URBAN AND SUBURBAN LOGISTICS REAL ESTATE

WELCOME TO LOGISTICS CITY

N°3 2022-2023

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EDITORIAL

URBAN LOGISTICS AND THE FABRIC OF THE CITY

The more trucks there are, the more urban logistics there is (logically); but the more urban logistics there is, the less trucks there are (in theory). This short aphorism, hardly caricatured, sums up the complex and delicate movement that structures a new urban and periurban logistics.

The revolution in consumption patterns, whether we are talking about B2C or B2B, is forcing companies to find new forms of supply and distribution that combine efficiency and a response to the environmental and social expectations of their stakeholders, from financiers to customers. On the other side of the spectrum, public authorities are dictating the pace of an accelerated transition – and rightly so – in road mobility.

The development of logistics real estate adapted to professionals and respectful of the requirements of cities has gradually emerged as an effective response, in that it allows for the optimization of mobility and the accelerated decarbonization of distribution activities. But it must not and cannot be an isolated response to the revolution that the climate challenge imposes on us collectively.

This handbook is a perfect illustration of this permanent tension between scales, uses and the visions of actors that are not aligned. The challenge is to reverse the perspective: is it real estate that meets the city's logistics needs, or is it the logistics operators who use this real estate? To what extent can urban logistics be designed, or at least oriented, for the benefit of territories and their users?

Urban logistics is as much a productive activity as a new brick in the fabric of the city, in which urban form, architectural quality, mixed use and suitability for local needs play an essential role.

Urban logistics is as much a productive activity as a new brick in the fabric of the city, in which urban form, architectural quality, mixed use and suitability for local needs play an essential role. The keys to understanding these issues are crucial and developed in this handbook, since the return of diversified economic activities [in dense areas] is a shared challenge for the renewal of the world's major cities.

Jonathan Sebbane,
Chief Executive Officer, Sogaris

EDITORIAL

TOWARDS A NEW LOGISTICS REAL ESTATE

This booklet, the third in a series of publications by the Logistics City Chair, addresses the issues of logistics real estate and its role in the spatial and economic transformations of metropolitan areas. Logistics activities have become more visible to political decision-makers and the media since the Covid-19 pandemic, but the sector had long since established itself as a facilitator and driver in the globalization of exchanges and the management of complex supply chains. The acceleration of the climate crisis and the geopolitical upheavals linked to the Russian war in Ukraine have further increased the pressure on supply chains. We are seeing a return to stockpiling, considered strategic in this period of uncertainty. The very concept of global exchanges of goods from the whole world to the whole world is being questioned. Faced with these disruptions, the sector is adapting and fulfilling its functions. Demand for logistics real estate is not waning, with take-up in France down by 14% in 2022 compared to 2021 (an exceptional year) but still at very high levels compared to the average of the last ten years.

Recent years have seen a number of controversies relating to logistics real estate. The growth of e-commerce has fueled fears of exacerbated competition with traditional retail structures (even though, according to the Institut de la Ville et du Commerce, the development of physical stores over the past twenty years has exceeded the growth of needs, contributing to the imbalance). Warehouses are also identified as contributors to land artificialization, due to the increasingly large surfaces they occupy, often on former agricultural land. A reform of urban planning legislation in France now makes it possible to better count logistics buildings in the calculation of the consumption of natural spaces, while regional authorities are beginning to lay down guidelines for "zero net artificialization" (ZAN for the French acronym) in their master plans. In cities, opposition to "dark stores" or small urban warehouses for ultra-fast deliveries of everyday grocery has been growing throughout 2022. These facilities are resented by local residents, particularly because of the concentrations of vehicles and noise they generate. Municipalities see them as threats to local commerce and urban life. While their legal definition continues to be debated, dark stores are and should remain few in number (less than a hundred in Paris). It is actually a paradox to want to classify them as warehouses, in order

to better prohibit them in cities, while at the same time wishing, for suburban areas, that e-commerce warehouses be considered as mass retail supermarkets so that they can be subject to the strict legislation applying to supermarkets in France.

Other important changes affect the spatial organization and architecture of warehouses. The electrification of logistics vehicles is progressing rapidly (+99.4% of new electric light commercial vehicle registrations in France between December 2021 and December 2022). Companies are taking the carbon impact of their logistics activities more seriously. Cargo bikes and electric mopeds are making their appearance in last-mile deliveries, requiring spatial reorganization of warehouses and the emergence of urban logistics hubs, which themselves require massive supply modes, including more trucks, for which environmental and safety aspects will have to be addressed. Tomorrow's warehouses will have to accommodate these new vehicles in all their diversity, just as they will have to be equipp ed with solar panels on the roof. The greening of the roof and of the spaces surrounding warehouses is also on the menu. At the same time, the issue of labor in the warehouses is gaining momentum. Logistics jobs are changing. Recruitment is difficult and jobs in warehouses must become more attractive, diverse and qualified.

A comprehensive vision of the new logistics real estate at all scales of metropolitan areas is necessary.

A comprehensive vision of the new logistics real estate at all scales of metropolitan areas is thus necessary. Through the research it is conducting on these evolutions, in a deliberately very international and comparative way, the Logistics City Chair team, with its professional partners and academic colleagues, wants to contribute to these debates and it is this collaborative research effort that this booklet wants to restore by proposing data, maps and analyses.

Laetitia Dablanc,
Director of the Logistics City Chair

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INTRODUCTION

Goods logistics and their distribution in cities is one of the major challenges facing urban societies today. Until recently, transport operators and delivery services were always considered as sources of nuisance and pollution. Today, these issues appear as essential elements in the functioning of urban spaces. Urban logistics is defined as "any service that contributes to the efficient management of goods movements in cities and provides innovative responses to the demands of companies and individuals while respecting high social and environmental standards" (Dablanc *et al.*, 2017). It appeared in the 2000s as a new model for understanding the transport of goods in cities and rethinking urban distribution. In particular, urban logistics is reflected in entrepreneurial and organizational innovations for logistics services in cities, as well as, on the part of public actors, in the implementation of measures for the management of traffic flows and parking (e.g., delivery and traffic schedules, dedicated delivery spaces, low-emission zones) to reduce congestion and pollution. Urban logistics is based on a process of environmental innovation, particularly in terms of vehicles (e.g., electric vehicles, electrically-assisted cargo bikes) and the use of new technologies, but also on innovations in the practices and organization of goods transport, such as optimization, modal shift, or digitalization.

Urban logistics is defined as "any service that contributes to the efficient management of goods movements in cities and provides innovative responses to the demands of companies and individuals while respecting high social and environmental standards".

E-commerce has been able to establish itself as a fast, increasingly instantaneous and service-rich alternative to physical purchases, with its various delivery options, tracking messages and frequent promotions. Since the Covid-19 pandemic, the multiplication of ultra-fast food delivery services in large cities (e.g., platforms like Getir, Gopuff, and Flink) has added a new dimension to instant delivery. These new consumption habits seem destined to last.

What are the consequences of these new developments for logistics real estate and the urban environment? This is one of the key questions of the scientific program of the Logistics City Chair at Gustave Eiffel University. Among other things, it concerns the return of logistics to cities (understood as city centers of metropolitan areas), after decades of exclusive relocation to the outskirts, a movement referred to as "logistics sprawl". In fact, the principle is not to replace these large peripheral logistics centers with small hubs in cities, but to refine the logistics structure on several scales in a continuum logic. This multi-scalar approach from XXL facilities to XS facilities would facilitate and decarbonize deliveries on a local scale.

The challenges of urban and suburban logistics real estate is the subject of this third volume of our Welcome to Logistics City series, after an initial handbook dedicated to *The New Urban Logistics* (2019) and a second on *E-commerce Mobilities* (2021), which will allow us to promote the work of the Logistics City Chair, in particular on scientific theme 1 (see below), and to conclude the first research cycle of the Chair (2019-2022).

What are the consequences of these new developments for logistics real estate and the urban environment? This is one of the key questions of the scientific program of the Logistics City Chair at Gustave Eiffel University.

Amazon Delivery Center (Amazon Prime), Brooklyn, New York.

Logistics real estate in academic research and research work of the Logistics City Chair

As a research topic, urban logistics has received a lot of attention over the last two decades. The European Union's research funding, as part of the multi-annual "Framework Program" and the "Horizon" program, has involved 231 projects in urban logistics or in urban mobility related to e-commerce. This list includes completed or ongoing projects that deal directly or indirectly with real estate. Several projects have focused on specific solutions, such as urban consolidation centers (SUCCESS, 2015-2018), electric vehicles (RESOLVE, 2015-2018) and crowdsourced distribution (CROWD4ROADS, 2016-2019). Other projects have introduced a global approach, such as "living labs" to stimulate innovation in urban logistics (CITYLAB, 2015-2018, which also set up an Observatory of e-commerce trends impacting mobility, since taken over by the Logistics City Chair[1]) and carbon footprint assessment (SmartEnCity, 2016-2021).

Logistics real estate is present at major conferences on urban logistics, such as the International Conference on City Logistics (ICCL), International Urban Freight Conference (I-NUF) and VREF Conference on Urban Freight. At the 4th VREF Conference on Urban Freight (March 2021, Gothenburg, Sweden), no less than 30 papers were related to warehouses and urban logistics real estate. At the 9th edition of the I-NUF Conference (May 2022, Long Beach, USA), four sessions dealt directly with the issues of warehouse location, the impact of urban warehouse development and the effects of e-commerce on new warehouse forms. In addition, the international research program METROFREIGHT-VREF Future of Transport Initiative (2012-2021) led by the University of Southern California supported a range of work related to logistics warehouses.

Projects on e-commerce mobility in cities are also being launched at the national and regional level. In France, the Plan Urbanisme Construction Architecture (PUCA) (Urban, Development, Construction, Architecture Plan) has funded the VIP project to examine the effects of online sales on territorial access to goods, by studying urban and peri-urban disparities. The French National Research Agency (ANR) is funding a research program (MOBS), in which the Logistics City Chair is participating, specifically dedicated to the analysis of consumer mobility and that of e-commerce operators.

Finally, in the context of academic research (whose works will be cited and mobilized throughout this handbook), many researchers have been working on warehouses, innovations in logistics real estate, location structures and their effects on logistics services, the economic organization of territories, the environment and, more globally, cities. Several recent studies have analyzed the location of warehouses in metropolitan areas and the evolution of this location over time. These studies have demonstrated a shift in the location of warehouses and logistics facilities to peri-urban areas (Bowen, 2008; Allen and Browne, 2010; Cidell, 2010; Heitz and Dablanc, 2015; Giuliano *et al.*, 2016; Heitz, Dablanc and Tavasszy, 2017; Kang, 2020a). The dynamics of logistics warehouse location are based on several criteria

1. Accessible through this link: https://www.ecommercemobilities.com/

and a complex structure of supply chain costs (transportation, accessibility, distribution activities, structure of the regional economy, warehouse equipment, land and real estate, organization of logistics flows and the last mile, etc.) (Dablanc and Rakotonarivo, 2010). This development has been characterized as "logistics sprawl" which can be defined as "the tendency of warehouses to move from urban to suburban and exurban areas" (Dablanc and Ross, 2012) and has been identified by research in all the case studies considered (Cidell, 2010; Dablanc and Ross, 2012; Dablanc *et al.*, 2014; Heitz and Dablanc, 2015). In the case of North America, several works have analyzed case studies: Atlanta, Los Angeles, Seattle, Toronto (Dablanc and Ross, 2012; Dablanc *et al.*, 2014; Woudsma *et al.*, 2016), and recently a comparative analysis on Chicago and Phoenix was produced (Dubic *et al.*, 2020).

Several works seek to understand the characteristics and determinants of logistics facility location:

- The ability to access larger and cheaper vacant plots in outlying areas and near highway networks and airports (Allen and Browne, 2010; Dablanc and Ross, 2012).
- The growth of the logistics industry, fueled by globalization and new production and distribution dynamics (Andreoli *et al.*, 2010; Sakai *et al.*, Beziat and Heitz, 2020; Kang, 2020b).
- The correlation of the dynamics of the location of logistics establishments with economic dynamics at the national and regional level (Bowen, 2008).
- The presence of public regulatory tools in terms of building permits and land use plans (Sakai *et al.*, 2016).
- Transportation costs although they have become less of a determinant in the last 30 years or so. The spatial distribution of logistics warehouses is only marginally dependent on transportation costs (Glaeser and Kohlhase, 2004; Dablanc and Ross, 2012) providing them with "increased location flexibility" (Rodrigue, 2004).
- The transformation of the logistics real estate sector, increasingly dominated by global firms whose activities are organized around multi-scalar distribution networks (Hesse, 2004).
- Land and real estate costs, which most often favor the location of warehouses on the outskirts of large cities (Oliveira, Dablanc and Schorung, 2022).
- Social and wage conditions that may play a role in the location of warehouses, such as the availability of a large and cheap labor force and the differential in labor costs, as in the case of the Inland Empire in Southern California (De Lara, 2013).

This non-comprehensive overview of the various research projects related to logistics real estate and the "warehouse" object in cities shows the growing attention of the scientific community and practitioners of logistics and planning to this topic. It indicates a convergence of interest between public and private actors. The Logistics City Chair builds on this accumulated knowledge and contributes to it by linking it to urban logistics real estate, one of the most recent dimensions of this research stream. Theme 1 of the Chair focuses on urban logistics real estate, new business

models for metropolitan logistics real estate, and strategies for locating warehouses in large metropolitan areas. Since 2019, the Chair has engaged in work on logistics sprawl (theme 1.1 on warehouse location characteristics), through the creation of a database on warehouse location for 74 global metropolitan areas[2]. From 2021 onwards, new work has been undertaken, in particular a cartographic study of logistics sprawl in 45 US metropolitan areas, which has led to the publication of an atlas available online[3], as well as research on the geography of Amazon's logistics system in the United States[4] on a national scale and in three metropolitan areas (New York, Chicago, Los Angeles). In addition, the Chair, consisting of Renata de Oliveira, Laetitia Dablanc and Matthieu Schorung, has conducted research on the relationship between logistical sprawl and the price differential for renting warehouses between urban and peri-urban areas[5], using the database mentioned above. Several scientific articles written by members of the Chair have been published in recent months on theme 1.1 (Oliveira, Dablanc, Schorung, 2022) and on theme 1.2 on urban logistics real estate and the concept of "proximity logistics" developed by Heleen Buldeo Rai (Buldeo Rai *et al.*, 2022).

Various research projects related to logistics real estate and the "warehouse" object in cities show the growing attention of the scientific community and practitioners for this subject, indicating a convergence of interest from public and private actors.

2. A presentation, prepared by Laetitia Dablanc, Laura Palacios-Argüello and Leise de Oliveira, of this database is available via this link: https://www.lvmt.fr/wp-content/uploads/2022/01/Dablanc-Palacios-Arguello-De-Oliveira-2020.pdf

3. This atlas was written by Matthieu Schorung with the help of Thibault Lecourt for the GIS and mapping work, under the supervision of Laetitia Dablanc. It is available for download at this link: https://drive.google.com/file/d/18pLAegEpFKSf5SkXpIzdpPXelwAaoJQU/view.

4. This research report is accessible through this link: https://hal-lara.archives-ouvertes.fr/halshs-03489397v1

5. This research report is accessible through this link: https://halshs.archives-ouvertes.fr/halshs-03369462.

URBAN LOGISTICS AND WAREHOUSES

Logistics real estate is currently one of the most dynamic segments of the real estate market, whether in Europe, North America or Asia. Its strong growth can be explained by sustained demand from traditional sectors, such as food retailing and industry, and by the considerable increase in e-commerce sales since 2020. This situation is making logistics real estate more attractive to investors, but is also leading to an increase in average rents, particularly in premium locations. Three-quarters of logistics real estate transactions take place in urban areas with more than one million inhabitants, confirming a major trend towards the "*metropolitanization*" of logistics activities in North America, Asia and Europe. Within this last group, the French market appears to be both mature and dynamic despite the slowdown in activity and demand at the end of 2022 (after an exceptional 2021) driven by food retail, industry and e-commerce, and mainly centered on the Lille-Paris-Lyon-Marseille corridor.

Overall, the global logistics real estate market continues to be driven by the growth of e-commerce, particularly in the B2C segment. While the United States and China dominate the global B2C e-commerce market in terms of value, Europe is holding its own, although with significant disparities in volume and value between countries. France ranks 2nd among European countries, behind the United Kingdom and ahead of Germany. This growth in e-commerce mechanically generates an increase in the volume of goods transported, which in Europe has risen by 69% in 2021. Nevertheless, 2022 was a pivotal year for e-commerce between a deteriorated global economic situation, a readjustment of the sector's prospects and a consolidation of the sector (as for all the giants of the digital economy – Amazon announced at the end of 2022 that it was laying off 18,000 employees). In France, the latest Fevad report (February 2023) points to a 7% drop in online sales in 2022 compared to 2021 (-1.6% of the business volume of marketplaces) but a 2022 level that remains higher than 2019 (de Matharel, 2023).

This continued expansion of e-commerce is transforming the organization of supply and distribution chains and the logistics landscape in a profound way. In particular, we are witnessing a dualization of the real estate market between a peri-urban market and an urban market that complement each other. Logistics facilities are increasingly operating on an interlocking scale: large regional facilities serve as central warehouses to supply intermediate facilities on the urban periphery, which are then used to supply and replenish the network of small and micro facilities in the city center. The rise of e-commerce is therefore accompanied by a transformation of goods mobility, particularly in the last mile segment, and even in the "last few meters" segment, i.e., as close to the consumer as possible.

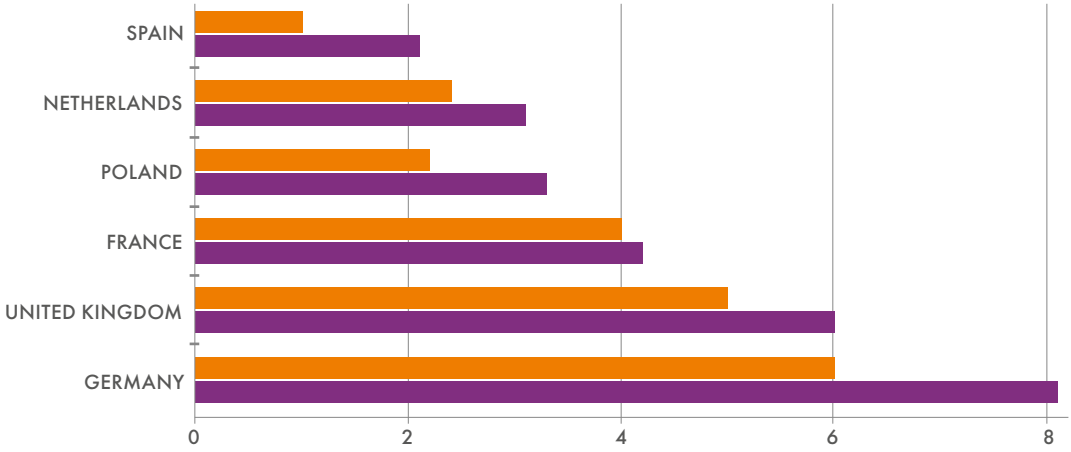
1 THE STATE OF THE LOGISTICS REAL ESTATE MARKET

Logistics real estate is one of the most dynamic segments of the real estate market, whether in Europe, North America or Asia.

In the six main European logistics real estate markets (France, Germany, Netherlands, Poland, Spain, United Kingdom), the number of transactions has increased by 29% between 2020 and 2021, marking an all-time record. The level of commercialization (expressed in marketed space) for these six countries combined reached 29 million sq.m. for 2021 alone, compared to 12 million in 2012. Germany is still the leading European logistics market, while two markets are growing very strongly: Spain and Poland, where growth in 2021 in relation to 2020 is over 50%.[1] These trends have been confirmed for the beginning of 2022: the logistics real estate market has continued to grow strongly (between +10% and +20% of surface areas marketed for the first two quarters of 2022 compared to those of 2021), particularly in the United Kingdom, Germany, Poland. Other markets are experiencing a decline in the market or very slow growth (France, Netherlands), mainly due to a lack of land availability or delays in new real estate projects.[2] The logistics market has experienced a clear slowdown since the third

Figure 1.1

Amount of marketed warehouse space in 2020 and 2021 in six European markets



Source: BNP Paribas Real Estate, 2022.

1. BNP Paribas Real Estate, "Logistics warehousing market in Europe sets new records", 3 March 2022. https://www.realestate.bnpparibas.com/sites/default/files/2022-05/European%20Logistics%20Market%20-%20May%202022_3.pdf

2. JLL, novembre 2022 https://www.jll.co.uk/content/dam/jll-com/documents/pdf/research/emea/jll-european-logistics-market-update-november-2022.pdf

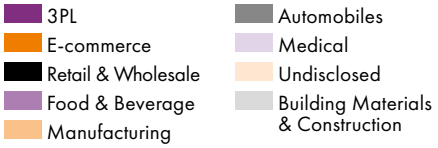
quarter of 2022 (-16% of take-up in Europe compared with the third quarter of 2021), linked to the global economic context. Specialists anticipate persistent difficulties in 2023 and a return to pre-Covid growth levels (Savills, Dec. 2022).

According to BNP Paribas Real Estate, several lessons can be drawn from these figures:

- The strong growth in the logistics real estate market is driven by the continued increase in e-commerce sales, including in secondary markets, and by a strong economic recovery in 2021.
- A disconnect between supply chain performance in recent years and the continued strong demand for logistics space has led to a major imbalance in some markets, particularly in premium territories[3] where the shortage of logistics space already existed.
- The projects currently under development will not be able to meet demand in the short term, especially in areas where the vacancy rate is well below 5%. Land availability is therefore more than ever the major obstacle to the development of the logistics real estate market.

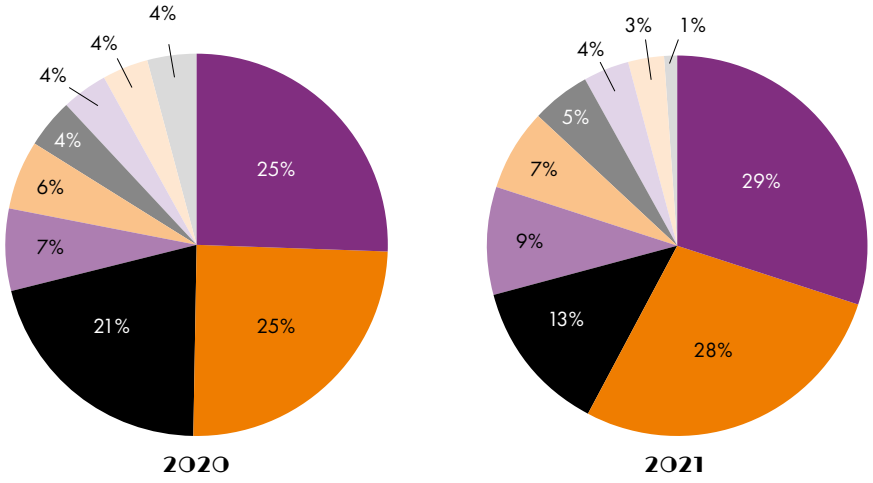
Figure 1.2

Main sectors for new commercialized warehouse space (2020-2021)



Source: CBRE Research, 2021.

The three main sectors for logistics real estate are logistics providers (3PL), e-commerce and the retail and wholesale sector. By 2021, the latter had surpassed e-commerce in market share, reflecting both the recovery of the traditional retail sector as the health crisis eases, the development of omnichannel strategies by large retail chains, and the slowing growth prospects of e-commerce in 2022-2023. In the U.S. market, e-commerce companies absorbed 28.6 percent of new logistics space marketed between 2016 and 2019.[4] For the year 2022, the 3PL and e-commerce sectors will once again account for the majority of new space marketed.



3. A premium territory refers to those territories that have the best locations and the greatest assets (in terms of accessibility, connection to major transportation facilities, proximity to major consumer markets).

4. https://www.areadevelopment.com/manufacturing-industrial/q2-2022/impact-of-e-commerce-on-industrial-real-estate.shtml

This strong growth in demand from e-commerce and logistics providers combined with a low vacancy rate is making the logistics real estate market more attractive to investors. Since 2013, annual investments in Europe have been growing strongly, from €18 billion in 2013 to €38 billion in 2018 and reaching an all-time high of €69 billion in 2021. According to Savills data, investment in the first three quarters of 2022 in Europe reached $42 billion. Given the economic slowdown, inflation, and the rising cost of credit, the level of investment will be lower than in 2021 (a record year) but much higher than in the past decade (Savills, Dec 2022). The United Kingdom, Germany and France are the leading host countries for these investments.[5] In addition, the demand for urban logistics spaces closer to consumers serves only to reinforce market imbalances: "*Demand for logistics space is fuelled by on-line business. The need to move the logistics chain closer to the end consumer is creating even greater demand for "last-mile" logistics not only for delivery but for collection too. It may be that more warehousing specifically dedicated to reverse logistics is required*".[6]

This strong growth in demand from e-commerce and logistics providers combined with a low vacancy rate is making the logistics real estate market more attractive to investors.

The dynamism of logistics real estate in Europe

The dynamism of the logistics real estate market in Europe, combined with reduced land availability, has three direct consequences: an increase in average rents, particularly in premium territories; increasing competition for premium locations; and a historically low vacancy rate (between 3 and 4% in Europe).[7] Rents increased by 3.4% in 2021, according to a panel of 49 territories in 22 countries analyzed by BNP Paribas Real Estate. The year 2022 confirmed the surge in land and logistics real estate prices.[8] Vacancy rates in almost all European countries have reached an all-time low in 2022: around 3% on average for the continent (and even less than or equal to 2% in Barcelona or Dublin) (Savills, Dec 2022).

Moreover, it is important to take into account the diversity of demand: often it is the large peripheral warehouses (known as XXL) that are the talk of the media and public opinion, especially those used for e-commerce. But the reality is much more complex. According to Prologis Research's 2012-2015[9] review, transactions involving e-commerce warehouses larger than 75,000 square meters accounted for only 25% of total e-commerce transactions, while 35% of transactions were for warehouses smaller than 20,000 square meters. Over a more recent period, transactions for warehouses over 50,000 sq.m. have tended to increase again, from 30% in 2015 to 34% in 2021 in the European market. The level of occupancy of warehouse space by online retailers has increased by 614% in the European market from 2015 to 2021.[10]

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5. *Ibid*
6. BNP Paribas Real Estate, "Logistics warehousing market in Europe sets new records", 3 March 2022.
7. https://www.realestate.bnpparibas.com/logistics-market-what-does-future-hold-europe
8. https://www.prologis.com/news-research/global-insights/logistics-real-estate-highest-demand-fastest-rent-growth-history
9. Prologis Research, 2016.
10. https://www.dexion.com/company/news-articles/general-news/demand-for-warehousing-set-to-grow-across-europe/

A geography of logistics warehouse rents

Since 2015, Prologis has maintained a Logistics Rent Index, which provides rental growth rates by continental region (North America, Brazil, Europe, Asia) and by major metropolitan area (100 locations).[11] This index is calculated based on Prologis' portfolio of assets and a price comparison of available sites. Since 2016, five markets have been identified as the most expensive in the world: London, Tokyo, Singapore, Osaka and the Midlands region (UK). The changing geography of logistics warehouse rents reflects changing market structures and the emergence of new markets (either near tight markets or in metropolitan areas with emerging logistics markets).

Continental zone	Rent growth in 2015	Rent growth in 2021	Cities with the fastest growing rents (2015)	Cities with the fastest growing rents (2021)
North America	9%	17,6% 58% for the Inland Empire region (Los Angeles)	San Francisco Bay Area Chicago Nashville Las Vegas Cincinnati	Inland Empire (Los Angeles) Toronto Reno Baltimore-Washington DC Las Vegas Pennsylvania
Europe	2%	7,2% 4,8% for continental Europe without United Kingdom (13,1%)	Barcelona Great London Munich Amsterdam-Schiphol Southern Netherlands	Great London Midlands Prague Frankfurt Munich

Source: Prologis Research, 2022.

11. https://www.prologis.com/news-research/global-insights/logistics-real-estate-highest-demand-fastest-rent-growth-history

EUROPEAN AVERAGE

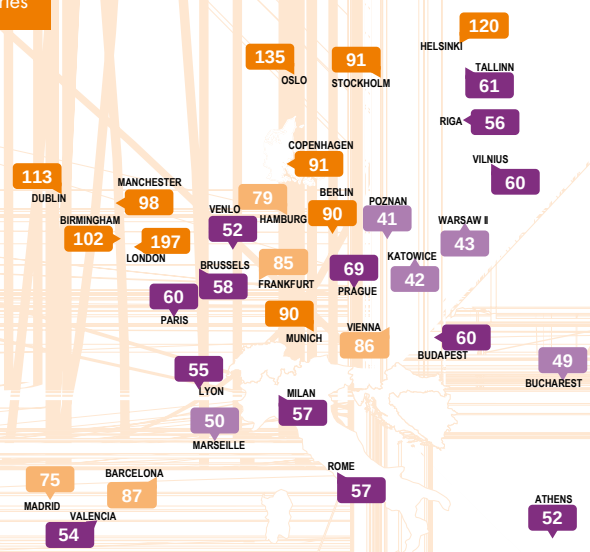
+3,4%

Q4 2021 vs Q4 2020
49 markets, 22 countries

Rent in €/sqm/year

- ≥ €90
- €70-90
- €50-70
- < €50

1 GBP€	1.1794
1 SEK€	0.0987
1 DKK€	0.1344
1 NOK€	0.1002



This relatively diversified demand is taking place in a context that is becoming increasingly constrained as land availability shrinks and new regulations are put in place (for example, in France, the ZAN objective of zero net land artificialization). This is all the more true given that the logistics real estate market is concentrated in a relatively small number of areas, a trend that has become more pronounced over time (the phenomenon of polarization and metropolitanization of logistics real estate). The level of geographical selection is particularly important, given a combination of location factors (accessibility, land, labor market, level of economic activity, etc.). Using Prologis Research's analysis, we can see that large cities – 75% of real estate transactions for e-commerce from 2015 to 2018 took place in agglomerations with more than one million inhabitants – account for the largest number of warehouses, confirming a process of metropolitanization of logistics activities.

