# Making city logistics more sustainable

Rauws, Ward; Buser, Maaike

# MAKING CITY LOGISTICS MORE SUSTAINABLE:

## LEARNING FROM THE OPPORTUNITIES AND CHALLENGES FACED IN DUTCH CITIES

Ward Rauws & Maaike A. Buser


university of groningen
faculty of spatial sciences

# INTRODUCTION

## City logistics: a growing challenge for cities

Parcel delivery is growing fast! Changing shopping behaviour in Europe is accelerating the e-commerce business and the demand for city logistics (Morganti, et al., 2014). The kilometres driven by delivery vans increased 111% between 2016 and 2020 in the Netherlands (ACM, 2021). While the growth of the city logistics sector enables a wide availability of on-demand delivery services for residents, businesses and organisations, the sector also contributes substantially to traffic congestion, noise pollution and CO2 emissions (WEF, 2020). Moreover, the parade of vans and lorries that finds its way into the city every day affects the quality of public space by blocking streets and sidewalks when loading and unloading goods (Bosona, 2020).

The majority of parcel logistics in cities concern last mile delivery; the last leg of the supply chain in which a parcel is delivered to or picked up from businesses or residents (Brown& Guiffrida, 2014). Since the last-mile is the most polluting, expensive and inefficient part of the logistics trip chain, it is not surprising that new innovations pop-up to make last-mile delivery more sustainable (Dablanc & Rodrigue, 2017; Jiang et al, 2019). New transport modes such as light electric vehicles and cargo bikes enter the city and pilots aimed at consolidation through parcel lockers and city hubs are developed (see for instance www.ulaads.eu). These are the first steps towards sustainable city logistics and more liveable cities.

## The bumpy road towards sustainable city logistics

While the importance of transitioning towards sustainable city logistics is acknowledged and ambitious policy goals are set, the road towards sustainable logistics systems is bumpy and full of challenges. The European Green Deal aims for a 90% reduction in emissions in transport by 2050 (European Commission, 2021). In the Dutch policy context, fifty cities and other logistics stakeholders agreed to strive for emission-free city centres by 2025 (Zero Emissie Stadslogistiek, 2021). However, a recent scenario study consulting 26 experts indicates that a transition towards sustainable city logistics is far from a given and jeopardized by substantial barriers (Plazier and Rauws, 2022). To overcome these barriers and foster sustainable logistics innovations and policy integration, sharing experiences and advancing collective knowledge is essential. This booklet aims to offer a modest contribution.

## Getting inspired

This booklet presents a compilation of results from Bachelor's and Master's projects on city logistics from the Faculty of Spatial Sciences at the University of Groningen. It aims to inspire logistics stakeholders including policy advisers, decision-makers and residents with new possible sustainable solutions. The results are presented in three overarching themes:

- NODES, exploring how to effectively implement parcel lockers and logistic hubs
- FLOWS, identifying favourable conditions for cargo bikes, small electric delivery vans and drone delivery
- POLICIES, addressing the consequences of sustainable logistics policies for small entrepreneurs and retail districts

The student researchers have conducted their research in 2021-2022 with the use of a mixed-methods approach (e.g. questionnaires, interviews, policy document analyses and literature reviews). The Netherlands serves as the geographical context of all conducted studies, with the majority focusing on urban areas in the North of the country. We would like to express our sincere thanks to all who participated in the research.

The booklet starts with a section on city logistics nodes and flows. The second section concentrates on logistics policies and their implications. The booklet concludes with a summary of the main findings and lessons for policymakers. On behalf of all student researchers, we hope that you enjoy reading about the research projects and that you will get (even more) inspired!

Dr. Ward Rauws & Maaike Buser, MSc

Student Researchers:

Arnout H. de Haan
Jasper Dallinga
Jennifer Septiana
Jochem van der Deen
Lieke Eegdeman
Maaike A. Buser
Randy ten Brink
Stef A. van Oosterhout
Youri Meerstra

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861833

ULaDS
URBAN LOGISTICS AS AN ON-DEMAND SERVICE

# NODES

## HOW DIFFERENCES IN URBAN FORM AND RESIDENTIAL TRAVEL BEHAVIOUR INFLUENCE SUITABLE PARCEL LOCKER LOCATIONS.

Maaike A. Buser

### Expected soon: the parcel locker

With an increasing demand for parcel deliveries, innovative solutions are invented to facilitate last-mile delivery and reduce CO2 emissions. One of the more promising solutions is the parcel locker. Based on self-service technology, the lockers provide a flexible and secure pick-up location for citizens to collect their packages at any time of the day. The success of parcel lockers however depends on whether consumers complete the parcel pick-up using a sustainable mode of transport (Buijs & Niemeijer).


***Figure 1*** *Parcel locker of the Dutch postal agency PostNL (Post&Parcel, 2018)*

To investigate the willingness of consumers to use parcel lockers, this study examines user preferences on the suitable locations for parcel lockers in the municipality of Groningen. The rural area of Ten Boer and the inner-city centre of Groningen are compared to identify the influence of behavioural patterns of residents and the preferred location of parcel lockers for their neighbourhood. At first glance, the results, retrieved from 71 respondents of a Maptionnaire survey, indicate no big difference in the place-based preferences for parcel locker's locations between the inner-city area and rural area. Inhabitants of both

areas indicate that the location of parcel lockers should be reachable within a walking distance of 400-800 metres or on a 1000-2000 metres cycling distance (i.e. 5 to 10-minute walking or cycling trip).

### The design of the neighbourhood matters

Upon closer examination, the data reveals that the distinct urban morphology of both areas produces differences in how parcels will likely be retrieved from the locker. In the rural area of Ten Boer, the urban density is lower which explains that most respondents prefer to use the bike for picking up parcels, while in the inner-city respondents indicate to go preferably by foot (figure 2). Moreover, the neighbourhood design and infrastructure in more rural areas stimulate car use while the spatial configuration and regulations in inner cities discourages car use. This influences the sustainability of chained trips to parcel lockers, in which picking up the package is combined with another activity. In both areas, respondents indicate that they expect to combine parcel collection with grocery shopping. However, when combining parcel collection with grocery shopping, in the rural area of Ten Boer respondents preferably go by car for groceries while respondents from the inner city go by bike or on foot. Reasons for this preference can be the density of available facilities, the urban morphology and the difference in grocery shopping; when shopping for groceries, respondents in Ten Boer indicate stocking up for multiple days (e.g. for a week).

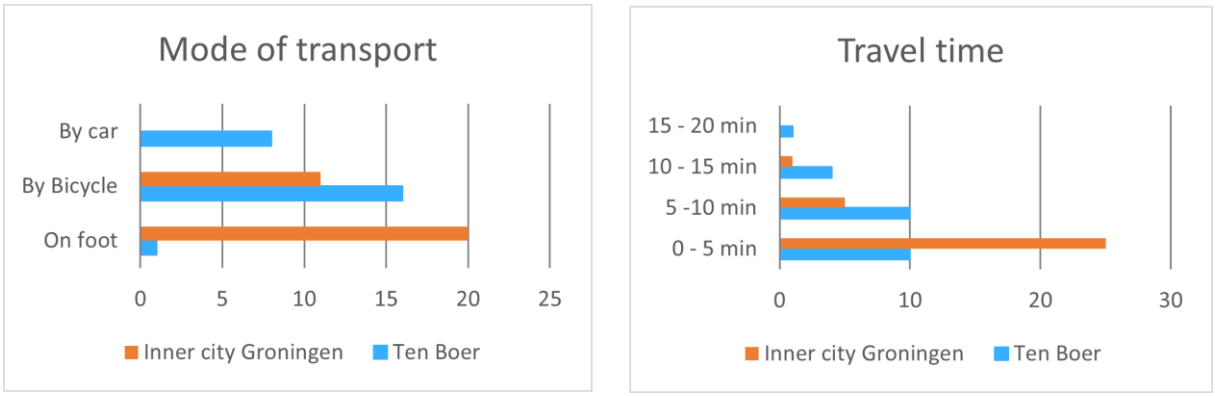


***Figure 2*** *Graphs indicating the choice of mode of transport and the travel time of respondents collecting a parcel*

Exploring suitable locations for parcel lockers, three criteria stand out. Respondents from both areas indicate that they are more likely to use parcel lockers that are accessible 24/7, at sites with high levels of social control and within a range of 5 to 10 minutes on foot or by bike. Nevertheless, the preference of respondents from Ten Boer for available parking lots nearby implies a difference in suitable locations for parcel lockers in urban and the rural areas (figure 3).

