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# Emerging Sustainable Urban Logistics Concepts: A Case Study in France

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## Abstract

The scarcity and price of land in the city had led to the remoteness of logistics activities, with low added value, to the large outskirts of the cities.

Recently, the Covid crisis, the alarming geopolitical context, ecological disasters have led to a change in purchasing behavior, the explosion of e-commerce. The fragility of our production and supply systems has led to the paralysis of a large part of our economic activities. Today, despite the scarcity of space and the cost of land, new innovative logistics spaces are making a comeback in city centers. The aim of this article is to analyze:

- The relevance of new logistics space concepts to meet new expectations
- How their integration into the categories of identified logistics spaces completes the network of the territory
- The conditions of their return to the heart of the city despite the urban, economic and ecological constraints imposed by the European Climate Plan
- The limits and opportunities of new concepts
- To enrich the nomenclature of Urban Logistics Spaces by taking into account their radius of action, their functionality and the mode of management.

This paper is based on the results of works, carried out within the framework of European urban logistics projects and the French national program "Urban Goods Movements", which have given rise to numerous publications.

## Introduction

For transport operators, the remoteness of logistics activities have had the effect of extending approach distances, reducing the ability to optimize routes and increasing costs. For economic activities, the store storage spaces have been transformed into sales space, which increases the frequency of restocking. This had a disastrous effect on efficiency, the cost of urban supplies and the energy balance. Recently, local authorities have become aware of the essential role of logistics and are encouraging the return of logistics spaces to the city centre.

Logistics projects are integrated into development, town planning, road and regulatory policies. This is an opportunity for logisticians to have better economic and ecological efficiency, better service to economic players. This context offers real estate developers, economic players and logistics providers the opportunity to deploy new concepts, invest closer to consumers and

*keywords:* urban logistics space, sustainable goods distribution, new urban logistics concepts.

invent new operating methods. City logistics is vital for the efficient functioning of urban ecosystems and the reduction of air pollution and congestion in cities around the world. Undeniably, there is hope in the role of low-emission city logistics in the fight against climate change and its impacts, and in achieving the European Commission's goal of CO<sub>2</sub>-free city logistics of by 2030 in major urban centres. The first real action taken by the European Commission dates back to 2011 with the white paper entitled "Roadmap for a single European transport area - Towards a competitive and resource-efficient transport system in the use of resources" (European Agency for environment, 2011), which vaguely mentions some initiatives to consider in terms of urban freight and logistics. In 2013, this was strengthened with the urban mobility package (UMP), with emphasis placed on urban logistics by defining a concept of sustainable guidelines for setting up and implementing a sustainable urban mobility plan (SUMP).

In 2019, a study supported by the EC called "New mobility models in European cities" resulted in a huge collection of data covering the sectors of passenger mobility and urban logistics, fleet composition, transport activity and traffic for the member countries of the EU. This non-exhaustive list of EU initiatives clearly shows the awareness of decision-makers of the role played by urban logistics in reaching the European Union's urban sustainability goals. This leads the different stakeholders of the entire logistics value chain to involve themselves actively at different levels.

This study is based on our continuous research work in the framework of the European programs COST (in which we were in charge of data collection), BESTUFS, CIVITAS, SUGAR, FREILOT, Citymove, LUMD, VREF.... in which we followed the experiments carried out in terms of urban logistics, visited the logistics spaces set up, met the project leaders and local decision-makers. Our exchanges with our European counterparts made it possible to compare the fields of action, the methods and tools put in place, and the results obtained (2004-2013). As part of the national program Transport de Urban Goods Movements, initiated by the Ministry of Transport (1994-2018), we were in charge of the research group on urban logistics. Our team was commissioned to create a survey method capable of understanding the relationship between the economic activities installed in the city and the number and type of vehicles involved in deliveries, their size, the occupancy rate of the road network and the environmental nuisances generated. These surveys made it possible to build the FRETURB model (Routhier and Toilier, 2007), a tool to help local authorities assess the share of goods in road congestion and pollution. We have also followed innovative experiences by exchanging and supporting start-ups, communities and operators. This work made it possible to publish the "Methodological guide to urban logistics spaces" (Boudouin, 2008), republished in 2018 (Boudoin, Patier, 2018), and to create a method for evaluating experiments on urban logistics spaces EVAL (Henriot, Patier., 2008), tested in several European countries and around the world (Brown, M., Julian A., Toshinori, N., Patier, D., Visser, J. (2009) Our research has given rise to a large number of publications in scientific journals, books, articles in the framework of international congresses.

In this context, we have carried out a critical inventory of recent developments in the methods of planning and managing urban logistics spaces, focusing in particular on the process that allows logistics to be integrated into the urban landscape (architecture, accessibility, actors involved, services provided, and mix of uses, proximity and performance). Data collection was carried out to allow detailed comparative analysis of several experiments, site visits, face-to-face interviews with logistics professionals, and participation in workshops as part of the Urban Goods Movements program. In France, the demand for investment is increasingly strong for the implementation of logistics projects. New multi-use and multi-actor concepts make these investments not only profitable but also sustainable, reducing their environmental footprint and making them better adapted to the requirements of clients. This growing collective awareness has opened the door for logistics professionals to obtain more finance to develop and deploy new logistics concepts in a favourable environment. The French authorities apply regulations on the access of urban vehicles in the framework of its sustainable urban logistics towards the decarbonation of the world transport sector by 2050. Different measures have been taken to increase the efficiency of logistics operations, notably the implementation of low and zero emission zones, the progressive elimination of gasoline powered vehicles through the obligation to display pollution criterion stickers on vehicles, the proposal of programs of subsidies to carriers and entrepreneurs for cleaner vehicles. These restrictions have accelerated with the Covid-19 pandemic which has radically changed consumer habits for shopping, the boom of e-commerce and the increase of deliveries and returns to vendors – leading to an increase of freight volumes, especially in urban areas. These trends of online purchasing and omnichannel distribution, combined with scarce warehousing space in many urban areas are constantly and radically changing the landscape of urban logistics and delivery flows. Consequently, the French authorities have worked in close collaboration with different logistics professionals during the last decade to propose innovative strategies that provide modern logistics facilities and increase the mixed use of land, while simultaneously respecting the neighbourhood and the environment, which is certainly the case of Urban Logistics Hotels. To our knowledge, few studies

have analysed the state of progress in the implementation of this new concept of urban integration and distinguished the synergies with other emerging concepts, i.e. mobile and ephemeral micro-hubs, dark stores and micro urban logistics hotels.

