THE INTERSECTION OF LOGISTICS AND LIVABILITY: RESTRUCTURING LOGISTICAL FLOWS AND INTEGRATING HUBS INTO NEIGHBORHOODS AS A PATHWAY TO INCREASE LIVABILITY

TABEA RADEMACHER
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MASTER SOCIETY, SUSTAINABILITY AND PLANNING
FACULTY OF SPATIAL SCIENCES, UNIVERSITY OF GRONINGEN
SUPERVISORS: PROF. DR. IR. TAEDE TILLEMA & DR. WARD RAUWS

Colophon

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Author:	Tabea Rademacher
Student number:	s3439429
Program:	Society, Sustainability and Planning
University:	University of Groningen Faculty of Spatial Sciences Landleven 1 9747AD Groningen
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Preface

Dear reader,

Before you lies my master thesis for the master program Society, Sustainability and Planning at the Faculty of Spatial Sciences from the University of Groningen. I would shortly like to express my gratitude to everyone who has supported me throughout the entire program and especially to everyone who has assisted me with this thesis.

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Abstract

Over the past years, changes within the consumption of goods has taken place. Consumers are inclined to shop online more regularly, which results in an increased number of package deliveries. Previous research has shown that many of these deliveries are to homes, which is challenging the last-mile operations in terms of capacity, transport volume, as well as traffic flow and road safety. Additionally, deliveries via trucks and vans are also seen as a disturbance to the neighborhood and as a negative impact on the environment and its livability. To manage these volumes, the re-structuring of logistical flows becomes from importance. For that, the integration of hubs to manage the last-mile delivery has been on the rise. This thesis is looking at the plans for the re-development of the neighborhood Spoorzone in Zwolle and Beurskwartier in Utrecht and investigates how restructuring logistical flows through a hub system can impact the livability of the neighborhoods. Contrary to the literature, which focuses much on the optimization of the package delivery and logistics sector, this thesis also takes into account the societal side. The findings show that livability can be increased by re-structuring logistical flows, integrating a hub system, and accounting for multifunctional spaces in the design that promote traffic and social safety. For this to be taken into consideration for future designs, an integration of these vital aspects is important, including a careful consideration for stakeholder management and collaboration.

Key words: urban logistics, re-structuring flows, neighborhood hubs, livability, safety, multifunctionality, collaboration, vibrancy

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List of Abbreviations

MCC	Mirco consolidation center
GRP	Goods reception point
ULB	Urban locker box
LEV	Light electric vehicle
STOMP	Stappen, trappen, openbaar vervoer, MAAS, private car usage
MAAS	Mobility as a service

1. Introduction

1.1. The need to innovate urban logistics for livable cities

Within Europe, around 73% of all inhabitants live in cities. This percentage is expected to grow by 9% in the upcoming 30 years. However, not only is the population growing, but also the consumption of goods. Especially online consumption through e-commerce changes the movement patterns of goods and people across urban space and increases the demand for urban freight transport (Bjørgen & Ryghaug, 2022; European Commission, 2013).

As cities are becoming increasing areas of pressure through various trends such as sustainability, aging, and the growth of the urban population, the demands for goods and services have been rising (TNO & FABRICations, 2022). This results in an increased volume of traffic. Much of this increase in traffic is part of the increase in deliveries and the movement of people (Strubelt & Bremerhaven, 2018; Taniguchi, 2014).

Over the past years, significant changes in the consumption of goods have occurred. As a result, consumers tend to shop online more frequently, especially since the COVID-19 pandemic, in which e-commerce has become even more dominant (Bjørgen & Ryghaug, 2022). This results in packages having to be delivered to the consumer's homes.

Therefore, cities become pressure points within transport and logistics, as the last mile delivery is moving away from shopping areas, in which the logistical infrastructure is in place, and is moving towards residential areas, which are not prepared for the change of this consumer culture (Gevaers et al., 2009). This development also impacts the goals of sustainable development in cities.

The last-mile delivery into the comfort of consumers' homes rather than into the traditional realm of shopping areas or large consolidation in urban peripheries increases the costs but also adds to poor environmental performance when looking at the inefficiency of deliveries (Gevaers et al., 2009). Delivery tours, even if optimized, come with many uncertainties surrounding the consumer, such as failed and therefore repeated deliveries, as well as returns from consumers (Bjørgen & Ryghaug, 2022). While it is called the last mile, the result is many kilometers traveled to accommodate the delivery of parcels within dense areas and deliveries back and forth to the urban consolidation center (eit Urban Mobility, 2020). This movement of goods shows that urban logistics is not just the delivery of packages but also comes with the implications deliveries have on the spatial dimension in which they take place.

About 40% of the pollution in urban areas is currently the result of freight transport (Lindholm & Blinge, 2014). Next to the air pollution and increased emissions of the freight traffic flows, also various other adverse effects on urban areas and especially neighborhoods can be identified. Freight delivery is linked to negative environmental effects like noise pollution and safety concerns like car crashes (Anderson et al., 2005; Bjørgen et al., 2019; Taniguchi, 2014; Trecozzi et al., 2022). Consequently, this compromises sustainable development for communities in urban areas (Trecozzi et al., 2022). To tackle the negative externalities and facilitate more sustainable development, the European Union set the goal of CO_2-emission-free city logistics in major urban centers by 2030 (European Commission, 2013). Not only would this lower the emission of CO_2, but it also reduces the emission of other harmful substances, as these negative externalities can have negative impacts on livability for residents within cities (Holguín-Veras, 2012). Next to the EU goal, additional initiatives like the Urban Mobility Package and the Low Emission Strategy were started (Aifandopoulou et al., 2019). Nevertheless, freight transport, logistics, and the connection to livability have mainly been ignored by local authorities. Especially in the Netherlands, over one-third of Dutch cities do not have a plan for urban freight deliveries for the upcoming years (Bjørgen & Ryghaug, 2022; Lindholm & Blinge, 2014).

The current solution for tackling the inefficiencies is the encouragement of consumers to use parcel lockers and pick-up points. These types of solutions are designed on an individual level and are for the pure functionality of picking up a parcel. However, especially with lockers, safety is frequently neglected as lockers are accessible 24 hours a day and are often placed along grocery stores, gas stations, and underexposed areas. (eit Urban Mobility, 2020). Consequently, after the opening hours of these services,

the area in which the parcel locker is placed is often found empty. Therefore, many consumers find home delivery a safer option, even if safety measures such as vandalism-proof material, security cameras, and ID scanners are used at the lockers location (Van Duin et al., 2020).

These individualized stations for picking up parcels can also be transformed into smaller urban consolidation centers like a micro hub, (shared) micro depot, or neighborhood hub. Different names are used, but they describe a place in which logistical facilities are integrated into places that are visited at a high frequency. In this way, functionality is linked with human activity and interaction (Amsterdam University of Applied Sciences, 2021; eit Urban Mobility, 2020; Rosenberg et al., 2021). A central location for collecting and delivering goods can be established at these neighborhood hubs while accommodating extra services desired within the neighborhood (eit Urban Mobility, 2020; Rosenberg et al., 2021). Therefore, a neighborhood hub in a frequently visited public space is more attractive and can become a natural meeting point where functionality meets interaction.

Furthermore, by not just focusing on the logistical side but also adding services, opportunities can be featured to increase livability. Such services can be, for example, kiosks, cafés, or urban furniture that invites to linger (eit Urban Mobility, 2020). In that way, not just another logistical hub is provided, but instead, a link between urban logistics, the urban fabric, and the community can be established (eit Urban Mobility, 2020). This can massively contribute to reducing pollution, as the last mile from neighborhood hubs to consumers is primarily based on emission-free vehicles or people picking up their packages since the last mile has been reduced even further (Katsela et al., 2022). Next to that, it results in increased livability for residents, as (1) pollution and congestion of urban freight are lowered through the bundling of goods, and use of more sustainable last-mile vehicles, (2) additional services are provided close to home, (3) a safer environment can be established through increased human activity in and around the neighborhood hub (eit Urban Mobility, 2020).

1.2. Scientific Relevance

The representation of neighborhood hubs that focus on the last mile delivery and other services within the literature is scarce. The lack of a coherent name and definition within the literature makes the concept of neighborhood hubs challenging (Katsela et al., 2022). As many projects on neighborhood hubs are in their planning stage, little scientific evaluation has taken place, and comparison of literature definitions and implementation strategies have yet to be compared. Discrepancies and similarities can be identified by defining existing literature and evaluating the policy plans of projects, which can further strengthen the development of neighborhood hubs as concepts.

Additionally, much research is focusing on mobility hubs or larger-scale logistical consolidation hubs, and only slowly research and policies are picking up the smaller-scale neighborhood hubs (Bjørgen et al., 2019; Cardenas et al., 2017; Katsela et al., 2022). Therefore, contributing to the logistical literature by expanding on the existing concept and taking a look at plans that integrate these kinds of hubs can add to the field of logistical solutions. Furthermore, also the impact of these hubs on livability is underexposed as research on these hubs is primarily focused on the logistical optimization of deliveries and less on their impacts on society. Therefore, additional themes can be interlinked and be exposed.

1.3. Societal Relevance

Currently, policies within mobility are focused on passenger transport (Aifandopoulou et al., 2019; Lindholm & Blinge, 2014) and the optimization of logistics and delivery, especially in terms of costs and benefits for stakeholders with the creation of sustainable urban logistics (Bjørgen et al., 2019; Cardenas et al., 2017). The overall focus on optimizing sustainable transport systems and its focus on passenger transport (Taniguchi, 2014) lacks the view from the societal perspective on the logistic side. Negative externalities from logistics directly impact society (Bjørgen & Ryghaug, 2022; Lindholm & Blinge, 2014; Strubelt & Bremerhaven, 2018; Trecozzi et al., 2022). A collective point of view must be established to prioritize safe, livable, and sustainable cities through structural changes to existing systems (Deloitte, 2022). While the

economic goal of having a functioning transport system that is viable over time is essential for the business sector, the environment is frequently seen as a constraint within the field of logistics, as it negatively impacts businesses. However, it also negatively impacts the environment and society. The lack of attention to logistics in urban areas and its relation to livability for residents directly impacts the residents' health and perception of the neighborhood. The residents' health compromises not only the impacts pollution has but also the general societal decline that is taking place. Reports show that loneliness is rising because of declining personal interaction (Brody, 2013, 2017; Putnam, 2000). Life is increasingly centered in private realms like homes and not within the public realm like neighborhood streets (Putnam, 2000). Therefore, interactions and connections within the neighborhood are declining, and residents experience more loneliness and depression (Putnam, 2000). Especially among older residents, a social network is often lacking (Rosenbaum, 2006). The lack of social interaction can cause, among other things, health problems like risks for illnesses, early death, and increased levels of anxiety and depression (Brody, 2013, 2017).

In the long run, the logistics sector depends on changes in society's consumption behavior, directly impacting businesses (Gonzalez-Feliu, 2018). Observations showed that understanding the implications of urban logistics on the community and the built environment is vital to developing livable urban areas while not neglecting urban logistics (Bjørgen et al., 2019; Trecozzi et al., 2022). For this reason, adaptations need to be facilitated in which all the environmental and societal pillars receive more attention. Equal attention should be paid to the possibilities and limitations of logistical strategies focusing on the local community to create a sustainable and livable environment.

Therefore, local authorities need to ensure a livable environment by securing good accessibility of goods and services, high-quality public space, and traffic safety while also protecting residents' health (Lau Leby & Hariza Hashim, 2010) and not just focusing on the resident as a pure economic stakeholder. Furthermore, to keep up with the logistical trends and achieve a livable environment, it is important to facilitate innovative logistical solutions considering the interaction of the community and the environment (Lau Leby & Hariza Hashim, 2010; POLIS, 2021). By creating more places of interaction, opportunities for companionship are created, and the risks mentioned above are lowered (Rosenbaum, 2006).

1.4. Research objective and aim

The problem outlined above leads to the need to dive deeper into the effect of neighborhood hubs on the logistical side and the societal perspective. To bring the societal domain into the technical field of logistics, a focus will lie on livability. Therefore, this thesis aims to investigate how livability can be impacted when logistical flows are re-structured through a hub system and how these hubs intend to function on a neighborhood scale. In that way, synergies and barriers for the interplay of logistical innovations and livable places can be identified. This research is based on a document analysis and semi-structured interviews based on the design explorations of neighborhood hubs in Utrecht and Zwolle. As a guideline for this thesis, the main research question is as follows:

> *To what extent can the logistical restructuring of the last mile through hubs integrate logistics and increase livability in neighborhoods?*

For a further investigation of the problem, the following research questions are composed to provide a guide for the main research question:

1. *How can multifunctional neighborhood hubs focusing on last-mile urban logistics be conceptualized and linked to livability?*
2. *What kind of last-mile solutions can be found in the study areas of Utrecht and Zwolle and to what extent is a consistent terminology and framework on delivery hubs crucial?*
3. *What are the differences in the operational and logistical management of package deliveries in the study areas of Utrecht and Zwolle and how do these differences impact the movement flows and collaboration between stakeholders?*
4. *To what extent do the hubs impact the spatial environment and the neighborhood's livability?*

1.5. Reading guide

This first chapter introduces the topic and objectives of this thesis. In the second chapter, relevant literature is presented which forms the theoretical background and in the third chapter the methods for this research are explained. In chapter four the results are discussed based on the findings and the theoretical framework from chapter two. The conclusion, including the answer to the research question and a reflection on the reseach process are laid out in chapter five.

2. Theoretical Framework

This chapter explains the theoretical background to frame the conceptual model. Firstly, the need to innovate urban logistics is discussed, in which neighborhood hubs are conceptualized from a logistical perspective. Additionally, critical components of livability are interlinked with neighborhood hubs to identify their socio-spatial opportunities. Through this, a theoretical framework is established, which builds the conceptual model that captures 'Accessible neighborhood hubs for livable neighborhoods' (Figure 4) through intertwining factors of neighborhood hubs and livability.

2.1. The neighborhood scale

When looking at cities, various levels of administrational scales can be identified (Figure 1). The largest one is the city itself. However, it is a broad scale for regional planning and comprises various households, neighborhoods, and larger districts that are a managing part of a city (Zhu et al., 2020).

Figure 1 Urban scales (Source: author)

The smallest scale is the individual housing units, such as houses and apartments. It reflects the individual bases of a city. Frequently, it fails to consider geographical aspects and its surroundings but instead covers the architectural side (Zhu et al., 2020). The level between the city and individual households is the neighborhood. It is the living environment of the inhabitants and is the most studied place within urban areas (Lewicka, 2010). A neighborhood can be identified through an administrative border set by the government, or it can be identified through subjective scales (Lewicka, 2010). According to (Galster, 2001), it is a spatially limited area, and its size depends on how homogenous the space is according to his neighborhood characteristics. Therefore, a degree of presence in the neighborhood can be identified (Galster, 2001). Neighborhood users can be identified, such as property owners, the government, households, and businesses. Households consume the neighborhood by occupying units, using public and private spaces, and consuming businesses. In turn, residents gain a degree of satisfaction or quality of residential life through various activities and services (Galster, 2001).

The neighborhood is a crucial scale to look at for residents' social, material, and transportation needs (Rogers et al., 2011; Williams & Hipp, 2019). It can be seen as a microcosm of the city in which resources, facilities, and spatial elements should be provided in proximity to facilitate neighborhood stay and activity (Jacobs, 1961; Kwantes et al., 2019). From a social perspective, the neighborhood activity by residents plays a significant role in its social capital levels (Rogers et al., 2011). Since the industrial revolution, community ties have declined due to the increased time spent working outside the neighborhood. Work relationships increased in importance, and mobility possibilities rose due to a large amount of labor (Putnam, 2000; Wellman & Leighton, 1979). Additionally, the separation of functions contributed to the development of spending more time outside of the neighborhood, as different daily tasks had to be executed elsewhere. This decreased local community ties between inhabitants and tied the community no longer to their neighborhood as distances and travel time opposed to smaller constraints (Putnam, 2000; Wellman & Leighton, 1979).

2.2. Multifunctional neighborhood hubs

Within the transport and mobility planning field, a hub is often linked to the opportunity for mobility for people and freeing up space within cities by encouraging a shift away from the car. This entails the integration of various modes of sustainable transport to achieve space-efficient transport (Deloitte, 2022). However, the transport and mobility planning field comprises not just passenger mobility but also focuses on the logistical side, including freight transport and urban logistics operations (Aifandopoulou et al., 2019; Lindholm & Blinge, 2014). New developments have taken place in which logistical hubs are introduced within neighborhoods. These logistical hubs are often called micro or neighborhood hubs (Katsela et al., 2022). From a logistical side, a micro hub can allow the consolidation of goods within the last mile. In the form of urban light freight, parcels are consolidated close to the final delivery point in a limited spatial area. This services the neighborhood level near the end receiver (Janjevic & Ndiaye, 2014; Katsela et al., 2022). The logistical facilities are integrated into a neighborhood at highly frequently visited places while linking functionality with social activity and human interaction (Amsterdam University of Applied Sciences, 2021; eit Urban Mobility, 2020; Rosenberg et al., 2021). Next to providing a micro consolidation point, other services desired within the neighborhood can also be accommodated (eit Urban Mobility, 2020; Rosenberg et al., 2021). In that way, more than just another logistical hub is provided. However, a link between urban logistics, the urban fabric, and the residential community can be established, namely, a neighborhood hub (eit Urban Mobility, 2020). In that way, a neighborhood hub focuses on the neighborhood on services, the logistical side of transport, and its users, which are set to be the neighborhood residents and not just on the mobility of people or the consolidation of goods.

2.2.1. Utilizing neighborhood hubs to pursue sustainable urban logistics

The transport of freight in urban areas is the last mile of the supply chain. The last mile is defined as: "the last stretch of business-to-consumer parcel delivery to the final consignee who has to take reception of the goods at home or a cluster/collection point. (Gevaers et al., 2009) (Figure 2). Over the past years, there has been an increased number of last-mile deliveries due to changes in consumer behavior, especially because of the growth of e-commerce (Bjørgen et al., 2019). E-commerce influences last-mile operations and challenges the delivery capacity and transport volume, but it also impacts traffic flow and road safety. Next to this, more delivery activity is noticed in residential areas (Bjørgen & Ryghaug, 2022).

