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'Proximity logistics': characterizing the development of logistics facilities in dense, mixed-use urban areas around the world

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Abstract

The maturation of digital(ized) consumption, together with the amplification of cities' initiatives in response to local and global environmental challenges, has placed goods transport, an essential but impactful activity, at the forefront of urban stakeholders' scrutiny. High-performance and low-impact supply chains benefit from the presence of logistics facilities in proximity to goods' destinations. This development of logistics facilities in high-demand areas, which are essentially urban, dense and mixed-use, we term 'proximity logistics'. It is the focus of this article. Proximity logistics entails extending and refining networks of logistics facilities towards urban cores and allows them to counteract some of the undesirable effects that their historic tendency to outward migration (or logistics sprawl) potentially brings about. The phenomenon is established around the world, albeit to different extents. In this article, we discuss the trends supporting proximity logistics' development and present a typology of facilities it could entail, followed by case studies of five cities: New York (United States); Paris (France); Seoul (South Korea); Shanghai (China); and Tokyo (Japan). We characterize the state of practice of logistics facilities in each city's dense, mixed-use areas, compare the characteristics in light of their context and distill learnings in support of sustainable land use patterns.

Keywords

Urban logistics, logistics facilities, urban warehousing, land use; last mile distribution; proximity logistics

1. Introduction

Goods transport is essential to the proper functioning of cities. It is both a derived demand from consumption being spatially differentiated from production and an integrated demand as it is a strategic part of today's supply chains (Rodrigue, 2006). Along with the environment in which it operates, urban logistics is changing rapidly (Browne et al., 2018). A first force of change is represented by consumer demand and supply, characterized by a growing e-commerce sector, an 'omnichannelisation' of retail models, an accelerating urban logistics start-up scene, and a maturing platform-based 'gig economy'. As Dablanc (2018) states, e-commerce plays a special role in pushing forward technological and other types of innovations that directly impact urban logistics.

A second force of change is represented by policies and planning, characterized by increased attention and sensitivity to urban transport and its negative externalities. More and more urban authorities implement dedicated access regulations because of goods transport's disproportionate impact (Verlinde, 2015). Although only 15% to 25% of urban transport kilometers traveled can be attributed to goods vehicles, they occupy 20% to 40% of motorized

road-space, cause 20% to 40% of CO₂ emissions, and are responsible for 30% to 50% of air pollutants (Smart Freight Centre, 2017). Some of these regulations are restrictive, limiting goods vehicles' access to certain areas, during certain times or to certain vehicles, others are supportive, granting access when adhering to certain conditions (Gonzalez-Feliu, 2018). Furthermore, cities are introducing low and zero-emission zones as well, and experimenting with pedestrianization initiatives, 'eco-neighborhood' redesigns, and 'x-minute city' visions.

The global pandemic related to COVID-19 accelerated these changes in demand, supply, policies, and planning (Villa and Monzón, 2021). In response, the urban logistics sector needs to become more efficient and zero-emission, while also responding timely and accurately to contemporary modes of consumption. As we demonstrate in the next paragraphs, low-impact and high-performance supply chains, particularly in high-demand areas, seem to benefit from having logistics facilities closer to where goods are used and consumed. To discuss the development of logistics facilities in dense and mixed-use urban areas, we introduce the term 'proximity logistics'. It is anecdotally observed in various cities including Amsterdam, the Netherlands (Ploos Van Amstel et al., 2021); London, United Kingdom (Steer & Cross River Partnership, 2020); Paris, France (Dablanc, 2018); Seoul, South Korea (Lim and Park, 2020); Shenzhen, China (Xiao et al., 2021); and various cities in the United States (Kang, 2020).

As such, proximity logistics opposes the historic tendency of logistics facilities to migrate ever further away from cities. Literature refers to this tendency as 'logistics sprawl' (Dablanc and Rakotonarivo, 2010). However, it does not necessarily replace logistics facilities from suburban or rural areas. Rather, it provides an extension and refinement of essentially global networks more tailored to the city. Onstein et al. (2021) describe the typology of facilities that has emerged as a result as going from 'XXL' to 'XXS'. Just like the term 'logistics sprawl' relates to locational patterns of logistics facilities in relation to cities, so does the term 'proximity logistics'. Similarly, proximity logistics facilities vary in size and activity. Their specificity lies in their location, i.e., within urban areas that are dense and mixed-use, and their service area, i.e., the city itself. It is this specificity that allows proximity logistics to counter some of the undesirable effects that logistics sprawl brings about (Sakai et al., 2015). Nevertheless, the relationship between logistics sprawl and transport externalities is more complex than usually presumed. Sakai et al. (2019) show that preventing logistics sprawl in itself does not necessarily generate environmental advantages and Kang (2020) calls to take facility characteristics and urban sprawl, leading to sprawling demand for goods, into consideration. Yet Sakai et al. (2019) also demonstrate that prohibiting logistics facilities from high-demand areas does cause negative externalities to increase significantly.

Counteracting logistics sprawl is even more important in the case of e-commerce, with its deliveries more fragmented than store replenishments, according to calculations by the consulting firm Oliver Wyman (2021). This study shows that logistics sprawl causes a 2.5g increase in CO₂ emissions per purchase for online shopping, compared to a 1g increase for store shopping in Europe. For e-commerce deliveries in particular, logistics facilities in urban areas are found to decrease transport distances and negative externalities, as demonstrated for a micro-hub in Paris (Morin et al., 2016). Houde et al. (2021) show that the increased proximity to consumers slowed down the growth of external costs associated with Amazon's long-haul trucking in the United States. In this e-commerce era, space for logistics processes in urban areas increases inevitably (Xiao et al., 2021). For cities, and large cities in particular, accommodating this demand while maintaining sustainable land use patterns is a major

challenge. A careful examination of developments is needed to evaluate land use planning efforts and impacts, as well as to update the theories of logistics land use (Xiao et al., 2021).

The objective of this article is to characterize and contextualize the development of logistics facilities in dense, mixed-use urban areas, by means of a comparison of case studies of five cities: New York City, United States; Paris, France; Seoul, South Korea; Shanghai, China; and Tokyo, Japan. Although the cities differ significantly from one another, they share high population density and high rates of e-commerce adoption, two criteria considered critical in the development of proximity logistics (Dablanc, 2018; Rodrigue et al., 2017). Our first research question centers around how each case's regulatory context towards logistics facility development influences proximity logistics, while the second research question queries its spatial, operational, architectural, and economic characteristics.

This article continues with a literature review in the second section, which discusses the main trends supporting proximity logistics' development and summarizes the different types of logistics facilities in a typology. The third section outlines our approach and methods to the case studies, which are elaborated in the fourth section. The fifth section discusses proximity logistics' state of practice in light of their various contexts and concludes.

2. Literature review and typology

2.1 The emergence of proximity logistics

This section discusses the main trends supporting the development of logistics facilities in dense, mixed-use urban areas, based on the framework proposed by Xiao et al. (2021) that outlines the determinants of logistics facility location. They distinguish three factors: economics; policies and regulations; and resource endowments.

Economic factors

Economic factors include new business models, technological advances, economic growth, and changes in demand. The most important development driving logistics facilities closer to consumers, is arguably the growing e-commerce sector (Houde et al., 2021; Rodrigue, 2020). Online consumers are spending larger amounts of money, purchasing a wider range of items and doing it more often (Buck et al., 2020). To online retailers, fast fulfillment and delivery has become a key feature. Initially, it was introduced to approach physical retail's advantage of 'instant gratification', allowing consumers to access their purchases immediately after payment (Dablanc et al., 2017). Subscription services such as Amazon Prime allow for increasingly fast deliveries (i.e., one or two days) of regular orders and same day or less for some orders. Today, 'instant deliveries' are increasingly common in cities. From regular household items and clothing to meals and groceries, online orders of all sorts are delivered at consumers' doorsteps within ten minutes to two hours after they are placed. Achieving such velocity requires logistics facilities to stock and prepare online orders in close proximity to consumers.

In turn, the success of online shopping spurred a transformation of retail models in general, towards omnicanalisation. Retailers implementing an omnichannel retail model integrate their online and 'offline' channels. As such, they introduce, for example, virtual screens, and digital kiosks in stores to facilitate consumers' access to the webshop and offer online consumers the possibility to collect ('click-and-collect') and return their orders in store as well (Buldeo Rai, 2019). Furthermore, retailers profit from their stores' proximity to consumers to fulfil and

deliver online orders faster. In doing so, stores' roles as showrooms and points of purchase are extended to include logistics services, including picking, packing, and shipping (De Silva et al., 2019). Yet, as De Silva et al. (2019) point out, logistics facility development related to online and omnichannel retail is not an isolated phenomenon, but reflects new logistics models that evolved in parallel to e-commerce growth.

The acceleration of start-ups in the urban logistics sector can be framed in this way. Such start-ups offer various logistics services tailored to cities, such as instant and on-demand deliveries, low and zero-emission deliveries, geo-localized deliveries, time-slotted, evening and weekend deliveries, consolidated deliveries, out-of-home deliveries; etc. Their customers are online and omnichannel retailers, but also various kinds of local businesses. Such services rely heavily on technological advances made in vehicle and communication technology (Mouratidis et al., 2021). For starters, there is the strong development of electrification for goods vehicles, with cargo bicycles and vans being the most mature options, and trucks, drones, and robots being tested extensively. Electric vehicles do not allow to replace conventional vehicles one on one, requiring logistics spaces in urban areas for charging, storing, maintenance, and cross-docking (Ploos Van Amstel et al., 2021).

Then, there is also the platform economy based on apps, providing labor to carry out these various logistics services. Partially evolved from the principles of the 'sharing economy', which strives to redistribute, share and reuse physical assets, most platform-based start-ups staying afloat in urban logistics today are much closer to the gig-economy, in which workers are simply paid by task (Buldeo Rai et al., 2017). Stripped from salaries and working conditions conform to the market, labor provided through platforms costs a lot less, possibly offsetting in this way the costs associated with owning or renting the logistics facilities in high-demand areas on which urban logistics start-ups tend to rely.

Policy and regulation factors

Factors related to policies and regulations cover negative externalities, tax contributions, industry connections, and employment growth. As Xiao et al. (2021) put it, localization of logistics facilities is not only subject to decisions at the business level but is also influenced by government policies at the regional and urban level. They point out that local authorities usually do not favor logistics activities in central areas, because of low contributions to tax revenues (Xiao et al., 2021). Moreover, logistics facility development is often prevented because of the negative externalities that the relevant transport activities generate locally (Yuan, 2021). Dablanc (2018) refers to warehouses in Los Angeles' very urban areas, stating that "existing zoning ordinances are not always welcoming to such buildings".

Producing logistics facilities entails negotiations between local authorities and different local and global firms (Barbier et al., 2019). Therefore, the development of logistics facilities in urban areas is also subject to how cities connect to industry strategies. Following exchanges with the logistics sector, cities that used to be reluctant to accommodate logistics facilities increasingly adopt policies and planning (Holguin-Veras et al., 2021). These exchanges address the practical difficulties of ever stringent urban access restrictions and the spatial needs associated with enhancing efficiency, implementing active transport modes and transitioning to zero-emission vehicles. For example, in Shenzhen, the Urban Development and Land Use Plan for 2016-2020 proposes an urban logistics network for last mile delivery hubs and the redevelopment of former industrial sites into e-commerce logistics facilities (Xiao et al., 2021). Similarly, the City of Paris organizes bids for tenders to transform

abandoned or underused urban sites into hubs, to reduce negative externalities from growing urban goods transport (Dablanc, 2018).