Large cities account for the largest number of warehouses, confirming a process of metropolitanization of logistics activities.

Despite the dynamism of the logistics real estate market over the past decade, several risks exist for the year 2023, including continued higher transportation costs – the cost of shipping for international transport returned in 2022 to its pre-Covid-19 level, after increasing by over 200% in 2021[12] – and supply chain disruptions related to the undercapacity of certain modes of transport, tensions in the raw materials market and the war in Ukraine that began in February 2022, which led to a major energy crisis and a return of inflation. The second half of 2022 was a turning point with a sharp downturn in the logistics real estate market in several major logistics markets, including France (for the last quarter of 2022, take-up was down 16% compared to the last quarter of 2021, according to Savills data).

France, a dynamic and mature logistics market

France is a dynamic and mature logistics market on a European scale despite the net slowdown observed in the last quarter of 2022: cumulative take-up of warehouses over 10,000 sq.m. is strong (3,287,852 sq.m. in 2019, 3,294,289 sq.m. in 2020, 3,745,820 sq.m. in 2021).[13] Cumulative take-up for 2022 (first three quarters) reached 2,395,200 sq.m., 14% lower than for the same period in 2021 (Savills, Dec. 2022). The year 2022 began on a very dynamic trajectory, but has seen a downturn since the third quarter due to the global economic slowdown, higher interest rates, and a contraction in land availability. According to VoxLog, total take-up in France for the whole of 2022 (3.4 million sq.m.) is down by 12% compared to 2021 (an exceptional year) but remains 15% higher than the average for the last ten years. In the Paris region, warehouses between 5,000 and 10,000 sq.m. show a 10.3% decline in take-up for the whole of 2022. The French rental market recorded 139 transactions in 2022, down 9% from 2021, but 18% above the ten-year average. 19 XXL warehouses were completed, representing 35% of the volume placed in 2022. Transactions involving warehouses between 10,000 sq.m. and 20,000 sq.m. represent 35% of the volume placed and 59% of the signatures in 2022 (82 transactions), while warehouses between 20,000 sq.m. and 40,000 sq.m. are in decline as they represent 30% of the volume placed (38 transactions), according to VoxLog.[14]

12. https://www.latribune.fr/entreprises-finance/services/transport-logistique/forte-baisse-des-prix-du-transport-maritime-qui-se-rapprochent-des-niveaux-d-avant-crise-943509.html#:~:text=Depuis%20mars%202022%2C%20ils%20ne,11.000%20dollars%20de%20septembre%202021

13. JLL, Panorama logistique de la France, April 2022.

14. https://www.voxlog.fr/actualite/7029/immobilier-logistique-la-demande-placee-reste-forte-en-2022

One of the main findings of the 2022 review is that the XXL warehouse segment (platforms larger than 40,000 sq.m.) was again very buoyant, with 19 signatures out of a total of 139 transactions (year 2022), with several notable achievements (e.g., the 73,119 sq.m. Lidl warehouse in Donzère or the 61,653 sq.m. Cdiscount warehouse in Sury-le-Comtal).

Three sectors of activity are driving the French market in 2022: food retail (e.g., the new Intermarché and Lidl warehouses), industry (e.g., the new Heineken and Danone warehouses), and e-commerce, which accounts for 22% of the demand for warehouse space.[15]

The logistics real estate market in France is also particularly polarized. This geographic polarization is centered around the Lille-Paris-Lyon-Marseille corridor, which is the country's major urban and industrial axis. Nearly 40% of logistics warehouses are concentrated in this area. Take-up (warehouses over 5,000 sq.m.) in the corridor will account for 53% of the volume of activity and 50% of transactions in France in 2022. In the last quarter of 2022, the corridor even accounted for 62% of transactions. The Paris region alone continues to perform very well compared to other French regions, with 28.5% of total space sold (2022).[16]

Three sectors of activity are driving the French market in 2022: food retail, industry and e-commerce.

In 2021, the French market was characterized by a very significant number of transactions, amounting to nearly 250. The Paris region and Hauts-de-France region account for half of the overall volume, with 1,190,000 sq.m. and 1,010,000 sq.m. respectively. The logistics market in the Rhône-Alpes region remains attractive, with 380,000 sq.m. of space available, but is still suffering from the scarcity of existing supply and, in particular, the absence of future developments. The phenomenon of secondary markets catching up has been growing for several years, especially in areas outside the backbone, such as the Atlantic coastal region.[17]

Indeed, for several years now, we have been witnessing a nationwide reduction in the number of warehouses located outside the backbone in underequipped areas, particularly in the west of France: two warehouses of more than 50,000 sq.m. opened in the Loire region at the beginning of 2022.

15. JLL, Panorama logistique de la France, April 2022.
16. https://www.jll.fr/fr/etudes-recherche/recherche/panorama-logistique.
17. BNP Paribas Real Estate, 2022. https://presse.realestate.bnpparibas.fr/logistique-en-france-un-marche-immobilier-en-forte-croissance-avec-426-millions-de-m%C2%B2-places-en-2021-2/

2 THE GROWTH OF E-COMMERCE, ONE OF THE DRIVERS OF GLOBAL LOGISTICS

E-commerce takes different forms depending on the parties involved in the transactions: business-to-business (B2B), business-to-consumer (B2C), business-to-government (B2G) and consumer-to-consumer (C2C). In many countries, B2C e-commerce sales have increased significantly over the past decade, driven by an increasingly connected population and changing consumer behaviors (e-commerce, omnicanality). In this publication, we will focus on B2C e-commerce.[1]

Strong growth in global e-commerce

UNCTAD estimates that the global value of global B2C sales was $4,900 billion in 2019, up 11% from 2018 (UNCTAD, 2021, latest figures released). Half of this value corresponds to trade in goods (versus services), which therefore generates goods movements. This figure is expected to exceed $5700 billion by 2022 according to e-Marketer (final figure not known at this time).

Between 2020 and 2021, e-commerce grew by more than 27% worldwide and by nearly 9.5% between 2021 and 2022.

According to CBRE (Euromonitor data, 43 countries analyzed), the global retail market in 2015 was 92% offline and 8% online (B2C) transactions, while in 2020, the latter would account for 18% of the global retail market (CBRE, 2021) and 21% in 2021.

1. For detailed explanations of the different forms of e-commerce, see the Chair's handbook n°2 (Logistics City Chair, 2021): https://www.lvmt.fr/wp-content/uploads/2021/07/LC2021-UK.pdf; and the Observatory of e-commerce mobilities: https://www.ecommercemobilities.com/.

A deeply disparate geography of global B2C e-commerce

Accounting for 57% of global Internet sales (B2C), China and the United States are the world's two largest e-commerce markets in absolute terms (CBRE, 2021), amounting to $2.8 trillion in spending (UNCTAD, 2021). The five markets with the highest e-commerce penetration are South Korea, China, the United Kingdom, Indonesia, and the United States, according to the International Post Corporation (2021). Developing economies, meanwhile, account for about half of the top 20 countries by level of B2C e-commerce sales in 2019 (UNCTAD, 2021).

From country to country, the level of use of the Internet for consumer purchases varies considerably. According to UNCTAD's B2C E-Commerce Index 2020 (UNCTAD, 2021), Europe remains by far the most e-commerce-ready region. The index rates 152 countries on their readiness for online shopping. Countries are rated on access to secure Internet servers, reliability of postal services and infrastructure, and the proportion of their population that uses the Internet and has an account with a financial institution or mobile money provider. China and the United States rank 55th and 12th respectively in the index. This is further evidence of the deep imbalance in household computer equipment, access to stable high-speed internet, and the propensity of households to turn more to e-commerce.

Figure 2.1

Sales of goods and services through e-commerce for the top ten countries in 2019

Source: UNCTAD, based on national statistics.
Figures in italics are UNCTAD estimates.

Rank	Country	Total online sales (in millions of $)	Share of e-commerce in GNP (in %)	B2B sales (in millions of $)	Share of B2B in total e-commerce sales	B2C sales (in millions of $)
1	United States	*9,580*	*45*	8,319	*87*	*1,261*
2	Japan	3,416	*67*	3,238	95	178
3	China	*2,604*	18	*1,065*	41	1,539
4	South Korea	*1,302*	*79*	*1,187*	91	115
5	United Kingdom	885	31	633	*72*	251
6	France	*785*	29	*669*	85	116
7	Germany	524	14	413	*79*	111
8	Italy	*431*	22	*396*	92	35
9	Australia	*347*	25	*325*	94	21
10	Spain	344	25	280	81	64
	Top 10	**20,281**	**36**	**16,526**	**82**	**3,691**
	World	**26,673**	**30**	**21,803**	/	**4,870**

When we look at consumers who make online purchases, we see that the share of consumers making online purchases still differs greatly between countries. This can be expressed by three types of indicators: the level of online purchases, the share of Internet users making purchases and the share of online sales in total sales. UNCTAD (2021) estimates that 1.48 billion people, or just over a quarter of the world's population aged 15 and over, made online purchases in 2019. The chart below shows online sales as a share of total sales for 31 countries, with the share ranging from 42% for South Korea to less than 5% for South Africa. Projections for 2026 (CBRE, 2022) identify widespread growth, especially among large emerging countries (China, Mexico, India) – South Korea would be the first country in the world to reach 50% online sales to total sales (for B2C).

The European situation also reflects the strong disparities already observed on a global scale (RetailX, 2020). Western Europe (United Kingdom, France, Germany, Benelux) will account for more than 60% of the sales for the entire European continent in 2021. The United Kingdom is undoubtedly the European leader (236 billion euros in revenues), followed by France (112 billion euros) and Germany (93.6 billion euros).[2]

When we look at per capita spending this time (Figure 2.3), it appears to be very uneven across countries: from €2,237 per year for a Briton to €1,148 per year for a French person, and only €351 per year for an Italian.

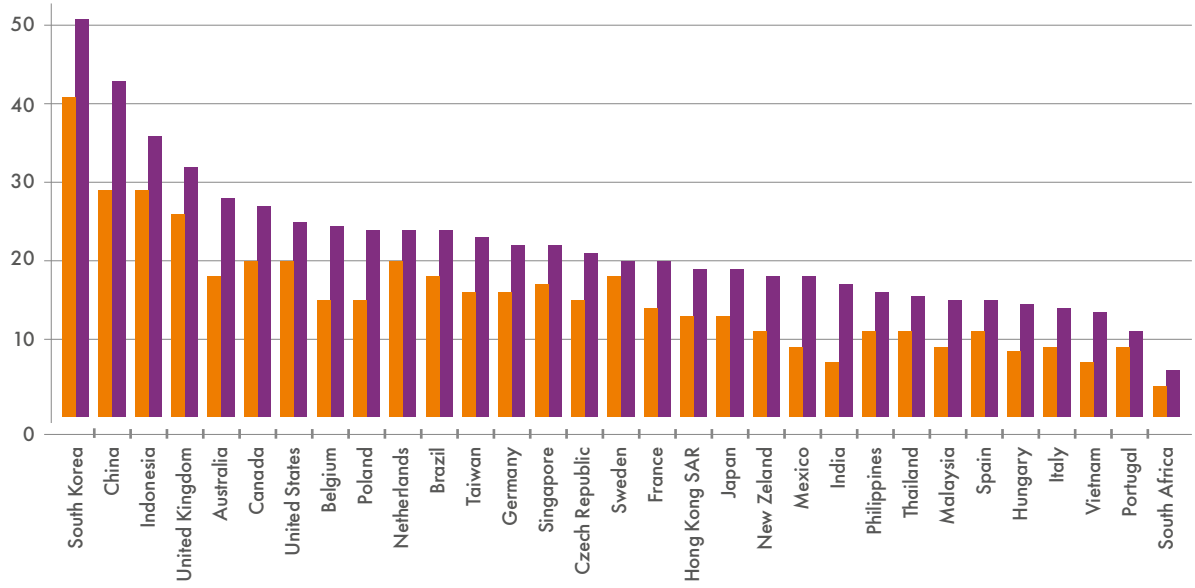
A Fevad report (2022) on e-commerce in France in 2021 indicates that the French spent €129 billion on the internet (products and services). E-commerce now accounts for 14.1% of total product sales, 0.7 percentage points higher than in 2020 (Fevad, 2020). In 2021, while product sales on the internet continue to grow, with an increase of 7% (compared to 32% in 2020), it is especially the services sector that stands out with an increase of 24% compared to the previous year, against only 6% for consumer products.

Figure 2.2

Online sales share of total sales in 2021 and estimated share in 2026

Share of online sales in total sales in 2021
Share of online sales in total sales in 2026

Source: CBRE, 2022.



2. https://www.fevad.com/exclusif-bilan-2021-du-e-commerce-en-europe-etude-ecommerce-europe-et-eurocommerce/

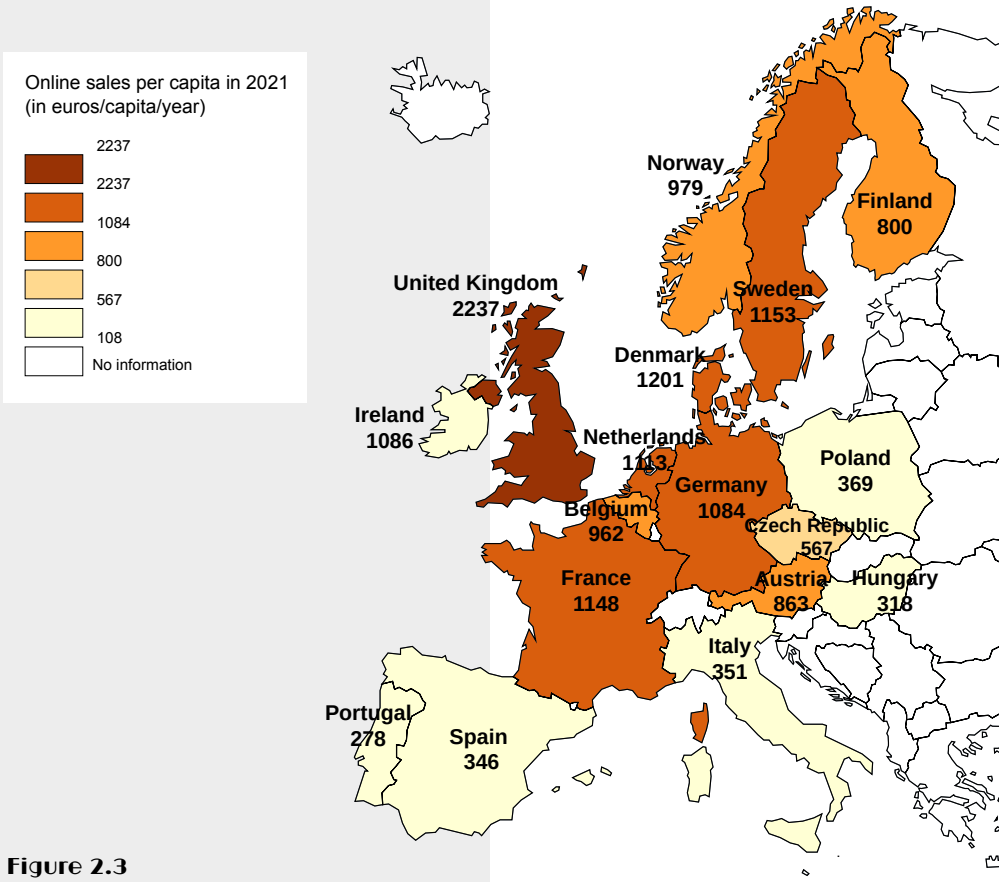


Figure 2.3

Online purchases per capita in 2021 for the main European countries

Production by Philcarto. Data: BNP Parisbas Real Estate, 2022.
Creation: M.Schorung, 2023.

A generalization of e-commerce which is not without consequences

This strong growth in e-commerce in all the major consumer markets around the world is creating considerable challenges both for the organization of global supply chains and for the optimization of travel and delivery within the constraints imposed by e-commerce (e.g., speed and security of delivery, omnichannelity, etc.). E-commerce therefore generates an increase in the need to move goods and the volumes transported (particularly parcels). According to Cushman&Wakefield, the volume of parcels in Europe has increased by 69% in 2021 compared to 2016. The estimates in the figure below illustrate this strong growth in Europe's largest cities: in 2021, nearly 500 million parcels will be distributed by e-commerce in London and 120 million in Paris. This situation is forcing logistics operators, carriers and logisticians, in conjunction with e-retailers, to transform their organizational methods.

E-commerce therefore generates an increase in the need to move goods and the volumes transported.

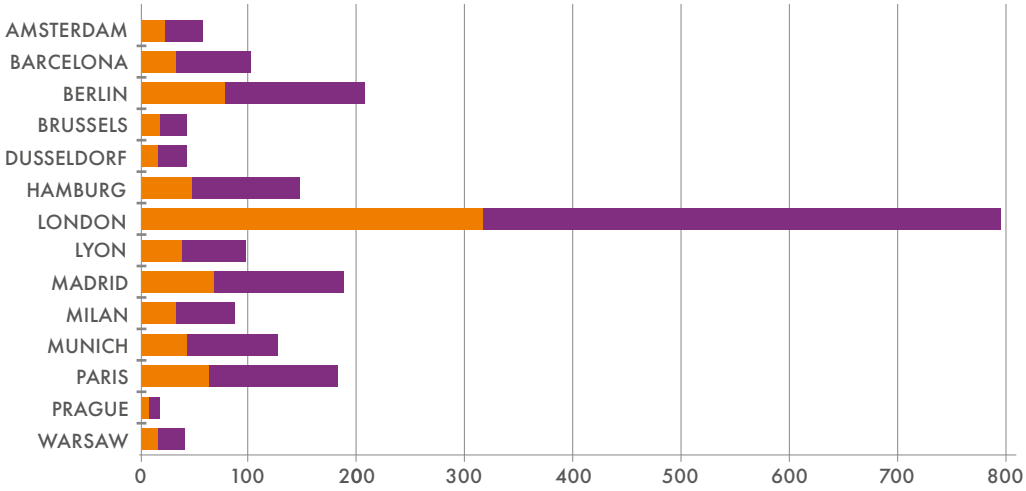
Figure 2.4

Estimated B2C parcel volumes by city in 2016 and 2021

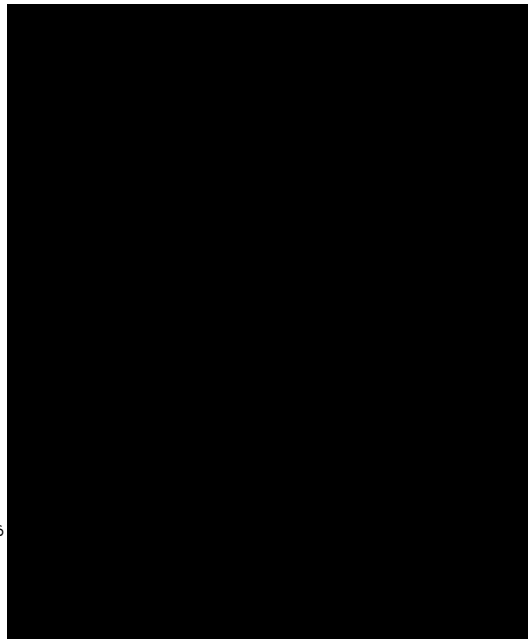
Estimated e-commerce parcel volumes (in millions) by city in 2016

Estimated e-commerce parcel volumes (in millions) by city in 2021

Source: P3 Logistic Parks and Cushman&Wakefield (2021).



Transshipment and delivery of the last meters by Amazon in New York City (NY).



© M. Schorung, 2022.

Transshipment and sorting of packages on the street, Manhattan, New York City (NY).

© M. Schorung, 2023.

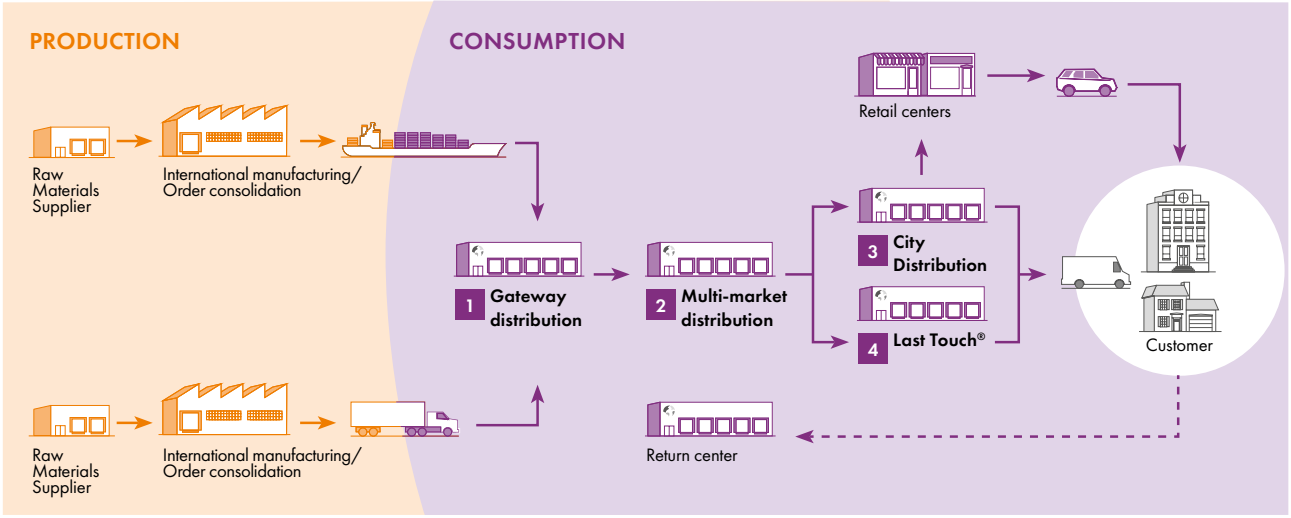
3 THE IMPACT OF E-COMMERCE ON URBAN LOGISTICS REAL ESTATE

The continued expansion of e-commerce is contributing to the transformation of the organization of supply and distribution chains and the logistics real estate landscape. Today's supply chain tends to segment and specialize, based on the location of logistics facilities in space, the specific characteristics of these facilities and the functions assigned for storage, distribution and the last mile.

Figure 3.1

The organization of the contemporary supply chain

Source: Prologis Research, *The Evolution of the Modern Supply Chain and Implications for Logistics Real Estate Performance*, Supply Chain and Logistics Real Estate, 2019.



A dualization of the logistics real estate market between suburban and urban areas

The growth of e-commerce and the increase in goods flows that it entails have led to an interest in the development of urban logistics spaces. E-commerce pure players are among the drivers of the logistics real estate sector, seeking to meet their growing needs for logistics space by turning to new categories of assets, ranging from XXL warehouses of 100,000 to 200,000 sq.m. to urban warehouses of a few hundred or thousand sq.m.

$1 billion additional e-commerce sales require 1.25 million additional sq. ft. of logistics space.

(CBRE, 2022)

This dual entry into the logistics real estate market is well illustrated by Amazon's recently opened warehouse facilities. During the 2000s, the e-commerce giant preferred to locate its distribution centers outside of the Paris region, before entering the Paris market with the construction of a 142,000 sq.m. XXL warehouse in Bretigny-sur-Orge. In the meantime, the company has also moved closer to the dense Paris area with the opening of small warehouses: in 2016, in Paris' 18th arrondissement to ensure Prime Now deliveries in two hours (4,000 sq.m. logistics space within a Geodis warehouse); and in the inner suburbs for distribution hubs in the port of Bonneuil-sur-Marne, in Le Blanc Mesnil and in Noisy-le-Grand, ensuring fast access to the center of Paris and sanctuarizing land in the dense area of the metropolis. In 2018, Amazon inaugurated a distribution center in Vélizy-Villacoublay (Yvelines department) to strengthen service to Greater Paris.

E-commerce growth will require an additional 15 million square meters of logistics space in the next 5 years in Europe.

E-commerce is a driving force behind this dualization of the real estate market between a suburban market and an urban market that complement each other. This urban market is still recent. Part of the market relies on public support for urban logistics or easier access to land (Heitz, 2017), but the existing dynamic, with buildings like the Chapelle International logistics hotel (whose logistics platform is not only used for e-commerce), and small logistics spaces like Grenier-Saint-Lazare (Paris 3rd arrondissement) or P4 at Porte de Pantin (Paris 19th arrondissement), shows the potential of this urban logistics market. More generally in Europe, demand for urban warehouses, which is still a real estate niche, is growing strongly. The recent mega-acquisition by Prologis (September 2022) of more than 130 last-mile logistics sites (representing a cumulative surface area of 1.13 million sq.m.) in several major European cities is proof of this.[1]

1. https://www.supplychainmagazine.fr/nl/2022/3615/prologis-soffre-plus-de-130-sites-dernier-km-sur-sept-pays-deurope-705307.php

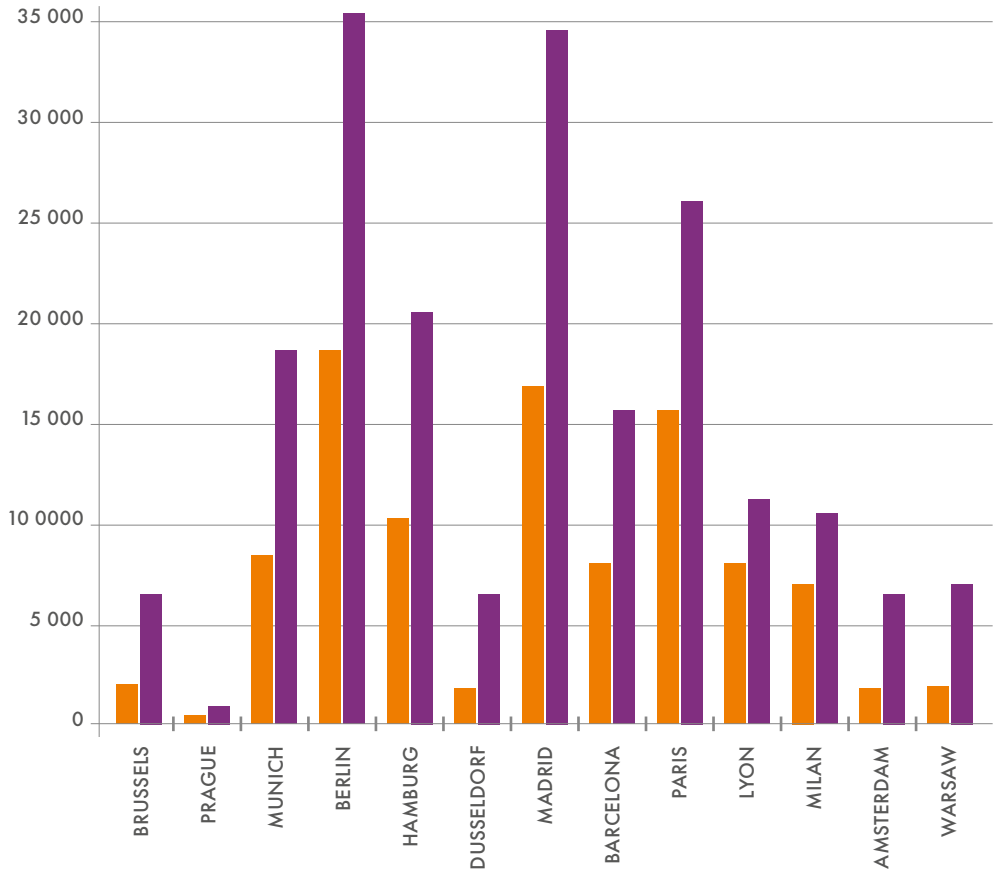


Figure 3.2

Estimated urban logistics real estate needs (expressed in sq.m.) in several European cities

Urban logistics space requirements (in sq.m.) in 2017

Urban logistics space requirements (in sq.m.) in 2021

Source: Cushman&Wakefield, 2021.

E-commerce has three types of consequences for the logistics real estate market:

- E-commerce requires a large amount of storage and distribution space, which reduces the vacancy rate of the logistics inventory.
- The higher the penetration of e-commerce in a given market, the more difficult it is to find new available logistics space.
- The demand for warehouses exceeds supply in all markets (developed and large emerging countries), which is causing rents to rise in most global cities. This imbalance between supply and demand is strongest in the already tightest markets with the lowest vacancy rates. This reinforces the idea that land availability is the main challenge facing the logistics sector; there is a correlation between the markets with the highest shortage of logistics space and the low amount of new space under construction (with the exception of South Korea) (CBRE, 2022).

The evolution of logistics facilities related to e-commerce

Due to its operational characteristics, e-commerce has created a new freight landscape. This term is used to describe the spatial distribution of freight activity and intensity in a metropolitan area (Rodrigue *et al.*, 2017). The e-commerce "freight landscape" has four fundamental impacts on freight movement in terms of (1) distribution patterns, (2) logistics facilities, (3) real estate footprint, and (4) vertical integration (Rodrigue, 2020). These impacts imply a pronounced materiality and are summarized in the figure below. In essence, a hierarchy of specialized logistics facilities has emerged to accommodate e-commerce operations and serve consumer hot spots. Rodrigue (2020) proposes a typology of six types of logistics facilities: (1) inbound transshipment facilities, (2) storage and distribution centers, (3) parcel hubs and sortation centers, (4) parcel delivery stations, (5) pickup points and local freight stations, and (6) rapid delivery hubs or micro-hubs.

The inbound cross-docking center and the distribution center (e-fulfillment) are the pillars of the order fulfillment process and represent the largest physical footprint. The sortation center, a medium-sized facility, is at the heart of the distribution process, routing deliveries to metropolitan areas and interfacing with local distribution networks. It reconciles the apparent contradictions between the need to serve high market density in central areas and the location of the majority of logistics sites in low density peripheries. The last-mile layer focuses on either fast delivery facilities or delivery stations/courier agencies where packages are assigned to

Figure 3.3

The six formats of logistics real estate related to e-commerce

Source: Rodrigue, 2020.

delivery routes. While the first two facilities are large and have a national or international scope, the last four facilities fall under the umbrella of urban logistics (Rodrigue, 2020).