## Nomenclature

ULH	Urban Logistics Hotel
ULS	Urban Logistics Space
UCC	Urban Consolidation Centers
EU	European Union
EC	European Commission
CO <sub>2</sub>	Carbon Dioxide
UMP	Urban Mobility Package
SUMP	Sustainable Urban Mobility Plan
LEZ	Low Emission Zone

### 1. Urban logistics spaces

Urban logistics spaces are based on the principle of consolidation. This concept is not new (Boudoin, 2008), (van Rooijen and Quak, 2010); it has been employed by logisticians and carriers for several years by concentrating themselves on their own supply chains. Consolidation without pooling between several transport operators and several customers is based on a logic of financial optimization but it has no advantage on the environmental level or with regard to road congestion since the vehicles used circulate half empty (Verlinde, 2012). Urban logistics spaces and more specifically urban logistics centres have long been considered the ideal and common structure for consolidation in urban areas capable of satisfying the various sustainability goals of cities. This type of structure has been tested extensively in Europe (France, Germany, Netherlands, UK, Italy) thanks to public subsidies, since public authorities considered it to be a means of reducing nearly all the negative externalities of goods transport in cities, encouraging consolidation and pooling between different transport operators, and facilitating the utilisation of clean vehicles (Allen, 2014; Browne, 2005; Campbell, 2010; Huschebeck and Allen, 2005; Lewis, 2007).

Despite their many advantages, most European UCCs had a short lifetime due to their dependence on public subsidies (Danielis, 2010; van Rooijen and Quak, 2010; S. Verlinde, 2012). Browne. (2005) noted that some UCCs were based on an intuition rather than on a genuine economic evaluation gauging their economic viability. At a time when the public authorities saw only the advantages of UCCs, private operators saw only disadvantages: an additional transshipment that was not offset by the use of the UCC, a loss of control over goods and direct contact with clients, the sensitivity of shared data, the lack of commercial approach from the managers of UCCs, localization often based on opportunistic rationales to the detriment of accessibility upstream and downstream, etc.(Browne, 2005; Huschebeck and Allen, 2005; Lewis, 2007; Vill, 2013).

Based on the analysis of the different advantages and disadvantages of the UCC, it is easy to conclude that this structure, alone, fails to optimize flows of goods transport in cities and to meet the goals of sustainability. It is necessary to adopt a systemic vision of logistics operations at the scale of a territory and to consider the UCC as a link in a consolidation chain in cascade. To ensure the full meshing of a territory, it is necessary to combine several sites of consolidation at different geographical scales.

The multi-level transshipment system was introduced into the urban logistics landscape by Crainic, (2004) who proposes a two-level organization allowing flows to be transferred from UCCs to satellite units which are characterized by a range of geographical locations and a positive environmental impact. More recently, (Boudouin, 2018) introduced a more ranked typology of urban logistics spaces with 5 levels of consolidation. Nonetheless, they did not describe the mechanism of transfer between the different levels. In 2013, Janjevic et al. focused in particular on the consolidation of flows as close as possible to reception points as well as identifying three additional operational typologies of logistics space of micro-consolidation that have been adopted by several European cities:

1) The “micro-consolidation centre”: it has the same operational organisation as a classical UCC but its area of distribution is more limited, located for last mile deliveries, with a smaller surface area and permitting the use of clean vehicles (such as cargo-bikes and electrically-assisted trolleys).

2) Boudouin et al. (2018) talk about the vehicle reception point to permit delivery to final destinations from the vehicle whereas Janjevičl. (2013) proposed the “Stationary transshipment point” to transfer flows to lighter vehicles better adapted to urban constraints.

3) The “Mobile depot” is based on the principle of combining a peripheral depot linked to a mobile logistics infrastructure to ensure last-meter deliveries. In 2022, Katsela et al. suggested three new typologies of micro-hubs that place to the fore collaborative rationales and the complexity of operational and organizational characteristics:

1) “Last mile collaboration”, initiatives driven by major transport companies, online retailers or a group of retail destinations (such as shop owners) that decide to subcontract their urban deliveries and home deliveries to a third-party logistics 3PL provider.

2) “Shared infrastructure”, the public authorities can also instigate certain consolidation infrastructures shared between several logistics operators. (Katsela, 2022) illustrated this second typology as the case of French logistics hotels although the latter, from our point of view, should belong to consolidation structures and not to micro-consolidation ones since they are situated geographically upstream of UDCs.

3) “Privates systems”, grouping the closed systems of micro-hubs via which private operators add a supplementary mobile or fixed transshipment point in their delivery networks.

In our approach, we propose a new structure of urban logistics spaces, by placing emphasis on the new concepts that have emerged recently. On the basis of a the classical typology proposed by Boudouin (2008), Boudouin (2018), we will enrich the logistic mesh necessary to supply the city by integrating these new concepts: urban logistic hotels, stationary and mobile micro-hubs, underground logistics, dark stores.

As shown in figure. 1, we have made the choice of positioning the logistics hotel between the urban logistics area and the distribution centre so that it can act as the interface between the city and the rest of the world. This proposal is close to that proposed by Patier and Toilier, (2018) while making a clear distinction between the urban logistics area and the urban logistics hotel. It is also somewhat different from the classification of Katsela (2022) who preferred to incorporate it in micro-consolidation centers. We place all the other objects of micro-consolidation after the UCC so that they can fulfil last meter deliveries. We insist on the notion of systemic meshing of the territory that recommends creating several levels of consolidation ranging from the urban logistics area to the urban logistics box via one or more consolidation structures. It should be noted that each logistics organisation must make rational choices when combining solutions allowing it to optimise its operation. These choices are made as a function of the characteristics specific to each economic sector such as the typology of flows and packaging, the quantities to be delivered, delivery frequencies and conditions, the final recipients, the typology of deliveries (at home, outside the home). Five new types of logistics spaces have been integrated.

