Curbing City Logistics

A Study of the Interactions Between Urban Logistics and Spatial Planning

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Abstract

The convergent trends of growing populations, increasing spatial density, pressure on urban logistics, and environmental legislation combine to necessitate this research project. While delivering to the city, urban logistics vehicles are stopped more often than they are in motion. Therefore, this master's thesis seeks to explore how urban planning and logistics research may combine to mitigate curbside externalities which result from the vehicles' most common status. This research explores urban logistics stopping along themes of the current situation, a stakeholder envisioned *desired* situation and finally evaluates interventions to shift the sector in a positive direction.

A mixed methods research design was invoked to accomplish a problem analysis approach. The methods include a desk research literature review, producing a typology of stopping (parking) practice, and thematized information to be used in the next stages. Additional data collection includes seven semi-structured stakeholder interviews, and an urban logistics driver survey.

The project's results are recommended to be used by policy makers, fellow researchers, logistics firms and / or spatial planners who wish to affect a more desired urban logistics stopping paradigm.

This research project produces several key findings which contribute to an overall understanding of the state of the curbside. A literature-derived conceptual typology decomposes stopping practice along spatial and temporal lines and produces proven, manageable, and useful information. Interviews highlight stakeholder desires for dynamic allocation of the curbside, the need for harmonious involvement in solution fitting, and the role of enforcement to ensure success of interventions. The driver survey contributes to understanding of stopping practices of the general and fresh, parcel and express logistics flows. Insights from the survey relay drivers' requests for more dedicated logistics space, and investigates their attitudes towards potential interventions and conflicts they regularly encounter.

This research project explores the currently neglected intersection between spatial planning and logistics research, highlights visions of a more desirable future situation, and implements this conceptualization as a method of evaluation for interventions selected from both academic and grey literature.

Contents

Chapter 1: Introduction

1.1 Problem Statement

A study of urban logistics and their relation to urban environment is overdue given global trends of growth and development. Already by 2018, over half of the world's population called a city their home. This trend has been driven by the highly urbanized continents of North America, South America, and Europe ranking first through third in that order (United Nations, 2018). A positive correlation exists between income and urbanization, and the growth in GDP is stated to be the most important driver of urbanization. In total, 80% of global gross domestic product is produced in cities (Dobbs et al., 2011). Due to the growth of urban areas, there is an increasing demand for city logistics operations which support the material needs of cities. Urban areas rely heavily on logistics for essential amenities such as the delivery of food and goods, the provision of services, construction and renovation materials, and waste removal. While all logistics flows are increasing to meet growing populations, the e-commerce sector has become increasingly visible due to the COVID-19 pandemic. The significant growth in both demand and provision of e-commerce, has added to an upward trend in the sector which was evident before early 2020. According to Dablanc and Rodrigue (2020), the e-commerce sector is projected to grow at a global rate of 5-10% per year. To accommodate this growth, cities must use spatial planning competencies to facilitate logistics in an optimal manner.

The increasing prevalence of urban freight transportation is causing several problems for dense populations of urban areas (Ranieri et al., 2018). Commonly detrimental negative externalities of freight noise and air pollution, accidents and congestion (Lemke et al., 2016; Moroz & Polkowski, 2016) Last-mile deliveries are the least efficient and most polluting segment of the total delivery chain. This part comprises up to 28% of the delivery cost and has been quantitatively observed to emit disproportionately. In one study, last mile deliveries accounted for up to 50% of all urban air pollutants (Gevaers et al., 2011; Visser et al., 2014; Zunder, 2021). In the Netherlands, there is a significant pressure to improve sustainability of urban logistics. The country has set an ambitious target to reduce the sector's CO2 emissions by 1 Mton. This goal serves as the genesis for the introduction of zero-emission zones, which will be enforced in many major Dutch cities starting in January 2025 (Quak et al., 2023). The 2025 target specifically restricts polluting logistics vehicles from the zero emission zones, and it is now evident that a one-to-one replacement of combustion vehicles with electric counterparts is neither feasible nor desirable. New logistics strategies are therefore crucial, and pressure to wholly rethink how urban logistics is organized has intensified. It is important to spatially contextualize how urban areas

facilitate logistics functions in order to reconsider a more desirable balance; logistics movements interact with the built environment and cause congestion, require space, and lead to accidents and conflicts. These externalities are magnified at the *curbside*, where operators require parking space in close proximity to the final delivery address (Yuen et al., 2018). In fact, studies have shown that urban logistics vehicles are stopped more than they are in motion during daily operations (Allen et al., 2018; Fransoo et al., 2022). Due to growth in populations and the spatial impacts of logistics operations, the curbside has become pressurized and is highlighted as an essential area of focus in attempts to negate adverse effects. In the 2019 Dutch context, more than 1250 formal complaints were made about urban logistics drivers; including dangerous driving and improper stopping (Molin et al., 2022). This research seeks to decompose curbside operations and support better organizations to address adverse effects.

The highest potential for systemic urban logistics improvement lies in a better organization and use of the delivery spaces in a city (Gardat & Serouge, 2016). As most time that logistics vehicles are in urban areas, they are stationary, research focusing on time and space in the parking context is key in order to work towards the best possible organization and outcomes; done so by synthesizing understanding urban logistics and the areas they service (Fransoo et al., 2022). In total, this paper responds in part to the "fundamental need to rethink how we cater to last-mile freight operations in urban [centers]" (Allen et al., 2018, p.10).

Urban logistics is a broad sector, with many actors, activities, and structures. Sometimes, the only way to define this sector is that their vehicles circulate in the city, and do not facilitate passenger transportation. Therefore, a holistic approach is affected to address factors contributing to curbside pressure. In this research project, competencies in spatial planning and urban logistics will both contribute to the discovery of knowledge and new urban conceptualizations. The "ultimate goal" of logistics and land use planning should be to affect a "seamless integration of urban freight activity into [urban areas]" (p.2) by aspiring towards this goal, planners can improve residents' enjoyment of their cities, help business succeed, and reduce logistics externalities such as congestion, emissions, accidents and conflicts (Holguin-Veras et al., 2021).

1.1.2 Scope

The scope of this research project is the application of problem analysis theory to consolidate and build scientific knowledge of how urban logistics stopping operations interact both spatially and temporally with the urban environment. The problem analysis framing was selected due to its applicability in framing research objectives which are historically underappreciated (Verschuren and Doorewaard,

2010). Problem analysis is the first of five steps in the "intervention cycle" (p.47) which work together to solve operational problems. This framework ensures that an understudied issue is brought into transparent conversation with stakeholders. This is achieved by focusing on the "gap" between the current situation and the discovery of a desired situation. Additional benefits of this approach include the tools to discuss the what and why of a problem, and systematic focus on solution fitting to address issues inherent to the current situation.

The following research will affect a Dutch context to ground research findings in the urban areas which are quickly advancing towards zero-emission goals, and already experience spatial pressure due to high levels of density and competing pressures from key stakeholders such as residents, retailers, logistics firms, and municipal actors. The research will leverage a mixed methods composition which includes a conceptual typology of stopping practice, stakeholder interviews, and a driver survey to build a holistic image of the current and desired organization of the interaction between urban logistics and urban area.

1.2 Research Question

In a review of topical literature on the intersection of urban logistics and spatial planning, contextualized by upwards trends in logistics volume, urban densities, and environmental awareness of the associated externalities, there is clear reason and ample motivation to undertake research which seeks to explore how the future of curbside stopping may be more beneficially organized. Thus, the aim of the following research is grounded in this motivation. In the following research, the *desired* situation is operationalized as being the opposite of the current situation. Used primarily in stakeholder interviews, the desired situation is purposely left ambiguous so that respondents may construct their response without influence. Desired in general is defined for this research as aspirational and preferential when compared to the current situation. By using this loose conceptualization the research accomplishes two goals; to give space to respondents to authentically shape the scope of this research, and to solidify the place that this project has in support of future research.

The main research question is as follows:

"How can a problem analysis approach to urban logistics stopping practice first improve current understanding by the decomposition of spatial and temporal aspects, then work towards definitions of the desired scenario, and assess interventions to bring the two stages closer together?"

1.2.1 Sub Questions

The following sub questions are:

1. *How can a typology of the current stopping paradigm incorporate key performance indicators (KPIs) and build upon the literature review to disperse manageable information of practice?*
2. *Which curbside interventions should be highlighted based on their capacity to reduce logistics externalities and facilitate more desirable stopping practice?*
3. *How does the involvement of stakeholders add current and future insight to the problem analysis approach, and what is their perception of the feasibility of selected interventions?*
4. *What is the current reality of drivers' interaction with the curbside, and how can their inclusion in this research support the selection of interventions?*

1.3 Research Gap

While there is a significant body of research focused on car parking and in urban areas, there is considerably less academic attention given to urban logistics stopping processes (Nourinejad et al., 2014). When research does turn its collective attention towards logistics stopping, most of the focus is related to traffic modeling and quantitative approaches such as Gardat and Serouge (2016); Gonzalez-Feliu et al., (2012); and Muñuzuri et al., (2017). Therefore, the first identified research gap is the space which qualitative research can leverage, in order to increase and harmonize understanding in this field. This type of research is of increasing importance given the large impact that commercial vehicles have on urban traffic as a whole; such vehicles make up 10 to 20% of all vehicles in the urban network, and they stop much more frequently than their passenger counterparts (Nourinejad et al., 2014). The second research gap this project responds to is the request from Gardrat and Serouge (2016) who argued that "further research into the value of time and space [is necessary] to determine the best possible outcome for cities." (p.449). A call echoed again by Fransoo et al., (2022) when the authors highlighted the potential benefits of focusing on the time which logistics vehicles are stopped rather than retreading arguments on route optimization or travel time reduction strategies. The following research raises new conceptualizations in academic understanding of urban logistics' claims to time and space; a goal which fits this identified research gap. The third gap is the opportunity to combine spatial planning and logistics understandings. And motivate conversations amongst primary stakeholders. Baker et al., (2022) commented that the current body of logistics research and literature "[is] lacking a sound and comprehensive research focus on the field of logistics for [urban] planners". Additionally, "local governments and the planning profession need to be more actively involved" (p. 11) in projects which

contain discussion and theory on the topic of urban logistics. By considering the complex nature of urban logistics, this project aims to foreground these conversations, increase theoretical understanding, and facilitate collaboration between public and private actors.

1.4 Relevance

1.4.1 Scientific Relevance

By considering contemporary research on urban logistics, and building upon the base provided by academic understandings, this project claims strong scientific relevance. Such scientific relevance is motivated by several factors. First, as described above, the project fits into a research gap which calls to merge spatial planning and logistics knowledge – the joining of two historically siloed fields of study. Additionally, this project addresses demands from researchers by investigating the value of time and space in its association with urban logistics stopping practice. The problem analysis research design positions this project to make novel contributions to the fields of planning and logistics and is derived from transparent and scientifically appropriate research methods. A final point of scientific relevance is achieved in the construction of results which are applicable to all urban freight traffic situated within Europe's dense and historical urban areas. By establishing this area of investigation, it is expected that the production of awareness will necessitate and benefit similar, subsequent research aims and developments.

1.4.2 Societal Relevance

This research project maintains a firm position of societal relevance due to several interconnections between society and the field of urban logistics. First, urban logistics functionalities are inseparable from modern living. Whether explicitly ordering goods to be delivered to the front door, making a shopping trip, having fresh coffee at an office building, or remodeling a kitchen; urban logistics supports everyday activities. Therefore, the importance of properly ordering the movements entailed in these activities is paramount, as the alternative to do nothing – or to reduce reliance on logistics functions is not a viable path of progress. Second, there are several inescapable and often negative externalities caused by increasing urban logistics movements (Holguin-Veras et al., 2021). Externalities such as congestion, emissions, and road user conflicts provide societal interest and motivation to seek alternative ways of organization. The following research aims to decompose stopping practice in order to remedy the most objectionable of these externalities, all of which can be related directly to the most common status of urban logistics vehicles – time spent stationary. The third point of societal relevance is found in the convergence of environmental awareness and urban logistics growth trends. In the Netherlands,

cognizance of the environmental impact of human behaviors is high, and there are ambitious plans in place to reduce environmental impacts – most pertinent to this research the zero-emission zones which go into effect in 2025. At the same time, urban logistics operations are continuing to grow, and pressure is mounting to find sustainable reorganizations of this sector. Therefore, the convergence of these two trends necessitates research to manage this growth through innovative interventions. This research contributes to *intervention cycle* (Verschuren & Doorewaard, 2010) by launching the first step in their five-step cycle: problem analysis research. The following project does not claim to have answers to all the questions posed above, but it will provide a solid foundation upon which progress can be made and is an essential first step towards a more desirable, livable, and organized urban future.

1.5 Reading Guide

This project is comprised of six chapters. In chapter one, the introduction, urban logistics and spatial planning trends were introduced, as was the main research question and sub questions. This chapter highlighted the applicability of following study by identifying three major research gaps, as well as the scientific and societal relevance.

Chapter two includes the literature review which focuses on urban logistics flows and vehicle types as well as a review of spatial and temporal themes and KPIs which culminates in the conceptual typology of section 2.2. Additionally, chapter two introduces the selection of interventions which will surface later in the stakeholder interviews and driver survey. This chapter concludes with the illustration of the conceptual framework, leading to the next chapter on methods.

Chapter three focuses on the research theories and paradigm affected in this project. Additionally, chapter three outlines how the literature review, interviews, and survey were created, and how they will be scientifically processed to derive meaningful results. Chapter three concludes with a discussion on the reliability and validity of this research project.

Chapter four offers the reader results from the survey and interviews and is separated by the themes suggested in the main research question – current, desired, and interventions. The results are separated by method of data collection.

chapter five contains a discussion on the results of the project. Broken down into three subsections, chapter five provides the key research findings, their interpretations and implications. This section bridges the chapter four results, and the chapter six conclusions.

Finally, chapter six offers systematic conclusion by comparing the main research question and sub questions to the results and discussion chapters. Chapter six concludes with the limitations encountered in the research process, and finally recommends future research directions, applicable to the fields of spatial planning and urban logistics.

Chapter 2: Theoretical Background

The following theoretical background will provide a detailed look at the state of the knowledge available on the topics outlined in the introduction and necessitated in the research questions. Included in this chapter is the literature review, a literature based conceptual typology for understanding of stopping practices, and the conceptual framework which serves as a visual guide to concepts introduced within.

2.1 Literature Review

2.1.1 Urban Logistics, Vehicle Types, and Flows

As a key pillar of this research is urban logistics and the associated freight activities, it is necessary to define both terms. While at first glance it may seem at that these phrases are interchangeable, it is important to explain the difference between the two, and their respective areas of focus. To illustrate the difference, below are definitions from established experts in the field. First, the more inclusive umbrella term of *urban logistics* is defined by Rodrigue and Dablanc (2020) as:

> The means over which freight distribution can occur in urban areas and the strategies that can improve its overall efficiency while mitigating externalities such as congestion and emissions. It includes providing services contributing to efficiently managing the movements of goods in cities and providing innovative responses to customer demands. (para. 1)

Urban freight is a more focused term, situated within the broad and inclusive definition of urban logistics. For this research, the most applicable and encompassing treatment comes from Allen et al. (2000) where the authors define urban freight transport as including

> (1) All types and sizes of goods vehicles and other motorized vehicles used for (core) good collections and deliveries at premises in the urban area, (2) all types of goods vehicle movements to and from urban premises including goods transfers between premises, ancillary goods deliveries to urban premises, money collections and deliveries, waste collections and home deliveries made from urban premises to customers, and (3) service vehicle trips and other

> vehicle trips for commercial purposes which are essential to the functioning of urban premises. (p. 46)

In the context of the research question and aim, stopping strategies for logistics are situated in the *urban logistics* sector, as the research will contribute to the efficient management of the goods in cities and mitigate externalities created in the last leg of the supply chain journey. These management strategies will act upon *urban freight* and intersect with urban logistics and spatial planning at the curbside.

Within urban logistics, urban freight is made up of a heterogenous mix of flows, services and activities. For example, how can you relate a plumber to e-bike courier to a tractor trailer bound for the supermarket? Sometimes, the only surface level linkage across urban freight is that the activities take place within a built-up area and are not strictly passenger mobility. However, in order to build a useful typology of parking, we must find an agreeable nomenclature of these logistics flows. This decomposition will bundle vehicles, operators, and services into categories to simplify the typological equation and enable insight into urban stopping practice.

First, we may refine the focus based on common vehicle types within the urban landscape. For this study, the focus will not include emergent technologies such as cargo bikes, nor will it include large tractor-trailer type vehicles for consideration. This delimitation sharpens the focus of the project to those types of vehicles which most commonly stop at the curb. Within this delimitation, there are effectively two classes of vehicle. The first vehicle is the delivery van. Delivery vans are defined as used for the carriage of goods and have a maximum gross mass not exceeding 3,5 tonnes (ECE, 2011). The delivery van is also commonly referred to as a *light goods vehicle* (LGV) (Grange et al., 2020). In the Netherlands, these vans are responsible for 85-90% of freight vehicle kilometres in cities (Kin et al., 2020). The second type of vehicle, commonly referred to as a *box truck* (McCormack et al., 2020), are also used for the transportation of goods but weigh more than 3,5 tonnes, and can be up to 12 tonnes (ECE, 2011).

Vehicle type	Maximum Gross Weight	Spatial Footprint
light goods vehicle / delivery van	Up to 3.5 tonnes	Length ≤ 2,60m
Box Truck	>3.5 tonnes, < 12 tonnes	Length ≤ 12,00m

Table 1 (ECE, 2012; McCormack et al., 2020)

A comparison between selected vehicle types

To provide additional context, the LGV dominates urban logistics modal choice across European cities. Figure (1) shows that, in 2022, LGVs comprised 73% of the urban logistics fleet across the European Union. This figure ranges from over 90% in Prague and Brussels to being relatively even in Barcelona, and finally to the outlier case of Bremen where the share of HGVs outpaces that of LGVs (Cartolano et al, 2022). With a focus on these two vehicle types, the research project maintains a parsimonious scope, and embeds findings within the two most common urban logistics vehicle types without undue confusion or distraction.

