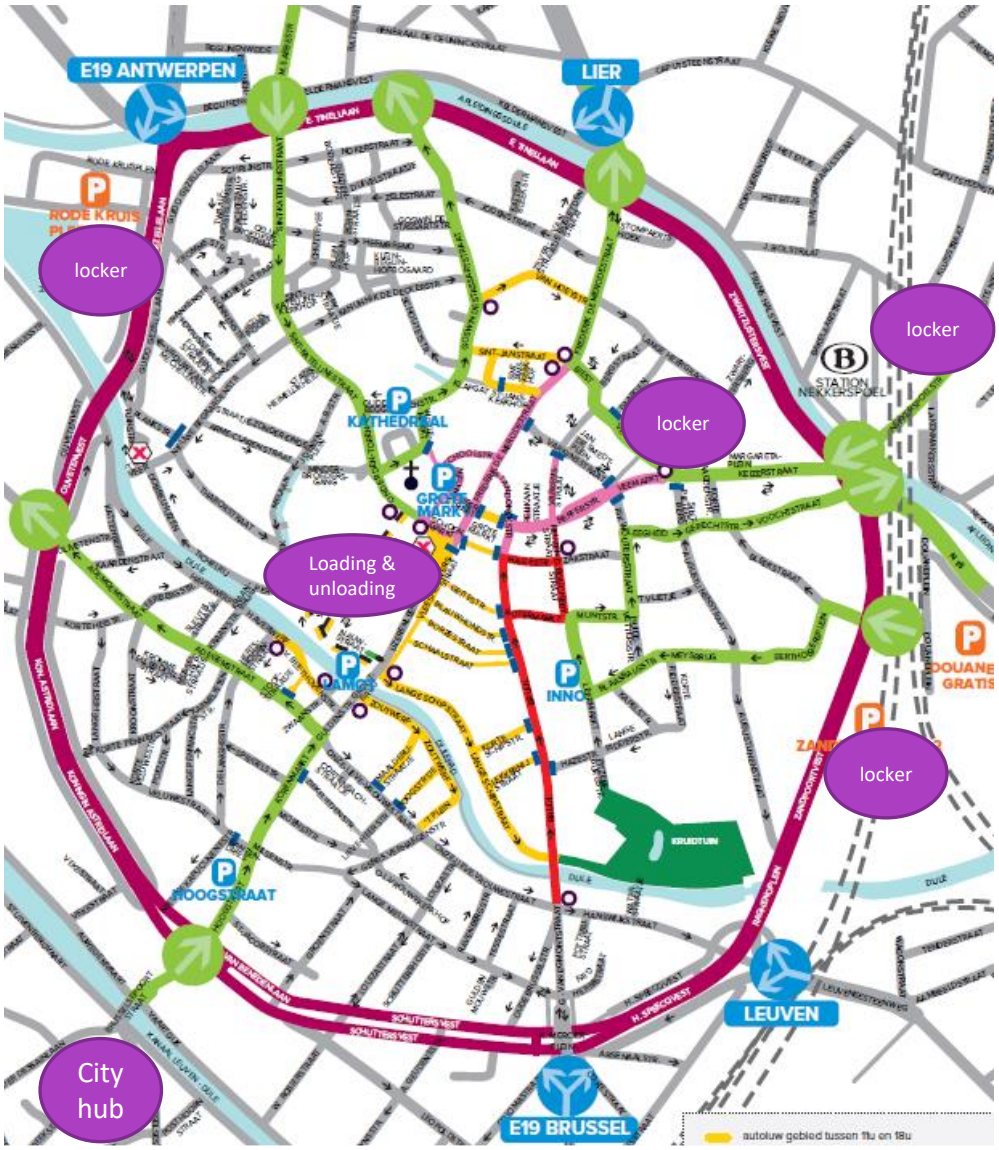
The city has been running three different pilot projects:

1. Installation of smart locker networks – last mile and first mile

2. Consolidation and optimization of the bikecarrier hub (new technologies, cooperating with bike couriers and stimulating electric transport).

3. Regulating loading and unloading zones with the installation of an app.

The shop owners that have participated in the pilot(s) are situated in the inner city area. The map below shows the different locations of the pilots indicated: location of the city hub, locations of the 4 smart lockers & location of street where loading and unloading have been monitored.



3.2.2 Mapping of freight flows in Mechelen - overviev

The main development of tools for mapping of freight flows has been carried out by the Vrije university of Brussels via the analysis of the ANPR & OBU data in 2018.

Earlier work that has been used in the analysis are manual countings on number of deliveries (1 day in 2015 at several access points to the inner city) as well as interviews with the shop owners, which creates insight in number of deliveries, volume of deliveries, time of deliveries and vehicle types.

In 2016, a survey was conducted, engaging shop owners at 3 streets of the inner city. The survey gathered data on number of deliveries, goods volumes, vehicles used, and delivery times.

Via the Locatus database, information has been available on number of businesses (shops) and floor space in the pilot area.

Regarding the locker pilot, key figures from the operation (number of parcels, parcel size etc.) have been collected regularly.

3.2.3 ANPR & OBU data

The Vrije university received data from 122 cameras in the regions of Mechelen and Willebroek for the period of Mon 8/1/2018 to Sat 13/1/2018 and Mon 5/2/2018 to Sat 10/2/2018.

The data was collected by the ANPR cameras that recognize number plates. Each observation has an identifier and three parts: timestamp, camera identifier and vehicle's number plate. For each observation in the dataset, the GPS coordinates of the camera and the camera description were included which briefly states the road segment where the camera is located. Furthermore, the dataset was anonymized.

Based on the vehicle registry (DIV data), a large number of different vehicle types could be specifically identified from the dataset.

The first step in modelling the data was to sort the data according to the date, vehicle identified and time respectively. In the next step of the data elaboration, the zone of the observation was added, next camera and zone they go to, the distance to the next camera, and the time it took the vehicle to get to next camera. Based on the distance and time the mean velocity of the vehicles could be calculated. Since the clocks were misaligned between some cameras, the data had to be elaborated manually, but the result made it possible to calculate the number of stops and parkings according to the following:

Stops: A point was marked as a stop, if the time that the vehicle took to get to the next camera was more than 30 minutes but less than 5 hours, more than the expected time.

Parkings: A point was marked as a parking, if the time that the vehicle took to get to the next camera was more than 5 hours, more than the expected time.

OBU refers to the Belgian road charging system for Heavy Good Vehicles (HGV), which been implemented since 2016.

