

City Logistics - Last Mile Concepts

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1. Introduction

High demand for logistics real estate

Logistics and industrial real estate have now established itself as an important asset class. It recorded its second-best year ever in 2018 with a transaction volume of almost €7.5 billion. This corresponds to an increase of 60 % compared to the five-year average. In view of the boom in online retailing, logistics real estate is set to remain on investor shopping lists in 2019, too. For the current year, a transaction volume roughly at the previous year's level is anticipated. Although, given the high demand, prime yields are likely to fall further in the current year. At the end of 2018, in the Big 7 cities (Berlin, Düsseldorf, Frankfurt/M, Hamburg, Cologne, Munich and Stuttgart) yields were 4.10 %, which was still one percentage point above office yields (3.11 %).¹

Innovation in last-mile delivery

A rapid increase in parcel volumes has been a consequence of the rise of online retail and has led to the growth in the demand for logistics real estate for 'last-mile' delivery. The 'last mile' is the term for the final step in urban goods distribution in the form of the specific delivery to an end customer.² However, the growth opportunities will also be accompanied by challenges, which will have to be managed in the future. The transport systems have not been designed for the growth in goods traffic on the last mile. In the cities there is little room for transshipment facilities in view of the scarcity of space that already exists in urban centres. At the same time, there is increasing pollution from noise and harmful substances. Against this background, innovative possible solutions are being sought. Urban logistics are thus undergoing a change. A veritable mood for change prevails on the last mile.

¹ JLL 2019: Logistics real estate to remain on investor shopping lists in 2019. Press release from 14 January 2019.

² Cushman & Wakefield

Aim of this study

The aim of the study is to provide an overview of the current and future developments in urban logistics and to examine the associated opportunities and challenges. The focus of our analysis was the question of how much space will be needed as a result of the growth in e-commerce and which types of real estate will be required for last-mile deliveries. Besides possible (re)utilisation concepts, innovative supply ideas for last-mile deliveries will moreover be highlighted.

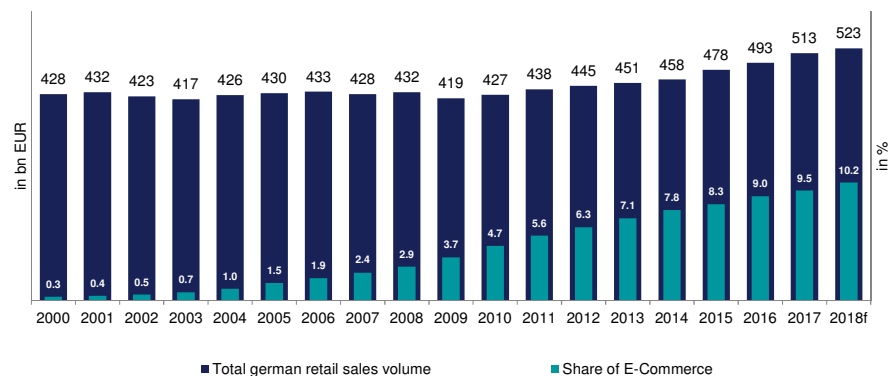
2. Urban Logistics - Innovation in Last-Mile Delivery

2.1 Current Market Developments

E-Commerce on the rise

A key driver of the increasing demand for appropriate logistics solutions - particularly in urban areas - is the rapid growth in online retailing. While the e-commerce share of total retail sales volume in 2008 was just 2.9 %, a share of around 10.2 % is expected for 2018. This means that online sales in 2018 have been estimated at €53.3 billion and the year-on-year increase at 9.4 %. Here, the online share of the non-food segment, at 14 %, is higher than the food segment (1.1 %). However, online food retailing is currently enjoying higher sales growth. The market potential of this segment thus appears not to have been exhausted yet. It is to be expected that digital grocery shopping will boost demand particularly for fresh produce logistics.

E-commerce share of retail sales volume (in %)



Source: IFH Cologne / HDE (German Retail Federation); own research

Changes in consumer behaviour are propelling market developments

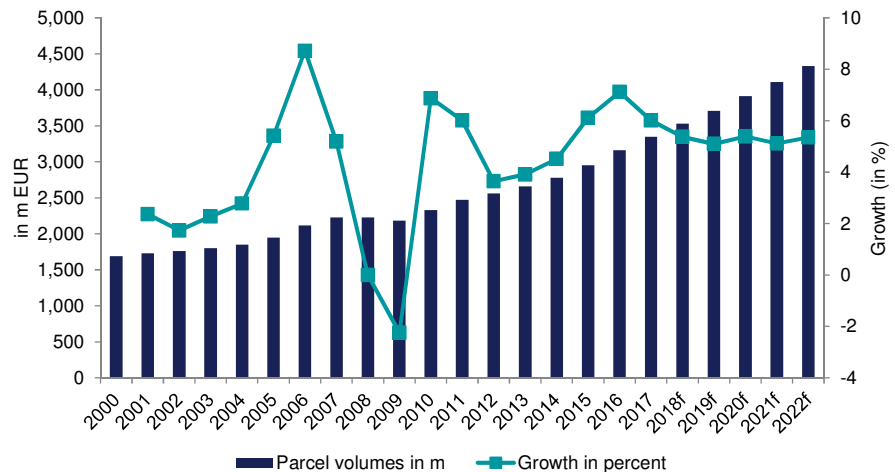
The e-commerce growth trend is being amplified by changing consumption patterns. Consumers wish to have ever faster, more flexible and convenient deliveries of their shopping right up to their front doors without any additional costs arising in the process. In particular, internet-savvy millennials in the age range 22 to 29 years prefer the same day delivery option right up to same hour delivery as well as free shipping and returns.³ This ‘immediacy’ trend is significantly affecting the supply chain and delivery logistics; they will have to be restructured and optimised in order to be able to meet service requirements.