The following graphic presents the nomenclature of logistics spaces that participate in the exchange of products from producer to consumer, according to their location (suburban, urban, district, building). The horizontal lines mark area boundaries and management mode (private, public-private). The nomenclature comes from the work of researchers involved in the French national Urban Goods Movements program (Boudouin, Patier, 2018). Four new types of spaces have been integrated and will be described in the text.

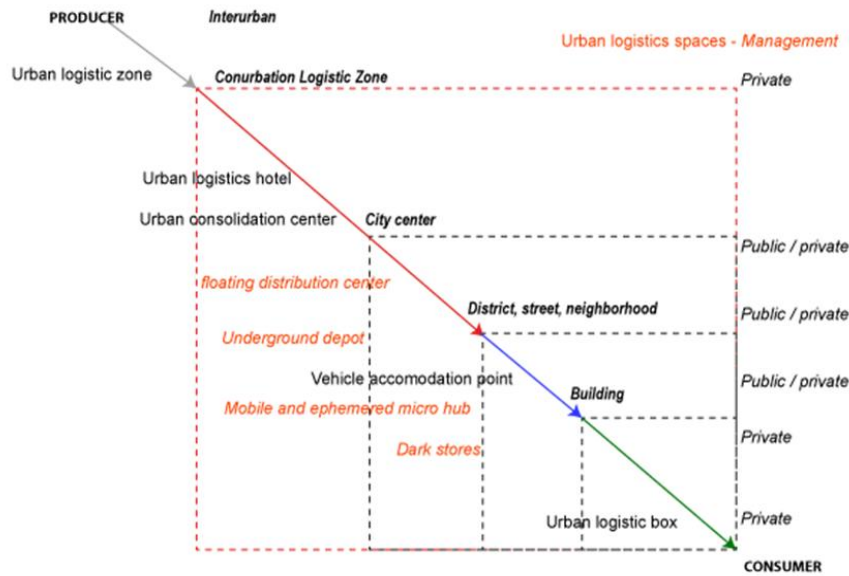


fig. 1. Typology of Urban Logistics Spaces (ULS) adapted from Boudouin et al. (2023).

### 1.1. The Urban Logistics Zone (ULZ) or freight village

The Urban Logistics Zone ensures the transit of goods between interurban and urban. It is preferably located in areas served by multimodal road-rail/river/sea transport; as close as possible to the center of gravity of activities generating flows of deliveries and collections to dense areas. It pools incoming flows to redistribute them within the conurbation. These may be specialized activity areas, on land targeted for these trades, agri-food markets, land made available for this purpose; often port, rail or river sites. They provide the interface between urban and interurban areas. The role of the community is to preserve the spaces likely to accommodate them and to ensure that the asking price is not dissuasive. It can finance or subsidize the equipment of the site, maintain the quality of the site and the security of access to it.

### 1.2. Urban Logistics Hotels

Densification and versatility of use allow the Urban Logistic Hotel to overcome the main factor that led to the eviction of logistics to the urban periphery, the price of land. The Urban Logistics Hotel (ULH) is a multi-storey, multi-purpose building. It is not just a multimodal consolidation hub, but a mixed urban project that integrates with the addition of new functionalities. Built in residential areas, it must meet the requirements of sustainable development: economic (profitability, job creation), environmental (reduction of negative externalities) and social (urban integration). It is above all an urban project that has multiple functions:

- reintegrate logistics in urban areas, closer to consumers, to reduce the km travelled
- pool multi-operator flows, space, means, services, *to reduce costs*
- consolidate incoming flows of goods and use alternative modes to road (rail-river-cargo-tram), *to reduce congestion*.
- distribute products in a consolidated way by clean vehicles, to *reduce negative externalities* (pollution, noise)
- integrate activities with high added value, mixed ecosystem, pooling of services and resources between different economic activities, to reconcile economic profitability and that of land by making real estate *investments profitable*.

The concept of urban logistics hotel was originally conceived in Tokyo, Japan, where the presence of logistics functions is well accepted by the public authorities and the population, occupying very large buildings, over seven

floors well visible in the city (Dablanc and Raimbault, 2015). This densification allows integrating logistics activities in cities where the space per logistics meter is under strong competition from the commercial meter. Partly based on the Japanese model, the Sogaris company introduced and pushed the concept of logistics hotel in France in collaboration with other actors in commercial and industrial property, and the SNCF (French national rail network) (Dablanc and Raimbault, 2015; Diziain, 2012). The different French urban logistics hotel projects have benefited from the strong and deliberate involvement of the French public authorities. The emergence of this concept has also been driven by strong incentives from the government and local authorities to reduce environmental nuisances and the imposition of very strict regulations (LEZ, parking, modes of transport, etc.) together with penalties in the case of violation. On the flipside of these advantages the ULH also has a number of limitations. Experimental projects in France have required very high financial investments. They are also complex to implement due to the large number of stakeholders that have to be coordinated and who must intervene at different moments of the lifetime of a ULH.

Table 1. ULH stakeholder and their respective roles

ULH Stakeholders	Roles
Project incubator	Initiate the action, participate in its financing (landowner) and may have the power to support the project with regulations (Region, local authority, Borough Council, etc.).
Project manager	Determines the architectural plan of the project and ensures its urban integration.
Project owner and prime contractor	Building the project (real estate developers, construction companies, technical design offices, architectural offices, etc.).
Manager	Marketing and managing the different forms and uses of the ULH (parking manager, real estate developer, etc.).
Space operators-users	Service provision (transporters and logisticians, training actors, leisure activity providers, craftsmen, etc.).
Clients of ULH services	Taking advantage of and purchasing the value-added services offered by the ULH.