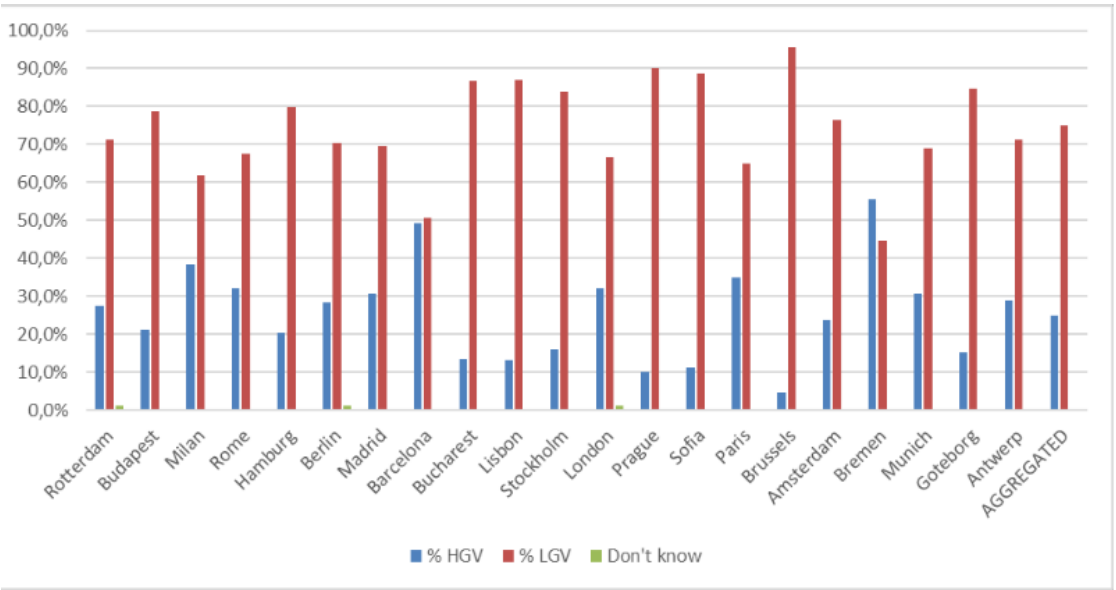

Figure 1 (Cartolano et al., 2022)

A Targeted Survey on European Urban Logistics Vehicle Type

The next step in this literature review is the segmentation of logistics flows, which seeks structure the diversity of urban freight movements into categories. Decomposition in these studies is largely based on segmentation factors such as the vehicle or route characteristics, market structuration, and number and length of stops made. These flows are are introduced in alphabetical order below.

Construction logistics

Construction logistics are increasingly important to understand as they are essential to the development and maintenance of cities and are under pressure from growing urban populations worldwide (Janne, 2020) as well as environmental requirements such as nitrogen limits the Netherlands. Construction logistics are unique in their vehicular demands with numerous types of specialized equipment needed for the diverse projects undertaken (Den Boer et al., 2020). Not only are construction logistics diverse in

vehicular make-up, but also can be characterized by a very wide range of transported items. (Lange and Schilling, 2015) First the building site needs to be assembled including accommodations for workers and preliminary materials, then the construction phase which see the transport of building materials and supplies. At the same time reverse logistics of building waste and work equipment is also important. Vehicular makeup of the flow indicates a reliance on vans and box trucks for specialized services such as renovation, plumbing, painting, installation and other similar projects. These modalities take a more marginal role in the larger scale building and infrastructure projects but remain relevant. In both subsegments, the work force also uses vans and trucks for personal mobility. (Holmes et al., 2020) The likely stopping patterns of construction drivers are longer term, and in more controlled areas. It is hypothesized that construction logistics have more controlled and anticipated spatial and temporal stopping claims as construction sites manage parking for associated vehicles (Lordieck et al., ND).

General and Fresh Cargo

It is likely that when one thinks of urban freight, they envision operations involved in the provision of general and / or fresh cargo. This flow is highly visible in the urban landscape. General cargo transports non-perishable goods such as fashion, electronics and household items, etcetera. Fresh cargo encompasses fruits, vegetables meats and other perishable goods. The perishable nature of the goods transported requires a complex chain of care to facilitate delivery in a safe manner, meaning that fresh cargo is one of the most difficult logistics flows to manage (Behdani et al., 2019). Both general and fresh logistics are diverse in the destinations of delivery – which can range from large retail outlets, specialized stores, or catering establishments to home deliveries, the last being a delivery segment increasing in visibility due to consumer trends brought about by the COVID-19 pandemic (Dablanc & Rodrigue, 2020). The vehicular make up of this flow is quite diverse and can range from trailer trucks to cargo bikes. Most commonly, retail locations receive shipments via tractor trailers and box trucks, while specialists are increasingly likely to receive (and send) shipments via box trucks or light goods vehicles. At home deliveries rely on a range of vehicle types, from box truck and delivery vans or cargo bikes (Holmes et al., 2020). The range of vehicle types and delivery destinations leads to the hypothesis that the stopping behaviors of general and fresh cargo will show great diversity and may lay claim to a range of spatial and temporal requirements around the urban landscape. Spatially, the vehicle type and stopping requirements are largely dependent upon the receiver. Stopping at a retail outlet (malls, grocery stores etc.) is expected to be comprised of larger vehicles and in private parking areas. However, when delivering to specialists or residences, the vehicles will likely be LGVs and rely much more upon public

infrastructure. Temporally the stopping will also vary based on the location and size of delivery, coupled with the type of last-mile modality and receiver characteristics.

Parcel and Express

The parcel and express sector is a dynamic flow of logistics which has arisen over the past two decades from the traditional general cargo flow. This flow facilitates delivery of small and light parcels (maximum weight of around 30kg) quickly and accurately across the globe, and is conceptually distinct from postal services (Ducret, 2014). The products are transported either from business to business (B2B) or business to consumer (B2C) and consist of household items, smaller goods, electronics and other similar items. B2C deliveries are typically associated with online shopping, and as the e-commerce market has grown rapidly in the past decade. B2B deliveries are much steadier as they typically involve higher-value deliveries with minimal missed deliveries and efficient management (Den Boer et al., 2017). This flow relies heavily on delivery vans, and smaller vehicles such as (motor)bikes to make quick deliveries across the urban service areas (Allen et al., 2018). Stopping for this flow is expected to more consistent than its counterparts temporally, with drivers likely stopping for very short times to complete a delivery. Spatially, however, stopping is expected to be more varied. Primarily making claim to public infrastructure, this flow can be expected to park in most any space available due to their short delivery time and organizational pressure for expedited delivery times. Therefore, it is probable that due to the short temporal requirement of delivery stopping, the spatial claims may trend more towards *unauthorized* behavior.

Service and Facility Logistics

From the facility side, this flow supports the functions of buildings by delivering goods and services dedicated to maintenance and functional operations. The service flow delivers goods and services which support the facility such as office supplies, cleaning crews, ICT systems and catering and other essential functions. Researchers in the Netherlands have found that large facilities can be visited by up to 40 service logistics operators in one day (Den Boer et al., 2017). The diversity of functions and services provided in this flow equates to a heterogenous profile and makes this flow quite difficult to organize conceptually. It has been estimated that this flow makes up around 10% to 41% of all urban freight transportation, based on varying definition criteria and methods of analysis (Holmes et al., 2020; CE Delft, 2016). The vehicular make up of this flow is largely delivery vans, but alternative modalities are also present. The temporal prediction is that of a varying profile given the diverse operational profiles contained in this categorization. Spatially, it is expected that a large amount of traffic can make use of

private loading docks or other, similar areas. However, public space should also be expected to be required, especially when attracted by business in historic city centers. Again, hypotheses into time and space components are made with less confidence given the heterogeneity demonstrated in the flow.

2.1.2 Logistics Stopping

In this research, there is a need for precise and specific definitions for a few key terms. An example of these linguistic limitations is the ambiguous use of the term *parking*. In academic literature, parking is used to cover a range of activities which are conducted when the vehicle is not moving, from loading to unloading, providing a service, or parked for indeterminate lengths of time while out of service. Parking is commonly used as a catchall which lacks the specificity that this paper requires. Therefore, this research proposes the adoption of a universal term for parking and unloading as *stopping*. Onwards, *parking* will be used to signify a logistics drivers stopped for the reason of providing a service. This means that parking likely requires a longer time window, and while the driver may bring goods with them to their destination, the professional driving the vehicle will primarily provide the receiver with a service. Examples include parking of a plumber, painter, two-man delivery crew or facility manager. These professionals park, and bring themselves and their tools, paint, electronics or other specialized equipment to their job site. The other possible aspect of a logistics stop is for *unloading*. Opposite of parking, unloading theoretically entails a shorter time frame. The purpose of stopping for unloading is to deliver goods to their destination. Possible examples include delivery of a parcel or fresh goods arriving at a retail outlet. With the specificity of shifting the umbrella term from parking or unloading to stopping, the following research will be more objective. This dichotomy of uses will further strengthen analysis and allow for specificity in the proposed typology.

In contemporary urban planning, stopping research and literature is overwhelmingly focused on the passenger vehicle. Not until relatively recently has attention shifted to stopping for logistics services. Now, there is a growing academic focus on how these services use time and space for stopping such as parking duration studies (Schmid et al., 2018; Allen et al., 2018), spatial availability studies (Chen, 2017) curbside pressure reports such as Dalla Chiara and Goodchild (2020), total system decomposition studies which necessarily include parking i.e. Allen et al., 2018 and numerous traffic modeling approaches such as the work done by Gardat and Serouge (2016); Gonzalez-Feloiu et al., (2012): Muñuzuri et al., (2017); and Nourinejad et al., (2014). Stopping is a key area of focus due to the amount of time that logistics vehicles are stationary during the provision of their services. Fransoo et al. (2022) found that the delivery vehicles were stationary for 80% of their daily operation. Parking for logistics services is a highly

impactful part of the urban equation and it is only just becoming a recipient of increased academic focus. The following research considers stopping for city logistics by the claims made upon both spatial and temporal dimensions of the urban environment. These claims are considered to establish a new approach to urban logistics understanding, and to identify patterns, requirements, and interventions in order to affect a more desirable ordering of the urban environment.

Temporality

Next is an introduction of literature on the temporality of urban logistics. These studies introduce the temporal aspects of urban freight and set the stage for further research produced in this project. Temporal considerations include the length of stopping time, the amount and type of visits per unit of time (i.e., per week), the time of day which operations are conducted, time spent searching of a stopping location, and dwell time conceptualizations.

Pursuant to the length of stop time, and in addition to Fransoo et al., (2022) and Schmid et al., (2018) there have been several studies on how long logistics vehicles are parked. Researchers from Seattle, WA found in that more than half (53.8%) of commercial vehicles parked for 15 minutes or less, 18.4% parked for 15 to 30 minutes, and over one quarter (27.8%) parked for over half an hour (Giron-Valderrama et al., 2019). From this study, the researchers found that service vehicles had the most variable parking times, with 56% parked for 30 minutes or less, 44% for 30 minutes to 1 hour, and 27% parked for an hour or more. Given that service logistics is a significant flow, such variable times add complexity to typifying and planning for service logistics parking. Echoing the results of the Seattle study, Holguin-Veras et al., (2021) found that while 82.9% of typical freight deliveries in New York City were completed in less than or equal to 30 minutes, the mean and standard deviation of parked time for service activities were six times larger, if not more. These findings, which point to the complicated nature of logistics temporality, is related to the diversity of logistics flows. Coming to terms with urban logistics, it is necessary to appreciate this diversity in attempts to make sense of the field.

Additional temporal understanding can be driven by a holistic image of *urban freight*. The temporal aspects of logistic pressure were illustrated in the following graphic (figure 2) based upon the streets of New York City (Meerman, 2015). This figure shows the intensity in demands of temporal usage by various logistics flows. The graphic is a clear indication of the pressure experienced by the curb. In order to abate negative externalities of logistics stopping, derivations such as figure 2 are helpful to increase understanding of these requirements, and to illustrate diversity of temporal requirements associated with various services and deliveries. A classical direction of urban logistics management is the use of

time-windows to restrict logistic vehicle access to selected areas of a city in order to split competing uses of dense areas and to reduce emissions (Grosso et al., 2014). Time windows have enjoyed attention in the past, but currently there is need to innovate additional strategies in order to account for growing populations and service areas.

Figure 2 (Meerman, 2015)

A Graphical Representation of Temporal Curbside Demand

There are numerous studies on the service attraction of different urban industries and services. These studies help planners determine the expected demands on street space based on the type of services located in that area. An example of this research is from the French based researchers Gardrat and Serouge (2015) where they calculated the number of movements per week for establishment types commonly found in a city. Leading the field in number of movements are *large stores* (83.94), followed in a very distant second place by *wholesalers* (21.67) and third place was perhaps surprisingly *book and stationary shops*, which were found to generate 13.8 movements per week. What this study lacked, however, is a treatment of e-commerce and service driven freight movements, specifically those which are not attracted by a commercial destination. The study does, however, add insight into the temporality of urban freight for business-to-business deliveries, and motivates the need for further investigation into the temporal aspects of urban logistics stopping.

The next theme of discussion is of time wasted by searching for parking, or 'cruising' for parking. Some of the leading research in this field is based in Washington State using the streets of Seattle as a laboratory. Seattle is a very interesting case city because the city has experienced a population boom as the city is home to many dot.com companies' headquarters, the largest among them being Amazon and Microsoft.

Hence, the streets of Seattle are experiencing growing pains, but there is a base of innovation inherent to the region which drives logistics research and interventions. An applicable study is written by Dalla Chiara and Goodchild (2020). The authors were interested in the time spent cruising by commercial vehicles and used GPS data services to study the phenomenon. Their results concluded that about 28% of total trip time, good for 1.1 hour per daily tour, is spent searching for parking. The researchers found great utility in increasing the availability of on street Commercial Vehicle Loading Zones (CVLZs), on decreasing time spent cruising. Furthermore, they were able to statistically correlate trip time deviations with the allocation of parking infrastructure. Inefficiency in this area of operations lead to negative externalities commonly associated with urban freight. The interventions introduced later will look to not only address societal impacts but also, at the same time, increase operation efficiency.

Dwell time is the final temporal aspect included in this section. Dwell time is defined as the "time that delivery workers spend performing out-of-vehicle activities while their vehicle is [stopped]." (Kim et al., 2021, p. 320). Dwell times vary widely across logistics flows and the areas in which stops are made. For example, delivery of a parcel will entail a much shorter dwell time than oversized goods, or a service-related stop where the service provider take their equipment to the location of service provision (Cherrett et al., 2012). Restricting dwell time is an oft-employed method of stopping management (i.e. 15 minute delivery zones), but it is difficult for policy makers to account for the complexity of behavior, and therefore often results in inadequately apportioned time restrictions (Kim et al., 2021), and may cause large commercial parking fine totals (Baker, 2019). Therefore, an adequate understanding of flow-differentiated vehicle dwell time, as well as consideration of the impact on societal and operational inefficiencies. This angle is focused on in this research to further situate the temporal aspects of freight and later discuss interventions which seek to improve upon inefficiencies. Taking cues from studies such as those above, this research project attempts to capture and define key temporal aspects of logistics parking to accurately portray the phenomena at hand. The next area of focus will dive into the other half of the outlined dichotomy – the spatial requirements of urban logistics.

Spatiality

The next focus of this literature analysis is on the spatiality of urban freight. As above, the literature assessed here will inform ways of thinking on how urban freight and logistics measures interact with the built environment. While a seemingly uncomplicated correlation between these two aspects arises, much of logistics planning and urban planning in the past have been siloed to their respective fields. However, due to growing demands for organization and innovation, these traditionally distinct fields of

practice are becoming more open to trans-boundary exploration and research. Examples of how logistics stopping makes claims space could include where on the road the vehicle stops, the vehicle's size or the location of their operations.

In urban areas, the curbside has may competing uses, and is a valuable part of the landscape which requires specially focused attention in order to successfully facilitate private, public and commercial uses. These different users have different requirements which need to be represented, from mobility to leisure and of course logistics stopping. Factors as seemingly innocuous as floor space relate directly to pressures placed on a curb, as the number and duration of stopping activities have been correlated with floorspace. Additionally, illegal loading is a frequent phenomenon, often caused not by driver negligence but as an effect of illegally parked cars which occupy dedicated zones (Chan et al., 2020). Below is an image of a curbside area which illustrates this diversity of requirements on a hypothetical city block. While the average European street may not support all these functions, most commonly they will be comprised of passenger parking, a bus stop, and logistics areas. Increasingly common are terraces which HORECA owners extend to their maximum limits in order to increase customer area. All these requirements are necessary to consider, and in designing the desired curbside organization, the competing spatial claims must be considered and synthesized into a functional layout.

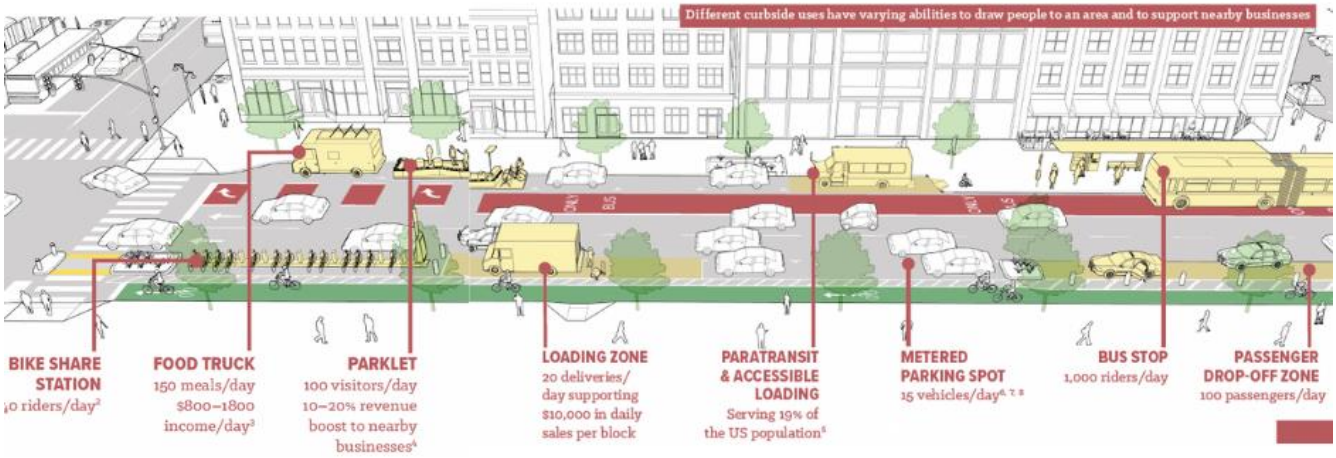

Figure 3 (Roe & Toocheck, 2017)

A Graphical Representation of Spatial Curbside Demand

In order to fit urban logistics into the busy city block, a decomposition of the spatial requirements is necessary. In their research on the patterns of parcel delivery operations in the center of London, UK. Allen et al., (2018) found during the average shift, the driver made 37 stops with 95% of such stops being

at the curb. Such a heavy reliance on public space for these operations means that the operations will clash with other users. The researchers stated that this evidence requires stakeholders to "fundamentally rethink how [we] cater for last-mile freight operations in urban centers" (p.10). the number of stops highlighted in this study provides a strong suggestion that logistics stopping needs to be treated with more careful regard. In the following research, this statistic will be investigated in the driver survey, adding Dutch context around logistics flows and requirements to the problem analysis approach.

