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UNDERSTANDING TRENDS & SCENARIOS OF FREIGHT TRANSPORT IN FUAS

Subtitle

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A. Introduction

Before 1980s, management of freight flows for urban supplies did not have an important impact on road congestion and air pollution in urban areas. Public authorities' actions related to logistics and freight transportation policy and planning in urban contexts were therefore focused mainly on specific measures dealing with emergencies. With urban traffic increasing, and the raise of congestion not only in big but also in medium cities, majority of public administrations were affronted with problems of urban freight distribution, that were up until that point traditionally managed only by the transportation carriers.

Between the 1990s and the beginning of the twenty-first century, with the backing of public administrations and other support funds, several studies and pilot tests have been implemented to learn how to organise urban freight distribution in order to decrease traffic and pollution deriving from this transportation sector. Most of these studies are oriented to support public authorities in decisions related to urban freight transportation planning. These studies resulted with increasing number of restrictive measures for urban freight deliveries (e.g. Low Emission Zones, Time Windows, Vehicle Weight and/or Size Restrictions, Congestion charging) with the main aim of mitigating negative impact of freight transport in urban areas. Despite huge efforts of all those projects and specific pilot cases, urban freight transport problems still exists.

One possible reason for this inefficiency is in the existing approach of measures that are mainly related only to the city centres and the last mile of classical supply chains. To fully understand possibilities for mitigating urban freight flows and to solve the problem holistically, we would need to tackle urban freight on the level of entire supply chain (including enterprise's strategies) and from the perspective of Functional Urban Areas (FUA) (Gonzalez-Feliu and Morana 2010). By the definition, Functional Urban Area (FUA) consists of the city and its commuting zone and is identified as polycentric cores and the hinterlands of FUAs identified on the basis of commuting data, including all settlements from where at least 15% of the workers commute to any of the core settlement(s) (OECD, 2016).

Freight transport in Functional Urban Areas (FUAs) is expected to develop along global trends having important impact on the Central Europe logistics efficiency. Main aim of this document is therefore to identify and summarize these trends in order to understand their influence on development of FUAs supply chains in the future. Report contains summary of these trends originating from strategic/political documents, industry driven initiatives, scientific articles and research papers. Trends and initiatives identified through deskwork analysis range from very general/global trends towards specific initiatives relevant for particular supply chains. Only those trends that might have direct or indirect influence on regional freight transport flows are captured.

Identified trends are presented and divided into the following 4 main categories:

- changing consumption (including e-commerce) & production,
- spatial organization,
- supply chain management & distribution,
- technologies & equipment.

The report starts with introduction to the topic. Each of following chapters is concentrated on one of the before mentioned category, presenting existing situation and expected trends. Based on these findings, potential future scenarios are drafted at the end. Final chapter gives also conclusion of the report stressing important aspects that have to be taken into consideration by public authorities when developing Sustainable Urban Logistics Plans to support FUAs freight transport services in the future.

B. Logistics trends

1. Consumption and production

Consumption can be defined in different ways, but is best described as the final purchase of goods and services by individuals (Hill, 2016). In the last ten years we have seen major developments in economic growth, globalization and opening of new markets that have changed how and what we consume. As we become wealthier, we consume more. We have also changed culturally and socially. 'Individualisation', the belief in the individual and the desire for ownership and personal freedom, means that by consuming, we can express ourselves through the goods and services we choose and can enjoy the feeling of personal freedom through, for example, our cars and plane travel (ECONATION, 2016).

Production is defined as a process of combining various material and immaterial inputs (raw materials, know-how) in order to make something for consumption (the output). It is the act of creating output, a goods or services that have value and contributes to the utility of individuals (Kotler, 2006). Production is driven by consumers' needs and expectations, which demands more and more personalized products to be delivered at customers' addresses. Consumer driven concept is leading towards pull logistics strategy and calling for responsive production with highly optimized and rationalized processes.

Goods deliveries (Patier, 2016) for professional and private customers generate an important flow of vehicles, from small vans (for express deliveries) to trucks (to supply the largest stores). Delivery services are increasing due to just-in-time management, e-commerce development and the emergence of new customer behaviours (home delivery, drive and delivery lockers).

1.1. Production is being brought closer to the end user

Globalization has increased freight flows with distributed production across multiple locations around the world. While this overall trend is continuing, a number of companies have started considering investments in the opposite direction (Adidas, 2016). Increasing amounts of production are being brought closer to the end user as a result of increased labour and transportation costs in Asia.