According to the French case studied in the framework of this work, the ULH requires strong involvement from the public authorities for it to be integrated in the local urban planning scheme. It has to respond to several regulatory requirements by obtaining numerous certifications and the performance of impact studies. In the case of multimodal ULHs, project leaders' risk being faced with problems linked to access to other modes. Mention can be made of the example of rail transport where the organization of the French railways gives priority to passengers to the detriment of goods traffic.

### 1.2.1. *Chapelle International*

The first ULH in France, "Chapelle International" was launched in 2009 at the initiative of the Paris City Council in the framework of a "major urban renewal" project and the "Paris Climate Plan", in order to carry out the environmental, economic and social metamorphosis of a district. It is a large urban project in which the logistics hotel must be integrated with a floor area 18,000 m<sup>2</sup> (total floor area 45,000 m<sup>2</sup>). It took 10 years to be commissioned. It was managed by a consortium: City of Paris, Grand Paris (urban planning), Haropa (Port of Paris), CDC (Bank of Territories), a developer for the railway network, the town hall of the 18th arrondissement of Paris, a property developer, a rail operator, an operator managing the logistics platform.

The global cost of €91.5 was financed by institutional investors, a logistics property promoter (construction of the building, railway branch line linking the urban rail terminal to the National Rail Network, travelling cranes, the acquisition of the land, the railway operator through the provision of the urban rail shuttle, and the logistics operator which rents and operates the premises in the global supply chain from the warehouse to Parisian food wholesaler (METRO), the installations and the utility connections. Besides urban integration, the other ambitious wager was to consider supplying the platform by railway and organising final distribution using clean VNG vehicles. The total cost of €91.5 million was financed by the Banque des Territoires (€5 million), Sogaris, logistics real estate developer



(€1.5 million) for the construction of the building, a railway junction linking the urban railway station to the network National rail, traveling cranes, acquisition of land. Eurorail invested in setting up the urban rail shuttle, XPO Logistics rents the premises and operates them; it has invested in the global supply chain from the warehouse to the Parisian stores (METRO), installations and technical links.

Besides its logistics function, it included offices, shops, service activities, urban agriculture, and sports grounds open to the population of the district. This represents a historic break in how logistics are perceived. It was no longer the “wart that had to be hidden”, but placed at the heart of the city, participating in the life of a new residential district, providing a multitude of places of activity and leisure in an area where property prices are high. The diversity of activities permits profitability and benefits the local population. 300 jobs were created in the first year. The ULH hosts the data centre of Paris City Hall, which stores the data of the municipality and the hospitals of Paris, and produces energy for heating this new urban district. The building provides 1 ha of planted terraces (8,000 m<sup>2</sup> of agriculture and sports ground). Start-up incubators dedicated to logistics, sustainable mobility and training in logistics occupy 12,000 m<sup>2</sup>. The local population has access to shops, services, restaurants, terraces, sports facilities, and service and agriculture activities, without having to see goods or trucks. A hypermarket company has 5,300 m<sup>2</sup> of basement space available for its logistics activities. A logistics provider manages the railway logistics terminal where it uses 100% VNG-LNG powered vehicles to deliver to the company’s different subsidiaries and ensures doorstep deliveries to the district’s residents. The shops and services operate well and the population profits from the site.

In this rail-road scenario, with one rail shuttle a day (diesel, due the lack of a clean locomotive), between Paris and the bulk breakdown centre in north Paris, the estimation of the environmental gains in comparison to a 100% road option amounts to a saving of 2.6 million kms of road travelled, a reduction of 1,537 tons of CO<sub>2</sub>, 99% of NO<sub>x</sub> and PM, 63% less congestion, 85% less damage over a one-year period of operation, and 4,257,792 pallets a year. The monetary evaluation of these environmental gains amounts to €1M/year. On the functional level, the tests carried out to control the capacity of access and loading/unloading proved positive. No goods were conveyed by rail due to a technical problem linked to the connection of trains upstream, and a lack of anticipation by the railway operator SNCF/RFF regarding the technical limitations. The transport tests upstream by diesel train (lack of own locomotive) and downstream by VGN carried out to control the access and loading and unloading capacity proved to be positive.

This emblematic project has shown that with political will and involvement, the integration of logistics in the city is beneficial in terms of reducing flows and environmental effects. Unfortunately, it was unable to demonstrate the relevance of the massive arrival of products by rail despite complex work and very significant funding. The barriers are both political and economic.

### *1.2.2. Bercy-Charenton*

Bercy-Charenton-Paris, planned for 2023, carried out within the framework of the call for projects "Inventing the Metropolis of Greater Paris", has launched a bigger bet, by establishing itself in a central district of the capital, where it is planned to accommodate a luxury hotel and a shopping center on the banks of the Seine. The acceptance of a logistics space in the district can be difficult. The second bet is the creation of tri-modal links (rail, river, tram fret) to transport goods, a real challenge given the many unsuccessful attempts in other French and European cities

### *1.2.3. Port E Herriot*

Port E Herriot - Lyon, built at the Rhône -Saône confluence, on the left bank of the Rhône, and close to railways, has been the subject of a “Sustainable Environmental High-Quality Performance Charter”, with integrated and landscaped architecture respectful of biodiversity and an environmental ambition which resulted in the installation of a solar power plant. Built on a 49,000 m<sup>2</sup> site belonging to the Compagnie Nationale du Rhône (CNR), it will be operated under a temporary occupancy agreement. The project required an investment of €46 million, led by a consortium of actors including Lyon Parc Auto (car park management), Banque des Territoires, Poste Immo and Serl@Immo. Its delivery is in progress in June 2023. The ULH is designed to accommodate several logistics operators and intended to supply the center of the Lyon conurbation with clean vehicles. Of the 6 planned logistics units, most have already been sold. It is made up of two multi-storey buildings with a total area of 29,000 m<sup>2</sup>: a 4-

storey North building, with logistics activities (ground floor and first floor) and services (floors 2 and 3), a South building of two floors and two volumes to allow access for trucks to level 1. Companies with various activities: on the ground floor METRO, a wholesaler for catering, La Poste, the carrier DB Schenker, spare parts Renault, and FM Logistic. The site is ideally located 3km from the city center but has no connection with the river or the railway. A reflection on the subject is in progress.