OBU data has been available on macro level, and within this system every truck > 3.5 ton has an On-Board Unit that captures every 30 seconds:

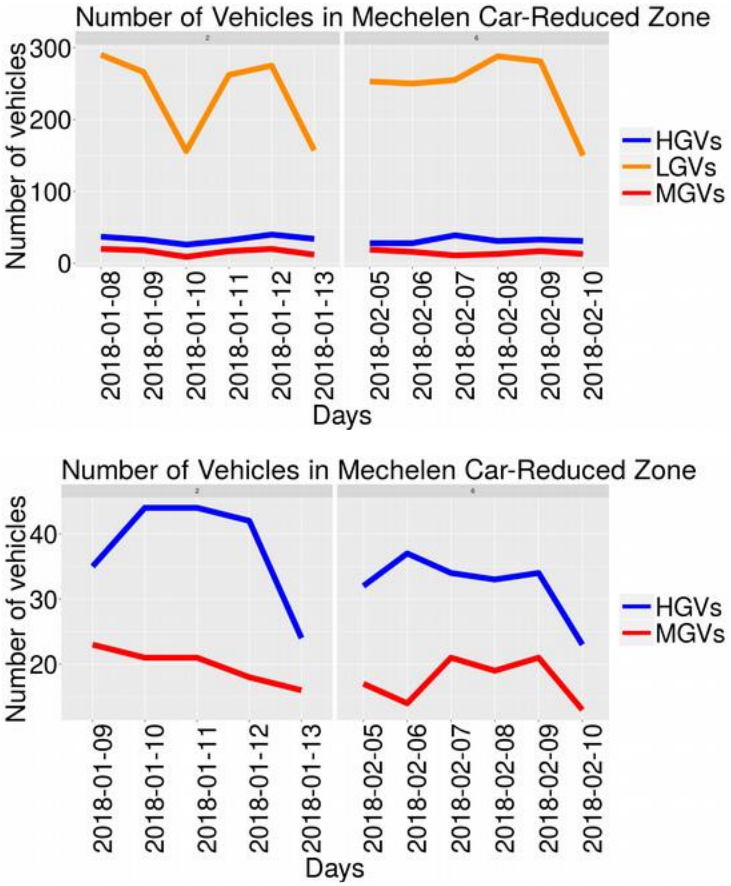
– ID, time stamp, GPS position

– direction, speed, country of registration, max. mass, Euro norm

The ANPR and OBU sources were combined in a joint analysis to illustrate the following figures in the Mechelen region and the car free zone within Mechelen respectively:

- Number of vehicles – total (per day and per hour)
- Number of freight vehicles (per day and per hour)
- Number of driven kilometres
- Velocity
- Entry and exit locations
- Overnight parking
- Number of stops (with frequency/dencity for specific areas)

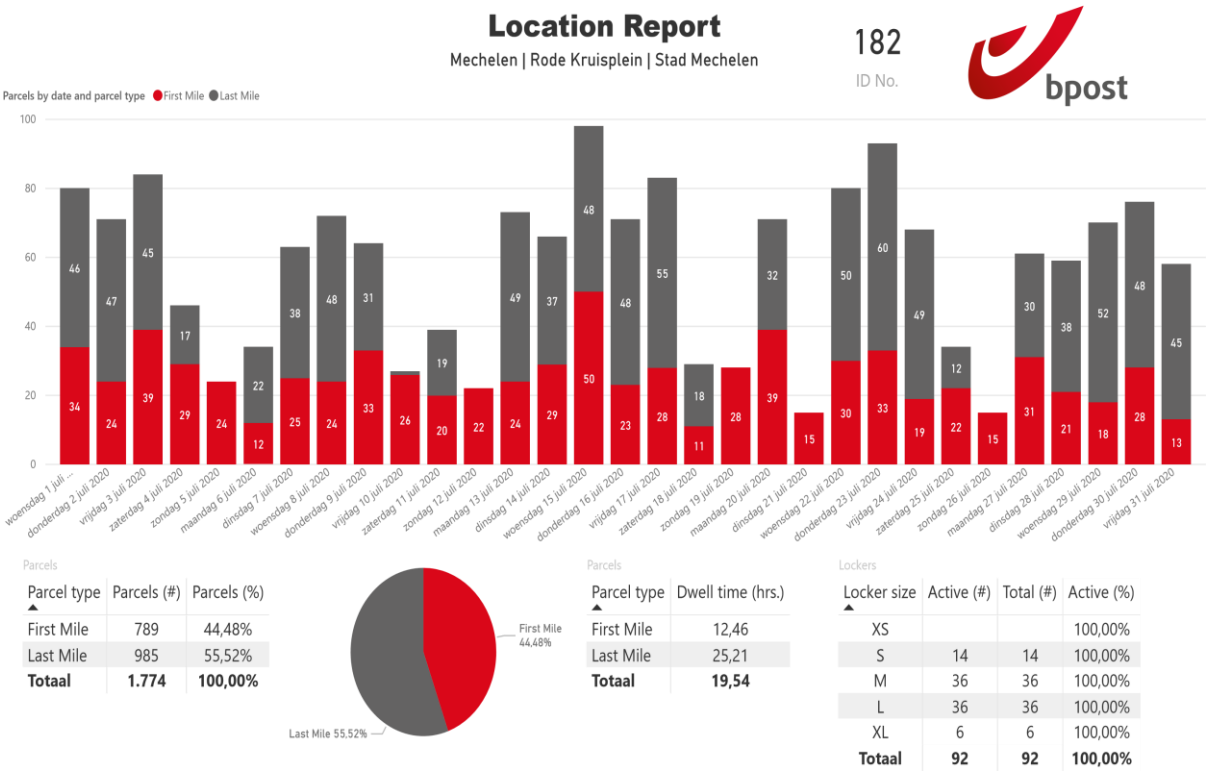
Example - figures regarding the number of freight vehicles from the ANPS analysis (top) and OBU-analysis (bottom):



3.2.4 The locker pilot

The scope of the data collection for the lockers has focused on the number of operations, and doesn't contain additional details.

No "before"-data is available for the smart locker pilot. The supplier delivers data from the operation of the pilot according to the figure below:



Parcels

Parcel type	Parcels (#)	Parcels (%)
First Mile	789	44,48%
Last Mile	985	55,52%
Totaal	**1.774**	**100,00%**

Parcels

Parcel type	Dwell time (hrs.)
First Mile	12,46
Last Mile	25,21
Totaal	**19,54**

Lockers

Locker size	Active (#)	Total (#)	Active (%)
XS			100,00%
S	14	14	100,00%
M	36	36	100,00%
L	36	36	100,00%
XL	6	6	100,00%
Totaal	**92**	**92**	**100,00%**

3.2.6 The Rebel Group

Rebel acts as one of the project partners in the growth trajectory of Mechelen to evolve towards a more sustainable and efficient urban freight distribution

Earlier work has included the creation of a SWOT-analysis of city logistics for the city of Mechelen, and presenting and discussing potential ideas. This in order to create more internal involvement, alignment, and more precise question formulations regarding efficient and sustainable urban freight distribution solutions.

By reaching out to different stakeholders (initially identifying how to engage, existing problems/"pains" and potential solutions) and arranging a co-creating session regarding three stategic themes (Technology, Collabolation and Spatial development, the conclusion was that there was no "super solution" for Mechelen. Instead the work aimed to work out road maps with 'early believers' for setting up potential pilot projects tailor made for Mechelen.