³ CBRE Research

Rising parcel volumes are generating sector growth

Parcels are increasingly being sent across Germany as a result of the boom in online retailing. According to a study by the German Parcel and Express Logistics Association (BIEK), it is anticipated that the courier, express mail and parcels (CEP) market reached 3.53 billion consignments in the previous year. Parcel volumes would thus have more than doubled in the period 2000 to 2018. A volume of more than 4.3 billion consignments is expected until 2022. At regional level most deliveries were attributed to Federal States with the biggest populations, namely, North Rhine-Westphalia (21.7 %), Bavaria (17.1 %) and Baden-Württemberg (14.8 %), while at the city level, as expected, the Federal capital of Berlin (4.1 %) had the highest share of overall CEP consignments, ahead of Hamburg (2.9 %) and Munich (2.8 %). If the amount is broken down by the number of residents, then this means that there were 37 parcel deliveries per resident in Berlin as well as 51 and 61 deliveries per head in Hamburg and Munich respectively. The high demand for deliveries is allowing the CEP market to record the strongest growth in a cross-sector comparison. In the period between 2000 and 2017, the sector reported the highest average value-added growth per year at 3.9 %.⁴

Forecast CEP consignment volumes (in millions of consignments)



Source: German Parcel and Express Logistics Association (BIEK); own research

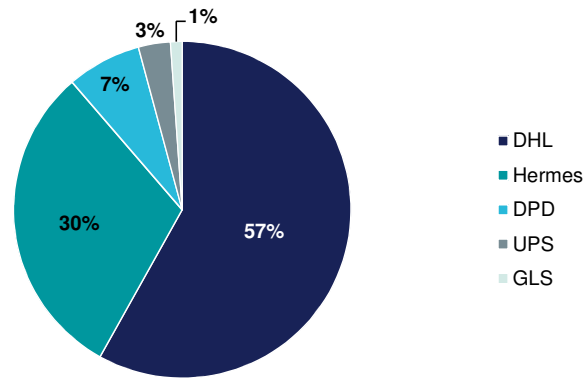
DHL is far and away the industry leader

When measured in terms of the volume of parcels, DHL with its market share of 57 % is shown to be the industry-leading CEP service provider ahead of Hermes to which 30 % of consignment volumes are attributable. These companies are followed by ones with significantly smaller shares, namely, DPD with 7 %, UPS with 3 % and GLS with 1 %. An analysis of the percentage share of sales confirms DHL's market-leading role, as more than two-thirds (69 % in 2016) of all sales are attributable to the delivery agent.⁵

⁴ German Parcel and Express Logistics Association (BIEK)

⁵ Estimates of the German Courier, Express and Postal Services Association (BdKEP), Date: 2016

Market share in end customer business in % (based on parcel volumes)



Source: BdKEP estimates; own research (may not add up to 100 % due to rounding differences)

Increasing demand for space in urban conurbations

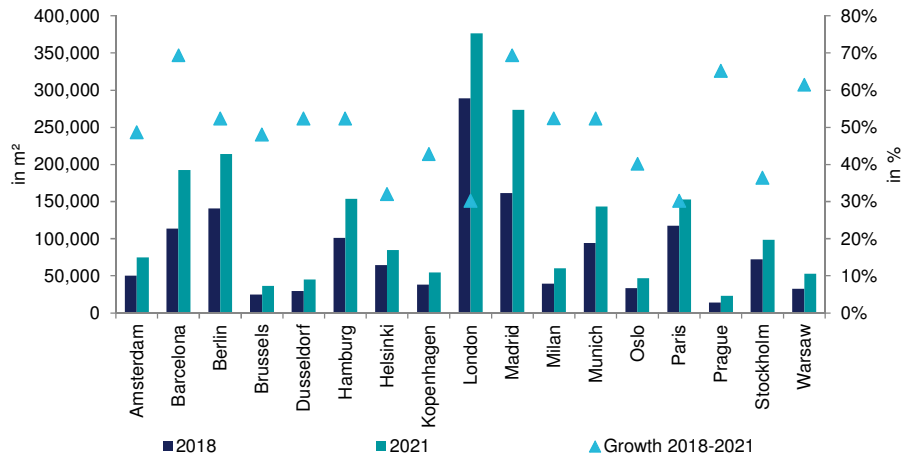
Dynamic online retailing and the deluge of parcels that it generates has resulted in growing demand for logistics space. When compared with conventional purchases in brick-and-mortar stores, an online purchase requires up to three times the amount of warehouse space.⁶ Urban populations in particular have a high proportion of internet users. Therefore, a majority of all online purchases are attributable specifically to urban conurbations. If this trend continues then there will be further intensification of the scarcity of space that already exists in German metropolises.⁷ The expected gap between current supply and future demand for space can be demonstrated with the help of Cushman & Wakefield's 'Urban Space Model'. Data on consumer behaviour at the country level are used here and broken down for the specific city area in order to quantify the local volume of parcels. Information about the average amount of goods in a delivery vehicle per day makes it possible to calculate the number of delivery vehicles that would be required to cope with the volume of parcels. With the help of the well-known ratio of delivery vans per square metre of logistics space, the urban logistics space requirement can then be quantified. On the basis of this concept, for 2018, additional demand for space in German metropolises was forecast to be between 140,000 m² in the Federal capital of Berlin and 30,000 m² in Düsseldorf. Against the background of a continuing increase in the number of online shoppers and rising consignment volumes, by 2021, the additional demand for logistics space for the overall German market is expected to be around 52 % when compared with the reference year of 2018. Accordingly, there will be a need for 210,000 m² in Berlin and 45,000 m² in Düsseldorf. In a European comparison, the British capital of London is clearly the largest market, however, the relatively low growth reveals the consequences of the impending Brexit and the maturity of the existing e-commerce market. The Spanish market is expected to have the highest rate of growth at around 70 %.⁸ From the developments in city logistics that have been described it follows that there is thus enormous market potential for logistics real estate for last-mile deliveries.

⁶ Deka

⁷ Cushman & Wakefield

⁸ P3 Logistic Parks and Cushman & Wakefield

Urban logistics space requirement in selected cities in Europe



Source: Cushman & Wakefield; own research

2.2 Opportunities and Challenges

Before further specifying the space requirement and highlighting possible solutions for last-mile deliveries, in the following section, there is firstly a discussion of the current challenges but also the opportunities for urban logistics that have arisen as a result of the social trends and developments.