Policies and planning beyond the urban level play their part as well. Yuan (2021) suggests monitoring logistics' land use patterns and the environmental impacts associated with them, to achieve sustainable development of the logistics industry and maintain a just environment for citizens. On logistics facility development in cities, national governments do not have the strongest influence. Yet Sakai et al. (2016) present an example from the Act on Advancement of Integration and Streamlining of Distribution Business, enacted by the Japanese national government in 2005. This policy, which includes an estimation of carbon emission reduction in the evaluation process, broadened opportunities to develop logistics facilities in the Tokyo Metropolitan Area, among others.

When it comes to employment, urban authorities are usually not very enthusiastic about logistics developments, as it does not translate into many jobs compared to the amount of land consumed (Raimbault, 2021). Also, many of these jobs are low-paying and temporary (Yuan, 2021). In Japan, for example, an interview with the prefectural government of Kyoto conducted by an author in early 2022, confirms that authorities tend to support the development of more labor-intensive industries. While incentives for manufacturing are considered long-lasting, those for logistics are seen as unstable. Moreover, automated facilities, such as those owned by JD and SF Express in China, have shrinking numbers of employees (Xiao et al., 2021). The national logistics master plan in South Korea addresses the need to train and educate logistics experts adapted for automated facilities, although the instrument is not legally binding.

However, Raimbault (2021) points out that the contrary is often true for authorities in suburban areas, where the ratios of jobs and taxes to land consumption are considered attractive. Yet, in an internal document addressed to cities, the real estate developer of the French La Poste group claims that, with 75 jobs per 5,000 m², the average employment ratio of urban logistics facilities is far superior to that of traditional logistics facilities (Poste Immo, 2021). In New York City, jobs in logistics facilities have doubled from 2019 to 2021 to reach 16,500 positions (Haag, 2022). In an article on the topic, Haag (2022) even refers to job provision and tax contributions as advantages of urban logistics facilities. Moreover, the New York City Economic Development Corporation specifies salaries in e-commerce, rail and maritime, describing them as good-paying jobs (NYCEDC, 2020). These examples indicate that local authorities' perspective to urban logistics facility development has possibly improved over time, although it still very much depends from one city to another.

Resource endowment factors

Resource endowment factors include land availability, transport accessibility, labor pool, and market coverage, which, together with other spatial factors, are essential to shape the geography of logistics activities (Xiao et al., 2021). Traditionally, logistics is highly dependent on access to large plots of land, which must be located close to main cities and to major road infrastructure (Raimbault, 2021). For logistics facilities in cities' high-demand areas, land availability is poor by definition. As mentioned, solutions include constructing new facilities on abandoned or underused areas and reconstructing existing facilities by renovating or refurbishing. While renovation results in redoing everything, refurbishing implies reusing the existing. Xiao et al. (2021) discuss constructing logistics facilities on former industrial sites in Shenzhen, while Dablanc (2018) provides examples of reuse of a publishing company in

Barcelona and an aerial parking structure in Paris. With the slowing growth rate of commercial property sales and the accelerating vacancy rate of commercial properties (Zhang et al., 2016), these types of spaces are also increasingly used for urban logistics.

As Rodrigue (2020) suggests, the land use patterns of urban logistics facilities mimic those usually applied to retail stores. Both operating in high-demand areas, it automatically facilitates accessibility to transport and labor, particularly when compared to traditional logistics facilities. Like retail stores pursuing market density, so too demand urban logistics facilities a more fine-grained coverage of the market to carry out operations. As such, the development of logistics facilities in dense, mixed-use urban areas is determined by the availability of multiple spaces that are highly diverging in terms of size, urban implantation and former development type or function.

2.2 A typology of proximity logistics

Providing a consistent base for discussing the proximity logistics developments in the five case study cities that follow in this article, this section summarizes logistics facility types based on a typology by Rodrigue (2020), completed with perspectives from the typology by Onstein et al. (2021). Table 1 lists seven archetypes and indications on their size, service area and logistics activity. We include as well various other logistics facilities introduced in literature. They relate closely to one of the archetypes and are specifically of interest for developments in dense, mixed-use urban areas.

Table 1. Typology of logistics facilities.

Logistics facility	Size	Service area	Activity
Cross-dock facility Air hub	M to XXL	Regional, national or international	Cross-docking
Wholesale and retail facility	M to XXL	Regional, national or international	Storage, fulfilment and cross-docking
Fulfillment center	M to XXL	Regional, national or international	Storage and fulfilment
Sortation center	S to XXL	Regional	Cross-docking
Delivery station	XS	Local	Cross-docking
This facility type also covers urban consolidation centers (Dupas et al., 2020; Marujo et al., 2018; Rudolph et al., 2021); micro-consolidation centers (Janjevic and Ndiaye, 2014; Marujo et al., 2018; Rudolph et al., 2021); micro-hubs which can be independent, shared or consolidated (Kim and Bhatt, 2019; Rudolph et al., 2021; Russo et al., 2021; Schodl et al., 2019); and mobile hubs (Arvidsson and Pazirandeh, 2017; Sheffi, 2020; Srivatsa Srinivas and Marathe, 2021; Verlinde et al., 2014).			
Fast delivery hub	XS	Local	Storage and fulfilment
This logistics facility type also covers urban satellites (Alfieri et al., 2021); dark stores ; and warestores (Sheffi, 2020).			

Pick-up location			
Local freight station	XXS	Local	Collection

These facility types also cover parcel lockers; pick-up points (Onstein et al., 2021); click-and-collect stores ; and drives (Buldeo Rai et al., 2019).			

3. Methodology

As cited in Meyer's (2001) methodological article on the case study methodology, case studies are particularly useful for responding to 'how' and 'why' questions about contemporary phenomena (Leonard-Barton, 1990). They are tailor-made for exploring new processes or behaviors, or ones that are little understood (Hartley, 1994). As demonstrated throughout sections one and two, proximity logistics is such a topic.

Important to develop the case study design are: case selection, sampling time, and data collection procedures (Meyer, 2001). We chose to compare five cases that share two characteristics: high population density, implying a high demand for goods and thus logistics (Rodrigue et al., 2017); and high rates of e-commerce adoption, being a key driver of innovation in logistics (Dablanc, 2018). Following this theoretical sampling procedure, in which cases are selected purposefully rather than randomly, our five cases are: New York City, United States; Paris, France; Seoul, South Korea; Shanghai, China; and Tokyo, Japan. As Meyer (2001) puts it, it is desirable to include more than one case, but still fairly few to concede to the desire for depth and a pluralist perspective. With three Asian cities, one European and one North-American, cases differ in geographical spread. It reflects Asia's pioneering position in urban logistics real estate innovations (Dablanc, 2018).

In response to the two research questions formulated, we employed an embedded design. This implies that more than one unit of analysis is explored in each case (Yin, 1984). While the first research question centers around how each case's regulatory context towards logistics facility development influences proximity logistics; the second research question queries its spatial, operational, architectural, and economic characteristics. As such, each case explores the presence of logistics facilities in dense, mixed-use urban areas, its regulatory context, and its characteristics. The regulatory context includes land use policies, zoning ordinances, stakeholder debates, among others. Spatial characteristics include locations and neighborhood types; operational characteristics include logistics functions, operators, and vehicle types; architectural characteristics include surfaces, buildings, and floors; and economic characteristics include rent values, developers, and business models.

To operationalize our 'embedded, multiple-case design' (Yin, 1984), we employed different data collection procedures that allow for triangulation. The research is conducted based on an international collaboration of research teams with an expertise in urban logistics and its facilities (including location factors, logistics sprawl, and trends). Local research teams collected and analyzed data for each case, thus guaranteeing profound case understanding and facilitating knowledge of and access to documents and contacts. Each team focused on their case's dense, mixed-use areas and a variety of logistics facilities within these areas, as presented in section two. The precise geographical scope and approach to data collection and analysis is presented in what follows, with more details in appendix. Throughout several joint and bilateral videoconference meetings, case study findings were presented, analyzed

and discussed. Section four elaborates each case, while section five represents the joint discussion.

New York City, United States

The case study concentrates on the five boroughs of the City of New York. This is the most populous city of the United States (8.3 million people), with over 4 million more people than the next most populous city, Los Angeles (United States Census Bureau, 2021). The average population density is 10,527 inhabitants per km². However, density varies across each borough (Core Data NYC, 2021). Although these boroughs have different social distributions, one thing they have in common is the significant mix of land use areas (NYC Planning, 2021).

Due to the heavy population density in the city, and the increasing demand for e-commerce, the location of logistics facilities within the city is becoming increasingly important. However, these developments are linked to social, political, and private motivations that do not always align. Data collection for this case study consists of reviewing documents and interviewing experts. To understand current land use, existing regulations, zoning and land use maps (ZoLa) from the New York City Department of City Planning (NYC DCP) were reviewed, as well as agency freight plans. One such plan is “Delivering New York: A Smart Truck Management Plan for New York City” by the New York City Department of Transportation (NYC DOT).

To identify current developments, also investigated were business reports, press data, and journal publications. An interview was also conducted with relevant staff from the NYC DCP. Data collection spanned from June to October 2021. We analyzed the data by mapping regulations, zones, and existing urban logistics facilities, and by categorizing the facilities by type.

Paris, France

The case study is limited to the City of Paris, inside the first ring road of the Paris region area, corresponding to twenty boroughs called ‘arrondissements’ (105 km²). The city is characterized by a dense population (21,000 inhabitants per km²) and a high level of mixed land use.

Logistics facility development being a topic of interest to a specialized and general public alike, the data collection consists of systematically reviewing articles from the business and general press that report on logistics facility development in the city, as well as consulting secondary sources such as industry reports and company websites for additional details. Specifically, the data collection builds on an elaborate exercise by the Parisian planning association published in 2014. It lists all logistics facilities developed, under development and planned within the city (Apar, 2014). By extending and updating it with the most recent information available, we provide a complete picture of logistics facilities in Paris’ dense, mixed-use areas. We also conducted expert interviews representing the logistics sector active in Paris for verification and completion. The data collection spanned from April to August 2021.

We collected all information originating from the article review in a spreadsheet file organized per urban logistics facility. In separate columns, details on its location, size, activity, operator and vehicle usage, among others, were provided. We completed this file with information originating from secondary sources and expert interviews.

Seoul, South Korea

The case study focuses on the City of Seoul, where 9.7 million people reside in 605 km² with a density of 16,088 people per km². Because of the high demand for land and corresponding land rents in Seoul, most logistics facilities accommodating the city's logistics demand are located outside the city perimeter.

Most of the framework for regulating and providing guidance for logistics facility development in South Korea is governed by the central government, particularly the Ministry of Land, Infrastructure, and Transport (MOLIT). Municipal governments review development applications submitted by facility developers and provide development permits complying with the legal framework. This framework is again governed by the central government and advisory committees, consisting of experts from the private and public sectors, including the MOLIT. We reviewed national and municipal logistics masterplans and the recent changes in the law relevant to logistics facility development. Further, we conducted multiple interviews with warehouse developers, operators, and university professors. The data collection spanned from September to November 2021.