More European producers realise that they can maintain the same low costs and high level of quality, regardless of whether their production plants are located offshore in Asia or nearshore in Europe. Bringing the production closer to the end user results in fewer transportations, shorter lead times and easier planning of logistics flows as well as making corrections to shipping plans (Nevhagen, 2016).

Example:

Lenovo announces to move manufacture enterprise and data center products in Europe

http://news.lenovo.com/news-releases/lenovo-announces-move-to-manufacture-enterprise-and-data-center-products-in-europe.htm

1.2. Regional food supply

A powerful local and regional food movement is growing inside e.g. the United States and the EU; a movement that directly connects consumers with how, where and by whom their food is grown. The rise in farmers markets shows that demand for a trusted local and regional food supply is growing. The Sustainable Environments Programs support efforts to restore regional aggregation and distribution of food that will strengthen urban and rural connections and provide environmental, economic, and community benefits. This will effect also the inter FUA transport /logistics processes (Vilsack, 2016).

Example:

Gruppi di acquisto solidale (GAS) Italian networks initiated by consumers that link up to farmers to organize alternative food provision.

https://en.wikipedia.org/wiki/Gruppi_di_Acquisto_Solidale

AMAP (French Associations pour le maintien d'une agriculture paysanne) support peasant and organic agriculture through direct links between farmers and consumers

http://www.reseau-amap.org/Les

1.3. 3D printing-> digitalization of logistics

3D printing as an emerging manufacturing technology (additive manufacturing) can be used to create specialized products at distributed locations such as retail outlets or even within households. Goods can be built using 3D printers on-site and on-demand. 3D printers have the potential to replace traditional manufacturing and change the structure of manufacturing industries and supply chains. They can be used commercially (i.e. mass production), in retailing (i.e. in shops) and for personal use (i.e. at home).

3D printers can reduce freight transport particularly the distribution of goods. They can also reduce storage at warehouses and retail outlets as well as waste such as packaging. However transport is still required for the materials for producing goods (e.g. plastic and metal) as well from the supply chain for the manufacturing and distribution of 3D printers.

Example:

A restaurant in Spain is using a 3D printer to design intricate structures made completely out of food from mashed potatoes to chocolate.

http://www.bbc.com/news/business-35631265

Dutch students at the Delft University of Technology have created a 3D printed steel bike, which can be produced on demand.

http://www.treehugger.com/bikes/3d-printed-steel-bike-university-delft-mx3d.html

1.4. Batch size one production

New customer demands such as hyper customization are changing the manufacturing industry. The handling of 'batch size one' (i.e., only one item is produced) requires highly automated production sites and imposes complex new requirements on supply chains. In future, manufacturing and retail strategies will change to adapt to increasing consumer demand for product personalization. This will require agile supply chains ready to adapt to changes in time and place of batch size one production (DHL, 2016).

Example:

Adidas is developing a worldwide network of high-tech low-distance manufacturing facilities or 'speed factories'.
http://www.recode.net/2016/9/27/13065822/adidas-shoe-robots-manufacturing-factory-jobs

1.5. E-commerce growth

Enabled and driven by an increasing internet penetration, mobile phones and other technology, e-commerce has seen double digit growth over the past years. The consumer is allowed, more and more, to take part in defining the e-logistics that suits him or her, in terms of price, quality, time, green and/or fair. The "logsumer" (DHL, 2014) has more and more power to dictate how the last mile needs to be organized. This trend, even though it may enhance a consumer's shopping experience, will become a logistics service provider's main challenge for the future.

It is important to realize that having to transport goods to consumers' homes rather than to retail stores is going to increase the number of freight movements. Because the size of the deliveries will typically be small, the relative increase in number of freight movements is even larger. Thus, from a city logistics perspective, the increase in direct-to-consumer deliveries is a curse rather than a blessing (SCL report, 2016).

Example:

Walmart (World's Largest Retailer) Is Reigniting Its E-Commerce Growth

http://fortune.com/2016/08/18/walmart-ecommerce-2/

1.6. The sharing economy

DHL Trend Radar report (2014) identifies two important variants of the sharing economy: collaborative consumption (is focused on Consumer to Consumer networks, C2C) and collaborative business (services, manufacturing e.g. 3-D manufacturing, focused on Business to Business models, B2B).

