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Bridging the logistics divide with service inclusion for socially sustainable urban logistics services

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Abstract

The rise of e-commerce over the last decade has increased the pressure on urban logistics and highlighted important sustainability challenges. The COVID-19 pandemic exacerbated this trend and underscored the need to address social sustainability challenges with e-commerce. In particular, the pandemic drew attention to the uneven access to home deliveries and the importance of having a logistic system that is aligned with the principles underlying society and sustainable development goals. The purpose of this paper is to identify urban logistics services that emerged in response to access limitations linked to the COVID-19 pandemic, and to analyse how these services can enhance inclusivity and fair access to goods. We adopt an exploratory and qualitative research design based on a deductive content analysis approach. This method aims to systematize, objectively analyse, and draw assumptions from secondary evidence and semi-structured interviews with key actors. We identified several urban logistics innovations that spanned organizational, transportation modal shift, informational and technological approaches to face existing restrictions. The findings indicate a deficiency in inclusivity and equitable access to logistics innovations, prompting ad-hoc organization by citizens and private initiatives in response to the extraordinary circumstances of the pandemic. We introduced the concept of logistics divide to analyse the inequalities on who benefits from logistics innovations. This divide is a consequence of the uneven ability of different consumer segments to get access to those services either due to digital mastery, geographical barriers, legal barriers, or to economic reasons. The findings also showed that urban logistics actors have started to innovate to increase access to goods after the pandemic disclosed this logistics divide. In essence, this paper shows the importance of integrating transport and logistics research with transformative service research to decrease the logistics divide and achieve more equitable urban logistics.

1 Introduction

The last decade has seen an increase in innovations in urban logistics that take advantage of digitalization, new vehicle technologies and economies of agglomeration in cities. Online home delivery services (OHDS) resulting from e-commerce activities relate to a large part of these innovations. E-commerce sales amounted to USD 4.2 trillion worldwide and USD 394 billion in Europe in 2020 (Statista, 2021) accompanied with a significant surge due to Covid-19 pandemic. In Europe, a change in the consumer composition was observed during 2020 where different segments of the population such as the older consumer groups started using e-commerce for the first time (Postnord, 2021).

While e-commerce has been growing and crossing different borders, by reaching more people and areas, the appealed markets remain to be composed of young, active consumers with high social status and who are living in urban or sub-urban areas (Eurostat, 2020; Postnord, 2020; Roos et al., 2019). While the wealthiest urban populations take advantage of urban logistics services' benefits (Strale, 2019) the situation indicates that the elderly, the people from less advantaged parts of society or people who are geographically segregated are marginalized by lack of access to e-commerce markets, particularly through online home delivery services (OHDS). The pandemic has exacerbated the situation by expanding these marginalized segments of the population to people with chronic diseases or people who are sick (Figliozzi and Unnikrishnan, 2021; Sanchez-Diaz et al., 2021).

Innovations within the scope of urban logistics services are driven mainly by business logic where the priority of the companies is profitability which is determined by either location or density (Hesse, 2002; Cardenas et al., 2017). On the other hand, the rise in the number of freight vehicles travelling in urban areas due to increased e-commerce deliveries create significant congestion and emissions (Song et al., 2011; Liu et al., 2019). Therefore, a second important focus in urban logistics innovations concentrates on achieving enhanced environmental sustainability (Muñuzuri et al., 2005; Patier and Browne, 2010). However, despite the attention that is given to urban logistics innovations from these perspectives by both research and practice, the social aspect of sustainability remains overlooked (Hyard, 2013; Karjalainen & Juhola, 2021; Martins et al., 2023), particularly from a freight transport equity and justice lens (Fried et al., 2024).

From a consumer perspective, one of the main functions of e-commerce is providing home-based access to goods and services (Borenstein and Saloner, 2001; Rust and Lemon, 2001). Urban logistics services fulfill this function. Similar with traditional transportation services (Yago, 1983), urban logistics services have a societal role in making goods, services and inclusion opportunities available to people in an equitable way. Transportation justice literature defines the social benefits of transportation with equitable accessibility opportunities to all population segments and particularly to the worst-off (Pereira et al., 2017), a question which is widely studied in people's mobility literature but significantly neglected by urban logistics literature (Fried et al., 2024). When there are discrepancies between different segments of society in receiving urban logistics services, inequalities which hinder social sustainability emerge.

Building upon this discussion and inspired from the digital divide concept (Jurich, 2000) that asks, "Who is benefiting from the ICT revolution?", we define the gap between urban logistics service provision and the access by different population segments to this service the logistics divide and ask, "Who is benefiting from logistics innovations?" We explore the answer to this question at a time when major accessibility and vulnerability issues emerged during Covid-19 pandemic. Verhoef et al (2023), recently, present a detailed analysis of how Covid-19 has changed the competitive landscape of retailing. Context specific examples from different cities around the world provided similar insights about urban freight distribution's role in providing access to essential goods during the pandemic lockdowns (Beckers et al., 2021; Castillo et al., 2022; Guo et al., 2021). Our purpose in this paper is to extend this discussion and expand the understanding on urban logistics services from a social sustainability perspective with evidence from Covid-19 crisis. Two research questions were developed to operationalize the purpose: (1) What urban logistics

services and solutions focusing on last-mile delivery emerged in response to Covid-19? (2) How can socially sustainable urban logistics services be leveraged to achieve better inclusivity under circumstances such as Covid-19?

Our contribution to the literature is twofold. First, we discuss the social aspect of sustainability within urban logistics context by introducing a new concept called the logistics divide. Our results show that the societal gaps that are created by the logistics divide in a time of crisis are filled by new and different actors. The second contribution builds on service inclusion concept from service literature where we discuss how urban logistics service providers should use social sustainability concept to design more inclusive services for vulnerable segments of the society. These contributions extend our findings to a broader context than solely Covid-19 crisis and link transport and logistics research with the transformative service research agenda (Anderson & Ostrom, 2015; Rosenbaum, 2015). Considering the change in consumer composition for e-commerce in Europe, this will be a relevant research area for the further development of sustainable urban logistics services. Furthermore, our contributions also relate to UNSDG 10, Reducing Inequalities, particularly through the emphasis on service inclusion in urban logistics.

The rest of the paper is structured as follows. First, we configure concepts from three different research streams, namely urban logistics innovations, socially sustainable logistics services and service inclusion, to build our analytical framework. Then we explain our research design that is based on an analysis of both secondary and primary data that was collected during the first wave of the pandemic. We report our results based on our analytical framework and discuss how social sustainability can be leveraged to achieve inclusivity in urban logistics services. We conclude with implications for practice and research.

2 Frame of reference

2.1 *Urban logistics innovations:*

Despite discussions about the introduction of new technology and its impact on contemporary supply chains (Grawe, 2009), innovation has been a neglected concept by logistics literature until the beginning of 2000s (Flint et al., 2005). Trends such as accelerating competitive pressure due to globalization, deregulation of logistics industries and extension towards more sophisticated services by logistics service providers (LSPs) (Busse and Wallenburg, 2011) increased the need for logistics innovation. Similarly, e-commerce and e-business technologies have driven significant changes within supply chains such as alternative ways of doing business, enhanced visibility and changes to delivery channels, with new intermediaries (Allen & Browne, 2010; Dablanc et al., 2018; Taniguchi & Thompson, 2018).

Logistics innovation is service-centric by definition. Any logistics-related service that is perceived as new and helpful, whether by an internal audience (the logistics organization) or an external audience (customers) is called logistics innovation (Flint et al., 2005). Urban logistics services that support the effective distribution of e-commerce purchases are among these new services where innovative solutions are continuously being introduced. Due to the context that these services provided, namely populated and congested urban zones, a majority of these innovative solutions address the social and environmental impacts of urban deliveries while still fulfilling economic goals (Crainic, 2008; Strale 2019; Martins et al., 2023).