Considering the delivery process, the last mile is the most expensive part of the supply chain and can account for up to 75% of the delivery costs (European Commission, 2013; Macharis & Kin, 2017). Moreover, costs within this sector are growing because of rising inefficiencies within urban logistics. Next to the inefficiencies, the last mile also has an overall poor environmental performance (Gevaers et al., 2009).

Within the last mile, there are different types and places for the end destination for the delivery, for example, a distribution center, the clustering of goods, and home delivery. Home deliveries especially pose a significant problem within the last mile. There is a dilemma between the most efficient route based on the delivery location and the most efficient route for consumers based on the time windows that consumers can choose. A ping-pong effect occurs between the locations for the delivery of routes mapped on time frames, increasing the driven kilometers with which costs rise (Gevaers et al., 2009). The narrower the delivery time frame is, the higher the inefficiencies. Next, the higher delivery frequency of smaller orders makes the last mile challenging for sustainability in transport and mobility (Bjørgen & Ryghaug, 2022; Macharis & Kin, 2017).

Changes must occur within the delivery chain to keep logistics reliable, sustainable, and affordable (Macharis & Kin, 2017). The neighborhood hub can represent a viable possibility to achieve reliable, sustainable, and affordable logistics. When looking at the delivery methods from neighborhood hubs to the end consumer, the neighborhood hub also opens up possibilities of mode shifts to more sustainable alternatives. As the neighborhood hub is servicing a limited spatial area within a neighborhood, shorter distances to the end user are created and a shift to environmentally friendlier modes, like cargo bikes or

electric vans instead of the typical diesel vans is possible (Katsela et al., 2022). Changing to sustainable delivery modes can improve sustainability and livability and increase delivery performance while reducing negative externalities such as environmental impacts. Furthermore, it also removes urban traffic pressure (Katsela et al., 2022).

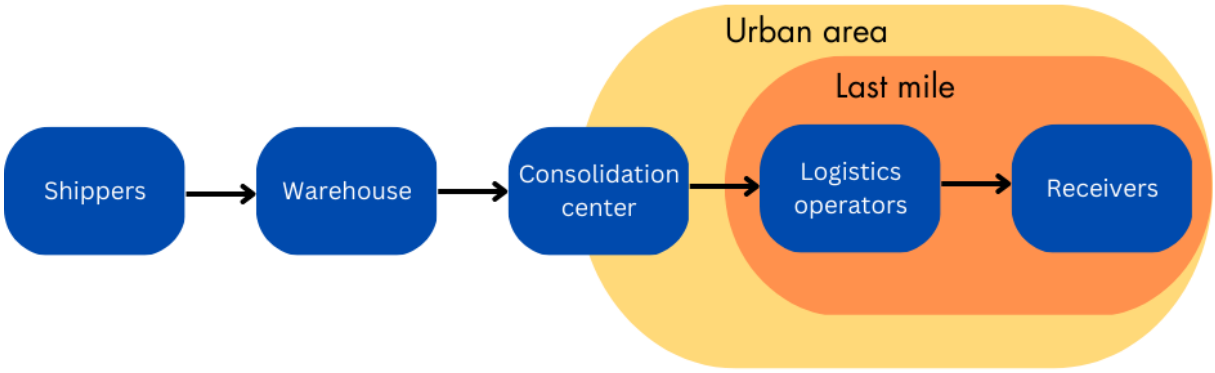

Figure 2 Traditional delivery process (adapted from Aifandopoulou & Xenou, 2019)

2.2.2. Operation of neighborhood hubs

The operation of sustainable logistics in neighborhoods can be arranged in different ways (Figure 3). Presented by Patier & Toilier (2018), six typologies are identified: the goods reception point, urban locker boxes, micro consolidation center, vehicle reception points with and without the consolidation of packages, and a mobile depot. The vehicle reception point is a reserved area within a neighborhood for delivery vans to park while delivering the last leg of the journey either by foot or with a more sustainable vehicle. These delivery vans can either come from different larger consolidation centers or a singular consolidation center. The mobile depots are small portable trailers that can be repositioned within a neighborhood and hold parcels and light goods vehicles for the last mile of delivery. For the neighborhood hub to operate as described in 2.2, the vehicle reception points and micro depots are not fitting for the operation of a neighborhood hub as they only facilitate the delivery process without using a permanent location.

Therefore, the hubs as described in 2.2 can operate as a micro consolidation center, a good reception point, and an urban locker box (Janjevic & Ndiaye, 2014; Patier & Toilier, 2018). As a micro consolidation center (MCC), the focus lies on bundling the goods for a limited spatial area before executing the delivery to the consumer in a limited spatial range by a fleet of non-polluting vehicles. To achieve this, goods are sorted in a larger consolidation center outside the urban area. Therefore, the frequency and time expenditure of larger trucks and vans inside residential areas is decreased as these vehicles are not used for at-home deliveries, as short-range vehicles can be utilized. The goods reception points (GRP) also focus on bundling goods from the larger consolidation center outside the urban area. However, the delivery is not executed to the end-receiver but to a reception point. This can aid in solving the problem of failed and repeated deliveries, reduce the total number of delivery trips and create the possibility of a pick-up point (Patier & Toilier, 2018).

Urban logistic boxes (ULB) can be installed in addition to the two systems. These bundle goods in urban areas in automated locker boxes that make direct parcel recovery possible independent of the presence of receivers. This creates fewer time constraints than for the goods reception points, as no service or receiver needs to be present (Patier & Toilier, 2018). These logistic boxes can be added to the two other systems to be located independently or adjacent to neighborhood hubs. All three systems can operate jointly or separately. Ideally, all three systems operate together to achieve the maximum potential for the logistical operation and the most convenience for the consumer.

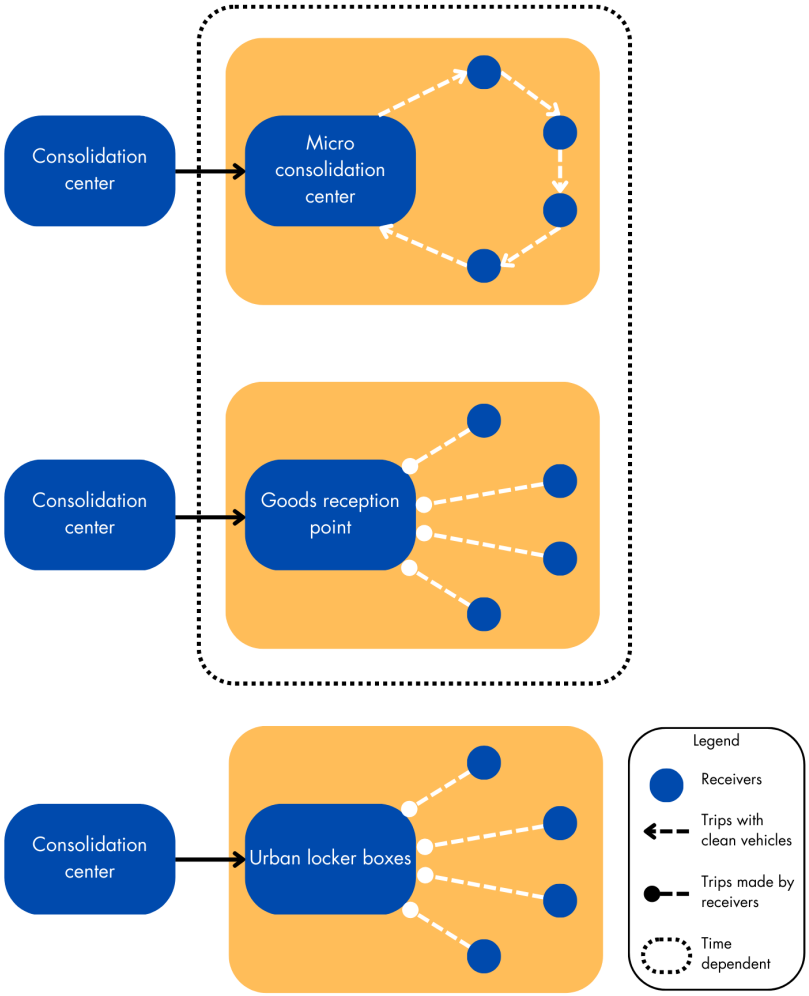

Figure 3 Suitable operations of neighborhood hubs (adapted from Janjevic & Ndiaye, 2014)

2.2.3. Management of neighborhood hubs

Parcel delivery points oftentimes consist of single carrier reception points or locker boxes. Examples of these are DHL or PostNL pick-up points, as well as DHL and Amazon locker boxes which are exclusive to one carrier within the delivery network. Separated management of these points increases the number of vehicles needed, scatters the accessibility of pick-up points over larger areas, and has many more influences on the resources used (POLIS, 2021). By changing the management structure to a white-label company, sharing resources can be encouraged. Examples are sharing infrastructure, smart management and operations, offices, vehicles, and personnel (Katsela et al., 2022; Van Duin et al., 2022).

Since space is scarce, so are the depots and consolidation centers needed outside city centers to operate neighborhood hubs within dense urban areas. Through a collaboration of freight companies, costs from sharing vehicles, routes, and space can be reduced (Katsela et al., 2022). Additionally, goods can be bundled instead of redistributed to multiple delivery companies (Katsela et al., 2022; Van Duin et al., 2022). However, a barrier is the current competition between existing delivery companies and the need for more trust between them (Katsela et al., 2022). Currently, little integration of white labels is present in the Netherlands compared to, for instance, Germany or Scandinavia (Bureau Nieuwe Gracht, 2018). However, collaboration can positively affect the development of neighborhood hubs as it bundles goods across carriers, reducing emissions and congestion in city centers through shared spaces and delivery (Katsela et al., 2022). To foster a higher degree of collaboration, companies need to be encouraged to collaborate through incentives by the government (POLIS, 2021).

2.2.4. Positioning of neighborhood hubs in neighborhoods

For the systems introduced in 2.3.2 (Figure 3), easy accessibility for vans and customers is necessary, as well as closeness to the receiver area (Janjevic & Ndiaye, 2014). To achieve extensive coverage, every hub should theoretically be part of a more extensive network of hubs spread across the city in a 300-500 meter radius (Gehl, 2011; Janjevic & Ndiaye, 2014; Patier & Toilier, 2018; Wu et al., 2018). A radius of 300-500m is seen as an acceptable walking distance for ordinary daily situations (Gehl, 2011) and it also is seen as a walkable distance to participate in community life and activities (Wu et al., 2018). Nevertheless, it could be less for children, the disabled, and older adults as the route quality and length of the streets influence this distance (Gehl, 2011). By establishing a network of neighborhood hubs based on a 300-500m radius, the distances are designed for every resident to use environmentally friendlier modes, which can, additionally to the delivery vans, take the pressure of the urban traffic (Katsela et al., 2022). Even if a network approach is not desired, implementing a neighborhood hub should consider environmentally friendlier modes and walkable distances for all age groups to highlight the convenience of the closeness of services.

Next to the distances that can help determine a neighborhood hub's location, the relevance, suitability, and feasibility should be considered (Janjevic & Ndiaye, 2014). The need for a neighborhood hub and the extent of its services depends on the demand within the neighborhood radius and is heavily dependent on the availability of resources such as monetary investments, public financing, and the support and involvement of stakeholders, business owners, and residents. As the logistical perspective is also largely from importance, a neighborhood hub needs to be able to administer a logistical network and suit a place for logistics carriers as the accessibility for these carriers is dependent on the already existing infrastructure (Janjevic & Ndiaye, 2014; Katsela et al., 2022). This makes a neighborhood dependent on the interplay between infrastructure and mobility (Kwantes et al., 2019).

2.3. The socio-spatial dimension of livable neighborhoods

For cities to perform economically, environmentally, and equitably in the future, cities need to be livable places (Yuen & Ling Ooi, 2009). To achieve livable places, the interaction between the community and its environment on a personal level with the neighborhood's residents must be continuously taken into account through time and space (Lau Leby & Hariza Hashim, 2010; Shafer et al., 2000). The topography of a certain neighborhood can impact the resident's social and psychological well-being, and trends like a growing population or rapid development can deteriorate the livability in urban environments. Nevertheless, livability is a difficult concept to define and measure depending on what background defines the scope of its meaning and is heavily dependent on what is being measured (Lau Leby & Hariza Hashim, 2010). As different amenities are needed in different stages of life, the perception of livability can change throughout life cycles (McCormack et al., 2020).

Re-occurring themes within the literature on livability within neighborhoods are the physical environment, the social dimension, safety, and the functional aspect (Lau Leby & Hariza Hashim, 2010). Within the social dimension presented by Lau Leby & Hariza Hashim (2010), the relationship status is measured within community life, which can be represented through vibrancy. Neighborhood livability should form a continuous network of lively public and private spaces (Jacobs, 1961).

The physical environment is meant as the working, living, and building social networks element, fostered through the functionality of a neighborhood through its accessibility. Furthermore, it is closely associated with the availability of a mix of public and private services desired by the local community through multifunctionality and third places. Therefore, various infrastructures and services should be provided to support daily life regardless of age.

Additionally, safety is a key component of livability. It is highly intertwined with the perception of residents of their neighborhood. An unsafe environment often impacts fear among residents. Instead, with a safe environment, seen from a traffic and social perspective, a neighborhood can bring a good quality of life (Lau Leby & Hariza Hashim, 2010; Lee et al., 2017; Mollenhorst, 2015).

2.3.1. The livability life-course of people

Throughout various stages in life, the understanding of livability can change. These are changes in needs and preferences and different consumption and migration patterns (Ruth & Franklin, 2014), especially the use of public space changes with age. The daily activities in different stages of life restructure every few years. Additionally, a decrease in mobility with age occurs. Currently, a significant shift within the percentage of the most common age group is taking place, and more special attention is given to the older generation (Ruth & Franklin, 2014).

Overall, different consumption and mobility patterns occur in different stages of life. Also, subjective thoughts on urban infrastructure systems, local environmental quality, amenities, and social networks vary by person and age (Ruth & Franklin, 2014). This leads to a continuous reorganization in life. Preferences within generations shift, and different needs are wanted today than yesterday or tomorrow. Nevertheless, adaptation is difficult to achieve with existing inflexible infrastructure and institutions (Ruth & Franklin, 2014). Therefore, physical and social infrastructure must be planned with the thought of an expanding life course by keeping a multigenerational perspective through optimizing the opportunity to increase the quality of life regardless of age (Zhang et al., 2019). The accessibility to services and mixed-use of neighborhoods plays a prominent role in achieving that goal (Zhang et al., 2019).

For neighborhood hubs to be inclusive of all ages, services can be implemented based on the desire of the residents and neighborhood. However, they should not be limited to the predominant demographic. Implementing multifunctionality can work in favor of making space for all age groups. In that way, neighborhood hubs can strengthen the livability factor within neighborhoods for all age groups by not limiting themselves to a particular function.

2.3.2. Accessibility in neighborhoods

In literature, accessibility is defined as the ability of residents to a set area to reach needed or desired opportunities, which can be activities such as working or shopping (Handy, 2002; Handy & Clifton, 2001; Litman, 2022). However, the ability to reach these opportunities depends on the land-use system, as this determines the spatial distribution of activities and the transportation system, which is the link between the opportunities and depends on travel time and costs (Handy & Clifton, 2001). Accessibility is, therefore, directly linked to urban form and the transport system, impacting neighborhood development and well-being. Consequently, every city has unique elements of spatial and transport structures to provide residents with access to opportunities (Rode et al., 2014).

Accessibility can be enhanced to improve access to opportunities. However, the objective of accessibility is not the mobility and movement to opportunities but rather the provision of opportunities and possibilities of reaching those (Handy, 2002; Rode et al., 2014). This also applies to the intention in neighborhood hubs. Accessibility is based on the physical proximity to opportunities. This can be enhanced through the concentration of services, economic activities, and people to foster exchange as well as the provision of sidewalks. That way, agglomeration economies through greater proximities and a degree of mixed-used can be established (Rode et al., 2014).

Additionally, attention to planning on a human scale, considering walkability, can bring opportunities closer to home as the potential range of opportunities is minimized (Rode et al., 2014). This can broaden the choice of activities and increase the number of opportunities (Handy, 2002). Furthermore, it can decentralize activities to the neighborhood level, aiming to increase local residents' use (American Planning Association, 1998).

2.3.3. Walkability

Neighborhoods portray vibrancy when social interaction is promoted within (semi) public spaces through the interaction of people through urban activities and spatial entities (Gehl, 2011; Jacobs, 1961; Montgomery, 1998; Vorontsova et al., 2016; Wu et al., 2018; Yuen & Ling Ooi, 2009). Walkability can encourage this interaction whenever the infrastructure and built environment within a neighborhood are

designed to impact the likelihood of walking (Rode & Floater, 2014). Next, walkable neighborhoods can add vibrancy by turning the streets into gathering places (Rogers et al., 2011). For this, the street design needs to encourage walking, a land-use mix needs to be present for the opportunity to access a variety of services, and planning on a neighborhood level should be encouraged to allow for the ability to walk to daily services (Lee et al., 2017; Rode et al., 2014; Rogers et al., 2011).

Neighborhood hubs can concentrate services but also offer the opportunity for mixed uses, which saves space, but also encourages pedestrian accessibility as shorter distances are promoted through a range of neighborhood hubs of 300-500m (Gehl, 2011; Vorontsova et al., 2016). Therefore, neighborhood hubs can support the encouragement of walkability within neighborhoods, which brings social benefits and positive impacts on the vibrancy and livability of a place (Rogers et al., 2011).