The next question is where do urban logistics flows stop within the public space? In a study done on the streets of Paris, Dablanc and Beziat (2015) found that parking issues plagued the delivery of goods within the confines of the very dense central district. The data they collected indicated that over 50% of operations were made with a double-parked vehicle and more than 60% of such operations were conducted with an illegally stopped vehicle, which includes double parking and encroachment of bus and bike lanes or on the sidewalk. This figure is even higher elsewhere in Europe, as researchers in Spain found that over 70% of urban logistics parking is in an illegal orientation (Munuzuri et al., 2012). Such encroachment of parking on public space may be an outlier in Paris due to the incredible population density of the French capital, but it stands to reason that similar trends would be evident in other highly dense European cities. Further spatial conceptualization of parking comes from Gardrat and Serouge, (2016) where they broke down parking behaviors into four distinct types; Double parking, authorized, unauthorized, and private. These behaviors provide a unified understanding of how (and where) drivers stop and allows for the basis of analysis in this research project. Based on parked location, the severity of expected conflict with pedestrians, bicyclists and other users can vary, and may add significant time to the delivery process (Kim, 2021). Spatial impact of logistics vehicles can also be related to the amount of space that the vehicle requires when stopped – and as shown before the vans and box truck vehicles can take a static amount of space of between 2,6 to 12 meters in length (ECE, 2011). Additionally, spatial claims, obstructions, and/or nuisance can differ based on the type of area where drivers stop. As Chen et al., (2017) suggest, parking availability and curbside pressure is correlated with / by urban area (commercial, mixed use, residential) which invalidates a one-size-fits all approach to parking regulations. Therefore, understanding of stopping aspects requires a nuanced and spatially informed approach to understanding, an illustration of which this subchapter attempts to replicate.

2.2 Towards A Typology

The typology proposed in this research relies upon classifying the 'ideal type' logistic parking behaviors. Once these types are outlined, then real world behaviors may be described based on their nearness to

these ideals. Necessary for the development of the typological theory is to decide upon, and provide a definition for, the first order constructs (Doty and Glick, 1994). This typology will borrow from the key performance indicators introduced below as the ideal types in the typology. The proposed typology relies upon classifying ideal type parking behaviors related to the distinct logistics flows and makes predictions for how these flows use time and space in parking practice. The value of this typology is to provide a consistent foundation for the discussion of stopping behaviors across the diverse flows of urban logistics.

2.2.1 Key Performance Indicators

In order to build understanding and the solution necessitated in sub question 1, it is important to select first order constructs. In case of this typology - key performance indicators (KPIs) will be used to summarize the spatial and temporal aspects.

Spatial Aspects

The selected spatial indicators or constructs for this typology are as follows; *Random, Dedicated, Authorized, and Unauthorized*. The indicators authorized and unauthorized are derived from Giron-Valderrama et al., (2019) and the FRETURB model as described by Gardrat and Serouge (2016). *Authorized* parking spaces are those which are legally provided for parking operations, and *unauthorized* are spaces used for parking but not legally authorized (Jaller et al., 2013). *Random* is defined as a random selection of a parking space, as drivers differ in stopping behavior (Dalla Chiara and Goodchild 2020). *Random* selection of parking space has also been applied in studies of queuing theory (Kim, 2021; Alho et al., 2018) *Dedicated* is the option positioned opposite of this behavior. Dedicated spaces are reserved for parking or unloading whether demarcated by signage or other methods to reserve space for logistics operations (Nourinejad et al., 2014). This concept and the possible benefits have been of interest to many researchers and is often used to facilitate logistic efficiency (Abhishek et al., 2021; Trott et al., 2021; Melo et al., 2019). As with the section above, this set of four indicators are chosen to be used in conjunction with one another and provide classification for four unique definitions of the spatial characteristic of a parking occurrence. For example, if a delivery van stops in a reserved loading zone to deliver a parcel, the stop would be spatially classified as dedicated and authorized.

Temporal Aspects

The temporal aspects differentiation of short- and long-term stopping. These indicators or first order constructs are grounded in literature on the subject. Based on work from authors (Allen et al., 2018; Fransoo et al., 2018; Schmid et al., 2018), the point to use as a cut off for short term is 15 minutes, thus

leaving long term parking to mean all operations over 15 minutes. This is supported by their findings which confirm the median nature of this time window. Furthermore, it can be expected that the logistics and / or service drivers who will be delivering goods will report shorter stops, while service-oriented stopping will require longer time windows. These constructs attempt to define the ideal type practices and to classify real world temporal aspects onto a time-based continuum. The set of indicators have been chosen so that they may be used in concert with the spatial constructs (below), providing unique classifications of defining the characteristic of a stop.

2.2.2 A Conceptual Typology

Level	**Area of Inquiry**	**Selected Constructs**	
One	**Stopping**	**Parking**	**Unloading**
Two	**Spatial**	**Authorized**	**Unauthorized**
	Impact	**Dedicated**	**Random**
	Temporal	**Short Term**	**Long Term**

Table 2 (own ill.)

A Conceptual Typology

This conceptual typology (above) provides a summary of the literature investigated in the previous subchapters on urban logistics stopping, and a basis for further analysis in this project and beyond. The typology is submitted to make sense of the fractured and diverse scope affected by researchers who are interested in objectifying logistics in a broad sense.

Due to a wide range of claims to time and space, the first key differentiator is the determination between *parking* and *unloading*. This signals a division between short and longer term stopping. The operators who fit in the *parking* category are providing a service; with those stopped for *unloading* are likely to be providing goods and, on a route, consisting of many stops throughout a delivery area.

The next level of the typology also stems from the central catchall practice of stopping and is a flexible modifier – adding more intricacy and information to either of the first two categorizations. In this second level, the two key terms *spatial* and *temporal* have been introduced. Additionally, and as before, the terms associated with these entries provide more detailed information about how space is appropriated.

This proposed typology offers a useful tool for understanding the key theme of this research project, namely “how do urban logistics vehicles use time and space for stopping?”. The typology above visually structures urban logistics stopping practice and suggests an adaptable framework of understanding. The

conceptual typology will be contrasted with insights derived from the survey to test applicability (section 5.2.3). It is positioned to increase the visibility and understanding of common practices in the field of urban logistics and will be used to understand the targeted changes and effectiveness of various interventions which seek to reduce the negative externalities common to busy and dense urban areas.

2.3 Interventions

As attention shifts towards the role that cities have in providing space for logistics services, so too does attention towards new methods of ordering logistics operations. Presented within this subchapter is a selection of *interventions* which aim provide an antidote to externalities and inefficiencies associated with urban logistics stopping practice. Supported by a scientific literature review with search terms such as 'urban planning' in combination with 'urban logistics' as well as 'management', 'strategies', 'solutions' and 'interventions'. For inclusion in this section, the main criteria were that the intervention must directly relate to stopping, be that a shift in the duration, number of stops, location or another factor. This section looks at how to change the penultimate stage of the logistics' journey for the better.

Of note is a two-fold conceptualization of how inefficiencies relate to urban logistics. On one end, inefficiency and cost can be incurred upon logistics firms by way of an increased distance their vehicles travel which leads to lost time due to congestion, and accidents (Holguin-Veras et al., 2021) as well as when they cruise for parking (Dalla Chiara & Goodchild, 2020), due to parking space unavailability and inadequate provision of appropriate (un)loading zones. Negative externalities are impacts either directly or indirectly related to logistics operation and imposed upon the general community of resident. Such externalities include congestion, pollution accidents, noise and aesthetic degradation (Holguin-Veras et al., 2021). Research has shown the potential for interventions which improve logistic efficiency and minimize operators' costs align well, and simultaneously minimize transportation externalities (Holguin-Veras et al., 2011; Quak & De Koster, 2006). This interdependency should be leveraged by stakeholders as it can provide "proverbial and elusive win-win situations." (Holguin-Veras et al., 2021, p.6).

The conversational tone of this research project shifts from theoretical to applied in discussion of parking and unloading interventions, due to the opportunity for a similar win-win situation as explained above. From Quak (2008), these interventions are "usually quite easy to implement on the short term at limited expense" (p.57). An additional benefit is they can expect to see voluntary participation from logistics firms as they are positioned to solve key problems the operators face when delivering in an inefficient manner to a spatially scarce area or city.

2.3.1 Enforcement

First, there is a large amount of literature which supports the very basic concept of the need for better enforcement of parking violations which occur in, and around curbside spaces reserved for logistics operations. In fact, enforcement is singled out as one of the most important aspects for success of stopping and unloading initiatives (Quak, 2008). A number of authors have claimed that there would be significant benefits if enforcement can be stepped up (Alho et al., 2018; Alho & Silva, 2014; Fransoo et al., 2022; Quak, 2008). However, these calls frequently entail a large increase in municipal spending, which is very often unappetizing for governments. Therefore, additional measures must be discussed in order to facilitate logistics operations on city streets and in public space. Naturally, there is discussion of promoting alternative methods of enforcement which may not require such an increase in spending or manpower. Various methods can include increased usage of camera cars for digital enforcement or the potential for logistics drivers themselves to police parking violations. The latter may be the most cost effective for municipalities – but would likely require much more research and discussion before implementation – barriers that do not apply to increasing the workforce or integrating more camera car patrols. Additional methods of low-cost enforcement have been used to varying success in cities and municipalities such as the implementation of rising bollards to enforce time-window regulations and area access (Quak, 2008). However, these more static methods of enforcement may become antiquated in increasingly dense and busy urban cores. And impractical in application to curbside stopping enforcement. Providing more stringent enforcement of logistics parking spaces has been proven to improve efficiency for operators and can even stimulate more deliveries on foot in suitably dense areas (Fransoo et al., 2022). Thus, it can be reasonably expected that if enforcement were to improve, logistics stopping in an area would require less vehicle circulation due to more deliveries on foot, and more consistent stopping in areas dedicated to logistics operations.

Further complicating stopping enforcement is the laissez-faire attitude effected by drivers and cities when it comes to policy on parking, and the difficulty to accurately determine a violation or trespass. As the running theme of logistics is its fragmented nature, so too are the ways in which drivers stop to deliver good or provide a service. Additionally, how can one reasonably expect for a ticket to be given if a vehicle is parked incorrectly for one minute while not causing adverse effects? Where is the line between acceptable delay borne from double parking versus unacceptable behavior which must be adequately deterred? This question raises its head in dialogs with drivers, municipal actors, and academics alike. The answer for majority of stopping offenses and transgressions is along the lines of “you know it when you see it”; a standard that is near impossible to translate into concrete terms.

2.3.2 Curbside Consolidation Centers

Curbside consolidation centers leverage the delivery vehicle as a moving warehouse and encourage drivers to conduct more deliveries to their service on foot as the hub is configured to provide the tools necessary to make on-foot deliveries over distances longer than they may otherwise be willing or able. Research from Allen et al., (2018) followed ecommerce delivery drivers in London and found that during their daily rounds, the drivers traversed an average of 7.94 km on foot, which suggests that this aspect of the last mile must not be overlooked in accounting for innovation. Similarly, Fransoo et al., 2022 suggests that when delivery drivers are comfortably provided a dedicated space to unload, they can realize great benefits to overall efficiency which could in part be explained by more walking in dense delivery areas. The potential of curbside consolidation centers is especially relevant for cities with precious curb space to spare, often where cruising for parking is a common constraint. New York City is an early adaptor of CCCs (Ginsburg & Cohen, 2023). By enabling the use of a curbside consolidation point, logistics firms particularly from the parcel and express flow, can expect increased productivity and curtail the negative externalities from their operations. These changes can, for example, shift modalities to cargo bikes or even hand carts or make use of self-collection delivery infrastructure. Cities can expect to benefit their citizens if walking for deliveries is promoted in their municipal plans, and correctly supported by relevant infrastructure and communication. In the framework of inclusion for this section, the curbside consolidation center would increase parking time, but decrease circulation and emissions from delivery vehicles as they would stimulate on-foot deliveries. The parking location would be set, and likely require digital management methods to book availability or see the occupancy.

2.3.3 Self-Collection Delivery

Self-collection delivery (SCD) is a group of interventions which attempt to reduce the inefficiencies of last-mile delivery by bringing warehousing closer to the consumers' collective front door. In bare terms, SCD requires a network of infrastructures where logistics operators (parcel and express or general cargo) deliver, and from where customers may pick up their items. There are four different categories of SCD infrastructures which may be stationary (e.g., a convince store), mobile (e.g., specially outfitted vehicles with lockers on the back), attended or unattended (e.g., parcel lockers with electronic systems) (McKinnon & Tallam, 2003). Perhaps the technology which has caught the most attention in the current sustainable urban logistics paradigm is that of the stationary and unattended parcel locker. Parcel lockers are designed and have been recently embraced to cope with the rising tide of e-commerce orders and returns, and consumers value their addition as a delivery option due to the possibility to collect a parcel

when it is convenient and additionally due to perception of sustainability that self-collection delivery provides (Mitrea et al., 2020). Employing parcel lockers has been shown to reduce curbside pressure, road-borne emissions and traffic congestion as they require less fractured trips by consolidating deliveries to a centralized area (Chen et al, 2017; van Duin et al., 2016). Therefore, parcel lockers have become an important part of the last-mile picture due to their potential to reduce the logistics externalities on a neighborhood by consolidating freight movements and making them less intrusive in the general areas they service.

2.3.4 Digitization

Next, there has also been a growing interest in the use of technology to enable parking reservation and associated systems to monitor parking space availability. In Europe, the digitization leader is Barcelona, and the Spanish city supports logistics stopping with their digitally managed, app-based delivery zone technology. The Dutch context has seen trials in Utrecht and Groningen, ran by the company Coding the Curbs (Coding the Curbs, ND). With the integration of technology, drivers first check in at a delivery zone and then must carry out their operations before a predetermined amount of time elapses, then drivers end their stop by checking out via the app. Benefits from such integration of technology are numerous, but two major advantages offered to the city are one: that they gain a wealth of data about the logistics operations on their streets -including vehicle type, stop duration and location preference and two: that enforcement of parking violations is subsequently possible via a similar application. Since enjoying success in Barcelona, the same application has expanded to Germany, Ireland and elsewhere. Digital innovations and interventions may be seen with increased innovative spirit as they require “Both changes within existing regimes and systematic change for the larger urban environment” (Fraske & Bienzeisler, 2020, p.355). For a city to embrace digitization, not only is a certain refocusing of a municipal mindset required, but also the physical infrastructure must also be shifted to accommodate new and innovative uses of space, enabled by technology. Barcelona was able to solidify their role in the forefront of the digitization push in part by adopting the technical foundation of such technology in their 2014 Urban Mobility Plan (Ajuntament de Barcelona, 2014). Learning from success is a key to the adaptation of digitization and it seems the Spanish second city is a great place to start for policy makers and others interested in bringing this technology to their city of focus. If we are to project digitization strategies onto the proposed selection criteria, we can expect that with more efficient curbside management, more of the city could be given back to the inhabitants. Due to the possibility to drastically increase efficiency in terms of planning, in routing and enforcement, full digitization of the curb could quite realistically promise a bright new future for the ever-growing metropolis. If implemented, digitization would likely

increase the length of stops, but in turn decrease the number of stops, and would be able to carry out a higher number of deliveries on foot. Another interesting possibility is shifting delivery locations, or unloading/parking space allocations, based on historical demand. If the data is properly collected, these possibilities could contribute to a much more efficient city.

2.3.5 Dedicated Infrastructure

"An advantage of dedicated infrastructure is that investments for freight transportation are only needed on a limited part of the infrastructure network." (Quak, 2008, p. 53). Following this acknowledgement of agreeability and the relatively low barrier to implementation, it is therefore necessary to include dedicated infrastructure in this conversation of interventions. These interventions include infrastructure to *restrict* and infrastructure to *facilitate*. The former may be done by time windows which can restrict an area for part of the day, or by physical means such as rising bollards – which often work in concert with time windows (Quak, 2008). The latter includes provisions such as increasing dedicated unloading zone stock, largely by conversion of existing parking infrastructure, and by providing support infrastructure to drivers in order to facilitate deliveries on foot in the densest areas of a city (Hesse, 2004; Mizutani, 1999; Patier, 2006). Additional dedicated infrastructure which would mitigate wrong parking would be the inclusion of more logistics only spaces. By increasing the number of dedicated delivery bays, there is less chance of unauthorized parking and thus conflict externalities. Additionally, and somewhat counterintuitively, a parking system may perform better if there are stricter restrictions on this increased number of delivery bays, especially in freight intensive areas such as downtown business districts (Abeishek et al., 2021).

As one might have noticed, the previous intervention types introduced above illustrate a bias towards delivery and not service logistics. Perhaps this can be accounted for the massive increase in attention related to the rise of online shopping, where in this somewhat niche field of research attention to other fields is limited. However, there is a need to think about logistics holistically, and to include service logistics in the broader conversations about transformation and reorganization.

Conceivably the most impactful changes for these flows could be done at a more basic level – by way of dedicated infrastructure focus. Examples could include the provision of dedicated parking or incorporating logistics parking into the passenger parking planning, coupled with an investigation into nudging parking underground.