#### *1.2.4. HLU Lyon Perrache*

The ULH was launched by the City of Lyon in the framework of an urban program to renovate Lyon Perrache. It was necessary to wait 28 years following the French National Urban Goods Program, for the local authorities to fully integrate logistics in their development projects, with the meshing of the areas of the territory occupied by economic activities.

This project showed awareness of previous errors and the measures considered to restore logistics to a central role. Located between the Rivers Saone and Rhone, the peninsula of Perrache at the heart of Lyon is undergoing radical change. This huge historic central area was a centre of life, trade, leisure, “lyonnaise bowling” competitions, games, bars, and circuses. The 1970s saw its demise as it gave way completely to the car: in 1976 a huge concrete transport hub was built in the square to accommodate a bus station, access to the train station, a carpark tower and the passage of the Paris-Marseille highway. The city lost one its most beautiful sites and suffered from noise and pollution. The building cut the city into two districts, one of which declined. In 2019, the city launched a major renovation project with 20,000m<sup>2</sup> to be redeveloped to open up the city, restore life, and introduce logistics as close as possible to the shops and residents. An exceptional lease of 99 years will provide funding, with the right to build up to 2023. The city maintains its ownership of the building. By 2028, the space should accommodate “coworking activities, restaurants, hotels, shops, spaces dedicated to soft mobility, urban logistics (spaces recovered thanks in part to the appropriation of carparks for private cars) and to the social and solidarity-based economy”. The requalification of more than 25,000 m<sup>2</sup> of land occupied by the railway station and its surroundings also includes space to absorb the increase of traffic that will pass through it in 2030. Who could have imagined that this vast esplanade in the heart of the city could come back to life after so many about faces linked to the whims of elected representatives under the influence of “modernity” and that an urban logistics space would be installed.

#### *1.2.5. Montpellier Agrifood Market*

In France, a Market of National Interest (MIN) is a wholesale market to which the public authorities have granted a specific status of Public Service since the 1960s. A network of 17 markets of this type is located near major road corridors and large cities. The French Code of Commerce defines them as “a public market management service reserved for producers and merchants that contributes to the organization and productivity of agricultural and food product distribution circuits, to the coordination of competition in these economic sectors, and to the food security of the population”. The objective of the MINs is to group in the same place wholesalers, producers and service providers and the demand of purchasers in the agricultural and horticultural sectors. The unity of place, time and persons provided by such markets makes it possible to supply local shops and lower material costs. The best known market of national interest is Rungis which supplies the Île-de-France Region (12,5 millions of inhabitants, world’s leading market). Like the logistics platforms, the MINs have begun to migrate from the outskirts of cities to more remote areas of agricultural production. This has had the effect of reducing the efficiency of supplying cities, a considerable increase in goods transport with economic and environmental impacts, and the disappearance of companies and institutions that provide associated local services vital for the smooth operation of activities installed in cities. In recent years, several large cities have evicted their MIN to the distant outskirts to recover land and reduce nuisances. A recent study has shown that the dispersion of activities has, on the contrary, led to an increase in distances travelled and pollutant emissions. The movements of hundreds of customers (restaurants, traders, communities) cause more nuisance than the large trucks that supply the platforms. This is how the MIN of Lyon, 2<sup>nd</sup> city in France lost its MIN label.

Conversely, the second largest market, Montpellier, has evolved into a “Logistics Hotel”. Far from evicting the market from the city, the municipality has enabled its evolution, giving it a major role by integrating it in a “Master Logistics Plan”, and in the “Urban travel plan”. It welcomes new actors, new activities that share space, pool resources, create synergies with the economic actors of the city and services to citizens and leading to the development of new activities and services such as the rental and maintenance of electric vehicles for final distribution with charging points, the creation of client warehouses for shops in the city centre, the development of agri-foodstuff product processing, a training centre, a meeting place, offices for start-up nurseries, and the installation of a waste processing plant. Installed in a space with a railway branch line and close to the tramway, the aim is to optimize services by using these modes of transport. It is now a logistics hotel with the pooling of spaces for new services, new actors and synergy with the local economy on 40,000 m<sup>2</sup> of buildings. Its qualification as a Logistics Hotel is linked to several factors: the reception of new players, new services, sharing of space and resources, new synergies with city center activities and services for citizens.

For Rungis, the municipality has redeveloped the entire district, extended a tram line to serve it, and established a charter for renovating buildings with aesthetic and environmental requirements as well as new lighting. These modifications allow it to blend with the surrounding residential neighbourhoods. A large number of French cities have projects in progress: Nice, Toulouse, Nantes, Strasbourg, Rennes and other large French cities, all installed close to motorways, waterways or railways with the challenge of possible modal transfer and concern given to integration in the urban fabric, by providing diverse activities.

### 1.3. Urban Distribution Center

The UDC is equipment which makes it possible to manage flows and optimize rounds for urban service; it pools downstream flows in logic of distribution (and return); surfaces, management by a single operator. There is a wide variety of them depending on the objectives. Its area of action is the city center due to the high commercial density and its attractiveness. It is located as close as possible to the city center while being easily accessible upstream for vehicles coming from outside and downstream for the service of the hyper center. A pooled CDU requires public intervention (local authorities). The obstacle to setting up a ULS is the cost of land. We present a new concept which marks a break with traditional logistics spaces; the mobile CDU is distinguished by pooled collection by a single operator of upstream flows, the absence of costly investment for consolidation, time saving and environmental gain.