2.3.4. Impacts on traffic & Social Safety

Safety is vital to residents and impacts satisfaction and livability the most (Lee et al., 2017; Mollenhorst, 2015). High crime rates, high vehicle traffic, and congestion are frequently viewed negatively (Lee et al., 2017). Social safety can be linked to familiarity with the environment within the neighborhood during the day and at night (Heylen, 2006). In contrast, traffic safety focuses on the type of modes on the streets and their speeds (Loukaitou-Sideris, 2006). To achieve the desired interaction between residents, vibrancy, and livability within the neighborhood, traffic and social safety need to have priority (Lee et al., 2017).

Social safety and its link to familiarity with the environment can be reinforced through human activity within the street (Jacobs, 1961). Mixed-functions and third places offer a multifunctional environment with commercial and residential structures. It aims to establish a multitude of activities that facilitates people to use the space for a variety of reason at different times of the day. Safety can therefore be improved through the presence of different users and an increase in human activity, which allows for Jacobs's (1961) famous concept of "eyes of the street". Neighborhood hubs can support social safety by providing different amenities that encourage people's presence during different times of the day. Ideally, these amenities need to be different enough to facilitate a flow of different users.

For traffic safety, the existing infrastructure within a neighborhood often plays a role. For example, pedestrians are at risk whenever the street design is oriented toward automobiles, as streets are wider and there is less room for sidewalks or bicycle paths (Loukaitou-Sideris, 2006). It not only makes it more dangerous for people at walking or biking speeds, but it also impacts the perceived safety of different age groups (Lee et al., 2017). To stimulate actual safety, traffic calming strategies like physical changes to reduce speed and the volume of cars can lower collisions and accidents. In addition, restrictive and facilitative policies can be implemented for a neighborhood hub to support traffic safety (Plazier & Rauws, 2021). Facilitative policies should support implementing and maintaining neighborhood hubs from the city level. Restrictive policies should restrict the traditional way of deliveries by trucks and vans through, for example, banning delivery with polluting vehicles or at any time of the day. These strategies can improve actual safety, but perceived safety is also heightened (Lee et al., 2017).

2.3.5. Integration of mixed-use and multifunctionality

Multifunctionality is closely linked to the concept of mixed uses. A neighborhood with mixed uses encourages the neighborhood to become a multifunctional hub by providing services close to the home of residents (Jacobs, 1961; Vorontsova et al., 2016). Within a neighborhood hub, residential and commercial uses are concentrated in a smaller area and not spread out over the entire neighborhood. Nevertheless, multiple uses can be introduced through a neighborhood hub, including combined functions that facilitate multifunctionality within the hub and mixed-use in the neighborhood (Vorontsova et al., 2016). In that way, a principle of mixed-use and multifunctionality is the efficient use of urban space and infrastructure as well as an investment in the quality of stay and the residential and spatial quality (Kwantes et al., 2019; Vorontsova et al., 2016). Through the neighborhood hub, a junction point for various social, economic, and

logistical services can be provided, adding value for residents and the neighborhood, while keeping in mind the environment through efficient use of space (Amsterdam University of Applied Sciences, 2021).

2.3.6. Creation of third Places

Third places can provide socio-spatial opportunities for neighborhood interaction and are generally places that are easily accessible for residents (Williams & Hipp, 2019). The basis for third places to establish themselves is mixed-use and multifunctionally as these can foster opportunities for experiences and relationships (Oldenburg & Brissett, 1982). Mainly including the interplay of walkability, third places have a higher chance of becoming places of voluntary and informal gatherings outside the private realm if they become integrated into the daily life of residents (Oldenburg, 1989; Oldenburg & Brissett, 1982). Walkability is particularly important as together with third places they can influence the chance of encounters (Rogers et al., 2011). Therefore, the impact of proximity is central to social interaction (Williams & Hipp, 2019).

In this way, third places are especially from higher use-value for local residents of a neighborhood and lower use for outsiders (Williams & Hipp, 2019). Regular visits of residents can familiarize neighbors, but also strangers. However, they can become ports of entry for visitors and newcomers as they tend to provide social infrastructure (Mehta & Bosson, 2010; Williams & Hipp, 2019).

As mentioned above and in Chapter 2.3.5, providing neighborhood hubs with logistical services and other amenities can increase human activity and interaction. Moreover, by providing this place for interaction, neighborhood hubs have the chance to become a place for regular visits of residents, which can transform them into third places in neighborhoods.

2.3.7. Vibrant neighborhoods

As discussed in Chapter 2.3.5, the combination of residential and commercial uses and service facilities provides a multifunctional environment for residents. By encouraging mixed-use and multifunctionality, neighborhood vibrancy can be increased by supplying a variety of opportunities these functions provide through easy accessibility (Vorontsova et al., 2016; Wu et al., 2018; Yuen & Ling Ooi, 2009). The proximity of functions for people's daily needs in a limited area is the driving force of urban vibrancy. These represent activities around the neighborhood mainly for residents and outsiders (Lu et al., 2019; McCormack et al., 2020). Essentially that neighborhood vibrancy stems from the interactions of people with urban activities and spatial entities (Gehl, 2011; Jacobs, 1961; Wu et al., 2018). Therefore the neighborhood must promote social interaction outside the private realm and in the (semi) public realm (Montgomery, 1998; Wu et al., 2018). According to Gehl (2011), the increase in human activities attracts other people and nurtures active street life (Montgomery, 1998). Also, Jacobs (1961, p.121) focuses on the interplay of "street commerce, liveliness, use, and interest to cultivate continuities of public street life". As neighborhoods grow in diversity and attraction, the activity intensity increases, increasing the vibrancy and promoting social interactions and a sense of community (Barreca et al., 2020). This can also help to form social capital by providing engagement opportunities and formal interaction (Barreca et al., 2020). Additionally, the increase of activities through multifunctional uses makes streets attractive for longer periods of time and can, therefore, also increase safety (Jacobs, 1961; Montgomery, 1998; Rode et al., 2014; Wu et al., 2018).

Neighborhood hubs can contribute to this vibrancy by providing logistical services and amenities, which adds to the mixed-use principle. Human activity and interaction between people can be reinforced, and a place for residents is created, and it can become a meeting place within the (semi) public realm.

2.4. Accessible neighborhood hubs for livable neighborhoods

Understanding the impact the last mile delivery has on the built environment and the community can aid with developing livable urban areas and integrating urban logistics into neighborhoods (Bjørgen et al., 2019; Trecozzi et al., 2022). Logistics and especially the last mile delivery need to be reliable, sustainable, and affordable, which is possible through the integration of logistics into neighborhood hubs (Macharis & Kin, 2017). Furthermore, neighborhood hubs can contribute to a neighborhood's social and functional structure. This comes together in the overarching framework of "Accessible neighborhood hubs for livable neighborhoods" (Figure 4).

From an operational side, a logistical facility that caters to a limited spatial area is needed that consolidates the parcels of residents close to their homes. This can be done via the micro consolidation center, goods reception point, and urban locker boxes (Janjevic & Ndiaye, 2014; Patier & Toilier, 2018). The micro consolidation center bundles goods for a set spatial area and delivers them to the consumer via a fleet of non-polluting vehicles. The goods reception point also bundles the goods for a set spatial area but is not delivered within the last mile but relies on pick-up from a shop in the neighborhood hub. Similar is the urban locker box. It also relies on pick-up, making parcel delivery independent of time and the presence of the receiver. A micro consolidation center and a goods reception point should be operated to enable pick-up or further delivery while also creating a space for social interaction. In addition, an urban locker box can be added for the convenience of receivers being unable to accept their delivery. As neighborhood hubs are located within neighborhoods, space is scarce, and the logistics management needs to be administered in collaboration through a white-label approach (Katsela et al., 2022; Van Duin et al., 2022). This way, resources and infrastructure can be shared on the already scarce space available, and no logistical carrier claims exclusivity. To foster this degree of collaboration, the government and municipality must ensure that incentives are available (POLIS, 2021).

For the location, accessibility for the logistics company and residents is necessary. For the logistics company, the neighborhood infrastructure must be suitable for larger vans to consolidate the goods and for last-mile delivery. For the last-mile delivery from the micro consolidation center to the resident, electric and non-motorized vehicles are used as their reach is generally small, less polluting, and more space-saving. For the residents, the neighborhood hub needs to be relevant enough to be used, and the location needs to be accessible. Therefore, proximity to residents is necessary as the neighborhood hub needs to serve a smaller area within the neighborhood. Due to its closeness, this can also encourage slower modes, such as walking.

Providing less polluting logistical solutions can improve efficiency and environmental performance in neighborhoods. For a neighborhood to be livable, it is essential to focus on the available facilities and services, safety, the residential environment, and social relations (Lau Leby & Hariza Hashim, 2010). These can be summarized in socio-spatial opportunities. Especially amenities can provide potential places for interactions (Oldenburg & Brissett, 1982; Williams & Hipp, 2019). A multifunctional neighborhood hub can bring a diversity of functions and services (Vorontsova et al., 2016). These (semi) public places bring together sets of different people and can grow into third places (Williams & Hipp, 2019). However, the established amenities depend on the location and context of neighborhood hubs.

Nevertheless, the diversity of functions can make the neighborhood hub more than just a logistics point, as there are many reasons to use the hub. People are attracted to visit through the presence of different amenities, and more activity is created, which impacts the liveliness and vibrancy. This can invite social interactions and engagement opportunities for residents and outsiders within the (semi) public realm (Gehl, 2011; Jacobs, 1961).

In this way, "Accessible neighborhood hubs for livable neighborhoods" can contribute to becoming social and functional centers that increase traffic safety by changing the last-mile logistics and providing amenities that attract residents and strengthen the social safety within neighborhoods.

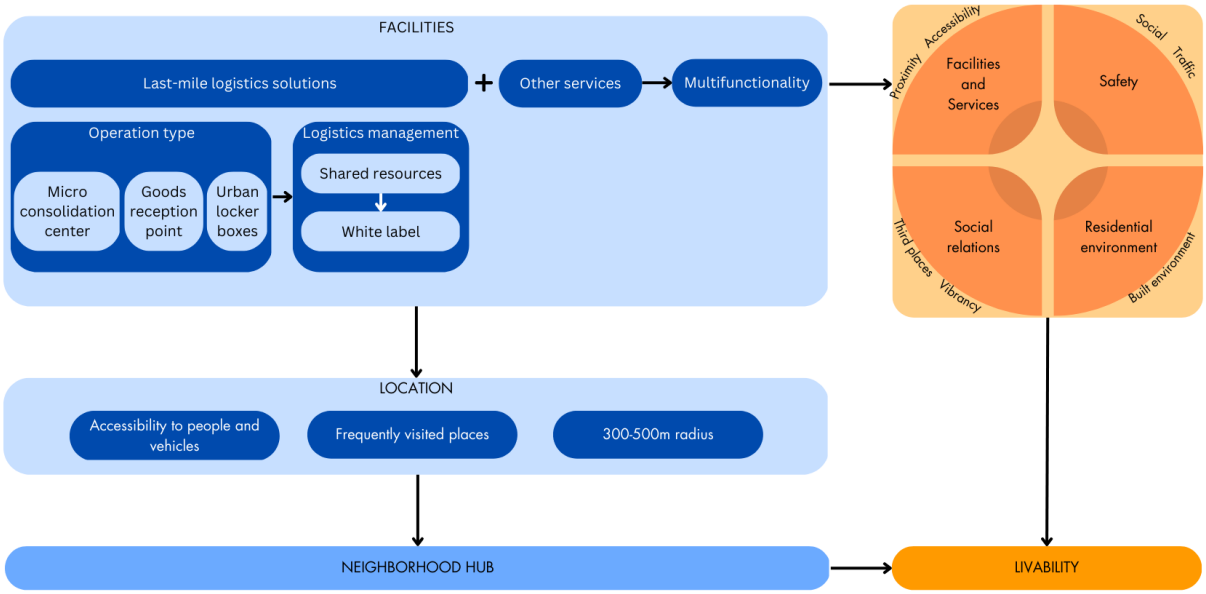

Figure 4 Accessible neighborhood hubs for livable neighborhoods (Source: author)

3. Methodology

In this chapter, the research design and the case selection are presented for this research. A comparative case study approach of two cases is used as a research strategy to find contrasts, similarities, and patterns. These can lead to insights on logistical flows in neighborhoods and a concept of neighborhood hubs in livable neighborhoods. To identify these similarities, differences, and patterns, two different qualitative methods are applied, which are supported by the theoretical background of Chapter 2. Additionally, the methods and the ethical considerations that this research is following are presented in detail.

3.1. Research Design

This research uses a comparative case study as a research strategy and qualitative research methods to answer the main question: *To what extent can the logistical restructuring of the last mile through hubs integrate logistics and increase livability in neighborhoods?* A comparative case study intends to develop a complete understanding of the case context and setting by interrelating various facts to discover differences, similarities, and patterns (Goodrick, 2020; Punch, 2014). In that way, a complete understanding of the case under the prerequisites of the conceptual model can be developed (Punch, 2014). The two cases of 'Design City Logistics Spoorzone Zwolle' and 'Living Lab City Logistics Beurskwartier Utrecht' are selected for the comparative case study. The intention is to investigate the interpretation and complexity of plans for logistical flows of neighborhood hubs and the impact on livability. In that way, similarities and differences between the cases and theory can be identified and a comparative analysis can be conducted. This leads to insights about the concept of neighborhood hubs in livable neighborhoods that can be assessed for applicability and transferability (Punch, 2014).

A combination of theoretical and empirical research is applied to develop these prepositions. A theoretical background is provided as a basis for the empirical research. Multiple data sources will be acquired to collect information on the cases. For research methods within the case studies, qualitative data is obtained. Qualitative data is retrieved by reviewing policy documents and expert interviews on the two cases of Zwolle and Utrecht. The first sub-research question is based on the theoretical background. The second, third and fourth sub-research question will be examined through document analysis and expert interviews. Therefore, different methods throughout this research will be triangulated to rely on multiple sources of evidence (Yin, 2018).

3.2. Case selection and description

In Chapter 2, the development of the need for logistical solutions through neighborhood hubs and their effects on livability has been introduced and discussed theoretically. The Netherlands is one of the most densely populated countries in the world and therefore has a scarcity of space (Tisma & Meijer, 2018). Much space is already built up and spatial planning is necessary to manage the land as it is a challenge to protect but also develop the landscape. Nevertheless, large spatial transformations are expected because of the need to adapt to climate change, urbanization, and mobility challenges (Tisma & Meijer, 2018). The need to integrate urban logistics into cities falls under the topic of mobility. Integrating logistical flows is difficult because of the density that especially urban areas have. However, integration and innovation of logistical flows are needed. The National Climate Agreement (Klimaatakkord) of the Netherlands prescribes a minimum of 30 Dutch cities to reduce their carbon footprint and implement low and zero-emission logistics through zero-emission zones by 2025 (Rijksoverheid, 2021). Cities included in this are the city center of Zwolle and Utrecht (Rijksoverheid, 2021), which have been chosen as cases for this research (Zero Emissie Stadslogistiek, n.d.). The zero-emission development is the first step to zero-emission road traffic by 2050 and can save up to one megaton of carbon dioxide per year (Rijksoverheid, 2021). The entry to zero-emission zones in Utrecht and Zwolle will get stricter for delivery vans from 2025 onwards. All new registered delivery vehicles must be emission-free from 2025, and a transition period is installed for existing vans. From 2025 only delivery vans classified Euro 5 or lower will be allowed, from 2027 Euro 6 and lower,

and from 2028 only zero-emission vehicles will be allowed to enter these zones (Urban Access Regulations, n.d.; Zero Emissie Stadslogistiek, n.d.).

For Utrecht, this 'zero-emission zone 2025' comprises the city center and the surrounding new developments of the Jaarbeurs and the Beurskwartier (Figure 5). The research area will be the Beurskwartier (Figure 5), which aims to slow down traffic by establishing a car-free area and improving biking and pedestrian infrastructure (Gemeente Utrecht, 2017). The Beurskwartier is a new development. Around 3000 homes will be constructed and is intended to start with the building process in 2023 (Gemeente Utrecht, 2017). It is crucial to consider logistical flows in this development since the new homes must be serviced in the future (Bureau Nieuwe Gracht, 2018). In 2017 a living lab was conducted by Bureau Nieuwe Gracht on integrating a smart and efficient logistical distribution network and how this can be achieved (Bureau Nieuwe Gracht, 2018) (Table 1).

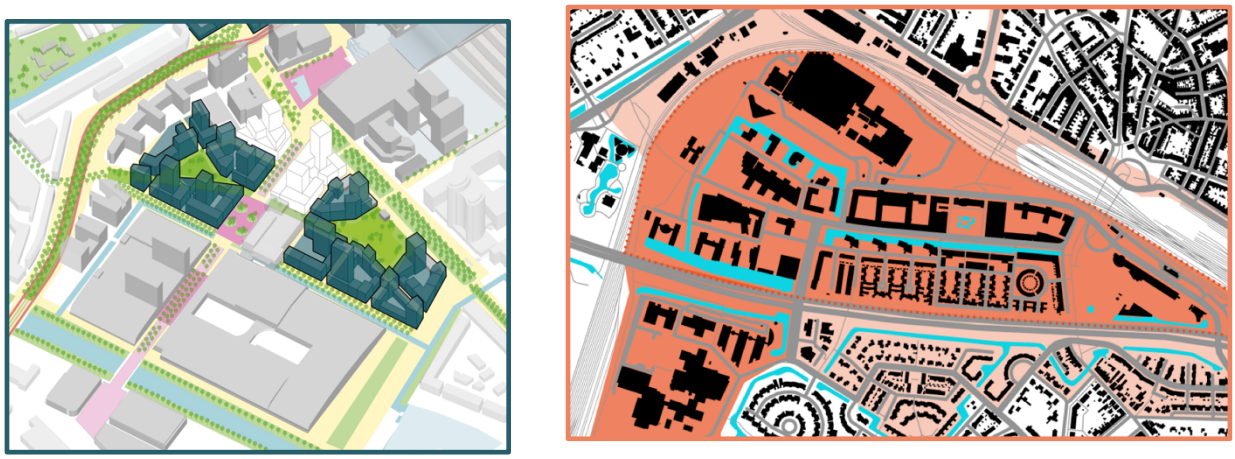

Figure 5 Left: Beurskwartier Utrecht (Source: urbannext, 2017); Right: Spoorzone Zwolle (Source: Gemeente Zwolle, 2017a)

Zwolle has an agenda for a zero-emission city center by 2025 (Gemeente Zwolle & &Morgen, 2018) (Figure 6). However, other developments outside the city center are also considering this. For example, the redevelopment of the central station area (Spoorzone Zwolle) is taking place south of the city center (Figure 6) (Gemeente Zwolle, 2020b). In this development, new housing and other functions are attempted to be integrated (Gemeente Zwolle, 2020b). Next, lowering emissions through biking and pedestrian infrastructure and discouraging car traffic is also a focus within the residential neighborhood (Gemeente Zwolle, 2018). This has an impact on the logistical traffic and should therefore be considered in a redevelopment. Designs for this integration have been made by TNO but have not been finalized yet by the municipality and no starting date for constructions is set yet (TNO & FABRICations, 2022) (Table 1).