Reurbanisation is putting a strain on city traffic

Over the last decades, a steady increase in the urban population has become apparent. At the turn of the millennium, three-quarters of all German citizens lived in cities, however, in 2020 the proportion is likely to be 77.5 %. According to forecasts by the UN, a further increase to 84.3 % is assumed by 2050. Additional strains on inner city traffic volumes should be expected as a result of this urbanisation. In German metropolises, in recent years, a distinct picture has emerged during peak hours. Annual congestion-related waiting times of 51 hours in Munich or 44 hours in Berlin clearly show that, in many places, urban infrastructure is now already overloaded.

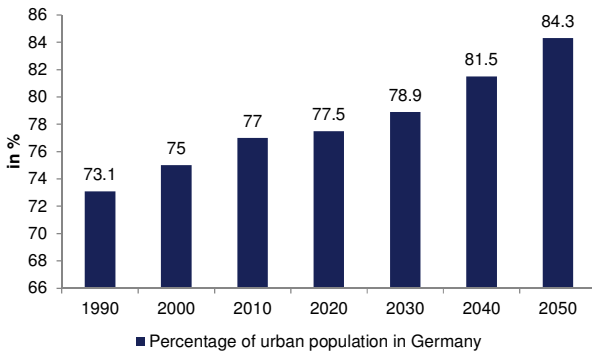
Urban delivery traffic intensifies the strain on infrastructure

This situation has been further exacerbated by the growth in e-commerce. Through this, it is no longer only inner-city retailers that are potential recipients of goods but rather every individual household, too. The cities are being confronted with an increasing strain on their infrastructure, in particular, due to the numerous parcel deliveries of small items to private households. Furthermore, the large number of parcel services that make deliveries simultaneously in the same parts of the city results in an unnecessary redundancy. The consequences are higher numbers of trips, poorer use of capacity as well as greater demands on the urban infrastructure. This results in more and more congestion, late deliveries, noise and harmful substances.

These developments have been exacerbated not least due to the double parking of delivery industry vehicles. That is why the German Parcel and Express Logistics Association (BIEK), German Retail Federation (HDE), Association of German Cities (DST) and Association of German Towns and Municipalities (DStGB) are calling for special short-term lay-bys to be provided for CEP services for the purpose of taking the pressure off inner city transport hubs, as is often the case in the taxi business.⁹

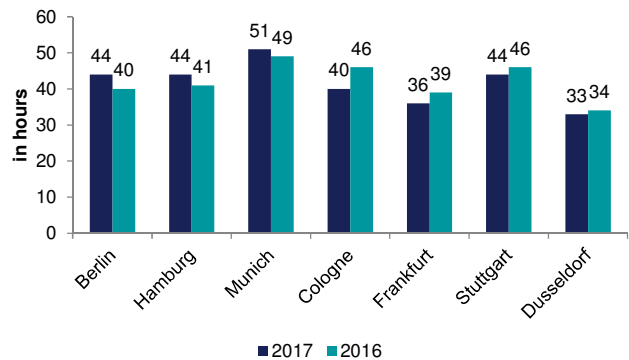
⁹ German Parcel and Express Logistics Association (BIEK)

Growth of the Urban Population in Germany (in %)



Source: UN DESA; own research

Waiting Times in Congestion during Peak Hours (in hours)



Source: INRIX Research; own research

Logistics industry needs to enhance its image

In response to the increasingly high levels of inner-city pollution from nitrogen dioxide (NO₂) and fine dust the cities have started to impose bans on diesel cars in order to improve air quality in the long term. Many German cities have recorded large deviations from the annual limit value¹⁰ of 40 µg/m³ for nitrogen dioxide that have signified a need for action. Landshuter Allee in Munich recorded an annual mean value of 78 µg/m³ (in 2017), which was the highest in Germany.¹¹ Against the background of increased environmental awareness, the logistics sector has a negative reputation as a result of its high traffic volume together with the air and noise pollution that it generates. These circumstances make it difficult to gain acceptance from residents for new project developments and, in many places, lead to protest campaigns. When designing real estate, developers should take into account not just the functional aspects of the users. It is important to create ecological and social added-value for local residents. This, coupled with appealing aesthetics, could help the logistics industry to enhance its image.

Electromobility as an opportunity

In order to enhance the compatibility of the logistics industry with cities, and to improve its image, electric-powered vehicles are already being used - particularly for last-mile deliveries. A consumer survey conducted by PWC revealed that there is great interest in electromobility as an eco-friendly and low-noise alternative to conventional delivery. Thus, as many as 61 % of respondents stated that an eco-friendly way of transporting the goods (e.g. delivery via electric cars or cargo bikes) was important. In fact, slightly more importance was therefore attached to the green delivery trend than to fast delivery, which 59 % of the respondents considered to be important.¹²

Against this backdrop, city administrations could create incentives to encourage the use of electric vehicles for transporting deliveries. Moreover, relaxing the time-based access restrictions on deliveries to retailers via electric vehicles in the evening would be a starting point for easing the strain on urban infrastructure (see also Chapter 4).

¹⁰ To protect human health a Europe-wide 1-hour limit of 200 µg/m³ was set for nitrogen dioxide. This limit may not be exceeded more than 18-times in a single calendar year. The annual limit value is 40 µg/m³ of nitrogen dioxide. To protect vegetation a critical value of 30 µg/m³ of nitrogen dioxide is used as an annual mean value.