In an earlier classification, urban logistics initiatives that lead to a new way of providing urban logistics services are divided into three groups: (1) consolidation of goods flows in the city (achieved through new concepts such as consolidation centres or new organisation); (2) use of new non (less) polluting vehicles (e.g. electric powered vehicles); (3) regulation (usually focused on restricting certain types of activity by time of day, size/type of vehicle) (Patier & Browne, 2010). Similar with the broader logistics innovation literature (Hazzen et al., 2011), the new services in the urban logistics setting are largely facilitated by digitalization trends and application of new technological tools (Dablanc et al., 2017). Hence, it can be stated that sustainability and

digitalization are important trends that shape the urban logistics innovation field. Furthermore, they are not mutually exclusive. Digitalization and information technology (IT) can be used to innovate for more sustainable logistics services (Gruchmann and Seuring, 2018).

Hyard (2013) differentiates between technological and non-technological innovations for sustainable transport. By classifying transportation as a service industry and using coexisting operations in freight or passenger transportation, Hyard (2013) proposes four main trajectories for non-technological sustainable transport innovations. Innovation that involves the material function of the transport service refers to physical transport, handling, loading or unloading. Informational innovation refers to treatment of information flows between different transport network actors. Relational innovation refers to direct contacts between multiple customer networks and innovation that results in behavioral changes among transport users. Finally, organizational innovation refers to reorganization or coordination of different transport operations and routines .

Urban logistics services represent a larger set of services that includes transportation. In addition to all activities that are performed to provide home delivery, it is composed of a range of ordering, storage, consolidation, deconsolidation and payment services majority of which are heavily associated with developments in e-commerce. Innovations of such services may include both technological and non-technological components. Therefore, as suggested by Hyard (2013), we combine these two components and divide urban logistics service innovations into four categories. Our aim is not to present an exhaustive list, but to give an overview of different logistics innovations affecting the urban setting to build a framework around different urban logistics innovations (see Table 1 for innovation categories and examples).

Table 1. Categorization of urban logistics innovations

Categories	Innovations (Examples of)
Organisational innovations	Demand management Omni-channel setting Organisational structure
Delivery mode innovations	Crowdshipping On demand/instant delivery Pick up points
Informational innovations	Delivery as a Service (DaaS) Big data
Technological innovations	Electrification, automation, robots Drones Physical internet (PI)

Ait, 2020

Similar with Hyard (2013), organizational innovations involve the methodological/organizational function consisting of organizing collective techniques or knowledge. Freight demand management is an example to organizational innovations where the aim is to influence the demand creator by adjusting the time, destination, frequency and delivery mode to decrease the negative externalities created, enhance environmental justice and quality of life in urban logistics systems (Holguín-Veras et al., 2018). It includes variety of initiatives, including receiver-led consolidation programs, voluntary off-hour delivery programs or spread-out pickup/delivery programs. Omni-channel settings allow retailers to operate parallel in multiple distribution structures by merging the functions and roles of traditional and online retailers (Lim et al., 2018). Structural decisions such as formalization or decentralization has positive impact on logistics innovation capabilities (Daugherty et al., 2011).

Delivery mode innovations refer to non-technological innovations in the distribution methods of online purchases to their final users. Crowdshipping is mostly infrequent deliveries made by private people using the available capacity they have while using their own means of transport (bicycle or private car) (Dablanc et al., 2017). Planned trips to perform such deliveries use the excess

transport capacity owned by the crowd (also called crowdsourced delivery, collaborative logistics, crowd logistics or cargo hitching) (Behrend & Meisel, 2018). Closely related with crowdshipping and advances in mobile information technologies, there are on-demand/instant deliveries that refer to customized and high-speed urban deliveries such as delivery in less than two hours, evening deliveries, same day deliveries (Taniguchi & Thompson, 2018). The diversification of urban delivery options increases rapidly where receivers are highly involved in service co-production (Halldórsson and Wehner, 2020). Several forms of pick-up points (Weltevreden, 2008) are provided as new forms of delivery.

Informational innovations involve the function of treatment of information, such as dealing with codified information and treatment of information flows within and outside the firm, tracing/tracking (Hyard, 2013). Urban logistics solutions that are driven by DaaS are a form of informational innovations. The purpose of such innovations can be listed as: (1) Matching freight operations with mobility activities such as merging parcel pick up with travel to work; (2) Collective use of transport systems using private and public infrastructure in the city; (3) Changing traffic flows related to transport of goods from freight gravity points to decentral UCC (Huschebeck & Leonardi, 2020). Similarly the inclusion and processing of big data that is available on freight vehicles, product packaging or various databases by technological tools such as Radio Frequency Identification (RFID), Global Positioning Systems (GPS) devices or Internet of Things (IoT) (Taniguchi & Thompson, 2018) to make urban logistics service delivery decisions are among informational innovations.

Finally, we include the technological innovations in our classification which refer to using new technology such as autonomous vehicles (Huschebeck & Leonardi, 2020), electric bikes and vehicles (Jaller et al., 2020) or drones (Müller et al., 2019) in urban deliveries. Majority of urban logistics innovations depend on developments in IT. PI was introduced as a new approach to mobility where such developments in IT are combined with intermodal connections and transport infrastructure. Hyperconnected City Logistics (HCL) is a system, that builds on PI where sustainability and efficiency of how physical objects are supplied, transported, stored, realized, and used in urban settings is achieved via collaboration and sharing of resources between multiple transport actors (Crainic et al., 2020).

Logistics innovations can advance relationships with customers, create competitive advantage, increase customer loyalty, and make market activities more efficient (Daugherty et al., 2011). The majority of urban logistics innovations also aim to enhance environmental sustainability in cities (Browne et al., 2012). However, how to use these innovations to achieve better social sustainability is yet to be explored.

The so-called logistics revolution (Bonacich and Wilson, 2008), marked with technological developments, enhanced productivity, hyper-connectivity triggers the question: "who are the winners and losers of the introduction of these new urban logistics services and policies?" (Strale, 2019). Chua et al (2018: 624) criticize the portrayal of freight mobility as "apolitical science of circulation" while they claim that practitioners of logistics services view themselves as "problem solvers using technology to serve a common good", but how common the good is, or, in other words, how equitable the provision of this service is still a question mark. Leveraging socially responsible logistics becomes a crucial action to achieve equitable access to urban freight by disadvantaged or marginalized individuals (Figliozzi and Unnikrishnan, 2021). Hence, to build a holistic sustainability perspective around urban logistics innovations, socially sustainable logistics needs to be discussed in combination with a service inclusion perspective. After all, inclusion and equity are crucial requirements for sustainable development (UNDP, 2011).

2.2 *Socially sustainable logistics:*

Logistics companies need to set and meet social and societal objectives to achieve social sustainability (Grant et al., 2017; Björklund, 2010) while assigning more importance to issues such as ethical conduct, community involvement, and gender equality (Murphy & Poist, 2002). Although most of the socially sustainable logistics literature addresses the competitive advantage

of such strategies from an economic perspective (Uyar et al., 2020; Macharis et al., 2014; Piecyk & Björklund 2015), it is also important to consider business performance from all three dimensions of sustainability. For better results regarding the social dimensions, logistics companies need to include societal objectives at all stages of their service provision processes. Responsible transport and empowering the individual for this cause has become an important goal particularly after the pandemic (Budd & Ison, 2020).

Social responsibility issues in logistics are addressed in four major ways, namely (1) following national or international legislation, operating, monitoring and auditing through codes of conduct, (2) focusing on employee well-being, training, education, health and development, (3) engagement with neighboring communities, corporate social responsibility campaigns and citizen involvement and (4) ethical and inclusive behavior towards customers (Martins et al., 2023; Murphy and Poist, 2002). Coordinating the objectives and activities of multi-scale, multi-actor logistics networks is a challenge in achieving logistics social responsibility (Carter & Jennings, 2002). LSPs and their social sustainability strategies have a crucial role to tackle with this challenge (Gruchmann et al., 2018) as they connect the multiple organizations in supply and distribution networks (Piecyk & Björklund, 2015).