These logistics facilities operate through a nesting of scales. The large regional facilities serve as central warehouses to supply intermediate facilities on the urban fringe, which are then used to supply and resupply the network of small and micro facilities in the city center. These small and micro facilities function as "infill facilities," stocking only the best-selling items and allowing for fast or ultra-fast delivery. When it comes to urban logistics facilities, there are significant differences in location, size, delivery radius and staffing. These requirements depend on the city and its structure, the degree of penetration of the e-commerce market and the delivery concept offered by retailers and/or logistics service providers. Several studies propose a typology to classify urban logistics facilities, which are spaces designed to improve the delivery of goods in cities from an operational and environmental point of view (Boudouin, 2006). This optimization is envisaged in two ways: by distributing parcels in more sustainable vehicles and by consolidating volumes in optimized flows.

These logistics facilities operate through a nesting of scales. The large regional facilities serve as central warehouses to supply intermediate facilities on the urban fringe, which are then used to supply and resupply the network of small and micro facilities in the city center.

The growth of e-commerce is therefore accompanied by a transformation of the mobility of goods, particularly in the "last few meters", i.e., as close as possible to the consumer. These last meters are costly both logistically and financially (price, time, location). In the last few meters, services are multiplying, allowing the customer different ways of collecting their goods. Goods can be delivered at home (for two thirds) or in alternative locations (for one third). These can be relay points, either businesses that accept the function of receiving parcels for individuals, or automatic lockers that can be located in public or private spaces. These deliveries in relay points or lockers allow transport operators to massify flows and limit the number of rounds related to home delivery, but also to increase the number of successful first-time deliveries.

SPATIAL DISTRIBUTION OF WAREHOUSES: SOCIETAL AND SPATIAL ISSUES

Traditionally, logistics facilities have tended to be located on the outskirts of large cities, particularly in suburban areas where density is low, land is available and cheap, and plot sizes are large. This "logistics sprawl" phenomenon can be explained by the fact that it corresponds to the development of large warehouses required by today's supply chains, but it produces many undesirable effects such as congestion, emissions, pollution and land artificialization. At the same time, some logistics sectors, particularly those linked to e-commerce, have started to look for new urban warehouses that will bring them closer to consumers and reduce delivery times. In most of the world's metropolises, a trend is emerging towards the development of logistics facilities in dense areas, some of which are mixed-use, known as "proximity logistics" (Buldeo Rai *et al.*, 2022); these facilities help to reduce the negative externalities of freight transport. The result is a dualization of logistics real estate with, on the one hand, a majority of peri-urban

logistics with XXL formats and, on the other hand, urban logistics still in the minority with a variety of customized formats. However, it would be simplistic to oppose these two forms of logistics, as they usually operate as a network across a metropolitan area.

The location of warehouses depends on several factors, including proximity to economic flows and activities, transport costs, land and property costs, availability of labor (at different skill levels), accessibility, proximity to consumers, and land availability, but the weight of these different criteria varies according to the type of activity and the function attributed to a given warehouse in the logistics system considered. Overall, logistics warehouses are located close to the economic, urban and infrastructural framework of all developed countries and the main emerging countries, according to the now well-known logic of metropolitanization of activities.

The main categories of warehouses and urban warehouses

MAIN CATEGORIES OF WAREHOUSES

Distribution center (DC): Warehouses for the storage and management of goods (intermediate goods, consumer goods, etc.). DCs are increasingly large (XXL warehouses of 50,000 to 200,000 sq.m.). In dense Asian cities such as Tokyo, Seoul, Singapore, warehouses are generally vertical (up to 20 floors or more).

Temperature-controlled warehouse: same as CD above but for goods that require cold or specific temperature storage (frozen, fresh).

Fulfillment center: equivalent of a distribution center, but the terminology is generally used for e-commerce operations. The number of SKUs (Stock Keeping Units) and the frequency of picks are higher.

Cross-dock terminal, sortation terminal: a terminal in which goods are not stored but pass through in less than a day and usually in a few hours or less. The goods are packages but also larger units such as pallets.

Logistics park, freight village: a collection of several warehouses managed by a single entity (often the property developer/owner) offering additional services to users such as security, meeting rooms, cafeteria. Freight villages are a more integrated version offering service stations, truck maintenance and sometimes multimodal services (Italian *interporti* offer rail-road intermodal services, German *Güterwerkehrszentren* may also include waterways).

NEW REAL ESTATE FORMATS FOR URBAN LOGISTICS

Logistics hotel: large multi-storey urban warehouse (vertical) with mixed use. Logistics occupy the main area, often in the basement and first floor. Other uses are located on the upper levels: offices, sports facilities, shops. Example Chapelle International in Paris (developer Sogaris).

Urban consolidation center: a 1,000 to 5,000 square meter facility that consolidates the goods flows of several carriers, bringing delivery rounds in city centers under the umbrella of a single delivery company (examples: *Cityporto Padova*, *Binnenstadservice* in Dutch cities, *Stadsleveransen* in Göteborg) There are specialized UDCs, such as the Construction Consolidation Centres in London, which pool deliveries to construction sites.

Logistics micro-hub: small logistics facilities (less than 2,000 square meters) where goods are prepared for last-mile delivery, often on cargo bikes or electric vans. They can be used by a single user (Green Cargo in London) or by several, who share space but do not pool shipments as they would in a UDC (Depot-bike in Prague). They are often located in old stores, underground parking lots or former gas stations.

Dark store: small urban warehouses, micro-hubs for ultra-fast delivery of groceries ("quick commerce"). Vary from very small (100-200 sq.m.) to larger (200-2,000 sq.m.) depending on the number of items sold.

Picking point / Drive (NB the term "drive" is mainly used in France...): places where food/grocery orders made online are collected. A "drive" may or may not include a storage/picking function. "Pedestrian drives" have recently been developed in urban centers.

Source: Dablanc, 2022.

4 LOGISTICS SPRAWL

Logistics sprawl corresponds to the growth in the number of warehouses on the outskirts of large cities, particularly in peri-urban areas where densities are low, land is available and cheap, and plot sizes are large (Dablanc and Rakotonarivo, 2010; Giuliano *et al.*, 2013; Dablanc *et al.*, 2018). Urban renewal, land pressure, and competition with other activities have created an increasingly unfavorable context for the development of logistics activities in dense areas (Heitz, 2017), whereas peri-urban areas offered logistics activities large plots and proximity to large consumer markets thanks to good road and highway connections. The availability of transport infrastructure in fact offers good accessibility on two scales: on the one hand, local (to delivery areas) and on the other hand, regional or interregional (to other cities, to other countries for logistics facilities that have an extended hub role). Local public policies in favor of the development of logistics policies also influence the location of warehouses, with, for example, the creation of logistics zones on the periphery to attract warehouses. The lack of regulation of metropolitan margins has favored the development of warehouses in peri-urban areas, fueling a process of logistics sprawl (Dablanc *et al.*, 2014), which shows that the geography of warehouses is concentrated in sparsely populated peri-urban areas (Bowen, 2008; Cidell, 2010). The intensity of logistics sprawl varies according to the type of warehouse (higher for distribution centers, lower for courier terminals) and according to the type of strategy implemented by the actor under consideration. This logistical sprawl is a reflection of the evolution of global supply chains (Hesse, 2008).

Peri-urban logistics in the majority and urban logistics in the minority

Since 2019, the Logistics City Chair has been building a database on warehouses in a large number of global cities. In total, this database compiles information on 74 cases (55 in North America, 12 in Europe, 4 in South America, 3 in East Asia) using 17 indicators (notably the number of warehouses, the ratio between the number of warehouses and the population/area, the average size of warehouses, the average distance of warehouses from the barycenter). An analysis of this database (Dablanc, Palacios-Argüello, de Oliveira, 2020) reveals two findings: 1) there is a positive relationship between the size of the metropolis and the number of warehouses per capita (the larger and more populous the city, the more warehouses per capita); 2) there is a phenomenon of logistical sprawl in the vast majority of cases (80% of the cases studied are affected by this phenomenon) (see Figure 4.1).

Figure 4.1

Logistics sprawl observed in the Logistics City Chair's database

Source: Dablanc, Palacios-Argüello, de Oliveira, 2020.

The index used shows logistical sprawl by diachronic comparison (two years considered per city): the closer the index is to the value 1, the greater the sprawl.

The lack of regional and metropolitan regulation of logistics has favored logistics development at the margins of cities, contributing to logistics sprawl: the result of negotiation between isolated peri-urban municipalities and real estate development actors integrated into international financial markets (Raimbault, 2014). The main negative impacts of logistical sprawl (congestion, pollution, land artificialization) contradict the objectives of the "sustainable city" which include densification, functional mix, reduction of congestion and CO_2 emissions, and efforts to limit land artificialization. These new sustainability objectives have led to a refocusing of the debate on the "last mile", rather than on the development of logistics in the periphery, as a compensatory measure to this sprawl. At the same time, a private demand for warehouses in dense areas has emerged. Some logistics sectors, especially those related to e-commerce, have begun to look for new urban warehouses. This new demand for real estate also corresponds to the objectives of public authorities to redevelop logistics activities in city centers in order to limit logistics sprawl. Thus, on the one hand, we are witnessing the development of peri-urban logistics characterized by the rise of large standardized logistics buildings, mainly intended for logistics providers, mass distribution or industry (Heitz *et al.*, 2017). On the other hand, we are witnessing the rise of urban logistics made up of buildings that are still largely "tailor-made" and that are subject to particular attention in terms of urban integration. This dualization of the real estate market reveals two patterns of development in logistics real estate: peri-urban logistics, which is in the majority, and emerging urban logistics, which is still in the minority. However, these two types of logistics now function as a network throughout the metropolitan area.

The lack of regional and metropolitan regulation of logistics has favored logistics development at the margins of cities, contributing to logistics sprawl.

The geographical impact of e-commerce is therefore reflected in two distinct developments in logistics real estate (Dablanc, 2018). On the one hand, the creation of so-called XXL distribution centers or mega-fulfillment centers (more than 50,000 sq.m.), which follow the historical trend of logistics zones moving away from urban centers, and, on the other hand, the search for space in dense areas to meet e-commerce-related demand. In order to meet the expectations of consumers, who generally appreciate faster deliveries according to surveys, goods must be located close to the consumer. Urban warehouses have been introduced by major e-commerce players such as Amazon, which has, for example, set up in several central locations in Los Angeles,

New York and Chicago, amounting to several dozen additional urban warehouses, ranging from 5,000 to 20,000 sq.m. (Schorung, Lecourt, 2021). Historically, Asian cities have been pioneers in urban warehouses, such as Tokyo, Hong Kong, and Seoul (Dablanc *et al.*, 2017). Because there is potential to optimize freight mobility in the city (distributing as much with less), pooled urban distribution centers have been envisioned to more collaboratively manage the operations of all carriers needing to deliver to a given urban area (a city center, for example) with very limited success. The rise of e-commerce has accelerated the development of so-called urban logistics spaces and logistics micro-hubs. New models are being organized from small logistics bases in dense urban areas to facilitate load breaks and enable last-mile deliveries with electric or non-motorized vehicles (Buldeo Rai, 2019).

The rise of e-commerce has accelerated the development of so-called urban logistics spaces and logistics micro-hubs.

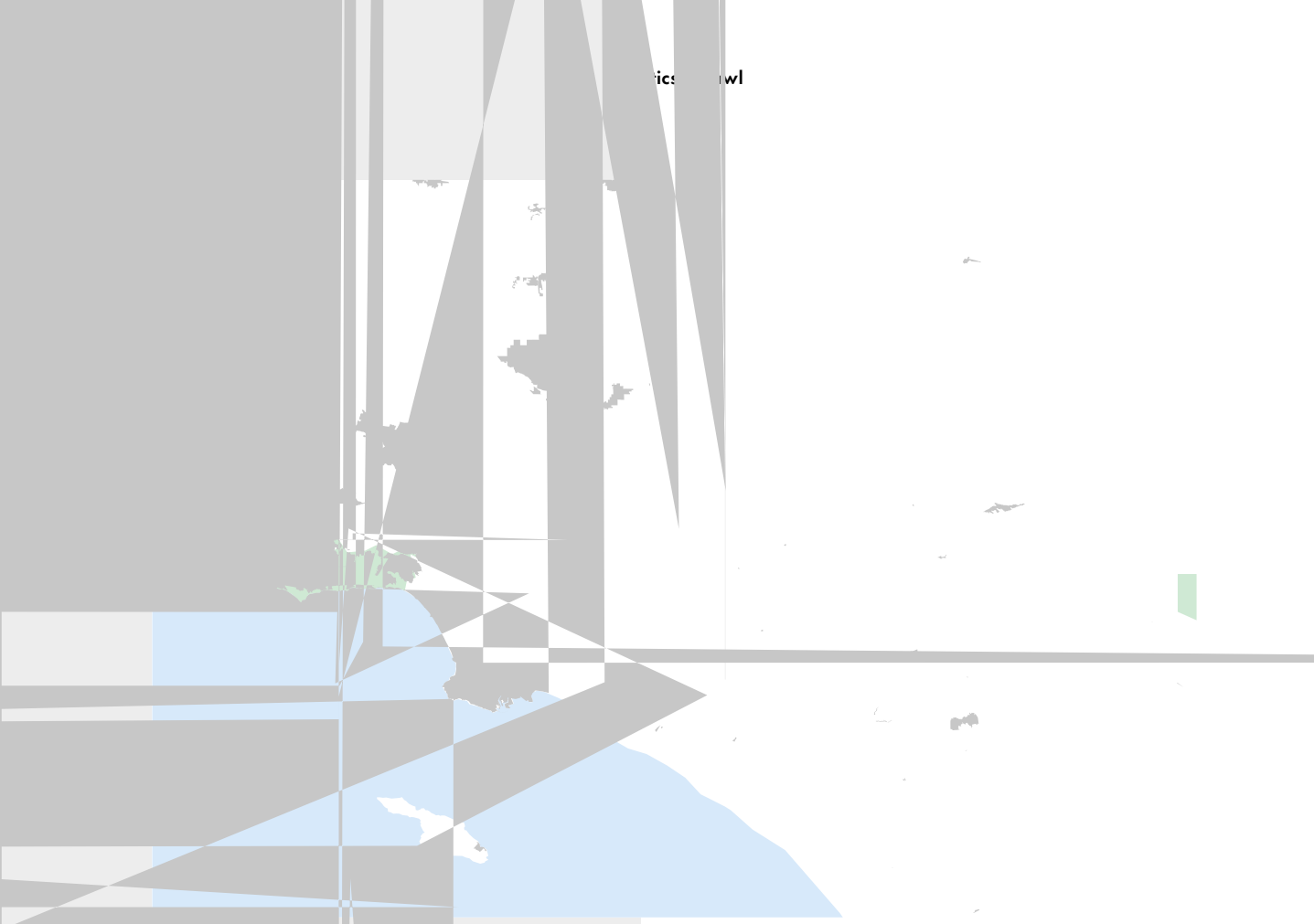
Spatial distribution of logistics warehouses

The dynamics of logistics warehouse location are based on several criteria and on a complex structure of supply chain costs (transport, accessibility, distribution activities, structure of the regional economy, warehouse equipment, land and real estate, organization of logistics flows and the last mile, etc.) (Dablanc and Rakotonarivo, 2010). Most scientific studies focus on the spatial dynamics of warehouse location in an undifferentiated way, without distinguishing between types of warehouses (distribution centers, cross-docking warehouses, see box, p. 39), types of companies (logistics companies, express carriers, e-tailers), or the catchment areas of each warehouse (to understand which warehouse serves which territories at a given time). This is primarily due to the lack of reliable and available data. A few recent works have begun to explore this field, for example for the case of the Île-de-France region (Heitz, Launay and Beziat, 2019; APUR, 2022), for Amazon's logistics system in the United States (Rodrigue, 2020; Schorung and Lecourt, 2021), or for the terminals of a carrier like DB Schenker (Robichet and Nierat, 2021). Depending on the type of warehouse and its size, the spatial location and distribution characteristics are differentiated. In the case of the Los Angeles metropolitan area, large distribution centers tend to be located on the outskirts of the city (reinforcing the process of logistics sprawl), but the vast majority of them are located in the eastern part of the metropolitan area. In the case of urban logistics areas, the dispersion effect is much more pronounced because the network is thin throughout the city (see Figure 4.2).

Depending on the type of warehouse and its size, the spatial location and distribution characteristics are differentiated.

In 2021, the Chair began a cartographic project to represent and analyze the spatial distribution of logistics warehouses in the main metropolitan areas of the United States, including some 45 case studies (Schorung, Lecourt, 2021). This work led to the publication of an atlas on the geography of warehouses in the United States.[1] This atlas shows a process of "metropolitanization" of logistics, with the concentration of logistics facilities in large urban areas: a mere eight metropolitan areas in the United States contain more than 300 large warehouses. It also allows us to understand the process of logistics sprawl, which is confirmed in most of the cases studied. Six of the top ten logistics hubs have seen an increase in logistics sprawl. Conversely, Chicago, Miami, New York and Seattle are hubs where logistics sprawl has decreased from 2012 to 2019, which will lead the Chair to investigate the causes in its research program in 2023.

1. Atlas available for download through this link: https://drive.google.com/file/d/18pLAegEpFKSf5SkXpIzdpPXelwAaoJQU/view



The question of the spatial distribution of logistics warehouses brings us back to the issue of warehouse location factors. In 2015, Prologis Research conducted a study on Europe to identify the location criteria for logistics warehouses.[2] Several factors are taken into account when deploying location strategies: the number of available sites, on an onfiguration; transport costs, which are now critical; the needs of the and th market concerned (e-commerce requires well-positioned warehouses eas); organization of the last mile segment; proximity to consumers; the of lar nd labor; and proximity to the distribution networks of carriers and riers. cording to this study, proximity to economic flows and activities and transp t appear to be the most important criteria. This is followed by the cost real e ate, the availability of labor, accessibility, proximity to consumers and ility.[3] owever, these criteria can vary depending on the sector of activity: the prio es labor and proximity to consumers, while the manufacturing sector ant i e city) prioritizes transportation costs. Globally, logistics warehouses lose the main economic, urban and infrastructural framework in all deve- ies a the main emerging countries.

Figure 4.3

Two examples of the atlas boards: the cases of Atlanta and Los Angeles-Riverside

Source: Schorung, Lecourt, 2021.

These two examples show the evolution of the spatial distribution of logistics warehouses between 2012 and 2019 for the Atlanta and Los Angeles metropolitan areas.
The proportional circles show the change in the number of establishments per centroid of each zip code. The standard derivation ellipse, shown on the 5 by 5 km grid maps, provides a representation of the evolution of logistics sprawl.

Complexity of logistic schemes: the case of Amazon

Amazon reflects many of the innovations in e-commerce and urban logistics: in 2017, Amazon's market share represented 37% of the total online shopping market in the United States and is expected to exceed 40% by 2023. In the U.S., Amazon's supremacy is clear: 39.5% of the e-commerce market in 2022, compared to 7.1% for Walmart (2nd), 4.3% for eBay (3rd), 3.7% for Apple (4th) and 2.2% for Best Buy (5th).[4] In the overall retail sector, Amazon is the second largest market player behind Walmart. The Covid-19 pandemic has had the effect of accelerating the already spectacular growth of the Seattle giant, whose sales have increased by 44.1% in 2020 and 22% in 2021 before returning to a post-covid (2022) growth of 9%. This performance is based on particularly deep vertical integration and efficiency in supply chain management, especially in the last mile.[5] Its logistics system is organized around an interlocking network of warehouses and logistics facilities of different sizes and types, 3PL and 4PL services,[6] and emerging proprietary transportation services (air and road freight). Amazon Cargo's fleet as of October 2022 includes 110 aircraft, mostly Boeing, but 10 Airbus aircraft are expected to be added by the end of 2023.[7] Over the past several years, Amazon has shifted its strategy toward direct ownership and control of most aspects of the supply chain to reduce its dependence on third-party logistics service providers (UPS, FedEx). This has helped the company reduce its delivery times.[8]

The Covid-19 pandemic has had the effect of accelerating the already spectacular growth of the Seattle giant, whose sales have increased by 44.1% in 2020 and 22% in 2021 before returning to a post-covid (2022) growth of 9%.

The Chair's cartographic work (Schorung, Lecourt, 2021) makes it possible to spatially represent Amazon's logistics system in the United States according to the type of warehouse or logistics equipment, according to the company's own typology: "air gateway", "inbound cross-dock", "regional sortation center", "pantry and fresh distribution center", "whole foods retail or distribution center" (see Figure 4.4).

4. https://www.insiderintelligence.com/content/amazon-dominates-us-ecommerce-though-its-market-share-varies-by-category [Accessed 6 December 2022].

5. https://www.forbes.com/sites/shelleykohan/2021/02/02/amazons-net-profit-soars-84-with-sales-hitting-386-billion/?sh=69d546a41334 [Accessed 6 December 2022].

6. A 3PL (Third-Party Logistics Provider) is a supply chain provider who is responsible for executing a more or less important part of the logistics of its customers. It is a form of subcontracting which concerns in particular the management of warehouses and transport (and all the associated and related services). The 4PL (4th-Party Logistics Provider) are full-fledged participants in a logistics processing chain. Offering software or computer applications adapted to the activities of a distribution chain, their purpose is to support the three usual types of actors: the shipper (1PL), the final customer (2PL) and the logistics provider (3PL), by planning and coordinating the information flows between them (Source: http://www.logistiqueconseil.org/Articles/Logistique/3PL-4PL.htm).

7. https://www.aboutamazon.com/news/transportation/amazon-air-adds-10-airbus-a330-300s-to-its-global-fleet [Accessed 6 November 2022]

8. https://www.forbes.com/sites/shelleykohan/2021/02/02/amazons-net-profit-soars-84-with-sales-hitting-386-billion/?sh=69d546a41334 [Accessed 13 June 2022].

Several observations can be made:

- There are few air gateways. They are generally not located in large airport hubs (except for Dallas and Los Angeles), as Amazon seems to be positioning itself either in medium-sized airports or in large airports that do not serve as a territorial base for a carrier or an express delivery company. As of 2021, Amazon's largest hub is located near Cincinnati in the city of Wilmington, while Atlanta (the largest U.S. airport) or Memphis (FedEx's territorial base) do not host one.
- IXDs ("Inbound Cross-Docks") correspond to processing centers for maritime containers loaded with goods imported into the United States, generally located near major multimodal hubs (ports, logistics platforms, rail hubs), which explains the high degree of territorial selectivity in the location of IXDs.
- Regional Sortation Centers are the intermediate regional links between several major distribution centers. They are used to sort packages for a given region, coming from several Amazon distribution centers. There are many such centers, and each major or intermediate metropolitan area is served by one or more of these intermediate sortation and distribution centers.
- Pantry and Fresh Distribution Centers cater to developing business services, but still have a modest logistics footprint with few warehouses. These are generally small, with two exceptions in the east, and close to major urban centers, allowing them to meet the fresh/perishable and everyday products orders of urban customers.

To complete this overview of Amazon's logistical organization on the scale of the country as a whole, we have represented the spatial distribution of all distribution centers, all categories combined, according to their temporal evolution (see Figure 4.5). To do this, we chose four time steps, one of which is forward-looking (end of 2024), allowing us to take into account all the location projects inventoried.

Until 2015, the location of large distribution centers was very selective geographically, concentrating in certain major economic regions of the country, such as California, the Atlanta region, and Northeast region. This may reflect Amazon's strategy of locating in a few driving territories with an already mature or strong market for e-commerce, and prioritizing locations near major "gateways" as evidenced by the Old South situation around Atlanta. From 2015 to 2020, Amazon's spatial footprint expanded dramatically, reflecting the massification of its business and the acquisition of a dominant position in the e-commerce sector. All major metropolitan areas and intermediate cities now have one or more large distribution centers, forming clusters of warehouses in the most urbanized regions (i.e., the Northeast region, Great Lakes region, Atlantic Piedmont region, Texas Triangle, California).

From 2015 to 2020, Amazon's spatial footprint expanded dramatically, reflecting the massification of its business and the acquisition of a dominant position in the e-commerce sector.

This overall evolution signals the company's horizontal integration strategy pursued during the 2010s, aimed at economies of scale and cost reduction through the multiplication of warehouses and the development of a fine network of large distribution centers and

9. The database used by the Chair for its research on Amazon (https://www.mwpvl.com/html/amazon_com.html) lists all the projects announced or planned by the company until the end of 2024.

Figure 4.4

Geography of Amazon warehouses as of January 1, 2021 by specialized category (excluding fulfillment centers) in the United States (expressed in square feet)

Source: Schorung, Lecourt, 2021.

specialized warehouses. The projects listed from 2021 to the end of 2024[9] reflect a dual strategy of the company: on the one hand, tightening the network in the best-endowed megaregions (Great Lakes, Northeast, Texas Triangle, California, Florida, Atlantic Piedmont, Northwest region); on the other hand, the deployment of an interstitial strategy aimed at filling "the holes" in less densely populated territories with projects planned in medium-sized cities and in states or regions that do not have a major metropolis (such as, Idaho, North Dakota, South Dakota, and New Mexico) as well as in smaller cities in states that are already endowed.

Figure 4.5

Geography of Amazon's U.S. fulfillment centers from 2010 to 2020 and with a projection to 2025 (expressed in square feet)

Source: Schorung, Lecourt, 2021.

This complexification and segmentation of Amazon's logistics organization is also occurring outside the United States, particularly in Europe. Map 4.6 shows the logistics network in Western and Central Europe: it is particularly dense in Germany and the United Kingdom (Amazon's two main European markets), unlike in France and Spain, for example. In addition, certain types of warehouses have an uneven presence on the European continent: Poland has only fulfillment centers; Germany is largely covered by a set of last-mile delivery centers (delivery "small" & "heavy"); the United Kingdom has several urban warehouses for Prime Now and Prime Fresh services. This map also shows that France is relatively "underequipped" compared to its major neighbors, partly due to strong opposition to certain locations (Nantes, Rouen).

Figure 4.6

Geography of Amazon warehouses (by warehouse type) in Europe as of January 1, 2022

Source: Chaire Logistics City (Schorung, 2022).

5 NEW URBAN WAREHOUSES AND "PROXIMITY LOGISTICS"

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 new shopping habits, which are reflected in a growing e-commerce sector, an "omnichannelization" of retail models, an acceleration of the urban logistics start-up scene, and a maturing platform-based gig economy (in France, we refer to this as an "uberized economy"). As L. Dablanc (2018) points out, e-commerce is playing a driving role in advancing technological, organizational, or architectural innovations that have a direct impact on urban logistics.

A second force for change is represented by public policy and regulation of urban logistics, characterized by increased attention and sensitivity to urban freight transport and its negative externalities. More and more local governments are implementing access regulations due to the disproportionate impact of freight transport (Verlinde, 2015). Although only 15-25% of urban transport miles traveled can be attributed to freight vehicles, they occupy 20-40% of motorized road space, cause 20-40% of CO_2 emissions, and are responsible for 30-50% of air pollutants (LAET, 2016; Smart Freight Centre, 2017). Most of these regulations are restrictive, limiting freight vehicle access to certain areas, times, or vehicles (Gonzalez-Feliu, 2018). In addition, cities are also introducing low- or zero-emission zones and experimenting with new pedestrianization initiatives and reflections in urban planning on the "fifteen-minute city". Urban logistics real estate, referred to here as "proximity logistics", aims to counterbalance the historic trend of installing logistics warehouses on the outskirts of cities.

Urban logistics real estate, referred to here as "proximity logistics", aims to counterbalance the historic trend of installing logistics warehouses on the outskirts of cities.

However, this proximity logistics does not necessarily replace logistics facilities in suburban or rural areas. Rather, it is an extension and evolution of essentially global networks to make them more suitable for the city. Onstein *et al.* (2021) describe the resulting typology of facilities as moving from XXL to XXS. Just as the term "logistics sprawl" refers to patterns of logistics facility location relative to cities, so too does the term "proximity logistics" (Buldeo Rai *et al.*, 2022). Proximity logistics facilities vary in size and activity. Their specificity lies in their location, i.e., in dense, mixed-use urban areas, and in 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 causes (Sakai *et al.*, 2015).

Countering logistics sprawl is even more important in the case of e-commerce, where deliveries are more fragmented than store replenishments, according to calculations by consulting firm Oliver Wyman (2021). This study shows that logistical unbundling leads to an increase of 2.5 grams of CO_2 emissions per purchase for online shopping, compared to 1 gram for in-store shopping in Europe. For e-commerce deliveries in particular, logistics facilities in urban areas (e.g., a microhub in Paris) are found to decrease transport distances and negative externalities (Morin *et al.*, 2016). Houde *et al.* (2021) show that increased proximity to consumers has slowed the growth of external costs associated with Amazon's long-distance trucking in the United States. In the era of e-commerce, the space allocated to logistics in urban areas is inevitably growing (Xiao *et al.*, 2021). For cities, and large cities in particular, meeting this demand is a major challenge. The table below summarizes the types of logistics facilities based on pre-existing typologies (Rodrigue, 2020; Onstein *et al.*, 2021).

Figure 5.1
Multiple formats of "proximity" logistics
Source: Buldeo Rai *et al.*, 2022.

LOGISTICS FACILITY	SIZE	SERVICE AREA	ACTIVITY
Cross-dock facility	M to XXL	Regional, national or international	Cross-docking
Air hub			
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 fulfillment
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); **microhubs** 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 fulfillment
This logistics facility type also covers **urban satellites** (Alfieri *et al.*, 2021); **dark stores**; and **warestores** (Sheffi, 2020).			
Pick-up location	XXS	Local	Collection
Local freight station			
These facility types also cover **parcel lockers**; **pick-up points** (Onstein *et al.*, 2021); **click&collect stores**; and **drives** (Buldeo Rai *et al.*, 2019).			

In most of the world's metro areas, the trend of developing logistics facilities in dense and some mixed-use areas, known as "proximity logistics," is emerging. The study of five cities by Buldeo Rai *et al.* (2022), namely New York (USA), Paris (France), Seoul (South Korea), Shanghai (China), and Tokyo (Japan), demonstrates both: (1) the development of a new hierarchical system for urban logistics, with large-scale regional facilities connected to small-scale local facilities, as well as (2) the development of logistics facilities in close proximity to, or even within, dense urban areas (distribution centers, delivery stations, centers for rapid delivery). However, there are still many challenges to introducing logistics facilities in urban areas, including: the high cost of real estate operations, the reluctance of local residents, the scarcity of land, and competition from other space needs in dense areas (housing, offices, retail, etc.).