Two tracks for further developmend were identified:

- Developing a more strategic focused policy regarding city logistics
- Realization of pilot projects with 'early believers' or key players who actively want to implement city logistics solutions for Mechelen

The further work has resulted in the development two tools to facilitate the structural roll-out of urban distribution initiatives:

1.Trade-off tool for retailers

2.Trade-off tool for LSP's

The overall goals of the tools has been to

- Determine the focus of the individual business case for the retailer / LSP
- Working out a concrete 'City Logistics Pilot Project' with potential strategic partners together with the City of Mechelen
- Give the necessary strength to the City Logistics pilot project and eventually help in the structural roll-out of urban distribution initiatives

The goal of the Trade-off tool for retailers has been to:

- Provide insight into the total city logistics chain for retailers (first-mile & last-mile)
- Provide insight into the additional VAL / VAS 'Cityhub' can provide

This by generating Business case city logistics solution for retailers as:

I.Current situation: delivery by and cooperation with multiple LSP's

II.Alternative situation: delivery by dedicated city LSP (e.g. ECOkoeriers/ ODTH) and the possible added value of their VAL / VAS, with Focus on transport price, impact VAL / VAS, and on carbon footprint (WIP).

The goal of the Trade-off tool for LSP's has been to provide insight into the potential cost savings by making use of a dedicated city LSP.

This by generating input regarding numerical consideration between costs and revenues in the:

I.Current situation: direct supply to inner-city retailers

II.Alternative situation: delivery to the edge of the city via 'Cityhub'

3.2.7 Reflections

The OBU data provides better opportunities to identify actual stops and parkings than the ANPR-dataset, but with some shortcomings:

• Only trucks > 3.5 ton, no vans

• Coarse-grained vehicle categorisation (HGV/MGV) compared to DIV

• Exact stopping location hard to determine at times (interval 30 seconds)

It should, however, be added that even the data from 122 cameras in the ANPR-analysis only could provide a quite course view regarding velocity and stop/parking times.

Regarding the Rebel tools, it has been assumed that Mechelen and other cities can gain a better understanding of the logistics chain from different perspectives. As a result, policies can be adapted for both the short and long term. City authorities can also use the insights gained to make these city hubs attractive for both retailers and transport operators/carriers alike.

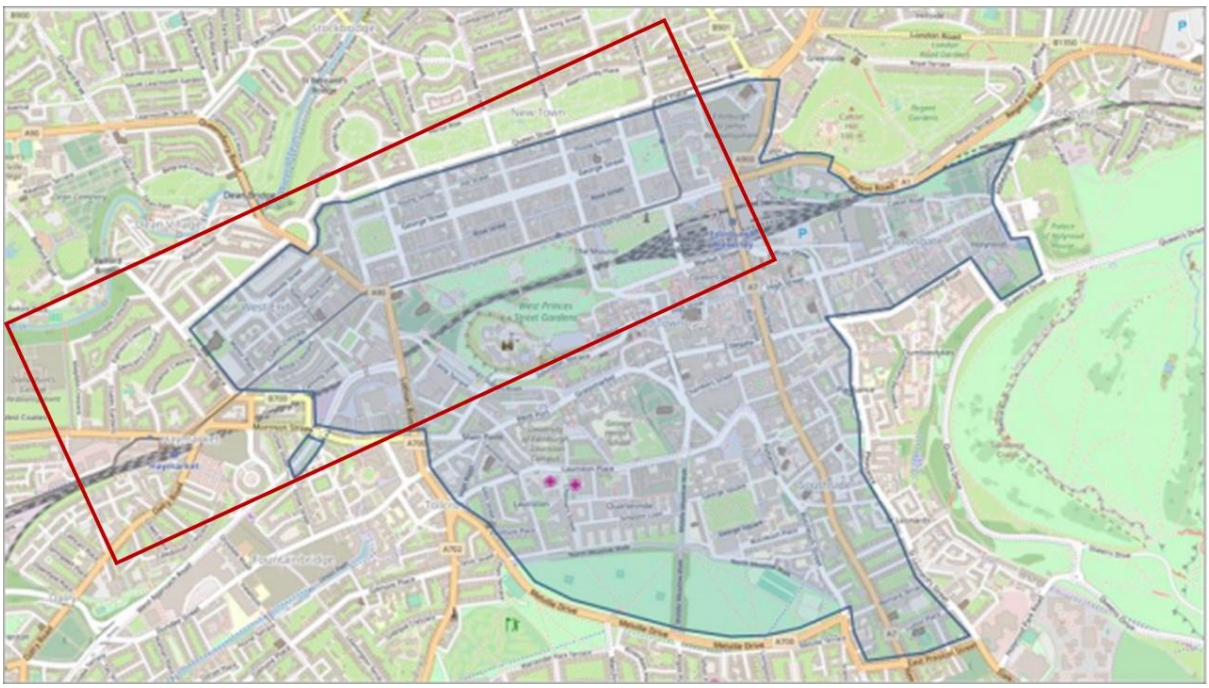
3.3 Edinburgh

3.3.1 General

The scope of the Sestran pilot involves various businesses, such as local business, law firms, coffee roasters etc.

Pilot area: image below with two defined areas.

1. A red box representing an approximation of the coverage of the pilot area equalling roughly 2.3 km squared in area across central Edinburgh.
2. An area shaded with a blue outline which is the proposed LEZ for central Edinburgh.



Within the pilot, a cooperation with TNT regarding last mile distribution has been established, were last mile delivery is performed with a cargo bike.

The future aim is to establish cooperations with the large freight forwarders regarding deliveries to the city center.

3.3.2 Available data

The volumes distributed by cargo bike for TNT have been about 40-65 drops per day, with an average of about 1,1 parcel per stop/shipment.

There have been no mapping of the goods flows in the area, except from a brief analysis of freight traffic to and from the low emission zone, provided by the Scottish Environmental protection agency (below).