Table 2. Socially sustainable logistics indicators

Social sustainability indicator	Murphy & Poist (2002) Carter & Jennings (2002)	Björklund (2010) (from GRI)	Piecyk & Björklund (2015)	UNSDGs
Diversity	X	X	X	
Ethics	X	X	X	
Working conditions and human rights	X	X	X	
Health & safety	X	X	X	
Philanthropy	X		X	
Community involvement	X	X	X	
Academic involvement			X	
Humanitarian logistics			X	
Reduce inequalities				X

Sustainable logistics literature is heavily dominated by environmental issues where social issues are widely neglected (Uyar et al., 2020). Strale (2019) highlights the heavy dominance of technical approach in, particularly, urban logistics literature as a cause of ignorance towards social and societal issues in this field. Table 2 provides a review of socially sustainable logistics indicators that are used by logistics companies to perform and communicate their social responsibility actions. In an early effort to incorporate General Reporting Initiative's (GRI) social sustainability indicators to logistics, Björklund (2010) lists four categories: (1) labour practices and decent work such as employment, labour/management relations, occupational health and safety, training and education, diversity and equal opportunities; (2) human rights such as investment and procurement practices, non-discrimination, freedom of association and collective bargaining, child labour, forced and compulsory labour; (3) society such as community, corruption, public policy, compliance; (4) product responsibility such as customer health and safety, products and service labelling, marketing communication, compliance. An analysis of CSR reports published by LSPs added humanitarian logistics and academic involvement to existing GRI indicators while stating that a consensus on social sustainability understanding in logistics industry was yet to be achieved (Piecyk & Björklund, 2015). We add one more indicator to this list to link UNSDG 10-Reducing inequalities to emphasize the equitable access requirement of logistics service provision. Such indicators enable practitioners of logistics assess their services ability to fulfill social sustainability goals while they also enable the receivers of the service or policy makers to assess the ability of the provided logistics services to acknowledge and address social and societal issues.

2.3 *Social exclusion and service inclusion in logistics*

The prevention of people from participating in economic, political and social life because of reduced accessibility to available social networks, facilities, goods and services due to poor transportation causes social exclusion in societies (Kenyon et al., 2002). Lucas (2012) relates social exclusion with transport inaccessibility by discussing the intersection between transport disadvantage caused by lack of infrastructure, security, finances or information and social disadvantage caused by lack of education, health, income or jobs. Bocarejo and Oviedo (2012) define social exclusion due to mobility as the process where an inexistence or insufficiency of proper means to move hinders individuals to participate in the political, economic and social life of the society which leads to a reduced accessibility to opportunities. Although the vast transport accessibility literature analyses the concept from a people's mobility perspective (e.g. van Wee & Geurs, 2011; van Wee et al., 2001; Bocarejo & Oviedo, 2012; Geurs & van Eck, 2001), an alternative standpoint that reflects on accessibility to freight mobility (Gonzalez-Feliu & Mercier, 2013), particularly equitable access to urban freight is highly required (Wang et al., 2023; Fried et al., 2024).

Reversed mobilities are introduced as a means to tackle the social exclusion problem of those population segments with hindered mobilities due to physical conditions (Cholat and Daconto, 2021), but they are not limited to such segments. Home-based access reverses the traditional access concept of individuals to locations, products or services to the ability of essential products and services being delivered at home and equally to all segments of the population (Figliozzi and Unnikrishnan, 2021). Considering this indirect accessibility perspective in OHDS or urban logistics service design in general, is an example of inclusive service design and a method to eliminate social exclusion for disadvantaged population segments. We agree with Farrington and Farrington (2005) in that, instead of providing wider passenger transportation services solely, policies in different sectors need to converge to achieve equal accessibility, whether it is people-based or goods-based. Leveraging the developments in IT, e-commerce and urban logistics, we argue that accessibility discussions should also be extended to inclusive design and delivery of urban logistics services.

Service inclusion refers to provision of fair access to a service, fair treatment during a service, fair opportunity to exit a service and equal level of value from a service for all customers in a market exchange (Fisk et al., 2018). When users interact with service providers, they could lack appropriate resources, knowledge and social network, worsening difficulties and causing discrimination that may result in stressful, unproductive and damaging service encounters (Fisk et al., 2018). These are described as negative well-being impacts of service provision which may occur due to the lack of desire the consumer has to be in a situation to receive the service, the ill-being or chronic nature of the consumer's status, prejudices, power dynamics, trade-off choices concerning service design that might stress and/or marginalize certain consumer segments (Anderson & Ostrom, 2015). Rosenbaum et al (2017) define them as vulnerable consumers.

In a global review of public service inclusion to achieve SDG 10, Mir et al. (2020) address three levels of drivers that lead to social exclusion of minorities and disadvantaged groups in societies. Macro-level refers to the structural inequities, racism, power imbalances and disadvantaged competition for resources in society at a sociopolitical level. At the meso level, there are institutional practices that fail to recognize the needs of such groups and, when combined with barriers to service provision, these result in inequalities in service outcomes. At the micro-level these two higher levels are both associated with and reinforced by individuals' lower system understanding, fear or mistrust of services providers and lower levels of capacity, literacy, social capital. The interplay between the three levels acts like a vicious cycle where the conditions at one level both affect the other levels negatively and are exacerbated by the conditions at another level.

Considering that transportation is a service industry that contributes strongly to consumers' well-being (Ungaro et al., 2022), a transformative service approach is needed for more inclusive service outcomes (Mogaji and Nguyen, 2023) and freight transport is not out of this scope. Particularly with its function of providing reversed or indirect access to essential goods by consumers at their homes (Cholat and Daconto, 2021; Figliozzi and Unnikrishnan, 2021), OHDS need to be analyzed with an inclusivity approach if equitable service outcomes are desired to be achieved. Within urban

logistics context, the providers act with profit-driven values and it is likely that they prefer targeting profitable market segments when they are offering or innovating their services. Evidence collected from different cities during Covid-19 period showed exclusion of certain customer segments from access to OHDS for essential goods (Sanchez-Diaz et al., 2021; Figliozzi and Unnikrishnan, 2021; Li and Zhou, 2024). Such an approach to urban logistics service design and provision would result in the exclusion of certain segments of the population whose needs remain unrecognized. Service design that takes diversity of human needs and vulnerabilities into consideration is critical in eliminating such exclusion (Fisk et al., 2018). According to Fisk et al (2018), four key pillars of service inclusion should be considered in order to design and provide equitable services to larger populations: enabling opportunities, offering choice, relieving suffering and fostering happiness. Within urban logistics services context enabling opportunities and offering choice are particularly relevant.

2.4 *Synthesis*

Urban logistics services provide access to products for people living in dense or distant urban areas. The concept has been challenged and transformed significantly after the rise of e-commerce and online deliveries. To meet the increasing demand and to improve the efficiency and effectiveness of urban logistics, providers focused on many technological and non-technological innovations. However, how these innovations are perceived and used by different consumer segments is rather unexplored.

Sustainability in logistics, or particularly in urban logistics, is widely studied from an environmental perspective while the social pillar of sustainability remains less prioritized. Considering its scope, urban logistics has inherent societal aspects to consider. Besides the provider-centric social issues such as employee health and safety, human rights, working conditions or business ethics, there is also a customer side to the social sustainability aspect and the service concept extends the socially sustainable logistics discussion to the interface between the urban logistics service provider and the customers.

Designing socially inclusive urban logistics services is essential to achieve social sustainability. This requires recognizing the needs of vulnerable consumer segments. However, traditional market forces favour homogeneous market segments at the risk of neglecting segments with great variety in customer's ability and requirements which results in a market failure, or a logistics divide, a gap between different market segments' ability to have access to information, goods, and services provided by new modes of deliveries. We argue for service inclusion in urban logistics to bridge this divide. Building on Fisk et al's (2018) definition, we define inclusion in urban logistics services as an egalitarian system that enables all segments of the population regardless of their capacities and abilities have access to OHDS, receive fair treatment when they interact with the service and have the fair opportunity to exit the service. We argue that inclusive urban logistics service design would eliminate service exclusion which in this context means, deliberately or unintentionally failing to provide OHDS to all population segments in an equitable and fair manner.