There are still many challenges to introducing logistics facilities in urban areas.

Multistory warehouse in the heart of the Tokyo metropolitan area: Tokyo Danchi Reizo.

The complexity and increasing segmentation of the logistics schemes adopted by the players make it necessary to read logistics real estate at different spatial scales, from the national to the micro-local, and at the entanglement of these scales.

The national scale: the major spatial equilibriums

Looking at the spatial distribution of logistics warehouses on a national scale makes it possible to represent the sector's major balances and to observe changes in the economic geography (industries, services) of the country under consideration.

Figure 6.1

The main logistics markets in France in 2021

Source: BNP Paribas Real Estate, 2022.

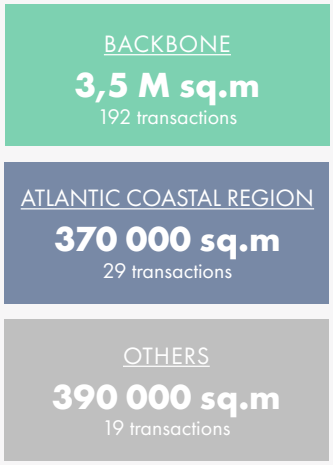


Figure 6.2

The geography of logistics warehouses in the United States

Source: Schorung, Lecourt, 2021.

Nearly half (46%) of these so-called "isolated" warehouses are operated by manufacturers and are smaller on average (15,800 sq.m.). Thirty-six percent of them are located in rural areas and 20% in urban units with fewer than 2,000 inhabitants.

The three extended logistics areas around Paris, Lille and Lyon account for 23% of warehouses with more than 5,000 sq.m.

Of the 60 so-called "dense" logistics areas with at least 10 warehouses, 13 are located in the Paris region. The logistics area with the most warehouses over 5,000 sq.m. is located north of Paris and extends over an arc of some 20 kilometers between Gennevilliers and Tremblay-en-France. It includes 120 warehouses of more than 5,000 sq.m. This logistics area is located along the highways linking the northern and eastern regions, as well as by the port of Paris. The second logistics area in the Paris region is located at the intersection of the A4 and A86 freeways, to the south-east of Paris, and includes some 40 warehouses of more than 5,000 sq.m. The Rungis national market (MIN) and the neighboring municipalities are home to a logistics area of around 30 warehouses. Large logistics areas are also located around Lyon and Lille. In particular, to the east of Lyon, two large logistics areas are located along the A43 freeway which links Italy and Switzerland.[2]

In the United States, the geography of logistics warehouses highlights the main logistics clusters (see Figure 6.2) (Schorung, Lecourt, 2021). Two states concentrate the most warehouses, California and Texas, to which must be added the states of New York and New Jersey (East Coast), which share the same economic, industrial and infrastructure environment. At the metropolitan area level, 13 metropolitan areas have more than 200 logistics facilities – only four have more than 500 logistics facilities (New York/Newark, Los Angeles/Long Beach, Chicago, Dallas/Fort Worth).

The megaregional scale: a new scale of analysis

The megaregion is a new scale of analysis clearly identified by political actors and transport authorities, and this new scale is also beginning to be taken into account by the scientific literature.

Definition of a megaregion

"Megaregions, networks of metropolitan centers and their areas of influence that have existing social, environmental, economic, and infrastructure relationships, are geographic areas that will contain two thirds of the nation's population by the mid-twenty-first century" (Ross, 2009). The megaregion is the result of a continuous process of polarization and accumulation of population, wealth and activities, which goes beyond the existing administrative units as well as the classical scales of analysis – city, urban area, metropolis.

2. *Atlas des entrepôts et aires logistiques en France en 2015*, 2017. https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2018-11/datalab-14-atlas-entrepots-aires-logistiques.pdf

Each megaregion forms a large but coherent territory, marked by environmental, economic, and infrastructural interactions, creating a new transactional and traffic space. An important part of a megaregion's competitiveness both nationally and in the global marketplace depends on the transportation infrastructure that ensures the fluidity of its internal and external exchanges of goods and people.

Three processes underlie the development of megaregions:

- the growth, intensification, and diffusion of economic activities that require more and more space to develop;
- the improvement of communications between urban centers resulting from the development of transportation corridors;
- the economic and functional specialization of urban centers and their increased interdependence, which is accompanied by very intense passenger and freight flows (Dablanc and Frémont, 2015).

Figure 6.3

The geography of logistics warehouses in the Great Lakes megaregion

Source: Schorung, Lecourt, 2021.

In its atlas of logistics warehouses in the United States[3], the Chair mapped the spatial distribution of warehouses at this megaregional scale for the eight U.S. megaregions identified by researchers and planning practitioners. An example in Figure 6.3, in the Great Lakes mega-region, we visualize a primary cluster centered on the Chicago metropolitan area and several secondary clusters around Detroit, Cincinnati, and Columbus. This research is in line with pre-existing work on the Paris Basin (Bahoken, Raimbault, 2012), making it possible to identify logistics clusters beyond the Paris conurbation alone, using a set of scales.

The subregional scale: the deployment of logistics systems

The analysis of the spatial footprint of warehouses at the largest scales (national and macro-regional) then requires a crossover of scales to understand how logistics networks are territorialized, this time at the regional and metropolitan scales. Let's take the case of Amazon in the United States as an example. New York and Los Angeles are the two largest consumer markets for e-commerce and are the two largest metropolitan areas in terms of the number of logistics warehouses according to the U.S. Census Bureau. They are also major gateways for international and domestic trade, as well as powerful multimodal trade and logistics hubs (Rodrigue *et al.*, 2017).

In the case of the Northeast megaregion, we focused the analysis on the central and southern part of the megacity, from New York City to Washington, D.C. (Figure 6.4), taking into account warehouses in the hinterland in relative proximity to major sea, air, and logistics gateways. From the map of Amazon's logistics system in this region as of January 1, 2021, we can see that most of the warehouses are located in the urban continuum of the megalopolis in a linear pattern, following the region's major transportation routes. Several observations can be made:

- The major distribution centers are mostly located in the outlying areas of the major metropolises (Baltimore, Philadelphia, New York). In addition, several of the largest centers are located in exurbanized areas, such as the three between Baltimore and Wilmington and the four centers between Philadelphia and New York, at the Trenton level.
- A second arc in the hinterland would provide a supporting function to the main arc of the megalopolis, with a cluster of several distribution centers on the outskirts of Harrisburg and Allentown and a large warehouse in the southwest in Winchester. The mismatch between the size of the logistics location and the size of the surrounding market might suggest that these hinterland warehouses are either logistics facilities serving core consumer markets or facilities that mesh numerous intermediate-sized inland markets.
- The large logistics warehouses that do not fall into the category of fulfillment and distribution centers – Inbound Cross-Dock, Regional Sortation Center, Pantry and Fresh Distribution Center – are positioned in two ways in the region, either peripherally on the fringes of the metropolitan area or pericentrally near the urban centers (Trenton, Newark, Baltimore). This pericentral position could confirm the role of these warehouses as an intermediate link in Amazon's global logistics chain.

3. Atlas available for download through this link: https://drive.google.com/file/d/18pLAegEpFKSf5SkX-pIzdpPXelwAaoJQU/view

Figure 6.4

Amazon's Northeast (Washington D.C.- New York City corridor) logistics network in 2021

Source: Schorung, Lecourt, 2021.

- Finally, there is a second level in this logistical network, which is an urban and local network with a multitude of small urban logistical spaces ("Last mile delivery stations" and "Prime Now hubs"). There is a fine network of urban delivery points, particularly dense in two major metropolises considered in the study area: Philadelphia and especially New York. The other two cities further south have a much weaker network, reflecting the relatively strong geographic selectivity of e-commerce and urban deliveries. The other urban logistics spaces appear to be scattered throughout the region, with a multitude of points in suburban areas, illustrating the strategy of penetrating suburban consumer markets. The Prime Hub service and its small urban hubs dedicated to these rapid delivery services are marked by even greater geographical selectivity, with only one deployment market in New York City, apart from a small Prime warehouse in Philadelphia.

Also at a subregional scale, Figure 6.5 this time illustrates the location of warehouses by major logistics sectors based on research conducted by A. Heitz, P. Launay, and A. Beziat (2019) to construct a new typology of warehouses in the Ile-de-France region. The e-commerce landscape in Ile-de-France represents at least 974,400 sq.m. of built space, with a total footprint of approximately 2.5 million sq.m. The average size of a parcel hub in the Paris region is 8,000 sq.m., but varies significantly by location and function, i.e., delivery, cross-dock, storage, etc. (Boïco, 2016).[4]

Figure 6.5

Towards a new typology of logistics warehouses in the Paris metropolitan area

Source: Heitz, Launay, Beziat, 2019.

4. https://www.institutparisregion.fr/mobilite-et-transports/transport-de-marchandises-et-logistique/etat-des-lieux-de-la-logistique-en-ile-de-france/

First of all, 50% of logistics facilities are located in less than 10% of the Ile-de-France territory: there is therefore a significant concentration of small warehouses and logistics facilities in dense urban areas, located not in the city of Paris, but in its closest suburbs ("Petite Couronne"). On the other hand, large facilities with many employees have spread to the periphery, in the "Grande Couronne". This approach reveals a complex freight landscape and a specific spatial configuration for each logistics sector. Logistics sectors are not homogeneous and have different spatial configurations, which both public decision-makers and private actors must take into consideration (Heitz, Launay, Beziat, 2019).

50% of logistics facilities are located in less than 10% of the Ile-de-France territory.

The scale of the metropolitan area: local dynamics

The metropolitan scale is often used to analyze the spatial dynamics of the logistics sector, either from a monographic or comparative approach. Studying spatial distribution at this scale makes it possible to identify the main logistics clusters, any imbalances in the location of warehouses, and changes in this location over time. The metropolitan scale is the preferred scale in the scientific literature for the analysis of logistics sprawl.

The Greater Paris metropolitan area (Métropole du Grand Paris) contains 3 million square meters of storage space and 784 warehouses (of all sizes) within its perimeter. Their surface area varies greatly, ranging from 200 sq.m. to 120,000 sq.m. The geography of logistics follows the major motorways in the eastern crescent of the region. This eastern bias can be explained by the commercial links between the Paris region and its partner territories in the north and south of France and Europe, and by the structure of the networks extending from the Paris region. The mapping work carried out by APUR (figure 6.6) shows the logistics imbalances within the capital region (80% of the food logistics surface area for large-scale distribution is located in the outer suburbs, especially in Seine-et-Marne and Essonne departments) and within the Greater Paris metropolitan area (this food logistics sector is concentrated mainly in Val-de-Marne department around Rungis and Orly airport). In Greater Paris, several other large warehouse clusters are emerging in the north of Paris (around the port of Gennevilliers and the Roissy airport area).

The Greater Paris metropolitan area contains 3 million square meters of storage space and 784 warehouses (of all sizes) within its perimeter.

In the United States, intra-territorial dynamics are quite different between, for example, the Philadelphia metropolitan area (Philadelphia-Camden-Wilmington) and the New York metropolitan area (NY-Newark-New Jersey) (Schorung, Lecourt, 2021, see Figure 6.7).

The Philadelphia-Camden-Wilmington metropolitan area has experienced growth in warehousing establishments (+21.9% between 2012 and 2019), but has a more limited logistics sprawl than other metropolitan areas studied in the Logistics City Chair atlas. The analysis of logistics facilities between 2012 and 2019 shows a change in location

Figure 6.6
Logistics real estate in the Greater Paris area
Source: APUR, 2022.

patterns: less dispersion in the central corridor between Philadelphia and Trenton with some ZIP codes experiencing a decrease in the number of warehouses; a strengthened logistics hub south of Wilmington; and new warehouse locations outside the city of Philadelphia (north and west of the metropolitan area). Warehousing development patterns in the Philadelphia region appear to be primarily organized by the megalopolis' urban and transportation corridor (following a northeast/southwest axis).

The New York-Newark-New Jersey metro area, on the other hand, has seen more limited growth in logistics establishments (+17.6% between 2012 and 2019), but this growth has occurred in an already mature and well-developed logistics market (993 warehouses in 2019). Logistics sprawl has been reduced there, which is one of the few exceptions among the cases studied in the atlas.

Figure 6.7

Logistics real estate in the New York and Philadelphia metropolitan areas

Source: Schorung, Lecourt, 2021.

The micro-local scale: New York City explorations

Looking at the spatial distribution of logistics warehouses and the deployment of logistics patterns in a given territory leads to the representation of logistics landscapes in an "off-ground" manner, often through cartography. A look at the local or even micro-local scale, on the other hand, makes it easier to understand the location of different types of warehouses and the concrete manifestations of urban logistics activities.

The New York-Newark-New Jersey metropolitan area is the largest metropolitan area in the United States for the number of logistics facilities. It contained 844 warehouses in 2012 and 993 in 2019, representing a 17.6 percent growth in this period. This metropolitan area acts as an international and domestic gateway for goods. As a result, the number of logistics establishments per 10,000 population has continued to increase, from 0.38/10,000 population in 2012 to 0.44/10,000 population in 2019 (Schorung, Dablanc, 2022). Four areas concentrate the most logistics warehouses: an axis along Interstate 95 through Newark Airport, an axis along Interstate 495 in Long Island; a pericentral crescent around Manhattan (Port of New York-New Jersey, western Brooklyn, northwest Queens, Interstate 278 in the Bronx). In these areas, large peripheral distribution centers can be observed.

Amazon Hub (Delivery Center) located in Brooklyn, New York City in the Red Hook neighborhood, near Manhattan.

New York City allows us to observe the diversification of logistics real estate products, from large peri-urban warehouses to urban distribution centers, as well as the ever-increasing penetration of digital commerce in the city's commercial fabric.

However, we are gradually seeing a return of urban logistics to the city center. Indeed, private demand for warehouses in dense areas has been emerging for several years. Brooklyn is a very good place to study this redevelopment of urban logistics in dense areas. The Red Hook neighborhood, for example, will be home to a new multistory warehouse in the next few months (the project is called 640 Columbia Street – see Part 3), which is one of the most significant innovations in urban logistics real estate. The particularity of this project lies first of all in its position in the metropolitan area, housed in a dense urban fabric and in the pericentral zone of New York, from which access to Manhattan and the rest of the agglomeration is easy.

The Amazon Prime Distribution Center on 35th street (between 5th and 6th Avenues) located in the heart of Manhattan (New York City).

The last mile segment: return of foot carriers and cyclo-logistics.

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Transshipments on the sidewalk: competition for public space.

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New York City allows us to observe the diversification of logistics real estate products, from large peri-urban warehouses to urban distribution centers, as well as the ever-increasing penetration of digital commerce in the city's commercial fabric. What is striking when you walk through the streets of New York is the increasing materialization of e-commerce in all its forms (e.g., pick-up points or click&collect, new innovative commercial formats) paradoxically accompanied by a growing dematerialization of purchasing practices, such as orders made more on mobile applications rather than directly in store, or the development of pick-up points in physical stores.

Fieldwork has shown the deployment of urban logistics (especially e-commerce) and the micro-scale operation of digital commerce. We can, for example, observe a diversification of vehicles used for the last mile: classic bicycle, electric bicycle, cargo bike, electric moped, vans, pushed or pulled carts. Bicycle and scooter delivery drivers either deliver small parcels to the final recipients, or deliver groceries or meals quickly (with the distinctive feature of boxes, stalls or carrying cases). As regards delivery vans, light commercial vehicles (LCVs), used by UPS, Fedex, and other third-party carriers on behalf of Amazon, allow for last-mile deliveries by delivery drivers on foot or by direct courier services. Finally, what's amazing about Manhattan are the swarms of foot carriers that provide the final delivery segment to package recipients. Amazon's delivery drivers are typically equipped with wheeled carts with fabric boxes to store and protect the packages. Other delivery drivers may be equipped with only a cloth box carried on their backs or a single cart with packages stacked in disarray.

We can thus see that the last mile segment of e-commerce relies on a combination of technology (websites, applications, algorithms, tablets) and quite low-tech solutions (walkers, carts, use of ordinary roadways, bicycles or cargo bikes).

The last mile segment of e-commerce relies on a combination of technology and quite low-tech solutions.

Often, there are no specific facilities to facilitate the operations and the work of the handlers: there is no parking lot or loading area. All these operations are done on the street, in the middle of passers-by and regular car traffic. The equipment is also parked or stored outside the warehouse on the public road. The observation of transshipment operations on the street and the sidewalk, as well as the distribution of orders between delivery drivers, reveals here again a strong hybridization between the digital and the resourceful. The driver has to empty their truck, right on the road and the sidewalk – trucks that are full to the brim. An employee (here from Amazon) scans the packages with a digital pad and distributes them according to the tour plan operated by a software. Afterwards, the packages are distributed to each delivery person in the area, who leaves with one to three colored boxes, either on foot with a cart or on a bicycle.

These ordinary scenes of urban logistics and e-commerce leave their mark on New York City's public space.[5] This does not go without raising questions about the use, or even the occupation – often illegal – of public space, in particular streets and sidewalks, by private companies.

5. The fieldwork in New York City conducted in February-March 2022 by Laetitia Dablanc and Matthieu Schorung is presented in detail via this link: https://www.lvmt.fr/wp-content/uploads/2019/10/Soiree-diapos-avec-Laetitia-et-Matthieu-VF_compressed.pdf

THE FORMS AND MODELS OF URBAN LOGISTICS REAL ESTATE

Far from the traditional image of warehouses in the eyes of the general public, between large suburban warehouses and old industrial-era warehouses in the inner suburbs, urban logistics real estate is a booming sector that is developing around technical and architectural innovations and aims to re-establish itself in the heart of urban areas, closer to consumers. The logistics landscape is gradually being structured around two poles. On the one hand, the creation of so-called "XXL" distribution centers or mega-fulfillment centers (over 50,000 sq.m.), which follow the historical trend of logistics zones moving away from urban centers, and on the other hand, the creation of urban logistics spaces in dense areas to meet the demand linked to e-commerce. Urban warehouses were introduced by major e-commerce players such as Amazon, which has gradually moved into central locations in major cities (first in North America, and now in the main European cities).

This has led to a significant change in the logistics plans of the players involved in logistics (carriers, shippers, e-commerce pure players, distributors, express carriers, etc.), as well as a more gradual change in the way logistics is conceived in urban areas. Multiple typologies of urban logistics spaces have been developed over time, using terms that are

now widely used (e.g., logistics platform, urban distribution space, etc.). These typologies aimed to disseminate an understanding of the different forms of logistics real estate and the way in which both public and private actors understood their location in cities. They were based above all on the location of the different formats of logistics real estate in the urban area, on the size and on the modes of transport and the associated multimodality. The existence of these different typologies reflects both the need to clarify and make visible the formats of urban logistics real estate and the need for supply chain organization to specialize the links between them. These typologies are particularly used today by large companies (public or private) that have to manage complex logistics processes (e.g., La Poste group, Prologis, Amazon, to name but a few).

Nevertheless, these highly standardized schemes may appear rigid in light of the increasing number of innovations in urban logistics real estate, new scales of intervention and the growing importance of public regulation of logistics. Traditional criteria based on warehouse size, location and a main function are gradually being called into question as the functions associated with urban logistics spaces become more complex and intertwined. Four developments are fueling this questioning: the necessary urban integration of logistics spaces; functional mix; the imperative of energy transition and decarbonization; land availability and social acceptability.

The aim of this section is to offer new ways of understanding urban logistics real estate, while taking a reflective look at existing typologies, and to emphasize the need to focus on the functions and uses of urban warehouses. As these new urban warehouses are not uniform, this section provides a brief and non-exhaustive overview of innovations in the sector, demonstrating the need to think differently about the return of logistics to the heart of urban areas and to take into account the possible positive externalities of these new warehouses for their local environment.

7 PLACES AND FUNCTIONS OF URBAN LOGISTICS: THE NEED FOR NEW INTERPRETATIVE TOOLS

Can we typologize logistics spaces?

Logistics in urban areas is by its very nature a constrained urban planning model. The high cost of real estate, the scarcity of land and competition with other urban functions (housing, offices, shops, etc.) as well as the acceptability of local actors and residents are all factors that make the development of logistics facilities in cities a challenge.

Thus, the models for logistics sites are mainly built *ex post* on the spaces and plots of land that remain available, in vacant lots or abandoned urban areas that cannot accommodate other functions. The formats of logistics sites in dense areas that we know about have therefore mainly been theorized on the basis of what already exists. This observation is not applicable to the classic programmatic practices, thus creating the need for a systematic entry point for a typology: housing, public facilities, shops, economic activities (excluding logistics).

In academic works as well as in the approaches of private actors, several typologies of logistics facilities are proposed to understand the role of logistics in an urban context.

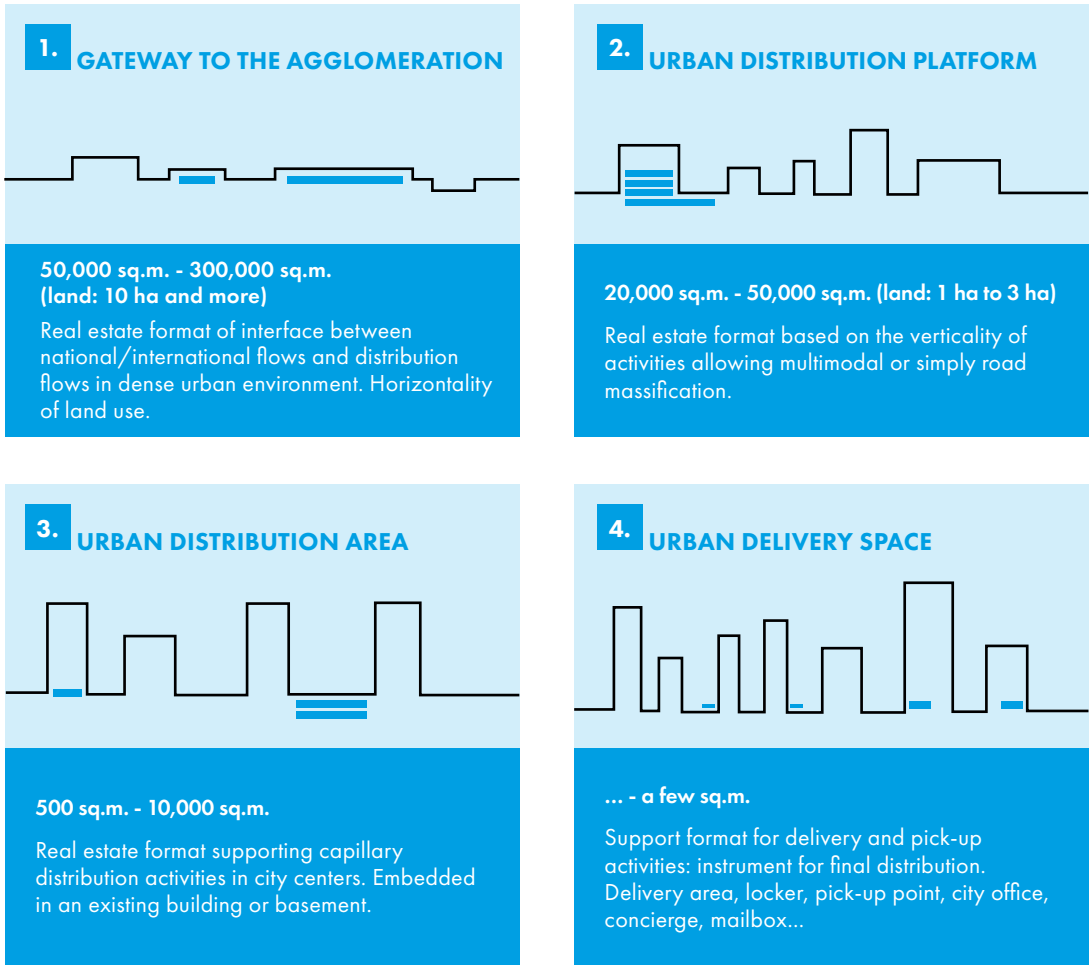
The models for logistics sites are mainly built ex post on the spaces and plots of land that remain available, in vacant lots or abandoned urban areas that cannot accommodate other functions.

Since 2000, the scientific literature has proposed different typologies of logistics facilities:

- First according to mainly geographical criteria, considering the metropolitan or sub-metropolitan scale, making "logistics facilities" as defined by M. Savy (2006) the reference framework.
- Then, according to the main operational characteristics in the management of goods flows, making it possible to characterize a logistics facility by specifying the way it is used in the urban space. Emerging concepts such as the urban logistics park or urban distribution centers have gained prominence in recent years.

In 2017, Afilog (French professional organization that brings together players in the logistics real estate and supply chain sectors) introduced a new typology based on cities' logistics needs, with two challenges: first, to define and name the real estate operations with logistics functions and inserted into the urban fabric, to guide land approaches, affirm principles of architectural design and urban insertion (both horizontal and vertical) and illustrate the use of these spaces. Second, bring together visions around places, rather than activities, to encourage urban development policies that favor a strategy of networking logistics spaces in urban areas.

Figure 7.1
The Afilog typology of logistics activities
Source: Afilog, 2018. https://www.afilog.org/logurbaine/typologie/la-logistique-revee-de-la-ville.html



Afilog's classification introduces supply chain characteristics to define two types of logistics locations:

- *Distribution*, which can lead to three levels of classification: 1. Gateway to the urban area, 2. Urban distribution platform, 3. Local distribution space. These locations systematically constitute an entry and exit node in the distribution chain.
- *Delivery*, which may correspond to a fourth level of classification: 4. Urban delivery space. This last place in the distribution chain is the one that is most finely inserted into the city center, with a variety of delivery methods.

The geographical character of the logistics site is thus understood according to its position in relation to the urban area: at the entrance, i.e., outside the urban area (entrance to the urban area), and inside it (adjective "urban"). From this interpretative framework, notions of theoretical surface areas are also introduced: the further the place is from the urban center, the larger the space that characterizes it in terms of square meters.

The geographical character of the logistics site is thus understood according to its position in relation to the urban area.

In 2020, APUR (Atelier Parisien d'Urbanisme) introduced its own terms to characterize logistics facilities, summarizing in a simplified way compared with the approaches adopted until then. Thus, logistics facilities can be qualified by their geographic location, their theoretical catchment area (their radius of influence) and their size. As these three criteria are closely linked, they have led to the development of a four-level classification:

The regional, national or international logistics terminal: surface area greater than 20,000 sq.m. located in the Greater Paris area, far from the urban center.

The local terminal, or logistics hotel: surface area of 3,000 to 20,000 sq.m. located on the outskirts of the metropolitan center, to manage flows on a metropolitan scale.

The urban logistics space: surface area of 100 sq.m. to 3,000 sq.m. in the urban center.

Local depots or pick-up-points: a few square meters in the urban core.

This classification transcribes a hierarchical reading of the metropolitan space and the organization of its logistics needs, by apprehending the usual scales. It also introduces a new key to understanding: at its final level, logistics is often designated by another space into which it manages to integrate/insert itself (the relay point, for example). The logistics function is thus perceived in a more diffuse way in dense space, often linked to other functions such as commerce. The place no longer necessarily designates the function. In this respect, it is important to to think of the logistics space regarding its function(s) and its use.

The logistics function is perceived in a more diffuse way in dense space, often linked to other functions such as commerce.

Thus, the sectorization of logistics spaces does not necessarily allow them to be approached from the angle of their functionality or to question more broadly all the parameters that can refine the reading of these spaces in their urban context. Since the end of the 2010s, based on an international comparative reading, some authors have sought to establish a general typology bringing together up to seven types of urban logistics spaces, integrating new information on the market area or radius, labor requirements and periodicity. The two main functions

associated with urban logistics spaces (cross-docking, storage) (Heitz *et al.*, 2019; Sakai *et al.*, 2020) are reflected in the typology of Meza-Peralta *et al.* (2020), who propose seven types of urban logistics spaces based on dimensions and volumes. The typology proposed by Boudouin (2006) breaks down urban logistics spaces into six categories, including three innovative categories (the goods receiving point, the urban logistics box, and the "mobile" urban logistics space. Other works include the catchment area or labor requirements (Bulwiengesa, 2017).

These academic typologies are not comprehensive and there are many variations developed or used by logistics operators themselves. But they bring three main observations.

1. Typologizing means defining criteria through the prism of selected characteristics: this therefore intrinsically reflects a certain reading bias.

2. Typologizing means using a certain language and words that allow us to qualify logistics places.

3. Typologizing means orienting a certain understanding of the logistics city and constructing representations of the way in which logistics locations invest the urban environment.

Characterizing the different forms of logistics facilities

The criteria for characterizing logistics facilities are multiple and influence the way in which logistics real estate typologies are defined.

The logistics function: the place is an interface to transportation

The subject of logistics is intrinsically linked to that of transportation. As highlighted by the Paris Region Institute, characterizing the logistics place through transportation allows us to consider the logistics place in its capacity as a place/flow interface and the implications that this has in terms of urban integration and logistics organization. The design of the site must be adapted to the evolution of goods transport practices in cities towards a more sustainable environment:

- The necessary parking to limit the congestion of the roadway.
- Direct interfaces with the roadway: road access, dock doors, which must allow for operational optimization.
- Recharging or refueling infrastructures adapted to the evolution of freight vehicle engines.
- Facilities provided for delivery drivers.

Transport, through the intermediary of the mode of transport, networks and parking, is therefore a direct determinant of the logistics site.

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The place function: the place has a hold on the logistics site

The factors that determine the location of logistics sites, their geography and the spatial dynamics of the territory can also be criteria for defining these sites.

Two phenomena can be used to describe the forces in place that have a direct effect on the geography of warehouses: the phenomenon of logistics sprawl, i.e., the distance of logistics warehouses from the urban center, and the phenomenon of polarization, i.e., the creation of logistics hubs in small areas of a metropolitan area.

These two phenomena, combined, allow us to describe the footprint of a logistics geography: "the concentration of warehouses and, more generally, of logistics activities in the largest urban entities, combined with their recent peri-urbanization, constitute what might be called "logistics metropolitanization" (Debrie, Heitz, 2017). Thus, the logistics fact is translated into a geographical and metropolitan fact, itself illustrated by a place: the warehouse. However, logistics sprawl does not erase the presence of warehouses in the dense spaces of the metropolitan area, which then take other forms.