*A floating logistics space:* Cities have been built around rivers which were their main mode of supply. The industrial revolution, with the construction of roads and motorways signaled the near disappearance of river traffic in cities. River banks previously used for docking boats were converted into carparks for private cars. Awareness of environmental issues in the 1980s led to the modification of these sites into promenades and landing stages for large river cruisers. The 1990s saw the beginning of the development of certain of these banks to accommodate logistics for the construction industry, with “shared” use according to the time of day. Today, for local politics in France rivers have become “an efficient tool for ecological transition”, with a challenge: preserving the environment, a priority for protecting the river and the development of logistics and industrial activities. For the decision-makers of Paris, “river logistics and the preservation of industrial activities along the Seine participate in protecting the environment if they allow responding to the needs of the population of the city as a whole”. The river has become an essential alternative to road transport with its still too many pollutant trucks. The wager is to find a sustainable economic model for investors in view to creating a “0-carbon fleet”. This is what is proposed by “Fludis”, a floating urban distribution centre, a new concept of electrically propelled boat-warehouse 38 m long, inaugurated in September 2019, equipped with two onboard cranes, it is a global and secured solution for last-mile deliveries. Its home port is equipped with a warehouse in the heart of Paris. The goods arrive by truck at night from the platform of the loader (specialized in the distribution of office supplies, leader in the distribution of products and services for companies) located at Genevilliers, a port in North Paris. The goods are loaded with the deliverers and their cargo bikes. It leaves every morning to serve 4 ports on the Seine and the canals of Paris. It carries 3,000 parcels a day, 30 electrically assisted cargo bikes with a useful load of 250 kg and delivery personnel who prepare their rounds during the trip (operation similar to that of a UCC). At each stopover the delivery personnel carry out one round with up to 250 kg of goods on their cargo bikes. They relay each other to perform 4 rounds a day (20 km per day maximum)

and deliver from 500 to 600 kg each (as much as a van). The result is very positive: the boat is independent of any infrastructure, the river is far less congested than the roads of Paris (road delivery personnel lose 1h in the morning in bottlenecks when entering the city and another hour in the evening when leaving; with 30 deliverers that means 60 hours of labour a day lost in traffic jams). In one year, a single boat avoids 300,000 km of road travelled by van and the emission of 110 tons of CO<sub>2</sub>, according to the calculations of its promoters. Keeping to the times of the clients thanks to short delivery loops, the optimisation of logistics m<sup>2</sup> on board, less stress and fewer professional risks, professional training, unloading as close as possible to the client, return flows of recyclable products in different points (no empty return), the reduction of nuisance for conurbations, a zero-carbon balance, and “stealthy” river logistics that blend in the urban fabric, these are all criteria that augur the very rapid development of this concept. Fludis is ready to operate 3 additional boats. There is every reason to think that this new concept can be included in the nomenclature of Urban Logistics Centre.

#### *1.4. Vehicle Reception Point*

The VRP is a public space reserved for professional delivery vehicles. It is intended for deliveries that are made "by hand" within a radius of 100 m, (considered a last mile logistics space) which may concern 150 establishments in a city center. A marking on the ground delimits the parking spaces for a very short period.

## **2. Other new concepts related to micro-consolidation**

Micro-consolidation has a lot of appeal for online shopping. Consumer expectations have changed. Deliveries should be quick and inexpensive. At the same time, customers have become aware of the environmental emergency and are sometimes more attentive to the professionalism of carriers and the working conditions of delivery drivers. E-commerce players create new needs by offering new services. The fierce competition between hypermarkets and e-commerce has led them to offer ultra-fast delivery services. Some food hypermarkets have established partnerships with bicycle logistics providers to deliver in less than "H+1" in major French cities. This example of receipt of the order, its preparation and its delivery in less than an hour requires that the point of departure and the final destination be geographically very close. This requires a territorial network with consolidation centers increasingly close to each other and working in synergy. These trends have pushed urban logistics players to create new concepts based on the principle of micro-consolidation: mobile and ephemeral micro-hubs, mini-hotels and dark-stores.

### *2.1. Micro-hub*

A micro-hub is a logistical infrastructure that permits the consolidation of flows as close as possible to the final recipient (Janjevic et al., 2013) in order to reduce distances and polluting emissions linked to the rounds they make in town, in very dense areas (Browne, 2011; Janjevic and Ndiaye, 2014; Katsela, 2022). They are located in the immediate vicinity of their catchment area within a perimeter from 1 to 5 km, thus promoting active and more environmentally friendly mobility, such as electric cargo bikes or walking, etc. Proximity with final client allows them to ensure H+1 or H+2 deliveries. However, they are limited by prices and they generally have small areas (Aljohani and Thompson, 2018) which limits their storage capacity and thus the number of product references processed. Requiring fewer investments, micro hubs are easier to organise than UCC or UHL, and can operate from a building or be based on a mobile infrastructure. They can also be permanent or ephemeral. Micro-consolidation has a lot of interest concerning goods transport in cities. Recent years have seen a radical change in consumption and purchasing practices. Many more of us shop online and demand fast and low-cost deliveries. At the same time, customers have become aware of the environmental emergency and are sometimes more attentive to the professionalism of carriers and the working conditions of delivery drivers. E-commerce players are also creating new needs by offering new services involving urban logistics. The fierce competition between hypermarkets and e-

commerce has led them to offer ultra-fast delivery services. Some food hypermarkets have forged partnerships with cycle logistics providers to offer deliveries in less than "H+1" in major French cities. This example of receipt of the order, its preparation and its delivery in less than an hour requires that the point of departure and the final destination be geographically very close. This shows the importance of meshing the territory with consolidation hubs that are increasingly close together and which work in synergy. These trends have pushed urban logistics players to create new concepts based on the principle of micro-consolidation that we have chosen to describe: mobile and ephemeral micro-hubs, mini-hotels and dark-stores.