Covid-19 pandemic created new vulnerable consumer segments such as risk groups or sick people who should stay at home and self-isolate either for a limited time or for a long time. This increased the demand for urban logistics services and many providers relied on their technological and non-technological innovations to meet the demand. However, who benefited from these innovations or if these innovations met the demands of vulnerable consumer segments is still unknown. The market gap between different segments that enjoyed the benefits of urban logistics innovations or could not reach these benefits created a logistics divide which needs to be analyzed and eliminated by more inclusive service design.

3 **Methodology**

We adopted an exploratory and qualitative research design as our focus is on an understudied area where multiple streams of literature are integrated to expand the understanding of the studied

phenomena. We combined a deductive content analysis based on secondary evidence with semi-structured interviews. Content analysis, which is an analytical and systematic approach to discovering specific sets of information within textual data (Berelson, 1952), helps to systematize, objectively analyze, and make legitimate assumptions from such data (Opoku & Hinson, 2006). The analysis of the text and other available material allows achieving an overview of the meaning in the material and increase the intersubjective understanding of the material (Groeben and Rustemeyer, 1994).

The analytical framework (Figure 1) is informed by the two research questions (RQs) which relate to different streams of literature. The first RQ is directly related to urban logistics innovations and the analytical framework sets the boundaries around the reviewed categorization of these innovations. Then the rest of the framework addresses the social sustainability and service inclusion literature to answer the second RQ. Here, the previously reviewed social sustainability indicators serve as initial categories for analysis. Then, for service inclusion, sub-categories are developed to reflect the service receiver side (marginalized consumer segments), the service provider side (different potential actors to fulfill the market need) and the service offer (in terms of means, methods or solutions). The evidence relating to these categories is expected to describe the logistics divide and the intersubjective understanding between the upper and lower sides of the framework provide an answer to RQ2.

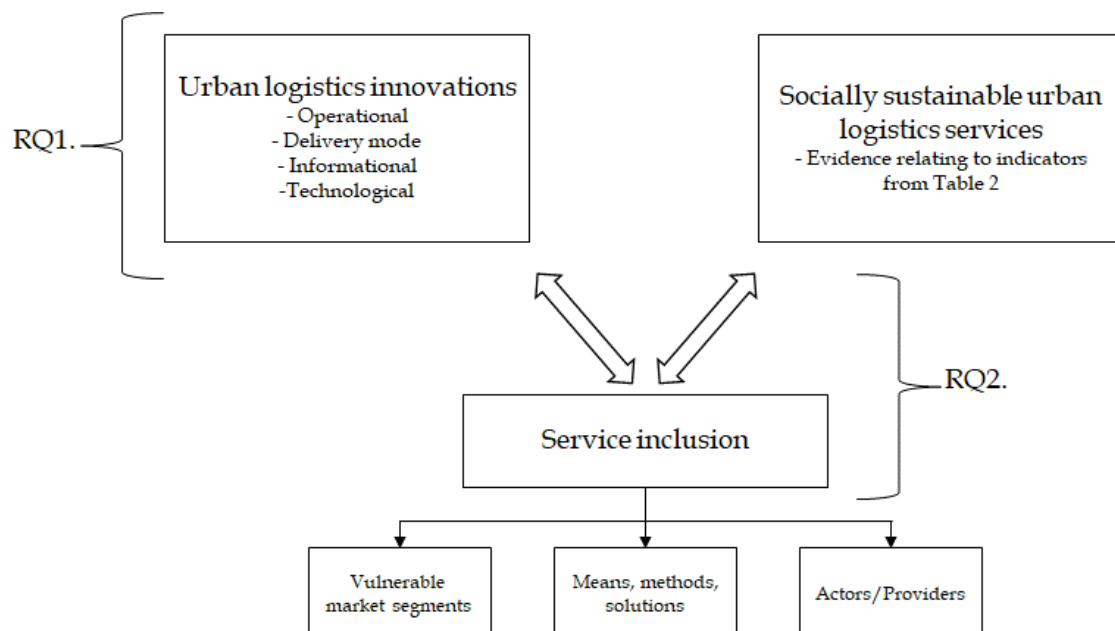


Figure 1. Analytical framework

Again, in line with the research questions, all data was collected during the first wave of Covid-19 pandemic. The research process is illustrated by Figure 2 and the different steps are explained in the forthcoming subsections¹.

¹ Please refer to Ait, 2020 for further details on research design, data and methods.

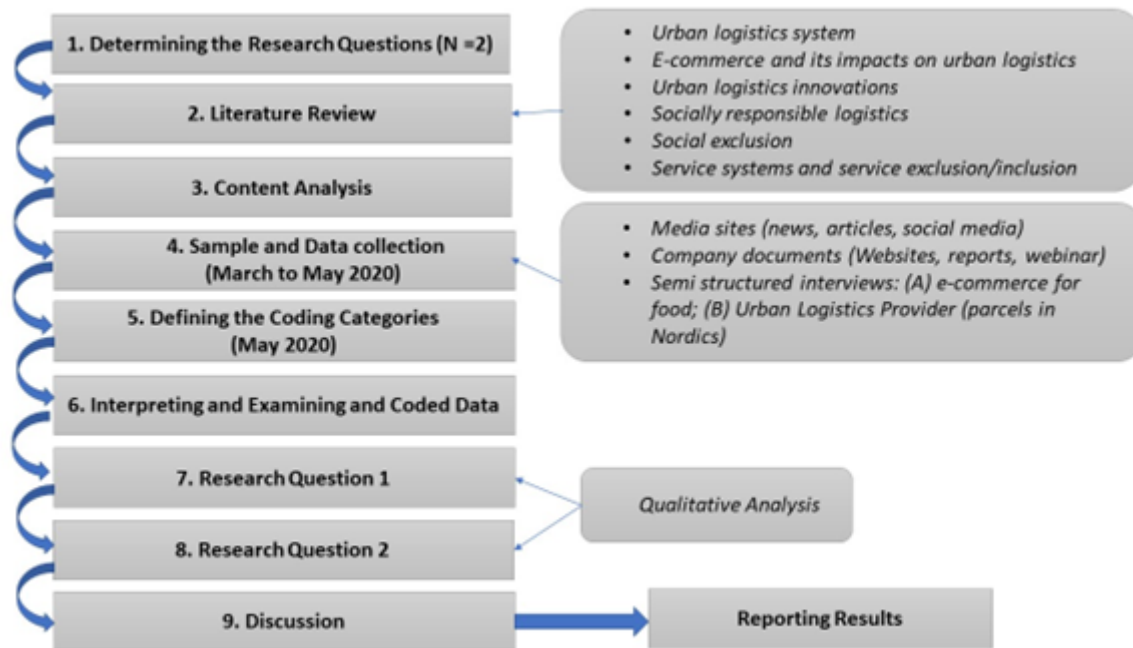


Figure 2. Research process

3.1 Research context, sampling and data collection

The first step after determining the research questions is reviewing the literature to build up a coding framework. Literature review provides a snapshot of the diversity of theoretical approaches presented in the literature. It does not cover all the literature, instead offers an informative and focused evaluation of purposefully selected literature to answer specific research questions. The different research streams are used to build the analytical framework which helped to build the ex-ante codes. These initial codes developed further into the larger coding framework and also informed the interview guide.

The data collection was focused on Sweden due to several reasons. First, urban logistics services have rather local characteristics, and they target local markets. Hence, urban logistics studies mostly focus on purposeful case settings and then make relevant inferences for other similar settings. Second, we focused on a specific period of time, the acute phase of Covid-19 pandemic, which was marked with many country-specific rules and regulations which defined how urban logistics services were delivered. Several examples analyzing urban logistics and e-commerce from different country settings during Covid-19 were published since then (e.g. Beckers et al., 2021; Guo et al., 2021; Castillo et al., 2022). Sweden is a special case among those as the country never declared a national lockdown, unlike the rest of many EU countries. However, the risk groups such as the elderly citizens or citizens with chronic diseases were recommended to avoid physical contact with others (Folkhälsomyndigheten, 2021).