¹¹ Federal Environmental Agency

¹² PWC 2017

Digitisation/big data opens up optimisation potential

In the course of digitisation, consumption patterns and the way goods are distributed are changing. Online retailing has fuelled the trend towards shorter delivery promises and this has been a significant determinant in the organisation and structure of logistics processes. Yet, for the delivery industry, last-mile delivery constitutes considerable cost and time factors. This situation stems from the fact that it is difficult to pool deliveries of goods in urban areas and the recipients are frequently not in when the first attempt at delivery is made so that additional expenses arise. Digitisation and intelligent networks are able to provide a remedy there by using large, complex data sets for forward-looking analyses (predictive analytics). The analysis of this data - which, for example, could result from an overarching fleet analysis for CEP service providers - would make it possible to prepare forecasts that relate to the development of city traffic at transport hubs. The cooperating CEP service providers would then be able to optimise their delivery tour management by means of these predictions. Furthermore, by analysing historic purchasing and ordering processes companies will be able to anticipate future consumer behaviour and to warehouse goods in advance in logistics buildings close to the end customer.¹³ It is likewise conceivable that there could be platforms on which CEP service providers could disclose the spare capacities of their delivery fleets so that these could be used by other providers. These examples illustrate how using big data could contribute to cost savings and increases in productivity. However, the lack of willingness to cooperate on the part of the CEP service providers stands in the way of such a consolidation of data. This unwillingness of the delivery agents is rooted in their fear that they would lose a competitive advantage if they were to disclose their data.¹⁴

Scarcity of space is exacerbating the situation

In the context of the delivery process along the supply chain, CEP service providers rely on both large-scale logistics buildings outside the cities as well as small-scale logistics real estate on the last-mile. The general scarcity of space in German cities means that no properties, or only very expensive ones, are available to logistics companies and intense competition prevails for the stock of the last remaining properties. In view of the shortage of space, the logistics real estate market is unable to keep up with other forms of use such as residential or office. The primary reason for this is that residential construction - for the purpose of creating affordable living spaces - enjoys greater political acceptance. Consequently, the municipalities face the challenge of granting sufficient building land for urban logistics. This is of particular relevance against the background of the 2002 German National Sustainable Development Strategy. As part of this, the Federal Government wants to gradually reduce the daily use of space for human settlement and transportation. The aim is to reduce the current level of land use of approx. 62 hectares (in 2016) to 30 hectares per day by 2020 before the transition to circular flow land use management (net-zero target) is achieved via defined intermediate goals. Innovative approaches such as tradeable area certificates are supposed to contribute to restricting land use further and to the realisation of sustainable development goals. Municipalities are able to control construction projects through the purchase and sale of so-called area permit rights.¹⁵

¹³ Savills

¹⁴ PWC (2017)

¹⁵ Federal Environmental Agency

3. Space Requirement for the Last Mile

3.1 Property Types and Requirements

Cascading delivery system model for city logistics

The challenges and opportunities that have been described (Chapter 2.2) have to be taken into consideration by the CEP service providers when designing their distribution structures in order to create successful and sustainable city logistics. The need for action, on the one hand, relates to the specific design of urban logistics real estate and, on the other hand, efficient supply chain schemes so that time-critical deliveries can reach end customers on schedule. According to expert opinions, city logistics should be guided by food retailing and should adapt its multi-stage delivery system for optimal supply. From a real estate point of view this means that, first of all, large-scale distribution centres are located in the surroundings of a city and urban fulfilment centres in inner city areas follow. Micro-fulfilment centres are used as supply centres for last-mile delivery. In order to get closer to the customers the system can be supplemented with further micro-warehouses by means of which CEP service providers are able to manage the fine distribution on the last mile.¹⁶

Cascading System Model for City Logistics - An Overview



Source: Bulwiengesa

Via “big boxes“ to micro-warehouses

E-fulfilment centres are logistics real estate for the first mile. They are positioned at transport hubs on the outskirts of a city and function as physical warehouses for online retailers before the order processing has been carried out and the parcels ultimately delivered to the customer. A characteristic of the real estate type ‘fulfilment centres’ is the collaboration with third party logistics service providers that are necessary so as to be able to deal with the range of tasks that arise when an online order is received. Warehousing, picking, packing and shipping as well as, in some cases, returns management are included in the service portfolio within this type of property. In urban areas, this type of real estate is used in a reduced form in terms of space and supply in order to ensure the delivery of time-critical shipments on the last mile.

¹⁶ Bulwiengesa 2017

The inner-city property types here are urban and micro fulfilment centres. In this case, urban-fulfilment centres are required specifically in fresh produce logistics in order to maintain the cold chain when handling perishable goods. Micro-fulfilment centres serve as local supply centres so that same-hour deliveries can be realised. The focus in terms of space for this type of real estate is less on the logistical aspect, but rather on the proximity to the end customer. For CEP service providers, micro-warehouses - small distribution centres on the last mile - are of strategic importance. These can be either mobile containers, parked delivery vehicles or stationary warehouses that can cover a densely populated catchment area within a radius of 1 km. Moreover, it is obvious that trouble-free and low-emission vehicles such as cargo bikes or electric utility vehicles could be used here for the short delivery trips in the residential areas. Final storage locations depend on a continuous supply flow that can be ensured through regional warehouses on the outskirts of cities.¹⁷

Overview of the Requirements Specifications for Various Urban Logistics Property Types

Object type	Description	General localization	Ideal location	Timeliness	Industry	Space requirement	Example
E-Fulfillmentcenter	Mega-HUBs in the wider agglomeration area	Extra-urban	At transport hubs in the wider agglomeration area	Standard delivery	Retail logistics/E-Commerce	from 25.000m ² up to 150.000m ²	Zalando
Regional warehouses	Medium-sized HUBs in the vicinity for subsequent delivery	Extra-urban to urban	In the surroundings of a city, partly in the inner city	Replenishment, standard delivery	Retail logistics/ CEP-Industry	circa 15.000m ²	Deutsche Post DHL
Urban fulfilmentcenter	Inner-city local supply centres	Urban	Conveniently located on the outskirts of the city or within a city district	Same day delivery (last mile)	Retail logistics	circa 4.000m ² - 6.000m ²	Amazon Fresh
Micro fulfilmentcenter	Direct delivery of online orders to the customer	Urban	Inner city in densely populated locations (close to the customer)	Same hour delivery (last mile)	Retail logistics	circa 1000m ² - 3000m ²	Amazon Prime Now
Micro-warehouses	Local fine distribution	Urban	Net-like distributed over the whole city (in proximity to the customer)	Same hour delivery (last mile)	CEP-Industry, partly retail	circa 15m ² - 25m ² (CEP), circa 200m ² - 500m ² (retail)	UPS, Hermes