2.4 Conceptual Framework

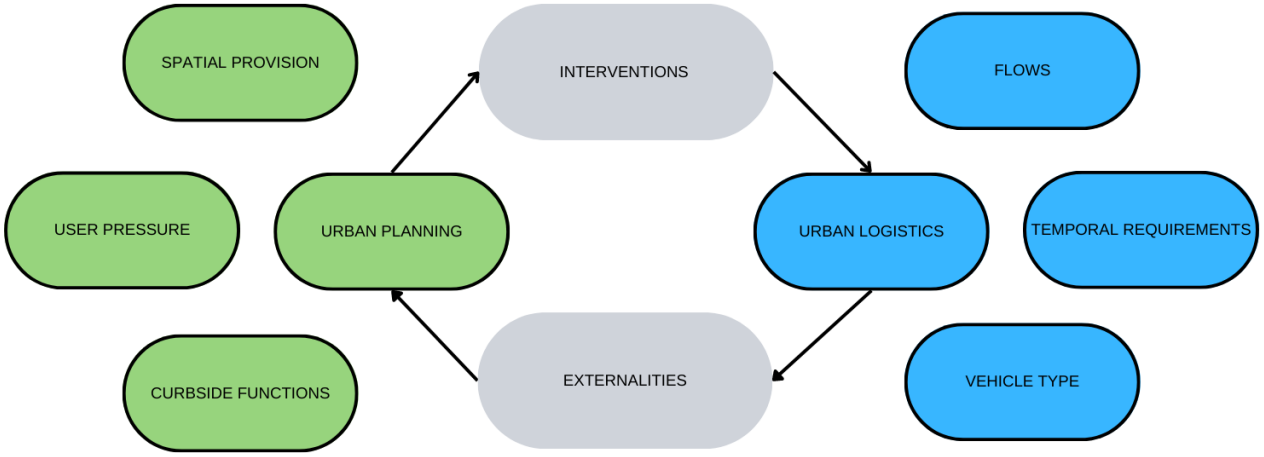

Figure 4 (own ill.)

A Conceptual Framework

The above conceptual framework is a visual representation of the research parameters included in this project. This framework shows the relationships between key variables related to the main research questions and tracks their interdependencies. The two main aspects which are brought together in this intradisciplinary research are those of *urban planning* (left) and *urban logistics* (right).

On the right side, logistics concepts which are foundational include the *logistics flows* – which are included to provide structure to the diverse types of logistics movements. Next, are the *temporal requirements* for stopping which vary primarily according to flow, and greatly impact urban logistics by translating to (in)efficiency effects. Finally on this side, the *vehicle type* indicator is included which, again, is largely dependent upon flow-based characteristics and requirements.

On the left side, relevant urban planning concepts are contextualized. Beginning at the top, *spatial provision* is related to the space given or used by urban logistics operators such as the four types of stopping behavior or provided as spatial infrastructure. Next, *user pressure* is conceptualized as a function of urban planning. User pressure comes from the growth of populations within cities as well as the increasing demands that citizens necessitate via their interactions with public space. Urban pressure is a consistent motivator for spatial planning interventions across the discipline, and this study is no different. The final spatial concept included in this framework is related to the curbside functions. This concept is, as illustrated in the literature review, the scene of several conflicts, innovations, and uses.

The middle of this conceptual framework shows the essence of this research. The graphic shows a conceptual cycle linking logistics and planning. In this cycle, urban logistics leads to externalities, these externalities act upon the urban environment and therefore, spatial planners are stimulated to create interventions in response to the externalities. The cycle completes when the interventions are then imposed upon urban logistics, in order to reduce the externalities. In systems dynamics terms, this is a reinforcing cycle, and as the reinforcing loop creates a desirable outcome, it may also be referred to as a virtuous cycle (STRLDI, 2019). This cycle is one where the growth of externalities induces the growth of interventions all of which is necessitated by increased logistics provision in growing urban areas.

Chapter 3: Methodology

The following chapter will discuss in detail the methods used within this research project. In this chapter, there is first a section on the research theories and paradigms which set the philosophical stage. Next, the process of the literature review is outlined. Then, a detailed description of the interview process and data collection. Then the survey design is discussed. The section wraps up with a section on the validity and reliability of the project.

3.1 Theories and Paradigms

In this research project, the guiding research theory is that of inductive research, with a research philosophy of scientific realism. This assertion sets apart and distinguishes the research project immediately from most published research in the logistics field. The separation comes from the attempt made within to produce theory on logistics stopping practice, which comes into conflict with JR Stock's (1997) generalization that logistics research does not have a rich history of theory development. However, it is comforting to note that the will to produce theory is not without foundation. It can be assumed that this project would be viewed favorably for its contribution to the furthering of logistics theory as this method of inquiry is argued for to advance a discipline and profession, and thus finds a place comfortably when the subject at hand is relatively new and underdeveloped (Swanson, 2000).

To further clarify the goals of this research project, it is pertinent to decide upon an acceptable treatment of the term *theory* – of which there are many competing definitions and conceptions. Indeed, this is the case for not only public discourse, but within scientific communities as well. For the latter group, the term can mean a range of different things, from conceptualizations to a simple hypothesis or explanation (Sayer, 1992). However, the definition most fitting for a theory as proposed in this paper

comes from Peter and Olson (1983) who suggest that a theory is comprised of “invented constructs and hypothesized relationships among them.” (para. 6) Or from Gioia and Pitre (1990) who simply state that a theory can be defined as “any coherent description or explanation of observed or experienced phenomena.” (p. 587) Consensus seems to settle on these purposively abstract definitions of what a theory is to allow breathing room for differing paradigms of research investigation. With constrictive definition, this encompassing nature decomposes into individualistic and presumptive exclusions. In summary, good theory is that which is plausible, and a plausible high-quality theory is “interesting rather than obvious, irrelevant or absurd, obvious in novel ways, a source of unexpected connections, high in narrative rationality, aesthetically pleasing, or correspondent with presumed realities” (Weick, 1989, p. 517). The goal of the theory produced in this project is that it provides the tools to solve a problem in the context of urban logistics stopping practice. With a completed theory, the goal is to clarify existing opacity and solidify relevant frameworks and stakeholder viewpoints in a concise, meaningful and applicable manner.

The research paradigm conceptualization used in this paper is influenced by the work of Kovacs and Spens (2007) and, by the authors’ own admission, occupies a messy middle space between two more widely agreed upon extremes, Positivism and Interpretivism. Scientific realism is an umbrella term which was designed to link the commonalities of all paradigms in the gap between positivism and interpretivism. This approach replaces the hunt for an absolute truth with the acceptance of a contextualized, relative, or approximate truth (Hunt, 1993; Muncy & Fisk, 1987). For scientific realists, data is created and interpreted in terms of a variety of theories, knowledge doesn’t exist without any context, and cannot be detached from the approach that created the information. A key principle of this lens is the acceptance that no on theory, research approach, methodology or method is chosen as the only option for advancing science. If one were to judge theory by the lens of scientific realism, they would judge not the truth, but focus would be on the practical value provided (Kovacs & Spens, 2007).

Inductive research will provide the basis for this thesis project, and as noted by Kovacs and Spens (2005), enjoys the company of a growing inductive momentum within logistics research projects. The inductive approach builds upon empirical observations to produce theoretical advances. In other words, observations are gathered and then “lead to emerging propositions and their generalization in a theoretical frame.” (Kovacs & Spens, 2007, p.13). Evidently, the function of inductive research concerns the generalization of results beyond the data (observations) produced for the purpose of research. This function mirrors the goals of this thesis project and confirms the methodological choice to pursue an

inductive strategy. Good inductive research does not intend to test hypotheses, but rather it aims to provide a clear and convincing story and should begin with an evident purpose (Paja et al., 2016). Inductive theory has an advantage over the predominant deductive approach as it allows for central questions to be addressed without the unnecessary constraints placed on the research process by following the latter research approach.

A further three research theories remain to be discussed in this section as they will all play supporting roles to the inductive research in this project. These theories are problem solving theory, typology theory and grounded theory. The following brief introductions will situate their roles in this research and provide justification for their inclusion. These three theories will be introduced in the order that they were implemented in the research process.

The first theory is problem analysis. This framing provided structure throughout the project, and heavily influenced the main research question and the schema for expert interviews, the survey, and subsequently the results, discussion, and conclusion. As Jonassen (2000) puts it, A problem consists of two critical attributes – first that there is an unknown entity in some situation which is the difference between the current and goal states. Second, finding the solution must have some value; a value which can be related in terms of social, cultural, intellectual benefit. Thus, for the case of this research, the logistics parking problem can be neatly ascribed to this framework. . Problem analysis theory was used to give structure to the ill-defined nature of the phenomena. Structure here came from the stepwise process of defining the current situation, the desired situation, and then analysis of the gap between these two stages.

Typology theory was leveraged to give order and suggest meaning for the fractured and often cumbersome field of urban logistics stopping practice. Typologies are not foreign to logistics researchers (i.e., Dablanc & Rodrigue (2014); Weustenenk & Mingardo (2023)) and in the case of this research proved an instrumental method for consolidating information from the literature review. Noted for their ability to “provide a parsimonious framework for evaluating complex organizational forms and explaining outcomes” (Doty and Glick, 1994, p. 230), the reliance on typology theory in this research was appropriate for the task. The key characteristic of a typology are the interrelated sets of ideal types which serve as a hypothesis for the ordering of a messy field of interrelated and competing uses.

Finally, grounded theory fundamentals of interview coding were implemented in order to collect insights from interview data. A differentiating and major strength of grounded theory is that founders Glaser et al., (1968) gave qualitative researchers a toolbox to derive data from recoded interview transcripts. In

this project, this strength was leveraged in the interview processing stage of the methods. Grounded theory, therefore, provided a scientific basis for the data collection from the interview process, and featured heavily in structuring the results section. Additional information on this stepwise process is included in section 3.2.2. under *coding process.*

3.2 Research Methods and Data Collection

The research methods of this qualitative study included desk research, seven semi-structured stakeholder interviews and a survey disseminated to the drivers of five different firms. Therefore, this is a mixed methods study with collected data that can be classified as both primary – produced in the surveys and interviews, and secondary – that which was derived from literature on the topic and within the field. The goal of using such a range of methods was to collect insights from as many relevant angles as possible, to provide a well-informed overview of this under-studied area of research.

The following figure (figure number 5) has been included to provide a graphical overview of the intersections between research sub questions and the methods used to address them. As illustrated below, the intersectionality inherent in this mixed methods approach strengthened the research findings and their validity and enhanced the knowledge development of the studied phenomena. By dividing the main research question into four sub questions, the research was able to advance based on logical increments and concluded in an adequate address of the overarching main research question.

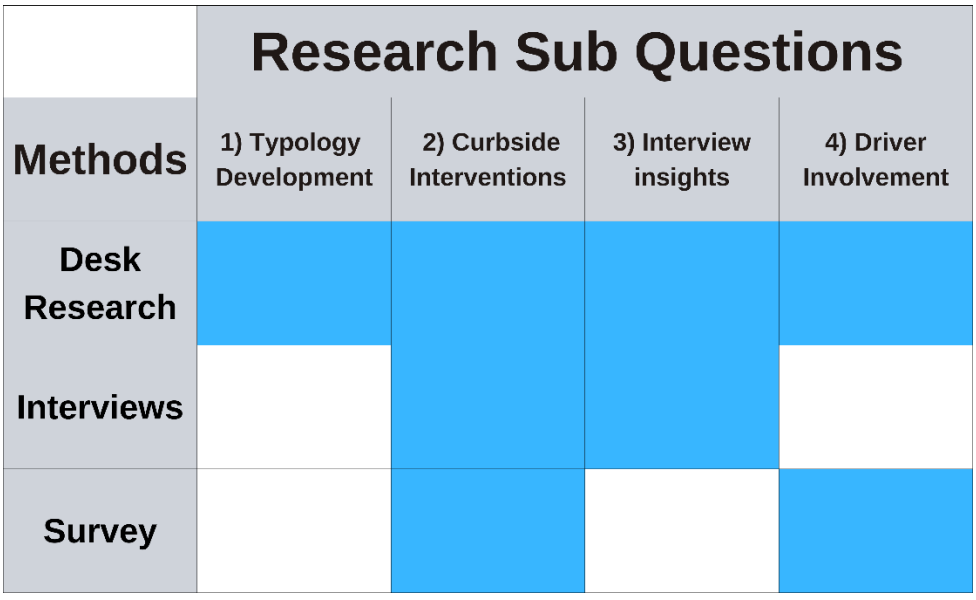

Figure 5 (own Ill.)

A Graphical Representation of Research Intersectionality

3.2.1 Literature Review

The first concrete stage of this research project was to conduct a literature review. This process was instrumental in situating the research within the contemporary field of urban logistics research and allowed for the identification of a literature gap. This gap is what gave credence to the research and motivated the findings as direct contributions to theoretical knowledge of the fields of urban planning and logistics. A systematic literature review approach was used to collect the required background data and information to address the research question of this study. This method was an appropriate research approach as the scenarios under evaluation contained scattered information and knowledge on the topic. (Lim et al., 2019). The desk research process used primarily academic studies, findings and other literature reviews, but also borrowed from conference reports and news articles. This structure provided a theoretical base for the logistics flows, for the conversation about key performance indicators, and for the identification of interventions. The scientific literature was essential for the conceptual typology, as thematic division of stopping into its spatial and temporal components translated into the ideal types and constructs of this component.

The selection process for the desk research literature was relatively liberal. Literature was selected for inclusion if one of several possible considerations were met such as the literatures' direct relation to logistics stopping, to urban planning, or to the number of concepts highlighted in figure 4. This means that a wide breadth of knowledge was included and used to support the research process. Literature also needed to focus on the city, which excluded a large amount of logistics research on the more traditional scale of trans- and international research. This also excluded research which investigated logistics stopping at most distribution centers and stopping studies on overnight or other long term storage. The key terms used in the literature review were as follows: *urban freight, urban logistics, spatial planning urban planning, parking, unloading.*

3.2.2 Interview Process

Research Purpose and Thematization

The interview process was designed to add depth to the research with an exploration of conceptualizations of desired scenarios and to lend perspectives to discussions on potential interventions. The semi-structured interview process was selected primarily because the nature of the research questions is exploratory. Therefore, having a general script for the interview questions, but allowing flexibility to explore different areas of intrigue was decided to be the most valuable and versatile approach to the interview data collection. In the exploratory interviews, the role of the

interviewer was to introduce various topics and talking points and then to follow up on the interviewees' answers in the hopes of generating new knowledge and understanding of the topic.

Thematizing the interview was an important and early step in the timeline of this project. Thematizing required the development of both theoretical and conceptual understanding of urban logistics stopping practice, in order to provide a strong base upon which the knowledge generated in the interviews could build in a coherent, congruent, and integrated manner. Furthermore, thematic knowledge of the matter at hand – the 'what', provided the basis for the 'how' – the method followed during the interviews. Familiarity with the theme investigated is an essential requirement to pose important questions (Brinkmann and Kvale, 2018) and therefore was not taken lightly. In the pre-interview stages, extensive work was required in order to ground the interviews in a contemporary and theoretical background of urban logistics and planning. Furthermore, the researcher's academic background in sustainability and spatial planning enabled understanding of the broader area in which urban logistics often finds itself. This thematization did not stop outside of the classroom, but rather continued as the researcher acknowledged the valuable insights made available by working within the professional logistics research environment offered by TNO. Building upon theoretical and literature research, this exposure to every-day language, routines, conversations and power structure was just as important with respect to building competency for the interviews. The interviews started about two and a half months after beginning the thesis project, and this time was used thoughtfully and appreciated in its capacity to thematize the interview stage of this research.

Once satisfied with the thematization, the rest of the interview process was underway. The first step in this stage was to develop a relevant design for the interviews. Designing the research interviews consisted of the 'how' of the study – or planning the procedures and techniques which were to be followed when needed. As the interview type was selected to be semi-structured, the questions and interview guide was more of a tool to prompt the conversation, not as a prescription designed to prompt the interview minute by minute. The interviews were conducted around three themes, which were in line with the main research question. These themes were as follows:

- How does the interviewee see the current situation of logistics stopping in their field?
- What does the desired situation entail, how does the interviewee envision such a situation?
- Opinions and conversations on the feasibility of interventions, relating to area of expertise

Around these three basic themes, the interview was generally open to leverage the opportunity for discussion about more specific and unique insights applicable to their competencies was not missed. The complete interview guides and questions will be found in appendix A of this report.

Participant Selection

The selection of a wide range of stakeholders and viewpoints was deemed necessary as urban logistics is a field in which there are many interests, competencies, and perspectives. By reaching out to a purposively selected range of candidates, this variance was effectively represented and recruited to provide the necessary level of insight. This added to the encompassing treatment of the themes throughout this research project, necessitated by the sizeable research gap. An additional benefit from the selection method was the ability to leverage different viewpoints to add to the problem framing aspect of this research. By affecting a problem analysis framework, the diverse group of interviewees contributed to a well-rounded treatment of the questions “where are we currently?” and “what does the desired situation entail?”. This is a defining feature of this project as researchers, policy makers, and professionals overall are still deliberating on the right organizational goals for the future – a necessary step after which tangible progress and solution fitting naturally follows.

The number of subjects selected for interviews was not prescribed before the interview process commenced but rather, due to the exploratory nature of design, the decision on the number of subjects was made based on the arrival at saturation – the point where further interviews yielded little or no new knowledge. In this study, saturation was reached at a total of seven interviews. The common narrative around subject sizes for similar projects is that increasing the number of participants may follow the law of diminishing returns (Brinkmann & Kvale, 2018) and that the ideal number of interviews is a rather small 15 ± 10, a range within which the seven interviews from this research sits comfortably.

Selection for these interviews followed the theory of purposive sampling. Purposive sampling is an oft-used technique for the selection of well-informed cases and is the most efficient use of resources on behalf of the researcher (Patton, 2002). This method required participants to be selected based on their knowledge and experience within the field, related to the phenomenon of interest (Cresswell & Plano Clark, 2011). Of course, the selection in a purposive sample also requires that participants are available and willing to interview, and on their ability to communicate effectively on the matter. These criteria were very important for obvious reasons, and since the research was conducted in English in a non-English as a first language country. However, in The Netherlands, this did not pose an insurmountable barrier. Following Morse and Niehaus (2009), sampling methods were designed to maximize efficiency

and validity of the project. As qualitative research places an emphasis on the depth of understanding, efficiency in this project was achieved by conducting interviews only until saturation was reached. Validity was produced and maintained by acknowledging the level of detail such an exploratory project required and maintaining an emphasis on participant homogeneity.