Due to the extraordinary circumstances during the time that the research was carried out, the core focus was given to secondary data, particularly online channels. Such an approach to data collection is common in content analysis, considering that Internet is a rich resource to use as a research tool, a field of study and for academic communication (Margolis & Pauwels, 2011). The secondary database was built during the period from March to May 2020, when all different urban logistics initiatives emerged, and crisis peaked. Initial search string included keywords and phrases such as the following: "access to goods and services during corona", "logistics + covid-19", "last mile delivery + covid-19", "e-commerce + corona", "e-commerce + covid-19". The reports, news, articles, webinars, web sites, social media pages and opinion pieces found were further examined to understand the nature of the innovation and its relation to inclusiveness or social responsibility. This enabled an observation of the developments around the world and the

country where the research was conducted (Sweden). Only data published in Swedish or in English was used. Both Covid-19 and urban logistics services are elements that shape the research context in that the implications of the results can be transferred (Miles et al., 2020) to a context beyond the specific country in which the investigation took place. Another measure taken to ensure transferability to other context and to assure generalizability of our data was that we looked for similar examples from other parts of the world in secondary sources. We benchmarked with similar urban logistics innovations or OHDS examples that were introduced to help those that were immobile due to the restrictions. Though these efforts were limited with available online resources, they still indicated similar patterns from other countries in the world such as China, India, UK, USA, Iceland and Denmark.

Secondary data was complemented with primary data to validate the categorization and to explore our findings further in-depth. A total of four grocery stores, three online food home delivery providers, one online pharmacy, two regular pharmacies, public authority for elderly support and one parcel delivery provider were contacted for interviews. Due to the extremely busy and turbulent nature of the period, only two respondents accepted having an interview. At the end two online semi-structured interviews were conducted with (A) an online food distribution company and (B) a logistics service provider for parcel deliveries in Nordic countries. The interviews focused on the solutions that were provided during the Covid-19 crisis and their social sustainability impacts. Both interviews were conducted in English, recorded and transcribed with the approval from the interviewees.

3.2 *Data analysis*

After the dataset based on online sources was developed, each source was recorded in relation to valuable information such as the illustrative words from literature review/source, owner of the initiative, type of solution, actors involved, date published or collected and the source with the link/file. An illustration of the initial phase is shown on Table 3. A total of 74 different sources and a total of 187 different posts from these sources were analyzed (Ait, 2020).

Deductive content analysis was used to code these posts into ex-ante categories illustrated by the analytical framework. First, each chosen initiative or solution was given an initial code such as innovation or social sustainability. Then for the coded urban logistics innovations, second-level coding was done according to the four sub-categories driven from the literature and shown on the analytical framework. Social sustainability actions that were linked to the indicators from Table 2 and service inclusion were grouped separately. At the third and final stage, these groups were further scrutinized to understand the content of the urban logistics innovation, the type of the social sustainability indicator, the method of service inclusion. In line with the deductive approach, the literature review informed the third-level coding process. The coding process also revealed the emergence of vulnerable market segments as the service receiver side and the different actors that were involved in the delivery of the service. Some even indicated different examples of service exclusion due to lack of access to formal OHDS.

A similar process is followed to analyze semi-structured interview data. Findings from semi-structured interviews were used to both validate the findings from the content analysis and obtain a more in-depth understanding on different initiatives and their social sustainability impacts with a service inclusion perspective.

Table 3. Illustration of data analysis process

Initial code (Level 1)	Category code (Level 2)	Literature code (level 3)	Illustrative words from original field notes/source	Whose initiative? LSP E-commerce company Citizen (/Consumer) State Local authorities Other solution provider	Type of solution Peer to peer Online (web site) Store-based Social media Smart device -based (App)	Actors involved (in delivering the solution) LSP E-commerce company Citizens/Consumers State Local authorities Other actors	Source	Link/File name
Innovation	organisational innovation	freight demand management	Coop is trying to ensure that seniors 70+ get their food. Therefore, specific delivery times for that group have now been added.	grocery store	Online (web site)	LSP, e-grocery, customer	E-handel	https://www.ehandel.se/coop-lanserar-leveranstider-for-aldre-har-ett-viktigt-ansvar
Innovation	delivery mode	instant delivery	Vembla is a startup, that provides fresh groceries and pharmacy products from the local stores delivered in 60 minutes by private persons/freelancers using walking	application provider	Smart device (App)	IT company, grocery stores, pharmacies, customers, LSP	Vembla	https://www.di.se/nyheter/ny-tjanst-hjalper-till-med-matinkop-under-coronakrisen-hm-miljonstottar/ https://www.vembla.se/

			or bicycles as a delivery mode. Online service is in Swedish and in English.					
Social sustainability	social responsibility	health and safety	In accordance with the guidelines of the Swedish Public Health Agency, we have instructed all riders to: Not go to work when showing signs of illness, Avoid close contact with anyone who shows signs of illness, Wash your hands (for at least 30 seconds) before and after each shift, Use hand sanitizer regularly, Minimize contact with customers and avoid touching the handles of the delivery bag	e-grocery	online, (Peer to Peer)	e-commerce, LSP, citizens, consumers	Foodora	https://www.foodora.se/en/contents/covid19?r=1

Social sustainability	service inclusion	offering choice	<p>Cooperation between Coop and the non-profit organization "Åldrekontakt" (translated to eng. Elderly Contact) help isolated elderly people to buy food by bringing together elderly people with volunteers in the immediate area. Contact with the elderly takes place by phone, being much appreciated by this group, and the food box is left outside the door to reduce the risk of infection.</p> <p>To facilitate the purchase, the volunteers who shop for an elderly person can pay with a digital purchasing service in Coop's stores, so that they do not have to spend money themselves. The payment is then</p>	NGO/store	online, store based, peer to peer	Grocery store, NGO, citizens, consumers	Coop	https://www.coop.se/Globala-sidor/aldrekontakt/
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			processed afterwards via invoice and is adjusted based on the payment method that the elderly person has access to.					
Social sustainability	service inclusion	offering choice	Sina provides access to digital doctor consultations and a home delivery service for medicines bought online for everyone, regardless of language or cultural background.	e-pharmacy	online	LSP, e-commerce, citizens, consumers	online	https://www.sina.se/

4 Findings

Like the rest of the world, a significant increase in e-commerce was observed particularly during the first and second quarters of 2020 (Svensk Dagligvaruhandel, 2020; Postnord, 2020). Although, a noticeable part of this increase in Sweden was observed in elderly consumer groups, there were reported hindrances in their abilities to access OHDS and several volunteer groups and community initiatives were established to help these consumers with their essential purchases (Krisinformation, 2020). Furthermore, the vulnerable consumer segments were not only limited with the elderly or people with chronic diseases. According to authorities "People living in socio-economically vulnerable areas were at a higher risk of contracting Covid-19 so seriously that they need hospital care." (SVT News, April 2020). Hence, the special conditions in Sweden during the time of data collection indicated the existence of vulnerable consumer segments and the potential hindrances for access to OHDS by these segments.

According to Supply Chain Effect (2020) there was a 32 % growth in B2C e-commerce and parcel deliveries between February and March 2020. B2B shipments have decreased as many stores and restaurants were closed. There was a demand decline for some products segments, such as fashion and clothes, while there was a demand surge for pharmacy products, groceries, handcrafts and information and communication technology products (Supply Chain Effect, 2020; Carufel, 2020). Consequently, the transit times increased, and existing service infrastructures could not meet the demand which caused lot of pressure on urban logistics services and service providers. Companies struggled to manage the demand, but also social distancing and new hygiene requirements, as well as personnel getting sick. To tackle with these challenges both businesses and other stakeholders used innovative methods to get and provide access to goods and services. The different innovative solutions that were frequently used during Covid-19 pandemic are mapped (Ait, 2020) and explained in the forthcoming section.

4.1 Urban logistics innovations

The categorization built in section 2.1 for different urban logistics innovations is used to classify the evidence. Different initiatives were coded into four main categories: (1) organizational; (2) delivery mode (3) informational; (4) technological innovations. Then they were differentiated based on lower-level codes. A summary of the findings together with illustrative sources is presented in Table 4.