	Explanation	Logistics sectors considered	Spatial Interventions	Documents and Policies
Design City Logistics Spoorzone Zwolle	Redevelopment of the station area with the construction of additional living, working, and meeting spaces at the Spoorzone. Smart emission-free logistics need to be considered for more efficient and cleaner delivery. No set date for construction for the re-development. The documents are for now only design explorations (TNO & FABRICations, 2022).	1. Heavy Freight 2. Delivery of fresh goods 3. Waste 4. Package delivery 5. Facility and services 6. Construction logistics	1. Logistical hubs (Neighborhood hub and micro hub) 2. Network (light electric vehicles (LEV)) 3. Public space (spatial solutions)	(Gemeente Zwolle, 2015, 2017b, 2017a, 2018, 2020a, 2021; Gemeente Zwolle & &Morgen, 2018; Karres and Brands, 2017; &Morgen, 2021; Royal HaskoningDHV, n.d.; TNO & FABRICations, 2022)
Living Lab City Logistics Beurskwartier Utrecht	Construction of the Beurskwartier, a new neighborhood southwest of Utrecht central station. Integration of logistical flows into the plans, considering that the zero-emission climate agreement has to be fulfilled by 2030 for this area. Start with the construction will be in 2023 (Gemeente Utrecht, 2017, 2021, 2022).	1. Package delivery 2. Grocery delivery 3. Meal delivery 4. Mechanics, construction, and service 5. Waste collection	1. Central service points at the neighborhood level serving a 400m radius 2. Service points at block level serving 80m radius 3. Controlled traffic flows with car-free zones	(Bureau Nieuwe Gracht, 2017, 2018; Gemeente Utrecht, 2017, 2021, 2022; Rondaij et al., 2021)

Table 1 Integration of logistical flows of Spoorzone Zwolle and Beurskwartier Utrecht

3.3. Data collection

Qualitative was collected for this research in different ways. Figure 8 illustrates a systematic overview of the research design. The literature review in Chapter two shows the relevant concepts upon which the rest of the data collection is built. Next, the design and policy plans of the Beurskwartier Utrecht and Spoorzone Zwolle were consulted, which builds the basis for collecting in-depth information on these projects from interviewing experts. Finally, each step is linked to sub-questions specified in Chapter one.

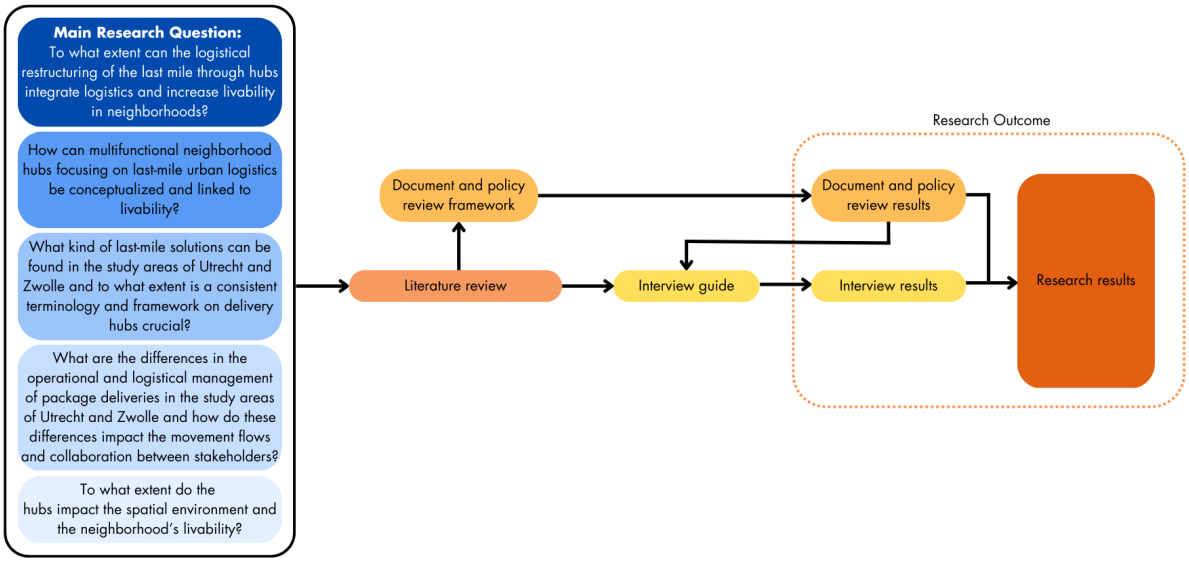

Figure 6 Schematic overview of research design (Source: author)

3.3.1. Literature review

The literature review in Chapter two identifies the relevant theories and concepts around urban logistics and neighborhood hubs. The review comprises a combination of grey literature, such as articles, policy documents, and scientific literature. All literature is collected by evaluation of relevance to the research. The scientific literature has been collected through Scopus, Google Scholar, and SmartCat, and the grey literature through logistical newspapers and government and company websites. Additionally, the snowballing method was used, in which literature references were scanned to find other relevant literature on the topic.

Critical theories and concepts were determined through the literature, and a theoretical framework was developed to form the conceptual model's foundation (Figure 4). The conceptual model acts as a guide for the interviews and analysis of documents and policies.

3.3.2. Documents and policy review

A document review is a research method that systematically collects documents, then reviews, analyses, and evaluates them (O'Leary, 2021). Reviewing these documents helps to understand the context of a case, as well as extract meaning to develop empirical knowledge, which can be compared to theoretical findings. Specifically, it can verify or refute findings from other sources (Bowen, 2009). In this case, a document review was used to gain insights into the integration of logistical flows and neighborhood hubs, project documents, and policies of the cases of Living Lab Utrecht and Spoorzone Zwolle are consulted (Table 2). The leading document for neighborhood hubs for Living Lab Utrecht is by Bureau Nieuwe Gracht (2017) and for Spoorzone Zwolle by TNO & FABRICations (2022). In addition, supporting policy documents of both municipalities were consulted in which relevant sections were examined. This information serves as a basis for analyzing the design and integration of neighborhood hubs in neighborhoods. Furthermore, it complements the in-depth interviews with professionals and experts working on these projects.

Project	Title	Author	Date of publication
Spoorzone Zwolle	Strategische Agenda Spoorzone Zwolle	Gemeente Zwolle	September 2018
Spoorzone Zwolle	Ontwikkelkader Spoorzone Zwolle	Gemeente Zwolle	June 2020
Spoorzone Zwolle	Ontwerpen aan stadslogistiek Zwolle	TNO & FABRICations	April 2022
Beurskwartier, Utrecht	Omgevingsvisie Beurskwartier & Lombokplein	Gemeente Utrecht	07 December 2017
Beurskwartier, Utrecht	Living Lab Utecht: Stadslogistiek in een duurzaam en bereikbaar Beurskwartier	Bureau Nieuwe Gracht	14 December 2018
Beurskwartier, Utrecht	Concept Stedenbouwkundig Plan Beurskwartier	Gemeente Utrecht	23 November 2022

Table 2 Document overview

3.3.3. Interviews

Qualitative data was obtained through in-depth, semi-structured interviews with professionals and experts working on planning and designing neighborhood hubs at the Spoorzone Zwolle and Beurskwartier, Utrecht (Table 3). In that way, the interviews can support the document analysis and display underlying motives, considerations, and reasonings that cannot be found in the document analysis. The main topics covered in the interview is the impact neighborhood hubs can have on last-mile delivery and how the re-structuring flows and the neighborhood design can increase livability. This includes an insight into the design choices made to facilitate a cleaner last mile, such as the operation choices and design of the environment that contributes to a livable neighborhood.

Semi-structured interviews give the opportunity of structure through the preparation of open-ended questions to ensure comparability, yet also give room for spontaneous questions to the interviewees' responses. The structure is executed through an interview guide.

The respondents were recruited through contact persons to the corresponding departments of the municipality and companies working on these projects through email and phone. This corresponds with purposive sampling, in which the interviewees are selected based on their relevance to the topic and research objective. First, this indicates that a sufficient level of professional knowledge surrounding logistics, neighborhood hubs, and the geographical context is necessary. Secondly, an affinity to the project of either Zwolle or Utrecht should be present, which suggests that the professionals are working on these projects. Specific attention was given to the different professions to include different experts in the interviews. A mix of mobility and traffic advisors and urban designers were included to investigate the different standpoints on the design of the area and the integration of traffic flows. Additionally, a researcher was interviewed who is knowledgeable in urban logistics and neighborhood hubs to also gain the scientific perspective.

Interviewee number	Background	Profession	Organization
1	Professional	Urban planner and regional designer	Bureau Nieuwe Gracht
2	Professional	Researcher	TNO
3	Professional	Urban designer	FABRICations
4	Professional	Mobility advisor	Municipality Zwolle
5	Professional	Traffic advisor	Municipality Zwolle
6	Professional	Urban designer	Municipality Utrecht
7	Professional	Traffic engineer	Municipality Utrecht

Table 3 Interviewees

3.4. Data analysis

The collected qualitative data was analyzed using several methods. It is important to analyze the data systematically to provide a comprehensive interpretation of the acquired data to draw meaningful conclusions. Therefore, the basis of the data analysis is the conceptual model (Figure 4). In that way, a link between theory and practice is ensured.

3.4.1. Document and policy review analysis

The analysis of the documents and policies was conducted through an coding framework that orients itself on the conceptual model and is therefore built through theoretical knowledge of the topic from literature. The coding framework guided the analysis of the documents and policies by selecting deductive and inductive objectives and themes (Table 4). These objectives were connected to passages within the documents and policies to recognize patterns and themes that afterward were linked to the semi-structured interviews to ensure triangulation. The documents were thoroughly examined and then interpreted, which was led through the coding framework that focused on the livability and neighborhood hubs, with specific attention to the opportunities of residents, the age-dependency, the design and accessibility of neighborhood hubs as well as their logistical flows (Table 4).

Concept	Objectives	Themes
Livability	Socio-spatial opportunities	Vibrant Safety Walkability Services and Amenities
	Age-dependency	
Neighborhood Hub	Design	Infrastructure Spatial integration Implementation (Inductive)
	Accessibility	Multifunctionality Location
	Logistical flows	Operation Management Collaboration Network Zero-emission fleet Delivery

Table 4 Coding Framework

3.4.2. Interview data analysis

To ensure a comprehensive analysis and interpretation of the data provided through the interviews, the semi-structured interviews were recorded through the dictation application provided by Apple Inc. The recordings were transcribed through the software Trint and coded through ATLAS.ti. Establishing codes before the analysis process can steer the identification of theoretical relationships before the data collection process. Therefore, a deductive code tree (Figure 7) was established through Chapter two's theories and concepts and is adapted by inductive coding to include codes identified during the analysis process. The code tree of the semi-structured interviews and the document and policy review are closely interrelated to ensure comparability.

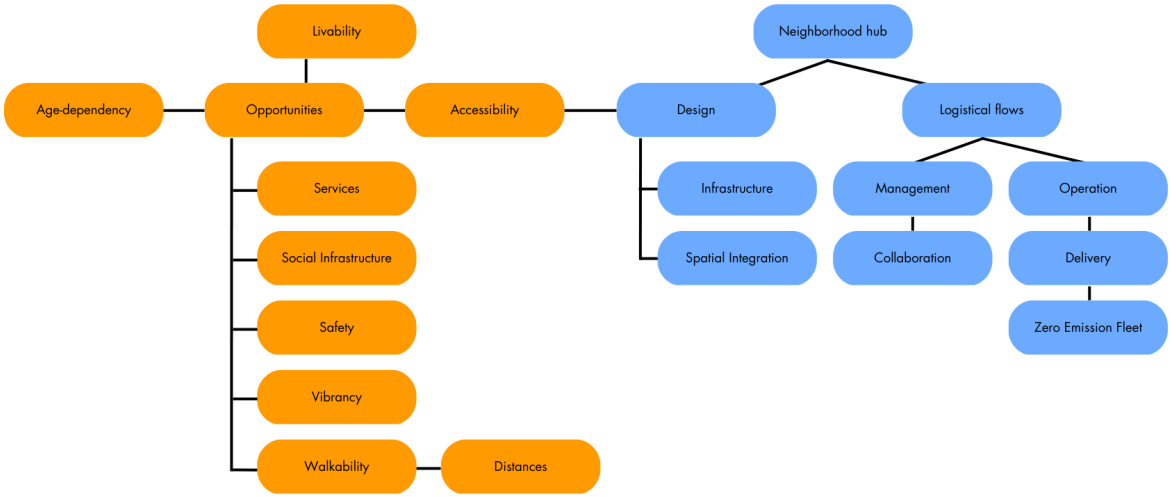

Figure 7 Deductive code tree

3.5. Ethical considerations

Within research, it is important to consider ethical matters throughout the research process to maintain ethical integrity and credibility. As this thesis is written within the University of Groningen at the Faculty of Spatial Sciences, the ethical checklist for research projects is consulted as a guiding document. Especially for the interview data, informed consent of participation, agreement to the recording of interviews, voluntary participation, withdrawal at any time, and exclusion of personal information that may identify the individual (unless stated otherwise by the interviewee) are considered at the start of the interview. Additionally, information about the goals and purpose of this research will be mentioned. Participation in the interview is only possible if respondents and interviewees agree to these terms. All data collected, audio tapes, and transcripts are deleted after the research process, and only processed data is used within the publication.

Lastly, it is worth noting the position of the researcher. The background knowledge and positioning of the researcher can influence the outcomes due to biases, beliefs, and personal experiences. To counteract this, the research is guided by the conceptual model, theoretical framework, and the supervisor's experience.

4. Results & Discussion

This chapter presents the cases of Zwolle and Utrecht in-depth and discusses them. The knowledge was gathered from analyzing design and policy documents and semi-structured interviews with experts involved in the plans. Firstly, the characteristics of the cases are introduced and elaborated on. Then the execution of neighborhood hubs, such as their operation and impact on the neighborhood, are described and compared.

4.1. Elaboration on the cases

Characteristics of Spoorzone Zwolle

The Spoorzone Zwolle is located south of the inner city of Zwolle and is adjacent to the train station (see Figure 8). Offices, educational institutions, and a large warehouse characterize the Spoorzone's north and west. Within that area, much space is reserved for parking and street space. In the southeast, a residential area with a mix of apartments and terraced houses will be part of the redevelopment. The area is characterized by a good connection through the station in the north and the national road N337 to the south, which connects to motorway A28. These roads and connections also separate the area from other neighborhoods to the north and south. Additionally, the connection to the east is separated by the train tracks. This secludes the area and gives only a few entry points.

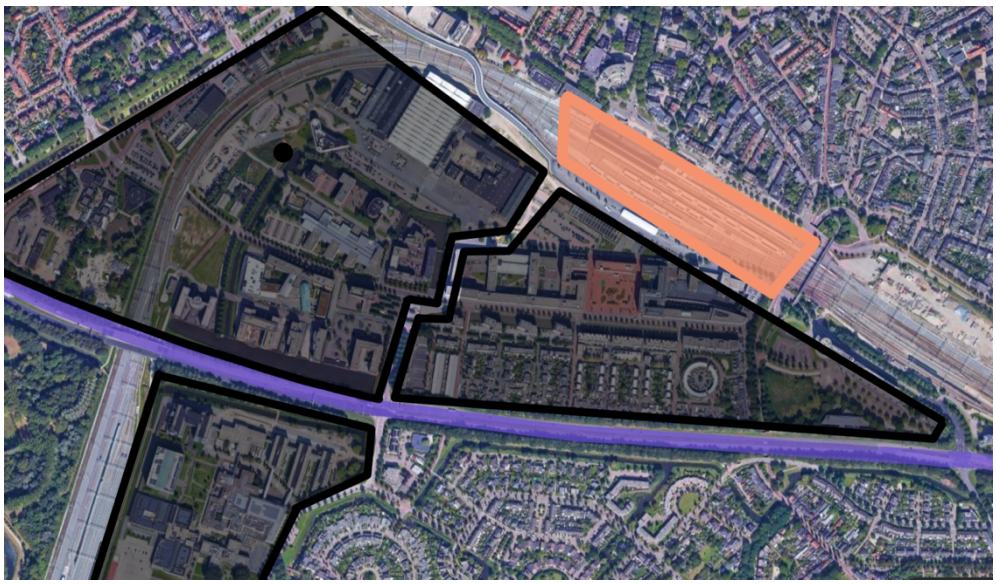

Figure 8 Spoorzone area (Black: areas, orange: station, purple: road) (Source: Author)

The redevelopment of the Spoorzone is based on the concept of superblocks. It can be divided into three areas: the Hanzearea to the East, Willemskwartier to the West, and Windesheim to the South (TNO & FABRICations, 2022). Within these superblocks, motorized vehicles are not allowed, and space is made available for these vehicles around the edge of each superblock. Additionally, each superblock aims to run its own logistics system with neighborhood and micro hubs allocated throughout the respective areas. This gives space within the superblock for recreation as the roads and paths are reserved for slow modes (TNO & FABRICations, 2022). The intention is to create an area for individuals that are not car dependent with a focus on apartments that can house one to two people. This especially includes young professionals and seniors (Interviewee 4 and 5).