### *2.2. A Mini-urban logistics hotels: specific case of underground micro-hub*

The mini-urban logistics hotel is situated between the micro-hub and the traditional ULH. The construction on several levels and the diversity of the activities accommodated make it possible to achieve economic profitability. Firstly, it offers services to the district in which it is situated such as micro-storage spaces for private individuals and professionals, a caretaker service, shared co-working spaces, and spaces for events and meetings. It also offers logistics activities, micro-storage, order reception-preparation, and stock management. It attaches particular importance to architectural aspects to ensure its integration in the urban environment. This type of structure makes it possible to convert former carparks into urban logistics spaces. Although it has advantages it also has certain disadvantages, above all in the case when installed at basement level. In the case of former carparks, the feedback from experience of French logistics and cycle-logistics operators reveals limits regarding the ceiling height of old parking levels (2 metres at most) and loads on pre-existing floors (less than 500 kg per m<sup>2</sup>). There are also technical and regulatory constraints relating to fire safety. Setting up this type of project is also complex due to the large number of stakeholders (fire brigade, police department, etc.). In 2020 in Paris, Sogaris submitted a demand for a permit and implemented tailored engineering to transform 1,600 m<sup>2</sup> of parking space into a logistics micro-hub dedicated to the district and the circular economy. This project was initiated in the framework of the project Reinvent Paris 2, "Grenier Saint Lazare" (Saint Lazare Granary) and deploys a hybrid and evolutive offer that combines logistics activities and activities having high added value, in synergy with a cycle-logistics micro-hub. The "Reversed Building" is an example of well-blended urban integration in a district. Its architectural originality stems from a multifaceted pavilion to manage the different interfaces with the district and public space. The slogan was "What the reversed building WILL NOT BE: a dark store or a dark kitchen, a giant warehouse, a self-storage space". The visible part of the granary was built and fitted using organically-sourced materials. A local diagnostic of the needs and uses of the inhabitants and local businesses allowed dimensioning and guiding uses. The project is part of the approach "Sustainable Buildings of the Ile de France (Ekopolis)". The strong points of this project are that it is part of a circular economy approach; it exploits the building's inertia to reduce heating/air conditioning requirements, the materials used are organically-sourced, and it gives importance to artistic activity.

### *2.3. Classical Micro-hubs*

It respond to temporary requirements for neighborhood logistics spaces, for example, construction sites that require the creation of a flow consolidation centre for the duration of the construction or certain events like the Paris 2024 al competition sites located in difficult spaces where ephemeral logistics could be the best solution for supplies. Another example of Olympic Games that will have requirements dispersed close to sever ephemeral logistics are systems that pool the use of m<sup>2</sup> in time. Still in Paris, we mention the RATP bus depots that exploit their residual capacities by performing urban logistics activities. This is an innovative approach that aims at improving the exploitation of industrial tools at the heart of the city to facilitate urban distribution. In agreement with the Ile de France Mobilités, RATP has decided to exploit its assets in the service of sustainable urban logistics. Through its offer RATP logistics, RATP has opened access to its sites to urban logistics activities ranging from part-time to full-time utilisation. The principle is to occupy the sites during the day when the buses are operating and the depot is empty. These sites therefore become cross-docking centres. In all, the RATP devotes 7,500 m<sup>2</sup> to urban logistics. Its partners Amazon and Chronopost operate 4 sites close to the inner Paris belt, Ornano to Saint-Denis, as well as the Paris bus centres of Corentin in the 14<sup>th</sup> borough, Lagny in the 20<sup>th</sup> borough, and Point du Jour in the

16<sup>th</sup>. In 2022, the RATP renewed its trust in Amazon by attributing it the bus centre of Charlebourg located at La Garenne-Colombes – 300m<sup>2</sup>) and welcomed a new client, Ecolotrans (doorstep deliveries) to occupy the 4,000m<sup>2</sup> of the centre of Châtillon-Bagneux. Regarding the latter site, the RATP with its new partner Ecolotrans, will set up an ultra-compact robotised system for storing and preparing orders. It is a robotisation solution for the densest micro-preparation of orders in the world. This innovative system allows increasing the efficiency of storing and carrying out orders.

#### 2.4. *Mobile micro-hubs*

Mobile micro-hubs provide several advantages over a traditional micro-hub. They improve the punctuality of deliveries (Verlinde et al., 2014), and facilitate the organization of night deliveries by reducing noise pollution caused by handling operations (Quak, 2012). They also permit a desynchronized contact between the carrier who brings the goods to town and the subcontractor (cargo bike company for example) who will carry out the last mile deliveries, or the customer himself. Mobile micro-consolidation systems can be used for delivering and collecting goods (Quak, 2012). They are easy to set up due to their mobile infrastructure that can take different forms: a truck, an autonomous ground vehicle with lockers (Faugère et al., 2020), a container (Quak, 2012), a cargo-tram wagon or even a barge (Patier, Toilier, 2018).

#### 2.5. *Ephemeral micro-hubs*

Micro-hubs can also be ephemeral (Faugère et al., 2020), making it possible to exploit certain spaces with logistics services during vacation periods. The City of Paris, with the financial support of the Ile de France Region, and in collaboration with bike-delivery operators (Cargonauts and Ecolotrans), has launched an experiment with a mobile and ephemeral micro-hub to fluidify the delivery of goods to shops, restaurants and private individuals in a district. Modules intended to house small lockers for goods deliveries are installed on parking spaces along roads, as close as possible to the consumers. Smaller than the parking space on which they are installed, these micro-hubs can be dismantled in less than 24h and do not require connection to networks or infrastructures. They can be displaced as a function of the needs of the operators and users, without any impact on the road. This system was awarded a prize by the jury of Booster Bois Biosourcés in 2021 (the professional organisation that, since 2004, has federated all the professionals of forestry and wood along with the Ile-de-France Region).

Two other micro-hubs are undergoing experiments in Paris for a period of one year, in the districts of Arts et Métiers and Bastille to study their impact on traffic and the pollutant emissions generated by the deliveries. Every day of the week, a truck of 20 or 30 m<sup>3</sup>, or a carbon-free utility vehicle, arrives in the morning and supplies lockers to organise the delivery of goods by cargo-bike. At the same time, it recovers the re-usable containers of restaurants stored the previous evening. The deliverer using a cargo-bike or electric tricycle load the goods stored in the structure and leave for its round in the district. At the beginning of the afternoon, he returns to the structure to deposit the containers given to him by his professional clients and reload for a second round. This project has been developed on the basis of the idea of tactical urbanism, which originated in the 2000s in San Francisco to define community, participatory and often ephemeral initiatives for developing public space: parking spaces transformed into micro-gardens, forecourts changed into agora, cycle tracks made visible by frescos painted on the ground, shared vegetable gardens, all with the same goal: making the city more friendly and welcoming, while encouraging questions as to its uses. Mobile and ephemeral micro-hubs do not only have advantages. They encounter several barriers to their development. They need the support of the public authorities, above all when public spaces are used. It is also necessary to consider the layout and equipment of these spaces, and managing traffic and safety in the surrounding environment since there is incoming traffic to supply goods and outgoing traffic to deliver order to final consumers. The transfer of a truck to cargo-bikes risks causing a phenomenon of bulking and thus new congestion due to the large number of cargo-bikes in circulation. In addition, there is the question of security and the transfer of responsibility in certain cases of desynchronisation between the dispatcher and the recipient.