Organisational innovations

Evidence was found for both demand management and omni-channel delivery solutions under this category. For managing the surge in both in-store and online demand time-based, price-based, quantity-based measures or a combination of these were used. Different time slots were used to separate different consumer segments such as elderly or risk groups and to limit the number of people in a store. Similarly, online purchases of elderly consumers were given priority and dedicated delivery times whereas the delivery time windows were extended to off-hours such as evenings or weekends. This was applied even to prescribed drugs with extended dispatching periods for those who cannot come and pick them on time. Such solutions were provided to assure access to food products by the segments of the population who cannot leave their homes.

As for quantity-based measures, retailers limited the sales of these products per person or per household, to prevent stockpiling and having supply problems of certain products such as toilet paper, personal hygiene products, durable food products (pasta, rice etc). The range of items that are available for sale through online channels were increased and the upper limit for home delivery packages were increased.

Table 4. Summary of different innovative solutions used during covid-19.

Urban logistics innovations	Categories	Sub-categories	Illustrative quotes/evidence
Organisational	Demand management	Time-based measures	Grocery stores open earlier for risk groups in corona times. (SVT News)
			LSP adjusted the timeframe for their evening deliveries from 5 to 9 pm to start from noon until 9 pm, but also making some deliveries on Saturdays. (Bring Webinar)
		Price-based measures	"Free of charge home delivery in Gothenburg area" (Spiceonwheels.se)
		Quantity-based measures	"Several supermarkets have limited the sales of certain products to avoid them selling out completely." (BBC)
			now order from a list of 47 essential items over the phone and pay for the items when delivered. (increased quantity of items sold online) (Charged retail, UK)
	Combination of price- and quantity-based measures	The acceptance weight for the parcels was increased from up to 2 kg instead up to 4 kg. (Bring Webinar)	
	Omni-channel setting	Merging offline and online functions	"Vejbæk-Zerr decided that if anyone bought two bottles of hand sanitiser at his supermarket, the second would be priced at 1,000 Danish kroner" (The Local.se)
		Expanding ordering and delivery mode options	B&M stores merging functions and roles between offline and online services
ICA has added to the regular e-store a meal app Ica Pronto, where you can order selected items and ready-made food from a local Ica store directly to your doorstep. (ICA.se)			
Delivery mode	Crowdshipping On demand/ Instant delivery	Peer to peer	Retailers extended their omni channel setting by joining the collaborative e-grocery services. This allowed them additional ordering and on demand delivery with instant deliveries
		NGOs/ aid organisations	Help elderly people in the neighbourhood with the grocery shopping by handing out pieces of paper into older people's mailboxes (Facebook groups such as Äldrehjälpen.se; Handlingshjälpen Corona, Corona in Västra Götaland etc.
		Collaboration	"Financial transactions are managed via FIKK so that both aid seekers and volunteers can feel secure." (Fikk.se)
		Instant e-groceries and e-pharmacy	Grocery store and NGO join forces to help isolated elderly people to buy food or prescription drugs by bringing together elderly people with volunteers in the immediate area. (Coop.se)
		Contactless delivery	Grocery stores and pharmacies started to offer instant delivery service
			"This enables your order to be left at your door without contact. Drivers are advised to minimize contact with customers and avoid touching the handles of the delivery bag." (Foodora.se)

	Pick up points	Employment	Employment of extra personnel. Store employees becoming LSP
		Home delivery	Grocery stores and pharmacies started to enable home deliveries (Postnord.se)
		Alternative origins or destinations	To order products by phone, pay and collect their goods at the pharmacy or outside the building (Apoteksgruppen.se) Possibility of ordering delivery of rural mail carriers. The recipient then does not have to go to the agent and can calmly wait for home delivery (Postnord.se)
		Contactless delivery	For home delivery, the physical contact was limited or avoided completely by placing goods behind the door or at the parking lot (Mathem.se; Interviewee A and B)
Informational	Information sharing	Training new personnel	To set up screens to meet and train new personnel contactless (Interviewee A and B)
		Customer service	Digital way of communicating with the end customer. To get answers to the questions regarding where the shipments are, about the invoices
		Digital signing	Digital signing for home deliveries, which meant that after receiving the order, that has left by LSP outside the end customer's door they will receive a SMS with a link where customer confirms receiving the order (Bring Webinar; Postnord.se; The Local.se).
Technological	Drones	Contactless delivery (Avoiding human contact)	Drones were used to deliver medicine to elderly by an LSP company when delivering prescription drugs from a pharmacy to elderly residence (Transport och Logistik)
	Robots	Deliver contactless and kill viruses	Delivery of food in the hospitals or quarantine hotels (Forbes)
		Unmanned supermarket	wholly unmanned supermarkets to buy essential goods in the epicentre of the outbreak (Supply Chain Effect)
	Autonomous vehicles	Unmanned delivery	Food and necessary medical supplies were transported to health-care professionals and the public in infected areas with autonomous vehicles. (Autofuture)
	Electrification	Electric cars	Pharmacy using electric cars to make home deliveries. (Apoteksgruppen.se)

Ait, 2020

Reduced or free home delivery for risk groups in certain areas or waiving delivery fees for local restaurants were among price-based measures. Sometimes these were used in combination with quantity-based measures to discourage stockpiling of critical items.

With regards to channels, many initiatives were observed where traditional stores started to offer online purchasing and delivery options as well. This period has been a catalyser for expanding omni-channel distribution. Additional product and service lines were introduced where multiple business partners collaborated to offer new services online. An example was collaborative e-groceries which allowed users to order both groceries but also cooked food from the same channel. The pandemic brought many new forms of crowdshipping which were mostly voluntary.

Delivery mode innovations

Neighbour groups, online communities, civil society organizations, municipalities and even religious organizations were self-organized to help providing access to goods for those who could not do it themselves. Technology helped a lot to these groups for enabling fast and accurate information sharing. Aid organizations were involved to assure trust to users. An example here was a retailer that connected elderly consumers with volunteers through a non-governmental organization (NGO). The contact with the elderly took place by phone, which was much appreciated by this group, and the food box was left outside the door to reduce the risk of infection. The volunteers who shop for an elderly person could pay with a digital purchasing service in stores, so that they do not have to spend money themselves. The payment is then processed afterwards via invoice and is adjusted based on the payment method that the elderly person has access to.

Another increase was observed in on-demand deliveries as well as instant deliveries (delivery less than 2 hours). While people avoided traditional stores and restaurants, they started to order food and medicine online to be delivered at their doorsteps which led to a rise in the number of restaurants joining instant delivery services such as UberEats or Foodora and a rise in people employed in these jobs. Instant delivery services spread to other segments such as groceries and pharmacies which led to collaborations between LSPs and these types of retailers. Sometimes store employees became a delivery personnel. As a result of these increases contactless delivery options such as leaving boxes at the door became the norm.

Pick up points were diversified as well to meet the increased demand. Besides doorsteps, parking lots, mailboxes or service points outside the stores became alternative pick-up points. In some cases, there was a reduction in the use of pick-up points and instead LSPs started to offer home deliveries to avoid crowds in stores where pick up points were located.

Informational innovations

There has been a rise in the use of digital tools to facilitate information flows between different parties during the pandemic. Such tools were used to provide training to new staff, to provide online information support to consumers through e.g. chatbots, to enable digital signature for confirmation of delivery, to inform the consumer about a door delivery and even for the delivery of e-services such as digital doctor appointments. In some cases, municipalities were involved in the information sharing process for e-groceries as they collected the orders on their waste collection routes and shared them with retailers to facilitate delivery.

Technological innovations

The crisis acted as a catalyst for the use and diffusion of technological innovations. Drones and robots were used for safe delivery to different places such as hospitals or consumers under quarantine measures at their homes or sometimes at hotels. In some cases, drones were used to secure social distancing while providing fast delivery to elderly homes or retirement communities for time sensitive medicines. Some e-commerce companies tested wholly unmanned supermarkets

where limited number of consumers could shop, and items are automatically scanned for payment at the exit.

Other technological developments such as autonomous vehicles were used to transport food and necessary medical supplies to health-care professionals, patients and the public in infected areas. Moreover, autonomous fleet shuttles were used in delivering Covid-19 tests to drive-thru test centres. In some cases, the environmental impact of these increased home deliveries was also considered, and the use of electric vehicles was emphasized in the response to the crisis.