For the redevelopment of the Spoorzone, the housing, services, and amenities are to be increased, ensuring integration of working, learning, living, and relaxing (Gemeente Zwolle, 2020b, 2021). Additionally, a focus is on a traffic-low area based on the STOMP principle. Therefore, the highest priority is a place for pedestrians (stappen) and bikes (trappen). After that, motorized mobility is integrated, such as public transport (openbaar vervoer), mobility services (MAAS), and private car usage (Gemeente Zwolle, 2020b). This prioritizes slow modes around which the entire redevelopment design focuses. With much attention

to mobility, the importance of logistical streams is explored. More deliveries to residents are expected since the neighborhood will focus on discouraging private car usage. Additionally, the increased housing, amenities, and services increase the need for logistical movements as more places must be serviced (TNO & FABRICations, 2022). This can increase small but frequent deliveries to the increased residents and amenities.

Characteristics of Beurskwartier Utrecht

The Beurskwartier in Utrecht will be a new quarter located southwest of the city center of Utrecht and southwest of the central train station (see Figure 9). Cultural buildings and offices are located in the northeast of the Beurskwartier, adjacent to the station. In the south, much space is reserved for parking in the way of large-scale parking lots. The southwest area, in the middle, is characterized by the event venue Jaarbeurs and a large warehouse. Roads surround the Beurskwartier. From North to West, the Graadt van Roggenweg runs, which connects the area to the motorway A2. On the east, the Van Zijstweg runs connecting to the train station. Within the Beurskwartier, little road space is present, as parking and larger buildings take up much space. It is not possible to cross through the Beurskwartier, only through the two roads surrounding it.

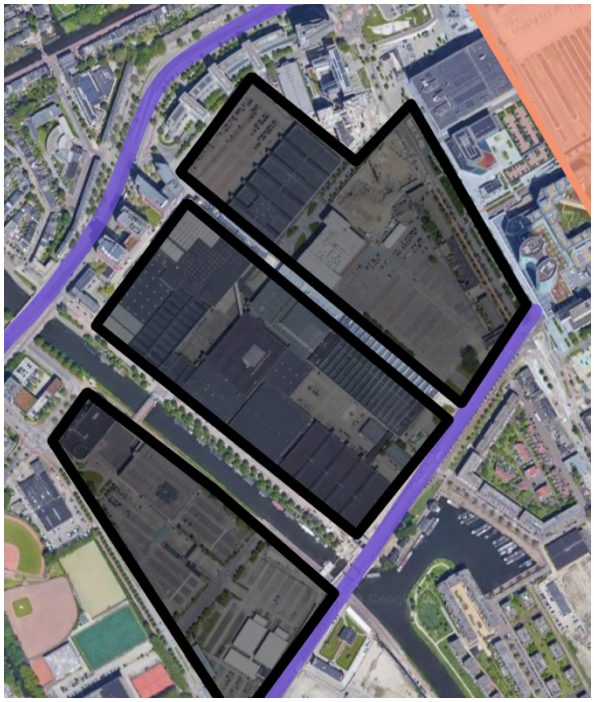

Figure 9 Beurskwartier area
(Black: areas, orange: station, purple: road) (Source: Author)

To develop this new quarter, 3000 new apartments are planned, as well as several services, amenities, and office spaces(Bureau Nieuwe Gracht, 2017, 2018; Gemeente Utrecht, 2017). These functions will be integrated within building blocks. Each building block comprises approximately 70x70 meters (Bureau Nieuwe Gracht, 2018). Around ten building blocks are planned, with a road surrounding one side to ensure access for logistics and other services and pedestrians and cyclists from the other side. This can encourage a living area in high densities combined with other functions (Gemeente Utrecht, 2017; urbannext, 2017). The area intends to cater towards people interested in living in a car-low environment, which could especially apply to young urban professional as well as a certain group of seniors that values closeness to facilities and services without having to use a car. Additionally, the area could also be from interest for families, as living in a car-low environment also gives the freedom for playing on the streets (Interviewee 1).

The new Beurskwartier keeps in mind sustainable development by expanding around transport Nodes. Slow traffic is encouraged throughout the whole neighborhood, with no car traffic passing through the area allowed (Bureau Nieuwe Gracht, 2018; Gemeente Utrecht, 2017). The priority in the plans is given to pedestrians, with biking being encouraged (Gemeente Utrecht, 2017). As much space is reserved for the car now, more room will be given to greenery and increased amenities to focus on the interrelationship between residents. This can contribute to higher livability within the neighborhood (Gemeente Utrecht, 2017). Cars can be parked at a distance south of the Jaarbeurs, and a new north-south connection will be installed for bikers and pedestrians instead. This can encourage the increasing deliveries because of the new residents and needs to be integrated within the plans. Therefore, logistics are to be integrated smartly without disturbing the priority of pedestrians and cyclists (Bureau Nieuwe Gracht, 2017).

4.2. The Structure of Hubs in the Spoorzone and the Beurskwartier

This section aims to provide insights into the research question "*What kind of last-mile solutions can be found in the study areas of Utrecht and Zwolle and to what extent is a consistent terminology and framework on delivery hubs crucial?*". This discussion is led by the placement and therefore the location of the hubs, considering the radius in which they operate as well as identifying the different operation types.

In the Beurskwartier, two different hubs can be identified (see Figure *10*). The district service points and the block service points. The district service point operates on a larger scale compared to the block service point. They are located on the border of the Beurskwartier, close to the station and south of the Jaarbeurs, whereas the block service points are located throughout the neighborhood. The placement of the block service points is much more frequent, with the idea in mind that these service each building block within a 50m radius (Bureau Nieuwe Gracht, 2017, 2018). Similarly is the structure of the Spoorzone in which the neighborhood hubs are placed along entrances to the neighborhood based on the idea of the superblock, which orients itself on the walking distance of 400m, making a total of 4 neighborhood hubs necessary for the three areas (see Figure 11 and Figure 12) (TNO & FABRICations, 2022). The micro hubs are integrated within the area in the neighborhood to service a smaller radius of around 80m (see Figure 12) (TNO & FABRICations, 2022).

Figure 10 District and block service points Beurskwartier (Source: Bureau Nieuwe Gracht, 2018)

In both neighborhoods, two similar types of hubs operate on different scales. Even though they are named differently, one type of hub operates on a larger scale, and the other type services a smaller range. When looking at the theoretical framework, the literature suggests that three kinds of delivery hubs are possible within the neighborhood scale (Janjevic & Ndiaye, 2014) (see Figure *3*). In the Spoorzone, the neighborhood hub, and in the Beurskwartier, the district service hub has the characteristics of a micro consolidation point and a good reception point. Both of these hubs offer the opportunity of home delivery for an extra charge and pick up at a larger distance from the residents' homes. This pick-up is time-dependent and further away from the residents' homes, as these hubs are intended to operate on a larger scale within the neighborhood. The micro hub in the Spoorzone and the block level service points in the Beurskwartier appear to be functioning as a goods reception point, as pick-ups are intended to discourage home deliveries and are therefore located much closer to the consumers' homes.

Nevertheless, these smaller-scale hubs are intended to be equipped with parcel lockers, which, according to the literature, lets them fall into the category of urban locker boxes. These are not time-dependent regarding delivery and pick-up like the goods reception point. However, when combined with different functions, it is not clear, according to the literature, in which category they fall. When looking at only the logistical function, the category of urban locker boxes fits both of the descriptions of the micro hubs and block service points. Yet, this terminology might be limiting in their entire functioning and only describes the logistical part of the hub.

Additionally, an extended operation description based on the functioning within both cases is necessary, as Janjevic & Ndiaye (2014) and Patier & Toilier (2018) mention home delivery as an option in their framework. In contrast, home delivery is not the standard for deliveries in the Spoorzone and the

Beurskwartier. Instead packages are intended to be delivered to hubs in which they can be picked up from for example locker boxes . Within the two cases locker boxes are integrated in the hubs instead of being an alone standing locker box. Therefore, the descriptions of Janjevic & Ndiaye (2014) and Patier & Tollier (2018) only fit the operational structure to a limited extent and the theories presented need to be expanded on as the different kinds of hub options are integrated instead of operating independently from each other.

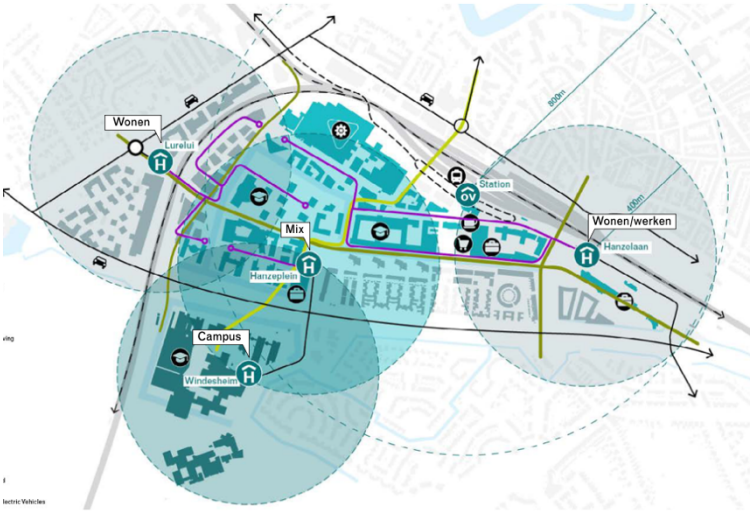

Figure 11 Different neighborhood hubs in the Spoorzone and their reach (Source: TNO & FABRICations, 2022)

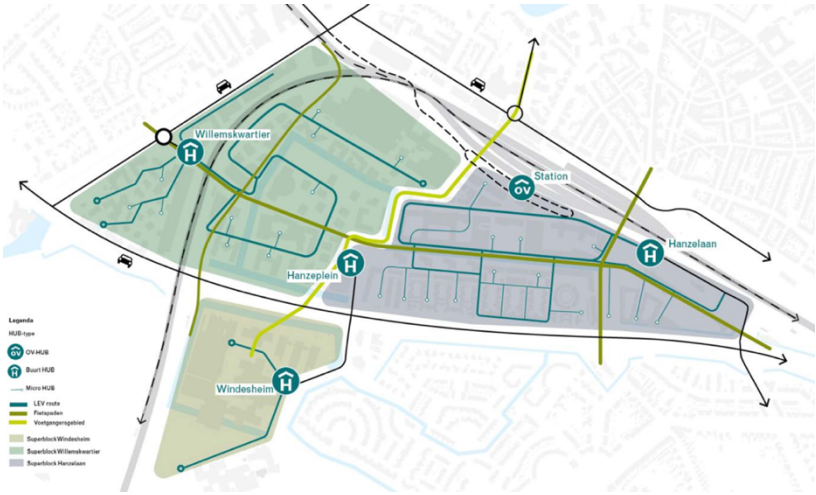

Figure 12 Location of neighborhood and micro hubs in the Spoorzone (Source: TNO & FABRICations, 2022)

Overall, the focus of this discussion seems to be closely linked to the semantics and definitions used for the different kinds of hubs. Literature and practice still need to be developed around the subject of hubs on a neighborhood level that service an area based on logistics such as package delivery. This also reflects on the inconsistency of terms used across projects and within the literature. Multiple researchers have made the attempts, but as concrete terms and definitions within the field are lacking, it is difficult to gain an overview of the systems used. This is specifically important, as the terminology can bring certain expectations connected to the concepts of hubs. The better the definitions and terminology is developed, the better the association can be to what is meant with the different kinds of hubs and their purpose. Similarly, this also accounts for the Spoorzone and Beurskwartier, where similar last-mile solutions are used, but completely different terms are given to the hubs. Yet, an extensive description of their structure is given, making it easier to identify them and compare them to the concepts presented by Janjevic & Ndiaye (2014) and Patier & Toilier (2018).

4.3. The Operation of Package Deliveries to Hubs and their Logistical Management

This section aims to provide insights into the research question "*What are the differences in the operational and logistical management of package deliveries in the study areas of Utrecht and Zwolle and how do these differences impact the movement flows and collaboration between stakeholders?*". This discussion is led by examining the package delivery and logistical management structure which also includes the collaboration between governments and logistics companies.

When looking at the operational side of package delivery, the larger scale hubs play a role in receiving and distributing the deliveries to the smaller hubs or the end consumer (see Figure *12*). In Zwolle, the neighborhood hubs are intended to cover a logistical radius of 800m. In this way, deliveries can be consolidated at each of the neighborhood hubs, and the bundled goods get further distributed to the micro hubs via light electric vehicles, foot, or bike (TNO & FABRICations, 2022). Nonetheless, in the Spoorzone, suppliers and delivery services can also consolidate at their existing consolidations points outside the neighborhood. Yet, the delivery scale is kept at light electric vehicles, and larger vehicles are discouraged from entering the LEV routes. Compared to that, in the Beurskwartier, goods get transported from urban consolidation centers outside the city on zero-emission vehicles to the district service points with further transport on light electric vehicles or directly to the block service points (see Figure 13) (Bureau Nieuwe Gracht, 2018). However, since off-site consolidation in the Beurskwartier is possible, deliverers can skip the district service points as any smaller zero-emission vehicles are allowed in the neighborhood. Interviewee 7 mentions the difficulties of larger trucks coming into the Beurskwartier, which already restricts the delivery directly to the block service points to a certain level:

> *The main idea is that they (deliveres) get to the hubs and the smaller hubs (…). But they have one disadvantage. If you have a big lorry, a big truck, like 20 meters long. It won't be able to enter there.*

In the Spoorzone on the other hand, the neighborhood hub seems to be emphasizing more on the on-site consolidation. This suggests to impact the operation of the hubs within both areas differently, but also the impact on the logistical flows in the areas. In the Spoorzone, Interviewee 3 describes the delivery in the following:

> *These hubs are basically functioning as a filter. So larger flows of logistics get to these (neighborhood) hubs, and the neighborhood hub functions as a gate, and from the (neighborhood) hub onwards, with smaller vehicles (…), they start to distribute goods.*

As a result, consolidation in the neighborhood is less of a focus in the Beurskwartier than it is in the Spoorzone as larger delivery vehicles, such as e-vans, compared to the Spoorzone, are still allowed to deliver directly to the block service points.

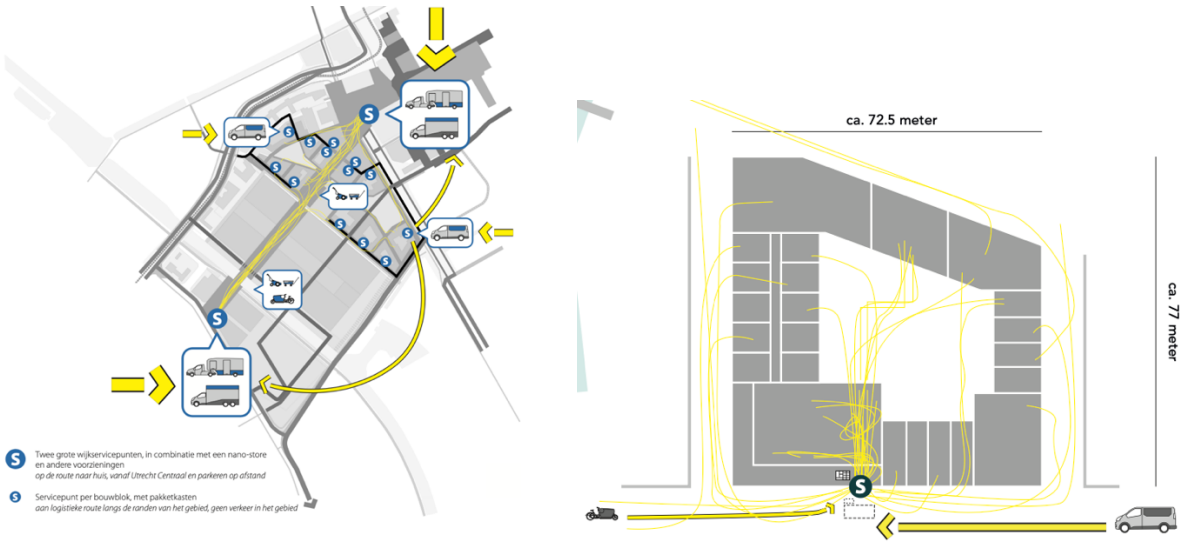

Figure 13 Delivery system Beurskwartier (Source: Bureau Nieuwe Gracht, 2018)

Next to the operation of hubs, the collaboration between companies at the hubs is equally essential. Literature suggests (Katsela et al., 2022; Van Duin et al., 2022), that a collaboration between deliverers regarding delivery and sharing of other infrastructure is vital to create a sustainable system. By sharing vehicles, space, routes and facilities not only dense areas can benefit from saving space through sharing but also companies can benefit in terms of lowering operation costs. The hubs intend to make sharing this infrastructure to consolidate possible. This is also supported by Interviewee 2, who says that restructuring the delivery of packages can make trips more efficient and less costly. Especially in Zwolle, access to micro hubs without light electric vehicles is nearly impossible. As those vehicles have a limited range and are not feasible to use over long distances, the LEV deliverers are encouraged and enforced to use the neighborhood hubs as a consolidation center to further deliver into the neighborhood to the micro hubs. This encourages using the shared facilities and infrastructure since the Spoorzone also does not make it possible to give separate spaces to different logistical carriers. This incentive is working differently than the structure at the Beurskwartier. Since e-vans for deliveries are allowed, the need to consolidate via the district service points is lower, which also means that the carriers will make use of their own consolidation sites and infrastructure, which according to Interviewee 4, seems to be their preferred option over sharing:

> *They (deliverers) do say we are going to share. But they only want it by their rules, (…) so it is not really sharing. And we are now discussing how we give away public space (to them).*

This is also reflected in the drop-off of packages. The delivery to these micro hubs is managed with locker boxes. In both cases, these locker boxes need to be white-label. However, the deliverer can be different companies (Bureau Nieuwe Gracht, 2018; TNO & FABRICations, 2022, Interviewee 6). Logistical companies are very interested in having their own locker boxes, whereas the neighborhood wants white-label boxes (Interviewee 4). By only allowing white label locker boxes more possibilities are there for the hub users, as one spot is established to receive package no matter the deliverer. Yet, it can restrict certain logistical carriers even further.