Collaborative consumption refers to a class of economic arrangements in which participants share access to products or services, rather than having individual ownership and is facilitated by the internet and mobile technology. Collaborative business involves sharing logistics infrastructure and services with competitors. In this way, new business models for logistics service providers and companies arise, again supported and enabled by new online and digital (data) sharing platforms (DHL, 2014). This enables companies to share existing assets and capacities, especially when these assets need a large amount of capital (Matzler et al. 2015).
Sharing assets and capacities may result in increased consolidation and higher capacity utilization, which may reduce the number of freight movements, the fleet size, and empty travel for collaborating logistics services.

1.7. Circular economy

There is a growing business movement toward what is described as a circular economy, an alternative to a traditional linear economy where the current widespread operating model can best be described as make, use and dispose. In the evolving circular model, we strive to keep resources in use for as long as possible, extract the maximum value from them while in use, then recover and regenerate products and materials at the end of each service life.

Logistics plays a critical role in implementing successful and sustainable circular strategies. As e-commerce and just-in-time delivery strategies have grown, so has the “last mile” challenge to deliver products to a consumer’s home or the loading dock of a manufacturing plant at a reasonable cost. Logistics can offer customers unique value by helping to incentivize greater participation in the circular economy through a seamless and convenient take-back model. Offering pre-paid shipping labels, smart packaging and convenient take-back mechanisms will fuel market demand (UPS, 2016).

In future, growth of capacities for regionally recyclable materials and growth of collecting points and capacities for non-regionally recyclable materials are expected.

Example:

> *Cirkle found opportunities in the reverse cycle*
>
> *https://www.ellenmacarthurfoundation.org/case-studies/finding-opportunities-in-the-reverse-cycle*

1.8. Demographic trends -> Grey power logistics

Within the next decades, population ageing will become one key driver of demographic trends in Europe: the old-age dependency ratio (≥65 years / 15-64 years) will increase from the current figure of about 30% to about 50% in the longer term (Eurostat, 2015). We are facing new demand: aging of the population - elder people discover the convenience of internet ordering (adoption of new consumer technologies), number of young people used to the internet and remote ordering by the internet is growing.

Grey power logistics (DHL, 2016), that is the logistics for an aging society, is likely to drive consuming and logistics. Certain goods, such as groceries are just starting to be sold by the internet etc.

Example:

> *Ecommerce for the Elderly - The idea that elderly people aren't using the internet is now extremely outdated.*
>
> *https://ecommerceguide.com/guides/older-shopper/*

2. Spatial organization

Regions are commonly organized along an interdependent set of cities forming what is often referred as an urban system. The key spatial foundation of an urban system is based on a series of market areas, which are a function of the level of activity of each centre in relation with the friction of distance. The spatial structure of most regions can be subdivided in three basic components (J.P. Rodrigue, 2016):

1. A set of locations of specialized industries (such as manufacturing), which tend to group into agglomerations according to location factors such as raw materials, labour, markets, etc. They are often export-oriented industries from which a region derives the bulk of its basic growth.
2. A set of service industry locations, including administration, finance, retail, wholesale and other similar services, which tend to agglomerate in a system of central places (cities) providing optimal accessibility to labour or potential customers.
3. A pattern of transport nodes and links, such as road, railways, ports and airports, which services major centres of economic activity.

Jointly, these components define the spatial order of a region, mostly its organization in a hierarchy of relationships involving flows of people, freight and information. More or less well defined urban systems spatially translate such development. Many conceptual models have been proposed to explain the relationships between transport, urban systems and regional development, the core-periphery stages of development and the network expansion being among those.

Spatial organisation of transport and logistics in FUAs is influenced by geographical situation as well as by distribution of resources and population. The fragmentation of production and consumption, the locational specificities of resources, labour and markets generate a wide array of flows of people, goods and information. The structure of these flows in terms of origin, destination and routing is closely related to spatial organization. Space shapes transport as much as transport shapes space. (adapted from J.P. Rodrigue, 2016)

The freight industry (Aljohani&Thompson, 2016) appears to have contradicting issues in urban areas, as it is required to operate efficiently and sustainably and adjust to the increasing urban freight activities. This has to be achieved with the majority of customers and retailers being located in inner urban areas while logistics facilities have been forced to relocate to the periphery of metropolitan areas. Inner urban areas still constitute a major retail and freight destination and attract/generate significant levels of freight movements with very limited supply of available and affordable commercial and industrial land to establish and operate logistics facilities.