4.2 *Socially sustainable logistics*

These urban logistics services that were provided as a solution to the crisis during the pandemic took place at the provider-customer interface which created some risks for both sides. Therefore, it was a time where social sustainability dimensions related to working conditions, health and safety became even more important. Many of the urban logistics innovations enabled reducing the social contact and enabling contactless deliveries. In traditional stores, customers and employees were offered different social distancing and hygiene solutions such as limited number of people in the store, provision of signs for social distancing in queues, provision of face masks, gloves, sanitizers and plexi glass protection at the checkout or customer contact zones. *“Several stores have set up plexiglass at the checkout. The cleaning has increased and there are sticker decals in the floor that encourage the customers to keep a distance from each other (SVT News).”* Changes were observed at delivery locations and short-term storage at the receiver sites to protect the health and safety of the receivers. *“As of March 13, goods being delivered to care homes and homes for the elderly will be delivered to cargo bays or incoming goods areas, and not to possible designated locations that have previously been specified (Postnord.se)”*.

Other measures were also taken such as changing in-store replenishment times to minimize contact or frequent disinfection in stores. To meet the customers' demand and protect their employees, companies made changes in their services and routines, in the production, in the sorting process, employees' routines and in the delivery process. Cleaning and disinfection processes were introduced in delivery vehicles and for drivers. Some initiatives were introduced for allowing self-quarantine for infected delivery personnel like the one from UberEats: *“We have worked with our global rental partners to ensure that any driver diagnosed with covid-19 or individually quarantined can return their car with no penalty.”* Health and safety measures for delivery workers were communicated with a social sustainability concern: *“Riders which have been in areas with widespread transmission are kept at home. (they will receive full pay for their missed work hours) (Foodora.se)”*. Unfortunately, some health and safety concerns cause negative impact on environmental measures such as quitting taking back reusable packaging or returned goods for take-back programs (e.g. Mathem.se).

Philanthropy and community involvement were the other important social sustainability indicators that were mobilized during this period. Collaboration between non-traditional actors and actors from out of logistics industry were observed to facilitate access to goods: *“Several of Sweden's leading food chains are joining forces to facilitate food purchases for people who need to isolate themselves due to the corona virus. The venture receives million grants from the H&M Foundation and is part of the Action Against Corona campaign, which the Norrskan foundation and Dagens Industri started (DI.se).”* There were examples of philanthropic organizations working to provide essentials to frontline workers and self-quarantined individuals by raising funds jointly for covid-19 prevention and help of those affected. Food and meal donations to hospitals by online food distributors, organization or participation in charity campaigns for similar causes, donations to vulnerable and isolated market segments or donations to local restaurants and cafes by urban logistics actors through, for example, waiving delivery fees were among other philanthropic activities. In many cases, online purchasing and delivery organizations became the interface for collecting and distributing donations to local restaurants or delivery partners.

4.3 *Service inclusion*

Even before the pandemic, the elderly, the people from less advantaged parts of society or people who are geographically segregated were marginalized by the lack of access to OHDS. The first restrictions recommended by the Public Health Agency in Sweden caused an increase in the number of people in need of access to OHDS as they had to stay at home. According to these restrictions anyone who had flu-like symptoms, belonging to 65 and higher age groups, having chronic illnesses were considered as risk groups as well as their relatives (Folkhälsomyndigheten.se; Socialstyrelsen.se). As the virus spread, reports showed that it was an overrepresentation of foreign-born residents who catch Covid-19 and stay at home (SVT News). This data was also associated with less-advantaged parts of cities. Such evidence indicated potential hindrances to access OHDS due to lack of former interaction with e-commerce and digital services, due to digital illiteracy, due to language barriers and due to lack of national identifiers such as a social security number or digital signature. Segregation of certain areas was underlined by several sources: *"Poor living, generational housing, poor public health and in some cases lacking Swedish knowledge have made the Järva area in Stockholm extra exposed (SVT News)."* Equitable access to OHDS was a requirement for these population segments and when the traditional logistics market forces failed to fulfill the need, other types of actors and new ways of service delivery were observed.

Service inclusion in OHDS was demonstrated in the form of offering choice or empowering opportunities for the service receivers. For example, due to the surge in the demand for online deliveries, those who needed essential items the most such as the risk groups were hindered. Some providers started to offer prioritized and specific delivery times for such consumer segments (Coop.se; e-Handel.se) and essential goods such as prescribed drugs (Apoteket.se). To continue providing services to those customers belonging to risk groups but not using OHDS, retail stores introduced similar methods of service delivery. Several grocery stores introduced earlier and dedicated opening times for elderly residents and risk groups (SVT News). There were many examples of volunteer groups that organized on social media channels such as Facebook to facilitate the home delivery services for those who are in need (Coronahjälpen, Äldrehjälpen, Handlingshjälpen). Similar initiatives were also started by private companies (Vembla.se) or retail stores (Coop.se) where volunteers or crowdsourcing were used for home deliveries. However, there were reflections from residents in the media about hesitations: *"She knows that there are help groups on Facebook but points out that it is difficult to know how to handle help from people you do not know. "It is always difficult with foreign people. It's not just knocking on the door and asking "can I help you?". It sounds good but in reality it is quite difficult. You don't know if you can trust this person, she says. (Strömstadstidning.se)"*.

Some other means for enhancing inclusive OHDS were providing multiple languages on the web pages (Interviewee B; Wembla.se) but also through volunteer initiatives (SVT News) because most of the grocery stores offering OHDS have only Swedish as a language option (The Local.se). Another hinder was about national identification and payment systems as most of the providers accepted only Swedish payment cards and Swedish digital signature service which is strictly connected to the social security number. Those residents lacking them could not get access to OHDS offered by grocery stores or pharmacies (The Local.se). Volunteer services were also required for those groups who are not comfortable with using digital tools. For such groups, phone services and pay-per-invoice services were offered by several providers.

The evidence also supports our arguments about the logistics divide. When the mainstream service providers fail to target these market segments, there emerges a market gap which is filled by other actors. During Covid-19 pandemic, this was carried on by non-governmental organizations such as the Red Cross or the Swedish Church, by public organizations such as municipalities, by retail stores vertically integrating to deliver their own products, by start-ups with a social cause and largely by citizens, volunteers, peers organized by social media channels or local communities. The involvement of so many different actors indicates that mass marketed OHDS are designed and advanced with the assumption that they are usable by all segments of the population, but they fail to do so. Where logistics services and innovations cannot reach certain populations, then equitable

access to these services is hindered and non-traditional market actors need to step in to fulfill the need.

5 Discussion

Although coronavirus put most people into risk and excluded from society, it still created some groups which were more vulnerable. These were risk groups, the elderly but also people living in socio-economically vulnerable areas, immigrants, and minorities. While some of these people could not go out for shopping because they are at risk, some of them also lacked the skills for online shopping. Low skills in technology use, language, unfamiliarity with interfaces, unfamiliarity with payment systems, higher costs or lack of trust might all create barriers for using e-commerce and online delivery services and create what Rosenbaum et al (2017) describe as vulnerable consumers. Our findings are an attempt to link transport and logistics research with the transformative service research agenda (Anderson & Ostrom, 2015; Rosenbaum, 2015). We asked the question "Who is benefiting from logistics innovations?" and the answer indicates that there are certain segments of the population who are not benefiting from those innovations but they lack access to logistics services that facilitate the delivery of essential goods.

5.1 Theoretical implications

Social exclusion during the pandemic was not a result of poor transportation as Kenyon et al (2002) describe, it occurred because the OHDS were designed in a way that failed to consider the differences between different consumer segments' skills, abilities and vulnerabilities. Bocarejo and Oviedo (2012) relate social exclusion with insufficiency of means for people's mobility whereas during the pandemic, when people's mobility was limited by default, it was a result of insufficiency of means to move goods to people. Our results are in line with similar studies that focused on accessibility questions for urban logistics and OHDS during the pandemic, certain customer groups such as low-income households, households with lower education levels, households with low access to digital communication means, households with immigrant or disadvantaged backgrounds were relatively underserved (Sanchez-Diaz et al., 2021; Figliozzi and Unnikrishnan, 2021; Li and Zhou, 2024). There were many urban logistics innovations initiated to address the surge in demand for OHDS during these times but there certainly is a gap between the winners and losers of these innovations (Strale, 2019) from a fair access perspective.