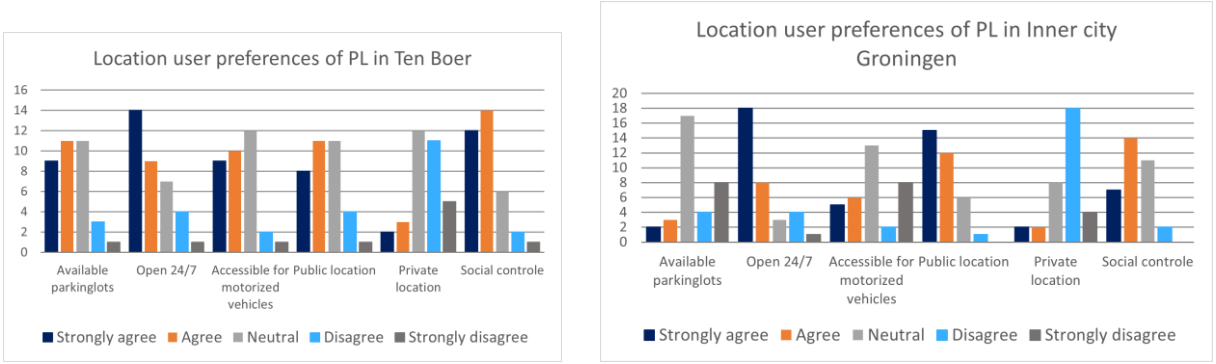


***Figure 3*** *User preferences for the location of a parcel locker in Ten Boer and Groningen*

### Conclusion

This study shows that a one-size-fits-all rule for determining suitable locations for parcel lockers does not exist as a consequence of differences in neighbourhood morphology and related travel behaviour by residents. Nevertheless, public sites with high levels of social control within 5 to 10 minutes on foot or by bike are criteria that offer a good start for location selection. Adopting a place-based approach in selecting the parcel locker location that stimulates consumers to collect the parcel in a sustainable way thereby creates the opportunity for parcel lockers to be a sustainable last-mile delivery option.

---

## DOES NEIGHBOURHOOD DESIGN INFLUENCE THE SUSTAINABLE USE OF PARCEL LOCKERS BY RESIDENTS. Randy ten Brink

### Do parcel lockers contribute to sustainable city logistics?

Parcel lockers can reduce the number of trips by logistics operators and as such help to reduce congestion and allow operators to avoid certain areas during peak hours. However, whether parcel lockers contribute to more sustainable city logistics also depends on the transport mode consumers use to collect their parcels (Buijs & Niemeijer). Urban form likely influences this relationship. The neighbourhood design and its perceived qualities for different types of mobility influence the travel behaviour of residents (Aditjandra et al., 2013), and thus also the trips to the neighbourhood's parcel lockers. The hypothesis is that in a densely populated neighbourhood with a traditional designed fine-grain street network residents are more likely to pick up their parcels on foot than in a suburban neighbourhood (Aditjandra et al., 2013, Handy et al., 2005).

To explore the relationship between travel behaviour and neighbourhood design, two neighbourhoods in Groningen - the traditional Noorderplantsoenbuurt and the suburban neighbourhood Reitdiep - are compared (figure 4). Three factors are examined: 1) the access to transport mode options, 2) the distance residents are willing to travel to a parcel locker, and 3) the willingness to trip chain. It is expected that the neighbourhood design can influence these travel behaviour factors via the subjective social safety of a neighbourhood and the facilitation of particular modes of transport (e.g. a dense network of sidewalks facilitates walkability).


***Figure 4*** *Noorderplanstoenbuurt (left) and the Reitdiep neighbourhood (right)*

## Similar travel preferences for traditional and suburban neighbourhoods

The distributed questionnaire resulted in 126 responses, 75 from the Reitdiep neighbourhood and 51 from the Noorderplantsoenbuurt. Interestingly, the results indicate no substantial differences in the perceived qualities of the neighbourhood for car use, cycling or travelling by foot. Similarly, no substantial difference was found between reported levels of safety. Hence, the study found no evidence for differences in neighbourhood design to be influential on travel behaviour. A possible clarification is that, compared to international standards, suburban areas in the Netherlands have a relatively high destiny of destinations and an excellent cycling and walking infrastructure.

In both neighbourhoods walking and cycling are preferred modes of transport for collecting packages, implying that residents are likely to make CO2-free trips to collect their parcels from the parcel locker. Nevertheless, in the suburban neighbourhood of Reitdiep the temptation for residents to occasionally use their car, for instance with bad weather conditions, is higher. Almost all respondents own a car compared to half of the respondents from Noorderplantsoenbuurt and indeed 8 % of the respondents in Reitdiep indicate that they prefer to use their car to collect a package from a parcel locker. Even this small percentage of car users potentially nullifies the positive sustainability effect of parcel lockers (Niemeijer, 2019).

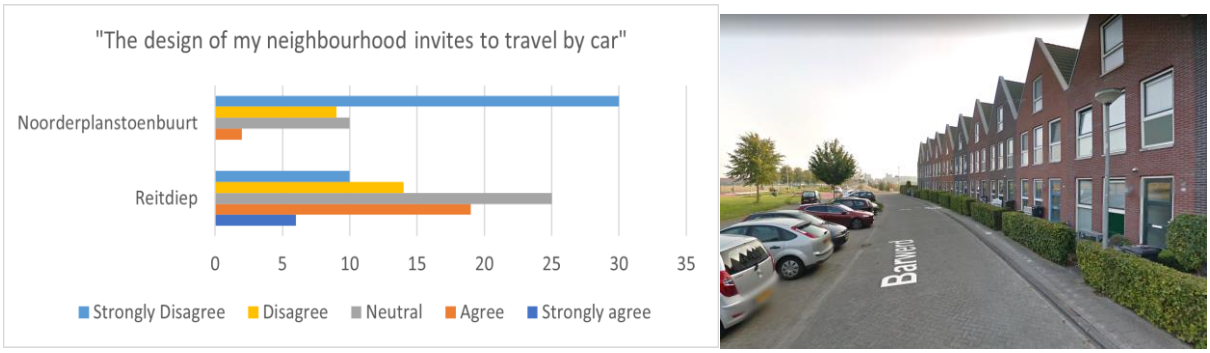


***Figure 5*** *The graph indicates if the neighbourhood invites resident to use the car. Reitdiep (right) invites the car more.*

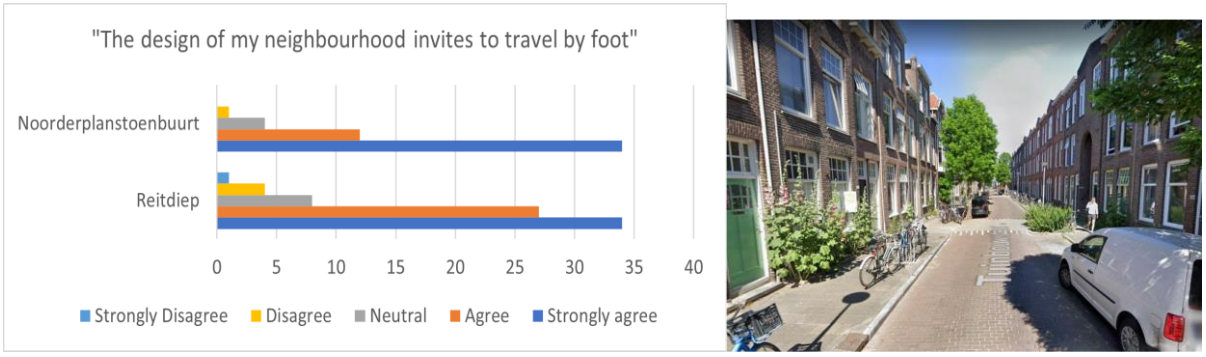


***Figure 6*** *The graph indicates if the neighbourhood invites resident to travel by foot. Reitdiep (right) invites the car more.*

## Conclusion

Parcel lockers can contribute to more sustainable last-mile delivery, especially in the traditional neighbourhood of the Noorderplantsoenbuurt. In this neighbourhood, all respondents intend to use a sustainable mode of transport (walking or cycling) for collecting their packages from the parcel locker.