We located all facilities listed in the national building registry and included those that exceed 1,000 m² in the building area. This threshold is required to report to the MOLIT to operate as a "logistics facility." We also located all logistics facilities in and around Seoul currently utilized by CJ Logistics, the largest logistics company in South Korea with approximately 47.2% of the market share in 2019.

Shanghai, China

The case study focuses on the urban core surrounded by the Outer Ring Road of the City of Shanghai. The study area, whose size reaches 664 km², covers the densest parts of the city. With 11 million residents living in this urban core, average population density is about 16,800 inhabitants per km². In contrast, the density is as high as 28,600 inhabitants per km² within the inner ring, while the density of the entire City of Shanghai is about 4,000 inhabitants per km².

Data of logistics facility development in the study area was from different sources: the Fourth National Economic Census by the National Census; the National Enterprise Credit Information Publicity System; and field work including interviews and small-scale surveys. We have located logistics facilities from the first two data sets according to firm-level definitions and verified a sample of them through on-site investigations. Those investigations were conducted between May and August 2021. Other major sources of data and information include plans, white papers, and official documents made by national and municipal governments, media reports, and articles of professional consulting companies.

Tokyo, Japan

The case study focuses on Tokyo City and its surroundings. In the Tokyo Metropolitan Area (including Tokyo City), the total size of "Urbanization Promotion Area", where zoning regulations are specified, is about 3,430 km² (about 8,800 inhabitants per km²). The focus of the study is the central part of the Tokyo Metropolitan Area, which has a monocentric urban structure with the location around the Tokyo Railway Station as the center.

The data of logistics facilities were obtained from various sources: a list of large-scale facilities in the study area, published by a for-business real-estate company (CBRE, 2021),

information provided by Japan Logistics Field Institute, Inc. (a consulting company in logistics real estate) and the Institute of Behavioral Sciences (a research institute who has engaged in a number of official freight surveys), delivery service providers' websites (Yamato Transport, Sagawa Express, and Japan Post), and Google Maps. The other data used in this research include GIS data for zoning regulation (Ministry of Land, Infrastructure, Transport and Tourism Japan, 2011) and business articles and public reports.

We reviewed zoning and relevant public policies, the trend in e-commerce and parcel deliveries, and the distributions of large logistics facilities (especially those developed recently) and small distribution centers for the last mile. The data collection and analysis were conducted between May and September 2021.

4. Findings

New York City, United States

In New York City, truck activity is vital for the correct functioning of the city as it receives 90% of its goods by truck. In addition, the daily on-demand delivery rate for the city is 1.5 million packages, with over 45% of New Yorkers receiving one home delivery per day (NYC DOT, 2021). Although the city has seen important growth in e-commerce for the last 10 years, the recent demand surge resulting from COVID-19 resulted in increased attention from all the entities responsible for developing urban freight plans, notably related to freight facilities development and regulations, to pay more attention to these topics.

Freight plans are developed at the City, State and Metropolitan Region Level. However, aspects of freight facility development in the City of New York fall under the jurisdiction of many different entities. The New York Metropolitan Transportation Council, the region's metropolitan planning organization, brings together regional stakeholders and develops a long-range freight plan that identifies regional priorities for infrastructure development and investment. The New York City Department of City Planning (NYCDCP) develops and maintains zoning regulations within the City of New York. The New York City Department of Transportation (NYCDOT) manages traffic control, curb access, and parking restrictions, on local streets; their priorities are to promote safe and efficient freight operations. The New York City Economic Development Corporation (NYCEDC) promotes economic development in the city, including strategic multimodal freight infrastructure. The Port Authority of New York and New Jersey manages the region's ports, airports, and their cargo areas.

Modern zoning and land use regulations in New York City date back to the 1960s-1970s. The city's zoning resolution generally divides the city into three types of areas: residential, commercial, and manufacturing. Warehousing development is permitted in all areas zoned as manufacturing (zoning M1, M2, or M3), as well as in one type of area zoned as commercial, C8 (City of New York, 2021). Areas with C8 zoning "bridge" commercial and manufacturing uses, and provide for heavy commercial services that require large amounts of land (City of New York (n.d.)). Warehouses can be developed "as of right" in these areas; no specific permission is required from the NYCDCP. As a result, the agency is not always immediately aware of new developments. As can be seen in Figure 1, areas zoned for warehousing development are frequently adjacent to residential areas. For example, in Red Hook, Brooklyn, a residential area is surrounded by zones where warehousing development is permitted.

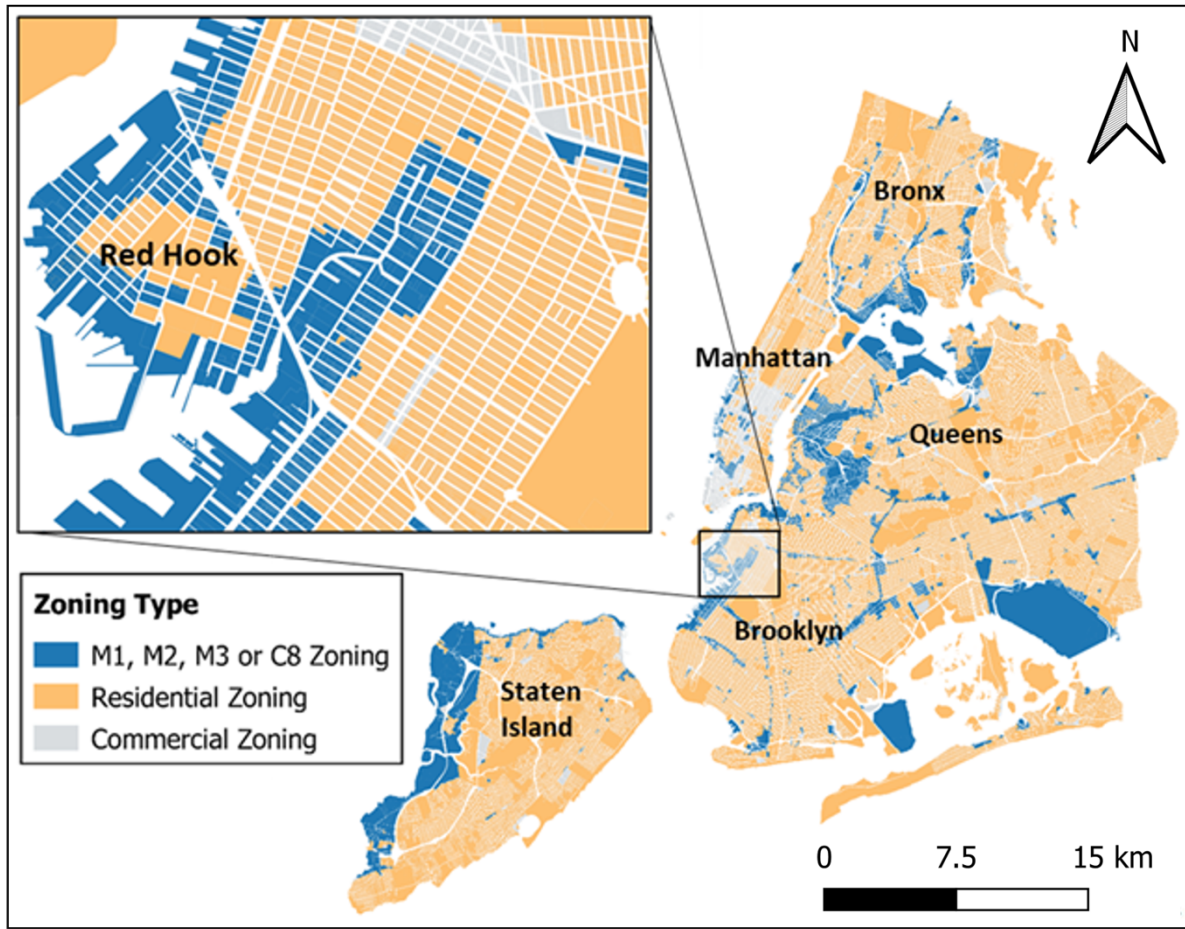


Figure 1. Areas with permitted warehousing development (map produced by authors).

The zoning resolution does not classify logistic facilities by function. Currently, the Department of City Planning classifies warehouses into four types: fireproof, contractor's warehouse, self-storage warehouse, and miscellaneous. The two boroughs with the most warehouses (i.e., count of tax lots) are Brooklyn and Queens. Here, most of the warehouses are under the 'fireproof' category (70% and 59%, respectively) (NYCDCP, 2021). One of the major problems with this categorization is that it does not identify what type of warehouses are destined to e-commerce or retail facilities, nor does it provide information on which part of the operations they support. Nonetheless, further development is taking place mainly in the aims of supporting e-commerce activities.

Within the boundaries of New York City, there has been an expansion of almost 428,000 m² of logistic space, from 2019 to 2021, most of it located in Staten Island (306,580 m², see Figure 1). As the city's least densely developed borough, it is the area most hospitable to development of large **fulfillment centers**. However, logistics facility development is also rapid in Brooklyn and Queens, where new multi-story developments are occurring. In Brooklyn, a four-story facility is being constructed in Sunset Industrial Park, near the Red Hook industrial area along the Gowanus Canal (Figure 2). This development will add 120,773 m² of space (Reuters Events, 2019). In Queens, two major developments are taking place. The first in Jamaica, Queens will add 16,741 m² of urban logistics space (Lambert, 2021). The second in Flushing, Queens will add 103,493 m² of space to the city in a five-story development (RXR, 2021).



Figure 2. Design for the new multi-story logistics facility in Brooklyn (Bridge Industrial, 2021).

Currently, the major lessee is Amazon with about 205,000 m² of space in the city. This company also already has contracts in place to occupy spaces that are under development, making it the company with the largest logistics footprint in New York City (Haag and Hu, 2021). In general, the new developments are modern warehouses that will serve not as fulfillment center but as **delivery stations**, where the rotation of packages will be significant. Most of these urban logistics facilities will accommodate trucks as main mode (Parry, 2020).

In addition, another 195,096 m² are currently under construction in other boroughs. Planning experts state that due to the high and growing demand of e-commerce related activities, this space will still not be able to meet the requirements of on-demand delivery and food and beverage companies. Due to this effect, the city looks for support in terms of space from adjacent areas such as the Lehigh Valley, the northern part of Philadelphia, and New Jersey. In these zones, many warehouse developments are high-cube and automated warehouses (NJTPA, 2021). In other efforts from the New York City Department of City Planning to understand freight facilities and to measure the impact and needs from growing e-commerce trends, the institution has created a repository of freight facilities supporting the last mile operation. However, this is an ongoing project that requires collaboration of the private sector but that will allow to provide updated information on the existing type of facilities.