Source: Bulwiengesa; own research

Innovative concepts needed for the implementation

The practical implementation of such multi-stage delivery systems is being constrained by local space shortages in the urban landscape. The market situation is being exacerbated by the competition for space from more popular asset classes as well as by the far-reaching environmental regulations that affect city traffic. In order to deploy the available resources efficiently and satisfy logistics requirements it is essential to have a creative approach to design and use for both the logistics real estate as well as for the last-mile delivery process. The broad range of configuration options for logistics real estate makes it difficult to provide a conclusive statement on optimum and model solutions, as a specific configuration will depend on the preferences of a particular owner and/or business. A highly diversified market for logistics premises is being created that is being shaped by the pressure of demand for new concepts of how space is used. The logistics real estate market is examined in greater detail in the next section.

¹⁷ Bulwiengesa 2017

3.2 Utilisation Concepts for Last-Mile Delivery

Converting Existing Spaces

The rejuvenation of obsolete commercial property units

The current shortage of space in densely populated areas means that even properties that were previously unsaleable are being traded at premium prices and city logistics stakeholders have to develop alternative concepts for solutions. Against the backdrop of the meagre requirements in terms of quality and space for last mile real estate, a re-purposing and conversion of the existing stock of properties is being considered. This could be in the form of one-time and existing commercial property units and vacant office space that, ideally, exhibit adequate structures for urban and micro fulfilment centres. Closed obsolete supermarkets and specialist stores, frequently, already have logistical equipment such as goods lifts, loading and unloading stations as well as waiting areas and cold stores for the temporary storage of food.¹⁸

Use of car parks for goods handling

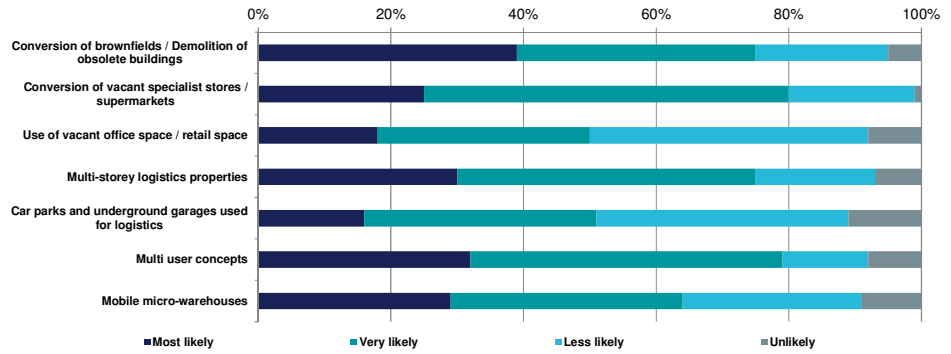
Furthermore, in order to make efficient use of the space that is available and, at the same time, address the problems of inner-city traffic, there is moreover a discussion underway about using underutilised car parks and underground garages. During the night and in the early hours of the morning, parking spaces could be reserved, based on requirements, where logistics service providers could store their goods as well as handle and process them. Moreover, cargo bikes could be loaded and unloaded here. A pilot project in Stuttgart, sponsored by the German Federal Ministry of Transport and supported by the Fraunhofer Institute for Industrial Engineering (IAO) is pursuing this approach in order to space out city traffic through delivery vehicles and, at the same time, provide emission-free deliveries. CEP service providers would benefit from both a financial perspective, because inner city logistics real estate would be many times more expensive, and also from the central location and reachability of the car parks in the context of the delivery process.

Former industrial sites as a resource-saving solution

Logistics providers would likewise be able to benefit from good infrastructural connections of disused industrial spaces such as goods yards or petrol stations whose original use has been relinquished. Against the background of political aspirations to reduce, at a national level, the sealing of new areas in the long term (see Chapter 2.2) the search for new construction land will become more difficult for developers. The use of derelict industrial spaces, so-called brownfields, frequently appears to be the only possibility to meet the local demand for urban logistics real estate at suitable locations. Depending on the requirements specification and the previous use, the redevelopment of a property could be appropriate for realising a build-to-suit project. Alternatively, the old facilities on the property can be permanently upgraded through revitalisation measures in order to satisfy the requirements of the logistics service providers.

¹⁸ Bulwiengesa 2017

Market players' assessment of the realisation of inner city use solutions



Source: Colliers International Germany; own research

Innovative Use Concepts

Multi-storey structures based on the Asian model

Already at first glance, the development of multi-storey logistics centres would appear to be a logical alternative to mitigate the effects of space shortages and expensive construction land in densely populated areas. Indeed, properties have already been constructed, in Asian mega cities, with up to 17 storeys and a useful area of 300,000 m² or more that, as a result, can be regarded as the forerunners of the multi-storey concept. The buildings are between 50 m and 70 m high and their visual appearance is adapted to the urban landscape by, e.g., planting greenery, as in Singapore. The popularity of multi-level properties in Asian regions is attributable not only to the lack of space but also to the attractive cost-benefit ratio as the costs that are incurred can be apportioned across higher space utilisation levels. Furthermore, with multi-storey properties it is possible to save not only costs but also time, as automated intralogistics systems can enable cross-level flows of goods. This new utilisation concept is already being implemented occasionally in Germany for e-fulfilment centres. However, because of the regulatory hurdles, it will not be possible to come even close to achieving the dimensions of the Asian complexes. There has been criticism of the increased construction costs that have resulted in increased rents and, in view of the cost sensitivity of the logistics providers, have been difficult to implement.¹⁹ The vast majority of market players, around 75 %, think that this utilisation concept is viable and ranked it after the conversion of former specialist stores and supermarkets.