The expectation that residents of a suburban neighbourhood will more often use the car is proven reversely. Most respondents are willing to collect their parcel from a parcel locker either on foot or by bike.

## CAN A SHARED LOGISTICS SYSTEM BE A DURABLE CONTRIBUTION TO SUSTAINABLE CITY LOGISTICS? Jochem van der Deen

### Bundling transport flows to supply the city centre more sustainably

Logistics hubs offer an opportunity to decrease the total of driven kilometres and lower the number of vehicles entering the city centre (Masson et al., 2017). Logistics hubs are based on the principle that multiple actors of the city logistics web cooperate in the last mile. With the trend of smaller electric vehicles that deliver goods within the city centre, the hub functions as a transfer point at which goods can be unloaded, sorted, and loaded to dedicated city centre transport (figure 7). Combining the city hubs with electric vehicles or other sustainable modes of transport can decrease the logistics' carbon footprint (Muñoz-Villamizar et al., 2017).

The potential benefits of a shared logistics system, also known as a logistic city hub or urban consolidation centre, is that different flows of transport are bundled. However, a shared logistics system can only become a positive contribution to sustainable city logistics, if it is located near the city centre and meets the conditions for electrification and accessibility. This research explores the sustainable contribution of a Shared Logistic System from an in-practice experience.

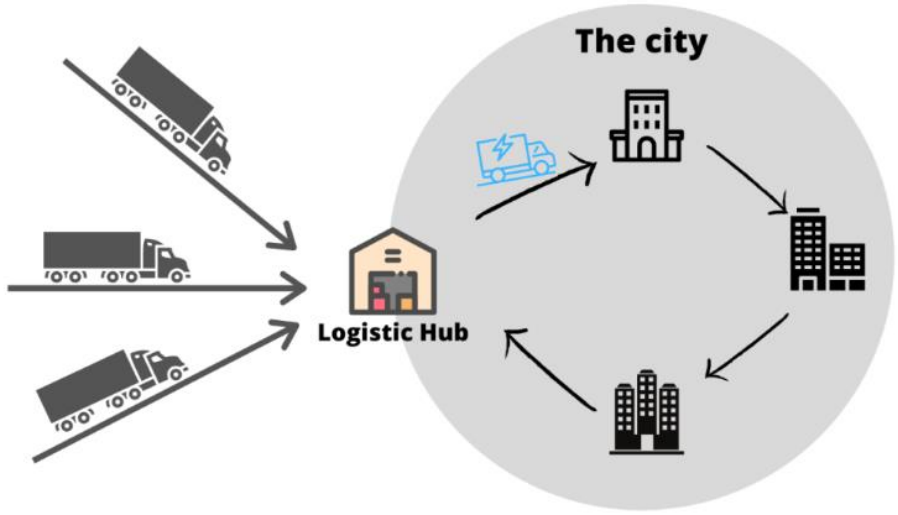


***Figure 7*** *An example of a Shared Logistics System*

### Key considerations for a sustainable Shared Logistic System

With the help of five expert interviews, three key considerations for a shared logistics system for sustainable city logistics have been identified: 1) the electrification of the transport vehicles, 2) the locations of the shared logistics system and 3) the accessibility of the shared logistics system. Next, challenges and opportunities in the operation of shared logistics systems have been mapped for the cities of The Hague, Amsterdam, Nijmegen, Groningen, and the region Zuid-Limburg.

### Performance of a Shared Logistic System in practice

The interviewees indicated that the electrification of transportation vehicles creates opportunities for using smaller and lighter vehicles for freight delivery which have a lower environmental impact than the motorised bigger trucks. Nevertheless, a part of the vehicles relies on public charging points, which forces drivers to take detours or wait for a charging point to become available. A solution could be the instalment of private charging points, only for the hub. However, the limited capacity of the electricity grid constrains the implementation of these points. Hence, the full potential of electrification cannot be realised currently, and this problem is likely to worsen as further growth of the shared logistics system is expected.

The accessibility and the location of the shared logistic system affect the performance of the consolidation hub. The shared logistics system should be easily accessible for freight deliveries, parking and unloading/ loading of goods (Browne et al., 2005). Furthermore, the location of the shared logistics system should be a balance between accessibility for freight transport coming from elsewhere – i.e., a location close to access roads with enough storage and parking space - and good accessibility to the clients in the city centre (Olsson & Woxenius, 2012). The idea of a shared logistics system is to minimise the driven kilometres in the urban areas, and since the capacity of electric last-mile vehicles is limited a location close to the city centre is most optimal (Masson et al., 2017).

An overview of the locations of the five shared logistics systems (SLS) that have been studied is presented in figure 8. As can be seen, the consolidation hubs are located at the edge of each city centre except for the SLS in the region Zuid-Limburg, which facilitates the bundling of freight for three cities (Sittard, Heerlen and Maastricht). The evaluation of the locations shows that these are strategically chosen and enable a good performance of the hub. However, in the case of The Hague, clients are widespread which causes inefficiency and in Zuid-Limburg, the aim to serve three cities creates inefficiencies in how routes are scheduled. Across the studied hubs, various practical measures have been taken to optimise their performance, such as a surplus of loading docks/places, active support of hub employees with loading/unloading vehicles and broadening roads around the hub.

### Conclusions

When the electrification, location and accessibility are considered shared logistic systems can be a durable contribution to sustainable city logistics. On top of these, the experts suggested that providing financial and or legal incentives for cooperation between logistics stakeholders, for instance between big clients like municipalities, universities and hospitals, is an additional measure that can further improve the performance of shared logistic systems.