Generally speaking, there are two basic criteria for locating a warehouse: access to the urban consumer market, which is therefore constrained by urban geography, and access to a major road network. The location criteria therefore correspond to accessibility criteria, emphasizing that logistics uses and transforms the territory.

Territory and geography are therefore, through accessibility criteria, a direct determinant of the logistics location.

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The supply chain function : perspectives from the stakeholders

These typologies are particularly used today by large companies (public or private) that have to manage complex industrial and logistics processes (La Poste group, Prologis, Amazon).

Beyond the criterion of accessibility resulting from the spatial phenomenon described above, the strategies for setting up logistics sites mainly reflect the strategies of private actors. For these actors, logistics sites serve a corporate function, either organized by the company itself or by a market: "A logistics site is a private investment choice made by a logistics provider, a shipper or a developer. It depends on the representations that these investors have of logistics activities and potential locations" (Raimbault, Douet, Frémont, 2013). This quote highlights the influence of representations of logistics space in the imaginations of private actors and the constraints of the real estate or land acquisition market in the development strategies of logistics locations by private actors.

We can illustrate, through the examples of Amazon and Prologis, the implication of private actors' strategies on the functional and spatial organization of logistics sites, by restating the visions held by actors who are key players respectively in the e-commerce market and in the logistics warehouse market. Indeed, the latter are progressively inventing their own typology of logistics spaces with the dual objective of segmentation/specialization of supply, storage and distribution chains.

Prologis' typology

For several years, the American giant Prologis has been deploying a last-mile-oriented strategy based on a segmentation of its real estate portfolio into four categories: "Gateway" (multi-markets buildings that incorporate access to major sea and intermodal ports), "Multi-market" (distribution facilities tend to be newer and larger and located at key transportation hubs at the periphery of major urban areas), "City" (properties well-positioned to provide 1-2 day shipping to a large market who tend to be small to mid-sized and located in urban areas), "Last Touch" (properties that can reach large dense, affluent populations within hours and these buildings typically are the oldest and smallest because they are in very infill locations) (Prologis Research, 2019) This functional segmentation is based on three criteria: distribution and delivery time; location within a metropolitan area and near major transportation networks; and the fit between the assigned function and the efficiency of a logistics facility.

The link between logistics site and consumption practices : the logistics site is influenced by and exerts an influence on consumption practices

Finally, we can look at the logistics site from the point of view of consumption practices and its interface with the new entrant in the supply logistic chain: the consumer, or more broadly, households. Studying the mobility of goods in the city from the point of view of consumer behavior allows us to highlight the fragmentation of the supply chain in connection with e-commerce and the emergence of new purchasing levers. We can thus observe a diversification of B2C delivery methods, which translates into the appearance and multiplication of new logistics locations, including the pick-up point, the post office, the drive-through, the locker and the store. Under the effect of e-commerce, the boundaries between commerce and logistics in dense areas are blurring, and physical commerce is becoming an object that logistics urbanism is gradually taking hold of through the hybridization of service interfaces.

Moreover, studying logistics locations through the prism of consumer practices means bringing into the urban logistics equation the mobility of people. For example, in 2018, the Paris Region Institute estimated that nearly 84% of online purchases generate physical consumer flows.

The mobility of people and the mobility of goods thus have common denominators, and the logistics location, as an interface and physical anchor linked to these practices, participates in their evolution.

We can observe a diversification of B2C delivery methods, which translates into the appearance and multiplication of new logistics locations, including the pick-up point, the post office, the drive-through, the locker and the store.

A new paradigm of uses and logistics services for cities

The existence of different logistics typologies reflects both, from the point of view of urban players, a need for clarification and visibility as well as legibility of urban logistics real estate formats, and, from the point of view of logistics players, a need for supply chain organization to specialize its links.

Nevertheless, these highly standardized schemes may appear rigid in light of the evolution of public policies relating to urban goods transport, and the challenges of innovation in urban logistics real estate to meet the issues of land scarcity, urban integration of logistics spaces, functional mix, decarbonization, and above all, social and political acceptability.

From the hypermobile city to the "quarter-hour" city, the logistics real estate situation is changing, and the traditional criteria based on warehouse size, location and a main function are necessarily being called into question as the functions associated with urban logistics spaces become more intertwined and complex.

A new approach is emerging, in which actors such as Sogaris are involved, seeking to better understand the determining models for logistics actors in the optimization of bulk breaking. The way in which the organization of the last and even the second-to-last logistics link is recomposed is very heterogeneous, depending on the sectors under consideration and their specific challenges. Bulk breaking based on intermediate real estate links was first imposed on the parcel and e-commerce industries, which are subject to routes with many delivery points. This is not the case for sectors such as wholesale or food retail, with routes involving fewer delivery points, for which the question of the trade-off between the cost of the bulk breaking, the transshipment and its potential for streamlining flows arises.

The challenge is to equip urban players to create conditions conducive to supply and distribution models that are as well adapted as possible to the urban context in question, to the areas to be served and to the constraints of roads and public spaces.

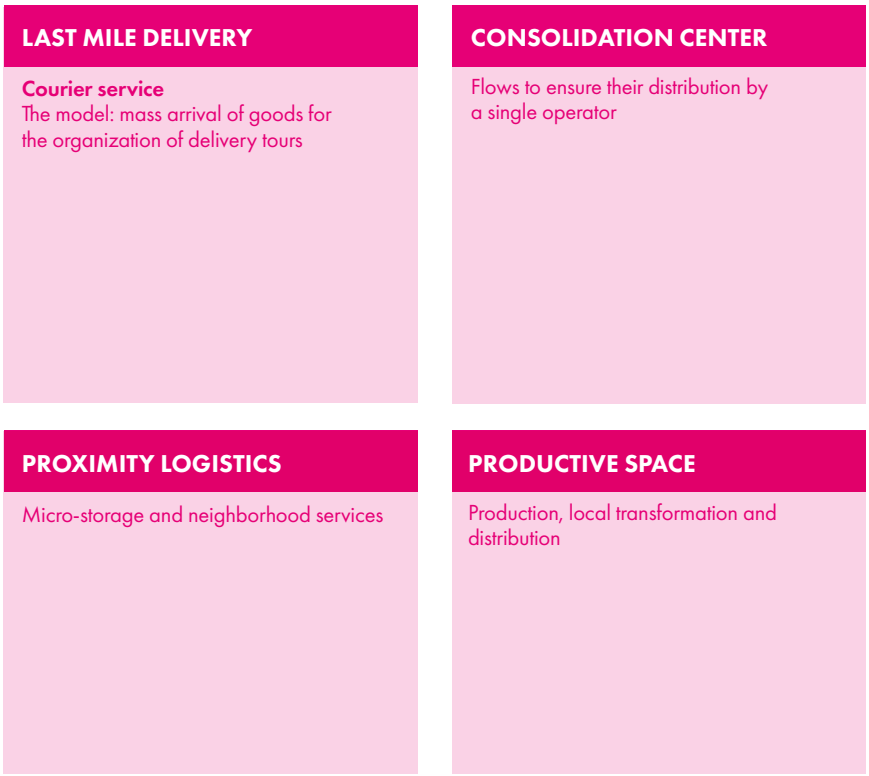
The challenge is to equip urban players to create conditions conducive to supply and distribution models that are as well adapted as possible to the urban context in question, to the areas to be served and to the constraints of roads and public spaces. The optimization of the logistics chain made possible by an efficient logistics network does not make heavy goods vehicles disappear, but rather repositions them on the most relevant links.

Starting with the opportunities offered by a given land source, it is the issues of use and function that shape the project and make it possible to define the logistics infrastructure to be developed, instead of trying to integrate a need into an existing standardized model.

Figure 7.2

From the hypermobile city to the fifteen-minute city: a new deal for logistics real estate

Source: Sogaris, 2022.



This approach allows for the emergence of new hyper-urban logistics spaces, combining several objectives:

- Organize invisible neighborhood logistics in a way that is different from the flows it generates, by relying on green mobility and the development of bicycle paths.
- Recreate centrality and animation and accompany a movement to reclaim public space for the benefit of pedestrians.
- Bringing human presence and local animation in areas with logistics functions.
- Encourage alternative modes of consumption and the local economy, by opening the field to reverse logistics.
- Create urban value and new amenities through the deployment of new urban services.

The mobility center project in the Saint-Vincent-de-Paul eco-district (Paris, 14th arrondissement).

This new paradigm for logistics spaces allows us to think of them as service interfaces that bring together a multitude of potential uses and services in the same place, of which urban logistics is only one component.

This new paradigm for logistics spaces allows us to think of them as service interfaces that bring together a multitude of potential uses and services in the same place, of which urban logistics is only one component. The example of the Saint-Vincent-de-Paul eco-district (Paris 14th arrondissement) illustrates these new approaches, which can be taken up by local players: the "concerted development" project led by Paris & Métropole Aménagement, is being built around a mobility center to be developed by Sogaris as part of the La Collective consortium (of which Altarea Cogedim is the representative), which will combine parking spaces and services for the mobility of goods and people for the entire new district, covering more than 3,000 square meters.

Towards a logistics urban planning and design

In addition to the tools available to public authorities in the exercise of their urban and regional planning responsibilities (defined and regulated by law), urban planning is an approach and a tool that can enable urban logistics to be taken into account in the strategies of local actors.

This approach puts the need at the center, aiming to create new neighborhoods that satisfy the identified needs (logistics and mobility flows included). It can even be considered as a comprehensive method to "allow an urban project to be in line with its various social, economic and environmental goals, rather than establishing a predetermined development model or urban form" (Ingallina, 2010).

Urban planning is an approach and a tool that can enable urban logistics to be taken into account in the strategies of local actors.

Urban planning allows the public authorities to take part in the design of the urban project by imposing constraints, such as a public facility, a share of green spaces or a predetermined proportion of housing, offices and shops, in the project specifications.

In the case of logistics, we have observed that all logistics sites are typologized or theorized according to the existing situation, because they are often designed after the urban projects have been completed, having to adapt to the numerous constraints already in place.

Public authorities still make little use of urban planning in the field of urban logistics. However, this tool would make it possible to impose and guide the development of urban logistics spaces from the initial phase of the urban project, thus avoiding the need to think about the organization of flows linked to the project or the needs of the district in terms of logistics areas a posteriori. Intervention at the planning stage would therefore make it possible to improve ULF's network in its territory and to better control or direct the development of urban logistics. On the contrary, this tool enables the public authorities to ensure that in all new urban projects, B2B and B2C flows will be anticipated with the development of adequate equipment beforehand. However, this implies that the public authorities gain expertise and tools to determine the appropriate logistics program.

In this respect, thinking of the logistics place through a fully-fledged planning approach would invite a conception of it as an architectural and urban response to a logistical need, generated by the urban fabric, on the scale of individuals as well as of economic establishments.

Thinking of the logistics place through a fully-fledged planning approach would invite a conception of it as an architectural and urban response to a logistical need, generated by the urban fabric, on the scale of individuals as well as of economic establishments.

In a context of scarcity and high cost of logistics land, the development of logistics facilities must necessarily be integrated into mixed urban developments, which guarantees better financial equalization. The systematic integration of an urban logistics space in development operations appears to be an interesting solution to meet the growing demand for logistics land while ensuring that this development is consistent with the objectives set. This integration should be based on three scales: taking into account at least the flow of goods generated by the project's inhabitants and activities, understanding at most the flows on the scale of the district, and positioning the logistics infrastructure in line with a cohesive strategy on a metropolitan and regional scale.

The O+ urban programming tool

Integrating urban logistics facilities into a development operation implies determining a fully-fledged planning approach. This approach invites the design of this space as an architectural and urban response to a logistical need, defined as the potential flow of goods generated by the economic activities and the inhabitants of the urban project. The definition of the logistic need at the scale of the urban project requires the development of tools that allow the transposition of a volume of goods flows into a surface (sq.m.) dedicated to logistics. As part of its freight strategy, the City of Paris has set the objective of providing developers with a tool to evaluate the flow of goods that will be generated in future urban projects. In the wake of this, the city has developed an urban logistics planning tool. Called "O+" (Urban Logistics Programming Tool), this tool developed by Adrien Beziat (Gustave Eiffel University) and Adeline Heitz (CNAM Lirsa) makes it possible to evaluate the potential flows of goods that will be generated by the various occupants of the urban project based on the project's real estate program, the type and size of housing, offices, shops and public facilities (hospitals, schools, sports facilities, etc.). The principle is to associate a volume of goods delivered with the profile of an activity or housing. The more precise the programming of the project, the closer the results will be to reality. In an urban project, the planning tends to be refined over time. Thus, the project can start without knowing the exact distribution between the types of housing or the types of activities. The tool allows, through a synthetic population (Yaméogo *et al.*, 2021) and B2B (Beziat, 2017) and B2C (Hörl, 2022) model generation, to determine the composition of the future project based on the current composition of the neighborhood known through statistical data such as the General Census of Population. The tool depends on survey data on B2C and B2B flows that are injected into the models (Gardrat, 2019). For Paris these latest surveys were conducted in 2012 while the B2C ratios date from 2018. These data are an important limitation because they probably underestimate the volumes of goods, especially for B2C. The tool could be updated in the future with new data.

Presentation of O+

Source: ©Heitz, Beziat, 2022.

This tool is still under development and relies on the development of a community of users to enrich and improve it.

O+ is above all a tool for diagnosing flows, but it does not allow for the sizing of logistics equipment to be developed within the framework of the urban project. It can therefore be used as a first step to determine the potential flows of goods as part of an urban project. In addition to this tool, which is used to evaluate flows, professionals need a programming method that enables them to design logistics sites within the urban project.

8 THE FORMS OF URBAN LOGISTICS REAL ESTATE: A WORLD TOUR OF INNOVATIONS

The logistics real estate market is undergoing a major transformation, with numerous innovations, particularly in the urban logistics segment. The main challenge for these new urban warehouses is to fit into dense areas where real estate costs are high and land is scarce. Logistics functions are constrained by location. Land availability is becoming a major determinant of the forms of logistics that will evolve or emerge in dense urban areas as well as on the outskirts.

Urban warehouses for the last mile, a systemic change

For several decades, the logistics sector has been represented in the collective mind either by large suburban warehouses (over 40,000 square meters) – large single-story facilities on the outskirts of cities – or by the old industrial warehouses, often made of bricks, that were built during the industrial revolution of the 19th century.

Urban warehouses represent a new type of real estate, which has taken hold with the rise of e-commerce. The geographic impact of e-commerce has resulted in two distinct developments in logistics real estate. On the one hand, the creation of so-called "XXL" distribution centers (over 40,000 sq.m.), which follow the historical trend of logistics zones moving away from urban centers, and on the other, the search for space in dense areas to meet the demand linked to e-commerce. To meet the expectations of consumers who appreciate ever faster deliveries – as opinion polls indicate – goods must be located as close as possible to the consumer.

Historically, Asian cities, such as Tokyo, Hong Kong, and Seoul, were the first to develop vertical urban warehouses.

Historically, Asian cities, such as Tokyo, Hong Kong, and Seoul, were the first to develop vertical urban warehouses (Dablanc *et al.*, 2017), which today can exceed twenty stories. As early as 2017, a Cushman&Wakefield report predicted an increase in real estate needs in some European markets by 2021, as much as 102% for Madrid, or 77% for German cities. An example of an urban warehouse used for e-commerce is the one built by Vailog/Segro at the port of Gennevilliers near Paris, on three levels, mostly occupied by Ikea to deliver to its customers in the west of Paris and its Paris stores. The architecture magazine *D'architectures* recently devoted an issue to warehouses testifying to the new interest in urban logistics.[1]

Because there is often a potential for optimizing urban goods mobility (i.e., distributing as much as possible using less resources), mutualized urban distribution centers had been imagined to manage in a more collaborative way the operations of all the carriers that have to deliver in a given urban area (a city center, for example). The loads of different transport operators are centralized and delivered by a single operator, often using clean vehicles. These distribution centers are located on the outskirts of the city to provide(ov)8 (.G).(ov)8 a20 (0.9 (r)1(ent)t hav)4 (e)0(ov)8 ts iro(ov)8 (it)-4 (s cus)12 ((at)8 and Seouho

designed on three levels, totaling 42,000 square meters, includes an underground logistics level, a logistics first floor with an area for rail freight operations – the rail component is still not in operation – as well as, on the roof and sides, other activities (offices, sports fields and urban farm on the roof, sports club) and a district heating plant powered by energy from a data center.[3] Other logistics hotels are currently under construction: one of 36,000 sq.m. in the Ardoines district (south of Greater Paris), in connection with a vast mixed real estate program; the other of 29,000 sq.m. in Lyon-Gerland.

Several large companies, both retailers and e-commerce pure players, have been developing an "urban fulfillment strategy" for several years to bring goods closer to major consumer areas (Deloitte, 2019). Since 2015, Walmart, the dominant player in the U.S. food retail sector, has adopted a strategy aimed at better penetrating the e-commerce market, with the acquisition in 2016 of Jet.com, an e-commerce specialist, and then of Parcel, an express delivery company specializing in fast delivery, and has set up an appropriate organization for the last mile. In the New York City area, Walmart has rented a 19,000-square-meter urban warehouse in the Bronx to process online orders. Since 2019, the retailer has been deploying "local fulfillment centers" inside its stores, which are dedicated to processing online orders.[4] Since 2021, there is also an ultra-fast delivery service, Walmart GoLocal, for which Walmart has just ordered 4,500 electric vehicles from the company Canoo[5] and is a service provided by gig workers.[6]

Both retailers and e-commerce pure players have been developing an "urban fulfillment strategy" for several years to bring goods closer to major consumer areas.

Amazon has also invested heavily in the urban logistics segment. On the one hand, the company plans to open nearly a thousand small warehouses in suburban areas in the United States.[7] On the other hand, last-mile delivery sites serve specific urban markets and neighborhoods. These are the most common facilities in Amazon's logistics system, generally modest in size with an average size of just under 11,500 square meters (Rodrigue, 2020). Providing last-mile deliveries, the spatial coverage must be as extensive as possible to facilitate access to distribution and delivery points by carriers, delivery personnel, or consumers. The map of the location of these facilities in the United States as of January 1, 2021 represents the extent of this spatial coverage.

3. https://www.sogaris.fr/fiche/chapelle-international/

4. https://www.winsightgrocerybusiness.com/retailers/walmart-leverages-its-stores-part-its-last-mile-strategy

5. https://finance.yahoo.com/news/walmart-purchase-4-500-canoo-100000208.html?guccounter=2 ; https://techcrunch.com/2022/08/16/walmarts-last-mile-delivery-service-walmart-golocal-tops-1m-deliveries-in-year-one/

6. The rapid development of "instant delivery" services by platforms dedicated to B2C is disrupting logistics employment with the use of a flexible workforce organized according to demand. A multitude of terms have emerged to describe this new type of worker: "self-employed delivery workers" and "uberized delivery workers" in France, "riders" in Italy and Spain, "gig workers" in the United States (L. Dablanc, Logistics City Chair, 2021).

7. https://www.bloomberg.com/news/articles/2020-09-16/amazon-plans-to-put-1-000-warehouses-in-neighborhoods?leadSource=uverify%20wall

Figure 8.1
Location of Amazon's last mile sites in the U.S. as of January 1, 2021
Source: Schorung, Lecourt, 2021.

New-generation urban logistics warehouses are renewing the traditional image of the warehouse, which is now focused on urban integration, architectural quality, functional mix and services for the population. The Wedge project in London is an example of this, with a mix of logistics hubs, residential units and urban amenities in a densely populated area on a particularly constrained site.[8] Also indicative of this new craze is the architectural competition launched by *Property Week* (a British magazine specializing in real estate) and Savills (a real estate consulting firm) to develop a multifunctional hub in the heart of London (10,100 sq.m.) that will house both a logistics hub and housing. The six proposals can be viewed online and demonstrate a strong urban and architectural integration ambition for urban logistics in hyper-dense areas.[9]

8. https://www.darlingassociates.net/2019/02/26/the-wedge-a-vision-for-an-ultra-urban-logistics-and-residential-hybrid/
9. https://www.propertyweek.com/features/six-in-the-city-sheds-of-the-future/5101426.article

Architectural model of The Wedge project in London.

Microhubs

In dense urban areas, new models of urban logistics real estate are being organized, based on small logistics bases, to organize transshipments and enable last mile or last meter deliveries with electric or non-motorized vehicles.

Microhubs or micro-fulfillment centers (MFCs) currently take three forms: 1) microhubs in the form of small dedicated spaces inside traditional intermediate or even large stores (such as Kohl's, Target, or Walmart); 2) microhubs for (quasi-)automated last-mile deliveries; 3) micro-hubs for direct sales by brands wishing to bypass the traditional retail sector.[10] The concept of micrologistics originated in the US, where it was first developed by the pharmaceutical industry. Facilitated by vertical modular solutions, automation and robotization, micrologistics improves the productivity of picking operations. Driven by online retail giants, such technologically advanced micrologistics facilities have gradually emerged in cities (Chasle, 2020).

10. https://www.cbinsights.com/research/micro-fulfillment-centers-supply-chain-tech/

MFCs involve e-commerce giants (such as Amazon, which has invested heavily in building last-mile delivery points) and food retailers (such as Walmart, which is building dedicated spaces in its stores), but also small merchants. This model is particularly interesting for fast deliveries (less than two days) which have become an "industry standard" (CB Insights Research, 2020).[11]

MCFs are used for local storage of consumer goods, but they are particularly well suited for transferring loads from one vehicle to another. Because of their location, they enable the use of environmentally friendly modes of transportation, such as cargo bicycles, electric vans, and pedestrian transportation, which have a shorter range than conventional diesel or gasoline-powered delivery vehicles (Katsela *et al.*, 2022).

MCFs are used for local storage of consumer goods, but they are particularly well suited for transferring loads from one vehicle to another.

These microhubs can be fixed or mobile, networked or single. A network of microhubs has been developed by PostNL in downtown Amsterdam, in which seven former post offices and sixty electric cargo bikes handle B2C parcels and business-to-business mail, totaling over 1,500 orders per day (van Rooijen, 2018). TNT has tested a trailer equipped with a loading dock and office as a mobile logistics base in Brussels (Verlinde, 2015), while UPS uses mobile storage containers to supply pedestrian areas in Hamburg (UPS, 2017). Finding an affordable location for both fixed and mobile bases, in some cases, may require support from local governments, which may take a financial form (e.g., a low-cost parking fee for a mobile base) and/or a non-financial form (e.g., identifying available urban logistics space) (Buldeo Rai, 2019).

Examples of micro-fulfillment centers are still few, but are beginning to grow, despite persistent technical and economic challenges. For Lama Scott (Takeoff Technologies), microhubs are less capital intensive and can be deployed quickly – an automated microhub at his company costs about $3 million. In 2019, the Walmart store in Salem, New Hampshire, USA, opened an MFC to fulfill online orders. An MFC network can also serve as the basis for a dedicated last-mile delivery service (often by a third-party operator), for example the MFC network of New York-based start-up Bond, which provides a delivery service to e-commerce companies.[12] The start-up Fabric inaugurated an automated MFC under an office tower in Tel Aviv (Israel) for Super-Pharm (pharmacy). Startup Takeoff Technologies, which specializes in developing (semi)automated microhubs to serve food retailers, built an MFC in Florida in 2018 for Sedano.[13]

Examples of micro-fulfillment centers are still few and far between, but are beginning to grow, despite persistent technical and economic challenges.

Kim and Bhatt (2019) illustrate three distinct ways to use microhubs: independent, where each business makes its own deliveries from its own microhub; shared, where each business makes its own deliveries from a shared microhub); or consolidated, where one business makes all deliveries for all businesses from its own microhub.

11. https://www.cbinsights.com/research/micro-fulfillment-tech-shipping-retail/
12. https://venturebeat.com/transportation/bond-raises-15-million-to-bring-last-mile-deliveries-and-nano-distribution-centers-to-online-retailers/
13. https://www.cbinsights.com/research/micro-fulfillment-tech-shipping-retail/

The location of a microhub is an important tactical decision in the microhub planning process.

The location of a microhub is an important tactical decision in the microhub planning process. The outcome of a facility's location selection must minimize operational costs and difficulties (financial and land, in particular) for stakeholders, while meeting regulatory requirements and addressing the concerns of the surrounding population. Katsela *et al.* (2022) list several location parameters that are balanced against logistical conditions (e.g., vehicle travel distance, speed, cost, fleet composition):

- demand variables (e.g., residential demand, commercial demand, employment density);
- infrastructure considerations (e.g., for pedestrians and bicycles, road classification, pedestrian areas, traffic regulation measures) and land use restrictions.

Buldeo Rai (2021) lists conditions for the location of microhubs used for deliveries. In terms of supply, the roads around the microhub must be accessible to trucks; an area of 20 to 25 meters with a slope of less than 12 percent, must allow trucks to turn; and attention must be paid to aesthetic and noise considerations for the neighborhood. The microhub itself requires: access via ramps that can accommodate a truck, as elevators incur more technical maintenance and risk; a minimum height of 3.5 meters; a higher load capacity for storage activities; and easy access to ventilation, natural light, and a safe environment. The requirements are less stringent for organizing deliveries, although the slope to exit underground spaces is important to consider for the use of cargo bikes. The cargo of a truck delivering packages to a microhub corresponds to about 50 to 60 cargo bikes. 1,000 sq.m. of logistics space requires a fleet of 10 to 15 electric vans. The sizing of the equipment must therefore take into account these transport constraints.

In Paris, some microhubs have already been operational for years, such as Chronopost in the underground parking facility of place de la Concorde. Other microhubs have disappeared, such as those of the Distripolis project of Geodis, which maintains its strategy of deploying green logistics bases but with larger sites. However, it is this type of logistics facility that has made the most progress in the French capital in recent years. Using existing buildings, these MCFs accommodate logistics activities in spaces ranging from 500 to 5,000 square meters. Alongside former parking lots, former gas stations and garages, offices, train stations, old warehouses and storage facilities are also used.

In Paris, some microhubs have already been operational for years, such as Chronopost in the underground parking facility of place de la Concorde.

Some developments are hybrid, in a temporary or transitional sense. Amazon and Chronopost, for example, use the Paris public transit company RATP bus depots for cross-docking e-commerce packages on a "time-sharing" basis, when the buses are on tour. The cargo-cycle delivery company Swoopin has occupied sites awaiting building permits, with short-term rental contracts in exchange for lower rents. Other microhubs are mobile, such as UPS and Stuart, which use trailers placed in public space or light constructions like the new Sogaris micro-hubs (see photo hereafter).

A Sogaris micro-hub installed in Paris for local deliveries.

In the shadow of the ring road in the 19th arrondissement of Paris, Sogaris, in collaboration with the architectural firm Syvil, has developed an urban logistics facility called P4. In an undesirable space (below a major highway), the delivery company Ecolotrans occupies this nearly 800 sq.m. space for its last mile logistics activities. CNG trucks are unloaded early in the morning by a team of about 30 employees, who then supply northern Paris with cargo-cycles.

In the United States and Canada, a company called REEF creates neighborhood centers for goods and services from parking spaces. It currently has more than 8,500 spaces, and is expanding in Europe. By transforming underutilized urban spaces into what they call "the power of proximity," REEF provides services to retailers, logistics providers and restaurants.

In fact, tiny logistics facilities have been popping up in Asian cities for many years now, often no larger than a garage. Chinese startup Missfresh has more than 1,500 mini-storage facilities and as of 2018 has raised $450 million (Dekonink, 2020)-its medium-term goal is to deploy 10,000 automated micro-hubs in 100 Chinese cities. The scarcity of land and very high rent prices are the two key factors behind this. Official definition and research works oo urban and suburban logistics in cities like Tokyo explicitly include facilities with a floor area of no more than 400 sq.m., a lower threshold than that used in similar North American or European research (Sakai *et al.*, 2015).

Multistory vertical warehouses

Land values and competition for land in cities not only encourage the limitation of the size of logistics facilities, they have also stimulated the development of vertical logistics. Multistory logistics allows for more usable space per square meter of land with two main formats: the multi-story warehouse *stricto sensu* (true individual floors accessible to trucks via exterior ramps); the warehouse with interior mezzanines (large mezzanines with freight elevators allowing access to upper floors) (JLL, 2019).

Like micrologistics, multi-level real estate operations are already common in Asia, including Japan, Singapore, and Hong Kong, where high population density and lack of available land make them a viable solution. In South Korea, most warehouses near Seoul have been built as multistory buildings to make maximum use of expensive land (Lim and Park, 2020), such as the Logiport Icheon site (built by La Salle Investment Management). More recently, major investors (GLP, Goodman, Blackstone, Prologis, La Salle Investment Management) have decided to expand into major cities, especially in China. Only a few years ago, such facilities were very rare in Europe and North America (JLL, 2017). Today, with the growth of e-commerce fueled by the Covid-19 pandemic, vertical logistics is expanding beyond Asian markets (Verledens, 2020). This can be seen, for example, in Mexico City with a two-story warehouse in the north of the city (Tlalnepantla) and another under construction in the Observatorio district (JLL, 2019).

Like micrologistics, multi-level real estate operations are already common in Asia, including Japan, Singapore, and Hong Kong, where high population density and lack of available land make them a viable solution.

Vertical facilities typically have two, three, or four floors. In the U.S., for example, there is a three-story building just minutes from downtown Seattle called Georgetown Crossroads (54,000 sq.m.) (three-quarters of which is leased to Amazon and the remainder to Home Depot) and a four-story building under development in the Sunset Industrial Park in Brooklyn, New York (120,700 sq.m.). At Georgetown Crossroads, trucks can access two of the three levels via ramps, while the Sunset Industrial Park building is designed for trucks to access all four floors.

European examples include the three-story Ney warehouse in the 18th arrondissement of Paris (120,000 sq.m.), the two-story Pantin Logistique building just outside Paris (150,000 sq.m.), the aforementioned Chapelle International logistics facility, also in the 18th arrondissement of Paris (44,965 sq.m.), Vailog's two-story Paris Air 2 building in Gennevilliers north of Paris (64,000 sq.m.), and the two-story warehouse X2 in development next to London's Heathrow Airport (21,775 sq.m.).