The majority of Central European freight has its origin and destination within the Functional Urban Areas (FUAs). Road transport is still the prevailing mode of moving freight over short distances (average distance of national freight transport trips in 85 kms), with its major problem of poorly utilized vehicles and empty running (EAA, 2015). These problems has to be solved on the regional level and are to be tackled by the public authorities.

2.1. Logistics sprawl

Urban place in cities (metropolitan areas) is becoming an increasingly scarce resource with many different users competing for the same resources. As industrial land in inner city areas becomes more expensive, it is common for it to be rezoned for commercial or residential uses (Taniguchi et al., 2015). Rapidly rising land prices and increasing traffic congestion in urban areas have forced companies to relocate warehouses to locations with relatively lower prices which are often not hindered by planning law. In addition, high urban land prices have encouraged retailers and other users of commercial floor-space to limit storage space in their premises, converting for activities which will provide better financial returns (e.g. increased sales areas). This has led to the suburbanisation of warehousing, being relocated to the edge of the urban area (Allen et al., 2012).

This phenomenon is termed as logistics sprawl: relocation and concentration of logistics facilities (warehouses, cross-dock centres, freight terminals etc.) towards suburban areas outside city centre boundaries (Dablanc&Rakotonarivo, 2010 and Dablanc et al., 2014). Logistics sprawl can increase the distance travelled by freight vehicles who service retail, commercial and residences in inner city areas. Many cities are experiencing growth in the population living in the central city areas and the drift of freight facilities to the outer metropolitan region can add to congestion and environmental impacts (Taniaguchi et al., 2015).

Example:

Logistics Sprawl in the Region Zurich

www.strc.ch/conferences/2016/Todesco_EtAl.pdf

Commercial Goods Transport, Paris, France – case study

http://unhabitat.org/wp-content/uploads/2013/06/GRHS.2013.Case_.Study_.Paris_.France.pdf

2.2. Spatial centralisation of stockholding

Spatial centralisation of stockholding has been adopted by manufacturers and retailers in order to achieve cost savings in their supply chains resulting in an increase in the use of fewer, large-scale national and regional distribution centres that serve a far larger geographical area. This centralisation has been made possible by the development of the motorway network, which allows companies to have fewer stock holding points by locating extremely large warehouses at strategic points with good accessibility to their hinterlands. Consequently the urban areas are supplied from these large centres thus increasing deliveries to urban centres whereas smaller distribution centres within urban areas have been discontinued (Allen et al., 2012).

The spatial and structural changes in the location of logistics facilities have altered the geography of freight in urban areas. Urban freight activities impact the overall built environment over a larger spatial extent than a logistics facility itself. The locations of facilities affect not only logistics companies, but also the urban environment in general. Jobs related to large logistics facilities in exurban areas may encourage more residential development in fringe locations, which may further expand urban growth boundaries (Aljohani&Thompson, 2016).

Example:

Investigating relationships between road freight transport, facility location, logistics management and urban form

https://www.researchgate.net/publication/257425576_Investigating_relationships_between_road_freight_transport_facility_location_logistics_management_and_urban_form

Top Logistics Locations in Europe

http://www.prologis.com/docs/160215_Top%20logistics%20locations%20in%20Europe_ENG.pdf

2.3. Spatial planning coupled with coherent spatial and transport policy

By concentrating on FUAs three relevant levels are to be managed:

1. international accessibility,
2. connectivity between FUAs and
3. the connectivity within FUAs.

While the first two represent priorities on a national level (national government) and need be coherent with European TEN-T plans, the third one, regional connectivity and accessibility is, or should be, the responsibility of the FUA itself. Here, the voluntary cooperation should play the main part, together with a more formal cooperation. Improving accessibility for different modes of transport is a basic requirement for further economic development of a FUA (Smits et al., 2015).

Furthermore as spatial planning determines business site locations (in various qualities and for different target groups, thus creating favourable conditions for private investments) it can have a major contribution to a region’s attractiveness.

FUA-level planning and strategy development needs trust between the municipalities, special cooperation instruments and promise on proportionate use of development means. Ensuring enough time and resources for planning, and mentoring the process at city/FUA level are necessary conditions for participatory and integrated planning.