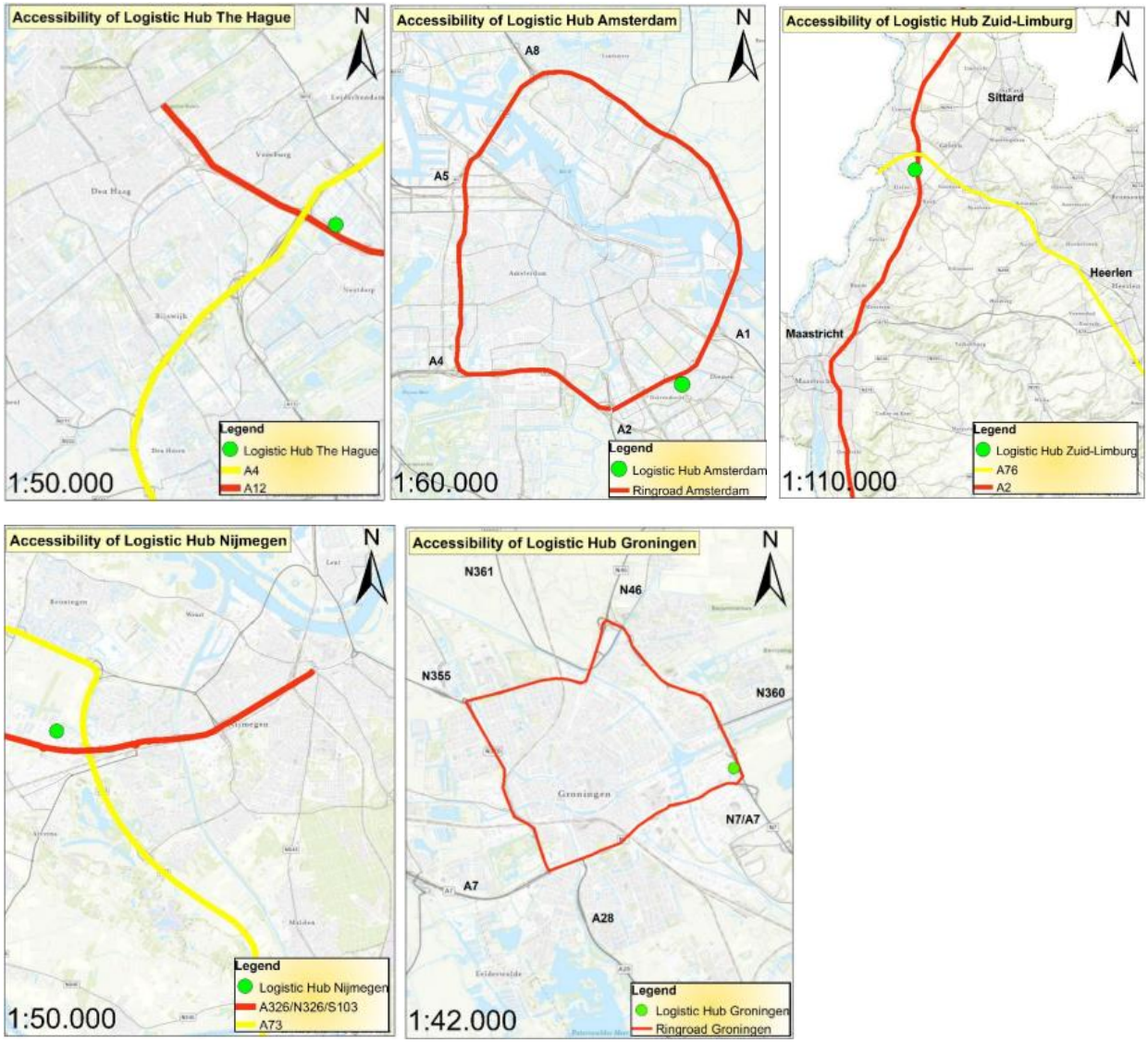


***Figure 8*** *The map shows the location of 5 SLS in The Hague, Amsterdam, Zuid-Limburg, Nijmegen, Groningen.*

# FLOWS

## THE PERCEIVED SAFETY OF CARGO BIKES. Youri Meerstra

### Cargo bikes are the new delivery vans

Traditionally, urban freight transport is carried out with motorised vans running on fossil fuels. This causes serious problems in inner cities when it comes to CO2 emissions, noise pollution and the attractiveness of public spaces. In multiple Dutch cities, vans are being replaced by cargo bikes to perform the last-mile delivery in an environmentally-friendly way, for instance by companies such as PostNL, DHL and Cool Blue. Additionally, families increasingly use cargo bikes to transport their children. All in all, the number of cargo bikes in inner cities rapidly increases (Riggs, 2016; Voermans, 2020).

***Figure 9*** *Different types of cargo bikes.*

This study investigates whether the growing number of cargo bikes (figure 9) affects the perceived safety of residents in the city of Groningen. It also analyses how perceived safety influences the public acceptance of cargo bikes. Perceived safety is defined as “the degree to which individuals perceive that using a system is safe for them” (Jahanshahi et. al., 2020, p.1216). With help of a survey, residents have been questioned about perceived safety in two scenarios: one scenario representing the current urban transportation network and the other scenario picturing an urban transportation network with an increased number of cargo bikes.

### Are cargo bikes perceived as dangerous?

The 39 respondents of a distributed questionnaire graded the perceived safety in the current urban transportation network on average with a 6.36 out of 10. Compared to the scenario with an increased number of cargo bikes which was graded with a 5.95, the current transport network scores higher on the perceived safety. To investigate possible explanations, the concept of perceived safety was tested for three factors: 1) the involvement of residents in a dangerous situation or accidents involving a cargo bike, 2) the ability of residents to either ride or handle a cargo bike and 3) the acceptance of cargo bikes.

Three respondents did experience a dangerous situation with a cargo bike. Indeed, their score for perceived safety resulted in a lower grade in comparison to respondents who did not have an unsafe experience. Furthermore, 31 respondents indicated to have never used a cargo bike before, and thus their score on perceived safety is not based on their experiences of driving a cargo bike. Finally, those respondents that scored high on the level of perceived safety also indicated a high level of acceptance

of cargo bikes. This suggests that for the acceptance of cargo bikes, a positive perceived safety by residents is important.

### Safety provided by the urban transportation network

Interestingly, all respondents proposed possible solutions for improving the urban infrastructure and transportation network to increase the perceived safety of cargo bikes. Dedicated parking spaces for cargo bikes should be made more numerous according to the respondents to reduce obstacles on the pedestrian routes. In addition, respondents suggest widening roads and intersections to create more room for both cargo bikes, cyclists, and pedestrians. Paradoxically, creating more room for cargo bikes on the street may mean that their average speed of driving will increase.

### Conclusion

A growing number of cargo bikes without urban infrastructure adjustments may lead to a decrease in perceived safety according to residents in Groningen. The relation between perceived safety and the acceptance of replacing delivery vans with cargo bikes indicates that enhancing the perceived safety of residents is important to reach the full potential of cargo bikes in last-mile delivery.

---

## ENABLING AND HAMPERING INNER CITY INFRASTRUCTURE FACTORS FOR CARGO BIKES. Lieke Eegdeman

### The next trend: cargo bikes

With the potential of cargo bikes to replace part of the unsustainable delivery services, it is expected that the use of cargo bikes will continue to grow (Boysen et al., 2020). Is the urban infrastructure capable of accommodating this trend and what are possible barriers for cargo bikes in last-mile delivery?

The municipality of Groningen aspires to become the ‘Cargo Bike Capital’ (Municipality of Groningen, 2021). The policy plan provides multiple pilots to stimulate the use of cargo bikes, making the cargo biker a permanent user of the urban transportation network. Considering this ambition, this study aims to identify enabling and hampering urban infrastructure conditions in Groningen for the optimal use of cargo bikes with help of the experiences of professional cargo bike drivers.

### Cycling cities have the advantage

Four design criteria, Safety, Comfort, Coherence or Usability of facilities and Directness, are assumed to generate functional and comfortable cycling infrastructure in Dutch cities (CROW, 1993). These criteria are taken to evaluate the cycling infrastructure in Groningen, a city in the Northern Netherlands that prioritises pedestrians and cyclists over cars. The results from 5 semi-structured interviews and 17 survey responses with cargo bike drivers indicate that the existing cycling infrastructure of Groningen works well for the use of cargo bikes.

The current cycling infrastructure of Groningen scores well in terms of comfort and safety. Crowded shared spaces are the only hampering factor. Here, the cargo bike drivers consider the chance of collisions considerable. Aside from this safety issue, the cycling route network of the city of Groningen ensures multiple routes that provide a direct connection from point A to B, enabling the cargo biker to

choose the most convenient route. Furthermore, the necessary facilities such as access to city hubs, parking, loading and unloading spots are all available and accessible for cargo bikers

### Boosting the cycling city

Despite the positive evaluations of the cycling infrastructure of Groningen, there are opportunities for further improvement. Due to the difference in speed and size between 'normal cyclists' and cargo bikes, manoeuvring around other cyclists and pedestrians can cause unpleasant situations for all (figure 10). Therefore, it is suggested to allow cargo bikes to use the bus lanes. This would create more comfort for the cargo bikers as they can avoid crowded places and choose a more direct route for their delivery.


***Figure 10*** *This figure shows the locations in the inner city of Groningen of safety issues.*

Another point for improvement is road maintenance during winter weather conditions. With snow and heavy rainfall, the inner city roads can become slippery or impossible to use. If the municipality wants to support the use of cargo bikes in all seasons, good maintenance of the roads is thus necessary for cargo bike companies to perform. Finally, with a growth in the use of cargo bikes, the municipality can take a facilitating role in 'asset sharing'. A shared storage space, charging equipment for electric bikes and parking lots, may stimulate the use of cargo bikes by more companies in the city centre.

# THE POTENTIAL OF DRONE DELIVERY IN RURAL AREAS. Jennifer Septiana

## Drones as a Service: an innovation for rural parcel delivery

The typical low population density in rural areas and remoteness of housing estates cause logistics delivery routes to be less efficient, leaving these rural areas to be excluded from next-day delivery or priority services (Leon et al., 2021; Savills, 2020). A new and innovative delivery method could be a fitting match, drone as a service (DaaS) for goods delivery (figure 11).