Both NYCDCP and NYCDOT have developed strategies to manage logistics facility development. NYCDCP has developed a plan to understand the current situation towards freight facilities, that includes (1) gathering information, (2) understanding the motivation behind each type of freight facility, and (3) developing plans that make these facilities more efficient. In its "Smart Truck Management Plan", NYCDOT identified a number of urban logistics approaches to manage e-commerce delivery activity, including (1) urban consolidation centers that will serve to reduce freight consolidation on the curb, streets, bike lanes, or sidewalks; (2) shared locker facilities to improve last mile delivery; and (3) multimodal freight hubs that will allow transfer between trucks and green modes such as barges and cargo cycles (NYCDOT, 2021). Although these plans are yet to be implemented, the city is supporting these strategies with other actions that look to make on-demand deliveries more efficient.

Paris, France

France presents a unique case of awareness on logistics urban planning, with a national urban planning code in which the provision of logistics facilities in dense areas is described as 'necessary'. In accordance, the City of Paris, which is in charge of zoning plans and building permits, stands out from other European cities with policies on logistics land use. More general Master Plans exist at metropolitan and regional levels, but they are not prescriptive. Since the early 2000s, the city has set an aim to reintroduce logistics facilities within its boundaries and accordingly reduce freight distances travelled. To this end, the city promotes the development of large multi-story and multi-activity facilities, called 'logistics hotels', as well as the creation of small logistics facilities for cross-docking all around the city with an exemption regime. As illustrated by Figure 3, it also introduced more than sixty 'location perimeters' on private land parcels, on which developers are obliged to integrate a logistics facility when building there, or reconstitute it when one is already present (Dablanç, 2021).

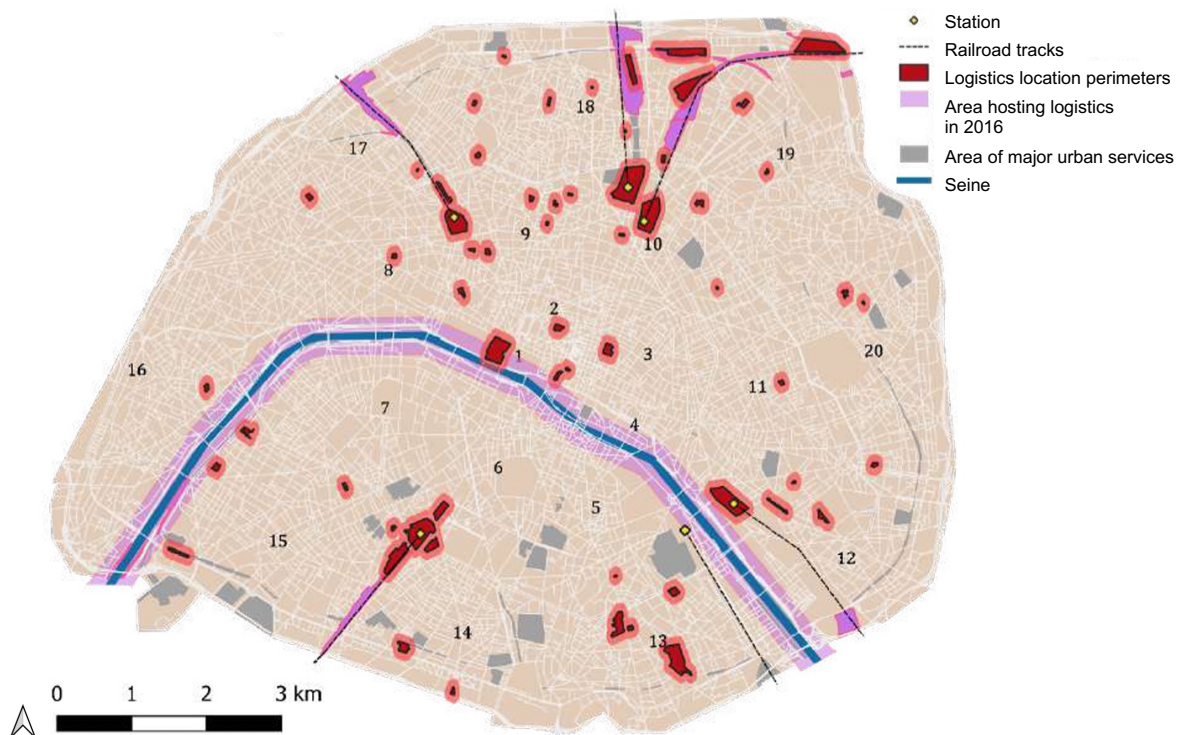


Figure 3. Location perimeters for logistics facilities in Paris 2016 zoning plan (Zachert, 2020).

In addition, the City of Paris has put in place experimental programs on sustainable urban logistics since 2015, testing various innovations with a diversity of stakeholders. Experiments include **mobile hubs** (a type of **delivery station**), parcel lockers, routing optimization, and off-hour deliveries (Paris&Co, 2018). In 2021, the City of Paris launched a broad consultation with a series of online workshops on urban logistics, including one on land use and logistics real estate, to develop its future strategy. In doing so, it opened up the debate with various stakeholder groups, including from the logistics sector, but also vehicle manufacturers and energy companies.

Paris' consideration of logistics as an essential function instead of a nuisance, translates into interesting developments. In an earlier overview of logistics facilities developed within its twenty boroughs, Apur (2014) identified over thirty sites. These sites are primarily concentrated at its borders: in the south-east and south-west, where the Seine river intersects with the city, and in the north. Most of these facilities are under 20,000 m², historical industrial and logistics sites supporting construction activities and transport by rail and waterways, serving as **delivery stations**. Nonetheless, such modes still account for only a marginal share of goods.

A few logistics facilities larger than 20,000 m² remain in the north of Paris. One example includes 'Entrepôt Ney', a 120,000 m² three-story ramped warehouse owned by Geodis and occupied among others by Amazon, where it stores 18,000 food items and other products to deliver within two hours. Combining storage and fulfilment, this **fast delivery hub** is being transformed to carry out deliveries on foot and by cargo-cycle. 'Chapelle International' is a second example. It is a 41,500 m² logistics hotel or multi-story and multi-activity facility developed by urban logistics real estate developer Sogaris and inaugurated in 2018. It includes a large parcel cross-dock facility for parcel distributor DPD, functioning as **delivery station**, among others. Some large multi-activity redevelopment projects that include logistics facilities are under development, such as by real estate company Segro in 'Gobelins' (75,000 m² for logistics) and by Sogaris in 'Bercy-Charenton' (17,000 m² for logistics), both within the City of Paris boundaries. Both are envisioned to serve as **delivery stations** as well. See Figure 4 for the design of Bercy-Charenton, created by enia architectes.

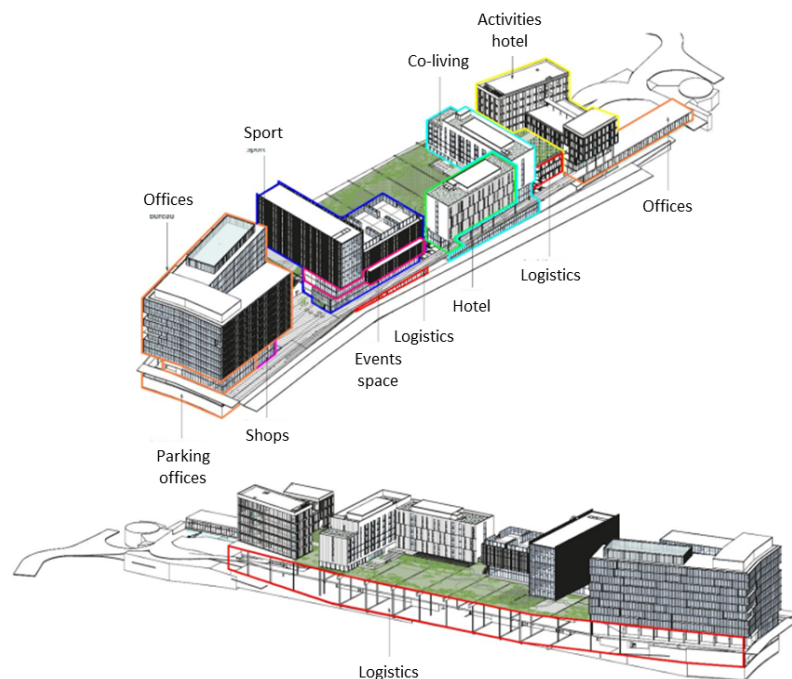


Figure 4. Design for Bercy-Charenton (Piechaczyk, 2021).

The few logistics facilities situated in the heart of Paris are not larger than 1,000 m² and mainly support business-to-consumer e-commerce as **delivery stations**. Such facilities work best for large volumes of small parcels, supplied by trucks and delivered with electric vans or bicycles. Some of these facilities are still operational today, with Chronopost's transformed underground parking spaces 'Concorde' and 'Beaugrenelle' as examples, others aren't, such

as Geodis' Distripolis project. Nonetheless, it is this type of logistics facility that surged most in Paris in recent years.

Making use of existing buildings (mostly former parkings and garages, but also offices, train stations, stores, and storage places), they serve logistics activities in spaces between 500 and 5,000 m². For the delivery of fresh and frozen products, Chronopost inaugurated in 2018 a 4,000 m² logistics facility in the basement of an office building. Some developments are hybrid, in a temporary or transitory sense. The first is exemplified by an experiment of 'time-sharing', in which Amazon and Chronopost use bus terminals for cross-docking e-commerce parcels when buses are out on rounds. The second is employed by bicycle delivery company Swoopin, which looks for short-term rental contracts in sites that are waiting an authorization for redevelopment. In this way, the **delivery stations** are occupying several facilities for cross-docking activities, with the advantage of lower rents. Other developments are mobile, such as UPS and Stuart using trailers that are placed in public space.

In the shadow of the ring road in Paris' 19th arrondissement, Sogaris together with architectural firm SYVIL, has developed a **delivery station** in a space that was previously lost to the city and its inhabitants (Figure 5). The nearly 800 m² is occupied by delivery company Ecolotrans and is dedicated to last mile logistics activities. CNG trucks are unloaded early in the morning by a team of about thirty employees, who then supply the north of Paris with small electric vehicles or three-wheeled bicycles. In conclusion, as one interviewee from the La Poste group states: "we haven't found miracle solutions yet". All companies identify the need to find the right facilities as one of the main challenges of these new urban logistics formats.



Figure 5. Logistics facility "P4" constructed under the ring road (Sogaris, 2021).

Logistics facilities for storage are increasingly surfacing as well, as exemplified by the influx of start-ups that deliver groceries within fifteen minutes from a network of small storage and fulfillment centers. They are called '**dark stores**', a type of **fast delivery hub**. Start-ups such as Gorillas, Getir, and Flink hold about 1,500 references in less than 500 m². Despite concerns about the viability and desirability of this development, it is mimicked by traditional supermarket chains such as Carrefour and Monoprix. Shared mobility services such as Cityscoot and Lime are making use of logistics facilities as well, for storage and maintenance of their vehicles. Real estate development companies such as Prologis have also restored buildings in the closest suburbs for storage, although such large-scale business-to-business initiatives are still rare.

Seoul, South Korea

In South Korea, a wide range of large-scale logistics facilities has been exclusively governed by various levels of the government, such as inbound **cross-dock facilities** in port complexes. For South Korea, an international trade-driven economy, an efficient and cost-effective transportation and logistics infrastructure are imperative to function competitively in globalized production and consumption markets. Accordingly, South Korean governments have been fully aware of the need for public intervention. They have been deeply involved in its conceptualization (planning), demand assessment (feasibility study), provision (construction permission), and operation (management) phases.