All these restrictions on the operation and management systems of the logistical carriers in both areas can also come with a risk. The structure of movement flows and delivery methods enforces restrictions on the delivery, which can also lead to resistance from the delivery companies. Interviewees from both cases have mentioned that limited or no discussions have been held with the big logistical carriers (Interviewees 4, 5, 6, and 7). However, the interviewees especially from the municipalities do not view it as a difficulty as the cities and municipalities can enforce implementation measures to a certain extent, but also yet still limited by restrictions in the Dutch law (Interviewee 1). Interviewee 1 has mentioned that discussions that were held, the carriers would only follow along if enforcements were made that are compliant to the Dutch law:

> *And the bottom line is you just need to tell them (the government) that they have to change the law, because they (logistical carriers) will not come up with this idea themselves. They want the visibility of their brand. And if you don't do that, you end up with five package walls in the entrance of a building. This is not what you want.*

What makes it more difficult in addition to the legal requirements for the implementation of white label lockers and shared resources, is that logistics companies work under their own different requirements, which is highlighted by Interviewee 2:

> *On the one hand, requirements towards their customers. They want (their package) at 10 in the morning or (have) contractual requirements to keep the customers satisfied. And the customers are receivers and shippers, and the other requirements are legal requirements. So their time windows and their wage restrictions or area restrictions.*

This shows that the operation with these hubs and their restrictions impose another restriction on the logistical companies involved in the delivery process. Therefore, involving these companies in the process is crucial, as they can also be seen as stakeholders in restructuring these flows. It also sheds light on the feelings of the different parties involved on each other, which shows that a need for open conversation is necessary for collaboration between and with each other. This can also aid in guiding wishes and desires and opportunities and barriers of the public and private stakeholders involved.

4.4. The Integration of Logistical and Residential Flows into a Network

This section aims to provide insights into the research question *"To what extent do the hubs impact the spatial environment and the neighborhood's livability?"* . This discussion is led by the interaction of multifunctionality and facilities and services from the conceptual model (see) and further goes into depth on the other aspects of livability such as safety, social relations and the residential environment.

The Focus on Slow Modes

The redevelopment of the Spoorzone focuses much on giving space to slower modes through restructuring the road system. The STOMP principle is applied, which focuses on road development from the view of a pedestrian to identify the most critical routes (Interviewee 4; Interviewee 5; Gemeente Zwolle, 2020b). With the pedestrian coming first, pedestrian zones are reserved first, followed by the cyclist, who also plays a significant role in the distribution network. Light electric vehicle routes are established, which may also be used by emergency services, but the use by regular visitors or car owners is discouraged and not the focus (Interviewee 3). The routes run through the entire neighborhood and are the internal connection between the neighborhood and micro hubs (TNO & FABRICations, 2022). The idea of these LEV routes goes back to the concept of the superblocks, which aim to keep cars and heavier traffic out of the inside of the neighborhood (Interviewee 3; TNO & FABRICations, 2022).

Similarly, in the Beurskwartier, different roads are reserved for different vehicles (see Figure 14). The routes on the north and south going towards the neighborhood hubs allows different vehicles accessing the hubs as long as these are from a zero-emission fleet. The living/working area only allows smaller zero-emission vehicles to service the block service points, with the exception that the Beurskwartier can only be accessed either from the east or the west, as the middle of the Beuskwartier is reserved for non-motorized traffic only and may not be crossed by larger vehicles. The roads between the building blocks that give access to the block service point allow for all traffic, considering that the roads are shared spaces with a maximum speed of 30km/h (Bureau Nieuwe Gracht, 2017).

This is also similar to the Spoorzone, in which the neighborhood hub can be accessed from two sides (see Figure *15*). One side has access to a road on which cars and other heavier vehicles are allowed and the other side has access to the pedestrian and LEV routes, which can help with the logistical distribution network throughout the neighborhood (Interviewee 3, TNO & FABRICations, 2022). In both cases, the flows of different speeds have been segregated to identify the main routes for each of the flows, which have been overlayed in the end. Interviewee 3 describes it in the following way:

> *The location that we have chosen for neighborhood hubs is basically at the intersection of many important routes. On the one hand, we have this interactive access for heavy vehicles. (…) the bike route, and also on the other side (…), we have the pedestrian- and sidewalk. (…) So it is really at the intersection of so many important roads. (...) We started to really analyze these flows currently and in the future and (…) scrutinized their behavior. (…) We (…) segregated these flows from each other to also reduce a little bit of conflict, first of all, between these logistic flows and, secondly, with the neighborhood in general.*

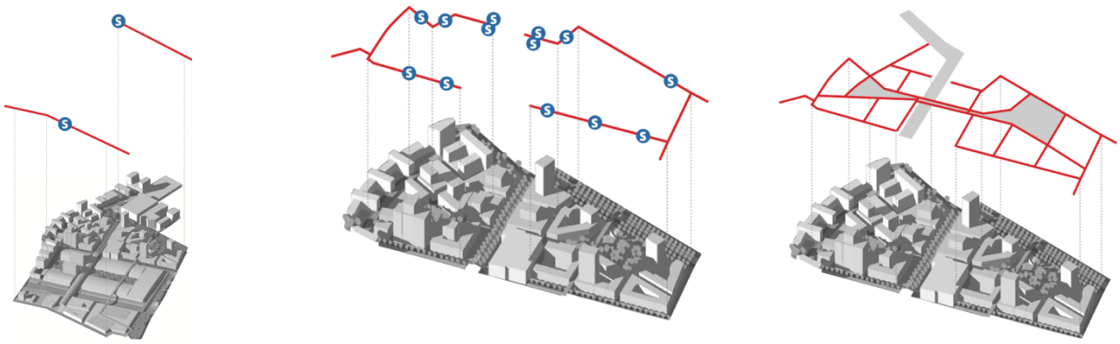

Figure 14 Different levels of access to the Beurskwartier (Left: access road to the district service point, middle: access road to block service points, right: non-motorized traffic paths) (Source: Bureau Nieuwe Gracht, 2018)

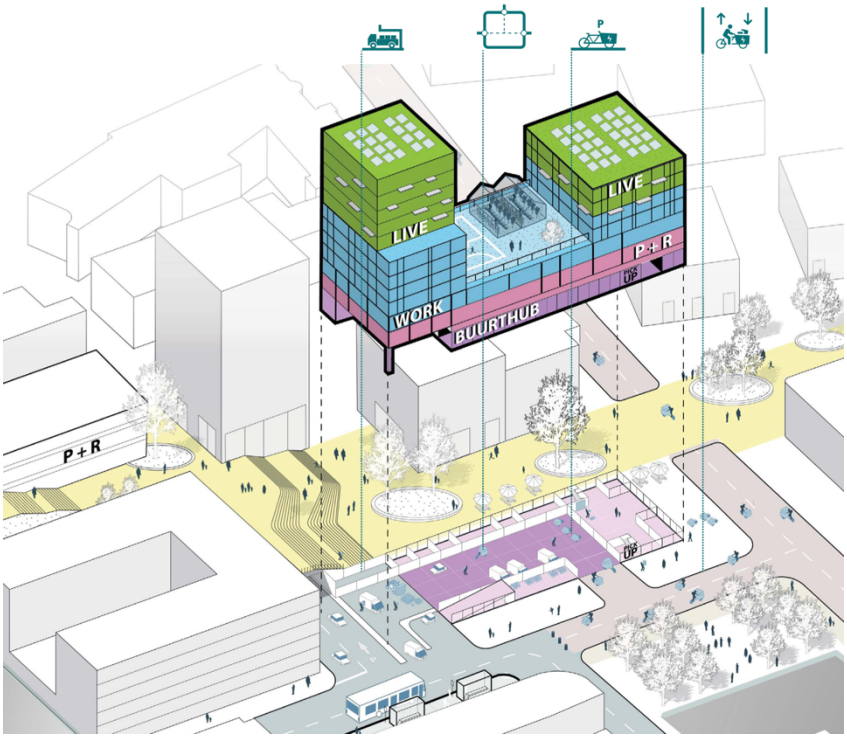

Figure 15 Division of neighborhood hub space in the Spoorzone (Yellow: pedestrians, grey: motorized vehicles, red: LEV route) (Source: TNO & FABRICations, 2022)

The Importance of Accessibility of the Hubs

As mentioned above, with the superblock idea in mind, the hubs are strategically placed alongside the border of each superblock in the Spoorzone to ensure easy access for logistics and distribution with crucial connections close by (see Figure 11 and Figure *12*) (Interviewee 3, TNO & FABRICations, 2022). Compared to that, the Beurskwartier comprises a smaller area. However, the placement of the district service points follows a similar strategy. Furthermore, as mentioned above, the building block can be accessed for logistical services from a road on one side, while the other side of the building block is strictly reserved for non-motorized traffic (Gemeente Utrecht, 2022). Therefore, the location choices of the hubs might be seen as a significant difference between the two areas.

Furthermore, the larger hubs in the Beurskwartier at the parking lot (see Figure 13) and the station are less integrated into the urban living and working fabric than in the Spoorzone. This makes accessibility for logistical carriers in the Beurskwartier easier due to the closeness to the edges of the neighborhood close to the main traffic arteries, while it can be more challenging to be used by residents since the district service points are outside of the main living area and rather rely on the movement around the station and the parking lot. However, since the parking lot in the Beurskwartier is also used by residents and visitors to park their vehicles, it can contribute to the usage as it is an area that gets passed when exiting or entering the Beurskwartier. Compared to that, the neighborhood hubs in the Spoorzone are integrated into every the tree superblocks (see Figure 11 and Figure *12*). This makes the accessibility for logistical carriers easy, and so is the access for the residents, as the neighborhood hubs seem to be integrated into every area.

For the smaller scale hubs in the Beurskwartier, the block service points are integrated into every building block and focus on the design and functionality, especially towards the resident. In contrast, the district service point serves more the logistical carriers, primarily due to its distance to the residential area. Within the Spoorzone, the placement is similarly done on a closer scale with the principle in mind to have facilities and service as close to the door as possible based on a close-by walking distance (see Figure *16*). Interviewee 4 describes it as this:

> *The hubs and the lockers will be near to the streets which are coming into the area, so that (the vans) do not come to the whole area inside.*

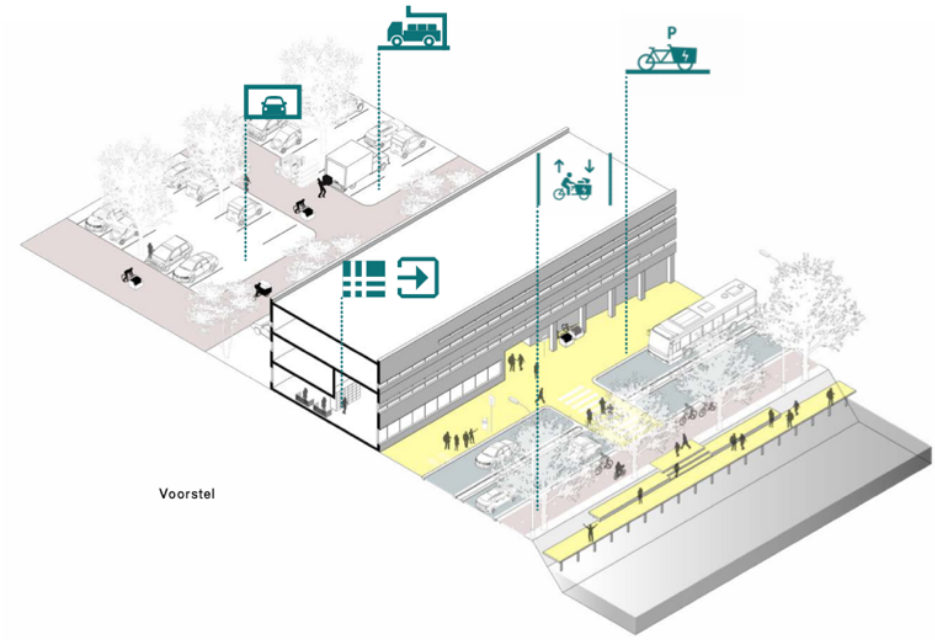

Figure 16 Access of a hub for vehicles and pedestrians (Source: TNO & FABRICations, 2022)

Through frequent and accessible placement, quick stops for deliverers are made possible. Different interviewees especially highlight that the hubs enable deliverers to enter and exit the neighborhood quickly, lowering the time spent within the neighborhood. This does not necessarily mean that less vehicles are coming into the neighborhood but that especially the dwell time of these vehicles is reduced, which is also mentioned by Interviewees 2 and 3:

> *You have to develop policy strategies to minimize the number of vehicles that come into cities. But in the end, there will be logistics vehicles. And this diversity is important. (…) If you have a parcel locker and the delivery guy can drop 10 parcels at once instead of having to go to ten apartments, you don't take away a vehicle, but you reduce the dwell time. (Interviewee 2)*

> *We decided to consider these micro hubs for a couple of buildings next to each other. Therefore, the delivery guys (…) don't have to stay a long time and spend a lot of time (…) to ring the bell of every door and wait for someone to collect the package. Therefore, they can just stop next to these lockers and put everything in there and just quickly leave the neighborhood. So with this micro hub solution we decrease the time spent in the neighborhood. (Interviewee 3)*

Next to the accessibility for the deliverers, also the accessibility for users is essential. Especially the closeness of hubs is a crucial factor in facilitating the efficient pick-up and delivery of packages (see conceptual model). According to existing literature, the average distance to neighborhood hubs should be between 300-500m because of its convenience to support walkability (Gehl, 2011; Janjevic & Ndiaye, 2014; Patier & Toilier, 2018; Vorontsova et al., 2016; Wu et al., 2018). However, micro hubs located at an even closer level are just as important, especially for daily usage. Both cases consider this by frequently placing two different scale hubs throughout a set area.

It is worth noting that neighborhood hubs alone may not necessarily encourage walkability. The entire design of the neighborhood, including restrictions on motorized traffic, plays a crucial role in promoting active transportation. Frequent placement of hubs can help to supply access to nearby facilities, encouraging walking and cycling as the primary modes of transportation. By prioritizing walking and cycling in the design of neighborhood spaces, it is possible to create an attractive and walkable area (Rogers et al., 2011). Logistical routes can be restructured to accommodate this priority, even if vehicles are still permitted on the roads. Through the frequent placement of hubs, logistic vehicles can spend less time on the road, benefiting both delivery services and residents. Residents can receive packages from a nearby location, and the urban space can be freed from constant car traffic. However, placing neighborhood hubs along important arteries can raise concerns about potential traffic congestion and the impact on surrounding residential areas. Therefore, careful consideration must be given to the location and placement of these hubs to ensure that they do not become a source of disruption for the community. Ultimately, the closeness of hubs is a critical element in the design of a neighborhood that can impact walkability and accessibility for different users, which seems to be of different importance considering which functions are integrated.

The Provision of Facilities and Services in the Hubs and their Effect on the Neighborhood

Multifunctionality is an important consideration, particularly when it comes to the development of neighborhood hubs. In the Spoorzone, these hubs can be combined with mobility hubs, as it is done, for example, with the OV hub that is located at the station, making it convenient for commuters to park at a distance and access shared mobility options on their way home (TNO & FABRICations, 2022). That is, however, a mobility-oriented hub that does not have its primary focus on organizing service-related logistical flows. When oriented towards logistics, they can be paired in the Spoorzone with other shared mobility options such as a shared bike or car, according to Interviewee 5, or other functions like waste collection, grocery delivery, recycling points, shared cars, and social spaces like libraries and cafes (TNO & FABRICations, 2022). Similarly, the district service points in the Beurskwartier can be an attractive and multifunctional space for residents and visitors (Bureau Nieuwe Gracht, 2017, 2018; Interviewees 6 and 7). With different services such as local restaurants, city markets, and nano stores, the district service point can be a multifunctional place for daily needs. Compared to that, the block service points can, next to the parcel deliveries, provide shared services like waste collection, mobility, and tools (see Figure 18).

Additionally, they can also include a janitor and bike storage for the residents (Bureau Nieuwe Gracht, 2018; Interviewees 6 and 7). Similarly accounts for the micro hubs in the Spoorzone. Since the servicing area of those two hubs is on a smaller scale, smaller-scale services and facilities are integrated, especially those necessary daily. Furthermore, by including these other functions in hubs, they can be activated as social meeting spots rather than being solely dedicated to one function of logistics. This not only enhances the efficiency of package delivery and pick-up but also contributes to the community's vibrancy and flexibility within what is possible when integrating functions instead of separating them.

One interesting approach in the Spoorzone is the neighborhood hub as a sandwich model. The neighborhood hub is integrated vertically within a building, moving away from separating functions and services (TNO & FABRICations, 2022). Within their sandwich model, living, working, parking and the logistical realm are integrated seen in Figure *17*.