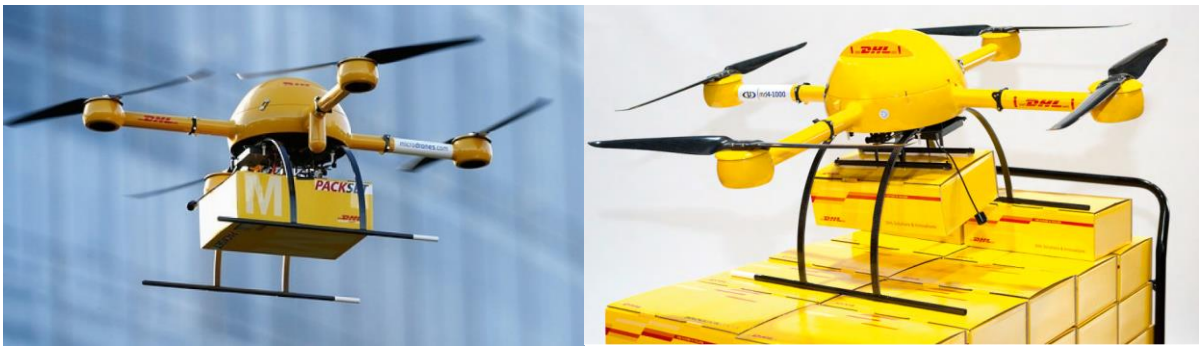

***Figure 11*** *DHL "paketcopter"*

The unfamiliarity with drone delivery and the perceived unsafety of drones forms a barrier to the acceptance of drone and its implementation (Chakravarti et. al., 2021). Familiarity of residents with the technology and the potential advantages together with safe and reliable landing zones can help overcome the concerns about drone delivery. This study explores four different landing zones in three villages in the Dutch province of Drenthe. Analysing the public perception of these landing zones, the study aims to examine the influence of the perceptions of drone applications and safe landing zones on the acceptance of drones by inhabitants.

## Where to land your package?

For the drone to detect a suitable landing zone for delivery, the proposed area should be unobstructed and vast (Loureiro et al., 2020). A private property, the street, the centre of a village or the edge of a town are evaluated as four potentially suitable landing zones. In the rural villages of Zeegse, Gasteren and Anloo, 44 respondents answered a questionnaire about their perception and acceptance of drones. Most of the respondents indicated preferring their own property as a landing zone for drone delivery. Interestingly, a significant relationship is found between respondents' feelings toward a landing zone and their support for drone delivery. When the respondent has a positive feeling about their front lawn as a delivery zone, they tend to support drones to deliver their goods.

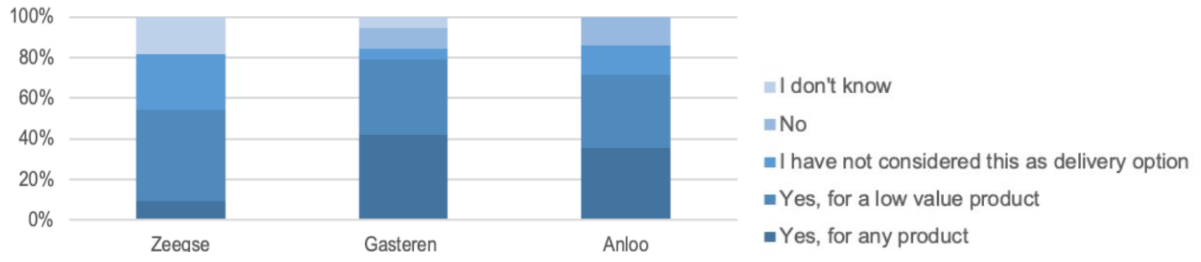


***Figure 12*** *Degree of trust for drone delivery*

### Public Acceptance of DaaS for goods delivery

Testing the familiarity with drones against the age, gender and education of respondents have revealed that only gender is an influential socio-demographic condition. Women are likely to be less familiar with drones, compared to men.

The majority of the respondents have a positive attitude towards drone delivery for first-aid medical use and delivery purposes. Those who are positive about drone delivery also have trust in the delivery process in general and specifically for low-value products. Despite the level of trust in DaaS as a delivery mode for goods, respondents are concerned about cluttered airspace and theft or the risk of hacked drones that in turn will become a safety risk. Animal welfare and possible nuisance are other concerns of the respondents and should be considered before implementation

### Conclusions

Although drone development is still at an early stage, Drone as a Service for the delivery of goods can get the support of respondents in the rural villages of the Dutch province of Drenthe. A safe and reliable landing zone is an important factor in generating acceptance of the technology and the front lawn is the preferred location. Highlighting the advantages of drone delivery and informing users of the service, can create higher support for DaaS. Noise hindrance, safety and animal welfare are possible barriers for the implementation and acceptance of drones in rural areas.

---

## ARE HISTORICAL CITY CENTRES READY TO WELCOME SMALL ELECTRIC DELIVERY VEHICLES?

Stef A. van Oosterhout

### Small vehicles become the big players in last-mile city logistics

The liveability and attractiveness of the inner city ask for new logistics solutions. Municipalities are presenting logistical policy plans that encourage the use of vehicles other than the traditional motorised vans. Nevertheless, urban infrastructure plays an important role in enabling or hindering sustainable solutions for the last-mile delivery of parcels.

This study investigates the infrastructural opportunities and barriers for small electric distribution vehicles in historical city centres in the Netherlands. As an alternative to big, noisy and polluting vans, small electric distribution vehicles (SEDV) are zero-emission, easily fit on a bicycle lane and can often park close to the delivery address due to their compact size. While the popularity of SEDVs increased (Rieck et. al., 2019), municipalities so far promote these vehicles without considering possible obstacles formed by the existing urban infrastructure.



***Figure 13*** *Examples of SEDV*

### The character of historical city centres

The original city wall allowed historic cities to create small multifunctional roads and a high-density building rate (Kofstof et. al., 1992; Morris, 1979). Since the cities originate from times when cars did not exist, the infrastructure is not designed for car use purposes. The different road types with varying road designs in historical inner cities can generate challenges and opportunities for SEDVs. For instance, steep bridges, high sidewalks, and roads with a small turning radius can be tricky for SEVDs; ''Delivery vehicle of Picnic falls on its side (and that's not the first time)'' (AD, 2019). Also speed differences between pedestrians, cyclists and SEDVs increases the risk of accidents (Dijkstra & Petegem, 2019). To explore the enabling and hampering conditions for SEDVs, the historical city centres of Leiden, Groningen, Zwolle and Leeuwarden are tested on four urban infrastructure design principles established by the ANWB (2020) to ensure road safety in inner cities; traffic safety, liveability, accessibility and road design. The historical city centres are evaluated on the four principles, based upon seven semi-structured interviews, a policy document review, and a participatory observation as a SEDV passenger in five different rides.

### Challenges and opportunities in historical city centres

The speed and silence of a SEDV are seen as the main reasons for unsafe situations in traffic. All interviewed policymakers express their concern for the allowed speed limit for SEDVs in the city centres compared to the speed of other road users. The silence of the SEDV contributes to the liveability of a city centre by preventing noise pollution. Nevertheless, this silence is also the main reason for unsafe situations according to the interviewee and the SEDV passenger observation. The risk of collision increases due to the inability of pedestrians and cyclists to hear the SEDV approaching. Some SEDV manufacturers are testing speakers to overcome this issue. As observed during the participatory observations, measures to promote liveability actually can hinder the wide application of SEDVs: time windows, which are implemented to reduce motorised traffic in the city centre restrict SEDV deliveries at certain addresses during the day.

The limited capacity for charging electric vehicles might hamper the delivery service with SEDVs. With the current challenge of adding more charging points, the network capacity could form a barrier eventually. Other facilities, such as (un)loading places, are seen as enablers for the use of SEDV in inner cities (figure 14). With the permission to unload close to the delivery address, no challenges are experienced.