The Korea Ministry of Land, Infrastructure and Transport (MOLIT) plays the key role in formulating the (1) Master Plan for Logistics Facility Development and (2) Act for Logistics Facility Development and Operation – a parallel system that governs the above-mentioned large-scale logistics facility development and management at the national level (Korea MOLIT, 2018). Until recently, three Master Plans have formulated various policies and regulations for (1) logistics and transportation infrastructure provision, (2) designation and development of logistics infrastructure, (3) operational improvement of the facilities, (4) consolidation and sharing of the facilities, (5) structuring domestic and international logistics connectivity, and (6) maintaining environmental sustainability from logistics and transportation activity (Korea MOLIT, 2018). The most recent Master Plan 2018-2022 emphasized public sectors' role in providing large-scale logistics infrastructure to secure domestic logistics businesses' competitiveness and connectivity in global logistics networks. Notably, the Master Plan recently started to respond to the increasing demand for automated **delivery stations** in central urban areas and the need to improve environmental sustainability of the logistics sector. The Seoul Municipality Freight Plans also acknowledge the need to address the demand for **fulfillment centers** and **delivery stations** (Seoul Metropolitan Government, 2018).

Meanwhile, the regulations for developing smaller-scale warehouses have also been continuously updated. In the 1970s, the Commercial Act for warehousing business and operation required commercial warehouse operators to receive facility development and operation permission. In 1991, the Act was temporarily revised to require the registration, not permission, of commercial warehouses, and the requirement was abolished in 2000 to deregulate the warehousing sector. With a growing demand for quality control and land management, the regulation for commercial warehouse registration, as part of the Act for Logistics Facility Development and Operation, was revived in 2017. But this time, the registration was limited to commercial warehouses with a building area greater than 1,000 m². However, private warehouses (e.g., the buildings, functioning as storage or distribution

facilities in non-logistics sectors) or those that are not commercially utilized for logistics purposes are not required to be registered. In principle, commercial warehouse development has been following the terms in the market economy – supply, demand, and pricing.

With the restructuring of goods supply chains and corresponding facility development responding to increasing online shopping demand, public policies for logistics facility provision have been continuously updated. The Korean government has used the term “provision” in that the Korea Ministry of Land, Infrastructure and Transport, in conjunction with local governments, has exclusively planned and provided development permits for logistics infrastructure. There have been several milestones.

In 1998, the “Act for Logistics Facility Development and Operation” first set out the necessity for the intervention from the public sector. At that time, the maximum thresholds for warehouse building areas developable in logistics parks were examined, estimated, and set by the MOLIT per jurisdiction per period. The rationale behind putting the restraint was to limit leapfrog development and minimize potential duplication of logistics functions, which could result in inefficient resource distribution. Problems arose: e.g., the public sector could not respond timely to fluctuating logistics demand from expanding online shopping. In 2014, a revision of the “Act for Logistics Facility Development and Operation” was enacted. Rather than restricting jurisdictional and temporal development quota, the revision has allowed the development of a logistics park based on the existing market demand and operating entity's financial feasibility.

In 2015, another revision of the Enforcement Decree and Rule for the “Act for Logistics Facility Development and Operation” has provided a legal basis for revamping and remodeling an outdated truck terminal into a mixed-use, multi-story, automated **fulfillment center**, a similar concept to the logistics hotel in Paris, France. For example, part of the complex can be earmarked for retail or wholesale trade, IT, R&D, and light-manufacturing businesses, as well as affordable housing. An old truck terminal located right on the west city limit of Seoul (Yangcheon) is currently being redeveloped, see Figure 6. The redevelopment is expected to have a mixed-use high-rise building (26 floors above and 6 floors underground) with a total building area of 830,000 m². Approximately, 38% of the building area is designated for logistics functions, 25% for retail trade, and about 37% for supporting businesses. The logistics functions are to be located on the lower floors and basement (Park, 2018).



Figure 6. The present view of the west truck terminal in Yangcheon, Seoul (left, Truck-News (2019) and the model view of the redevelopment project (right, Park (2018)).

Recent enactment of the “Last mile Logistics Service Industry Development Act” in July 2021 has formulated a legal basis for public interventions to develop last mile logistics facilities in the urban core. Until then, no legal basis for public intervention for last mile logistics facilities existed. Most importantly, with the Act, when new town planning happens, a portion of the development area can be earmarked for logistics uses. It has multiple implications. First, the Act acknowledges that last mile logistics facilities provide essential functionality for a city to function properly, as other utilities do, such as water, gas, and power. Second, it is expected to substantially decrease the development costs for last mile urban logistics facilities. In fact, it is challenging to build one within the city limits because of high land costs and residents’ resistance.

Instead, the development of unit warehouses has been in the realm of private entities, including manufacturing, trade, and logistics sector businesses. From the operational point of view, the distinction between a logistics facility and a unit warehouse is unclear and does not depend on “who” operates the facility. Yet, the two types of facilities are clearly distinguished from a legal and governance point of view. Hence, a governance gap exists, and it implies a potential disparity in which facility is subject to public intervention (e.g., subsidies, incentives, or regulations). For example, Coupang, one of Korea’s largest online shopping businesses, encoded as a retail business, operates multiple **fulfillment centers** in and out of the publicly-assisted logistics parks (About Coupang, 2021). CJ Logistics, the largest shipping business in Korea with a 47.2% market share, encoded as a logistics business, also maintains **delivery stations** in and out of the publicly-assisted logistics parks (CJ Logistics - Corporate Information, 2021a). Still, maintaining access to freight demand and consumer markets in central urban areas is a goal tough to achieve for both companies without public assistance.

CJ Logistics, in addition to its significant position in the business-to-consumer parcel shipping market, has been originally specialized in contract logistics (business-to-business), forwarding, and multimodal logistics, including rail and maritime shipping. Until the privatization of CJ Logistics’ former business entity in 1968, its main business area was freight transportation and loading and unloading services at the rail stations starting in the 1930s. This unique path dependency has allowed the company to secure a large number of sizable sites for proximity logistics operations, e.g., **delivery stations**, in the urban core until now. Initially, the sites were part of the rail yards acquired as a land grant when the company was a public enterprise (CJ Logistics - Corporate Information, 2021b).

The map in Figure 7 presents the locations of CJ Logistics’ facilities ranging from main **fulfillment centers**, **sortation centers**, and **delivery stations**. The company operates multiple **delivery stations** in the urban core (darker shades represent higher population density in 2019), and the company has owned all of the locations for decades (CJ Logistics - Corporate Information, 2021b). When comparing the spatial distribution of CJ Logistics’ assets with existing warehouses, a clear comparative advantage for operating site selection can be seen for CJ Logistics. A large number of CJ Logistics’ facilities are within or near the city boundary of Seoul, whereas a significant level of concentration of large-scale warehousing facilities are seen along with highway networks around Yongin, Gwangju, and Icheon (30-50 km from Seoul). Without historical path dependency, CJ Logistics would not have been able to secure such high levels of market accessibility.

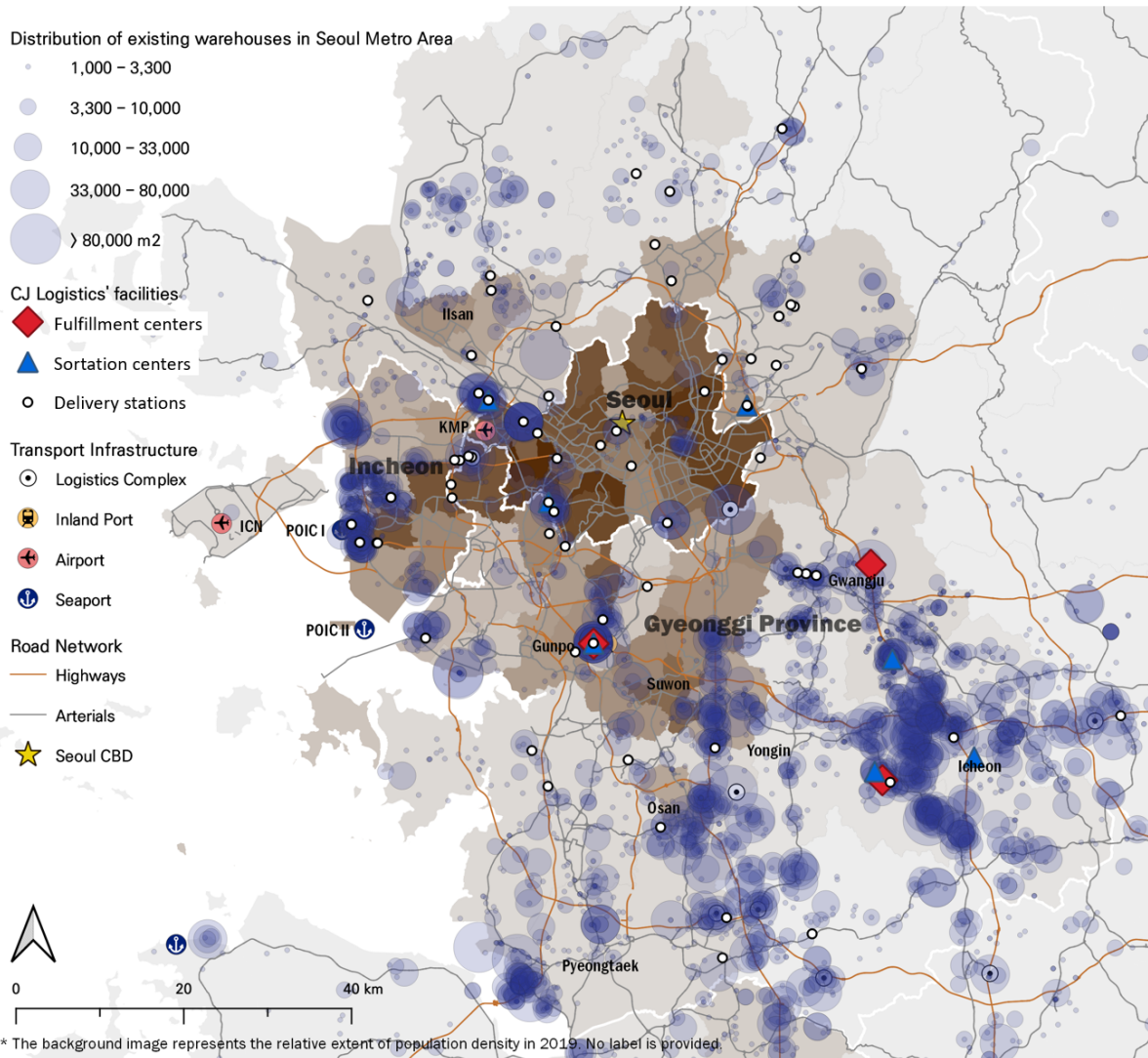


Figure 7. Comparing the spatial distribution of existing warehouses and CJ Logistics facilities in and around the City of Seoul (map produced by author).

South Korea's urban structure has justified the inevitable involvement of public entities in the form of infrastructure planning, land acquisition, and cost assistance. For example, its highly urbanized and highly concentrated aspects increase urban land costs to the level logistics businesses cannot afford to operate cost-effectively. Without public involvement, no such development would have been possible. Otherwise, numerous logistics facilities have been built in urban outskirts with diminishing accessibility to consumer markets and labor pool, resulting in the logistics sprawl.