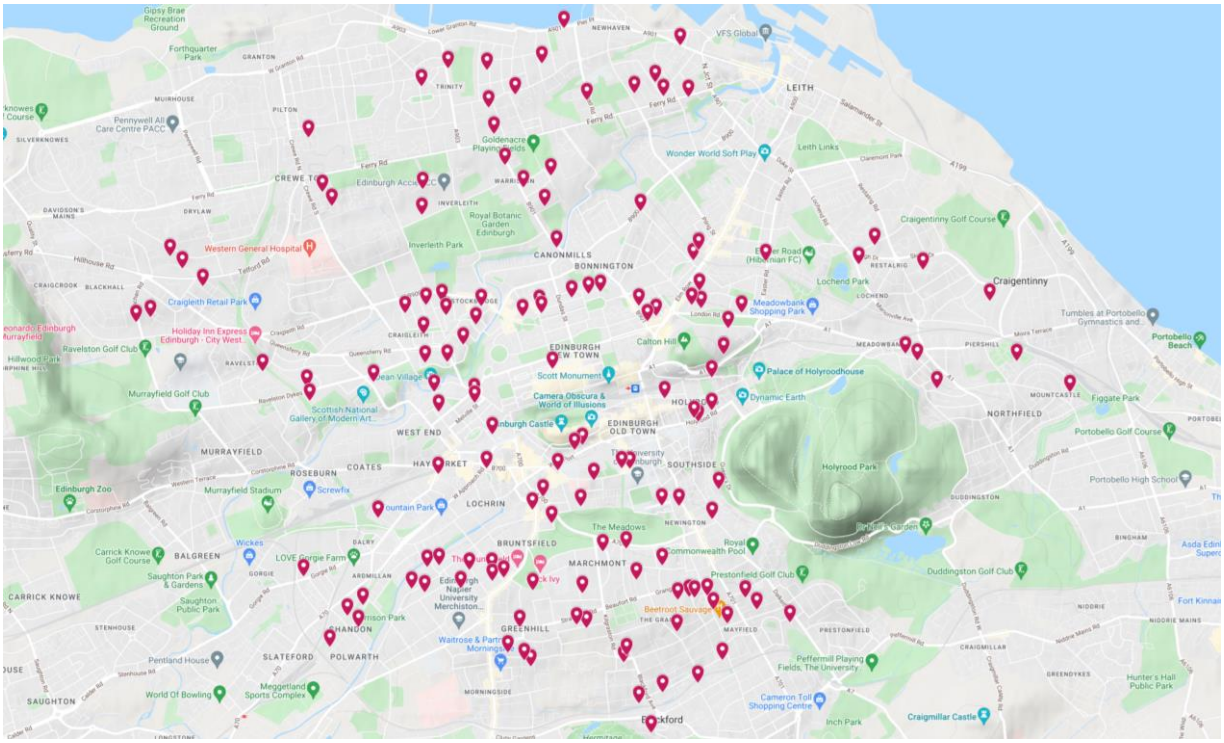
Freight Flows into the LEZ area over 24hr period are (best available estimate):

Type	In	Out
LGV	3556	3063
HGV	942	940
Total	4498	4003

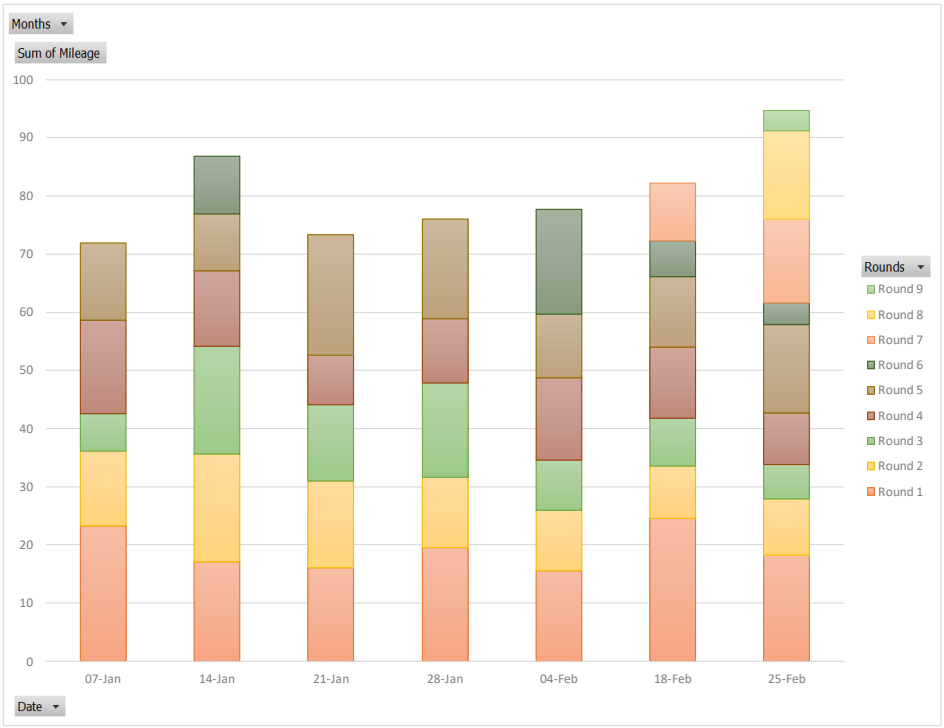
Figures provided by SEPA (Scottish Environmental Protection Agency)

UPS-trackers have been be used in order to map the delivery routes in detail, and to examine how to make the distribution more efficient. This provides a detailed overview of the distribution system by the cargo bikes in terms of position, stop time, number of stops/deliveries, driven distances etc.

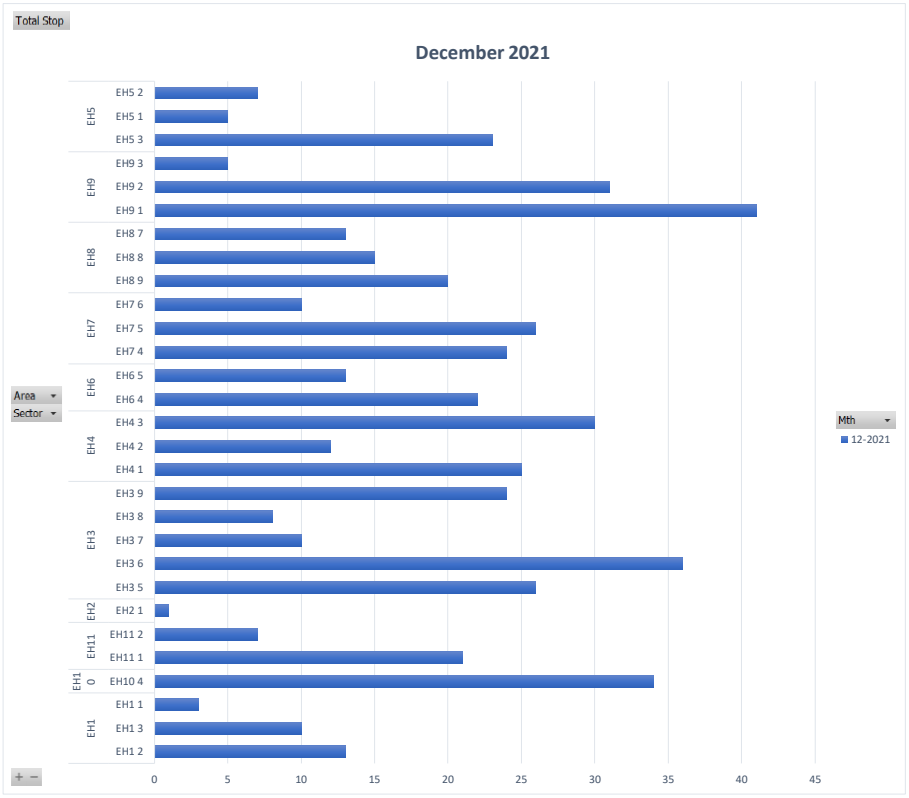
Example - all locations with stops within week 49 in 2021.