In Asian cities, multistory facilities are reaching even higher levels. Singapore's 4 Changi South Lane complex has seven floors, four of which are used for warehousing (18,794 sq.m.). On Hong Kong's Tsing Yi Island, Goodman developed the Interlink building in 2012, which has no fewer than 22 floors (223,000 sq.m.). The first 15 floors are fully accessible by freight vehicles, while the remaining floors are accessible by freight elevators. As cited in a Savills (2019) report, "the real impact [on optimizing urban logistics] of this building in terms of real estate is only now being felt, as other cities around the world begin to address the urban logistics issues that Hong Kong has already tackled."

Georgetown Crossroads multistory warehouse in Seattle (USA).

Some facilities are designed to meet high activity flows requirements, while others are focused on storage. In addition to having multiple floors, vertical facilities are also multi-user, combining both retailers and logistics service providers. Hong Kong's Interlink houses international tenants such as logistics service providers DHL and Yusen Logistics, as well as fashion retailer Net-a-Porter. In Ney, Paris, some 40 different companies operate – with fashion and small local logistics companies making up the majority of occupants. Amazon also operates a Prime facility there. In South Korea, in Yangcheon (near Seoul), a multistory logistics hotel is being planned on the site of a former truck terminal. This 830,000-square-meter real estate project will be spread over 26 floors and 6 underground levels, and will correspond to a multifunctional complex (38% of the space for logistics functions, 25% for retail, and 37% for offices) (Park, 2018; Buldeo Rai *et al.*, 2022).

Many developments are also underway in New York City, particularly in the area of urban logistics real estate. In Brooklyn, Queens and the Bronx, several projects are underway, including the aforementioned Sunset Industrial Park, the 640 Columbia Street project in Brooklyn, another five-story warehouse in Flushing Queens (approximately 80,000 sq.m.) and, finally, the 2505 Bruckner project in the Bronx (JLL, 2019). Nevertheless, elsewhere in the United States, despite extensive consideration, multistory warehouse projects have not progressed, particularly in Los Angeles where a two-story warehouse project was abandoned due to high costs and unfavorable site configuration.

Goodman Interlink in Hong Kong: a 22-story logistics building.

Rental values can differ within a single warehouse by floor (Lim and Park, 2020): rents are lower for upper floors because they are less accessible (JLL, 2017). At Pantin Logistique, the range is approximately €80-100 per square meter on the first floor, and €50-60 per square meter on the top floor (JLL, 2017). In the U.S. market, the cost is $150 per square foot for a two-story warehouse, and even reaches $260 per square foot in Seattle at the Georgetown Crossroads warehouse.

Rental values can differ within a single warehouse by floor: rents are lower for upper floors because they are less accessible.

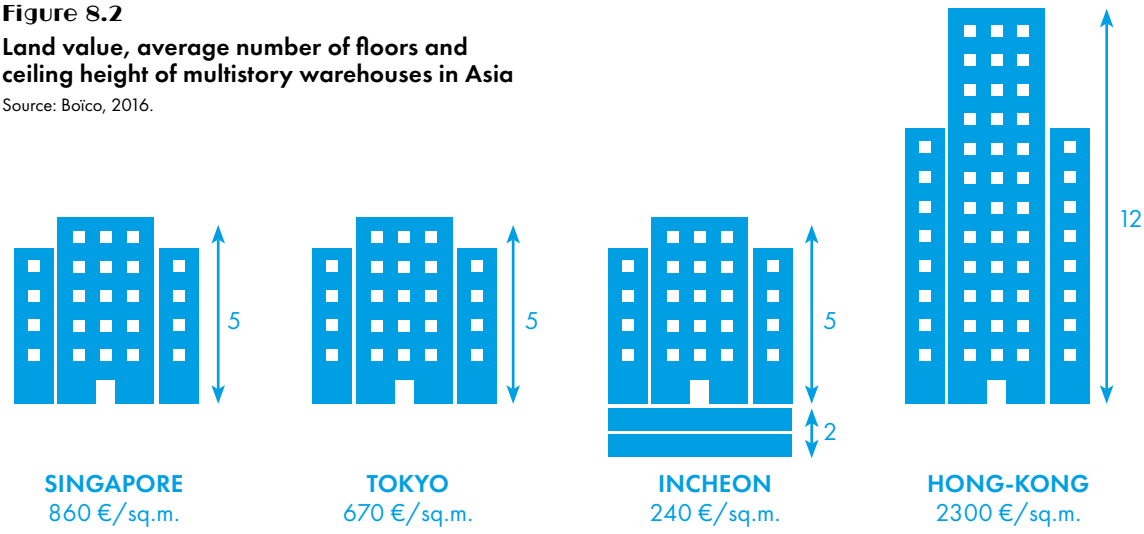
The multistory, multi-user, multi-functional design of vertical logistics contributes to the viability of its business model. However, three limitations related to multistory warehouses have been identified: the financial limit (these are projects requiring very heavy initial investments, notably related to construction costs), the use limit (large Asian warehouses are primarily used for international logistics and secondarily for e-commerce) and the configuration limit (the spiral access ramps are designed for trailers of 7 and 12 meters maximum) (JLL, 2019).

Yangcheon Road Park, Seoul (South Korea) location chosen for the future logistics hotel project.

Figure 8.2

Land value, average number of floors and ceiling height of multistory warehouses in Asia

Source: Boïco, 2016.



Automated warehouses

The automation of warehouses in industry and logistics centers is one of the main factors that contribute to increasing the efficiency and productivity of industrial activity. The robotization of a warehouse allows the automation of operations with very little or minimal intervention of human operators. Robotization in a warehouse has proven to be a competitive differentiator, producing several benefits:

- Reducing or minimizing direct operator intervention.
- Increasing the speed of the process, allowing for a reduction in operating time.
- Optimizing space.
- Increasing the exhaustive control of the warehouse stock, as well as the traceability of all the procedures and movements that are carried out.

Robotization requires a high degree of standardization of elements: dimensions of packages or pallets, weight of the load, types of movements.

What are the tasks affected by robotization? i) The extraction and deposit of goods (by a stacker crane or a Pallet Shuttle); ii) The transport of goods between the different areas of the logistics center (by conveyor, self-propelled balancelle or AGV – Automated Guided Vehicle – robots); iii) Picking assistance systems (by anthropomorphic robots for automated order preparation or by auxiliary robots that accompany the order preparation).[14]

Reuse and repurposing of abandoned spaces

An already dense and costly urban space provides an incentive to make more efficient use of available land, even the most constrained sites. A number of logistics facilities being developed in cities are giving old space a new use. The growing demand for urban logistics space has opened up a new field of investment opportunities and redevelopment of previously vacant or underutilized sites.

14. https://www.mecalux.fr/blog/entrepot-robotise

Some examples of robotization, partial or advanced

1. MONOPRIX WAREHOUSE IN MOISSY-CRAMAYEL (SEINE-ET-MARNE, FRANCE)[15]

To support the development of e-commerce and reorganize its non-food logistics, Monoprix (Casino group) has invested in a 100,000 sq.m. logisitics facility in Moissy-Cramayel (Seine-et-Marne department), which will replace the three existing warehouses. The new building was officially inaugurated in October 2022 and has several special features. Built and leased by Prologis, it is said to be carbon neutral. Monoprix has chosen Exotec, a French start-up specializing in robotization that also works with Cdiscount and Carrefour. With this new facility, Monoprix intends to process 45 million parcels for stores, but also for e-commerce and click&collect. "With this new site in Moissy-Cramayel, we are gaining about 15% more space than our old warehouses, but above all 30 to 40% more productivity thanks to robotization. And it's a place that represents the green growth that Monoprix wants to achieve," explained J.P. Mochet, President of Monoprix. The building, designed by Prologis, is equipped with photovoltaic panels on the roof that provide 25% of the electricity consumption.

2. CARREFOUR WAREHOUSE IN PLESSIS-PÂTÉ (ESSONNE, FRANCE)[16]

In 2016, as part of its e-commerce strategy, the Carrefour Group took over a 24,000-square-meter warehouse located in Plessis-Pâté, Essonne. Faced with the increase in demand generated by drive-through purchases, the retailer is undertaking its robotization in 2019 with technology from the same start-up Exotec. The site has 225 robots, 155 of which are dedicated to dry goods. In total, the site sees 200,000 items a day go in, and as many go out. "This is the first site equipped by Exotec for food, and the third largest site in the world in total," says Mourad Bensadik, supply chain e-commerce director for France at Carrefour. The group has eight centralized order preparation sites, two of which are mechanized (but not robotized in this way). Carrefour has also robotized four micro-fulfillment sites attached to hypermarkets out of the fifteen it operates. They use between 21 and 26 Exotec robots. Ultimately, this technology should help rethink the way warehouses are designed, taking advantage of smaller square footage, but more vertical.

3. GEODIS WAREHOUSE IN INDIANAPOLIS (USA)[17]

In order to respond to the lack of manpower during peak periods, Geodis tested a new method of order preparation using collaborative robots. 30 autonomous mobile robots from Locus Robotics were deployed in a 13,000-square-meter warehouse in Indianapolis. This site manages more than 30,000 items for a major online retailer of women's clothing. To date, 80% of the units in an order are collected by the robots.

15. https://www.lsa-conso.fr/monoprix-dispose-d-un-nouvel-entrepot-robotise-de-100-000-m2-pour-son-non-alimentaire,394161
16. https://www.usine-digitale.fr/article/plongee-au-c-ur-d-un-entrepot-carrefour-robotise-par-la-start-up-exotec.N1083194
17. https://geodis.com/w-fr/newsroom/communiques-de-presse/geodis-double-la-productivite-dans-son-entrepot-d-indianapolis-ux-etats-unis

Examples of such repurposed and reused facilities include empty superstores and department stores, grocery stores, or vacant commercial space; former government facilities, abandoned industrial sites in various stages of rehabilitation, and underutilized office space; and vacant space near or underlying infrastructure (under road or highway overpasses, for example) (Franklin Templeton, 2019; Savills, 2019). In Germany, UPS leases a former kiosk in downtown Herne, supplying the entire city using cargo bikes (Bulwiengesa, 2017). In Spain, Amazon rents the headquarters of the publishing house Editorial Gustavo Gili in the center of Barcelona. The building stores the 20,000 most commonly ordered products on Amazon in its large basement and employs more than 100 people to make deliveries across the city within two hours (Savills, 2019). In the United States, one example is the Millennium Mile project in Chicago, led by JLL, an underutilized parking lot in downtown Chicago that will be partially repurposed for last-mile logistics (JLL, 2018). Utilizing existing underground spaces such as city parking lots represents an alternative to building high rise (JLL, 2017). In central Paris, Chronopost operates two underground facilities: a former city-administered parking lot under Place de la Concorde and under an existing building in Beaugrenelle, along the banks of the Seine (Bulwiengesa, 2017).

"If one thing is obvious, urban infill and last mile aren't just old warehouses. And they aren't just at the urban center. E-commerce companies are thinking of a lot of creative new places and methods for delivering goods faster." (JLL, 2018)[18]

Sogaris' local logistics hub (called P4) under the Paris ring road (Porte de Pantin, north-east of Paris).

18. https://www.us.jll.com/en/trends-and-insights/research/urban-infill-the-route-to-delivery-solutions

A significant barrier to the repurposing and reuse of existing infrastructure for urban logistics concerns the areas in which this infrastructure was built. This is because these areas are generally not classified for industrial use, including logistics (Savills, 2019). Exemptions can certainly be obtained, but before issuing them, cities are likely to take into account the reservations expressed by the population regarding the impacts in terms of traffic, pollution and noise, which logistics facilities generate. Although research on urban logistics has established the societal and environmental benefits associated with the reintroduction of logistics in cities, stakeholders cooperation remains a key issue to be resolved.

The Reverse Building Project of Sogaris (Paris).

Transformation of a former automated parking lot on six basement levels into an "Urban Granary", deploying local logistics services geared to the needs of merchants, professionals and residents, completed by a meeting room open to the public and, above ground, by a neighborhood concierge kiosk.

LOGISTICS REAL ESTATE, REVEALING ECONOMIC, LAND AND SPATIAL DYNAMICS

The development of logistics on the outskirts of urban centers is largely due to the dynamism of the logistics real estate market and the existence of private players dedicated to this sector and seeking profitability. Due to the low productivity rate per square meter and in order to be profitable, logistics real estate developers have tended to propose larger buildings to achieve economies of scale. As these large surfaces need an abundance of land, they can only be built in peri-urban areas, thus favoring the phenomenon of logistics sprawl already mentioned.

Until the mid-1990s, in the United States and Europe, the construction, investment and management of warehouses were generally handled by the warehouse users themselves: the shippers and logistics companies. Gradually, however, they have outsourced logistics real estate to a development market. From 2010 to 2019, investment in logistics real estate has quadrupled. The takeover of Logicor, one of Europe's large logistics asset developers, by a Chinese sovereign wealth fund in 2017 illustrates the arrival of a host of new entrants to this market.

With the emergence of city logistics warehouses, the question arises as to whether this type of warehouse promotes cost savings. Given the cost structure of urban logistics, these warehouses have a net advantage in terms of transportation costs. The savings on transport operations at least partially offset the sharp increase in land and property costs in dense urban areas. Nevertheless, the issue of transport costs is once again a concern for logistics players.

But is the location of warehouses in urban or peripheral areas solely related to the differential in land/rental values? Research conducted by the Logistics City Chair on U.S. metropolises (Oliveira, Dablanc, Schorung, 2022) concluded that, on the one hand, the location and price of warehouses are primarily related to the density of urban activity and that, on the other hand, logistics sprawl in the United States is not significantly related to the differential in warehouse rental prices between central and suburban areas. There are, however, major differences between metropolitan categories that our research will need to explore further.

The case of the Grand Paris Seine Ouest intercommunality, southwest of Paris, presented in the section below, provides a detailed understanding of whether a territory is "served" or "serving" in terms of urban logistics via the location of warehouses and the catchment areas of the main express carriers. Ultimately, this understanding should enable a territory, and even better a coalition of public and private actors, to build a strategy for sustainable urban logistics.

9 ECONOMIC MODELS AND STRATEGIES OF ACTORS

Logistics sprawl (see chapter 4) is explained at its most fundamental level by the evolution of supply chains and logistics real estate demand (Hesse, 2008). The outsourcing of logistics in the 1980s created new players such as logistics service providers (3PLs) who needed new buildings to consolidate the goods of different shippers. They themselves entrusted the production of their buildings to real estate =The objective of these players was to propose a logistics real estate offer that meets the needs of logistics operators (mutability, automation, space and large single plots, modern equipment), while meeting the profitability requirements of a real estate asset that is particularly easy to transfer from one client to another. Logistics buildings have become a financial and real estate asset that represents a growing share of investors' portfolios (Fender *et al.* 2016). The emergence of a logistics real estate market and dedicated private players seeking financial returns (P3 Logistics Parks, Logicor, Logistis, Prologis, Segro, Goodman) has greatly facilitated the development of logistics in the periphery (Fender *et al.* 2016; Raimbault, 2014). Due to the low productivity rate per sq.m. and in order to be profitable, logistics real estate developers have tended to propose larger buildings to achieve economies of scale. As a result, they are building warehouses that can reach and now exceed 100,000 to 150,000 square meters, which require abundant land. Peri-urban areas appeared to be the solution to this equation between financial profitability and real estate demand, contributing to logistics sprawl (see chapter 4). Urban warehouses are a recent segment of the logistics real estate market and complete the range of offerings. These two markets, which meet different needs, are far from being in opposition to each other, and are very often complementary within supply chains: from a giant fulfillment center of an e-retailer in the suburbs, parcels are then supplied to the cross-docking agencies in the inner suburbs where the final delivery rounds are prepared.

Peri-urban areas appeared to be the solution to this equation between financial profitability and real estate demand, contributing to logistics sprawl.

Until the mid-1990s, in the United States and Europe, the construction, investment and property management of warehouses were generally handled by the warehouse users themselves (Hesse, 2004). There are two types of warehouse users: shippers and logisticians (Raimbault, 2013). Shippers are the owners of the goods. They are mainly industrialists or large-scale distribution companies. They may also decide to outsource their logistics activities, such as transport, warehousing or supply chain management, to specialized service providers: logisticians. Gradually, the real estate issue of logistics implementation has been outsourced to a development market. Between 1994 and

2007, 61% of warehouse space was built by real estate developers, not by warehouse users (Oblog, 2007). As a result, the warehouse has become a real estate product suitable for development by a market of developers, an investment product and a reference asset (Raimbault, 2013).

Between 1994 and 2007, 61% of warehouse space was built by real estate developers, not by warehouse users.

The massive adoption of international accounting standards (IFRS), which are less favorable to the presence of real estate assets in the accounting balance sheet of companies, as well as the reform of listed real estate investment companies (SIIC), have helped stimulate the use of investors (Raimbault, 2013). The SIIC is a type of French company that owns buildings and is subject to a special tax regime. Most often, this company manages real estate assets on behalf of its shareholders. SIICs have become instruments to encourage real estate outsourcing through various tax schemes (Boisnier, 2011). In order to offer a legible product to investors, and one that corresponds to their acquisition criteria, developers had to agree to create a standard product in the early 2000s: the Class A warehouse.

SIICs have become instruments to encourage real estate outsourcing through various tax schemes.

In 1997, the Observatoire Régional de l'Immobilier d'Entreprise (ORIE) published a classification grid for warehouses. This grid was updated in 2003 under the name CELOG. It gathers about ten criteria that allow to differentiate warehouses according to their uses and their specificities. A class A warehouse corresponds to a high-functioning warehouse, while a class B warehouse meets standard standards (see Figure 9.1). There are 13 mandatory criteria to be met for the warehouse to be considered Class A versus 10 for a Class B warehouse (JLL, 2018; Ulliac, 2021).

In order to value class A warehouses, several criteria have been added to the CELOG grid: a technical criterion, a location criterion and an occupancy criterion. This new grid is called TLOG. According to an article by JLL (2018), Class A and B warehouses accounted for nearly half of the logistics warehouses in France. Nevertheless, there are also other types of warehouses: class C warehouses, which do not meet any of the criteria of classes A and B; refrigerated warehouses, which are thermal facilities that allow for the maintenance of a low temperature; and courier warehouses, which are walk-through buildings and generally less than 20,000 sq.m. The latter are intended for distribution, i.e., groupage and deconsolidation, with doors along the entire length of the building.

Figure 9.1
Criteria* for the classification of warehouses (in France)

*Mandatory criteria are marked with an X.
Source: JLL, 2018.

CHARACTERISTICS / WAREHOUSE CLASS	CLASS A WAREHOUSE	CLASS B WAREHOUSE
Holding of operating permits	X	X
Fire extinguishing system to standards	X	X
All warehouse space in the ground floor and on the docks	X	X
Dock levelers and airlocks	X	
Truck parking	X	
Frame: 20/12 authorizing 240 m² without minimum post	X	X
Docks	1 per 1000 sq. m. of warehouse space minimum	1 per 1500 sq. m. of warehouse space minimum
Depth < 2 times the frontage with a maximum of 130 m	X	X
Access that does not cross an urban area	X	
Insulation and heating	frost-free	frost-free
Minimum soil resistance in tons/m²	5	3
Minimum maneuvering area (m : meters)	35 m	32 m
Minimum height used on the entire storage area	9,3 m	7,5 m

According to N. Raimbault (2013), the short history of this market "accounts for its volatility". Indeed, the market has not yet experienced a full real estate cycle, unlike other real estate assets. Nevertheless, certain market characteristics are already apparent. First, the demand is from a small number of companies, generally European or global in size. Second, it is an asset with a high rental yield but a low capital return[1]. These specificities help to explain the dynamics of structuring the market around "a growing role of integrated and globalized firms and its financialization with investment funds" (Raimbault, 2013). Moreover, the rules of this market tend to be defined by the firms that drive this dynamic. Initially, a network of warehouse builders, such as ABCD or GSE, was formed to meet the needs of a logistics building. Subsequently, the builders were replaced by real estate developers, as the issue became more about financial backing and access to land than about the construction itself. Thus, the constitution of a development market would be closely linked to the emergence of standardized logistics buildings. However, this vision is only partial. Indeed, logistics real estate appears in some cases as a simple diversification activity for generalist developers, producing modest volumes.

The builders were replaced by real estate developers, as the issue became more about financial backing and access to land than about the construction itself.

Two mechanisms have led to the emergence of a logistics real estate investment market: first, the outsourcing of shippers' existing assets and, to a lesser extent, those of logistics providers. In addition, the majority of shippers and logistics providers want to rent new buildings. This preference for renting tends to be reinforced by the effects of outsourcing logistics activities. Most often, shippers outsourcing their logistics activities do not offer any real estate solution to the logistics provider. The latter must therefore find a building in which "it can perform the logistics service requested" (Raimbault, 2013). Consequently, the logistics provider must sign a lease in its name.

The terms of logistics contracts are generally for periods of two, three or five years. Warehouse users are looking for the greatest possible real estate flexibility, which encourages them to rely on investors. At the same time, investors must be able to offer a warehouse to logisticians, which requires that they have "a ready-to-use, abundant and geographically well distributed asset base in the different logistics markets to allow for this turn over" (Raimbault, 2013). In order to be as competitive as possible, investors need to secure space for logistics in key locations where demand is concentrated, especially at the entrance to large and medium-sized metropolitan areas. Over the past ten years, the logistics real estate market has changed significantly in terms of investment. From 2015 to 2019, the volumes invested in logistics real estate were around €3.1 billion per year, compared to €900 million per year for the period 2010 to 2014 (Cushman&Wakefield, 2021). The amount of investment in logistics real estate has therefore quadrupled. This acceleration can be explained by two main factors:

- Generalist investors, i.e., investment funds, banks, insurers and real estate companies, have increased their exposure to logistics real estate. This has been done as part of asset allocation strategies, which is a step in asset management that consists of defining the share to be given to each category of securities within an investment portfolio.
- New entrants have entered the French market, while some players who had divested their assets have also returned to the market.

1. The overall yield for logistics real estate in 2012 was between 7.25% and 8% (approximately 9% rental yield and -1% capital yield). By comparison, the overall return on office or retail real estate averages between 4.5% and 7% (sources: CBRE, 2012; Jones Lang LaSalle, 2012).

From 2015 to 2019, the volumes invested in logistics real estate were around €3.1 billion per year, compared to €900 million per year for the period 2010 to 2014.

What all of these investors have in common is that they have identified the existence of a favorable entry point into logistics real estate. Indeed, the explosion of e-commerce and the need for warehousing to meet this demand has highlighted the undervaluation of the logistics real estate segment in terms of both rental yield and return on capital (Cushman&Wakefield, 2021). The performance of the rental market supports this analysis, with a sharp increase in the volume of take-up. Despite the economic upheaval caused by the Covid-19 crisis, investment intentions in logistics real estate have strengthened. The players described as "historical" are those who are traditionally active in the French market. Players who were present before 2010 but who remained inactive until 2016 are described as "returnees" (Cushman&Wakefield, 2021). New entrants represent 30% of the volume invested in logistics real estate over the 2017-2020 period, for a total of €4.1 billion invested in France. Incumbents accounted for 64% of the volume invested in logistics real estate over the same period, for a total of €8.8 billion. While the presence of new entrants in France is not a new phenomenon, their presence increased significantly in 2017, following the acquisition of Logicor by China Investment Corporation. This acquisition had the consequence of "distorting" upwards volume commitments (Cushman&Wakefield, 2021). Indeed, Logicor had been owned since its inception in 2012, and until 2017, by an American investment fund, Blackstone Group. Logicor is a particularly important company in logistics as it is the second largest owner of warehouses in the country, with nearly 2.5 million sq.m. of warehouses, 45% of which are located in the Paris region. The takeover of the company by a sovereign wealth fund wholly owned by the Chinese state symbolizes the arrival of a swarm of new entrants to the logistics real estate market.

While the presence of new entrants in France is not a new phenomenon, their presence increased significantly in 2017, following the acquisition of Logicor by China Investment Corporation.

Several players such as Greenoak and Highlands Logistics (AIMCO/STAM) have also driven the market in recent years, pursuing a strategy of buying critical assets (Cushman& Wakefield, 2021). In other words, two-thirds of the acquisition volumes of these new entrants have been concentrated on acquisition amounts exceeding 100 million euros. For their part, the incumbent players tend to make acquisitions in excess of €50 million. These volumes correspond to "the rotation of portfolios structured over

2. Management of financial assets. This activity consists of managing capital (owned or entrusted by a third-party investor) in compliance with regulatory and contractual constraints, applying the investment guidelines and/or policies defined by the owner of the assets under management, to obtain the best possible return based on a chosen level of risk. Between 2017 and 2018, CIC, Greenoak Capital, Ares, Barings, Valor, Highlands Logistics, and Swiss Life were the leading market movers. From 2019 to 2020, these players continued their acquisition strategies. Other players such as Union Investment and Round Hill Capital also joined the market.

the years with generalist or specialist logistics funds" (Cushman&Wakefield, 2021). In addition, this modus operandi makes it possible to deploy value creation strategies on a European scale rapidly, balancing the risk of geographical exposure while practicing asset management methods on an asset-by-asset basis.[2] This has enabled the acquirers to gain several years of development time, particularly in France. Obtaining administrative, urban and environmental permits in France is among the most complex procedures in Europe, representing a considerable barrier to entry (Cushman&Wakefield, 2021).

Van Nuys warehouse area, Los Angeles.

10 REAL ESTATE COSTS VERSUS TRANSPORTATION COSTS

The strategies of economic actors tend to be based on a network of warehouses determined by the cost of transporting goods inbound and outbound, by major facilities (port terminals, airports, highway interchanges) and by major consumer basins.[1] In addition to the cost of transportation, other criteria include the value of the land, the strength of the network (in terms of the number of warehouses), the size of the employment area and the quality of the infrastructure. The criteria are changing as urban logistics develops. In recent years, the structuring of economic players' logistics chains has evolved in order to consolidate flows within dense areas. Urban logistics warehouses (ULAs) make it possible to centralize and distribute goods in cities (Afilog, 2022). According to JLL Industrial President Craig Meyer, site selection is a calculation between land and real estate costs, transportation and labor costs relative to rent levels and possible delivery times (JLL, 2018).

"Warehouses are perceived by many of our fellow citizens as low-value buildings that we wouldn't need, which is totally wrong!" (Afilog, 2022)

Deloitte (2019) conducted a New York City case study to understand whether or not an urban warehouse lowers costs, with a comparison between several locations (three locations in New Jersey based on proximity to Manhattan, one location in the Bronx, see Figure 10.1). This analysis shows that while rent and labor costs are more expensive in the Bronx, delivery costs are much lower. An urban logistics space therefore offers a significant competitive advantage, especially for the fast and instant (sub-day) delivery segment: "It is at least 22 percent more cost-effective to serve the same multibillion-dollar e-commerce demand in NYC out of the Bronx versus other New Jersey locations due to higher transportation costs from locations outside the city after considering the cost of getting in and out of the city" (Deloitte, 2019).

1. https://plateformes-magazine.com/articles/a-la-croisee-des-dynamiques-de-marche-et-des-politiques-publiques-limplantation-des-entrepots-ne-doit-rien-au-hasard

Figure 10.1

The cost structure of urban logistics real estate

Source: Deloitte, 2019.

* The distribution of costs is expressed as a share on a 100 basis.

In terms of cost, in the New York case studied, an urban warehouse has a net advantage in terms of transportation costs.

In terms of cost, therefore, in the New York case studied, an urban warehouse has a net advantage in terms of transportation costs. In an appropriate location, an urban warehouse can significantly increase the catchment area in the densest areas. Such a warehouse format potentially offers other services: access to complementary inventory for retail during inventory management (allowing for replenishment of stock in the event of same-day shortages); facilitation of online order management and instant delivery; and improved management of return logistics.

JLL (2018) characterized the cost structure of city logistics:

- Logistics stricto sensu accounts for 80% of costs: 50.3% for transportation, 21.8% for storage, and 9.5% for employment.
- Other activities account for the remaining 20%: 7.8% for customer relations, 4.3% for rent, 2.7% for administration, 2.2% for supplies and equipment, and 1.2% for ancillary costs.

In addition to the need for faster deliveries, the cost of transport is therefore a major factor in the choice of location in dense urban areas and the choice of logistics real estate, particularly for the most complex operations such as multistory warehouses. Savings on transportation operations now offset the sharp increase in land and real estate costs. According to CBRE estimates, the average building price in U.S. cities for a typical single-story warehouse is $30 per buildable square foot. This average price is $150 for a two-story warehouse – this price even reached $260 per square foot for the Prologis multistory warehouse (3 stories) in the near suburbs of Seattle (JLL, 2018). Investors who commit to multistory warehouse projects in dense areas can therefore only make their operation profitable by a sharp decrease in the cost of transportation for customers, by a higher average rent for the rental of these logistics surfaces, or even by direct or indirect support from the public authorities, particularly for the most complex operations.

"When it comes to operating a distribution center, transportation and labor are the big cost buckets and can account for as much as 60% of the operating cost." (JLL, 2018)

Construction of the Vitry logistics hotel (south of Paris) by Sogaris – a new generation urban warehouse in the heart of a new station district of Greater Paris.

11 THE ISSUE OF REAL ESTATE PRICES

The rise of global supply chains, online consumption, and outsourcing of logistics activities have all contributed to the emergence of a vibrant metropolitan logistics real estate market worldwide. Within metropolitan areas, the scarcity of land and urban space, economies of scale, and the need for large parcels of land have led to the relocation of logistics facilities to less dense and more peripheral areas of cities. Over the past decade, numerous case studies on logistics sprawl and the location of warehouses in large urban areas have emerged (see Chapter 4). Reflections on the coordination of urban forms and functions, urban logistics, and real estate strategy are of interest to public and private actors.