***Figure 14*** *SEDV's (un)loading in the city centre of Leiden (left), Zwolle (middle) and Groningen (right)*

## Conclusion

Overall, the urban infrastructure of the Dutch historical city centres does facilitate the last-mile delivery with SEDVs. Policymakers indicate that they promote SEDVs without introducing changes to the road design, except for decreasing the speed limit to ensure road safety. Nevertheless, the participatory observations and the expert interviews bring up examples of road design in practice which form possible challenges. Steep bridges, roads with a small turning radius or high sidewalks can be a barrier to delivering goods in the inner city. Moreover, the silence of SEDVs may cause unsafe solutions for cyclist and pedestrians, and the limited charging capacity may hamper the wider application of SEDVs.

# POLICIES

## HOW DO SUSTAINABLE CITY LOGISTICS POLICIES INFLUENCE SMALL ENTERPRISES IN THE CITY CENTRE? Arnout de Haan

### The special position of small enterprises

Local authorities intensify their policy actions to foster a transition towards more sustainable city logistics, including zero-emission zones, delivery windows, and (micro)hubs. These policy actions require local businesses to adapt their operations. They for instance need to rearrange the supply and export of their goods.

This study investigates the effects of policies for more sustainable logistics on small enterprises in inner cities. Typically, small businesses have fewer resources to adapt to new policy requirements than large and medium-sized enterprises (Bushe, 2019). They have limited time, knowledge, and financial capacities to innovate their business operations. Adopting a capability approach, this study examines the effect of policy initiatives on small enterprises in the inner cities of Groningen and Zwolle, the Netherlands.

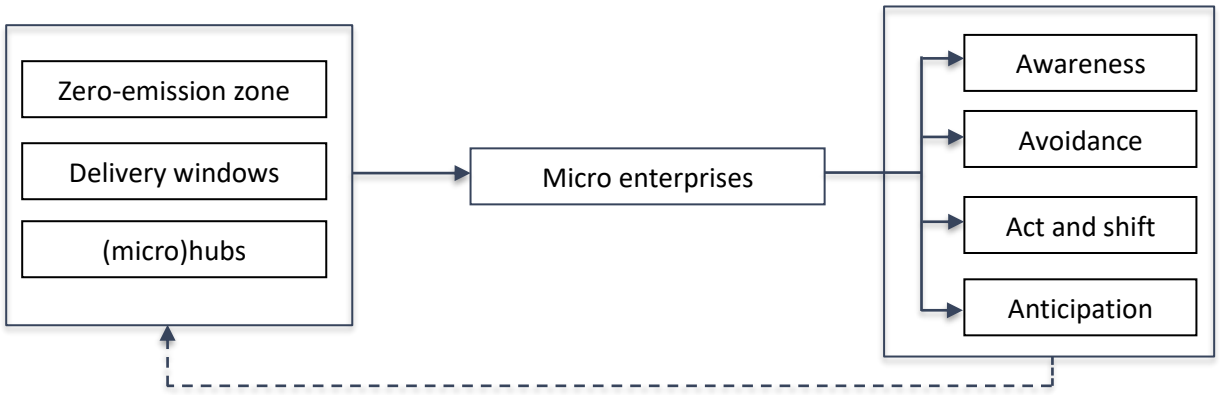


***Figure 15*** *Conceptual Model on how logistics policy measures influence the capabilities of small enterprises*

### Assessing ability and willingness to adapt

Adopting a capability approach allows for analysing the social implications of city logistics as the capability approach focuses on the situation of single actors. The capability approach is concerned with the *ability* of stakeholders to adapt to imposed laws and regulations as well as the *willingness* of stakeholders to adapt. Hence, it does not focus on the available means in isolation, for example, having access to electric vehicles. It rather focuses on "what people are able to do with these means, - the outcome" (Stanford Encyclopedia of Philosophy, 2020). For instance, are companies able to charge their electric vehicles to transport and deliver goods?

A comparative case study is conducted, investigating the impact of three types of policy measures on the capability of small enterprises: a zero-emission zone, restricted delivery windows and (micro) hubs/UCCs. The impact of these policy measures is structured along with four types of behaviour ingredients that enable entrepreneurs to make their logistics more sustainable: Awareness, Avoidance, Act and shift, and Anticipation. The data is collected with a mixed-methods approach, both a survey and interviews are used to gather insight on the topic. The survey has had 35 responses from local entrepreneurs, and eight interviews were conducted with experts, policymakers, and consultants. The

results indicate that the new imposed sustainability initiatives will affect the capabilities of small enterprises.

### Awareness shapes ability and urgency

Results from the study show that the majority of the small enterprises in question are acquainted with the three policy initiatives. Furthermore, the businesses who are more acquainted with the policy changes expect more significant effects on their operations and/or have anticipated better in comparison to enterprises who were less acquainted. Hence, awareness shapes ability and urgency. Nevertheless, across the whole set of respondent Awareness scores only half of the points on average. From the policy-side Attention is given to introducing the new sustainability initiatives; however, information is missing on how small enterprises can take part in it.

### Limited options to avoid freight traffic

Enterprises can avoid some of their freight traffic using a (micro)hub. The questionnaire shows that small enterprises do not need a micro hub nor are they able to invest in a hub on their own. Interviewees expect hubs only to be efficient when used by (almost) everyone. The possibility to share a logistics hub or join a 'hub service' could be a solution, however, this initiative is currently underdeveloped.

### Shifting logistics operations worries entrepreneurs the most

Entrepreneurs consider policies that require them to shift logistics operations in time or shift to more sustainable transport modes to have the most impact on their capabilities. The implementation of a zero-emission zone would require such an Act and Shift. They indicate that a lack of information due to the complex nature of city logistics and resources holds them back in taking action to adapt to the policy initiative. Suggested interim solutions are to improve the accessibility and depth of information for entrepreneurs. Policymakers can also support entrepreneurs in decision-making on future investments and as such mitigate the impact on the entrepreneur's capability.

### Anticipation is key but receives little attention

In keeping viable options for their business operations open, anticipating changes in city logistics policies is key for entrepreneurs. However, the implementation process of the zero-emission zone in the city of Groningen showed the two sides of the anticipation concept. While an extended deadline was set for small enterprises to be able to anticipate the zero-emission regulations, this extension reduced the urgency of investment. Hence, it is still likely that crucial decisions will not be made in time hindering the capacity of small enterprises in the future.

### Conclusion

Policies for more sustainable city logistics are likely to put much pressure on small enterprises. This pressure will negatively affect the four capabilities of these companies to adapt in time: Awareness, Avoidance, Act and shift and Anticipation . Entrepreneurs perceive limited support from local authorities in preparing for changes in city logistics. Fostering exchange and cooperation amongst small entrepreneurs in exploring viable adaptations of their business operations can be a way to better understand their abilities and willingness to contribute to more sustainable city logistics systems.

## PREVENTING A VACANT INNER CITY: HOW CAN RETAILERS ADAPT TO E-COMMERCE AND VEHICLE RESTRICTIONS. Jasper Dallinga

The purchasing behaviour of consumers is changing the business concept of retailers in inner cities. With the continuous growth of online shopping and the rising demand for last-mile delivery, retailers face an uncertain future. Moreover, high logistics costs in combination with new and more restrictive logistics policies incentivise retailers to rethink their business concepts.

In the city of Groningen, this challenge is getting very real with the introduction of a zero-emission zone in the inner city (figure 16)(Gemeente Groningen, 2021). With time windows and new regulations for the use of transport vehicles, new ways of delivering supplies to retailers have to be developed.

***Figure 16*** *Zero emission zone in Groningen*

This study sheds light on how retailers together with logistical policymakers can anticipate the changing purchasing behaviour of consumers and identifies opportunities to enhance the attractiveness and liveability of inner cities under these conditions. Main trends and challenges for retailers in the inner city have been identified with help of document analysis and four expert interviews.