Participants were selected in line with knowledge that had been highlighted and deconstructed in the desk research stage of the project. The completion of the thematization directed the need for the inclusion of leading voices from the relatively small field of urban logistics researchers, which was then further limited by selecting for those academics who have published articles relevant to the goals of this project. These researchers which were selected and available included Prof. Dr. Jan Fransoo from Tilburg University, Prof. Dr. Giuliano Mingardo of Erasmus University Rotterdam, and Dr. Heleen Buldeo Rai of Vrije Universiteit Brussel.

An additional group of participants were selected due to their roles in municipal in governments and positions related to their municipalities' accommodation of urban logistics. These professionals were chosen for interviews to provide a real-time view into the political appetite which municipalities must innovate, regulate, and accommodate logistics stopping practices, and to judge the feasibility of interventions according to their perspectives. Parking is a highly politized and crucial aspect of urban life, and those who oversee public space were important to consult during this research. The selection included two participants from the largest cities in the Netherlands. Mr. Joeri Jongeneel from Amsterdam, and Mr. Jos Streng from Rotterdam.

Finally, the third group which was selected for participation in the interview process were stakeholders from stakeholder associations, included for their proximity to the business side of this area of focus. It was deemed crucial to include their input as operators, business owners, and logistics service providers are those who will need to operate within any of the proposed interventions related to their operational practices. As the research sought a high-level overview of the research questions at hand, stakeholder associations were most attractive due to their capacity for synthesis and coordination of many logistics providers. The interviewees selected and who were available for participation included Mr. Marco van Burgsteden from kennisplatform CROW and Mrs. Anne-Marie Nelck from Transport and Logistics Netherlands (TLN).

The Interview

All seven of the semi-structured interviews were carried out in the same conditions via Microsoft Teams and with similar time limits (planned 30-45 minutes, however some ran longer) in order to maintain

consistency. Additionally, all seven interviews were conducted in the month of June 2023. In order to prepare, Microsoft Teams was tested prior to the interviews for its capabilities in recording conversations and transcription. Once the interviews were over, the data was all saved locally and the transcripts were read back by the researcher in conjunction with the video recordings in order to clarify any mistakes that had been made in the automatic transcription software and to add markers for where the interviewer or interviewee had spoken, as this function was not available for the automatic transcription generation.

In order to conduct a successful interview, a standardized introduction process was set. This was accomplished by following a loosely scripted guide which served the purpose of introducing the interviewer and their background, the reasoning for the research project, and then the goals for the interview. This script was the same for every interview which was conducted. Additionally, care was taken to satisfy ethical requirements including the notification for the interviewee that the conversation would be recorded, and that their name and comments during the interview would be directly or indirectly incorporated into the research thesis results. Once this housekeeping was in order, then the interviews commenced in full.

Coding Process

Once all the interviews were finished and the transcripts fully cleaned and ordered, then began the coding process. This process was undertaken to derive data from qualitative interviews and was instrumental in shaping the discussion and conclusions of the research project.

The interview coding process was based on the guiding philosophies of grounded theory, as introduced by Glaser et al., (1968). Specifically, the coding method used was thematic analysis. Thematic analysis is most often used to identify broad themes and patterns derived from semi-structured interviews and is useful for linking themes from individual interviews together in an overarching summary (Burnard, 1991). For this research project, interview transcription and coding were done using the computer program Atlas.TI, which was provided under a student license from Radboud University.

The coding process used in this analysis was informed by and borrowed from the 14-step process outlined by Burnard (1991) and was modified to accommodate certain technological advancements which have been made in the last 32 years. However, the methods presented in *A Method of Analyzing Interview Transcripts in Qualitative Research* are sound and provide a justifiable and methodologically consistent base for the purposes of this thesis project. Included below is the adapted stepwise interview coding process:

- Step One: During and after each interview notes were made to serve to record the ideas and themes discussed in the interviews. These are in free form and have been used to give the general ideas a space to ruminate after the discussions with interviewees. After the interview was finished, the auto-generated transcripts were downloaded from Microsoft Teams and then read through while watching back the interview in order to add missing data and clean up mistakes in the auto-generation.
- Step Two: This was a continuation of the first step as the transcripts were read through again and more notes were made on the themes and content of the interviews. The aim was to become immersed in the recorded data.
- Step Three: The transcripts were then uploaded to Atlas.TI and read through again. This time, the reading process included adding open codes to all relevant data. Open coding is the process of freely generating descriptive codes to denote various aspects of the interview via the transcripts.
- Step Four: This stage was about the codes generated in the previous stage. Once all the transcripts were subjected to open coding, then the list of codes was analyzed and grouped together to reduce the number of categories by reducing similar codes into broader categories.
- Step Five: The new list of codes was once again worked through, and recurring or similar codes were removed to produce a final list.
- Step Six: Once the code lists were finalized, then began the work of writing and synthesizing results. The themes which were discovered during the coding process were solidified, and the author decided to link the data to examples from literature and commentary within the research paper. This method enables the findings from the data to be in direct conversation with contemporary knowledge. This allows for comprehensive treatment and well-founded results and discussion.

For a full report of the coding data and transcripts, please see the supplemental information file.

3.2.3 Survey Process

Participants

The target audience of the survey were the drivers for logistics companies who operate within cities in the Netherlands. The respondents were recruited via non-probability voluntary sampling. That is, their responses were solicited by managers who acted as intermediaries between the researcher and respondents. Once the manager had received the link to the online survey, they were free to provide the

link to their employees as they saw fit. Additional participant recruitment was accomplished by sending the managers posters for distribution which included a brief introductory text about the survey and a QR code for the respondents' ease-of-access. The eligibility requirements for the respondents were relatively broad in scope, with the main requirement being that they worked with in urban areas. The survey was intended to gather information from the logistics flows of service and facility, general and fresh, as well as parcel and express. However, after the survey closed, only the latter two were fully represented, which means that the survey does not represent responses of facility and service drivers. In consultation with researchers knowledgeable about construction logistics, the decision was made not to pursue this segment for survey response as parking for construction sites is generally planned on site with parking provided for all their needs during a project, thus they can be said to be accounted for already. This claim is also confirmed in qualitative literature on the subject, as Lordieck et al. (ND) found in their survey of Swiss city logistics that only 9% of construction logistics drivers report lack of parking space to be an issue on their job and conclude that this is likely due to mandated parking provision on construction sites.

Data Collection

The survey for this research project went online during the first week of July 2023. This is the point when it was sent to the participating companies' managers. From that moment on, the distribution was under the purview of those liaisons. The first day of significant uptake of the survey was July 13th, 2023, when the responses started to grow in number. This coincided with the distribution of the poster which encouraged drivers to respond to the survey in a medium other than WhatsApp or the company email. Once clicking on the link or scanning the QR code, the respondents were directed to a Microsoft Forms page which contained the survey and prompted response to the ten-question survey. There were no incentives offered to encourage participation in the survey, and there was no plan organized for dealing with non-response. The survey closed on August 10th, 2023. In total, the survey received 80 responses during its availability.

The Survey

The deployment type of this survey was online, facilitated by Microsoft Forms. The survey consisted of 10 questions with question types ranging from short answer to single or multiple choice. None of the questions were required, which was a choice made in order to provide the respondents with the ability to skip a question if they did not feel comfortable providing information, even though the anonymous nature of the survey results was stressed in a few different stages.

Questions one, two, three, five and six all related to their current situation, based on thematization developed in the literature review, desk research stage of the project. Questions four, seven, eight, and nine related to the interventions discussed in the literature review and interviews and the future-oriented nature of the research project. These were designed to ask about opinion around the changes that the drivers might like to see in order to make their jobs more efficient and less stressful. Question ten was an open response which asked for additional comments.

The first question asked the drivers about the company they work for, as a way of ascribing their logistic flow in post-processing. This decision was chosen rather than asking the driver to self-report their flow directly as the academic nature of this treatment and the range of options was feared to be not easily transferrable. The second question asked about vehicle type. The options were van, box truck, larger than a box truck, or smaller than a van. Question number three asked the drivers where they most often park within the urban environment. Question number four was designed in the same manner as question three with the only difference being that instead of asking where they commonly parked, it asked which of the spaces they most preferred to park. In question five the drivers were asked to self-report the length of time that they spend at each stop they make. The answer options were designed based upon contemporary literature which suggested bins of time within which deliveries are made. In this survey the bins were from 0-5 minutes, 5-15 minutes, 15-30 minutes, 30-60 minutes, 1-2 hours and finally longer than 2 hours. Question number six, limited to numerical responses only, asked the drivers to self-report the number of stops that they make on an average workday. Question number seven simply asked the respondents how satisfied they are with the parking experiences they have on the job. In this question, “satisfaction” was explained to include the ease of finding a space, the parking accessibility and the proximity to the final address of delivery. The five response options ranged from “very satisfied” to “very dissatisfied” with the middle option of “neutral” bookended by “satisfied” and “dissatisfied”. Question number eight asked about the challenges that the respondents face the most while working. This question offered the respondents six different options to choose from, all of which were informed by conversations with researchers in the field and desk-research. For the full list of answer options, please see appendix B. Question number nine was oriented around the attractiveness of various interventions which have been discussed in the literature review portion of this thesis. Finally, question number ten asked the respondents if they had any further comments or questions which were not addressed in the previous nine questions. The survey thus concluded with a thank you message and confirmation that their responses had been sent.

The full survey including questions and response options is included in appendix B

Survey Design

The respondents for this survey were only contacted for answers once and were not followed for a longer period of time. All respondents were presented with the same exact survey, with the order of questions and response options in static positions, opposed to randomized. The respondents were not grouped in any way prior to their responses, but after their responses were collected, they were split into representative flows based on their self-reported employer characteristics, supported by the flows outlined in the theoretical framework section 2.1.1.

The survey data was collected not for quantitative processing, but rather as an exploratory supplement to the data collected in the desk-research and interview stages. The combination of these three distinct methods provided a triangulated base upon which the results, discussion and conclusions were constructed. To supplement the results of the survey data, a selection of graphical insights was included in chapter four. These graphics were either produced by the Microsoft Forms software, or after the fact by downloading the CSV formatted information to excel where the additional graphs were created. As the results are qualitative, these graphs are included as suggestions or insights, and were not intended to state any concrete conclusions as would be the case for more quantitative research approaches.

3.3 Validity and Reliability of Research

3.3.1 Validity

The goal of this paper is to conceptualize urban logistics stopping, and there have been several steps taken to ensure the validity of the results produced. Validity in qualitative research is associated with the appropriateness of the research methods and processes involved in data collection (Leung, 2015). Chief among these strategies is that of triangulation, which improves validity by producing well rounded results (Middleton, 2023). By using multiple theories and methods, the expectation is that this study has yielded valid results. The first type of triangulation used was theoretical. Theory triangulation is realized by utilizing competing or complementary theoretical approaches to address the same problem, or in the case of this thesis, to address the research question and sub questions. In this thesis, three theoretical viewpoints were incorporated into the analysis – grounded theory, problem analysis theory and typological theory. By engaging with a diverse range of theories, validity was improved due to these various methods of investigation. The second type of triangulation was methodological. In this project, validity was further supported by integrating both a survey and semi-structured expert interviews. This

structure allowed for methodological triangulation and is useful as it protected against possible research bias and other flaws inherent to a reliance on one type of data collection method.

Due to the non-probability voluntary sampling method of the survey, steps were included to account for the possibility of bias which would affect the validity of the research findings. These strategies included the use of short and to-the-point questions with clear and exhaustive answer options, difficult concepts were broken down as much as possible including the use of images to illustrate the intricacies where appropriate, and finally, the language of the survey was designed to be as straightforward as possible to avoid potential confusion amongst the participants.

3.3.2 Reliability

Research reliability is the extent to which research can be reproduced by using the same methods, and conversely, the method's ability to produce the same results (Leung, 2015). Reliability in qualitative research projects is more difficult to enforce than in quantitative research, but not impossible. The following expands upon the steps taken to ensure both internal and external reliability.

Internal reliability was established and ensured as the methods of literature review, interviews and the survey were all conducted by one researcher. Since all the interviews were coded by one researcher, there should be no concern that competing interpretations derailed reliability of the findings. This internal reliability remains consistent in the other methods used, as competing interpretations were again not possible in this individually undertaken research project.

External reliability is provided by an in-depth methods section and standardized survey questionnaire and interview guides. This allows for the research to be conducted again in the same manner, and for the expectation that any derived results would match those produced in this first attempt. Another measure of external reliability was the selection of interview participants to include primarily those who live and work within the Dutch context. This measure allows for reliable results to be abstracted and applied with confidence within this European region.

Chapter 4: Results

The following results section will be divided into three parts keeping with the structure of the main research question; from the current to the desired situation, and then looking at the steps to get from one stage to the other (interventions). The sections will include results from both the interviews and survey insights, separated to accurately represent the collected data.

4.1 Current Situation

4.1.1 Interviews

The predominant theme derived from the expert interviews when discussing the current state of logistics stopping is that much is left to the drivers to sort out on their own. While any given municipality will have considered the inclusion of (un)loading areas and maybe access restrictions, most of the movement in the urban core is expected to be self-organizing. The ad-hoc and even haphazard nature of the current paradigm was captured in many interviews. Mr. van Burgsteden commented, “it [logistics stopping] is a bit of a blind spot” before clarifying that he believes transportation planners have other areas on which they focus, and logistics stopping is not necessarily within the “DNA” of their area of expertise. Mr. Streng echoed the comments above, noting that current conversations on the topic are “quite limited” and that the practice is “self-organizing” to a large extent – within the boundaries that a city might impose such as traffic regulation aiming to avoid unnecessary hinderance. Dr. Buldeo Rai provided an explanation for the lack of operator-led innovation in the field when it comes to changing how goods are delivered by highlighting the conservative nature of the logistics sector – which would explain how the status quo is rarely disrupted in the established activities of delivery. She also mentioned that “logistics is not typically an activity that is welcomed into the city with respect to zoning laws” in the context of warehousing, but that this feeling of ambivalence extends from the building site to the curbside.

Additionally, there was a theme in the interviews about the need for more communal awareness, from non-public stakeholders (i.e., citizens and business owners) of the importance of providing public space for logistics to function harmoniously in our cities. Prof. Fransoo highlighted this dilemma, stating that “it is very obvious we need to allocate more [urban] space for freight delivery and then everyone would be better off, [but] the difficulty is that everybody is better off but not everybody is better off all the time”. Mr. Jongeneel added more concrete examples to this statement by commenting on how difficult they had found it to even secure two parking spots for logistics trials in the city of Amsterdam. When citizens are told they can no longer use the spaces they are used to parking in, their mind does not immediately

go to allowing logistics functions to take over in the old passenger parking spaces – they would rather see more bike parking or trees or terraces. Therefore, these conversations emphasized how difficult it is to reinvent the urban fabric, especially if the goal is to welcome logistics functions rather than applying classically appealing urban planning and landscaping strategies. However, according to Prof. Fransoo, if the residents of an affected area were able to experience the benefits of a street free from logistics-imposed traffic obstructions, they are more likely to accept the tradeoff of giving a few spaces away to logistics to enjoy a more harmonious street-level environment.

A final theme of discussion was an acknowledgement of the high degree of stress placed on drivers to make their deliveries quickly. Often, especially for parcel and express deliveries, drivers are not worried about looking for appropriate parking as they just need to go to one address and can leave their vehicle in a suboptimal area to make this quick stop. This stressful nature of the vocation is a large part of the overall negative externalities associated with urban logistics. The current situation is marked by externalities wrought by the competitive nature of logistics economy.

4.1.2 Survey

Various questions in the driver survey aimed to gather insights into the current situation. First amongst these was the vehicle type question. The results show that most common was the box truck at 53%, followed by delivery van at 35% and then “larger than a box truck” made up the remaining 12% of responses. No driver surveyed answered that they used a vehicle smaller than a delivery van. This data has been used to produce figure 6, which assigned vehicle type to the flows represented by survey respondents.

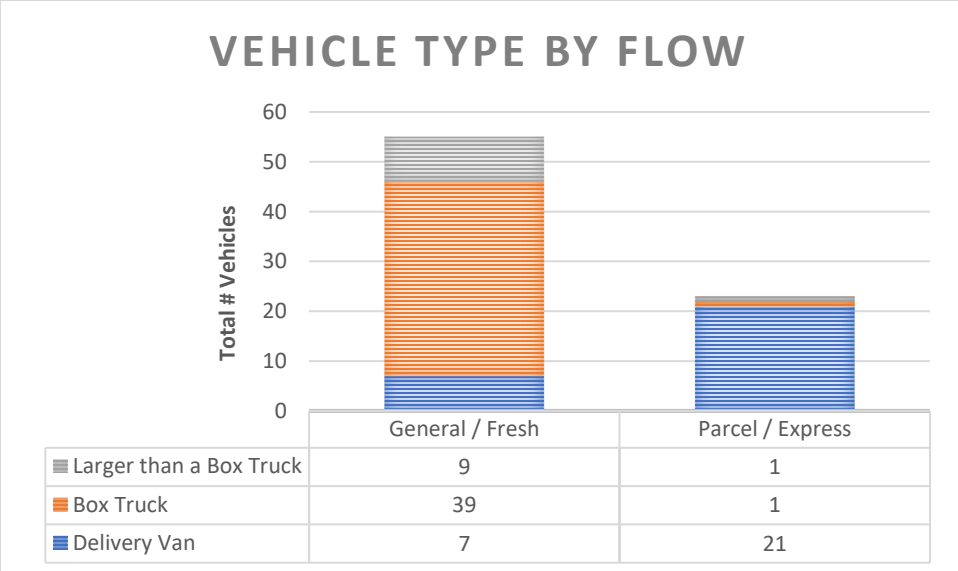

Figure 6 (own ill.)

Vehicle Type by (Logistics) Flow

The next thematic question asked about the spaces that are most often used for stopping, with the option to select up to three responses. Respondents provided a range of answers, with authorized parking in a load/unload zone or a general parking place (total 104) leading but closely followed by self-reported unauthorized parking (either double parked or on a bike / pedestrian walkway) with a total of 87 reports of such behavior. Only 14 respondents reported that they made use of a private parking area.