Our findings have provided a categorization of urban logistics innovations that were used during Covid-19 outbreak and linked some of these initiatives with social sustainability in logistics. This categorization showed the need for a variety of urban logistics services that address the needs of vulnerable consumer segments. However, to understand the needs first these market segments need to be targeted, analyzed and listened to. The heavy reliance on technology to make urban logistics services more digital, more efficient, more connected over-emphasizes the technical side but fails to address the societal side (Strale, 2019). Logistics divide results because of the gap between different consumer segments' ability to benefit from these urban logistics innovations. It was Covid-19 pandemic that created new and more visible vulnerable segments this time but an important learning from this period should be the recognition of such segments and how a more inclusive service design can help to improve their access to goods and services.

As Mir et al (2020) addressed, the inability of LSPs to address the needs of disadvantaged groups in the society at the meso-level results in lack of trust, understanding and skills for an effective use of available services at the micro-level by the same groups. If urban logistics service innovations will continue to ignore the needs of these groups or fail to focus on service inclusion, this will reinforce the marginalization of these market segments further. To reduce the inequalities in service provision, OHDS should not be perceived solely as services focusing on enhanced convenience of privileged consumer segments but also a means of reversed mobilities (Cholat and Daconto, 2021) or access to essential goods by disadvantaged parts of the population.

Inclusive service design for urban logistics is a mechanism that can address the logistics divide and social sustainability actions can be leveraged for service inclusion. We agree with Figliozzi and Unnikrishnan, (2021) in that collaboration between policy makers and LSPs with respect to finding subsidy mechanisms and identification of urban areas that have low access to OHDS would be a promising solution to address these issues. Such an action would relate to both community involvement and ethical and inclusive approach to OHDS customers while contributing to the social sustainability efforts of LSPs. Our results showed the involvement of many actors in OHDS for vulnerable segments. Collaborating with these actors when designing urban logistics services would increase inclusivity and reduce potential inequalities in service delivery.

According to Fisk et al (2018) the first pillar of inclusive service design is offering choice between different service offerings and enabling consumers to opt out of a service at any stage. Some urban logistics innovations during this period were good examples of offering choice. Combination of ready-made meals which are more affordable than their counterparts at restaurants with regular online grocery shopping via the same channels, providing alternative pick-up points outside the shops for risk groups, providing multiple delivery options that support social distancing measures and inclusion of non-traditional parties such as store employees or volunteer groups for deliveries were among the examples. On the other hand, in some cases, initiatives were inclusive of only digitally literate consumer segments. Contactless payment options that depend on electronic payment interfaces require ownership of smart phones, membership to banks, ability of using digital signatures, owning social security IDs which all might have hindered certain consumer segments to use such services.

A second pillar of inclusive service design requires enabling opportunities by providing access to services and the ability to receive or co-create services (Fisk et al., 2018). Our findings showed some examples of such initiatives. Offering different opening hours special to risk groups, offering multiple language options in online purchasing, prioritizing the delivery of elderly population's online orders, inclusion of non-traditional actors such as volunteer groups, NGOs or store employees enabled vulnerable consumer segments to have access to urban delivery services. Measures taken against stockpiling enabled equal access to critical products like food, hygiene products or medicine and reduced shortage of goods when some people started panic buying. Using new technology such as robots and drones to deliver critical material to infected zones or hospitals was also an example of enabling opportunities. Covid-19 crisis demonstrated that new technologies, being previously only experimental or hindered by laws and regulations, are enabling more equal access to goods and services while helping to combat spreading of the virus.

Last-mile delivery is considered as the least efficient and the most expensive leg of the delivery process (Fernie et al., 2010). Hence, it is not surprising that all providers of OHDS target profitable market segments when designing their services. However, they are also eager in reinvesting the earnings in technological urban logistics innovations such as electric vehicles, new fuels or autonomous deliveries due to the rising demands on environmental sustainability and reduced emissions in the cities by all stakeholders. We argue for similar investments in the social pillar of sustainability by offering lower cost services for those disadvantaged customer segments. During the pandemic, the access to OHDS was hindered also due to higher costs of purchasing essential goods through these channels: "92-year-old Kerstin is forced to pay SEK 370 to bring home the grocery bag, being almost double the cost that she is used to pay. (SVT News)". If fair access is the precondition of service inclusion, then subsidizing access to OHDS is a critical mechanism to reduce its cost and achieving this purpose. Municipalities, governments and other actors can support this action, but it is also within the social responsibility of logistics companies. As Karner et al (2020) argues it is essential to collaborate with the state but also move beyond the state to achieve transport justice. We argue for the same in the case of inclusive OHDS.

5.2 *Managerial and societal implications*

Practitioners and policy makers in urban logistics services field need to have an alternative accessibility approach as Gonzalez-Feliu and Mercier (2013) also call for. Our findings show the

need to consider accessibility to goods by people, particularly during a period when their mobility is limited, and freight mobility is essential. Adding onto Farrington and Farrington's (2005) recommendation, during the e-commerce era, it is not only the people's mobility that matters with respect to equally accessible transportation; it is also the goods' mobility. Policy makers in urban logistics services should approach the innovations in this field with a service inclusion and accessibility lens. The scaling of many pilot projects, test beds, technological developments should be undertaken with the consideration of vulnerable consumer segments and their ability to benefit from such developments. An important question to consider for the future is "which part(s) of the society will benefit from the new technologies in urban logistics?"

Our results reveal that current urban logistics services are not prepared to work with such a high demand and to provide inclusivity to all citizens in the society. The existing urban logistics service infrastructure could not handle the peaking demand and the different choices that need to be at place for offering equitable access to multiple consumer segments. Consequently, many non-traditional actors and initiatives emerged to fill the gaps, often in an uncoordinated manner. NGOs, volunteer groups in neighborhoods, religious organizations and social initiatives were established to fill these gaps and provide access to goods. Learnings from such initiatives would enable urban logistics service providers leverage service innovations in combination with socially responsible service design to achieve better inclusivity. As Karjalainen and Juhola (2021) also address, such an approach would reduce the stakeholder marginalization that prevails in sustainable urban logistics services.

5.3 Limitations and further research

The purpose of this research was to expand the understanding on socially sustainable urban logistics services during Covid-19 crisis. By mapping the different urban logistics service innovations introduced to tackle the crisis and analyzing them in relation to different social sustainability indicators, this study provided a review of urban logistics services' response to an acute crisis. The discussion of accessibility to urban logistics service innovations from a service inclusion lens initiates a synthesis between these two literature streams and calls for scholarly research in urban freight logistics service design that includes an equity and inclusivity perspective for different and vulnerable consumer segments. Such a perspective in service design will mitigate the risk of creating a logistics divide for urban logistics practitioners and policy makers.

This research is limited to the acute phase of Covid-19 pandemic and the disruption in the provision of logistics services due to infection prevention measures. However, the logistics divide is not only limited to such disruptions. Further research is needed to explore, understand, and analyze how contemporary logistics services are designed. The fit between vulnerable consumer segments' needs and the mass marketed logistics service design elements need to be evaluated. The potential gaps in this fit are likely to create market failures in logistics service provision in the future considering the changing demographic structures due to societal trends such as migration and ageing populations.

This research focuses on conventional urban logistics services and providers of those services. However, there are many other non-traditional logistics service providers that address the logistics needs of vulnerable consumer segments such as home care services, municipalities and regional authorities, hospitals and other healthcare organizations or even migration institutions. These public institutions are not logistics professionals, and they can benefit significantly from synergies if they are to collaborate with traditional logistics service providers. Future research that is looking into the collaboration opportunities between these two actors or analyzing cases that lead to improvement in logistics service provision to vulnerable consumer segments would generate valuable insights both to practitioners and policy makers.

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