Therefore, this can be considered a mixed-function area, where the hub is combined with other urban functions to create smart combinations that bring together various streams, facilities, and services. Interviewee 3 describes her vision of the neighborhood hubs in this way:

> *So neighborhood hubs for us (are) more like a multifunctional, socially and communal space in which we encourage everyone to go there to sport, for work or to take coffee to meet neighbors. But it is also a space to take or collect your package. So because we believe that if we want to integrate spaces for logistics in a very sustainable way, we shouldn't see them as a waste to also better spaces in our neighborhood. But, we also need to add more societal and sustainable values to that. Therefore, they can really be integrated and people see these hubs more as a destination to go, not just for the sake of collecting the packages. So it happens (…) through your daily activities.*

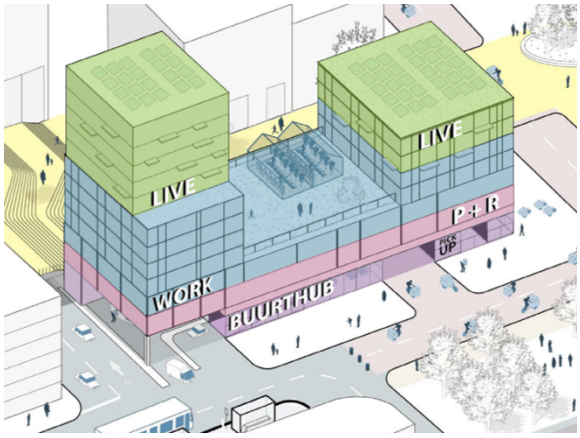

Figure 17 Sandwich Model Neighborhood Hub Spoorzone (Source: TNO & FABRICations, 2022, edited by author)

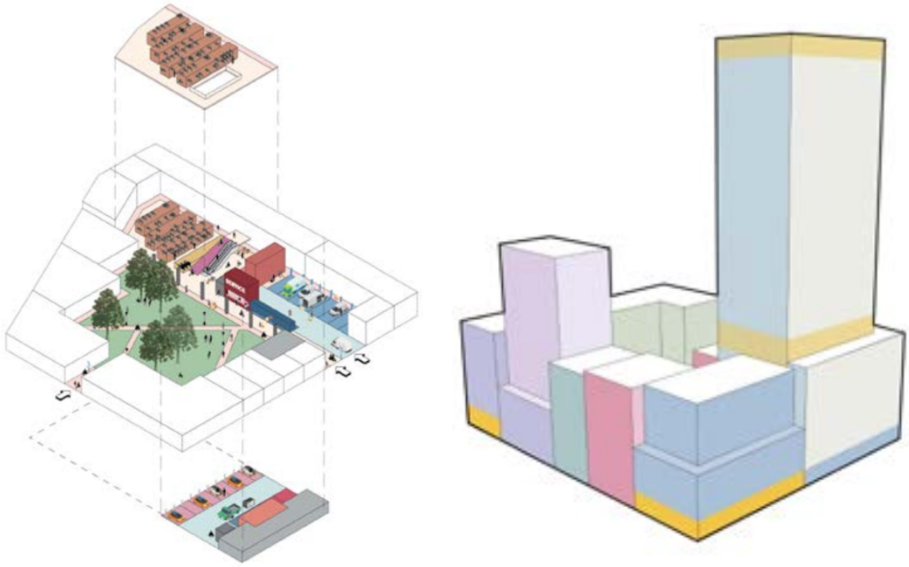

Figure 18 Mix of functions in the Beurskwartier building block (left: integration of logistics, right: mix of functions) (Source (Gemeente Utrecht, 2022)

Similarly, the building blocks within the Beurskwartier are designed. The stacking and mixing of functions of the building block can be adopted. The basement can be reserved for parking and technical facilities. The ground level provides space for different facilities such as bike storage, the janitor, as well as package lockers. The space for unloading delivery can also be provided on the ground floor inside and outside, as the building block is designed in a U-form and creates space in the middle of the building for different logistical services. Lastly, the space around and above can be a mix of living and working spaces (Bureau Nieuwe Gracht, 2017, 2018; Gemeente Utrecht, 2022). Interviewee 6 describes the way the building work aims to function like this:

> *There is an (outside and inside) of the building block. You could enter with your bike, for instance, and then via the stairs (or via the courtyard) you could go into the building where you live. (…) And if you come back from or you want to go away from your house, you also need to go via the hub to get your bike. But you also have a local trash can where you can dump your waste. So there's always moments where you meet other people, residents from the building. This courtyard is really designed to attract as (many) people (as possible) and you have people walking around there. This image is this like our hub in the in the building block would look like, you know, the deliveries (see* Figure 18*). And then in the center, there's also room for the concierge that manages the place, keeps (it) clean, can answer questions, can help with packages that don't fit in the package wall (...). But also the residents can park their bike there or shared cars. So that is the way that the building block is going to function for people to meet each other here.*

In both cases, the ground floor and other levels of buildings can be utilized for functions that promote social interactions, making the area more vibrant and livable (Gemeente Utrecht, 2022; TNO & FABRICations, 2022; Interviewee 6) as all areas mix and cluster functions, which can encourage activity on the street level to generate human activity. Nevertheless, it is essential to consider what functions are needed and how much space is made for those. When space is being made, it also needs to be filled, as keeping it empty and unused is expensive. Further, combining all these functions and getting different stakeholders to cooperate can be difficult and also expensive. Therefore, the question of profitability can be raised, as well as which role the local, regional, and national government and as well other stakeholders play and how these hubs are coordinated.

This is also emphasized by Interviewees 3 and 4, who question the financial responsibility of getting the hubs to function:

> *We probably have a negative business. (But) a negative business case can be a positive investment in the future. (Interviewee 3)*

> *What is difficult is: What is our role? What is the governance? Is it public, Is it private? And also how can we do the financing? Because will not be a very economical place. (…) Maybe the public sector has to finance it. (Interviewee 4)*

Yet, the mix of functions is seen as equally important and, therefore, also rated higher by Interviewee 3 than the potential negative business case that might occur in the beginning by implementing the structure of hubs with different services and facilities. Finally, interviewee 4 stresses the importance of the social side and building a community with a design around multifunctionality and the hubs:

> *A (neighborhood) hub is much more, it's social, it's economical (…) We want to go make the step to a community hub (to make it) multifunctional. All these things are taking up all the same space. (...) You can make a combination and make the most effective designing of the space.*

Integrating the logistical flows and other functions directly into the buildings and, therefore, into the urban fabric can create integrated places with social and sustainable values. Therefore, space must be given to all these functions while not neglecting one, yet logistics cannot be dismissed because of their importance in daily life. However, much focus in literature and also by professionals is still solely on mobility that is disintegrated from other functions, such as a parking garage or a place to use a shared bike or car, which is different from the goal of the neighborhood hubs. This is also emphasized by Interviewee 5:

> *It (hubs) must be integrated where you can live, maybe like a doctor or a gym. It is more than mobility and parking. (…) A neighborhood hub is not a parking garage. It is more than that.*

When taking a look, the block service points in the Beurskwartier are designed to foster interaction between people in their own communal building areas. (Interviewee 6, Gemeente Utrecht, 2022). Additionally, by providing various services and facilities at close distances the area can also become interesting for people of different ages which can create a mix of generations flowing and interacting within the neighborhood. These interactions that are strived for are mainly created within the semi-private realm, which is particularly important for residents, as these are the spaces they can meet and interact with each other from which other social interactions can be built. In that sense, the creation of third places can especially start from these low-threshold semi-private realms that offer low-threshold entry points into the community, which is especially important on the building block level since these areas are visited daily by the residents. Yet, it is also important to note that these interrelations built in these semi-private realms inside the building blocks are mainly outside the public eye and might strengthen the relationship between residents in the same building but not between buildings and towards visitors. This could lead to a separation between the building blocks and result in the adverse effect of creating exclusive spaces for interaction within buildings rather than outside and between people of different building blocks. Yet, interaction between neighbors on different scales should still be seen as an important relationship and be treated as a potential for a base connection for further interactions and relationships. Effects like these can also depend on the scale and range of facilities and services as well as on the willingness for social interaction.

The Role of Multifunctionality and the Built Environment to Create Safe Neighborhoods

As mentioned above, the mix and clustering of functions can generate more human activity, as described in the literature (Jacobs, 1961). This also translates into increased activity and therefore increased social safety through eyes and ears in the environment during different times of the day, as it is emphasized by Interviewees 6 and 4:

> *So during the daytime, it's also active (because of the social functions) and there are a lot of offices and in the evening, probably more residents are there. So (…) it's going to be quite a vibrant area to be (in). (Interviewee 6)*

> *The social services, they want to cluster (as well) (…). It can become a nice place because you (can) also (have) eyes and ears and maybe a janitor who can check if everything is all right. (Interviewee 4)*

This shows that the hubs and building blocks are designed with interaction in mind to create a vibrant neighborhood. The different functions within the hubs and the design around the blocks are created to combine private and public space (Interviewees 6 and 7). Regarding social safety, the intermediate spaces are designed to encourage interaction and create a vibrant neighborhood. The goal is to create a stable active environment by considering different functions, enabling different streams of people in and out of the neighborhood and through slower modes (Interviewees 6 and 7).

Additionally to creating safe social spaces, also traffic safety is considered in both plans through different instruments. In the Spoorzone, low-speed routes throughout the neighborhood are planned, as well as a separation of flows through pedestrian spaces, light electric vehicles, and bike routes (Interviewee 3, TNO & FABRICations, 2022). Interviewee 3 highlights that bike path arteries are designed to create a safe environment by increasing their width. In literature, the risk of wide streets is mentioned to put pedestrians more at risk (Loukaitou-Sideris, 2006). This is directed towards streets used by cars, however, the impacts of broader bicycle paths might also put pedestrians at risk and must be watched closely.

In general, much traffic is taken away by not allowing motorized delivery vans and changing the logistical structure to the usage of the hubs (Gemeente Zwolle, 2020b; TNO & FABRICations, 2022). The hubs allow smaller vehicles to come in, which brings movements to a more human scale. Moreover, faster speeds are redirected around the neighborhood to parking lots instead or to the different neighborhood hubs (Gemeente Zwolle, 2020b; TNO & FABRICations, 2022). In the Beurskwartier, low-speed zones, and shared spaces are created in which the maximum speed allowed is 30km/h. These shared spaces combine all traffic instead of separating them (Bureau Nieuwe Gracht, 2018; Gemeente Utrecht, 2022). Yet, the Beurskwartier focuses immensely on pedestrians, as much space is exclusively designed around walkability. Spaces in between the building blocks are meant for slower modes, and the car and even the bike are in many spaces only seen as a guest (Bureau Nieuwe Gracht, 2018; Gemeente Utrecht, 2017; urbannext, 2017). This can also add safety for people of different ages, as children and older individuals might have difficulties navigating in a environments with higher speeds. By creating areas of low-speeds and reduced traffic, these spaces can bring safe environements to all age groups. Additionally, to lower the amount of traffic in the neighborhood, especially for logistics, a delivery route and time windows are intended to be set to also reduce the potential conflicts between the modes throughout the day (Bureau Nieuwe Gracht, 2017, 2018). As a result of the changes in the delivery system in both cases, vehicles are expected to stay for shorter periods of time in the neighborhood, leading to fewer vehicles and, therefore, fewer car-related accidents (Interviewees 2, 4, and 7).

On top of that, the lower speeds through cycling and walking are said to increase traffic safety (Lee et al., 2017). Discouraging the car while putting the pedestrian and cyclist first plays a significant role in both plans and is also highlighted in the literature (Lee et al., 2017; Loukaitou-Sideris, 2006). Restrictive measures towards the car are mainly integrated into both plans through a focus on the pedestrian and cyclists and structural changes. This is mainly done through facilitative measures, like integrating a hub system and aiming to change the users' behaviors, but also restrictive measures of which vehicles are allowed on which roads and when. Both of these measures also aim to reduce the volume of cars through the delivery system with hubs. However, it is also essential to note that under the "slower modes", faster speeds are possible,

such as with the e-bike (Interviewee 1). This is because the cycle paths design considers giving them more space to avoid collisions and accidents. However, significantly faster modes, such as e-bikes, can still impact the actual and perceived traffic safety between the different modes and can, therefore, also impose a threat even though the car is banned from specific areas.

The environment can become more vibrant and livable by designing space within the neighborhood as a place to stay rather than just a traffic space. This approach can also promote vibrancy in the built environment by creating lower speeds, more open space, and less space for cars which is focused on in the Spoorzone and the Beurskwartier (Bureau Nieuwe Gracht, 2017, 2018; Gemeente Utrecht, 2022; TNO & FABRICations, 2022).

To conclude, dense urban areas need to maintain high livability. Social spaces can be created by reserving more space for recreation rather than heavy traffic or mono functions. Lower speeds and shared spaces are necessary to generate a common space for everyone and absorb logistical flows into the environment. This way, the neighborhood can foster integrated spaces that highlight safety, multifunctionality, and social relations.

5. Conclusion

5.1. Answering the research questions

In this section, the three sub-questions will be answered with the help of the literature and the results presented in Chapter 4. Ultimately, the answers to these sub-questions will answer the main research question.

1. How can multifunctional neighborhood hubs focusing on last-mile urban logistics be conceptualized and linked to livability?

The concept of neighborhood hubs in the literature is seen as a solution for the last mile delivery while restructuring the package delivery system in neighborhoods. Despite the focus on logistics within neighborhood hubs, also the integration of social and economic functions that can benefit the neighborhood can be therefore emphasized. Therefore, a neighborhood hubs can provide additional services and facilities that are vital to the livability of the neighborhood. By integrating different facilities and service also other aspects within livability can be strengthened such as the environment residents live in, which can also contribute to safety and increased social interactions. In conclusion, neighborhood hubs are about more than just providing logistics but they can also become an vital place in a neighborhood that can impact the livability of residents.

2. What kind of last-mile solutions can be found in the study areas of Utrecht and Zwolle and to what extent is a consistent terminology and framework on delivery hubs crucial?

In Zwolle and Utrecht, innovative approaches are being taken to improve last-mile logistics in their neighborhoods. In Zwolle, four neighborhood hubs and several micro hubs are integrated into the neighborhood. The neighborhood hubs have space for unloading and loading, as well as for living, working, parking, and package pick-up. The delivery network is dedicated to light electric vehicles through LEV routes as a coherent network, and spaces are designed to prioritize pedestrians and cyclists.

In Utrecht, two district service points and approximately 10 block service points are located within 10 building blocks. The neighborhood hubs are combined with parking at a distance, while the micro hubs in each building block are combined with multiple functions such as bike storage and waste disposal. There is space for loading and unloading within the building block, and innovative logistical routes are designed to reach each building block from one side while keeping the other side free of motorized traffic. The streets are shared spaces with a speed limit of 30 km/h.

In both cases, similarly working hubs are considered, yet the terminology differs between them. The inconsistent terminology can make it difficult to identify the logistical functionalities a hub like these have. Additionally, the terminology that is chosen might also limit the possibilities there are for the hubs depending on the facilities and services that are offered. Because of this, it is important that a clear definition is given when describing the different hubs to distinguish what exactly can be expected from their operation, management and functionalities.

3. What are the differences in the operational and logistical management of package deliveries in the study areas of Utrecht and Zwolle and how do these differences impact the movement flows and collaboration between stakeholders?

In the cities of Zwolle and Utrecht, there are innovative approaches to reducing the pressure on the delivery system by using hubs as delivery points instead of home deliveries. In Zwolle, there is an interplay between neighborhood hubs and micro hubs. The neighborhood hubs act as a filter for micro hubs, with all deliveries coming into the neighborhood hub and either being consolidated onto light electric vehicles to be brought to micro hubs or stored for direct pick-up. This approach helps reduce the number of vehicles on the streets and makes the delivery process more efficient.

In Utrecht, district service points are used to which packages can be delivered to get loaded onto e-vans or other non-motorized vehicles to get delivered. Alternatively, the classified vehicles can come

directly into the neighborhood to use the reserved (un-)loading spaces within the building block to deliver their goods. This approach helps reduce the number of delivery vehicles on the streets and promotes the use of more sustainable modes of transportation.

However, both hubs operate differently than the concepts that the literature suggests. A larger focus in both cases focus on the discouragement of home deliveries through micro hubs, as well as the consideration of consolidation on site in the case on the Spoorzone in Zwolle. By reducing the home deliveries and using hubs as delivery points, the pressure within the delivery system can be taken off. Additionally, both cases have two hub systems that operate intertwined for a smoother delivery system, whereas literature implies a rather separate way of working (Janjevic & Ndiaye, 2014; Patier & Toilier, 2018). Lastly, because of the scale that these hubs operate, many different stakeholder are involved in running such a logistical hub. For this to work accordingly, stakeholders involved need to collaborate and carefully managed to integrate all interest groups in the operation.

4. To what extent do the hubs impact the spatial environment and the neighborhood's livability?

The integration of hubs and re-structuring logistical flows puts importance towards the traffic system in place. In both cases a focus is on non-motorized traffic, and a coherent network for slow modes within the neighborhoods that aims to reduce the number of delivery vehicles on the streets and promote the use of more sustainable modes of transportation. Additionally, restrictive and facilitative measures for traffic safety are applied to create a higher actual and perceived safety by users. This actual and perceived safety can also be applied to social safety, which can be increased through creating recreational spaces instead of traffic spaces. By bring residents out of their homes to pick up packages at nearby locations, generating more activity on the streets, especially when the hubs are integrated with other functions and services that are useful to the residents. A multifunctional hub and mixed-use environment does not only mix people, but it also provides opportunities on close distances.

In conclusion, the integration of hubs and re-structuring logistical flows with a focus on sustainable and non-motorized traffic, traffic safety measures, and the creation of recreational spaces can lead to increased actual and perceived safety for users while promoting more sustainable modes of transportation. The creation of multifunctional hubs that offer a variety of services and amenities can also generate more activity on the streets and bring residents out of their homes, creating opportunities for social interaction and community engagement. Yet it is not achieved solely by the integration of hubs. Equally important are the spatial design of the traffic and recreational space as well as the inclusion of other functions. Ultimately, all these efforts can contribute to a more livable and sustainable urban environment that benefits both residents and businesses.

Main research question: To what extent can the logistical restructuring of the last mile through hubs integrate logistics and increase livability in neighborhoods?