Shanghai, China

In February 2019, the Ministry of Commerce, and the Ministry of Transport, among other government agencies of China issued an official notice to promote efficient urban delivery and designated 30 pilot cities to encourage the application of innovative practices such as shared logistics facilities (Ministry of Commerce et al., 2019). Although Shanghai was not on the list of those pilot cities, the municipal government has long been aware of the importance of urban logistics, and developed a series of plans and guidances to support the sustainable development of the industry. One of the most influential plans was the Plan of Modern

Logistics Development during the “Thirteen-Five” Period in Shanghai issued in 2016 (Shanghai Municipal Government, 2016). The plan emphasized the service quality and environmental sustainability of last mile deliveries, and encouraged the development of express delivery logistics parks and hubs.

Another document with more details was the “White Paper on Strategic Development of Urban Freight Transportation” in Shanghai (Shanghai Transportation Commission, 2019). The white paper stressed the increasing demand of e-commerce and new business models, and proposed a series of strategies for improving the efficiency of urban logistics. According to the white paper, there were two urban delivery-oriented logistics parks, 31 processing hubs, 4180 express delivery stores, and enormous formal and informal local facilities. Figure 8 shows the spatial distribution of logistics facilities according to the data set from the National Enterprise Credit Information Publicity System. Major hotspots are located in the northeast corner, the north part and the central areas along the Huangpu River. While the facilities in the northeast corner next to the port are medium to large size **fulfillment centers** or regional **parcel hubs**, those in the central areas are generally small or micro size ones, such as **delivery stations** or **local freight stations**.

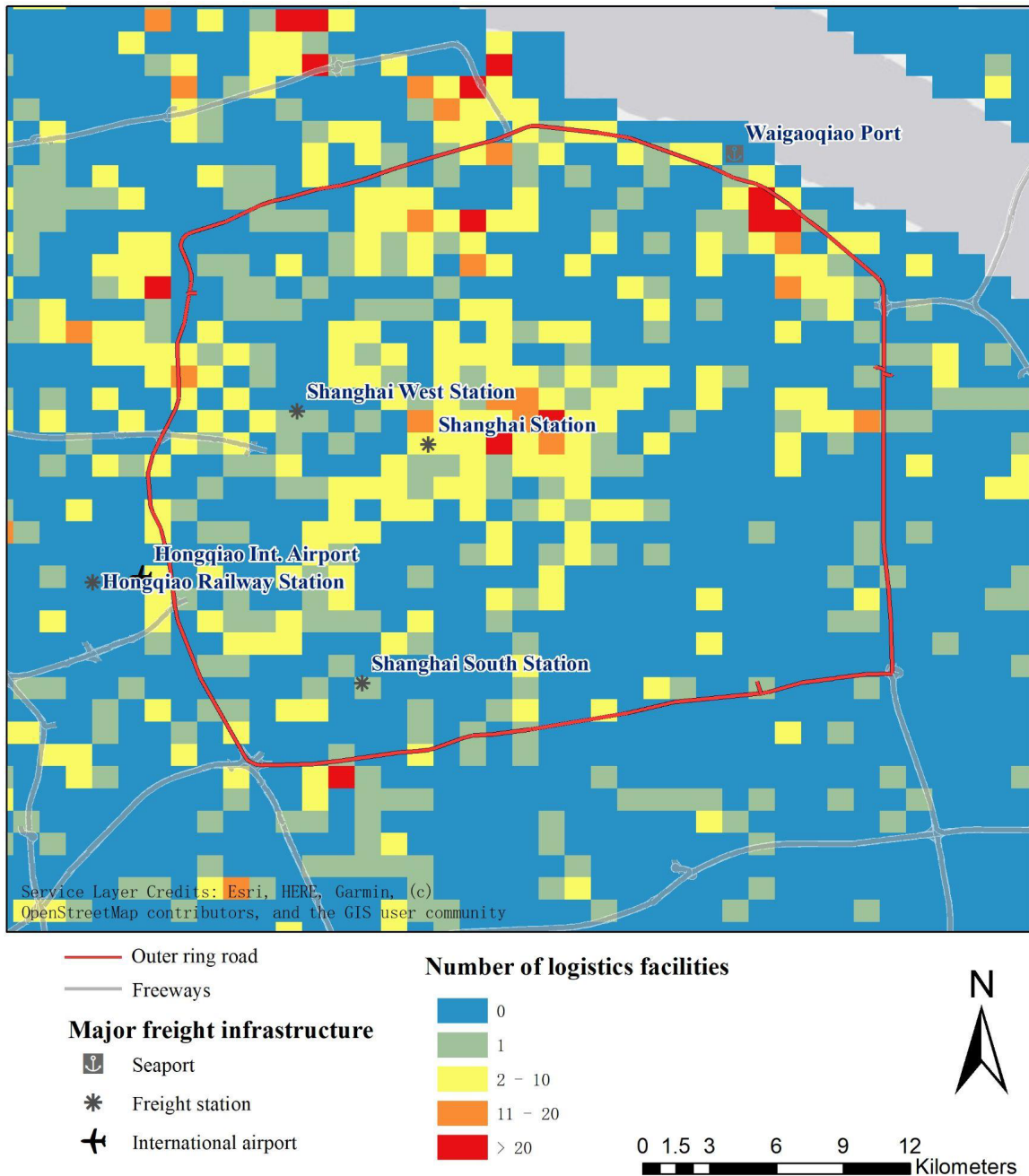


Figure 8. Spatial distribution of logistics facilities (map produced by author).

While the urban logistics network had been well developed, there were several challenges for further enhancing efficient deliveries. Among them, the mismatch between demand and supply in urban logistics would be the most critical one. Traditional residential neighborhoods did not plan adequate space for goods warehousing and distribution, making last mile deliveries rather challenging. The dramatic increase in land rents in the central areas leads to major difficulties in developing new logistics facilities or even redeveloping old ones. An interview with a manager of Yuantong, a large delivery company in China indicated that the trend of logistics decentralization was overwhelming. Their **sortation centers** have been gradually relocated to outer suburbs, leaving small-size **local freight stations** in the urban core only.

The difficulty of developing shared logistics facilities in central areas turns out to be significant as well. Shared logistics facilities were included as one of the most promising practices in various documents and guidances issued by the national government agencies. However, issues such as land use planning, operation and collaboration models, charge schemes, and information security have become major barriers that prevent widespread development of such facilities. An interviewee from the SF Express, China's largest private logistics company acknowledged the needs and difficulties, "we look forward to collaborate with other logistics companies in using the shared facilities and reducing redundant delivery supplies." However, relevant stakeholders including local residents and players along the logistics chains have not reached a consensus about how to distribute the benefits and costs.

There are limited large-size logistics facilities in the study area, given the continuous movement towards the suburbs during the last decade. One example is the Shanghai Logistics Center of SinoPharm Logistics. SinoPharm is the largest company in China, specialized in manufacturing, trading, and delivering medicines and pharmaceuticals. This facility is dedicated to deliveries to hospitals, drug stores, and households in Shanghai. It was completed in 2016 and is located in the Jingan District, only seven kilometers away from the old Shanghai Railway Station. With a built-up area of more than 42,000 m², the three-story facility was equipped with an advanced automated warehousing system that enables fast loading, unloading, transshipping, and storage. The first floor of the facility was assigned to loading/unloading and cold chain management, the second floor generally contained functions of unpackaging and resorting, while the third floor was dedicated to bulk sorting. Another case is the Logistics Center of the Shanghai Linghua Logistics Co., Ltd., which belongs to the Mitsubishi Logistics Corporation. This logistics facility is a two-story structure with more than 10,000 m² and 12-meter net height. The facility is located in the east part of the Pudong District, around 8 km away from the financial center of the city, Lujiazui.

In fact, the two typical cases of large-size logistics facilities belong to either a state-owned company or a foreign company, instead of major express delivery companies. As express delivery companies need to cover a large number of customers widely located across the city, they otherwise choose to depend on an enormous number of small-size **local freight stations**. As said by the interviewee from the SF Express, the company plans to convert a traditional logistics network with facilities in similar sizes into a new hierarchical system with two levels of facilities. The top level is regional or sub-regional distribution centers with a huge number of square footage in the suburbs and the bottom one is **local freight stations** with limited space for storage. In the meantime, they would like to increase the turnover of the goods movement through hiring more delivery workers. The interviewee admitted that land was so expensive yet scarce in the core areas of Shanghai that the company chose to rely more on human capital than land resources.

In terms of those small-size **local freight stations**, their forms vary a lot. In general, they can be categorized into two types: self-operated and shared ones. The self-operated facilities are owned, managed, and maintained by logistics companies, mostly express-delivery companies. Facilities of the same company usually have similar appearances and structures. For instance, Cainiao Network, a major logistics delivery collaborative network in China, had made specific requirements for individually owned Cainiao Stations, which serve as the last mile delivery hubs. Each of the stations needs to be larger than 20 m², equipped with independent parcel storage space and front desks for receiving customers. The station would be guided by the Cainiao Network company in remodeling such as color schemes, icon

placement, and organization of in-station space. Two typical Cainiao Stations are shown in the photos (Figure 9).



Figure 9. Two typical Cainiao Stations (photos collected by author).

Tokyo, Japan

Tokyo has been historically a port city since the early 17th century. After the nation-wide modernization in the late 19th century, the vast land reclamation was implemented and the bay area was developed as an industrial region. Keihin region - the coastal area of Tokyo, Kawasaki, and Yokohama city - is, even at present, one of the largest industrial regions in the country. The coastal area and the area along Arakawa River are designated as industrial zones under zoning regulation. Roughly 35% of the area within the Central Circular Route (an 8 km radius of the center) is for industrial use. A large share of logistics facilities have been located within those industrial zones as shown in Figure 10, a map produced based on the Ministry of Land, Infrastructure, Transport and Tourism (2011). Furthermore, in Japan, zoning regulations for urbanized areas are not strict for developing logistics facilities. Logistics facilities can be located in all types of commercial and industrial zones as well as one of the residential zone types, i.e., the zoning type which is typically designated for the areas along arterial roads.