Mileage for the different rounds in December 2021:



Stops per district in December 2021



3.3.3 Reflections

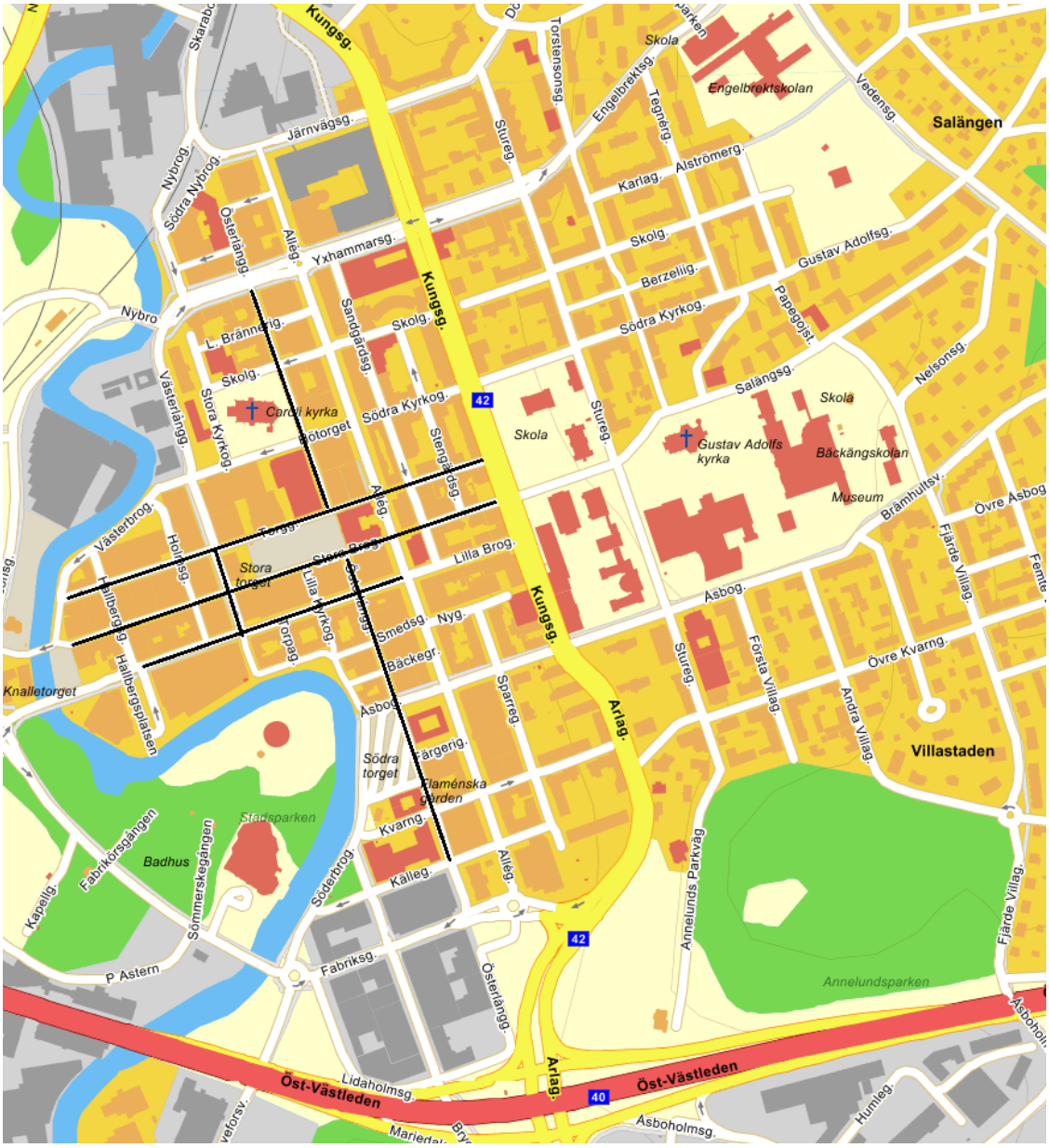
The statistics from the routes and goods volumes provides a lot of details which makes it possible to simulate and compare to conventional distribution in terms of costs, emissions, energy consumption

etc. However, some kind of more detailed base line measurent could be useful in order to estimate the relative impact and potential to the transport system of Edinburgh.

3.4 Borås

3.4.1 General

The pilot area (as well as the area studied regarding goods and freight) is mainly focused around the street segments marked in black, but further elements west to road 42 (see map) have been relevant for the pilot.



3.4.2 Data collection

The freight analysis in Borås has been based on three different studies:

1: Interviews with retailers in the area regarding mainly routines, demands and qualitative issues regarding goods and deliveries.

2: Registration of deliveries and shipments to retailers in the area during one main and one complementary 3 week period.

3: Comparison to a major freight study recently performed at the Nordstan shopping center in Gothenburg, where statistics to certain retail chains and types of companies have been used to complement the data collection from Borås city.

The businesses in the area were identified through the use of public available databases for registered businesses in the area. There is a complete list of the businesses in the studied area, which could be extended to further streets if relevant. Types of businesses are available, but not details such as number of employees, floor space and turnover.

Almost all of the identified retailers were contacted (most by physical visit, but some by phone), regarding a short interview, as well as an inquiry for registering deliveries and shipments.

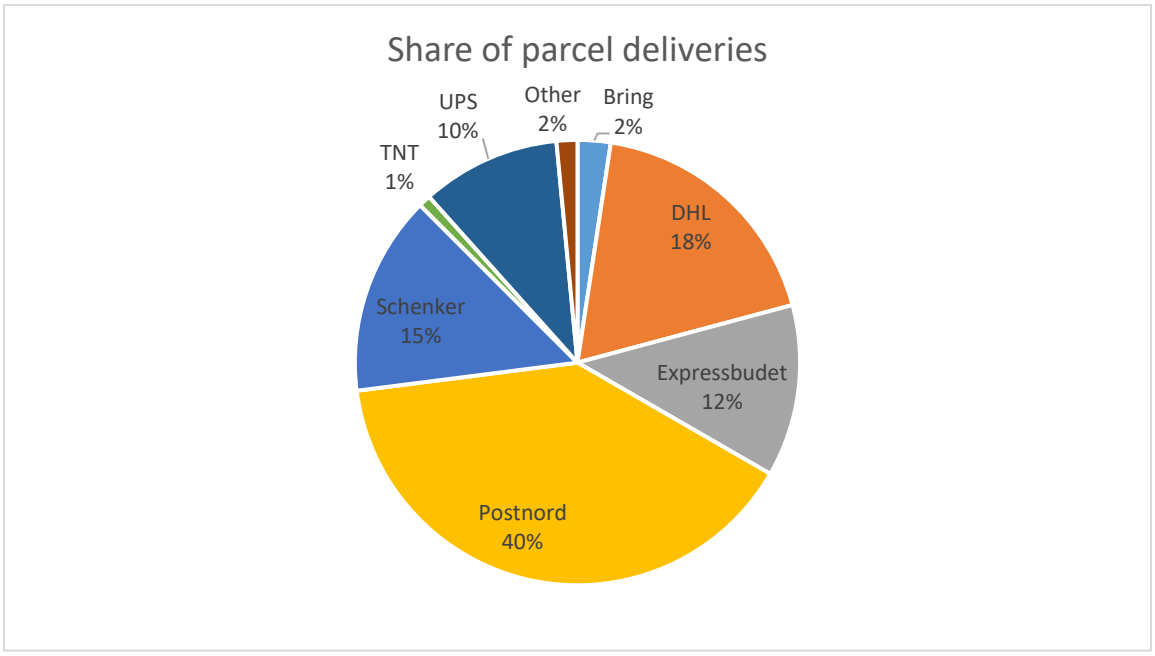
The reception among the stores was varying, with most of the retailers positive to participate in the study. A few businesses declined to participate, and in some cases in turned out to be tricky to find the right contact person to carry out the interview or registration of deliveries.