Multi-tenant properties for flexible use

The level of land use on the last mile can be further flexibilised for CEP service providers through multi-user real estate. Unlike single tenant properties, such properties distinguish themselves through their heterogeneous tenant structures and enable cross-enterprise multiple use of logistics real estate. This is relevant against the background of a fast-paced business environment and it allows the players to have the ability to smooth out fluctuations in individual warehousing space requirements in a better way. This is why such a set up would lend itself to a cooperation on the part of the local CEP service providers. Multi-tenant properties are highly valued by project developers because they have relatively high-grade third-party usability and provide stable cash flows. In turn, users benefit from lease terms that are short when compared with single tenant solutions.

¹⁹ Süddeutsche Zeitung, Drees & Sommer

Mixed-use properties as a compromise solution

Hybrid properties constitute another building form that unite, for example, space for logistics, production and offices under one roof. Resources can be conserved here through synergy effects. Mixed-use properties characteristically provide flexible customisation options at times of increased or decreased demand that are enabled by the modular construction of these properties. Combinations of department stores and logistics properties could be possible in urban areas by means of which, on the one hand, the supply function would exist but, on the other hand, the property could also serve as a collection facility (“click & collect”). As a result of the incremental blending of e-commerce with brick-and-mortar retail, hybrid logistics centres should also be seen as multi-channel real estate, which can make it possible for the retailers to supply their network of branches while simultaneously to processing online orders.

Parcel stations

Another approach for last-mile delivery consists in setting up intermodal stations such as, e.g., parcel stations/parcel delivery boxes. These have the advantage that, in this case, deliveries can be pooled, while customers can flexibly collect their parcels at any point in time. Currently, many delivery service providers are establishing their own networks of parcel stations (e.g. DHL Packstation, Amazon Locker, Hermes Paketshops). However, these offerings are not popular among consumers because they still prefer delivery at their front doors. Yet, as the network densities increase, this approach to a solution could become more attractive and, at the same time, the delivery traffic could be reduced. A cooperation between various service providers as part of a cross-provider parcel station (multi-label parcel shops) could make it even easier to receive goods.²⁰ Comparable concepts also include pick-up stores at railway stations or shop premises, petrol station or kiosks. As these locations already exist in a city, they have relatively high potential as solutions.²¹

Movable Space Concepts**Micro-warehouses for mobile fine distribution**

In order to meet the challenge of the growth in short-term express deliveries (same-day or same-hour), besides traditional stationary logistics solutions, increasingly experiments are being conducted with so-called micro-warehouses, to which the modest size of their space requirement lends its name.²² A micro-warehouse should be a small enclosed space (approx. 15-25 m²) that is weatherproof and theft-proof and enables cargo bikes to be loaded through the availability of electric loading infrastructure and storage areas as well as sufficient door width.²³ By setting up containers or delivery vans to serve as micro-warehouses, CEP service providers hope that they will be able to (partially) substitute these for stationary logistics real estate. In micro-warehouses parcels from upstream warehouses are stored temporarily for a short while prior to being delivered.

²⁰ Ifo Schnelldienst 01/2019

²¹ Bulwiengesa 2017

²² ibid.

²³ BIEK Sustainability Study 2017

Compared with conventional hubs, micro-warehouses can be located closer to end customers and, in this way, they can shorten last-mile delivery. By shortening the delivery routes and due to the relatively low level of storage volume micro-warehouses cover a small radius (approx. 1 km) and are particularly suitable for frequent trips with small items and less so for pooled delivery tours. As B2C deliveries mostly consist of small items or just one product, and will have been ordered by private households, the micro-warehouses should be deployed in densely populated areas (typically inner city zones).²⁴ Furthermore, micro-warehouses are essential for the innovative delivery concepts that are presented in the following chapter - such as the cargo bike, which has very limited transport volume.

The biggest disadvantage of movable micro-hubs consists in their lack of legal certainty. Cities have to be consulted about the installation of containers or delivery vehicles that will serve as micro-warehouses as special use permits are needed. The risk here is that permits that are granted can expire or be revoked. Furthermore, micro-hubs shrink the supply of central urban spaces that are fought over anyway.²⁵

Flex-hubs

The flex-hub approach is similar to the one pursued for micro-hubs. Generally, flex-hubs can also be deployed in mobile situations. The difference to micro-hubs is the needs-based scalability of flex-hubs. These types of containers are modularly constructed and can be easily connected to each other. As a result, the precise space requirement can be made available and continuously adjusted. It would thus be possible to provide logistics services in areas where there is no suitable logistics real estate. In contrast to micro-hubs, no upper limits are set with respect to the space requirement so that flex-hubs could also be considerably bigger than micro-hubs. However, the modular container concepts that are available in the market are currently regarded as being inflexible and, therefore, inadequate. That is why companies such as Siemens and BMW are developing their own flex-hub concepts. Another drawback of existing concepts is that due to building regulations a horizontal configuration rather than a vertical one is likely to be permitted. This would limit the suitability of flex-hubs for inner cities because they would exacerbate the above-mentioned scarcity of space there. That is why flex-hubs should be deployed, in particular, in less central commercially used areas.²⁶

4. Excursus - Innovative Concepts for Last-Mile Delivery

In order to be able to deal with generally rising delivery volumes and also the environmental and noise challenges of last-mile delivery, in Germany, numerous innovative delivery concepts are being tested. In the following section, there is a brief overview of the most important solution approaches.