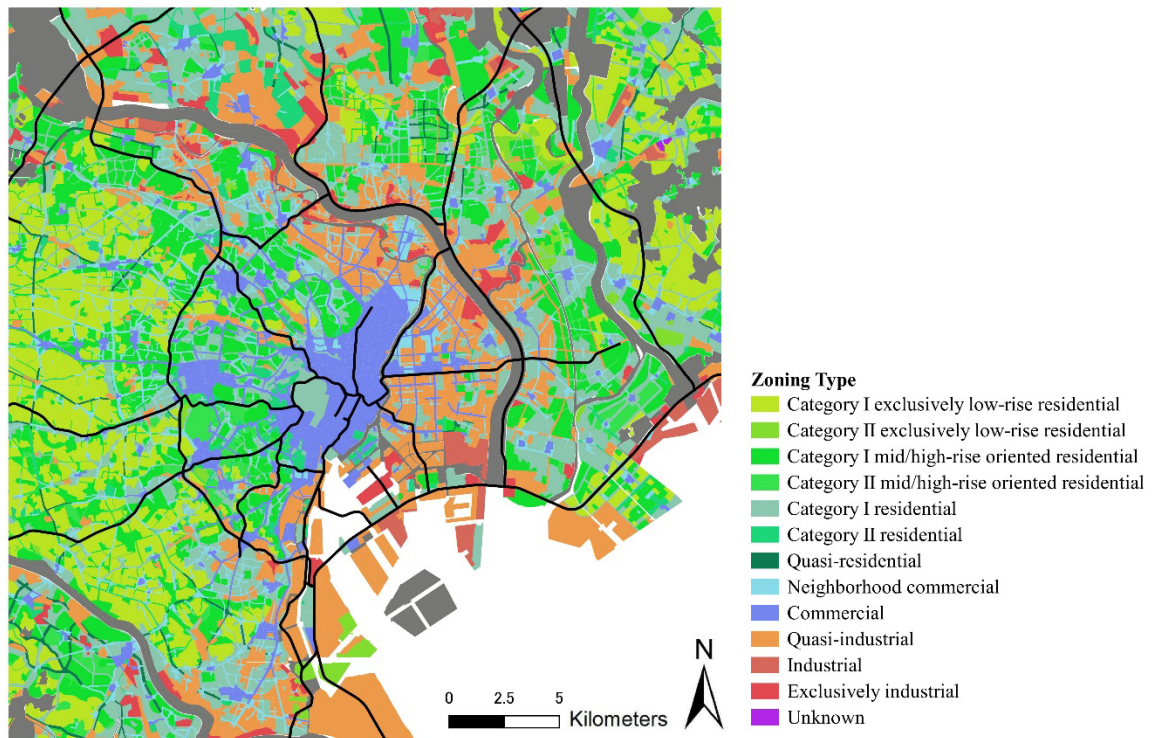


Figure 10. Zoning types in the central part of Tokyo (map produced by author).

However, despite the favorable zoning to logistics, high land prices in urbanized areas and the shortage of space for large-scale logistics facilities have been identified as an issue by the public sector. Coastal areas, which are close to the areas with the highest density, are highly occupied. Moreover, the development in exurbs, where most land is designated as Urbanization Control Area (UCA) is strictly prohibited. The Government of Japan developed a policy measure to secure the space of logistics facilities in the high-density urban area back in 1966, “Act of Concerning the Improvement of Urban Distribution Centers”. Based on the act, the government designated four distribution business parks in Tokyo, where only logistics activities are allowed, around 1.8 km² in total, at 8-15 km from the center.

More recently, the government enacted two programs for catering to the growing need for large-scale logistics facilities. One is “Act on Advancement of Integration and Streamlining of Distribution Businesses” (AAISDB) enacted in 2005. With the AAISDB, the public sector can allow the development of logistics facilities in UCA (and/or provide financial support), if such development contributes to the efficiency improvement in logistics operations. The other is the financial support for the “Internationally Competitive Distribution Business Base Development Project”, which started in 2013. The purpose of the latter is to encourage the renovation of logistics facilities in the port area. The Tokyo Danchi Reizo, a cold storage with 136,000 m² located in the coastal area of Ota Ward, Tokyo, was developed in 2018 using this program, replacing its old buildings developed in the 1970s (Figure 11). At the local level, the municipal governments concern the mixed land use of industrial and residential purposes, which is caused by the residential developments within traditional industrial areas, especially in quasi-industrial zones, and some of them introduce the policies to regulate such developments (e.g., Sagami-hara city, Kanagawa).



Figure 11. Tokyo Danchi Reizo (photo taken by author).

Looking into large-scale facilities, based on the report from Transport Planning Commission of the Tokyo Metropolitan Region (TPCTMR, 2015), the logistics facilities have been increasing in size and converting for lease. According to CBRE (2021), there are about 150 multi-tenant logistics facilities developed during 2011-2021 in Tokyo City and its surroundings, which accounts for 13 million m² (Figure 12). The supply is still growing fast; 2.6 million m² of such facilities were developed in the Greater Tokyo Area (seven prefectures including the study area), in 2020 only (Japan Logistics Field Institute, Inc., 2020). These facilities are located both in the port area and exurbs. Those in the port area, proximity logistics facilities by definition, replaced old warehouses. The above-mentioned Tokyo Danchi Reizo is an example. On the other hand, those in exurbs are often at the sites which were newly developed following the completion of Ken-O Expressway sections - the road functioning as the 3rd ring road. Despite the rapid growth in supply, 98.7% of the floor space in the Greater Tokyo Area is occupied as of 2020 (Japan Logistics Field Institute, Inc., 2020).

In Japan, 23.1% of newly developed multi-tenant logistics facilities are occupied by e-commerce vendors (it was 3.5% in 2010), based on the data shared by the Japan Logistics Field Institute, Inc. Major e-commerce vendors, such as Amazon and Rakuten, locate their **fulfillment centers** and **cross-dock facilities** in them, instead of having their own facilities. Many of those facilities, especially those developed recently, introduce automation using robots. In recent years, the development of logistics facilities is largely driven by the growth in e-commerce. In Japan, the share of the e-commerce market in retail was 6.76% in 2019 and 8.08% in 2020 (Ministry of Economy, Trade and Industry, Japan, 2021). In the study area in 2020, around 20 Amazon facilities are located within those multi-tenant logistics facilities.

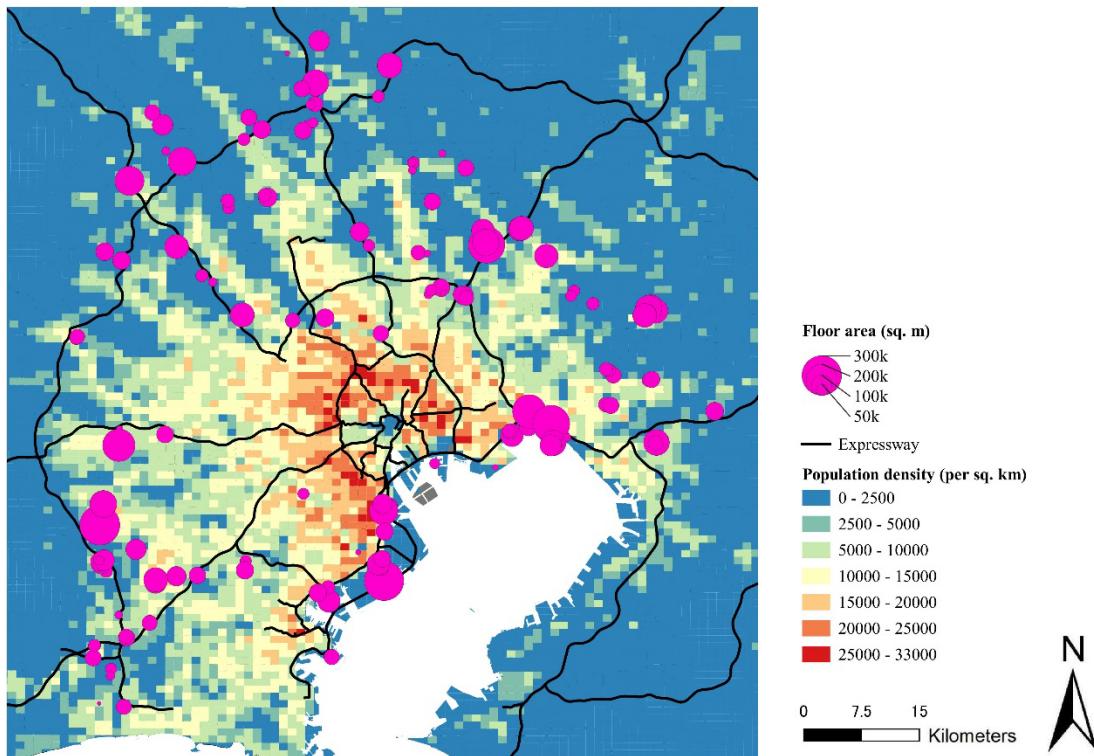


Figure 12. Multi-tenant large scale logistics facilities developed during 2011-2021 in Tokyo and the surroundings (n=148, map produced by author).

Compared with large facilities, it is less struggling to find spaces for small, last mile facilities, although delivery operations are increasingly challenging due to the fast growth of demand. Parcel deliveries grew faster than e-commerce; the growth between FY 2019 and FY 2020 was 11.9% and reached 4.8 billion in FY 2020 (Ministry of Land, Infrastructure, Transport and Tourism, Japan, 2021). In Japan, about 90% of parcel deliveries are carried out by three major delivery service providers (Yamato Transport, Sagawa Express, and Japan Post) (CARGO NEWS, 2021). While various transport modes (truck, van, and bicycle) are used for urban deliveries, the deliveries using automobiles became challenging in the business districts in Tokyo after the enhancement of the parking regulation enforcement in 2006 (Nittsu Research Institute and Consulting, 2006). Since the parking spaces for goods handling have not been expanded, such stricter enforcement puts the delivery service providers in a difficult situation.

One of the solutions to the situation is the dense deployment of small-scale **delivery stations**, which function as origins for the last mile deliveries (and also **local freight stations**), allowing for deliveries using handcarts and electric assisted bicycles. Figure 13 shows the locations of Yamato Transport's **delivery stations** in the central business district. The aforementioned zoning regulations favorable for logistics facilities as well as the (large) scale of demand handled by delivery service providers work favorably for such a strategy. Similarly to small retail shops, delivery service providers rent the first floor of office buildings in business districts or residential buildings (i.e., apartments) in residential and mixed use areas. It should also be noted that, in the central 23 wards in Tokyo, 99% of the population live within 500 m from convenient stores (i.e., small retail shops remain open 24 hours)

(Diamond Chain Store Online, 2015); these stores also function as pick-up and drop-off points for parcel deliveries.

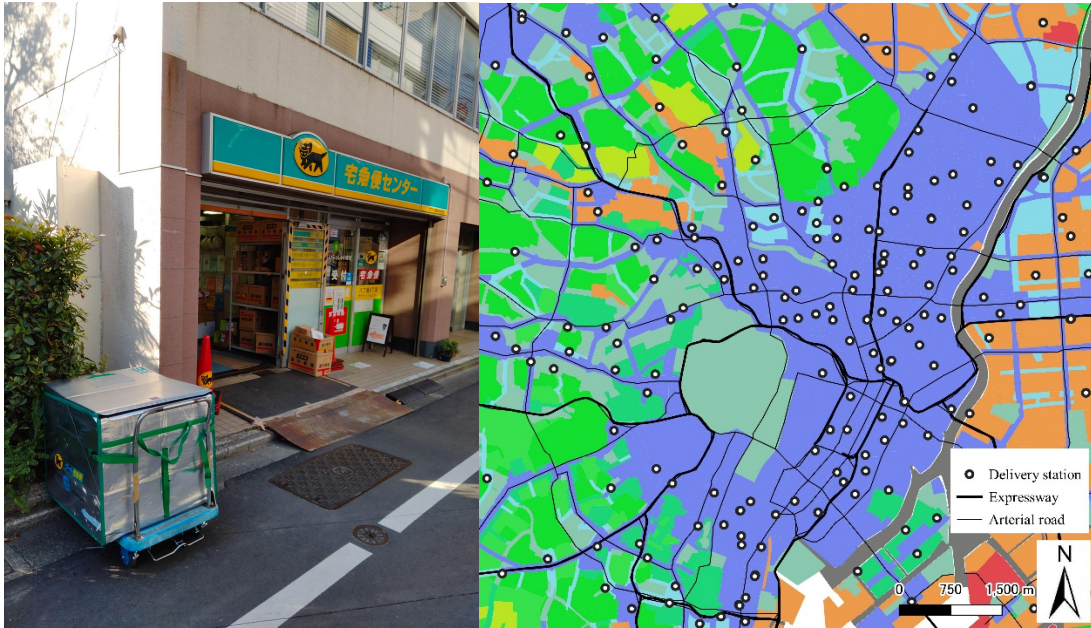


Figure 13. Yamato's delivery stations in the central business district around Chuo Ward and Chiyoda Ward (photo taken by author). Note: the legend for zoning type (right figure) is the same with Figure 10 (map produced by the author).