## 2.6. *Micro fulfilment centres*

The class of micro-hubs includes a black sheep, the “dark store”, “picking store” or “quick store” which are all different names for the same facility. When the health crisis led to the closure of traditional stores, dark-stores appeared as a simple, quick and inexpensive solution that could be implemented for certain actors of urban logistics in response to the boom of online orders and express doorstep deliveries (Aljohani and Thompson, 2018), and for retailers who wanted to develop their e-commerce capacity quickly and without major investments. In 2022, more than 80 dark-stores were identified in Paris and its suburban outskirts. These small micro-fulfilment centres (from 200 m<sup>2</sup> to 800 m<sup>2</sup>), are located on the ground floor of residential buildings and are very often rented. They transform traditional small shops into small logistics warehouses (Shapiro, 2022) when they do not receive the public. However, according to the guide setting out French governmental rules applicable to urban planning and quick commerce intended for elected representatives, the designation of the structure remains unchanged as an “artisanal and retail commerce” if the dark-store has a point for receiving clients, such as a pedestrian drive or a “click and collect” counter (Pijaudier-Cabot, 2022). It suffices to display clear opening hours despite the predominance of urban logistics activities.

Dark-stores do not require an external display to identify them for clients. Often, their windows are obscured, inaeesthetic and may or may not bear stickers, although urban planning rules very often demand that windows should be as transparent as possible. They operate like a classical micro-hub. The goods arrive from large logistics platforms on the outskirts and regions, transported by large delivery vehicles, to be received and stored by the employees on site. Everything is designed, from picking to laying out the shelves, to optimise the preparation of orders and deliveries as close as possible to e-shoppers. Once these orders have been prepared, they are then passed to deliverers equipped or not with scooters to be carried to their final destination. The concept of darks stores dates back several years but its spread has been due to two main factors: 1) the boom of e-commerce and 2) new actors in urban distribution, above all start-ups (French like Frichti, Cajoo, American like Gopuff/Godija, British Zapp, German such as Flink and Gorillas, and even Turkish like Getir, Russian, Yango Deli which belongs to the Yandex Group) that seek to compete with the traditional hypermarkets.

This phenomenon has expanded with the health crisis and the period of lockdown that spurred its rapid growth. Dark-stores provide a certain type of agility for satisfying demands for express deliveries from e-commerce even outside the usual opening hours of traditional physical sales points. They also allow exploiting premises with little real-estate value through lack of clients or with poor siting to transform them into premises for storing and preparing orders in the city centre. However, they remain highly contested systems that are complicated to control and which lie outside a clear legal framework. They are deployed haphazardly in cities, leading to strong demand for rented premises in all the districts of large French cities. Many dark stores have been installed in premises formerly occupied by small supermarkets, shops, restaurants, etc., constituting unfair competition for the independent shops that stimulate the local life of neighbourhoods. On a daily basis, dark stores give rise to several nuisances due to very long operating hours (from 8 a.m. to 12 p.m. and even 2 a.m. at weekends; the company Zapp even offers a 24/7 service) and goods transport flows in the city generated at the entrance and exit at the ground floors of dwellings, leading to disputes between neighbours and road use conflicts. Also to be taken into account is noise pollution and the deterioration of the living environment of the people living in these districts. Lastly, mention should also be made of the fall in the real estate value of buildings located in the immediate vicinity of these micro-fulfilment centres.

In France, Paris is at the head of major French cities combatting this type of warehouse and with the Atelier Parisien d’Urbanisme APUR, it wants to strengthen urban planning to gain greater control over the utilisation of properties. The matter is especially urgent given the spread of dark stores as far as small municipalities located in the inner outskirts of Paris (for example, Saint-Ouen and Boulogne Billancourt), and they are developing in other cities (Lyon, Toulouse, Nice, etc.). The attractiveness of some medium sized cities has faded with the progressive disappearance of shops, artisanal trade, and human contact.

### 3. Conclusion

The supply methods for city centers have changed a lot with the explosion of e-commerce, the Covid-19 crisis, the geopolitical context and the establishment of low-emission zones. The last link in the logistics chain is the most complex, the most constrained, the most expensive, all the more so since the migration of logistics platforms to the outer suburbs. We wanted to highlight the major role of logistics spaces, how strengthening the network of the territory is essential to improve the exchange of products, reduce the environmental impact, adapt to societal transformations, closer to consumers. It was necessary to integrate the new links into the nomenclature of the logistics spaces and to show the role of each. We do not treat international, national, urban, neighbourhood flows up to the recipient in the same way. The needs are very different, depending on the volumes transported, the distances to be covered, and the types of products transported.

We have highlighted the role of each, their field of action, their mode of management. It was necessary to see how the concepts that make up the supply chain from producers to consumers had evolved since 2018, when the last guide to urban logistics spaces was published. Local authorities, which have become aware of the vital role of urban logistics, play an important role. Thanks to major urban renewal projects, they reserve space for logistics, finance part of the development and themselves create on-street consolidation centers or disused sites, and put in place regulations to facilitate virtuous deliveries. The evaluation of the experiments shows remarkable technological and organizational advances; some failures due to the acknowledgment of inability to achieve the targeted objectives. In particular, those relating to the road-rail-tramway-river multimodality could not be sustained due to the lack of clean energy traction, and, for rail, a considerable delay due to a policy of deployment of passenger networks to the detriment of the freight networks which have been dismantled; however, it is on the upstream link that there is the possibility of consolidating incoming products and avoiding the proliferation of trucks on the roads.

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