Question five sought to establish the temporal aspect of the drivers stopping practice and asked for an estimate on how long they park for each delivery. The results show that almost all the respondents stop between zero to 15 minutes, with slightly more stopping between 5-15 minutes than zero to five minutes. Only 12 respondents stopped for times over 15 minutes with 11 between 30-60 minutes and one report of stopping for 15-30 minutes. This data did not, however, relate directly to the flow associated with each respondent. This differentiation was therefore produced (figure 7) and is included below. Figure 7 shows that the parcel and express deliveries were concentrated in very short stop times, often not exceeding five minutes, while general and fresh deliveries often took comparatively longer to complete.

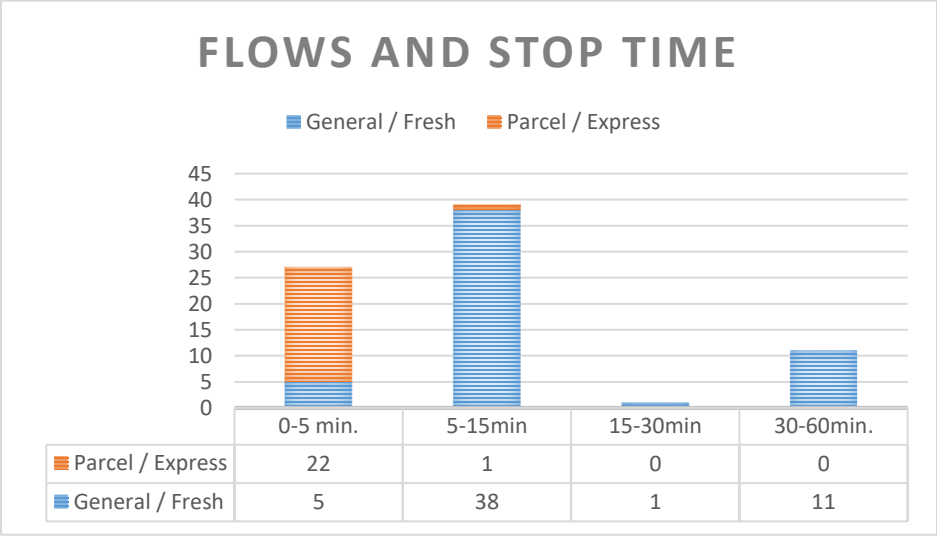

Figure 7 (own ill.)

Logistics Flows and Self-Reported Stop Times

Another current situation question asked respondents for an estimation of the number of stops that they make per day. Of the 79 total responses, the average was 31 stops per day. This was further broken by

vehicle type (Figure 8). These visualizations give a small quantitative overview of the different requirements placed upon by drivers and their vehicles in different logistics flows. Figure 9 illustrates a sharp divide in time stopped per delivery and differentiates the flows of parcel/express as having typically shorter stop times than general / fresh deliveries.

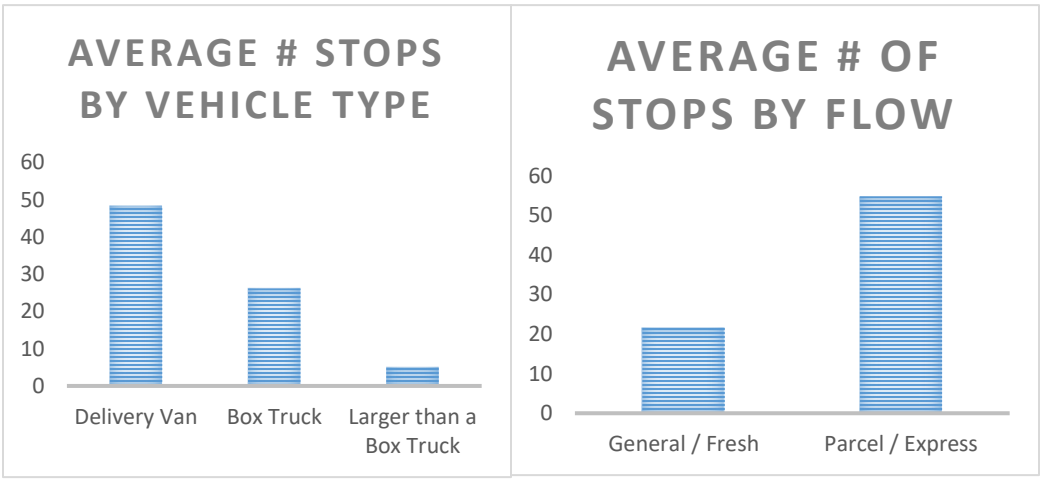

Figure 8 (left) Figure 9 (right) (own ill.)

Graphical Representations of Self-Reported Stopping Practices

The results show that on average, the delivery vans make more stops than box trucks, and that the parcel / express drivers stop more than their general / fresh counterparts during an average working day.

The final question for general insight about the current situation asked drivers to report their satisfaction with their parking experiences. These experiences are shown in the graphic below.

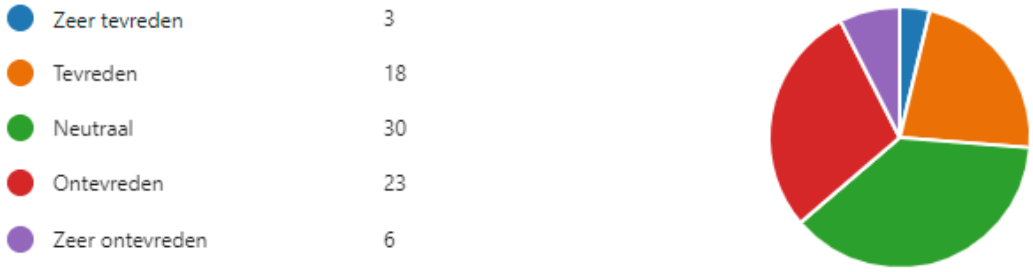

Figure 10 (own ill.)

Self-Reported Satisfaction index

Note: dutch text reads from top to bottom as very satisfied, satisfied, neutral, unsatisfied, and very unsatisfied.

Takeaway messages from figure 10 include that there are more total respondents who report being (very) unsatisfied at 29, than there are those who would say they are (very) satisfied of which there are 21 such responses. The middle category, 'neutral' had the most respondents.

4.2 Desired Situation

4.2.1 Interviews

The second main question for all the interviews was about how city logistics might look in a desired future scenario. Designed to be thought provoking, this question and the subsequent conversations were a key part of the research as they would serve to structure conversations about ways forward. Without a plan for the future – and without goals for how the city should be ordered, there would be no guidance on how to shift the current paradigm. Therefore, in the interviews, forward thinking was a key focus.

In the conversations with experts, three broad themes emerged; a difficulty in defining how the future should look, the need for a balanced approach to the problem, and broad optimism for digitally assisted and dynamic allocation of space.

> *"An ideal situation? That's a very difficult question."*

This quote from Dr. Buldeo Rai succinctly summarizes the feelings that many interviewees expressed when first queried about their envisioned future of urban logistics. Mr. Jongeneel echoed the sentiment by noting that "there is not one silver bullet for this problem" and that "there is difficulty because [logistics stopping] is such a new field, especially for people working at the municipality" and that it is hard to envision where to go from the current situation. However, Mr. Streng suggested that "the guiding principle would be developing policies in dialog with the stakeholders" but for those to be successful, there is a need to have a clear picture about what city logistics entails. Furthermore the municipality of Rotterdam currently plans for logistics with the goal of relegating as many activities to private space as possible, in an attempt to mitigate externalities of other road-users. It is with this goal in mind that the city adapts their plans for logistics and plans for the future.

Further investigation of this key question revealed that the interviewees maintained a consensus on the need for the future to have a balanced allocation of logistics space to other public uses. Mr. van Burgsteden encapsulated this sentiment when he mentioned that the future should see "an optimization between the sufficient supply of goods […] and a minimization of the social burden from [negative externalities of logistics]." Interviewees suggested the benefits of an investigation into KPIs which are

both important to logistics and may also be used to measure the urban quality of life – and that successful future planning would do well to take this dichotomy into account. If properly integrated, then logistics may “run smoothly and safely, but then only for the time being of the operations. After that, the space is given back to the people.” The need for properly balanced life in urban areas was evident to the interviewees, and after this lofty goal was established, conversation shifted to the key role that technology will play in the future ordering of urban logistics stopping.

Perhaps the most agreed upon topic over the seven expert interviews was that cities should look forward to embracing a dynamic allocation of curbside space. This topic came up in each interview and enjoyed broad support from the interviewees. Dynamic allocation means that the curb can have a flexible profile. For this could mean that part of the day there is space for logistics operations, then the allocation would shift to make room for terraces, bike parking, or pedestrian space, and then during the night it shifts to passenger parking for residents nearby. There was clearly great interest in finding a way to make this idea come together, and the strategies to do so were included in the next major question – that being a conversation on potential interventions.

4.2.2 Survey

As with the interviews, the survey was also designed to platform drivers’ opinions on their desired scenario, even if the medium did not stimulate as free-flowing conversation as the former. The first such question asked where drivers would most like to park to carry out their work and presented the same options as the question which asked where they park most often. 64 respondents indicated that they would most like to park in a dedicated load/unload zone, followed by 52 selecting a general parking space, the next most popular choice was a private loading area with 20 votes. 26 respondents indicated that they would prefer to park in an unauthorized manner, and the two remaining options received three votes a piece. Clearly, the drivers’ preference is for dedicated logistics parking. An interesting aspect of the responses is that drivers reported their desire to park in ‘unauthorized’ areas, which might be due to the very short time needed to make a delivery, reflecting drivers’ preference to park as close as possible to the delivery address in order to save time during their busy day. However, this selection did not near the popularity of other options. Figure 11 is a graph which illustrates the desired parking locations per logistics flow. From this representation, it is clear that the drivers prefer authorized to unauthorized parking locations.

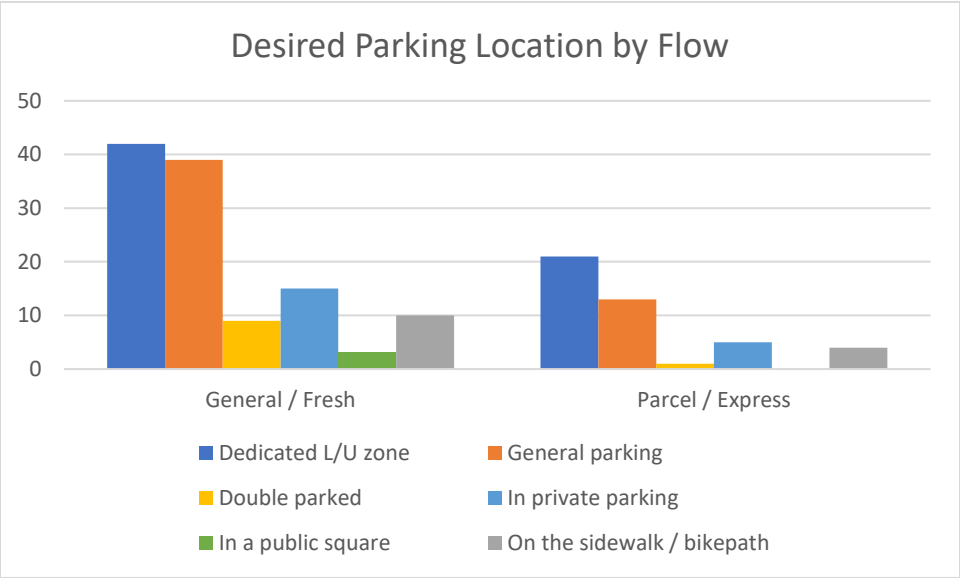

Figure 11 (own ill.)

Desired Parking Location by Logistics Flow

A latter question focused on elucidating the challenges that drivers face over the course of a shift, with the intention that their elimination or rectification would equate to a more desirable situation. Far and away the most chosen response was that drivers just do not have enough space to conduct their daily tasks (50 responses). The breakdown of responses to this question are show in figure 12. Interesting responses highlighted here include that drivers frequently find friction in their interactions with other road users, which could point to the need for more planned acceptance of logistics functions in the spatial organization of a city. Overall, it seems from these responses that increasing this acceptance or dedicated infrastructure, coupled with the necessary associated enforcement, may be the most effective method to reduce drivers' challenges and daily conflicts.

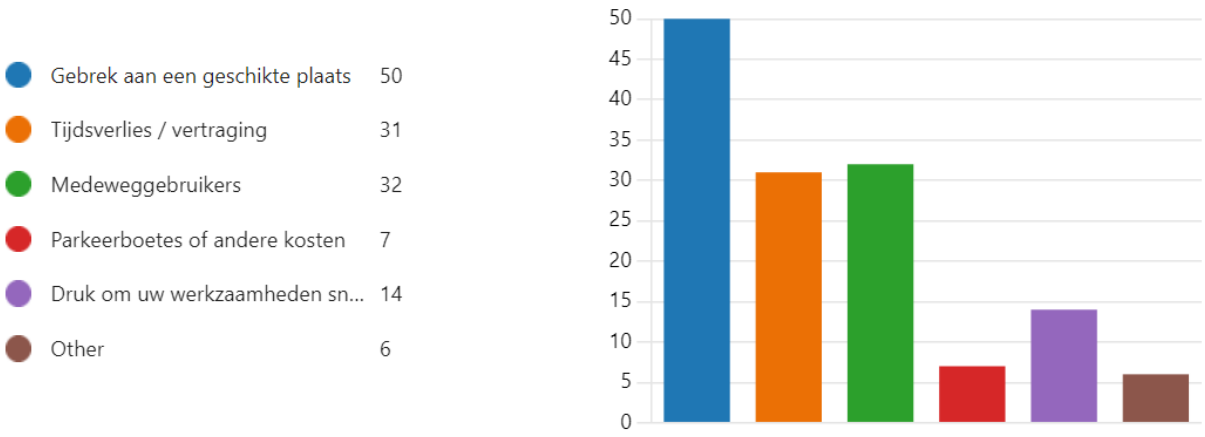

Figure 12 (own ill.)

Self-Reported Stopping Challenges

Note: Dutch text reads from top to bottom as Lack of available space, lost time / delays, fellow road users, parking fines or other costs, pressure to get work done quickly

4.3 Interventions

4.3.1 Interviews

A broad range of interventions were discussed in the seven interviews. While the themes remained consistent, viewpoints differed amongst the participants. This aspect of the interview invited interesting conversation and highlighted diverse perspectives. Takeaways included a rethinking of the enforcement paradigm, the usefulness of low-tech solutions, as well as digitization to enable a more desirable organization of urban logistics.

Interviewees frequently discussed digitization of the curb. Whereas dynamic allocation of space is an overarching theoretical goal - digitization is the driving technology which enables strategies such as dynamic allocation and space reservation. Prof. Jan Fransoo was the expert interviewed who is closest to the real-world application and research of digitization measures. At the time of the interview, he was conducting a study on integrating digital management for curbside operations in Mexico. He highlighted the importance that for a digital system to work, it must guarantee or strongly suggest the availability of a space when it is needed for logistics stopping. This is somewhat in opposition to conventional digital technologies – which may be seen as almost synonymous with *live* data, digital space management technology must use an *approximation* of the spaces' availability as logistics route planning is done in advance – a technique of back casting the aggregated data to predict future occupancy and facilitate usage. Additionally, instead of enforcement with expensive camera systems or other strategies, he suggested that QR assisted check-in / check-out would be most accessible for the drivers and sufficient for the backend management. Dr. Buldeo Rai concurred and stressed that any digital management system must be designed in a way that any logistics driver is able to use it, and that it must actually provide benefit to the driver. The driver usability and benefit were widely agreed upon as a key determinant in success of this potential system. In addition to showing enthusiasm for the benefits at the curb, she also saw great opportunity for municipal benefit in the information that would be collected if these operations will be tracked and recorded. In the interviews it was also acknowledged that, consistent with the level of attention given to logistics stopping, any digitization is likely to be packaged within larger, city-wide digitization drives and less likely to be a standalone intervention.

In contrast with the optimism of the interviewees in academia, those with a professional background in policy advocated a more cautious treatment of digitization. Mr. Streng advised that digital management, while promising, must come at a point when other more traditional paths of regulation have been fully implemented or exhaustively explored. Additionally, in his opinion, digital management should be a role of the public authority. He pushed back on the idea of inviting a third-party company to implement such technology could quickly blur the lines between policy as a beneficial necessity and tend towards an exploitative overreach. Going forward, logistics stopping policy and regulation needs to be more clearly demarcated than it currently is, and the curbside problem better understood, before steps towards digitization should commence. Mr. Jongeneel, who comes from a similar municipal background, commented that while "technically [digitalization] works, but in real life it relies upon the right situation to be successful." While Amsterdam has not been able to find such a situation to pilot the technology, it is on the municipal radar to intervene on urban logistics. However, Mr. Jongeneel mentioned other trials for example in the cities of Utrecht and Groningen which are being followed closely in order to find good use cases for curb management technology. An additional theme from these conversations is that the success of digitization would necessitate scaled up enforcement of the delivery spaces, enforcement which yet is still not feasible. A final barrier to implementation of digital management is due to the fractured nature of municipal parking policy, commented Dr. Mingardo. It is not feasible to have a "one size fits all" approach to parking policy, and thus would require unified municipal ambition from local authorities to get digitization up and running. Additionally, any new policy must have a degree of flexibility to accommodate the diverse requirements of the field which is difficult to achieve. This fractured nature also complicates matters as any new implementation would either need to be specific to the city where it is applied, or municipalities must homogenize their policy in order to benefit from technical benefits piloted elsewhere.

Enforcement of logistics stopping was a conversation which engaged all the interviewees as well and ran almost in parallel with that of digitization. On a basic level, the consensus was the enforcement is necessary for any policy to function as intended. At the same time, good enforcement is difficult to achieve as it is expensive for municipalities, requires clear communication and the heterogeneous nature of urban logistics stopping adds a level of complexity not inherent to more homogenous passenger car parking practices. There were also discussions of the right amount of enforcement, and the difficulties in trying to police such a fractured practice and the necessity of judgement calls, stemming from the lack of specific laws on the matter. Mr. Streng added insight from the municipality viewpoint when he commented that a well-designed policy should mean that the need for enforcement is limited, congruent

with the reality that enforcement capacity is limited from the start. Prof. Fransoo's research has shown the benefits of stringent enforcement on improving logistic efficiency, and overall positive outcomes. He shared that there may be two different ways of looking at the topic; top-down enforcement driven by the municipality or bottom-up enforcement which places the role in the hands of drivers or other stakeholders, enabled by technology to report violations they come across. As top-down enforcement relates to the challenges such as cost and judgement, illustrated above, bottom-up enforcement may be a productive new direction of inquiry. A hypothesis supported on behalf of Mr. Streng and the municipality of Rotterdam. Initial reaction to this suggestion was mixed, with participants acknowledging the potential for its usefulness but raising questions about the ethics, practicalities, and acceptability. Mrs. Nelck from TLN cautioned that driver-initiated enforcement would not immediately solve the problem of non-logistics vehicles parking in a designated load/unload zone. Therefore, this strategy would need to be studied further so that it could be seen as a benefit to the drivers rather than a burden. Dr. Mingardo echoed this stance in stating that bottom-up enforcement should again focus on usability, acceptability, and practicality for all involved stakeholders, especially drivers.