Through research conducted in 2021 and 2022 into American main cities, on several European cases and on a selection of cases in emerging countries (Brazil in particular), the Logistics City Chair explored two hypotheses linking urban characteristics to the spatial structure of warehouses: (i) the location of warehouses is closely related to the land/rental values of logistics facilities; (ii) logistics sprawl is higher in cities with a high differential between the land/rental values of city centers and outlying areas (Dablanc et al, 2020; Oliveira, Dablanc, Schorung, 2022). The research was based first on the compilation of metadata related to logistics desertification and metropolitan area characteristics (Dablanc *et al.*, 2020); then on the collection of open access information (OpenStreetMap) related to urban activity, in order to propose an urban activity index based on the location of points of interest and on the density of the road network. Then, data on logistics real estate (warehouse locations and rental prices from the LoopNet website) were compiled for about 50 metropolitan areas, in order to understand the relationships between logistics real estate rental prices and the spatial distribution of warehouses.

This analysis provides evidence for understanding the relationship between urban structure, warehouse location and rental prices.

Three categorical variables are related: the number of warehouses, average rental values and the urban activity index. This analysis provides evidence for understanding the relationship between urban structure, warehouse location and rental prices, helping to test the hypothesis that logistics sprawl is greater in cities with a high differential between rental values in city centers and those in outlying business parks.

In Figure 11.1, the average warehouse rental price for each metropolitan area is presented. The metropolitan areas with the highest average warehouse rental prices are in the United States (San Francisco, Los Angeles, San Diego, Miami, New York) – the average rental price of a warehouse in San Francisco is US$178.49/ sq.m./year. In the Paris area, the average price is over US$ 100/ sq.m./year.

Figure 11.2 shows average warehouse rental prices collected from the LoopNet real estate website (LoopNet, 2020), spatialized and ranked by metropolitan area location.

Based on this differential, figure 11.3 ranks the metropolitan areas. Metropolitan areas with no significant differential are defined as those where warehouse rental prices between central and suburban areas are less than 10 percent. Metropolitan areas with a ratio greater than 1.1 were classified as metropolitan areas with higher warehouse prices in the suburbs, and metropolitan areas with a ratio less than 0.9 were classified as metropolitan areas with higher warehouse prices in the core. The remaining areas were classified as having no significant differential.

Figure 11.1

Average warehouse rental prices (expressed in US$ per sq.m. per year)

Source: Oliveira, Dablanc, Schorung, 2022 – data collected from LoopNet (2020).

Figure 11.2

Average rental prices for warehouses (expressed in US$ per sq.m. per year) by location (between central business zone AH and peripheral business zone PAZ)

Source: Oliveira, Dablanc, Schorung, 2022 – data collected from LoopNet (2020).

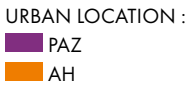
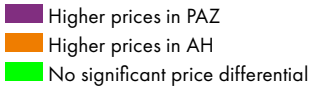


Figure 11.3

Representation of the proportional difference in rental prices for warehouses according to their location (between central activity zone AH and peripheral activity zone PAZ)

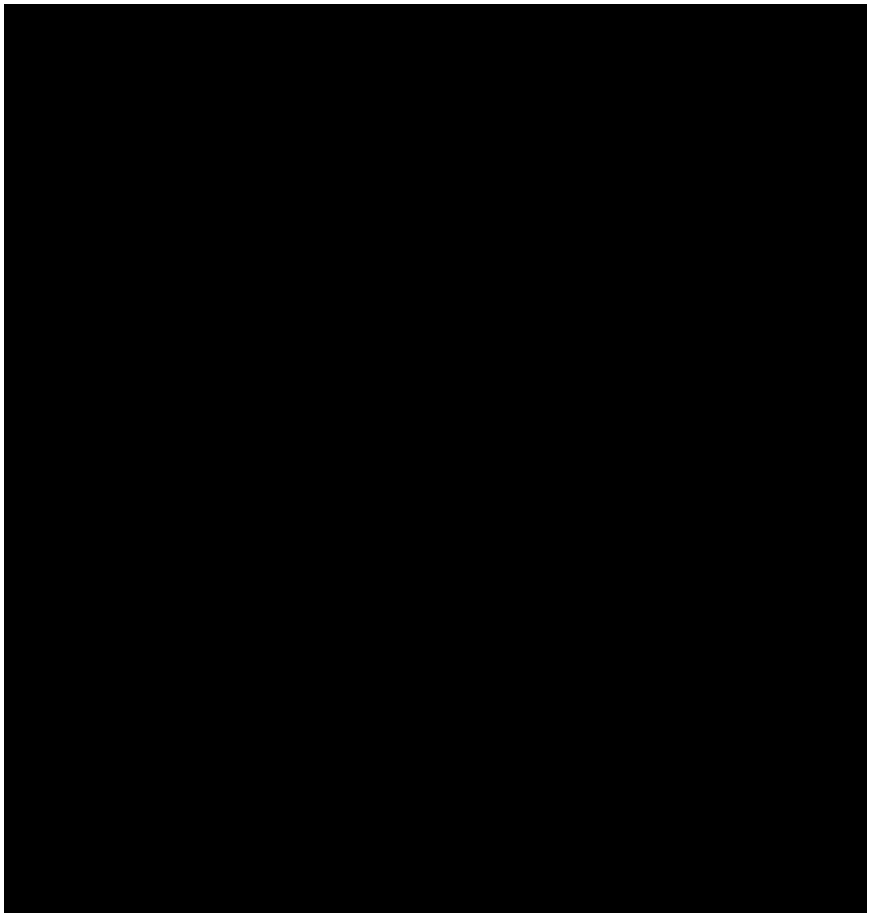
Source: Oliveira, Dablanc, Schorung, 2022 – data collected from LoopNet (2020).



Several U.S. metro areas (e.g., New Orleans, San Antonio, Albany, and Detroit) yield a counterintuitive result: warehouse rental prices are significantly higher in peripheral activity zones. This may be due to the age and condition of the logistics facilities in these areas (more modern facilities are found in peripheral areas). Metropolitan areas with significantly higher differential warehouse rental prices, i.e., where central prices are higher than peripheral prices, are Boston, Paris, Salt Lake City, Nashville, Greenville, Charlotte, Sao Paulo, etc.

Two conclusions can be drawn: (1) warehouse location and prices are related to the density of urban activity; (2) logistics sprawl is not significantly related to the differential in warehouse rental prices in central and suburban areas, but there are major differences between metropolitan categories. Further research is needed to expand on this initial exploration. Indeed, the price differential for warehouse rentals is based on a sample of prices from specialized websites that are not exhaustive. We do not have a complete database that lists all the real estate and land values of all the warehouses in a given geographic area and at different times. It will be necessary to integrate cases from other regions of the world, in particular from the European and Asian continents, what the Chair will produce for the case of Tokyo in 2023.

Warehouse area in Sao Paulo, Brazil.



12 WAREHOUSE CATCHMENT AREAS: THE CASE OF THE GRAND PARIS SEINE OUEST

There is a lack of knowledge about how a given area is logistically organized in order to understand whether it is an area that is "served" or an area that is "serving" urban logistics. To understand this better, the Grand Paris Seine Ouest (GPSO) intermunicipal public authorities[1] launched a study aimed at building an intermunicipal strategy for sustainable urban logistics. For this purpose, prior knowledge of warehouse locations, logistics systems and catchment areas was essential. A research by the Logistics City Chair (Escarfail, 2021) aimed to provide a better understanding of warehouse locations (by company) and the catchment areas of the main carriers and express carriers, in order to really understand how the Grand Paris Seine Ouest territory is served.

Grand Paris Seine Ouest launched a study aimed at building an intermunicipal strategy for sustainable urban logistics.

Figure 12.1 lists only the companies that provide standard parcel services (for the year 2021), i.e., those that deliver packages of less than three tons in 24 hours or more.[2] The spatial distribution of their parcel sorting warehouses reflects the process of logistics warehouse sprawl discussed earlier (chapter 4). Two rings of warehouses stand out: one in the departments bordering Paris, especially Seine-Saint-Denis, Val-de-Marne and the northern end of Hauts-de-Seine; the other following a north-east/south-east axis in localities even further from Paris. The map also shows several clusters of warehouses to the north and southeast of the urban core. The average distance to the center of gravity is 21.5 km.[3] The evolution of the barycenter of standard parcel sorting warehouses confirms the phenomenon of logistical sprawl, with an average distance of terminals from their barycenter that was 6.3 km in 1974 and 18.1 km in 2010 (Dablanc and Rakotonarivo, 2010).

1. These intermunicipal public authorities, called Etablissements Publics Territoriaux in French (EPTs), are official governments providing intermunicipal cooperation on specific activities (including zoning). EPTs are specific to the Greater Paris area, although other forms of intermunicipal governments exist in other French regions.

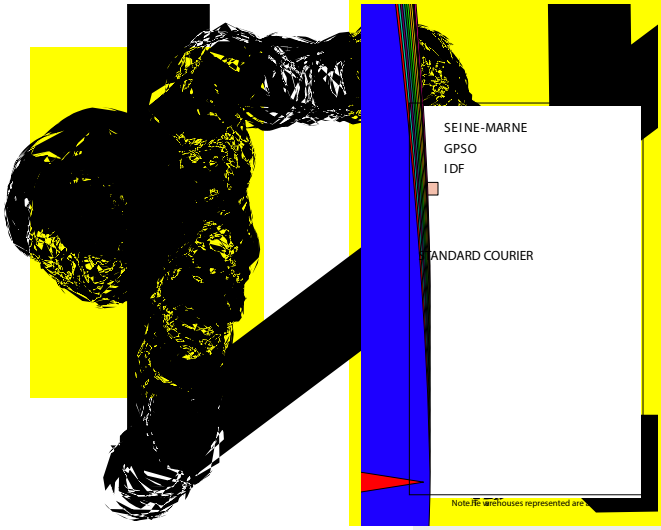
2. https://www.faq-logistique.com/Messagerie.htm [Accessed 6 May 2022].

3. Centrography is a method that calculates the distance between the center of gravity of the represented distribution points (Dablanc and Rakotonarivo, 2010; Heitz. 2017). The distance between the two barycenters (the crosses) allows us to measure looseness. The ellipses tell us about the average distance of the distribution in space.

Figure 12.1

Map of the main standard parcel sorting warehouses in the by major parcel distribution company (2021)

Data: database Sirene INSEE, companies' websites, GoogleMaps.
Source: Escarfail, 2021.



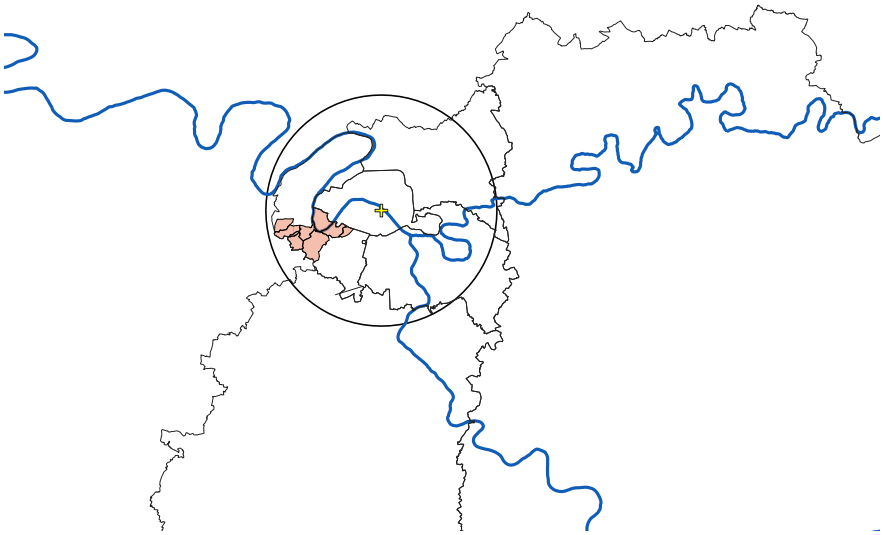


Figure 12.2 shows the warehouses of the ten largest express parcel companies operating in the Paris region. The spatial distribution differs from that of standard (non-express) parcel services, and their warehouses are closer to the heart of the urban area. There are even warehouses in or very close to Paris. The clusters of warehouses to the north and southeast (Roissy, Orly, Port of Gennevilliers) of the urban core are also found on this map, along with a cluster further west in the Yvelines department (west of GPSO). The average distance to the center of gravity is reduced compared to standard parcel warehouses: 16.8 km average distance to the center of gravity. This finding confirms the emerging trend of recentralization of some logistics facilities, particularly those linked to express delivery and thus e-commerce.

We note that GPSO accommodates only one facility, a Colissimo courier agency. In addition, there is an Amazon warehouse at the southern end of the area, located on the edge of Meudon-la-Forêt in the commune of Vélizy-Villacoublay, with a surface area of 13,000 sq.m.: this is an intermediate warehouse intended for urban distribution that opened in 2018.

The mapping study of logistics in the Paris region confirms the emergence of this dual market for logistics warehouses, to which we have already referred several times, with, on the one hand, peri-urban warehouses, generally large in size, which need easy access to large, inexpensive plots of land, and, on the other, urban logistics warehouses, smaller in size, which are the mainstays of urban logistics and e-commerce deliveries. The differential in barycenters is evidence of this. However, it seems to us that the small-scale analysis is insufficient to understand the geography of logistics warehouses in the GPSO territory. The scale of the intermunicipality must also be mobilized by identifying the courier warehouses that serve the GPSO.

The mapping study of logistics in the Paris region confirms the emergence of a dual market for logistics warehouses, on the one hand, peri-urban warehouses, generally large in size, which need easy access to large, inexpensive plots of land, on the other, urban logistics warehouses, smaller in size, which are the mainstays of urban logistics and e-commerce deliveries.

In order to refine this logistics geography of the GPSO, we have identified and represented the parcel sorting terminals that serve the area. Figure 12.3 shows only those warehouses that directly serve the GPSO territory, while providing information on the vehicle fleet used by each agency.

First of all, it is interesting to note that several agencies per company serve this territory and that in particular warehouses bordering the GPSO are used to serve it.[4] The average distance to the center of gravity for these warehouses and express agencies alone is 12.2 km. This suggests that courier companies divide administrative territories into several sectors. However, there is a limit to this approach, related to the organization of routes. It would be possible to understand in even greater detail how companies organize their routes within a catchment area, in order to identify possible optimization strategies implemented by them. Nevertheless, it was not possible to obtain this

4. It should be noted that the warehouses identified (Figure 13.3) do not only serve the municipalities of the Grand Paris Seine Ouest but also other municipalities, particularly in the south of Paris. The Chronopost sorting facility in Beaugrenelle, in the 15th arrondissement of Paris, serves the municipalities of the GPSO, in addition to the 15th and 16th arrondissements of Paris.

Figure 12.3

Mapping of nine express parcel delivery companies' sorting terminals serving GPSO in 2021

Source: Escarfail, 2021.

type of information. Despite this methodological limitation, this cartographic production provides better knowledge about which express delivery agencies serve GPSO. We note a fairly strong difference in location: while Colissimo agencies are relatively close to the area (with even one agency in Issy-les-Moulineaux), France Express agencies, for example, are far away (one in Trappes in the Yvelines department, another in Gennevilliers in the north of Hauts-de-Seine). Above all, this map shows the impact of the express parcel sector in terms of logistics real estate, and therefore in terms of flows: 21 agencies are mobilized to provide express parcel services in the GPSO area alone.

This map shows the impact of the express parcel sector in terms of logistics real estate, and therefore in terms of flows.

Figure 12.4
DHL and UPS to serve the GPSO territory in 2021
Source: Escarfail, 2021.

In order to further refine the logistics geography of the GPSO territory, this research has attempted to represent the catchment areas of each warehouse for each express delivery company (Escarfail, 2021): here we offer an example with the DHL and UPS companies (figure 12.4). The first thing to note is that the organization of the agencies' catchment areas is very diverse, with the principles of optimizing routes or bringing together warehouses and service territories varying greatly from one express delivery company to another.

In conclusion, let us recall that the GPSO has engaged since 2016 in designing a cooperative intermunicipal urban logistics strategy,[5] with the support of the company Sogaris and the consulting firm Jonction (Jonction, 2017). This effort is part of the development and implementation of a climate plan (GPSO, 2018). Therefore, it is in the public interest for communities to gain a better understanding of logistics flows, the functioning of logistics spaces and companies (see Perspectives at the end of the handbook).

5. https://www.seineouest.fr/votre-territoire/grands-projets [Accessed 5 September 2022].

NEW E-COMMERCE BUILDING FORMATS AND THEIR IMPACTS ON CITIES

Under the influence of e-commerce pure players, traditional distributors and retailers are increasingly moving towards omnichannel distribution strategies that combine and hybridize physical channels with online channels, and vice versa. This transformation of the retail model is resulting in an enhanced role for physical stores. From simple points of sale, they are becoming local logistics hubs, serving as collection points for online purchases (click&collect, delivery hub, drive-through), as drop-off points for returns or as micro-shipment centers for rapid product delivery (ship-from-store). More generally, e-commerce is a factor in the creation of new urban logistics spaces, such as networks of relay points with human presence and automatic delivery lockers, which allow service providers to optimize the efficiency of rounds and deliveries, thus reducing the number of vehicle-kilometers and other induced effects (fuel consumption, transport time, operational costs).

The growth in demand for food e-commerce during the pandemic has led to the emergence, from 2020-2021, of new so-called quick commerce players (Gopuff, Flink, Getir, etc., many of which have already disappeared, notably following takeovers, the latest being the takeover of Gorillas by Getir in December 2022, see chapter 14), which promise to deliver groceries in less than twenty minutes in urban centers. Characterized by their speed of delivery thanks to fleets of two-wheelers (bicycles and mopeds), they offer a narrower range of products than a traditional supermarket and operate from small local warehouses called dark stores. Located in various places in the heart of the dense city, the "dark stores" generate a lot of traffic to and from the store. Their extremely rapid and anarchic growth has provoked a reaction from the public authorities, who now wish to regulate this sector, in relation to the nuisance it causes in the public space, but also to the competition, real or supposed, that it would exert on traditional urban commerce. However, studies still need to be carried out to gather data on the real effects of this form of commerce, which is part of a broad and profound evolution of city commerce as impacted by e-commerce.

13 OMNICANALITY AND NEW FORMS OF URBAN LOGISTICS FACILITIES

E-commerce has led to an increase in innovative combinations of physical and digital solutions through concepts such as click&collect, ship-from-store and other methods.

Omnichannel e-commerce that blurs the boundaries

In the field of e-commerce, a distinction is made[1] between pure players on the one hand, merchants with a purely online presence (e.g., Zalando, Zooplus), including online marketplaces that facilitate transactions between sellers and buyers, such as eBay and Le Bon Coin; and multi-channel merchants on the other hand, mostly traditional companies that launch online services in order to capture a share of the e-commerce market. The distinction between pure players and physical retailers (brick-and-mortar stores) is becoming increasingly blurred as companies adopt an omnichannel or online-to-offline (O2O) strategy. Omnichannel retailers are similar to multichannel retailers, except that they do a much better job of combining and hybridizing the different channels together (Ailawadi and Farris, 2017). Omnichannel implies that channels can be "mixed and matched" and used seamlessly, simultaneously and interchangeably (Buldeo Rai, 2019).

A major implication of an omnichannel strategy is the role given to the store (Hagberg *et al.*, 2016), which is now seen as part of a larger, more connected, integrated, and seamless shopping experience (Cao and Li, 2015). The physical establishment is no longer just a place dedicated to selling products, but a space that becomes multifunctional. In addition to traditional sales functions, stores also serve as collection points for online purchases (click&collect), drop-off points for returns, and micro-shipment centers for faster, more cost-effective, and more sustainable product deliveries (called ship-from-store) (Buldeo Rai, 2019). In this way, stores become local logistics hubs.

1. https://www.ecommercemobilities.com/on-the-retailers-side

Figure 13.1
The formats of omnicanality
Source: Buldeo Rai, 2021.

	MODIFIED STORE SETTING	NEW STORE SETTING
Operational offering	Showrooms, zero-inventory stores, digital assortment extension, digital shelf extension, virtual shelf expansion Buy online, pick-up in store (BOPIS/ BOPS), click&collect, curbside pick-up, reserve online, pick-up and pay in store (ROPS) Buy online and return in store Buy online, get it delivered from the store (BOGIDS), ship-from-store (SFS), warestores, dedicated stores as fulfilment nodes, dark stores	Click-and-drive, third party access points, lockers, collection points, pick-up stations, delivery points Stores-on-wheels
Experimental offering	Experience stores, flagship stores, concept stores, pop-up stores, temporary stores, third places Cashierless stores	

New logistics facilities: lockers, pick-up points and click&collect

E-commerce has not only changed transportation patterns but also created new logistics spaces. Increased use of pick-up points allows logistics service providers to improve parcel consolidation and delivery round efficiency, which, combined with more successful deliveries, reduces vehicle miles, transport time, fuel consumption and operational costs per delivery. For consumers, the use of collection points is an assurance of reliable, flexible, convenient and secure parcel delivery. There are currently four main networks of collection points in France: Chronopost/La Poste via its subsidiary Pickup, Mondial Relay, UPS (formerly Kiala) and Relais Colis. Some post offices are also part of the Chronopost relay points network and allow the collection of Colissimo packages (APUR, 2020). In American, Asian and North European cities in particular, there is an increase in unattended relay points or automatic "lockers". With the same advantages as human-attended delivery points, delivery lockers also offer the possibility of picking up a package at any time. These delivery lockers are often placed in public or semi-public spaces, such as train stations and shopping centers. They are also placed on campuses and in building lobbies.

Alongside drop-off points, another alternative delivery location is rapidly developing: shops, in the form of click&collect. Retailers with both a physical and online presence offer the customer the option of collecting or returning orders in the store(s) network. In non-food retail, click&collect has increased in-store service offerings (Buldeo Rai, 2019). In shopping centers, the increase in in-store delivery flows generated by click&collect

Figure 13.2

The spatial deployment of pick-up points: the example of the Grand Paris Seine Ouest

Source: Escarfail, 2021.
* This map is missing the automatic lockers (such as Amazon lockers).

services even raises questions about the spatial configuration of stores, circulation spaces, and the overall organization of goods flows in the shopping center itself. In food retail, this service has developed under the name of "drive" (an English word that is mostly used in this form by the French). The drives are either located in or next to the supermarkets or in a separate warehouse. A new type of drive-through has been introduced that better responds to the density and travel behavior in cities: the pedestrian drive-through (APUR, 2022). For the moment, few click&collect networks have the density of the networks of pick-up points.

Towards new logistics organizations for shopping centers

Urban malls depend not only on the mobility of consumers, but also on the mobility of goods to function. Brettmo and Sanchez-Diaz (2021) consider freight intensity as a major indicator of a shopping center's success. Thus, if the primary goal of shopping centers is to facilitate consumer access, the same imperative must apply to the supply of goods and their internal movement. Shopping center operators can allocate dedicated areas in the building for loading and unloading activities for all locations (Eidhammer *et al.*, 2016), or even consolidate deliveries by a specific operator to ensure each store is supplied (Brettmon and Sanchez-Diaz, 2021).

In practice, however, this potential does not necessarily materialize. The transport of goods remains poorly optimized, especially for urban shopping centers. Indeed, in cities, there is competition between space uses and between transportation modes (Eidhammer *et al.*, 2016). Downtowns often have narrow streets making it more difficult for goods vehicles to pass through, and real estate prices are high, reducing the amount of space that can be dedicated to inventory and storage (Cheah *et al.*, 2021). Finally, cities are increasingly issuing regulations aimed at reducing emissions (CO_2, pollutants) in order to improve air quality, which will ultimately pose obvious challenges for the supply of these urban shopping centers (Rosenzweig *et al.*, 2010). These few identified barriers also arise, but to varying degrees, for large peri-urban shopping centers.

A few studies have attempted to estimate and assess the freight intensity of urban shopping centers. Medium-sized shopping centers, such as Nordstan in Gothenburg (Brettmo and Sanchez-Diaz, 2021), generate between 246 and 556 daily freight trips for 120 to 194 locations. This high level of daily movements can largely be explained by the spread of omnichannel and the transformation of physical stores into multifunctional hubs (Hagberg *et al.* 2017).

Work conducted by the Logistics City Chair on the Beaugrenelle shopping center in Paris (Marcher, 2021; Buldeo Rai, Marcher, 2022) highlighted a number of operational issues related to the supply and movement of goods including: chaotic supply operations leading to financial, safety, and ergonomic risks for delivery workers; piecemeal delivery practices that are not aligned with regular supplies; and a lack of storage space. In response to these observations, the results of this research explored three possible solutions.

The first solution draws on the concept of "joint logistics" developed in the European CITYLAB project (Nesterova *et al.*, 2017; Ørving *et al.*, 2018), the "centralized receiving station" recommendation shared by Dalla Chiara and Cheah (2017), and the service implemented by the French urban logistics specialist Urby. It emphasizes the need for dedicated staff with a dedicated operator to support freight-related operations.

The second solution is based on the concept of "urban distribution centers" (Paddeu *et al.*, 2014) that pool delivery rounds (see Chapter 3).

The third solution is inspired by the demand management systems for shopping centers presented by Alho *et al.* (2022), the shopping center coordination platform explored by Song *et al.* (2022), and the service implemented by the American software specialist Building Intelligence for several shopping centers in the US. The aim is to support operations related to goods, storage and distribution with advanced management technologies.

14 QUICK COMMERCE AND DARK STORES

The concept of "instant deliveries" are services that deliver products ordered via online platforms and performed within two hours or less (Dablanc *et al.*, 2017). They first developed for meals, with deliveries often made by freelancers, self-employed entrepreneurs, or individuals who accept on-demand assignments via these platforms ("gig workers"). With the Covid-19 pandemic, a new instant delivery sector emerged, that of "quick commerce", promising delivery of groceries in less than twenty minutes. Online shopping habits have indeed been boosted by the pandemic, including for online food offerings (UNCTAD, 2021), and this potential has attracted a range of start-ups and larger companies. With around 2,000 product references, quick commerce services are ten times more limited than those of traditional urban supermarkets (generally between 20,000 and 30,000 product references). Some players are therefore positioning themselves on impulse purchases and urgent needs, while others are proclaiming their ambition to replace supermarkets altogether.

To make these activities operational, fast-food companies rely on readily available staff (partly employees) and on a very dense network of small store-like warehouses in each city where they are present. These warehouses are called "dark stores", a term that has become fairly universal (Buldeo Rai, 2022).

The main purpose and advantage of dark stores over regular e-commerce warehouses is their ability to deliver quickly. They serve neighborhoods within a radius of less than two kilometers, using two-wheelers, including electric mopeds and e-bicycles or cargo bikes. Some of the pioneers, including the American company Gopuff (2013) and Turkey's Getir (2015), who are the dominant players in the sector in Europe and the US in 2022, launched this market, nearly a decade ago. But the pandemic accelerated this movement, and saw the emergence of dozens of companies worldwide, including Gorillas (Germany, 2020), Flink (Germany, 2020) and JOKR (Schorung *et al.*, 2022). By the end of 2022, these companies in North America and Europe were fewer in number following numerous buyouts (e.g., Frichti by Gorillas in March 2022, Cajoo by Flink in May 2022, and Gorillas by Getir in December 2022).

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A McKinsey study estimates that the top 15 quick commerce companies had opened over 800 dark stores in Europe by the end of 2021 (Delberghe *et al.*, 2022). Founded on a capital-intensive business model, seeking to monetize a rapid shift in consumer behavior, quick commerce companies quickly attracted significant amounts of venture capital. Based on data from Pitchbook, an article in The Spoon reports that they raised $4 billion in 2021, nine times more than the previous year ($430 million) (Wolf, 2022). In 2022, on the other hand, quick commerce has been plagued by the drying up of venture capital funds and increased resistance from the cities in which these companies operate. This has led to buyouts but also bankruptcies, closures, and layoffs (Davalos and Levingston, 2022).

A McKinsey study estimates that the top 15 quick commerce companies had opened over 800 dark stores in Europe by the end of 2021.

Dark stores are deployed in different types of locations. In London, these can be railway viaduct arches, light industrial sites, and shopping center basements. The most common type of location, however, is former stores, a consequence of commercial vacancy rates in large cities due to a combination of structural (transformations in traditional commerce, competition from e-commerce) and conjunctural (economic effects of the Covid-19 pandemic) factors.

The smallest dark stores (up to 200 square meters) are often located in former stores on the first floor of residential buildings in the dense urban center. A significant amount of space is often allocated to bicycle parking and storage, probably due to the lack of other secure outdoor locations during closing hours. During busy periods, mopeds and bicycles are parked at the curb next to the warehouse. The larger dark stores are located in industrial areas that are still in operation or being redeveloped, in former manufacturing buildings or in small warehouses in outlying areas. They often have courtyards or adjacent parking lots, providing space for vehicle parking. Their location outside the dense urban center allows them to have a larger storage area, up to 500 square meters. As a result, there is more stock per unit of product, which reduces the frequency of replenishment.

The smallest dark stores (up to 200 square meters) are often located in former stores on the first floor of residential buildings in the dense urban center.

The central warehouse has a larger surface and is usually located in the periphery. It is owned or subcontracted, reflecting the players' desire to control their product inventory and their supply chain. Gopuff's supply chain in Paris was based on a vertically integrated model. According to our research, Gopuff sourced the core of its offer (up to 4,000 items) directly from a traditional central purchasing office, as well as from small local suppliers for products such as bread. The central warehouse was supplied by trucks on a monthly basis for non-perishable products, and on a bi-weekly basis for fresh products. The "dark stores" were supplied weekly by light commercial vehicles, some of which are electric. The supply activities of the dark stores were outsourced to a logistics service provider (Mariquivoi, 2022).

Figure 14.1

Dark stores in Paris and London: an uneven deployment

Source: Chaire Logistics City, Schorung, 2022.

In line with government concerns, our observations confirm that dark stores are transportation-intensive facilities. Figure 14.2 shows the number of delivery vehicles arriving and departing from three Parisian dark stores on an average day during the week. Transport activity via the dark stores tends to increase throughout the day, with peaks around midday, towards the end of the working day and later in the evening. A similar pattern is observed over the weekend, but the late evening peak appears more pronounced and longer. A dark store therefore generates approximately 150 to 300 vehicle movements per day during the week and slightly more during the weekend. We compared our results with observations by Srinivas *et al.* (2019) of a dedicated Amazon Prime Now hub for two-hour delivery in Sacramento, California. This facility is about five to ten times larger than an average dark store, but generates fewer delivery vehicle departures per day: 97 Amazon Flex passenger cars versus 126 scooters or bicycles for an average dark store.