Out of a total of about 60 retailers contacted, complete data were obtained from 27. Regarding 15 stores within retail chains, data was available from almost identical stores from the Nordstan analysis, so in the end, by combining the two sources, qualitative data could be put together for 42 stores.

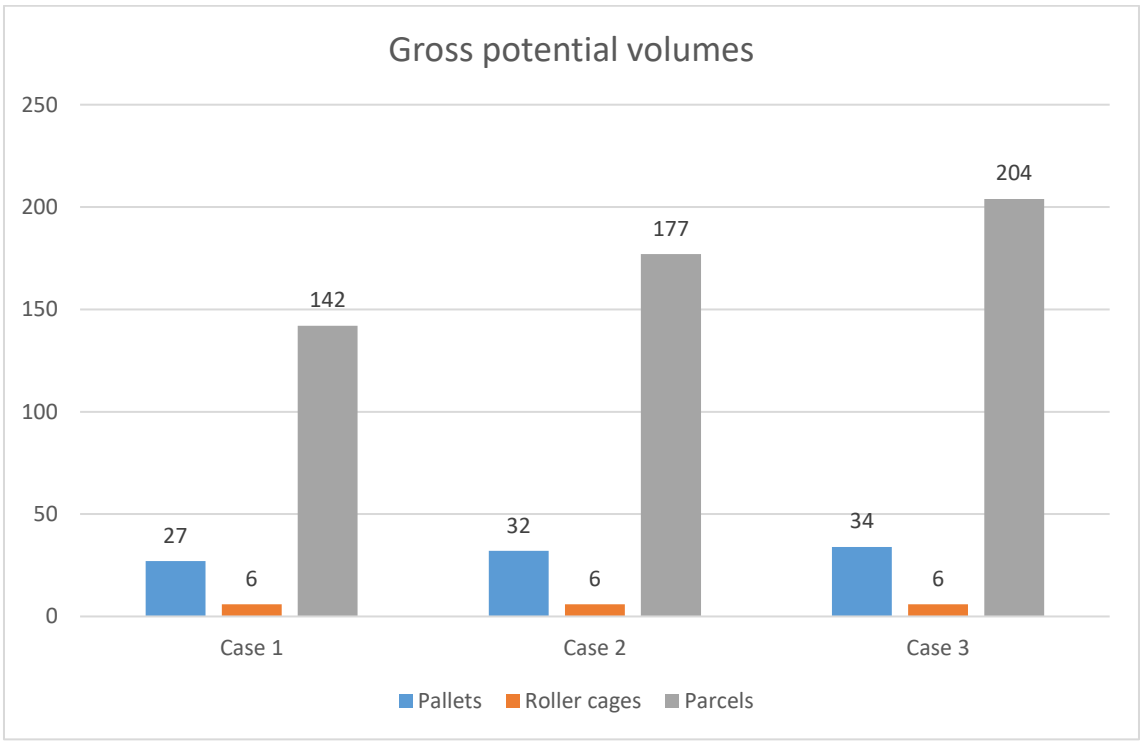
Regarding deliveries and shipments, data has been collected for number of units (with number of pallets, parcels etc), time for delivery, routines for delivery, and transport company. Deliveries have been registered for the majority of the shops in the pilot area through manual registration (by staff at the shops) during 3 week periods.

Below are some key figures obtained from the data collection and analysis:

Share of parcel volumes between transport companies on the pilot area of Borås.



Based on the measurement, it was also possible to calculate mean volumes of goods for the retailers included in the analysis (case 1) as well as to extrapolate for further businesses within the area (case 2 and 3).



3.4.3 Application in the pilot

During the pilot Good Goods (goods distribution with electric van, started December 2020), handled goods volumes have been monitored continuously. By using the baseline measurement, it has been possible to estimate the share of goods handled out of the total volume of parcel distribution in the

area. Key figures have also been calculated regarding reduction of emissions and energy consumption compared to conventional vehicles, based on driven distances.

3.4.4 Reflections

Based on the manual registration of goods flows to the stores, it was possible to obtain a detailed and accurate view of goods flows to the different retailers (date, time, goods types, volumes, distribution vehicle etc.), and also a brief picture of the different transport companies operating in the area, and their respective share of parcels, pallets and roller cages distributed.

The mapping of the goods flows are, however, delimited to goods deliveries to businesses on a few streets in the city center, and can not provide a complete view of the overall freight traffic volumes.

Similar to the Groningen study, it was considered a successful approach to make personal visits to the businesses, and discuss the adressed problems and suggested solutions to get input to the further development process, and increase awareness.

3.5 Drenthe

3.5.1 General

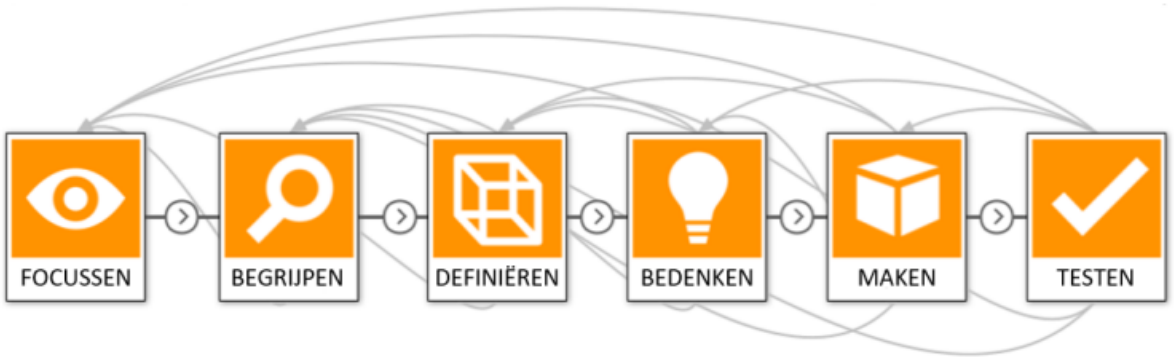
The province of Drenthe aimed at industrial development of the area around Groningen Airport Eelde. One aspect of this industrial development was the development of a strategy for Royal FloraHolland. The function of the *flower auction Royal FloraHolland* changed due to changing market circumstances and continuing digitalization in the trade of flowers. As a consequence in the future less space is needed to carry out the same activities. Given that the location consists of a large warehouse with both cooled and uncooled parts and can be reached by Longer Heavier Vehicles (LHV), the province assumed it could play a *strategic role in the regional distribution logistics*. Together with a private entrepreneur, the province designed an initial concept to establish *a (City) consolidation hub, based on a terminal facility operated by the company Royal Flora Holland*.