An interesting departure from the more transport focused conversations came via the interview with Dr. Mingardo. From his background in passenger parking, Dr. Mingardo postulated that, given the historical development of passenger parking regulation – from unregulated to restricted to paid, that logistics parking should not be seen as exempt from this historical trend. Rather, the insistence thus far that logistics parking is different at a core level than passenger parking might not make very much sense in our dense city centers. Therefore, perhaps we can expect to see logistics parking – at least for longer term stays – to follow passenger parking as cities turn to paid parking to wrangle logistics in the same way as their proven success with passenger parking. As cities increase in density and size, there is increasing competition for curbside spaces. It seems that logistics stopping should be prioritized for these areas going forward, as passenger mobility may be (re)directed towards modalities that do not require passenger car parking and associated spatial burdens. The preference of the future is therefore to give these spaces to logistics, as the operators have less viable alternatives than stopping as near to their final destination is possible given their goods and service transportation roles.

During these conversations on logistics stopping interventions there arose a new and interesting area which, until then, had not received attention in this research. Dr. Buldeo Rai platformed a suggestion from her own research area, which was to pay more attention to ways of effecting consumer behavioral changes. She commented that consumer expectations for e-commerce deliveries is now "quite

malleable" in terms of when and where and how a delivery is made, and this malleability can and should be leveraged in its potential to shift delivery to a more sustainable and desirable practice. Given that the model of next day delivery is a relatively recent phenomenon, there is an opportunity to reinvent consumer expectations. This could enable (more of) a shift towards parcel lockers or pick-up points which would alleviate logistics congestion and pressure on the curb. While this shift may only apply to some specific logistics flows, it was noted in subsequent interviews as an important direction of study in its applicability to rectify the negative externalities of urban logistics experienced daily in urban areas. Mr. Streng agreed that this is an important direction of future research and that the so-called "demand management" aspect of urban logistics should not only include private consumers but to all receivers in general.

The final type of intervention which did not enjoy such extensive conversation was the topics of curbside consolidation centers and physical infrastructure. These interventions were relegated due to extensive interest exhibited in the discussion of the above interventions. However, it was noted by Prof. Fransoo and Mr. Jongeneel that CCC development and deployment could be of great benefit to create the right type of environment. And that they should enable drivers to carry out deliveries on foot rather than driving to and stopping in front of each location. This is congruent with zoning an area of the city for pedestrian usage. If these special accommodation zones are enacted, the stakeholders responsible for development should not forget to add infrastructural accommodations for logistics providers as well. Additionally, conversations were positive at the potential for increasing parking spaces for logistics, but frequently discussed alongside the restrictive nature of dense urban areas and spatial competition.

4.3.2 Survey

The survey targeted drivers' perceptions about various interventions applicable to their work. While somewhat limited by the format of survey and not an interview, effort was made to introduce the general themes in a comprehensible and succinct manner. Far and away the most popular intervention choice amongst the drivers was to increase in specially reserved parking spaces or load/unload zones. This option received 54 votes. Tied for second place, with 23 votes apiece were interventions to make the spaces larger and to give more time at the spaces for delivery operations (i.e., longer than the current default of 15 minutes). The integration of technology (such as space reservation or availability maps) did not appear to be a popular option for the drivers, receiving only 5 of the 136 total votes. However, the survey design goals, and target audience likely limited the ability to fully explain what the inclusion of technology could entail and how it would fit into their day-to-day tasks. Another interesting

aspect of responses to this question was the drivers' ambivalent reactions towards enforcement as a helpful measure.

The last question was an open response that asked if the respondents had any further comments to share about their work and on the topics of the survey. More time for deliveries and per customer was mentioned twice. Interventions to address safety were also foregrounded as one driver mentioned that some areas where there is not currently enough space for their vehicle to park, especially in new (green) developments, and that due to this lack of space they must frequently double park which causes "aggression from road users [to increase] significantly and alarmingly". Another comment on safety asked for more secure unloading areas where the driver can be better separated from traffic. Finally, the diversity of their stopping locations was reinforced as a driver referenced question three and commented that, they often must park in all six locations during one shift.

Chapter 5: Discussion

5.1 Key Findings

Along with the rise in e-commerce prolificity, growing urban densities, and sustainable city initiatives such as the zero-emission zones in the Netherlands, so too has risen stakeholder interest in managing logistics impact and negative externalities. These trends all come to a head at the curbside. This research project has applied a problem-analysis framework to increase knowledge of the heterogenous nature of urban logistics stopping practice; to accomplish the first stage of the *intervention cycle* of research. By way of a mixed-methods research, the goal of this project was to identify the spatial and temporal claims that logistics vehicles make on urban space. Doing so necessitated analysis of the current and desired situations, and about interventions which elevate stopping practices from the former towards the stakeholder described latter orientation.

This research project has produced several key findings which contribute to an overall understanding of the state of the curb. A literature-derived conceptual typology decomposed stopping practice along spatial and temporal lines into proven and manageable information for decision makers and researchers. Interviews which highlighted stakeholder desires for increased dynamic allocation of the curbside, the need for harmonious involvement in solution fitting, and the role of enforcement to ensure success of interventions. The driver survey contributed to understanding of stopping practices of the general and

fresh, parcel and express logistics flows and relayed driver desires for more logistics space, and spotlighted conflicts encountered by these professionals essential to urban functions.

5.2 Interpretations

In this subchapter, the results will be placed in conversation with the main research question in order to show how they contribute to answering the goals of this research project. To contextualize the following, the main research question is restated:

> *"How can a problem analysis approach to urban logistics stopping practice first improve current understanding by a decomposition of spatial and temporal aspects, then work towards definitions of the desired scenario, and assess interventions to bring the two stages closer together?"*

This master's thesis was inspired by current curbside research, such as the work done in Seattle, WA (Giron-Valderrama et al., 2019), in New York City (Schmid et al., 2018), in Washington DC. (Tipagornwong & Figliozzi, 2015) and sought to add a European scope this emerging research theme. On the other side of the Atlantic Ocean, inspiration was drawn from the research in the Netherlands, specifically TNO's logistics department. The structure of the research sought to involve a breadth of stakeholders via the problem analysis framework. This subchapter will work piecewise to provide meaning, importance and relevance to the results produced by this study.

5.2.1 Decomposing the Current Situation

Following the conversations with stakeholders from academia, policy and logistics organizations, there was a clear sense that, currently, logistics is not a very desirable topic of conversation, and little motivation seems to be present in order to change the status quo. The status quo being that urban logistics is "a bit of a blind spot" and thought to be "largely self-organizing". This is especially true within the crossover between spatial planning competencies, policy and logistics. The elementary correlation between these three fields has not yet been investigated to its fullest potential. The first concrete finding on this stage is that there needs to be more space given to conversations and concerns about urban logistics ordering. If decisionmakers are determined to negate the negative externalities of the practice, they must do so by working together with logistics. Preliminary steps should be to find more space for logistics and foreground conversations of about welcoming the sector into the city. These items are difficult now as not a lot is known about how urban logistics operates. Therefore, this study aims to provide knowledge to enable these first steps.

To provide knowledge for the necessary advancement of and cooperation with urban logistics, this project gained a firm grasp on behavior of the flows General and Fresh and Parcel and Express logistics. Focusing on the stopping practice, which can account for up to 80% of a vehicle's daily operations (Fransoo, 2022), this grasp is significant in terms of impact potential. From the survey, key points include the striking prevalence of the sub-15-minute stop time for urban logistics operations. This finding not only meets the expectations of other research but also it provides confirmation of the most likely timeframe upon which urban logistics strategy can be built. The survey also confirmed the 'messy' nature which was expected of urban logistics stopping. This finding is highlighted by the range of responses for drivers' stopping location and does add complexity to planning for urban logistics. While often found in unauthorized locations, their clear preference is for authorized spaces. However, the messy nature of this practice should be accepted as inherent, and policy should be shaped around this, with flexibility to accommodate these requirements if possible. A well-designed policy should mean that the need for enforcement is limited, and by building policy with flexibility in mind, this can become reality.

Another aspect of knowledge generation on the current situation, comes from the conceptual typology proposed in section 2.2. The typology was created in order to provide a type of 'shorthand' basis of knowledge along which to structure conversations and understanding of urban logistics stopping practice. Much like the logistics flow divisions, the typology in this project is a hypothesized relationship between constructs, as the inherent messiness of the field restricts absolutes. However, the typology is intended to provide sufficiently detailed information and guide future dialog around urban logistics. Typologies and urban logistics research combine well, and this research continues this relationship.

In summary, the current state of urban logistics stopping is an underappreciated yet vital aspect of the urban matrix. This research paper attempts to provide a relevant baseline. The current situation necessitates unified community knowledge to provide a background upon which progress may develop and is marked by gaps in awareness of various stakeholder groups.

5.2.2 Paths Towards the Desired Situation

By uncovering a situation which may be aspired towards, this aspect of the research contributes to both framing and the assessment of interventions and impacts. A difficulty in the future-focused aspect was evident in the interviews, as one of the major themes of responses was that is it hard to imagine how this organization may appear. However, with further inquiry, themes such as the need for a balanced approach to logistics strategy, and an embracement of technology were elucidated. A key finding which

was widely agreed upon by interviewees is that the future of curbside stopping would benefit greatly from digitization and dynamic allocation of space. Such technology has potential to make the highly contested and pressurized curbside, a ubiquitous and underappreciated component of urban space, more productive and conducive to desires of stakeholders including logistics operators, café and business owners, residents and visitors. Leveraging dynamic zones of use along temporal and spatial lines can order the curbside in such a way that many of these requests are enabled. This research established knowledge which should be utilized in a productive manner by municipalities to unlock their curbsides currently, hampered by discrete and monofunctional regulations. Flexibility is key for progress. A curbside can be allocated to logistics operations, provide space for terraces and bike or passenger vehicle parking based on the temporal requirements of each user and the desired goals of a municipality. Passenger vehicles currently occupy a place of privilege on the curb but may be easier to move to underground parking in densifying cities given their usage patterns. For reasons such as longer length of time parked, and that they often park only a handful of times per day, the desired situation likely requires an investigation into how passenger parking may be redesigned in order to facilitate broader municipal goals.

If cities are serious about mitigating negative externalities from logistics activities, then they should investigate providing more space for stopping. As Prof. Fransoo pointed out “everyone would be better off, [but] the difficulty is that everybody is better off but not everybody is better off all the time” and therein lies a paradox which has yet to be fully appreciated. This research enables confidence in making decisions and predictions about when and where a logistics vehicle will stop in a city. These insights coupled with the more macro-temporal research such as that shown in overview in Figure 2, and macro-spatial trends like in Figure 3, can provide an excellent basis for planning real-world reorganizations.

While more theoretical conversations were discussed in the interviews, the survey alluded towards conclusions of less complexity, which would be of interest to the more cautious opinions voiced by representatives of the municipalities present in the interviews. As Mr. Streng and Mr. Jongeneel pointed out, before digitization, we should try to do more with what is currently available at the disposal of governments. And the drivers would likely agree. The drivers’ responses to where they would most like to stop, and their daily challenges, were simply that they cannot find enough space. Therefore, before going all in on digitalization, it would be appropriate to investigate the allocation of more dedicated logistics parking. This update to the curbside would be well received even by the public who, while expected to push back initially, would likely appreciate the benefits after a successful trial process.

Additional positive impact would be evident in the decrease of friction between drivers and other road users if they are provided more space for stopping. This friction is nonnegligible, as nearly 1 in 4 survey respondents highlighted occurrences of conflicts with other users. It would also be worthwhile to make the most out of those currently available by developing curbside consolidation centers. These interventions would be designed in a way to stimulate longer-term logistics parking and motivate deliveries made on foot. Successfully implementing these centers would abate the externalities paradigm and make stopping practice more manageable and predictable. However, the centers would need to be placed in areas of sufficient density. If successfully implemented, CCCs would provide ample benefits which replace the nuisance resulting from drivers parking at each stop along their delivery route. Whether providing more static spaces of logistics stopping or implementing a system of dynamic allocation, given the uptake of e-commerce delivery and general trends of urbanization, and increasing density, that there is a need for a referendum on the space cities provide for urban logistics.

Good enforcement is key to enable a desired situation and ensure success of most any interventions. Traditionally, the onus of enforcement is taken on by the municipality and administrated in a top-down manner. Research as shown the significant benefits of proper enforcement such as increased operational efficiency and the abatement of externalities such as congestion or conflicts. However, for several reasons, enforcement is very hard to achieve for urban logistics stopping. Therefore, it is common practice that logistics is left to ‘self-organize’, and largely only the more erogenous transgressions receive a punitive response. These findings have stimulated the need to innovate when it comes to enforcement. One such innovative idea comes along with conversations of digitalizing the curb – the idea of enabling bottom-up enforcement. In this new strategy, mentioned in the interview with Prof. Fransoo, would leverage digital integration and empower logistics drivers to report parking violations, most likely those where passenger vehicles are parked in dedicated logistics zones. However, this solution cannot be taken as an end all solution to curbside externalities and will require significant research on numerous practical challenges before serious implementation discussions may commence. Some such practical challenges could include the reluctance of logistics firms to share extensive operational data, the prevalence of many and very short stops for deliveries, the driver accessibility of the technology, and municipal cost/benefit analysis of its implementation.

The survey responses push back somewhat on these ideas of the necessity of enforcement. In question nine, which asked if drivers would like more or less enforcement, both options were selected almost evenly. This hints at a conclusion that enforcement may not be the most impactful measure in alleviating

curbside stress, and that drivers do not see a need for different levels of enforcement in their current paradigm. This theory should be explored further as it counters the widely accepted conclusions espoused in the interviews.

An alternative approach to enforcement is the integration of strategies to reduce the need to stop at the curb in general. With the rise of self-collection delivery technology, these 'parcel lockers' can replace door-to-door delivery routes and therefore require a fraction of the time at the curb. A wholesale embrace of SCD infrastructure, and associated methods such as parcel pick up points would be able to order spatial and temporal delivery characteristics and mitigate the need for increased enforcement while necessarily negating negative externalities all at once. In the same theme, curbside consolidation centers have similar benefits, but would require further research to fully prove their best use cases.

5.2.3 Expectations and Explanations

One of the main expectations of this project was that the typology would be confirmed by data derived in the driver survey. Upon closer analysis, the confirmation is only partially available. The main reason is that the flows which were represented in the survey are only half of those outlined in the literature review and subsequently represented theoretically in the conceptual typology. Therefore, of the first division of the typology – parking and unloading – unloading fully represents the survey respondents. As for temporal aspects, many respondents would be in the short-term category, with only 12 of the 80 respondents reporting unloading times greater than 15 minutes. In hindsight, it may be pertinent to add a 'very short' stop category to better represent a division between these two flows. As for the spatial aspect of the typology, the survey suggests that authorized stopping (118 selections) was nearly equal to unauthorized stopping (94), equating to 44% of self-reported parking locations. Findings that are in line with those from Dablanc and Beziat, (2015) where 50% of operations were made with a double-parked vehicle and more than 60% of such operations were conducted with an illegally stopped vehicle, but less than the 70% illegal parking figure from Munuzuri et al., (2012). From the survey, it seems that the usage of dedicated or random spaces tends towards a preference for dedicated spaces by logistics drivers.

There were a couple unexpected results from the data collection process. The first was the widespread interest professed by the interview respondents about the possibilities of digitalization of the curb. From the thematization before the interviews, this topic was relatively under-addressed and most of the research focused on more physical interventions such as CCCs and SCD points. However, given the interest from the stakeholders, the literature review was revised in order to account for this promising intervention. A second unexpected result was that while the drivers reported rarely using more than 15

minutes to make their stops, they often reported wanting more time to make deliveries as a potential intervention. This is somewhat difficult to explain but may warrant further investigation. It can be theorized that the response of needing additional time is related more to the general pressure under which they work, but further research could be necessary to decompose this contradiction. The third unexpected result is the split between interviewees and survey respondents' attitudes towards digital and physical interventions. The drivers overwhelmingly favored physical interventions such as adding more dedicated areas or providing more safety infrastructure around these dedicated spaces to enable more confidence in their ability to complete deliveries. From the side of the interviewees, much of the excitement was about digital interventions, with less attention to the physical side of things. This split is important to acknowledge when planning for a future where both groups need to work together to improve the practice.

5.3 Implications

As a result of this research, numerous theoretical and practical implications have been made clear in order to positively impact both the urban logistics sector and the general public. In the following subchapter, these suggestions will be discussed.

Theoretically, this research contributes to the field of urban logistics research by providing a new conceptualization of parking terminology; the division between *parking* and *unloading* which is encompassed by the general term of *stopping*. The wider adoption of these terms is recommended to clarify conversations around logistics stopping. This approach should be implemented by stakeholders such as researchers in academia and municipal actors for less confusion around curbside operations. The conceptual typology also suggests additional ways to define the spatial and temporal aspects of stopping and can be used by these same actors to clarify their intentions, research directions and policy decisions. Additional theoretical implications of the project are borne from the scope of the research. Inspired by similar curbside research done in the North American context, this project added a Dutch - and more broadly European - scope to research on the battle for the curb. In doing so, the findings enable context specific decision making and empowers stakeholders who are interested in effecting a more desired situation with respect to urban logistics stopping.

Practical implications of this research start with the need for more awareness about the benefits of giving urban space to logistics. The study of interventions, which are grounded in the reduction of negative externalities, suggests how their implementation is essential for a sustainable future of this sector. These findings should be used by policy makers not only during planning stages, but also in

communities' education about benefits they receive through intervention(s). As discovered in the interview section, "logistics is not typically an activity that is welcomed into the city with respect to zoning laws", and the results of this project necessitate a shift in these attitudes by illustrating the benefits of a more welcoming approach to logistics planning.