5. Discussion and conclusion

Throughout all cities studied in this research, we identified a trend of logistics facility development in dense and mixed-use areas, which we have termed 'proximity logistics'. The five cities examined, i.e., New York (United States); Paris (France); Seoul (South Korea); Shanghai (China); and Tokyo (Japan), demonstrate both (1) the development of a new hierarchical system for urban logistics, with large-scale regional facilities connecting to small-scale local facilities, as well as (2) the development of logistics facilities closer to or even in dense urban areas. Following the introduction of a typology for logistics facilities, based on Rodrigue (2020) and Onstein et al. (2021), we identified the presence and growth of **fulfilment centers**, **delivery stations** and **fast delivery hubs** in urban areas.

As smaller sites for cross-docking last mile deliveries, **delivery stations** are tailored to local operations in urban areas. In absolute numbers, they are the most common across cases. Their cumulated surface remains however modest because of their small size. Contrary, **fulfilment centers**, which are larger sites for storage and fulfilment, typically serve cities, regions or even nations. With the increase in online shopping, we detect an emergence of fulfilment centers attending to cities. While **delivery stations** are fit into cities' existing infrastructure, **fulfilment centers** consume more standalone space and pose challenges to cities in terms of building design and traffic management. Fulfilment centers' small variants are **fast delivery hubs**, providing local storage and fulfilment. **Dark stores** and **warestores** are particularly on the rise, which are **fast delivery hubs** by online or omnichannel retailers located in stores. Their future importance remains however unclear.

This trend of urban logistics facilities presents a paradox, as these five very large and highly developed urban areas are unwelcoming to logistics facilities by nature. Large cities are

expensive, their development is highly regulated, and they are full of people and businesses who potentially resent the goods transport that proximity logistics represents and brings closer. It shows that higher levels of service for urban goods delivery are now required, overcoming the cost of operating these facilities in dense urban environments and the lack of easily deployable space to develop them. **Economic factors** are, thus, driving proximity logistics, more so than policies and regulations and definitely more than factors related to resource endowment. E-commerce as a technological advancement and business model is an undeniable accelerator of proximity logistics, albeit not the only. The COVID-19 pandemic not only pushed deliveries to consumers' homes, at the expense of office deliveries which may consequently be declining. It also encouraged various business types to settle (again) in dense, mixed-use urban areas. Proximity logistics is thereby directly responding to changes in demand. Nonetheless, governments' perspective on proximity logistics proves to be important, in particular when cities' initial regulatory framework on logistics facility development is restrictive. Cities show different motivations to introduce supportive and restrictive **policies and regulations**, from reducing transport externalities to tax contributions and employment growth. The availability of land, access or labor, all factors related to **resource endowment**, are hardly drivers for proximity logistics and considered more as challenges to be overcome.

In this discussion, we highlight some similarities and differences among the five cases. For starters, the urban logistics facilities identified are not always similar from one city to another. As proximity logistics relies on whatever space is available to transform, it appropriates particularities in each city every time. Urban logistics facilities are thus found in various sizes, at various levels and with various equipment. For example, the degree of automation varies. In New York, there are some automated facilities in suburban facilities, but not in urban ones. In Paris, automation is limited overall. In contrast, several examples of multi-story and automated logistics facilities are found in Seoul, Shanghai and Tokyo. Yet all five city cases converge in prioritizing brownfield developments for logistics facilities: by building on unused or underused spaces (e.g., under the Paris ring road) and renovating or refurbishing former buildings. Such buildings are either outdated logistics facilities (see New York City, Seoul, Shanghai and Tokyo), or miscellaneous: subway infrastructure, parking facilities, offices, etc. In some cases, it is stimulated by the government. More generally, we identified creative uses of urban space, with examples of temporary use through time-sharing of buildings or the siting of vehicles or containers on public space serving as mobile hubs.

Where the five city cases converge as well is the development of multi-story, multi-tenant and multi-activity logistics facilities. While multi-story buildings are more common in Asian cities, as demonstrated in Seoul, Shanghai and Tokyo, there are now several examples elsewhere as well, as exemplified by the cases of New York City and Paris. Multi-use facilities are an emerging type. They combine logistics activities with housing, retail or other uses. This allows to respond better to the various necessities that emerge in dense, mixed-use urban areas. As such, it is also a way to ease acceptance of local communities that are not always favorable towards logistics facilities. As a low-margin sector, logistics can benefit from merging its activities with others as a way to afford expensive land or rents. Mixed-use facilities exist now in Paris and Seoul. This is explained possibly by a specific commitment from local governments in these two cities. Local governments also display a preference for shared logistics facilities, see for example in New York or Shanghai, despite challenges.

One way in which the five city cases differ widely is the degree of governmental intervention. In Seoul, public entities are involved in infrastructure planning, land acquisition, and cost assistance, while permissions for logistics facilities are granted by default in certain areas in New York, impeding public entities' awareness of new developments. Acknowledging however that logistics developments are now necessary, all five local governments have taken action to address or alleviate existing barriers, such as land costs and competition for space. Public action revolves mostly around zoning: 61 'location perimeters' designed for logistics in Paris; earmarked areas for logistics uses in Seoul; and the designation of space for logistics facilities in Tokyo. Next to favorable zoning, other types of action to facilitate proximity logistics include the use of government or agency property in Paris, the support for renovating facilities in Seoul and Tokyo and the repository of facilities in New York City. In Shanghai, one of the large logistics facilities identified belongs to a state-owned company, while historical logistics players with governmental ties demonstrate a clear advantage in accessing urban space, such as CJ Logistics in Seoul and the La Poste group in Paris.

Proximity logistics is not yet the perfect solution to urban challenges, including nuisances from goods transport. As such, urban logistics facilities can be strongly rejected by local communities. In overcoming the difficulties of developing such facilities, public and private stakeholders alike need to define what it takes for proximity logistics to become a good neighbor. From the current situation in which different types of facilities are developed somewhat opportunistically, in a quest to catch up with demand, a framework to standardize must-have and nice-to-have characteristics is called for. To this end, best practice research of these real estate products has a number of questions to address, including on characteristics that are spatial (e.g., location in relation to residential and commercial areas, location that fosters multimodality), operational (e.g., management to foster multimodality, sharing and consolidation), architectural (e.g., design to enable local acceptance and to support the energy transition), and economic (e.g., financial evaluation of sites that are multi-tenant and multi-activity). The clear trend towards the development of new logistics formats highlights their relevance and significance for cities and is worthy of further investigation.

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Appendix

Table 1. Chronological list of data collections per case

Date	Methodology	Subject	Organisation
New York City, United States			
14/09/2021	Experts meeting	Multi-State Freight Group Meeting	NJTPA
22/09/2021	Expert-interview	Department of City Planning	NYC DCP
Paris, France			
19/04/2021	Expert-interview	Head Customer Development	Pickup DPD
09/05/2021	Expert-interview	Head of Research	CBRE
16/05/2021	Expert-interview	Director of Urban Logistics Projects	Poste Immo
04/06/2021	Expert-interview	Director of Development and Innovation Projects and Director of Development and Innovation	Sogaris

16/06/2021	Expert-interview	Real Estate and Industrial Plan Director	DPD France
16/06/2021	Expert-interview	Head of Social and Environmental Responsibility Projects	Chronopost
22/06/2021	Expert-interview	Deputy General Manager and Public Affairs & Sustainability Manager	Pickup Stuart
21/07/2021	Expert-interview	Director of the Île-de-France network	URBY
10/07/2020	Site visit	Chapelle International	Sogaris
27/05/2021	Site visit	Ingénieur Keller	Poste Immo
27/05/2021	Site visit	Beaugrenelle	Sogaris/Chronopost
Seoul, South Korea			
17/09/2021	Expert-interview	Professor	Inha University, Asia Pacific School of Logistics https://apsl.inha.ac.kr/
17/09/2021	Expert-interview	Research Fellow	Korea Transport Institute https://www.koti.re.kr/
17/09/2021	Expert-interview	CEO	LogisValley http://www.logisvalley.com/
17/09/2021	Expert-interview	CEO	TKG – The K Global http://www.thekglobal.co.kr/
25/10/2021	Expert-interview	Vice President	IGIS Asset Management https://www.igisam.com/
25/10/2021	Expert-interview	Director	CJ Logistics https://www.cjlogistics.com/en/main
25/10/2021	Expert-interview	Senior Staff	LX Pantos http://www.lxpantos.com/
25/10/2021	Expert-interview	CEO	Nlogis http://nlogis.com/

26/10/2021	Expert-interview	Vice President	Kuehne+Nagel (Korea) https://kr.kuehne-nagel.com/
26/10/2021	Expert-interview	Director	Hanjin https://www.hanjin.co.kr/
26/10/2021	Expert-interview	Deputy Head of Department	Dongwon Loex https://www.dongwonloex.com/
05/11/2021	Expert-interview	Professor	Inha University, Asia Pacific School of Logistics
05/11/2021	Expert-interview	Vice President	Korea Integrated Logistics Association https://koila.or.kr/
12/11/2021	Expert-interview	Professor	Dongseo University
12/11/2021	Expert-interview	Professor	Kyungbuk University
Shanghai, China			
05/05/2021	Expert-interview	Head of logistics center	Bestseller Shanghai
02/06/2021	Expert-interview	Regional headquarter staff	Prologis
16/06/2021	Expert-interview	Supply chain manager	SF Express
16/06/2021	Expert-interview	Regional manager	SF Express
17/06/2021	Expert-interview	Real estate department staff	SF Express
05/05/2021	Site visit	Location and size of logistics stores	Quyong Road & Siping Road, Hongkou District
01/07/2021	Site visit	Development and design of logistics center	Shanghai Logistics Center of SinoPharm Logistics
02/07/2021	Site visit	Development and design of logistics center	Logistics Center of the Shanghai Linghua Logistics Co., Ltd.
02/07/2021	Site visit	Location and size of logistics stores	Pinglu Road & Lingshi Road, Jingan District
Tokyo, Japan			

25/05/2021	Expert-interview	Surveys and policies for logistics facilities	The Institute of Behavioral Sciences
02/09/2021	Expert-interview	Market trend in logistics real-estate	Japan Logistics Field Institute, Inc.
24/12/2021	Site visit	Chuo Ward, Tokyo	Yamato Transport/ Sagawa Express

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