### The transformation of the retail store

The first trend introduces two new functions for retail stores; a showroom and a stockholding location. As a showroom, retailers store their supplies in another location close to the city. Consumers can explore

the collection, try out products and purchase these products in-store, after which the goods will be transported from the warehouse location elsewhere in the city to the consumer's home or a pickup point. As a second functionality stores can turn themselves into a stockholding location for the delivery of online-ordered goods to the consumer's addresses. The delivery of foods from restaurants, e.g. Thuisbezorgd and Uber Eats, as well as grocery courier services such as Gorillas and Flink, are examples. Both functions have implications for the logistic flows. Turning stores into showrooms (figure 17) enables retailers to rent smaller spaces but increases the number of home deliveries. Furthermore, the stockholding function asks for substantially more parcel transportation in and out of the city centre.

However, experts indicate that the rise of showrooms and stockholding locations in inner cities will meet resistance from citizens and local authorities. Physical stores contribute to the attractiveness and liveability of the inner city. To keep these physical stores viable rental prices need to be lowered and the retailers have to invest in concepts for their stores and reorganise their logistics in line with the zero-emission restrictions.

***Figure 17*** *Pictures of a retail showroom*

### Micro depots and cross-docking centres for inner-city logistics

Micro depots and cross-docking centres can play a key role in these new inner-city logistics systems. They would allow shop owners to bundle flows of goods and collectively set up and commission a network of zero-emissions delivery services for the last mile. In collaboration with the municipality, retailers could invest in logistics real estate. Through such collaborations, traditional retailers may prevail and a high level of vacancies may be prevented. Hence, the transition towards more sustainable city logistics in combination with the rise of e-commerce and on-demand delivery requires new forms of logistics real estate on the edge of the city.

# CONCLUSION

Initiatives are taken at many frontiers to make city logistics more sustainable and contribute to attractive and liveable cities. As the presented studies show, each comes with its own opportunities and challenges. The overall impression that arises from the studies is that both public and private actors have just started rethinking the logistical system and their own roles and responsibilities. Many more steps towards sustainable city logistics can thus be expected. Across the three overarching themes of nodes, flows and policies, three main conclusions can be drawn, concerning modes of transportation, the importance of space and the role of local authorities. Also the consolidation of freight flows and generating public support for policy initiatives are key topics.

Change is on the horizon, especially for modes of transportation. Cities and regions are experimenting with cargo bikes and (small) electric delivery vehicles to make last-mile delivery more sustainable and regions explore the potential of drones to do so for more remote places. The corresponding studies indicate that the public does support the transition toward sustainable modes of transport, as long as the safety of the service is enhanced for both drivers and residents.

Space matters! Urban morphology is a decisive factor in the success of sustainability initiatives. Neighbourhood design shapes the travel behaviour of residents and thus influences whether residents choose a sustainable mode of transport to collect their parcels from a parcel locker. Differences in urban density affect the potential for consolidation centres and parcel lockers. It is challenging to find the right location for a city hub in a highly densified urban areas for example. The location of the consolidation centre should be accessible for both (un)loading transport and for freight transportation into the city centre. In boosting sustainability it is thus important that we look beyond the logistic systems themselves and also take into account the interdependencies with the urban environments, its residents and urban planning proposals.

The role of local authorities becomes more prominent. Compared to urban mobility - the transport of people - the involvement of local authorities in city logistics is minimal. The presented studies show that this is changing. By supporting new initiatives, facilitating collaboration and installing stricter access regulations for city centres, local authorities take a more active role. This booklet shows that policymakers should keep an eye on how policy measures can play out differently for small entrepreneurs in comparison to bigger ones, and how the urban environment might present more challenges than seen at first sight. Policymakers are advised to intensify dialogue between stakeholders to get to grips with the potential effects of policy measures earlier in the policy design process. Furthermore, residents and/or consumers should not be overlooked in fostering the transition to more sustainable city logistics as the presented studies on parcel lockers and drones indicate their willingness to make use of sustainable delivery services. Mobilizing their transformative power by making more sustainable choices should be part of city logistics. A clear vision of the local authority on city logistics in combination with more carrot and stick measures can help in contributing to the transition to sustainable city logistics.

This booklet provides insight into multiple sustainable city logistic solutions that public and private actors are implementing in Dutch cities to become CO2 neutral in 2025 and to enhance the quality of the urban environment. Future research projects may further exploit the potential of geospatial analyses, combining logistical flows with urban functions and morphological conditions as well as

behaviour patterns of logistical providers and citizens. This would allow for a systematic evaluation of sustainability initiatives and policies across Dutch municipalities. Students and researchers may also put more emphasis on behavioural interventions by building on insights from psychology. After all, the consumer stands at the basis of the increase in city logistics as their goods ordering requires delivery services. Future research can investigate how consumers can be made more aware of their choices and thereafter make more sustainable choices, not only as an individual but also on a community level.

To conclude, the innovations of logistic operators and the public support of residents for sustainable logistic services indicate that there are many opportunities to reduce the negative externalities of city logistics. When complemented with a more proactive stance of local authorities, including a clear vision, promoting collaboration between stakeholders and strict regulations, the transition towards sustainable city logistics can be made.

University of Groningen, Faculty of Spatial Sciences

Publication: July 2022

# REFERENCES:

AD. (2019). Bezorgwagentje Picnic valt om (en dat is niet voor het eerst). AD. Retrieved on October 4, 2021 from https://www.ad.nl/rotterdam/bezorgwagentje-picnic-valt-om-en-dat-is-niet-voor-het-eerst~abb955ca/

Aditjandra, P., Mulley, C. and Nelson, J. (2013). The influence of neighbourhood design on travel behaviour: Empirical evidence from North East England, Transport Policy, volume 26, p. 54-65.

ANWB (2020). Verkeer in de stad. Een nieuwe ontwerpaanpak voor verkeer in de openbare ruimte.

Autoriteit Consument & Markt (ACM) (2021). Post- en Pakketenmonitor 2020. Retrieved on December 10, 2021 from https://www.acm.nl/sites/default/files/documents/post-en-pakkettenmonitor-2020.pdf

Bosona, T. (2020). Urban freight last mile logistics—challenges and opportunities to improve sustainability: a literature review. *Sustainability*, *12*(21), 8769–8769. https://doi.org/10.3390/su12218769

Boysen, N., Fedtke, S. and Schwerdfeger, S. (2020). Last-mile delivery concepts: a survey from an operational research perspective. OR Spectrum, 43, pp.1–58.

Brown, J. R., & Guiffrida, A. L. (2014). Carbon emissions comparison of last mile delivery versus customer pickup. *International Journal of Logistics Research and Applications*, *17*(6), 503–521. https://doi.org/10.1080/13675567.2014.907397

Browne, M., Sweet, M., Woodburn, A., & Allen, J. (2005). Urban freight consolidation centres final report. Available from:. University of Westminster, Report for Department for Transport (Dft), Transport Studies Group. 190. http://ukerc.rl.ac.uk/pdf/RR3_Urban_Freight_Consolidation_Centre_Report.pdf

Buijs, P., & Niemeijer, R. A Greener Last Mile: Reviewing the Carbon Emission Impact of Pickup Points in Last-Mile Parcel Delivery. Available at SSRN 4169737.

Bushe, B. (2019). The causes and impact of business failure among small to micro and medium enterprises in South Africa. Africa's Public Service Delivery and Performance Review, 7(1), 1-26.

Chakravarti, R., Iwai, S. & Wijewardane, S. (2021). Strategies to improve social acceptability of drones. Max Bell School of Public Policy: Canada.

CROW. (1993). Sign up for the bike – design manual for a cycle friendly infrastructure. Centre for Research and Contract Standardisation in Civil Engineering, The Netherlands.

Dablanc, L. & Rodrigue, J.P. (2017). The Geography of Urban Freight. The Geography of Urban Transportation. Routledge, London.

Dijkstra, A. & Petegem, J. van. (2019). Naar een algemene snelheidslimiet van 30km/h binnen de bebouwde kom? SWOV.

European Commission (2021) Delivering the European Green https://ec.europa.eu/info/publications/delivering-european-green-deal_enDeal. Retrieved at 16 june 2022

Gemeente Groningen, 2021. Ruimte voor zero-emissie stadslogistiek: Visie op de toekomst van vracht- en bestelauto's in de binnenstad van Groningen. Groningen.