A dark store generates approximately 150 to 300 vehicle movements per day during the week and slightly more during the weekend.

Quick commerce is part of a retail model that was already changing before the Covid-19 pandemic. It did not invent dark stores, nor is it the first to test the store as a fulfillment center for local delivery: several supermarket chains (such as Monoprix in France) have tested dark stores to accompany the growth of online orders. Other chains have temporarily or permanently transformed physical stores into dark stores during the health crisis or to support their "online food shopping" branch on a more permanent basis; this is the case, for example, of Franprix in France or WholeFoods in the United States (Schorung *et al.*, 2022). In California, the quick merchant Gopuff has established its dark stores within each BevMo outlet, a liquor distribution chain that Gopuff acquired in 2020. The quick commerce model has proven itself in Asia, where it originated: in China, instant delivery of groceries has been an established consumer practice for more than five years with companies like Hema Fresh. The fact remains that, more than other retailers who make use of dark

Figure 14.2

Quick commerce: a transport-intensive activity

Source: Chaire Logistics City, 2022.

stores, quick commerce reflects a haphazard implementation in cities. In 2020 and 2021, investors have pursued a so-called "blitzscaling" strategy of highly accelerated growth to gain an advantage over competitors and assume control of the market ("winner-takes-all" strategy), even though the total number of dark stores does not exceed a hundred in any given city.

However, since the beginning of 2022, this very rapid development has encountered the drying up of access to financial investments and raises questions about the need to regulate the sector. These questions primarily concern the use of public space. How can we limit the nuisance caused to local residents by the movements and parking of delivery personnel? How to deal with the overuse of bicycle and road infrastructures? But these questions are also of a commercial nature: are dark stores a threat to small retail stores or even to urban retail stores? Does the multiplication of these inaccessible spaces, hidden from the public, threaten a certain form of urban life and street animation? Finally, from a legal point of view, how should dark stores be considered, particularly with regard to local urban planning documents: are they commercial spaces or logistical spaces?

Municipalities are expressing their concern and are multiplying initiatives[1] aimed at regulating or even freezing the development of dark stores. Some public officials are putting forward arguments that may be considered too moralistic, since they overlook the fact that this offer, which remains an extremely small part of the overall food trade in large cities, responds to a demand (probably a niche demand). In March 2022, the City of Paris, for example, decided to initiate a procedure to close 45 of the 80 dark stores identified by the APUR, because of non-compliance with the rules of the Paris zoning plan. In the Netherlands,[2] in Amsterdam and Rotterdam, a one-year moratorium on the opening of new places of this type was decided in January 2022. The City of Barcelona decided to close all dark stores in January 2023. However, in some cities like Paris, the means of regulation with regard to quick commerce remain fairly limited.

Municipalities are expressing their concern and are multiplying initiatives aimed at regulating or even freezing the development of dark stores.

Platforms are now seeking to be more respectful of local rules. Getir is experimenting with click&collect to classify its warehouses as "shops". Others are innovating and offering fresh produce takeaway, such as GoPuff in New York, which has inaugurated GoPuff Market, combining logistics space, a store and a café. Cooperation strategies are emerging with municipalities. In Paris, the city council has offered to help "quick merchants" like Cajoo (acquired in May 2022 by Flink) find suitable premises such as underground parking lots. A controversy between the state, local authorities and platforms grew during the summer of 2022 in France over the legal characterization of dark stores. On October 5, 2022, the Paris Administrative Court ruled in summary proceedings that they were "urban logistics spaces" not subject to the same rules as long-term storage. The legal debate continues in France while waiting for a national decree: the French government took a position in August 2022 in favor of a classification of dark stores as warehouses.

1. « Pourquoi la multiplication des "dark stores" au cœur des grandes villes inquiète les municipalités » https://www.radiofrance.fr/franceinter/pourquoi-la-multiplication-des-dark-stores-au-coeur-des-grandes-villes-inquiete-les-municipalites-8232975

2. Rotterdam joins Amsterdam in freezing new "dark stores" – https://www.reuters.com/business/retail-consumer/rotterdam-joins-amsterdam-freezing-new-dark-stores-2022-02-03/

Gopuff Market between Soho and Tribeca in New York with its storefront reserved for takeaway sales.

The necessary regulation of quick commerce in terms of respect for urban planning rules and limiting nuisances should not, however, make us forget that this sector is only the reflection of a more general evolution of urban commerce. Online sales have penetrated urban life and transformed consumer habits. Deliveries from physical stores, click&collect, pedestrian click&collect, and automatic lockers are all other markers of these developments in cities. The effects of dark stores on the local economic fabric should perhaps also be put into perspective: Paris currently has around 100 dark stores for more than 60,000 local businesses.

Deliveries from physical stores, click&collect, pedestrian click&collect, and automatic lockers are all other markers of these developments in cities.

The most important thing in these debates is to collect reliable data, particularly on the movements of delivery staff and the vehicles used for delivery, as well as on the flow of deliveries, in order to gain an overview of the organization of sustainable urban logistics in all its dimensions on the local agenda, in light of an urban retail landscape disrupted or transformed by e-commerce.

PROSPECTS

A NEW LOGISTICS URBANISM

A destination in the shadow of regulatory planning

The territorial issues raised by the real estate dimension of logistics activities have grown and are now being discussed by regions and urban authorities. Warehouses represent jobs, and when they are located in cities, these jobs represent an often welcome addition of low-skilled jobs in the heart of large cities. Urban warehouses are also objects of innovation, as many recent projects have shown. They help reduce the carbon footprint of logistics, develop the use of soft or alternative modes of transportation and offer services in cities. However, logistics real estate also raises concerns, whether diffuse or expressed, on the part of public authorities on both environmental and social levels:

- Land artificialization[1] caused by warehouses (even though they account for less than 1% of artificialized land in France).
- Energy consumption, especially from old, poorly insulated warehouses.
- Potential threats to low-skilled jobs due to the automation of some warehouses.
- Air and noise pollution and greenhouse gas emissions from logistics vehicles entering and leaving warehouses.
- Poor accessibility of suburban logistics terminals by public transport (which is becoming a real issue today, as the younger generations do not always have a driver's license).
- Threats to small retail and to the urban lifestyle when urban warehouses take the form of dark stores.
- Problems of job attractivity, recruitment and professional training.
- Contribution of warehouses to building local resilience in the event of a health, climate or energy crisis.

1. Regarding land artificialization in France, Article 191 of the Climate and Resilience Act of 2021 set a national goal of no net artificialization of land in 2050 and to do so states that "the rate of land artificialization in the ten years following the enactment of this Act must be such that, over this period, the total consumption of space observed nationwide is less than half of that observed over the ten years preceding this date."

Because of all these issues, local governments are increasingly concerned about warehouses. To this end, France's legislative framework includes numerous provisions that broaden the conditions for exercising a "logistics urban planning" policy. Urban planning and development powers have evolved and offer governments a range of different instruments (see box hereafter). Intermunicipal zoning plans have become widespread, which can facilitate better spatial and regulatory organization of logistics facilities in a metro area by avoiding strictly municipal decisions on the location of warehouses, thus counteracting the phenomenon of logistics sprawl. Inter-municipal authorities are now in charge of economic activity zones (ZAE), where many logistics facilities are located. The Regions are responsible for the regional master plan for planning, sustainable development and territorial equality (SRADDET), which brings together pre-existing plans such as the regional climate and energy plan and the regional intermodality plan. The SRADDETs are now responsible for setting medium and long-term objectives "in terms of the development and location of logistics facilities", taking into account "the flow of goods, particularly to city centers, the location of major roads, the development of local commerce and e-commerce, the integration of these facilities into the landscape and the economical use of natural, agricultural and forestry land". On the side of the "territorial coherence schemes (SCoT)" at supra-intercommunal level, the new document of artisanal, commercial and logistic development (DAACL) adds to the determination of the conditions of implantation of the shops that of the "commercial logistics" and thus of e-commerce warehouses. It should also be noted that the requirements on the design and architecture of warehouses in terms of environmental performance are increasing. New warehouses must green their facilities or install a renewable energy production system (e.g., solar panels on the roof) on at least 30% of the roof surface or via parking shades. The professional members of Afilog, the French association of logistics developers, had also committed to an average of 50% coverage of photovoltaic panels (or other renewable energy) on their warehouses when they signed the charter of reciprocal commitments on the economic and ecological performance of logistics real estate in 2021 with the French administration.

Intermunicipal zoning plans have become widespread, which can facilitate better spatial and regulatory organization of logistics facilities in a metro area by avoiding strictly municipal decisions on the location of warehouses, thus counteracting the phenomenon of logistics sprawl.

However, the issue of urban logistics and its challenges are difficult to address from a regulatory point of view and remain poorly integrated or even excluded from urban planning. On the scale of an area such as Greater Paris, in the regulatory documents of many municipalities and public inter-municipal organizations, urban logistics is not necessarily considered as an urban issue or a city function in its own right and is not taken into account in the planning and sustainable development projects (PADD) and regulations.

This absence of urban logistics in the PADDs, and zoning plans is partly explained by the relative old age of these documents compared to the recent explosion of e-commerce and the manifestation of its impacts in the city, in the absence of an organization of flows and regulation of these activities.

In land use regulations, logistics is still mainly associated with the sub-use "warehouse" or, more generally, authorized only as an activity accessory to other uses (commerce, craft services, industry, offices). However, this regulatory approach is less and less in

line with the organization of logistics function in urban areas, marked by the increasing outsourcing of supply chain management (less on-site storage) and a more complex spatial organization (increasingly distant distribution centers and large cross-docking hubs on the outskirts of urban areas and distribution spaces closer to consumer areas and city centers). These changes have resulted in new requirements in terms of floor space and location, and in a specialization of the functions that can no longer be defined as just "warehousing."

Case study: French regulatory texts on warehouses and logistics urban planning[2]

In France, eight laws in less than ten years have included, directly or indirectly, measures that specify jurisdictions over urban logistics real estate: the MAPTAM law (modernization of territorial public action and affirmation of metropolitan governments) of January 27, 2014, the ALUR law (access to housing and renovated urban planning) of March 24, 2014, the NOTRe law (new territorial organization) of August 7, 2015, the TECV law (energy transition for green growth) of August 17, 2015, the Energy and Climate Law of November 8, 2019, the LOM (Mobility Orientation Law) of December 24, 2019, the Climate and Resilience Law of August 21, 2021, the 3DS (Differentiation, Decentralization, Deconcentration, Simplification) Law of February 21, 2022.

These laws have consolidated the national codes that allow local governments to organize the accommodation of warehouses, especially in cities. At the regional level, Article L4251-1 of the General Local Authorities Code (specified by Decree no. 2022-762 of April 29, 2022) states that "The Region (...) shall draw up a regional plan for development, sustainable development and territorial equality" (SRADDET) which "sets (...) the medium and long-term objectives for the development and location of logistics facilities." To do this, the SRADDET must take into account "the flow of goods, particularly to city centers, the location of the main roads, the development of local commerce and e-commerce, the integration of logistics buildings into the landscape and the economical use of natural, agricultural and forestry land." The SRADDETs must set out the objectives of zero net artificialization at the subregional level and not exceed half the consumption of these areas compared to that observed during the ten years preceding the promulgation of the law.

At the level of intermunicipalities, Article L141-6 of the Urban Planning Code, resulting from the Climate Law, gives the Territorial Coherence Plan (SCoT) responsibilities with respect to e-commerce warehouses, in particular the task of determining "the conditions for the implementation of commercial logistics buildings (...) according to their surface area, their impact on the artificialization of land and their impact on spatial balances, in particular with respect to the development of local commerce, the frequency of purchases or the flows generated by people or goods. These conditions favor the economical consumption of space, particularly at the entrance to the city, through the compactness of built forms, the protection of natural, agricultural and forest soils, the priority use of vacant surfaces and the optimization of surfaces devoted

2. Note to English speakers who read this Section in its entirety: you may be eligible to a bottle of champagne from the team at the Logistics City chair.

to parking." The SCoT's artisanal, commercial and logistics development document (DAACL) "locates the preferred sectors of implementation with regard to the area's logistics needs, with regard to the capacity of existing or planned roads to manage the flow of goods and with regard to the objectives mentioned in the second paragraph of article L141-3."[3] The DAACL may also "provide for conditions allowing the development or maintenance of local commercial logistics in urban centers in order to limit the flow of goods from peripheral areas to urban centers." This obligation aims to rebalance the constraints between e-commerce and physical businesses, even if what falls under commercial logistics is not strictly defined. Warehouses are still excluded from commercial development authorizations (required for large supermarkets in France), but they will nevertheless be included in the objectives of "reducing the consumption of natural, agricultural and forest areas." Logistics objectives should be integrated into the zero net artificialized lands' objectives of SRADDETs.

At the metropolitan and urban level, article L151-16 of the national Urban Planning Code empowers the regulations of the zoning plan to "delimit, in urban or urbanizing areas, sectors in which the preservation or development of logistics infrastructures and facilities is necessary and define, where applicable, the nature of these facilities as well as the requirements to ensure this objective." Since 2016, article R151-28 of the Urban Planning Code has included logistics in the "warehouse" sub-use within the "secondary or tertiary sector activities" use. This sub-use covers "constructions intended for the storage of goods or logistics" according to the ministry in charge of urban planning. This explicit mention of logistics in the same category as warehousing could make it more difficult to set up different or specific rules for light logistics facilities (excluding storage). The example of Paris below is a reminder that the rules for defining "warehouse" buildings can be complicated and the boundaries blurred. For its part, Article L1214-2 of the Transport Code gives mobility plans (formerly urban travel plans) the task of "organizing the supply conditions necessary for commercial and service activities and for private individuals (...) by taking into account the surface requirements for deliveries in order to limit congestion on roads and parking areas, by improving the preservation, development and use of existing logistics infrastructures, particularly those located on non-road access routes, and by specifying the location of future infrastructures and equipment, with a view to multimodal transport." Article L1214-2-2 specifies that the mobility plan "may include, when the metro area is served by a waterway or rail network, a waterway or rail service plan, which identifies in particular the terminals that can be used for urban goods and passenger transport by water, the possible locations for the different modes of supply in order to ensure, in particular, the multimodality of these supplies, the areas and facilities for access to the rail network, their main destinations and functions as well as the links with existing and future logistics facilities."

For their part, the obligations and standards that apply to the design and architecture of warehouses are becoming increasingly sophisticated. For example, Article L111-18-1 of the Urban Planning Code organizes the use of warehouse roofs and parking lots: "(...) new constructions of more than 1,000 sq.m. of floor space dedicated to a commercial

3. Objectives to be respected in article L141-3: "balance and complementarity of urban and rural polarities, economical management of space limiting the artificialization of land, ecological, energy and climate transitions, supply of housing, services and mobility adapted to new lifestyles, agriculture contributing in particular to the satisfaction of local food needs, as well as respecting and enhancing the quality of both urban and natural spaces and landscapes.

operation, industrial use, craft industry or covered public parking (...) can only be authorized if they integrate either a renewable energy production process system, or a vegetation system based on a mode guaranteeing a high degree of thermal efficiency and insulation and promoting the preservation of the recovery of biodiversity (...) on 30% of the surface of their roof or parking shades created."

There are many other tools for managing logistics real estate. For example, in Ile-de-France, a specific permit (Article L510-1 of the Urban Planning Code) is needed from the State as part of the regional development policy in Ile-de-France. It applies to storage facilities when they are larger than 3,000 sq.m. It should be noted that previous versions required a traffic study "including an evaluation of the traffic generated (by route, type of vehicle and time slots)" to be provided for applications concerning warehouses. Also in the Paris region, a tax on offices, retail, storage and parking facilities also applies to warehousing facilities of more than 5,000 sq.m. ("premises or covered areas intended for the storage of products or goods, without being integrated into a production facility, except those belonging to an agricultural cooperative society"). Since 2011, the tax includes parking spaces (of more than 500 sq.m.) and is modulated according to the areas of the Paris region (four times more expensive in the center of Paris than in the second ring of suburbs).

The "warehouse" building category and the example of the Paris zoning plan

French municipalities, particularly Paris, stand out from other major European cities with an original policy on logistics urban planning, including support for the introduction of new types of logistics facilities on municipal territory such as "logistics hotels," protection of existing warehouses, and in Paris the obligation to set up urban logistics spaces in some 60 areas identified in the zoning plan. The general amendment of the zoning ordinance in 2016 has indeed allowed urban logistics spaces to be included in "location perimeters". There are 205 location perimeters in Paris, including 62 dedicated to urban logistics spaces. In these perimeters, an urban logistics hub of 350, 500 or 1,000 sq.m., depending on the case, must be included in all development projects, in order to provide Paris neighborhoods with a network of hubs that can accommodate innovative logistics organizations using clean vehicles such as cargo bikes. The city's new logistics strategy announced in June 2022 continues and develops this policy, with the identification of several dozen new logistics perimeters announced. This type of provision is permitted because Paris had included light logistics functions (with no storage over three days) and their buildings in the CINASPICs.[4] This would perhaps be more difficult to do today: since 2016, the national Urban Planning Code has included all logistics in the "warehouse" sub-category, which covers "constructions intended for the storage of goods or for logistics." This explicit mention of logistics in the same category as warehousing could make it more difficult to implement different or specific rules for light logistics.

4. CINASPIC: constructions and installations necessary for public services or collective interest. Today, the category that comes closest is that of "public interest equipment and public services", article R. 151-28 of the national Urban Planning Code.

We saw in part 14 that quick commerce "dark stores" operated by ultra-fast food delivery platforms, which are the subject of major and multi-faceted controversy in cities such as Paris, Lyon, Amsterdam, New York and Barcelona, were the topic of recurrent discussions about whether or not they were warehouses (the instant delivery companies deem their activities to be trade and not warehousing). In France, a compromise was reached between the government and representatives of local governments in September 2022 around a draft decree according to which dark stores will be considered warehouses, even if they offer click&collect services. However, the Paris administrative court in an order dated October 5, 2022, found that these dark stores were "urban logistics spaces" (thus without long-term storage, as defined by the 2016 Paris zoning code) rather than warehouses as defined by the urban planning code. An appeal procedure is underway.

Allowing architectural and urban planning innovation in urban warehouses

Developing innovative warehouses, such as vertical ones, in dense areas remains a regulatory challenge in France and in many other European countries. In France, while the 20-meter distance rule from a neighboring building has been relaxed, distances to property lines, for example, are still governed by a complex heat flow calculation that can only be waived on a case-by-case basis. In addition, the urban planning regulations of large cities often limit the height of buildings (e.g., 15 meters), which can be unfavorable to high-rise warehouses, such as those seen in Asian cities. Moreover, building permit applications for urban warehouses are examined very cautiously by the fire department, given the risk of fire, because the rules for superimposing programs that fall under different regulations (classified facilities, labor code, establishments receiving the public, high-rise buildings) are not defined. The warehouse category defined in the Urban Planning Code is not currently very favorable to the mixing of activities, particularly for setting up logistics spaces at the ground floor of buildings.

Effective urban planning for urban warehouses must take into account the following issues:

- The use of brownfield sites (industrial, railway, but also commercial or former offices) in cities for logistics.
- Accommodating new modes of transport operation (electric vehicles, cargo bikes, multimodality), which will impact the configuration of warehouses.
- The development of co-activity (bus depots, coach parking facilities).
- The issue of access (links between logistics buildings and public space), including a much greater effort on public transport access, pedestrian and bicycle paths around logistics sites.
- Underground charging stations, the installation of which is hampered by fire issues.
- Architectural innovation, verticality, mixed use and joint activities (consolidating the use of logistics facilities in time and space between several operators).
- The question of obsolescence, modernization and reconversion of pre-existing logistics sites in cities.

The regulatory blind spot currently constitutes an obstacle to the development of dedicated spaces for logistics in cities and to the reconversion of areas that can be used to meet the many challenges of logistics in cities: efficient organization of the last mile, supply of urban businesses, decarbonization of freight flows, improvement of air quality and reduction of noise from freight vehicles.

All development and urban planning at different government levels must now integrate these multiple dimensions and must facilitate architectural innovation for warehouses. Logistics facilities in urban areas must have an appropriate framework in terms of safety, working conditions and energy and noise performance. Master plans must provide a framework for the development of logistics parks that are land and energy efficient and protect biodiversity. The location of logistics parks on polarized and well-connected sites (guaranteeing the accessibility of goods and people) is an issue at all levels of logistics real estate.

By giving urban logistics a normative definition and a functional and operational dimension in local urban planning documents, local authorities have a powerful lever for regulating and integrating logistics in line with urban issues.

The regulatory blind spot currently constitutes an obstacle to the development of dedicated spaces in cities and to the reconversion of areas that can be used to meet the many challenges of logistics in cities.

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THE LOGISTICS CITY CHAIR

The Logistics City Chair was launched in 2019 in partnership between Gustave Eiffel University and the real estate group Sogaris. In 2020, the Chair was joined by La Poste Immobilier, a subsidiary of the La Poste group. Subsequently, the Ile-de-France Region also provided financial support to the Chair. For the year 2022, the Chair received the support of the GeoPost group. On the proposal of the representatives of the group of academic partners and the group of sponsoring partners, the Orientation and Evaluation Committee held in April 2022 confirmed Laetitia Dablanc, Director of Research at Gustave Eiffel University, as Director of the Chair. At the end of 2022, the Chair was renewed for a further three-year period (2023-2025).

The ambition of the Chair is to include in the field of urban studies the issue of logistics facilities and the analysis of the territorial impact of digital and environmental transformations and new ways of consuming. In this respect, the Chair is dedicated to research on urban logistics with three research focus areas: a first theme dealing with urban and peri-urban logistics real estate; a second focusing on trends and new consumption practices and their impact on urban logistics and its real estate as well as on the urban environment; a third (introduced from 2021) addressing public policies, governance of logistics and data.

The description of the field of study and the scientific program of the Chair were the subject of a white paper on the new urban logistics entitled "Welcome to Logistics City" (available in French and English at *https://www.lvmt.fr/wp-content/uploads/2019/10/Welcome-to-Logistics-City-1.pdf*). In 2021, the Chair's second handbook was published on the mobilities of e-commerce, written by Heleen Buldeo Rai and Laetitia Dablanc (available through this link: *https://www.lvmt.fr/wp-content/uploads/2021/06/Welcome-to-Logistics-City-2021.pdf*).

The ambition of the Chair is to include in the field of urban studies the issue of logistics facilities and the analysis of the territorial impact of digital and environmental transformations and new ways of consuming.

Chair's Orientation and Evaluation Committee

(2022 composition)

	College of Academic Partners	College of Sponsoring Partners
College Representatives	**Muriel Jougleux,** Vice-President of Partnerships and Professionalization, University Gustave Eiffel Substitute Régis de Montigny	**Jonathan Sebbane,** General Manager, Sogaris President of the OEC
	Serge Piperno, Vice-President Research, University Gustave Eiffel	**Rémi Feredj,** General Manager, La Poste Immobilier
College Representatives	**Julien Aldhuy,** Associate Professor, Director of Lab'Urba research unit, University Paris Est Créteil	**Cécile Maisonneuve,** Senior Fellow, Institut Montaigne
	Nathalie Granes, Head of service (Department of Transport), Ile-de-France Regional Council Substitute Pierre Launay	**Claude Samson,** President, Afilog Substitute Diana Dizain, Director, Afilog
	Adeline Heitz, Associate Professor, Conservatoire national des arts et métiers (CNAM)	**Olivier Storch,** Deputy Chief Executive Officer, CEVA Logistics Substitute Guy-Pierre Sachot, Director of Urban Logistics Deployment France, La Poste Group & GeoPost
	Susana Val, Director, MIT Europe, ZCL Saragosse	**Marion Waller,** Executive Director, Pavillon de l'Arsenal / Environmental philosopher
Experts and non-voting members	**François Combes** – Director of the SPLOTT research unit, University Gustave Eiffel	**Jean-Louis Boudol,** Director of urban logistics projects, La Poste Immobilier; member of the Steering Committee
	Laetitia Dablanc, University Gustave Eiffel, Director of the Chair, member of the Steering Committee	**Juliette Berthon,** CSR and Innovation Director, Sogaris; member of the Steering Committee
	Pierre Zembri – Director of the LVMT research unit, University Gustave Eiffel	

Steering Committee of the Chair

(2022 composition)

Laetitia Dablanc
Research Director, LVMT, Gustave Eiffel University, Chair Director

Sandrine Wenglenski
Associate Professor, LVMT, Gustave Eiffel University

Matthieu Schorung
Research Fellow, SPLOTT, Gustave Eiffel University

Juliette Berthon
CSR and Innovation Director, Sogaris

Jean-Louis Boudol
Director of urban logistics projects, La Poste Immobilier

Presentation of co-financing organizations (2022)

GUSTAVE EIFFEL UNIVERSITY

Gustave Eiffel University is a French university specializing in smart and sustainable cities, with a particular focus on transport and mobility. Gustave Eiffel University is the result of the merger of the University of Paris-Est Marne-la-Vallée (UPEM) and IFSTTAR (French Institute of Science and Technology for Transport, Planning and Networks) and includes component institutions (École des Ingénieurs de la Ville de Paris (EIVP) and École d'Architecture de la Ville et des Territoires (EAVT)) and member schools (ESIEE Paris and École Nationale des Sciences Géographiques (ENSG-Geomatics)).

SOGARIS

As a long-term investor and real estate company specializing in urban logistics, Sogaris is developing a real estate network that meets the new needs of e-commerce and the rapid evolution of distribution flows in cities. As a private company with public capital, the Group promotes the emergence of new, more virtuous and more innovative distribution methods in cities, for the benefit of its customers and the regions. Firmly committed to low-carbon, controlled urban logistics, Sogaris has made reducing the impact of goods transport a key objective of its strategy to deliver sustainable cities.

LA POSTE IMMOBILIER

La Poste Immobilier, a subsidiary of La Poste Group, is the Group's property company, developer and service provider. La Poste Immobilier manages, develops, maintains and adds value to a portfolio of approximately 6 million square meters representing more than 10,000 service, industrial and commercial buildings throughout France. It assists the Group's business sectors (Mail and Parcels, La Poste network, Digital branch, GeoPost and La Banque Postale) in the implementation of their real estate projects in order to provide them with real estate adapted to their needs, at the cutting edge of environmental standards while contributing to the objective of controlling costs. La Poste Immobilier also offers services to local authorities and companies. With nearly 900 employees working in its regional offices and headquarters, it maintains a relationship of trust and proximity with its partners.

REGION ILE-DE-FRANCE

The Ile-de-France Region is the regional authority (nearly 10,000 agents and a budget of 5 billion euros) covering the entire Paris agglomeration and the Paris basin (12 million inhabitants). It is responsible for transportation, high schools, economic development, the environment and strategic planning. The region is also committed to supporting Parisian universities and public research. The region, through its transport department, supports research efforts related to transport, mobility and logistics.

GEOPOST

GeoPost is a holding company owned by La Poste Group. DPDgroup is the express parcel delivery network of GeoPost, present in 49 countries. GeoPost has one of the largest parcel delivery networks in the world (No. 1 in Europe) with more than 1,400 hubs and depots, 95,000 vehicles and over 120,000 employees. In addition to transport and delivery, the GeoPost holding company is committed to supporting the e-commerce boom and developing last-mile delivery and digital solutions.

WELCOME TO LOGISTICS CITY N°3

This third issue of "Welcome to Logistics City" was written by Matthieu Schorung, Laetitia Dablanc and Heleen Buldeo Rai, under the editorial direction of Laetitia Dablanc, and with the editorial support of Juliette Berthon, Jean-Louis Boudol, Inès Balligand and Gabin Jouquan. This handbook also includes contributions from Caroline Adamy, Juliette Berthon and Adeline Heitz. It is based on the research work carried out within the Logistics City Chair in 2021 and 2022, the contributions of first- and second-year master's students and the website www.ecommercemobilities.com managed by Heleen Buldeo Rai until the end of 2022.

MATTHIEU SCHORUNG

Matthieu Schorung, a transportation geographer, holds a PhD in Geography and Urban Planning from the University of Paris-Est with a dissertation on passenger rail transportation in the United States. He joined the Logistics City Chair as a postdoctoral fellow in January 2021. He is responsible for theme 1 of the Chair, which focuses on urban logistics real estate, new models of logistics real estate, and strategies for the implementation of logistics buildings in large urban areas. He is the co-author of a university textbook on transport (*Géographie des transports. Territoires, échelles, acteurs* (Armand Colin, 2022)). His areas of research are urban logistics, warehouse geography, public transport policies, and urban and regional planning through transport.

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LAETITIA DABLANC

Laetitia Dablanc, PhD from École des Ponts-ParisTech and graduate of Cornell University, is Director of the Logistics City Chair. She is Director of Research at the University Gustave Eiffel in Paris and leads the Young Researcher's Initiative of the World Conference on Transport Research Society (WCTR). Her research interests include freight transport, freight and the environment, urban freight and logistics, and public policy and spatial issues related to urban logistics.

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HELEEN BULDEO RAI

Heleen Buldeo Rai, PhD from the Vrije Universiteit Brussel (VUB) with a dissertation on sustainable urban logistics in omnichannel commerce, joined the Logistics City Chair as a postdoctoral fellow in January 2020, remaining until November 2022. A Palladio Foundation award winner in 2020, she was responsible for theme 2 of the Chair on trends and new consumption and distribution practices impacting urban logistics. In 2021, she published a book based on her thesis entitled *Duurzaam online shoppen. Praktijkgids voor e-commerce van morgen*. Her research areas are urban logistics, urban logistics real estate, e-commerce and e-commerce mobilities. She is now Senior FWO Fellow at Mobilise (Vrije Universiteit Brussel).

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Urban logistics is based on a constant process of innovation in terms of transport organization, warehouse design and the use of digital technology. Its environmental and land footprint is growing. With the rise of e-commerce and the reorganization of supply chains, goods transport is now a major challenge for urban societies.

What are the consequences of these transformations on logistics real estate? What new balances are emerging in urban and peri-urban areas for the integration of logistics warehouses and the minimization of their impacts? This 3rd volume of the *Welcome to Logistics City* series by the researchers of the Logistics City Chair and their partners analyzes these questions in a comparative and international perspective.