²⁴ BIEK Sustainability Study 2017

²⁵ *ibid.*

²⁶ Bulwiengesa 2017

Night deliveries using quiet electrified vehicles are possible

It is certain that alternatively-powered vehicles will transform last-mile delivery and change the requirements for logistics buildings in the long term. There are incentives for CEP service providers to reduce their dependency on diesel-powered vehicles. Among other things, these include the bans on diesel cars in cities that are under discussion. Indeed, mixed fleets of vehicles are already being deployed. For example, DHL uses 9,000 electrified StreetScooter vehicles (different versions of electrified delivery vehicles that it manufactures in-house).²⁷ Electric vehicles lend themselves to be deployed, in particular, in conjunction with the micro-warehouses that were discussed in Chapter 3.2, as their arrangement at close intervals shortens the delivery routes and, thus, mitigate any operating range problems of the current electric vehicles. Moreover, silent electric engines mean that delivery times could be extended into the night and this could make fleet electrification even more attractive. A project carried out by Fraunhofer IML/ ISI, in cooperation with the retailers Tedi and Rewe, came to the conclusion that night-time deliveries using electric delivery vehicles would also be possible in Germany despite the relatively stringent noise regulations. Night-time deliveries would provide benefits to all (inner city) stakeholders. In this way, noise levels and emissions of harmful substances in inner cities could be reduced, traffic flows would be more spaced out, congestion would be lower, and deliveries could be further flexibilised. The biggest problem currently seen for night-time deliveries is the legal certainty. Regulations would have to be relaxed and incentives for night-time deliveries would have to be created.²⁸

Electrified cargo bikes will replace delivery vans in some cases

Besides traditional delivery vehicles, increasingly, electric cargo bikes will be deployed in conjunction with micro-warehouses. Variant forms of these bikes can be used both to transport large pooled deliveries weighing 250 kg as well as for making small express deliveries of single items.²⁹ Bikes make it possible to easily use narrow side streets, traffic calmed zones and pedestrian precincts. Moreover, in contrast to conventional delivery vans, in inner urban areas electric cargo bikes could contribute to calming the traffic because they require parking spaces that are smaller and easier to find and do not need to double park. Ideally, cargo bikes deliver more quickly and are able to replace delivery vans in some cases.³⁰ Overall, electrified delivery methods are highly rated by end customers. As already demonstrated in Chapter 2.2, 61 % of end customers already take note of whether the delivery vans are operated conventionally or electrically, and they even attach greater weight to this factor than to a quick delivery time.

The car boot as the new delivery address

In addition, extending delivery addresses to the car boots of (end) customers' vehicles was also tried out in a Hamburg-based logistics project called SMILE (Smart Last Mile Logistics). It is uncertain if this concept can prevail owing to the low acceptance levels by the end customers who were surveyed. In the course of a study by PWC, end customers were asked about their attitudes to alternative delivery methods. Only 16 % could imagine deliveries been made to their car boots.³¹ Moreover, DHL recently shelved this concept because, currently, not all cars have the technical capability for this type of delivery.³²

²⁷ StreetScooter. Tools on Wheels

²⁸ BIEK Sustainability Study 2017, Fraunhofer 2017

²⁹ Logistik: Das Warenlager im Parkhaus (The Goods Depot in a Car Park)

³⁰ BIEK Sustainability Study 2017

³¹ PWC 2017

Parcel deliveries by taxi

Furthermore, delivery capacities in passenger transport could be acquired and used. Additional freight space could thus be created via taxi vehicles that transport people as well as parcels.³³ As many as 48 % of those who were surveyed by PWC were able to imagine this type of delivery.

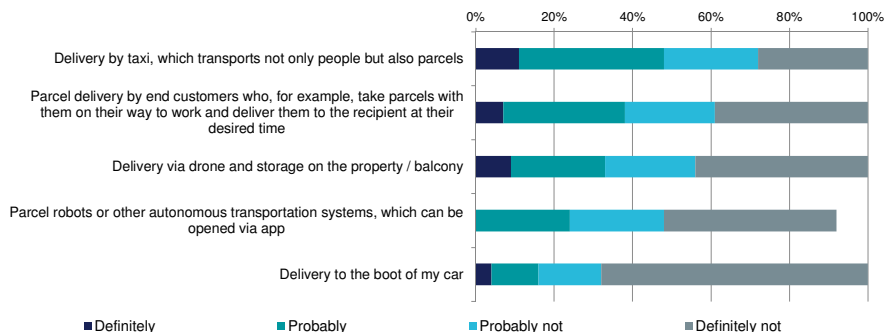
Crowd-delivery - Customers become delivery agents

Crowd-delivery is a similarly unconventional concept where end customers themselves are specified to be the delivery agents for other private individuals. There are already providers for this concept, on a small scale, such as the Berlin-based start-up CoCarrier. However, it is uncertain if this concept would be suitable for the mass market in view of the low acceptance levels (38 %) by the end customers who were surveyed.³⁴ The reason for the scepticism could be concerns with regard to the reliability and security of the deliveries or the private sphere when non-professional delivery agents are involved.

Large-scale deployment of drones and delivery robots unlikely in the medium term

Another concept that has attracted increasing attention in recent years is semi and fully automated delivery by drone or parcel robot. Drones are an unmanned, aerial and reusable means of transport that, under current legislation, - including cargo - may weigh up to 25 kg. Service providers such as Amazon or DHL are experimenting with loads of between 0.5 – 2 kg.³⁵ The idea of shifting flows of parcels from the ground into the air appears to be tantalising. However, the potential for drones to transform last-mile delivery permanently is considered to be minimal, at least in the medium term, owing to the extensive regulatory requirements. Accordingly, drones need so-called ascent permits, they have to be carefully monitored, may not fly over areas that have been classified as being sensitive and may not pose a risk through loss of transmission or a crash. The consumers that were surveyed also expressed doubts. Only 33 % stated that they would like to use deliveries via flying drones. Consumers were likewise sceptical towards autonomous delivery parcel robots, which have been tried out, for example, in Hamburg by the “Starship“ company.³⁶ Only 32 % of respondents were able to imagine a parcel arriving via an autonomous delivery robot. Besides fully autonomous delivery robots, parcel couriers could deploy physical support robots. Although, load carrying companion robots, which were tested by DHL, are uneconomical and will not be suitable for the mass market for the foreseeable future because of their high technology costs.³⁷

End customers’ acceptance of new parcel delivery concepts



Source: PWC; own research

³² Interview with Frank Appel, 04.02.19 Tagesspiegel (a daily Berlin newspaper)
³³ PWC 2017
³⁴ Who is who Logistik 2018
³⁵ ZF Future Study 2016, Logix 2018
³⁶ ibid.
³⁷ Interview with Frank Appel, 04.02.19 Tagesspiegel (a daily Berlin newspaper)