The practical implications of digitization findings highlight a need to focus research attention and harness political willpower towards the adaptation of dynamic curbs. Policy makers should take an active role in addressing logistics and focus on measures other than putative controls. Digitization received high amounts of interest in the interviews from researchers and organizational representatives, but it was less exciting to municipal representatives and not represented in the driver survey. Therefore, the next steps should include specific focus on how to make digitization accessible and beneficial to logistics drivers and operators, as well as how it could practically be implemented by cities. Research capacity will be essential in setting this progress in motion and should make use of advances in modeling technology such as digital twinning. When planning for digital implementation, it is important to use the temporal knowledge gained from the survey to determine impact that digitization may have. The data confirms that parcel / express deliveries are made using very short stopping times, and therefore it would be harder to add value to the drivers' experience if they are required to check in and out of a location when stopping. This dichotomy must be considered for acceptance of the technology, as the desire of implementation is to facilitate, not hinder logistics stopping.

The preceding research has highlighted three paths along which we may expect logistics enforcement to advance: 1) more top-down enforcement, 2) following the model of paid passenger parking, and 3) bottom-up innovation. Given the difficulties inherent to top-down enforcement, and the competitive disadvantages as well as reliance on enforcement for paid parking, the first two paths should remain closed. This research has strongly suggested the need to develop knowledge on bottom-up enforcement methods and to leverage a dual capacity strategy along with curbside digitization.

Finally, a few promising physical interventions are suggested for further implementation on the curbside. The interventions of curbside consolidation centers and self-collection deliveries have been sufficiently developed in theory, and now must be practically implemented if municipalities are serious about mitigating negative logistics externalities and accommodating for future growth of the sector. In the right context, these interventions can stimulate on-foot deliveries and reduce congestion, accidents, and other road-user conflicts. In addition to these 'novel' interventions, it is time for cities to increase their dedicated load/unload zones. By providing the driver's most preferred stopping location, they can expect

to decrease reliance on unauthorized stopping and therefore an abatement of associated externalities. If the number of these zones are increased in concert with CCCs ideas, there will be more deliveries made on foot, drivers' and pedestrians' safety will increase, and we can advance closer to the shared, desired situation highlighted in the interviews. Increasing the number of physical spaces and the infrastructure associated with them (as is necessary for CCCs), would be a targeted benefit for logistics flows with short to very short stopping times. The drivers in these flows should not be expected to utilize any application that will add undue time to their routes but can be expected to park in an appropriate area, if such a space is provided for them.

Chapter 6: Conclusions

This conclusions section starts with a systematic response to the research sub questions, which in turn, provides a generalized conclusion for the main research question. After these conclusions, then the limitations and recommendations for future research are discussed to wrap up the research project.

6.1 Systematic Conclusions

This section is intended to complete the research project by distilling conclusions in a systemic manner, relating them to the main research and sub questions. In order the answer the main research question, four sub questions were developed to guide the project in actionable pieces. Therefore, all five questions deserve an answer.

To arrive upon an answer for this main question, first the four sub questions will be restated and directly responded to; after which a result will be provided for the overall research project.

The first sub question was: *How can a typology of the current stopping paradigm incorporate key performance indicators (KPIs) and build upon the literature review to disperse manageable information of practice?*

The typology (below) was built following the literature review especially after an investigation of potential KPIs, indicators derived from contemporary research. The ability of the typology to "disperse manageable information of practice" has been discussed in section 5.2.3. Takeaway messages include the success of the in fully capturing the stopping behaviors of all survey respondents, which indicate that it can provide information about practice. The one drawback in confirmation was that the survey was not representative of all logistics flows that the typology was designed to capture, therefore, additional

testing and research may be needed. Overall, the typology provides proven success in capturing the general and fresh and parcel and express logistics flows and is expected to do the same for additional logistics flows.

Level	**Area of Inquiry**	**Selected Constructs**	
One	**Stopping**	**Parking**	**Unloading**
Two	**Spatial Impact**	**Authorized**	**Unauthorized**
		Dedicated	**Random**
	Temporal	**Short Term**	**Long Term**

Table 2 (own ill.)

The second sub question was: *Which curbside interventions should be highlighted based on their theoretical capacity to reduce logistics externalities and enable desirable outcomes?*

This sub question was answered with a literature review. In the thematization process undertaken to prepare for the interviews and survey, several potential directions for interventions were explored. The final conclusions were that the interventions which should be highlighted, based on capacity to reduce externalities, were as follows: enforcement measures, digitization, curbside consolidation centers, self-collection delivery, and dedicated infrastructure. As this sub question related the theoretical capacity of the interventions to reduce externalities and enable desirable outcomes, the answer to this sub question was not yet put into conversation in the interviews nor the survey. This list of interventions was developed as the themes included often came up in academic and grey literature as new ways of logistics organization. The list of interventions only includes those which directly relate to logistics stopping, so some currently innovative solutions for externality reduction (i.e., micro hubs and alternative modalities) in the sector were excluded from the scope of inclusion.

The third sub question was: *How does the involvement of stakeholders add current and future insight to the problem analysis approach, and lend insight to the feasibility of interventions?*

The seven, semi-structured stakeholder interviews were an integral part of the research project and provided a wealth of important information applicable to urban logistics research. This sub question set the agenda for the interviews, as questions were grouped around the three themes of the question. For the current situation, stakeholders illustrated that logistics is not a very desirable topic of conversation, and little motivation seems to be present in order to change the status quo. The status quo being that urban logistics is “a bit of a blind spot” and thought to be “largely self-organizing”. Therefore, this project

develops understanding of the impact of current externalities due spatial, developmental, and economic trends may be largely attributed to this hands-off approach to regulation. Since the current situation yet is largely only of interest to a niche field of researchers, this paper generates spatial planning and logistics management knowledge to be used for future developments.

The question also motivated an investigation of how this future should appear. In the interviews, there was at first difficulty in answering this question, but in the end a few broad themes or goals emerged. The two main ideas being that curbside stopping would benefit greatly from dynamic allocation of space and enforcement is key to enable a desired situation. Meaning that enforcement is necessary to ensure success of most any interventions suggested via desk research. These two goals have been found to have an integrated aspect. Good enforcement can become more feasible with innovation into alternative methods of enforcement. Suggested in the interview was the idea of further research into how digitization would enable *bottom-up* enforcement. Doing so would allow for success in both areas of priority. These interviews also found that an alternative approach to enforcement is the integration of strategies to reduce the need to stop at the curb in general. And therefore, items such as dedicated infrastructure, CCCs and SCD strategies were appreciated for their ability to reduce stops along logistics routes. However, this dedicated infrastructure would be expected to mostly impact parcel and express logistics, leaving the other flows in need of alternative developments.

The final sub question was: *What is the current reality of drivers' interaction with the curb, and how can they support the implementation of future scenarios?*

The survey was structed in the same way as the interview themes, and the current situation at the curb was a central finding of the survey. The survey generated data for the flows of parcel and express and general and fresh logistics. It highlighted the busy nature of drivers' obligations marked by numerous stops, for short times and the wide range of spatial stopping claims. These findings highlighted the inherent *messiness* of the sector. Additionally, the survey made it clear that it is not only logistics imposing externalities upon citizens, but about 25% of the respondents reported occurrences of users in conflict with them. It was clear that the current situation is less than ideal for any group of stakeholders and needs to be intervened upon.

Following the current situation questions, the survey looked to determine how the drivers may desire the field to shift to better accommodate their needs. In terms of space, the drivers' responses show that they too do not like to park in unauthorized locations, and that they have a clear preference to stop in authorized spaces such as a dedicated logistics zone or regular curbside space. The findings also hint at

the necessity of developing beneficial aspects for operators in digital allocation or enforcement strategies as the responses to interventions showed that currently the drivers only desire an increase of physical and dedicated infrastructure.

With the four sub questions thoroughly discussed, the main research question is stated once more:

"How can a problem analysis approach to urban logistics stopping practice first improve current understanding by a decomposition of spatial and temporal aspects, work towards definitions of the desired scenario, and assess interventions to bring the two stages closer together?"

In overall response to the main research question, this research has utilized a problem analysis approach to show that the current status of urban logistics stopping is that it does not receive enough attention from many stakeholders. The current situation is marked by negative externalities such as congestion, emissions, accidents and conflicts, and is left by policy to largely self-organize. The heterogeneity of the field makes it difficult to grasp fully. In order to provide succinct information about stopping, a typology which breaks down spatial and temporal aspects has been developed and was proven to encapsulate the stopping practice of the flows represented in the survey. The desired situation of urban logistics is to order the field in such a way that logistics may work reliably in an urban environment while decreasing the current negative externalities. This desired situation will be achieved when curbsides may be dynamically allocated, and enforcement which helps, not hinders policy goals. Interventions are necessary in order to bring about the desired situation. Two main areas which should be focused on for their role in enabling the desired situation are digitization measures and bottom-up enforcement. The benefit of both is that there is an interdependency which may be leveraged to provide both via the implementation. However, more work must be done before they are feasible. For the drivers' perspective, they are aware that more space for logistics functions is necessary. It is evident that with any implementation of digitization, the drivers would need to see tangible benefits in their daily operations. In conclusion, the best mix of interventions would both be high and low technology, and cities can benefit from a more desired situation by looking into physical interventions before digital interventions are ready for deployment.

6.3 Limitations

This subsection includes the limitations which are relevant to the main research objectives. In this section, an accurate picture of what may and may not be concluded from the study is provided.

The first limitation is that the survey only represented drivers from two logistics flows, which left out insights from service logistics. This was not for lack of trying as the survey was sent to service companies as well. However, due to scheduling conflicts and other variables outside this project's purview, the survey did not include these drivers. The survey was able to collect rich data and draw well informed conclusions of the two flows which did participate.

The second limitation is again the representativeness but this time of the interviews. While seven interviews were conducted with participants from academia, policy and stakeholder associations backgrounds, the interview participant roster would have benefited from the inclusion of managers in the corporate structure of logistics firms. These viewpoints would have added insightful information to the conclusions. Still, as with the survey results, the interview results do represent a broad range of opinions and should not entirely be discounted due to this limitation.

The third limitation in this project was the scope of research. In undertaking a large and self-directed research paper, it was difficult to maintain a high level of focus and depth of discussion throughout. It is likely that the research objectives would have benefited from a stricter scope and more focused research goals in general. Yet while at the same time mindful of this limitation, the research data, conclusions, and discussion should remain applicable as they still provide valuable information on the state of current and future urban logistics stopping and interventions.

6.4 Recommendations

An exciting aspect of conducting research in such an underrepresented area of focus is the opportunity to act as an authority on new and important directions for future research. A number of suggestions have arisen during the course of this project and are listed in this final subsection.

The first, and primary direction for future research is the next stages in the *intervention cycle* of Verschuren and Doorewaard (2010). As this research has situated and expanded upon the problem analysis framework, and suggested interventions in line with the diagnosis step, the next step is to research concrete intervention designs, build a plan for their implementation, and finally to evaluate how the interventions perform in a real-world context. These next directions should benefit from this research of this project as a base for future progress.

Another possible research direction is to set up a similar survey with drivers from all of the diverse flows of logistics, with the explicit goal of gathering their insights into the applicability of interventions. While this research did gauge broad interest into interventions, a more targeted survey would be helpful for

example to investigate more specific aspects of how digitalization could be structed in order to provide the greatest benefit for drivers – focusing for example on usability and applicability.

Related to this project's conclusion on the widely held desire to investigate digitization of the curb, and the necessity of enforcement to support policy. A future direction of research should focus on the two-fold benefits in implementation of bottom-up enforcement strategies and how they can enable digitization policy success.

As a result of this research, there is an opening for more scientific investigation into how consumer behavioral changes could play a role in affecting a more desirable situation. With e-commerce growing yearly, the delivery of these goods as it is currently will not disappear. However, given the very new abilities of next day delivery, researchers have concluded that there is an opportunity to shift expectations. Therefore, research into consumer nudging would be an insightful direction of future research.

A final recommendation is to look at how spatial differentiation of urban areas relates to logistics pressure and externalities driven by increasing logistics prevalence. Especially motivated by the growth in ecommerce, cities are becoming increasingly aware of logistics externalities and have enforced several policies aimed at their reduction. However, logistics has a different impact on different spatial configurations, and therefore blanket policies may not be the most useful in improving their impacts. For example, the usage and impact of a CCC is likely very different when located in a historic city center rather than a newly built suburban area. Therefore, future research can add valuable information to policy maker's toolbox by investigating nuances attributed to spatial differentiation of urban areas.

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Appendix A

Interview Guide

Interview questions – semi structured, used in a supporting manner

- Introduction
    - Thank you for taking the time today
    - I am excited to have this conversation with you
    - Small personal background and explanatory background of my research thus far
        - I studied a BS in environmental science at UW Madison
        - MSc in spatial planning at RU, focus on mobility, and now urban logistics
    - My thesis project is to build a typology of urban logistics stopping practice, to learn about claims to time and space per flow
    - Additionally, an exploration of interventions and their feasibility
    - Finally, comments on the siloed nature of these multi-disciplinary issues
    - Explain key themes, and how I use the terms
        - Stopping = parking or unloading
        - Flows of logistics
            - General/fresh cargo
            - Parcel and express
            - Facility/service
            - Construction (finishing mostly)
        - Spatial and temporal aspects as a way to create “ideal types” and allow comparison
    - The goal of these interviews is to bridge institutional gaps, to provide a comprehensive background on parking, and to determine ways to provide a more suitable ordering of urban logistics
    - Ask if it is alright to record the meeting and if they will allow the responses to be used in the thesis work.

The Interview

1. Can you please tell me a bit about your background, and why you entered into the world of logistics?
2. How do you, given your background and experience understand/structure/interact with logistics stopping(parking)
    a. Do you have a focus on a specific flow, or general area?
    b. How does it arise in your field, what are the major themes topics
    c. Or does it not come up at all?
3. Do you have a sense of what an “desired” parking/ ordering scenario of urban logistics?
    a. Is it tied to a reduction of externalities?
    b. Is it sustainability focused

c. Maybe it is close to complete now
d. Is it related to technological advancements

4. Reaction to/ conversation about the list of interventions that I have included in my thesis
    a. *Feasibility, hurdles, potential*
        i. **Curbside sorting hubs** – an even smaller scale micro hub – allows transport on foot in dense urban areas
        ii. **Enforcement possibilities** of L/U zones
            1. Studies point to the key role enforcement plays, but there are significant hurdles in both monetary and manpower to provide
            2. Other enforcement mechanisms or strategies?
        iii. **Physical Infrastructure**
            1. Conversations on the applicability and appetite for more logistics specific infrastructure to support flows
            2. repurposing areas to provide logistics services when their unused – parking garages are the classic example, but maybe there needs to be even more creativity? Theaters for example are mostly empty as are offices (post covid), other ideas?
        iv. **Digital management methods** – such as coding the curbs, space reservation, availability (used in public parking garages, maybe could be scaled up)
        v. **Behavioral pushes** – rules for use of pick-up points, time windows based on reducing residential nuisance, or environmental aspects (AH already does this)
5. Do you have flow-specific interventions which are promising in the transition from current to ideal? What is needed for this transition?
    a. How would they be transferrable to other logistic flows
    b. What area are they based on? – rural, peri-urban, urban etc

<u>ENDING</u>

- Any other questions or comments?
- Would you like me to send you a completed copy of the thesis?

Possible domain specific questions

- Experts
    - How do you see new logistics ordering, modality shifts, or spatial trends disrupting or convoluting logistics stopping
    - Duration researchers – what was your motivation for this study
        - What was surprising
- Municipality
    - When was policy on urban logistics parking/unloading last addressed?
    - Is this considered an issue or focus for the city?
        - Do you get complaints?
        - Do externalities play a role in these discussions or is it underappreciated
        - If so, are there markable differences between competencies / offices
    - Do cities do enough to accommodate parking? How could they do more?
        - How is it in newly planned areas

Appendix B

Survey Questions

Questions

1. Please fill in the name of your company, or the general business you conduct
2. Which type of vehicle do you **most often** drive?
    a. Delivery van
    b. Box truck / lorry
    c. Smaller than a van
    d. Larger than a box truck
3. While working, where do you **most often** park or unload? (Select up to **three** options, using the photos as an *approximation* of each location)
    a. In a general space on the street
    b. In a load/unload zone on the street
    c. Double parked (only in the middle of the street)
    d. On the sidewalk or bike path
    e. In a pedestrian area (i.e. shopping street or public square)
    f. In a garage or private parking
    g. Other
4. While working, where would you **most like** to park or unload? (Select up to **three** options, using the photos as an *approximation* of each location)
    a. In a general space on the street
    b. In a load/unload zone on the street
    c. Double parked (only in the middle of the street)
    d. On the sidewalk or bike path
    e. In a pedestrian area (i.e. shopping street or public square)
    f. In a garage or private parking
    g. Other
5. How long **on average** do you spend at a stop?
    a. 0-5 minutes
    b. 5-15 minutes
    c. 15-30 minutes
    d. 30-60 minutes
    e. 1-2 hours
    f. More than 2 hours
6. Please estimate the **number of stops** that you make during an average day of work
7. How satisfied are you with parking experiences you have on the job? (Parking experience can include how easy it is to find a space, accessibility, proximity to final address etc.)
    a. Very satisfied
    b. Satisfied
    c. Neither satisfied nor dissatisfied

    d. Dissatisfied
    e. Very Dissatisfied
8. Which of these challenges do you experience **most** while stopping? (select up to **two** options)
    a. Lack of available space
    b. Lost time / delays
    c. Hostile or aggressive drivers, bikers or pedestrians
    d. Parking fines or other costs
    e. Pressure to conduct your work quickly
    f. Other
9. Which of the following *interventions* would be **most beneficial** to your parking experience? (select up to **two** options)
    a. More parking enforcement
    b. Less parking enforcement
    c. More dedicated “logistics only” parking
    d. Larger “logistics only” spaces
    e. Longer time windows at loading/unloading zones (more time to complete your delivery)
    f. Shorter time windows at loading/unloading zones (to increase the turnover of available spaces)
    g. Integration of technology - such as space reservation or parking availability maps
    h. Other
10. Do you have any other comments or questions?

Thank you very much for your participation. Your responses have been sent.