The concept included a pilot between October 2018 and October 2019 to test specific activites:

1. Supplying shops in downtown Groningen
2. A business case for existing logistics service providers for using the hub
3. GHGE 2.0: takeover by Royal Flora Holland and development of Truckbreak
4. Matchmaking distribution logistics on Royal Flora Holland compound and GHGE

3.5.2 Elements of the study and use of data

The province of Drenthe explored strategic opportunities for the location of FloraHolland and the establishment of a City consolidation hub. Research was conducted according to the de '*Design Based Research*' (DBR) methodology. According to the DBR methodology a prototype or concept is designed and consecutively tested for its merits. The methodology doesn't rely on extensive data collection and analysis upfront. Instead it is iterative by nature in order to continue evolving prototypes until a working prototype is developed or the conclusion is drawn that no viable solution can be found.



Iterative phases Design Based Research process (Easterday et al., 2014: 319): *Focus, Understand, Define, Design, Implement, Test.*

In the period October 2018 until October 2019 the 4 prototypes were designed and tested. The test of the two of these prototypes (shops in Groningen and existing logistics service providers) included elements of data collection and data modelling.

1. Supplying shops in downtown Groningen

The idea behind the first prototype was that retailers in the city center could try to the concept of hub, without incurring costs or running a risk. Costs would be covered by the pilot project. The first phase design was build on a potential of 10-15 retailers with sufficient volume. At the completion of the pilot, the objective was to identify clear benefits for retailer (service), city center (limited number of vehicles, clean air, CO2 footprint) and the hub operator (viable business model).

To achieve this, potential hub customers among retailers in the City center of Groningen were identified and approached (1-on-1 interviews):

Bezocht	Winkel	Onderzoek?	Adres	Kans
Ja	Talens		Carolieweg	L
Ja	Marvari		Folkingestraat	0
Ja	Pindakaaswinkel		Folkingestraat	L
Ja	Confetti		Folkingestraat	0
Ja	Delicious Chocolate		Folkingestraat	0
Ja	Intertoys		Folkingestraat	0
Ja	Toy Toy		Folkingestraat	0
Ja	Leuk & Lekker		Grote Kromme Elleboog	L
Ja	Van Erp		Grote Kromme Elleboog	L
Ja	Dille & Kamille		Grote Kromme Elleboog	0
Ja	Burmann	v	Grote Markt	0
Ja	Expert YPEY	v	Nieuwe Ebbingestraat	0
Ja	Riemer		Nieuwe Ebbingestraat	L
Ja	Ekoplaza		Nieuwe Ebbingestraat	0
Ja	't Binnenhuis		Nieuwe Ebbingestraat	M
Ja	De Koning		Nieuwe Ebbingestraat	M
Ja	Onderdelenhuis		Nieuwe Ebbingestraat	L
Ja	O42		Oosterstraat	
Ja	Living 27		Oosterstraat	
Ja	Dime House		Oosterstraat	0
Ja	HK Living		Oude Boteringestraat	V
Ja	Godert Walter	v	Oude Ebbingestraat	0
Ja	Plato		Oude Ebbingestraat	?
Ja	Zwerver		Oude Kijk in 't Jat Straat	M
Ja	Holtbar		Oude Kijk in 't Jat Straat	L
Ja	WirWar	v	Oude Kijk in 't Jat Straat	M
Ja	TK Maxx	v	Guldenstraat	0
Ja	Wereldwinkel	v	Stoeldraaierstraat	0
Ja	Flokstra		Stoeldraaierstraat	0
Ja	America Today		Stoeldraaierstraat	L
Ja	De Groningse Kinderboekhandel		Stoeldraaierstraat	L
Ja	Ateliers Rare Toggery		Stoeldraaierstraat	0
Ja	The Body shop		Herestraat	0
Ja	So Low		Vismarkt	0
Ja	Slijterij Groningen	v	Vismarkt	0
Ja	Wijsneus		Vismarkt	M
Ja	Laif en Nuver		Vismarkt	V
Ja	100% Voetbal		Zuiderdiep	0
Ja	Expo		Zwanestraat	L
Ja	Woonzooi		Zwanestraat	L
Ja	Schoenenzaken		Zwanestraat	L
Ja	Cookinglife		Zwanestraat	L
Ja	Diezijner		Zwanestraat	H
Ja	Musjes		Zwanestraat	M
Ja	Magasin Dstrezzed		Zwanestraat	M
Ja	Catwalk		Zwanestraat	L
Ja	Het Kadocafe		Folkingestraat	?
Ja	La Ligna		Stoeldraaierstraat	?
Ja	Zumo		Folkingestraat	H

The process included 3 moments of data collection (questionnaires) to evaluate opportunities and results: before, during and after the pilot:

The first Questionnaire for the retailers (before the start of the pilot) included the following elements:

- Type of retail activities (location, shop, opening hours, products, customers, business model)
- Basis description of delivery process (names of suppliers, number of suppliers, number of days between order and delivery, people involved in delivery process etc)
- Delivery moments (days of the week, morning/afternoon etc., specific 'slots' for deliveries, number of deliveries)
- Potential return flows and process (waste, other)

- Type of transport/vehicle used for deliveries
- Logistics Service Providers (LSP's) or Transport Companies involved
- Packaging (type, volume, weight – box, container, pallet etc.)
- Technical (and other) requirements for unloading and delivery in the shop
- Specific requirements (temperature controlled, fragile good, dangerous goods)

The second Questionnaire for retailers (during the pilot) focused on data and information regarding the consolidation process (hub), deliveries and service:

- Reliability of deliveries (and consequences for processes retailer)
- Communication of delivery moments (and delays)
- Options for retailer to direct deliveries (and change delivery moments)
- Preferences for delivery moments, delivery sizes and specific services
- Internal opportunities for retailers as a result of the use of the hub (e.g. more square meters for core retail activities)
- Barriers and limits for retailers when using the hub (e.g. costs, delivery frequency, etc.)

The third and last Questionnaire (after the pilot) focused on future opportunities and services:

- Outsourcing / future use of hub by retailers: type of activities in the delivery process (basic services, labeling/packing, etc.)
- Benefits of outsourcing of pre-retail activities (for retailer): time, space, money
- Future activities and use of the hub (e-commerce, further development of retail activities in city)
- Importance of social and environmental benefits ('green entrepreneurship')

2. A business case for existing logistics service providers for using the hub

As the first prototype did not function as expected, a new prototype for the hub operation was implemented and tested, focusing on the business case for existing logistics service providers (LSP's). Seven well known LSP's which operate in the region were interviewed. These interviews focused on the operational aspects of the available bundling / logistic hubs facilities. Lessons learned were implemented in the prototype.