Summarising assessment: mostly still a long way off

From today's perspective, it will probably only be the electromobility trend that will have a long-term impact on last-mile delivery. By contrast, the other above-mentioned innovative concepts are still suffering to a much greater extent from regulatory or technological problems. In particular, drones and robots are affected by stringent regulatory requirements. In order for these technologies to be extensively deployed the regulations would have to be relaxed and the costs would have to fall. Another condition would be cities with a high degree of digitisation. It would only be these "smart cities" in conjunction with big data that would enable the use of the smallest potential for enhancing efficiency by, for example, maximising transport volumes (the keyword here is taxi car boot). Data protection compatibility with the current legal situation has to exist through these concepts. It is legally highly questionable that parcel delivery services possess precise location data in real time for their customers or for their walking routes (the keyword here is car boot deliveries and crowd delivery).³⁸ Ultimately, the acceptance of the customers and their willingness to pay for innovative delivery concepts would also appear to constitute bottlenecks.³⁹ The new concepts have, more or less, been clearly rejected. None of the concepts managed to convince at least every other respondent.⁴⁰ In day-to-day life you will increasingly see electric delivery vehicles and, occasionally, also electric cargo bikes. However, drones, robots, car boot deliveries, crowd concepts or taxis that deliver parcels remain marginal phenomena for the time being. It remains to be seen which concepts will be suitable for the mass market.

5. Conclusions and Outlook

City logistics - a future market segment with potential

City logistics is considered to be a future market segment with potential. The main drivers that will permanently change city logistics, including last-mile delivery, can be clearly specified. Besides the growth in urbanisation that is anyway already happening, the increase in e-commerce as well as changes in customer behaviour and the concomitant rise in consignment volumes pose new challenges for city logistics.

Cascading delivery system model is emerging

Against this background, the growing demands in terms of capacity and flexibility being made on CEP service providers are reflected in adjusted supply chains and increased space requirements. A cascading delivery system model is emerging that stretches from large-scale distribution centres in the surroundings of cities through urban fulfilment centres and right down to micro-fulfilment centres and micro-warehouses for fine distribution on the last mile.

City logistics - big space shortages and image problems

The inner-city space shortages constitute a key obstacle to growth. In 2018, for the biggest German logistics regions the order of magnitude of this was quantified as being 140,000 m² in Berlin and 30,000 m² in Düsseldorf. In view of the volume of consignments that has been forecast up to 2021, space shortages are set to increase by 52 %.

³⁸ ZF Future Study 2016

³⁹ BIEK: CEP Study 2018

⁴⁰ PWC 2017

Opportunities for city logistics

However, finding **space** is not the only problem for city logistics as it also has an **image problem**. It has to become more efficient, sustainable as well as quieter and taking into account the changes in customer behaviour. Against this backdrop, creative design approaches both for logistics real estate as well as for the last-mile delivery process. The most important solution approaches have been summarised in the following table.

1. Conversion of the Existing Stock of Properties

- a) **Derelict commercial property units, unused office space and closed obsolete supermarkets and specialist stores**
 - usually do not have all the features required of a logistics building, however, that can be used as urban and micro fulfilment centres
- b) **Car parks and underground garages**
 - use of underutilised car parks and underground garages (for example, in the early morning or at night) creates logistics space and eases the strain on inner city traffic
- c) **Disused industrial facilities**
 - abandoned industrial facilities, goods yards or petrol stations have good infrastructural connections and can be redeveloped or revitalised

2. Innovative Use Concepts

- a) **Multi-storey structures**
 - offer attractive cost-benefit ratios (the costs are offset against higher space utilisation levels for buildings that are up to 70 m high) and efficient intralogistics enable time savings; on the downside there are strict building regulations
- b) **Multi-tenant properties**
 - multiple use of properties through various parties (fluctuations in individual warehousing space requirements smoothed out in a better way); the downside is that the parties have to be willing to cooperate
- c) **Mixed-use properties as a compromise solution**
 - different forms of use (production, logistics, office) in one property and by means of which synergy effects arise; construction should ideally be modular, which means that increased or decreased demand is flexibly scalable
- d) **Parcel stations**
 - deliveries can be pooled here, and customers can determine the collection date and time themselves; nevertheless, customers prefer delivery at their front doors

3. Movable Space Concepts

- a) **Micro-warehouses**
 - setting up containers or delivery vans at close intervals to serve as micro-warehouses (approx. 15-25 m²) shortens last-mile delivery and makes it possible to partially substitute these for logistics real estate
 - particularly suitable in inner urban areas; on the downside, there is a lack of legal certainty (special use permits are needed)
- b) **Flex-hubs**
 - modularly constructed containers that can easily be connected enables needs-based scaling of the space
 - Most appropriate deployment locations are industrial areas on the periphery; on the downside, there are building regulations

4. Innovative Delivery Forms

- a) **Night-time deliveries**
 - carried out by electric vehicles, eases the strain on inner city traffic, noise and exhaust fumes are reduced; on the downside, there are strict regulations
- b) **Cargo bikes**
 - enable more flexible deliveries (e.g. through pedestrian precincts or traffic calmed zones) and are able to replace delivery vans in some cases
- c) **Autonomous drones and robots**
 - could shift flows of parcels into the air or unburden delivery agents; obstacles: technology costs and far-reaching regulatory requirements

Outlook - City logistics has pioneer status due to the plethora of new requirements

As a result of the plethora of modified requirements, city logistics still has pioneer status. Logistics service providers have recently started to experiment with new technologies, concepts for use and space as well as forms of delivery. In order for city logistics to be able to provide quality services in the future, too, they will have to enter into additional and new forms of cooperation. Close cooperation is necessary between all the city logistics players in order to increase the overall efficiency of city logistics through the reduction of redundancies, while taking into account the various interests involved. Moreover, a number of issues relating both to infrastructure and regulations have to be clarified by the public sector so that the city logistics industry can fully develop its market potential.

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