Integrating logistical flows into a neighborhood requires a restructuring of the current system. The segregation of logistical flows and giving them attention can provide opportunities to find integrated solutions that contribute positively to the environment. Instead of leaving logistics on the streets, integrating logistics through hubs into buildings can lead to rethinking the logistics and traffic space.

Hubs not only facilitate the delivery process but can also provide logistical services and social and economic functions that are of great importance over short distances. In addition, by increasing services and amenities, there can be an increased activity of people, which can create opportunities for more social interactions and increase safety through a constant flow of people. As a result, integrating logistics into the flows of movement in a neighborhood and making it more human scale can trigger many positive outcomes that are not directly linked to logistics but much to increasing the livability of people: logistical vehicles spend less time in the streets and less logistical vehicles on the roads, focus on slower modes and reclaiming space for pedestrians.

As space is scarce, integrated solutions that occupy the same space are necessary. Logistics should not be seen as separate or a nuisance to a livable environment. Integrating logistics does not have to be done in

a way that space needs to be sacrificed. Instead, logistics can be combined with many different functions to utilize space within neighborhoods more efficiently. Therefore, integrating logistical flows in a neighborhood requires a holistic approach that considers the needs of the environment and people, which the hub concept considers and can be built upon depending on the neighborhood context. Additionally, by integrating different logistics sectors next to package delivery, such as waste management, grocery delivery or service logistics into the hub system and combining them with other social and economic functions, it is possible to create a space that is efficient and enhances the residents' quality of life.

5.2. Theoretical reflection and contributions to literature

The study focuses on integrating logistical hubs into neighborhoods and their impact on livability. Especially in literature, logistical hubs mainly focus on package delivery, which contradicts the plans for the Spoorzone and Beurskwartier, which look at package delivery as one of the logistical topics. However, it is seen as one of many. Additionally, much attention is given to the operationalization and details of package delivery within the literature. Less focus is on the overall integration of the hubs in the spatial environment, which this research intends to highlight.

In terms of the concept of livability, much literature is out there that can also be seen as very diverse. Yet, few connections were made to the impact of hubs on livability, making it difficult to select themes of livability that were relevant to this research topic. One topic that has been highlighted by literature but has yet to be highlighted in the documents or interviews is people's life courses. It seems to be an important aspect of creating livable places. Meanwhile, within the Spoorzone and the Beurskwartier, the target group identified for these places is the specific group of young urban professionals with little attention to other age groups.

This research also shows that the impact on livability can be positive or negative depending on how the flows are restructured and the integration of hubs is executed. The placement of hubs is crucial and dependent on the overall system that is considered. Slow modes of transportation should be prioritized to impact livability positively. With that starting point and the awareness of integrating logistics on a more human scale with services, amenities, and necessary functions close by can contribute positively to restructuring flows.

Another important finding is the difference of terminology used between the two cases studied, but also the difference within the literature. The use of terms varies largely in theory and practice, which makes it difficult to find comparable plans, that are using the concept of logistical hubs. The many different names, and also a lack of explanation of the concepts make it additionally difficult to find these concepts in literature.

In summary, the study contributes to understanding the integration of logistical hubs into neighborhoods and their impact on livability. It emphasizes considering multiple logistical topics and other functions besides package delivery. It also highlights the importance of slow modes of transportation and rethinking logistics to make neighborhoods more human-scale with services and amenities close by. Finally, the literature suggests that within the concept of livability, people's life course plays a significant role, which suggests that it should not be disregarded planning process even if a focus lies on a specific target group.

5.3. Methodological reflection

For this comparative case study, the cases of the Spoorzone and Beurskwartier were chosen based on their advanced consideration of integrating hubs for their logistical flows. For both of the plans of these cases, much attention has been directed at integrating logistical flows as one of the critical aspects, which needs to be improved in many spatial planning and environmental visions (Omgevingsvisie). This narrowed down the selection of potential cases. Additionally, many plans still need to be implemented, which is also the case for the Spoorzone and Beurskwartier. This also reflects in the number of policy documents available. While visions and strategies of both cities are available, little information is given on the logistical side, which limits the usable policy documents to 2-3 documents per case.

Furthermore, the plans that are made are design explorations and are still to be adjusted and implemented in the near future. Therefore, making definite statements about these developments is difficult, as they still need to prove their effects. Yet, the importance of integrating logistics can be highlighted. Moreover, it is difficult to generalize the two cases as both work in similar spatial areas but are still different in many areas, such as demographics and other context-driven factors.

Generally, the data collection went accordingly. The interviewees' choices were based on the connection to the plans to provide in-depth information on especially the socio-spatial side, which the plans have only given limited insights into. The semi-structured interviews gave enough room for the interview to be structured enough to be able to compare the interviews, yet also gave room to adapt to the knowledge of the interviewee. In total, seven interviews were collected, and it was noticed that besides gaining new information on the plans in every interview, the last interviewees gave a repetition of motives on the hubs and the socio-spatial impact. This hints at data saturation, which was also the motivation to not search for further experts on the topic. Yet, additional information from other stakeholders to expand further on the expert knowledge could have been part of this research. Specifically professionals from logistics and delivery companies could have been a good addition to also gain an insight from their perspective on the plans to implement such hub system. This could have added an additional perspective to the view of experts from the municipalities, to give especially a broader view on the collaboration and stakeholder involvement.

5.4. Recommendations for further research

The first suggestion for further research is to look into the feasibility of integrating a hub system and restructuring logistical flows in existing neighborhoods in different contexts. As the context presented in this research is along good transport nodes and in an urban environment, research can look at different contexts, such as urban and rural neighborhoods, as well as car-dependent areas or dense city centers. This can give insights into the viability in different spatial contexts, but also into the different spatial needs and organizations that come with such considerations. Additionally, also the impact on livability can give insights into the different needs and wants of residents in different spatial contexts.

Secondly, also the surrounding areas after an implementation of such a hub system are important to study. Especially the impacts that such a system has on a certain area compared to the surroundings that do not operate with hubs can be from interest to draw comparisons. For that it is also interesting to look at the other structures that are implemented in the neighborhoods that re-structure flows and what impacts there are to the other neighborhoods such as the impacts of a car-low neighborhood, strengthening of walkability and the provision of services.

Thirdly, research can expand on the integration of different logistical sectors within the hubs, their operation, and their impact on the logistical flows within neighborhoods. This research took the primary stance on hubs from the package delivery points. However, many other logistical flows are present in daily vehicle movements, which must also be integrated and considered for an overall system to function properly.

Lastly, when looking at the multiple logistical sectors, many empty vehicle movements are happening after unloading. Within that field, there might be possibilities to create more circular systems in which empty trucks of one logistical sector can also take care of the retour logistics of another sector. For this, more research needs to be on the logistical movements and also the potential for collaborations to create more sustainable transport systems.

5.5. Implications for planning practice

This thesis has identified insights into re-structuring logistical flows in neighborhoods to increase livability. This research provides an overview for municipalities and other planning and design experts with an understanding of hubs and what more to implement to create social spaces that can contribute to the quality of life of residents and visitors. By diving deeper into the innovative plans of Utrecht and Zwolle, recommendations can be drawn. It must be kept in mind, however, that re-structuring flows needs to be seen within the context of its environment. Therefore, the findings of this research may not be generalizable

and fitting for every context, but specifically for those with a similar frame of reference, such as an urban area with good public transport nodes and a certain willingness to invest in a non-traditional logistics structure.

A key finding is that integration of various aspects is vital when re-structuring logistics. This integration is also essential within the area, spanning from traffic flows over stakeholder collaboration to social opportunities. For the traffic flows, much depends on the scale at which it is intended to be implemented. With car-low neighborhoods as a goal, the traffic flows of different modes need to be carefully considered, as well as the overall built environment that is present or to be constructed. A design that works for the area but is also integrated into the overall location is essential to not create segregated areas in terms of social relations. Overall for this to work also the parties involved need to collaborate. Stakeholder management for hubs is crucial because of all the different aspects and parties involved.

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7. Appendix

Consent form interview

Research project: Master thesis Society, Sustainability and Planning
University: University of Groningen, Faculty of Spatial Sciences
Researcher: Tabea Rademacher

Dear participant,

First of all, I want to thank you for taking the time to participate in this research project. The aim of this research thesis is to gain insight into how restructuring last-mile logistics in neighborhoods can influence livability and how neighborhood hubs can integrate logistics into a neighborhood. It will focus on the creating more livable places by embedding logistics into a neighborhood. In this way, I want to inform you about the course of your participation.

The interview will be approximately 60 minutes, depending on length of answers and any new questions that may arise. In addition, this interview will be conducted online. Also, the interview will be recorded and transcribed to analyze it and answer the research question for this research project. In addition, you will have the opportunity to receive the transcript to check for factual inaccuracies.

For further comments and questions, please contact:

Tabea Rademacher
[redacted]

I hereby declare that (highlight the of you selected answer):

I am willing to participate in this research project on a completely voluntary basis.	Yes	No
The results of this interview may be processed in the research project.	Yes	No
Grant permission to have the interview recorded by pre-recording software for processing purposes.	Yes	No
Grant permission to use my name in the research project.* *If one interviewee responds no, all interviews will be using pseudonyms.	Yes	No
When No: A pseudonym can be used (example: respondent 1)	Yes	No

Name of participant:

E-mail (*to receive transcript)*:

Date:

Signature:

Interview Guide – Spoorzone, Zwolle

(Introduction)
My research focuses on urban logistics and its flows within cities and especially surrounding the topic of neighborhood hubs and livability in Utrecht and Zwolle. These subjects have gained interest in recent development plans for districts in both cities. The interviewees are experts and professionals who have worked on the policy documents both from different companies and municipalities. And today I want to gain more insight into the plans, their design and the underlying reasons.

Before we start I wanted to ask you a few things.

Participation
- Participating in my research is voluntary and you can stop at any time without any reason.

Privacy
- After the interview your name will by anonymized.
- Throughout the thesis this anonymized data will be used, that means that your name will not be mentioned, but references to company or job can be made.
- The transcript and data will be shared with my supervisor.
- The recordings and transcripts will only be stored for 4 months.

Are you agreeing to this information?
Do you have any additional questions?

Questions

Theme	**Question**	**Probing Question**	**Link to theoretical framework**	**References**
Introduction of interviewee	What is your function within the municipality/company you work for?	Can you tell me a bit more about it?	Getting to know the interviewee and their role within the municipality or company.	
Introductory questions	What is the overarching goal of the Spoorzone development?	How would you describe the Spoorzone as it is currently?		
Logistical flows	One of the development themes are the logistical flows of package deliveries. What is the main logistical structure that is being developed and implemented? What is your motivation to integrate logistics into the urban landscape?	How much of the design is centered around accommodating logistical flows?	Operation of Neighborhood hubs	(TNO & FABRICations, 2022)
	You have described the main structure of the logistics. How does the package delivery process play out within the Spoorzone if you would have to describe it?	How did you ensure to make space in the design for unloading, reloading, charging infrastructure and parking spaces for the LEV vehicles?	Logistical accessibility and operation	
	How much of the design is centered around accommodating logistical flows?	Where do you see the future of existing pick-up points? How do they fit into the picture of the neighborhood hubs?	Logistical accessibility and operation	

	Within the report, you mention the neighborhood hubs and micro hubs that can act as package delivery points. How do you expect the service points on neighborhood level hubs to work with different logistical carriers?	Have you consulted with the different logistical carriers? What is their view on the hub development?	Operation & Collaboration	(TNO & FABRICations, 2022)
Livability	How is the Spoorzone made accessible for residents in terms of mobility but also other social opportunities?		Accessibility	
	In what respect do the neighborhood hubs and not just the neighborhood offer multifunctionality?	Are there plans for the hubs to include other amenities and services next to being a pick-up point? If yes, are there already concrete ideas for each hub?	Accessibility & multifunctionality	
	The plans also mention a focus bringing logistics to a more human scale. How do you want to achieve that through the design?	Is there an encouragement for social infrastructure? Which ideas are there?	Vibrancy	(TNO & FABRICations, 2022)
	Earlier I asked about how much of the design is concentrated around logistical flows. How much of the design is designed around the quality of life?		Livability	
	Which elements in the design can make the Spoorzone vibrant and also safe for visitors?	Why have you chosen those elements? How does integrating logistics play a role for this?	Vibrancy and Safety	
	What would make residents and visitors want to stay in the Spoorzone?			
	Would you say that the development is targeting a specific group or demographic or is the goal to have a mix of social statuses and ages?	How much thought went into the recognition of different age groups within the design that covers the package and delivery logistics?	Age-dependency	
	In which ways is slow traffic being encouraged and fast traffic discouraged?	Because of which reasons have you chosen for a design like this?	Safety, Walkability	
Policy	Overall, how important would you consider the integration of logistical flows into new or re-developments?			
	What difficulties towards the other companies parties involved did you face by giving a larger focus to logistics within this plan?			

	What difficulties did you face within your organization by giving focus to logistics but also to the livability aspect simultaneously?	Where there any difficulties with expert knowledge such as a lack of knowledge on this topic or a lack of capacity of staff?		
	What do you see as the biggest challenge within urban planning, livability and logistical flows in the upcoming years?			

Thank you for your contribution to my research. Is there anything else that I have not brought up yet you would still like to mention? My thesis will be completed around March. If you are interested in receiving it, I am more than happy to share it with you.

Interview Guide – Beurskwartier, Utrecht

(Introduction)

My research focuses on urban logistics and its flows within cities and especially surrounding the topic of neighborhood hubs and livability in Utrecht and Zwolle. These subjects have gained interest in recent development plans for districts in both cities. The interviewees are experts and professionals who have worked on the policy documents both from different companies and municipalities. And today I want to gain more insight into the plans, their design and the underlying reasons.

Before we start I wanted to ask you a few things.

Participation

- Participating in my research is voluntary and you can stop at any time without any reason.

Privacy

- After the interview your name will by anonymized.
- Throughout the thesis this anonymized data will be used, that means that your name will not be mentioned, but references to company or job can be made.
- The transcript and data will be shared with my supervisor.
- The recordings and transcripts will only be stored for 4 months.

Are you agreeing to this information?
Do you have any additional questions?

Questions

Theme	**Question**	**Probing Question**	**Link to theoretical framework**	**References**
Introduction of interviewee	What is your function within the municipality/company you work for?	Can you tell me a bit more about it?	Getting to know the interviewee and their role within the municipality or company.	
Introductory questions	What is the overarching goal of the Beurskwartier development?			
Logistical flows	One of the development themes are the logistical flows. What is your motivation to integrate logistics into the urban landscape?	How much of the design is centered around accommodating logistical flows?	Operation of Neighborhood hubs	(Bureau Nieuwe Gracht, 2018)
	You have described the main structure of the logistics. How does the delivery process play out within the Beurskwartier with the hubs and the routes?	How did you ensure to make space in the design for unloading, reloading, charging infrastructure and parking spaces for the logistical light electric vehicles?	Logistical accessibility and operation	
		Where do you see the future of existing pick-up points? How do they fit into the picture of the neighborhood hubs?	Logistical accessibility and operation	
	Within the report, an example day is given on when which delivery takes place. How do you expect the service points on neighborhood level hubs	Have you consulted with the different logistical carriers? What is their view on the hub development?	Operation & Collaboration	(Bureau Nieuwe Gracht, 2018)

	to work with different logistical carriers?	The plans suggest that logistical carriers can deliver via the hubs or directly into the neighborhood. How do you want to ensure that deliverers actually make use of the hub? Private vehicles are discouraged from entering the neighborhood. But logistical vehicles can go in. Acoording to the deliveries example would then the roads within the neighborhood not serve some kind of monofunction?		
Livability	How is the Beurskwartier made accessible for residents in terms of mobility but also other social opportunities?		Accessibility	
	In what respect do the neighborhood hubs and not just the neighborhood offer multifunctionality?	Are there plans for the hubs to include other amenities and services next to being a pick-up point? If yes, are there already concrete ideas for each hub?	Accessibility & multifunctionality	
	The plans also mention a focus on interrelationships between residents. How do you want to achieve that through the design?	Is there an encouragement for social infrastructure? Which ideas are there?	Vibrancy	(Bureau Nieuwe Gracht, 2018)
	Earlier I asked about how much of the design is concentrated around logistical flows. How much of the design is designed around the quality of life?		Livability	
	Which elements in the design can make the Beurskwartier vibrant and also safe for visitors?	Why have you chosen those elements? What would make residents and visitors want to stay in the Beurskwartier? How do you expect the design to impact the livability?	Vibrancy and Safety	
	In which ways is slow traffic being encouraged and fast traffic discouraged?	Because of which reasons have you chosen for a design like this?	Safety	
	What would make residents and visitors want to stay in the Beurskwartier?			
	Where do you see the ageing population in this	How much thought went into the recognition of different age groups within the design	Age-dependency	

	neighborhood hub development?	that covers the package and delivery logistics?		
Policy	Overall, how important would you consider the integration of logistical flows into new or re-developments?			
	What difficulties towards the other companies parties involved did you face by giving a larger focus to logistics within this plan?			
	What difficulties did you face within your organization by giving focus to logistics but also to the livability aspect simultaneously?	Where there any difficulties with expert knowledge such as a lack of knowledge on this topic or a lack of capacity of staff?		
	What do you see as the biggest challenge within urban planning, livability and logistical flows in the upcoming years?			

Thank you for your contribution to my research. Is there anything else that I have not brought up yet you would still like to mention? My thesis will be completed around March. If you are interested in receiving it, I am more than happy to share it with you.

Code frequencies – Document analysis

Concept	Objectives	Themes	Frequency
Livability	Socio-spatial opportunities	Vibrant	3
		Safety	6
		Walkability	4
		Services and Amenities	1
	Age-dependency		0
Neighborhood Hub	Design	Infrastructure	8
		Spatial integration	8
		Implementation (Inductive)	3
	Accessibility	Multifunctionality	13
		Location	9
	Logistical flows	Operation	21
		Management	0
		Collaboration	2
		Network	6
		Zero-emission fleet	11
		Delivery	20

Code frequencies – Interviews