Handy, S., Cao, X. and Mokhtarian, P. (2005) Correlation or causality between the built environment and travel behavior? Evidence from Northern California, Transportation Research Part D: Transport and Environment, volume 10(6), p. 427-444.

Jahanshahi, D., Tabibi, Z., & Van Wee, B. (2020). Factors influencing the acceptance and use of a bicycle sharing system: Applying an extended Unified Theory of Acceptance and Use of Technology (UTAUT). Case Studies on Transport Policy, 8(4), 1212-1223.

Jiang, L., Chang, H., Zhao, S., Dong, J. and Lu, W. (2019). A Travelling Salesman Problem With Carbon Emission Reduction in the Last Mile Delivery. IEEE Access, volume 7, p. 61620-61627.

Kostof, S., Castillo, G., & Tobias, R. (1992). The city assembled: the elements of urban form through history. London: Thames and Hudson.

Leon, S., Chen, C., & Ratcliffe, A. (2021). Consumers' perceptions of last mile drone delivery. *International Journal of Logistics Research and Applications*, *1-20*, 1–20. https://doi.org/10.1080/13675567.2021.1957803

Loureiro, G. (2020). Survey of approaches for emergency landing spot detection with Unmanned Aerial Vehicles. CLAWAR.

Masson, R., Trentini, A., Lehuédé, F., Malhéné, N., Péton, O., & Tlahig, H. (2017). Optimization of a city logistics transportation system with mixed passengers and goods. EURO Journal on Transportation and Logistics, 6(1), 81–109. https://doi.org/10.1007/s13676-015-0085-5

Morganti, E., Seidel, S., Blanquart, C., Dablanc, L. & Lenz, B. (2014). The impact of e-commerce on final deliveries: alternative parcel delivery service in France and Germany. Transportation Research Procedia, 4, 178-190.

Morris, A.E.J. (1979), History of Urban Form: Before the Industrial Revolution. London: Routledge.

Municipality of Groningen. (2021). Ruimte voor zero-emissie stadslogistiek.

Muñoz-Villamizar, A., Montoya-Torres, J. R., & Faulin, J. (2017). Impact of the use of electric vehicles in collaborative urban transport networks: A case study. Transportation Research Part D: Transport and Environment, 50, 40–54. https://doi.org/10.1016/j.trd.2016.10.018

Niemeijer, R. 2019. Interview with Rudy Niemeijer, 29th of March 2021. Online environment, The Netherlands.

Olsson, J., & Woxenius, J. (2012). Location of Freight Consolidation Centres Serving the City and Its Surroundings. Procedia - Social and Behavioral Sciences, 39, 293–306. https://doi.org/10.1016/j.sbspro.2012.03.109

Plazier, P., Rauws, W., Neef, R., & Buijs, P. (2022). *Futures scenarios for last-mile logistics in mid-size European cities: ULaaDS D2.4: Futures scenarios based on a Disaggregative Policy Delphi*. ULaaDS.

Rieck, F., Balm, S., Staal, C., & Hogt, R. (2019) Will automatic driving Light Electric Freight Vehicles be the future solution for urban Transport as a Service?

Riggs, W. (2016). Cargo bikes as a growth area for bicycle vs. auto trips: Exploring the potential for mode substitution behavior. Transportation Research Part F: Traffic Psychology and Behaviour, 43, 48–55.

Savills (2020). The challenge of rural logistics. Retrieved on September 24, 2021 from https://www.savills.com/research_articles/255800/307368-0

Stanford Encyclopedia of Philosophy (2020). "The Capability Approach", *The Stanford Encyclopedia of Philosophy* (Winter 2021 Edition), Edward N. Zalta (ed.), URL = https://plato.stanford.edu/archives/win2021/entries/capability-approach/

Voermans, T. (2020). Heb jij ze al gespot in de stad? Bezorgers kiezen massaal voor cargobikes. Retrieved on May 25, 2021 from https://www.ad.nl/auto/heb-jij-ze-al-gespot-in-de-stad-bezorgers-kiezen-massaal-voor-cargobikes~affac266/. Rotterdam: Algemeen Dagblad.

World Economic Forum, WEF (2020). Future of the Last-Mile Ecosystem. Transition Roadmaps for Public- and Private-Sector Players.

Zero Emissie Stadslogistiek (2021). Op weg naar ZES. Retrieved on 01-06-2021 from https://opwegnaarzes.nl/

References of figures:

Figure 1: Post&Parcel (2018). PostNL extends parcel and letter machine pilot. Retrieved on the 5 th of March 2021 from https://postandparcel.info/92556/news/e-commerce/postnl-extends-parcel-letter-machine-pilot/

Figure 4: Noorderplantsoenbuurt: Ben-s.nl Groningen (2021). Wijken in Groningen – Waar wil jij wonen?. [online] Available at: https://www.ben-s.nl/blog/wijken-in-groningen-__-waar-wil-jij-wonen (Accessed 21-05-2021). Reitdiep: Biezen, B. van de (2021). Groningen – Luchtfoto – Reitdiep. [online] Available at: https://www.hollandluchtfoto.nl/media/fc923086-f78c-412e-80ee-03ac7fb02dd5-groningen-luchtfoto-reitdiep (Accessed 21-05-2021).

Figure 5: Google maps (2020). Streetview. [online] Available at: https://www.google.nl/maps (Accessed 11-06-2021)

Figure 6: Google maps (2020). Streetview. [online] Available at: https://www.google.nl/maps (Accessed 11-06-2021)

Figure 9: RIPPL (2021). RIPPL #51: Stadswerkplaats - Groningen's brilliantly unassuming cargo-trike hire service. Retrieved on May 26, 2021 from https://www.rippl.bike/en/rippl-51-stadswerkplaats-groningens-brilliantly-unassuming-cargo-trike-hire-service/. Nijmegen: Fietsdiensten.nl. INGKA (2020). IKEA installs cargo bikes to drive change. Retrieved on May 26, 2021 from https://www.ingka.com/news/ikea-installs-cargo-bikes-to-drive-change/. Leiden: INGKA Holding B.V..

Figure 11: Heutger, M. & Kückelhaus, M. (n. d.). Unmanned Aerial Vehicles in Logistics: A DHL perspective on implication and use cases for the logistics industry. Troisdorf: DHL Customer Solutions & Innovation.

Figure 16: Gemeente Groningen, 2021. Ruimte voor zero-emissie stadslogistiek: Visie op de toekomst van vracht- en bestelauto's in de binnenstad van Groningen. Groningen.

Figure 17: RetailSpaces (2018). 6 Retail Showroom Concepts Worth Paying Attention To. Retrieved on the 1st of July 2022 from https://info.retailspacesevent.com/blog/6-retail-showroom-concepts-worth-paying-attention-to. Studio Mfd (n.d). Celebrate the Day Retail Showroom. Retrieved on the 1st of July 2022 from http://www.studiomfd.nl/projecten/gusta-retail-design-showroom-breda

Bachelor projects:

Jochem van der Deen (2021). Shared Logistics System with Logistic Hub: A durable contribution to Sustainable City Logistics?

Jennifer Septiana (2022). Potential of Drone Delivery in rural areas. How drone applications and perceived safety landing zone of Drone influence the public acceptance.

Jasper Dallinga (2021). New logistical flows in the inner city. How Groningen can anticipate changing consumer purchasing behaviour in their city logistics policies.

Stef A. van Oosterhout (2022). Infrastructural opportunities and barriers for last-mile delivery by small electric distribution vehicles in historical city centres.

Lieke Eegdeman (2021). Towards a cargo bike friendly city: the case of Groningen

Youri Meerstra (2021). Perceived safety of cargo bikes: A barrier against a “greener future”?

Maaike A. Buser (2021). Willingness to use parcel lockers. A comparative case study of Groningen and Ten Boer.

Randy ten Brink (2021). The parcel locker as a sustainable last-mile alternative: An explorative comparison between two neighbourhoods in the city of Groningen.

Master Thesis:

Arnout H. de Haan (2021). Reviewing Sustainable City logistics from a capability approach perspective: A comparison on the impact for micro enterprises between the cities of Groningen and Zwolle.