Based on truckspotting - in fact literally spotting trucks in the streets – twenty-one 'unknown' transport operators were identified. Those were called by researchers from the University in order to get more in-depth insights (volume, amount of stops, frequency).

In order to convince LSP's, the cost for use of the hub + delivery were compared to the costs incurred by the logistics service provider on the route from Eelde to the Groningen city center and back. Use of the hub could be beneficial for LSP's in case of single/small deliveries which would require a full trip to the City Center. The Hub operator could consolidate several small loads to arrive at an optimal and therefore cost-efficient load factor.

To substantiate this, open source data were used to develop a preliminary business model to compare alternatives (December 2018/January 2019). Parameters for the logistics service providers, such as costs per hour and logistics travel and stop times have been estimated by the Hub operator and researchers of the NHL Stenden University of Applied Sciences and the University of Groningen. The cost of the Hub operation was calculated by the Hub operator and verified by the research team.

Alternatief 1: Zelf rijden						
Element		*Eenheid*	*Waarde*	*Optimistisch*	*Pessimistisch*	*Typisch*
Tijdsduur naar de stad		min	15,00	10,00	30,00	15,00
Tijdsduur per stop	1e unit	min	12,00	5,00	20,00	12,00
Tijdsduur per stop	add unit	min	3,00	2,00	5,00	3,00
Tijdsduur tussen stops		min	5,00	2,00	15,00	5,00
Tijdsduur terug naar A28/Eelde		min	15,00	10,00	30,00	15,00
Kosten logistiek diensverlener		EUR/u	50,00	40,00	60,00	45,00
Aantal units	enkel	# (unit)	1,00	-	3,00	1,00
Aantal units	dubbel	# (unit)	-	-	3,00	-
Aantal units	triple	# (unit)	-	-	3,00	-
Aantal units	totaal	#	1,00			
Tijdsduur trip		min	42,00			
Kosten logistiek dienstverlener		EUR	35,00			
Kosten logistiek dienstverlener		**EUR/unit**	**35,00**			

Alternatief 2: Naar de hub						
Element		*Eenheid*	*Waarde*	*Optimistisch*	*Pessimistisch*	*Typisch*
Tijdsduur naar de hub (incl dokken)		min	5,00	3,00	7,00	5,00
Tijdsduur stop	1e unit	min	5,00	3,00	10,00	5,00
Tijdsduur stop	add unit	min	1,00	-	3,00	1,00
Tijdsduur terug naar A28/Eelde		min	3,00	3,00	5,00	4,00
Aantal units		#	1,00	-	3,00	1,00
Tijdsduur trip		min	13,00			
Kosten logistiek dienstverlener		EUR	10,83			
Kosten logistiek dienstverlener		**EUR/unit**	**10,83**			

Example: part of the business model used for prototype 2 (LSP's): *Comparison of direct transport (small shipment) and use of the Hub.*

3.5.3 Reflections

The four prototypes appeared interesting from a theoretical point of view, yet did not appear sufficiently profitable in practice. By using the data tools presented (1-to-1 interviews, questionnaires, business modelling/comparison of operation) the Hub operator and researchers learned about various bottlenecks while aiming to realize a hub, including insufficient knowledge and development of market demand, possible friction with existing hub-structures and consequently results opposed as to what was aimed at, and high demands for reliability and communication, which are very difficult for a start-up Hub operator to meet. These bottlenecks can be overcome, but not in the time span of one year of the pilot project. A trajectory of multiple years is needed, but even then uncertainty about the profitability of the hub will remain for a long period of time. Until that time the hub prototypes tested in the pilot are not profitable by definition. An important question is whether the final merits of the hub are worth the long trajectory and high costs. In a certain long trajectory the hub can actively work on the creation of demand, the mobilization of customers and the invitation to cooperate.

4 Discussion and conclusions

Based on the experiences from the various mapping methodologies described in the earlier chapters, as well as implications from a concluding meeting on WP4 on the 4´th of April 2022, some general conclusions can be made.

4.1 Outset and targets

The first step of the mapping process is to clearly define the information needed need from a policy and a business case perspective, and to have a clear link to the problem/solution case. Such as:

- What are you trying to do?
- What helps/what hinders?
- Who will use it? Commercial/Government/Public
- What does it mean – insights?
- Consistency: compare apples with apples
- Time – have enough
- Geography: defined area

A good start is to clearly define the data needed from a policy perspective and a business case perspective. Focus may be environmental targets (often policy related), but economic targets as well (related to the business model of the companies involved).

It´s important to formulate clear data expectations, and also to identify possible data that could be gathered (quantitative/qualitative, goods traffic flows, specific information regarding deliveries etc.).

4.2 Collecting qualitative and quantitative data

Qualitative and quantitative data have different areas of use, where quantitative data generally includes information on traffic flows and vehicle types, and qualitative data includes certain specific details of delivery patterns (and prerequisites for delivery) as well as the types goods, carriers etc.

Examples of gathering quantitative data are use of cameras, involvement of students to count vehicles, collaboration with logistics service providers involved to use their corporate data.

Examples of gathering qualitative data are consultation with /interviews with / questionnaires for retailers, consultation/interviews with real estate owners, interviews with residents / people on the street.

Gathering quantitative data may be a time-consuming process, with repeated contacts and dialogue with a large number of actors. If the partners of the project/initiative lacks the staff to perform these tasks, it is also an option to outsource these specific activities, e.g. universities, knowledge institutions, consultancy. One may focus on different target groups, using different questionnaires. Also, the ‘before’, ‘during’ and ‘after’ questionnaires where targeting different groups of

stakeholders. Data from similar cases may also be available, to possibly complement and strengthen the analysis.

Even though large amounts of quantitative data may be quite easily available from various monitoring systems, a significant effort may have to be made in order to elaborate the data to ansver the specific questions. Anomymization of the data is also an important part.

It has proven very important to stress the importance of mapping tools as vital element of the pilot design. No data, no pilot!

Before the start of the pilot, it may also be needed to make agreements regarding the use of data (corporate data vs. open source data).

Finally – its important to select the right mapping tools that fit the required data. One may use quantative data (e.g. number of trips, volume) in combination with qualitative data (gathered via interviews, focus groups, questionnaires, etc.). Important: each context (e.g. project or pilot) requires a different mix of mapping tools

4.3 Stakeholder engagement and cooperation

Initial information, dialogue and interviews with the businesses in the area of interest helps to create awareness of the problem/situation and further commitment to participate in the process, and it has proven important to involve stakeholders in the data collection process. To gather certain data from the stakeholders is also sometimes a matter of trust, in order for them to share their (sometimes confidential) data.

Sometimes the process can be executed in a more efficient way, because the businesses are represented by a ‘chair’, so that they all don’t have to be contacted individually.