Example:

Logistics and spatial planning – Regional Development Outcomes, Spatial Planning Needs

http://www.th-wildau.de/fileadmin/dokumente/interim/dokumente/WS3_Wildau/interim_Wildau_13.09.07_4_FUBerlin.pdf

2.4. Urban distribution/consolidation centres

An urban distribution/consolidation centre (Van Audenhove et al., 2015) collects shipments in a specialized warehouse at the edge of the city, where they are consolidated before being shipped into the city for last mile delivery. The objective is to increase truck usage to optimize the total distance travelled by trucks, which benefits the city's congestion level and air quality. The UDC's impact depends mainly on the extent to which it can increase truck usage, which is influenced by the nature of the goods, the transporters and the local density. Although many are no longer in operation due to lack of financial viability, we expect to see a second wave of UDC implementations, building on the lessons learned from the previous implementations.

The centres can vary from large consolidation centres to centres on neighbourhood or street scale (micro depos/micro distribution platforms).

Examples:

Beaugrenelle (Paris 15ème) Urban Logistics Centre

http://www.bestfact.net/beaugrenelle-paris-15eme-urban-logistics-centre/

Micro depo Nuremberg

https://www.dpd.com/home/news/latest_news/pilot_project_in_nuremberg_can_micro_depots_revolutionise_the_last_mile

Micro distribution platform Valencia

http://www.smile-urbanlogistics.eu/projects/smile-pilots/valencia-pilot-electric-mobilty-and-urban-consolidation-centers-desciption

2.5. Construction consolidation centres

The concept and purpose of consolidation may be new to construction but is in fact a fundamental logistics process. A 'Construction consolidation Centre' operates much like any regional distribution centre, but is specifically located and geared to service the needs of an urban area with tight logistical constraints (housing developments, in-city developments and renovations) (CSB, 2016). In Construction Consolidation Centres, multiple bulk material deliveries are stored and transported to construction sites.

Example:

London Construction Consolidation Centres

https://tfl.gov.uk/info-for/deliveries-in-london/delivering-efficiently/consolidating-deliveries#on-this-page-2

2.6. Multi-story logistics facilities in dense areas

In Japan or Hong Kong, large multi-story logistics facilities have been developed in dense areas of the largest conurbations. In Paris (Europe) the largest current logistics development project is Chapelle International, a three story 45,000 m2 facility mixing logistics activities and other types of activities (data centre, offices, sport, urban agriculture) located within the first Paris ring-road. In Europe, small-scale freight facilities have made an appearance in city centres. In the city of Paris, more than 35 urban logistics facilities exist today. In the US, Amazon's new faster delivery services (Amazon Prime Now, Amazon Fresh, Amazon Pantry) require the company to use warehouses closer to major consumer markets. In New York City, Amazon has set up a 5,000 m2 distribution centre on the 5th floor of a Manhattan building on 37th street (Dablanc et al., 2016).

Examples:

Prologis multi-story logistics facility in Tokyo:

http://www.prologis.com/en/prologis-grows-in-tokyo.html

Chapelle International in Paris:

http://www.chapelleinternational.sncf.com/

Amazon distribution centre in Manhattan, New York:

https://www.cnet.com/pictures/amazon-prime-now-a-peek-inside-the-manhattan-warehouse/

2.7. Pick-up point networks & Lockers

Pickup points (Savelsbergh&Van Woensel, 2016) are locations where customers can pick up their orders. They can be unattended, e.g. locker boxes, or attended, e.g. fuel stations. The kind and number of goods that can be stored in locker boxes, but also the services offered at a station, depend on the features of the boxes and the layout of the stations. Examples of pickup point networks include E-box (France), Locker Bank (UK), DHL PackStation (Germany), Tower24 (Germany), Kiala (Belgium), and de Buren (The Netherlands). Pickup point networks (either attended or unattended) are one of the prime examples of differences between Europe and the United States. Pickup point networks are already quite common and rapidly expanding in Europe, whereas they are almost unheard of in the United States.

Examples:

InPost

https://inpost.co.uk/en/about-us

Amazon Lockers

https://www.amazon.co.uk/Click-and-Collect-with-Amazon-Lockers/b?ie=UTF8&node=2594544031

DHL Packstation

http://www.eltis.org/discover/case-studies/street-package-collection-and-delivery-stations-germany

https://www.dhl.de/en/paket/pakete-empfangen/packstation.html

2.8. Integration of public and freight transportation networks

Combining people and freight flows has the potential to lead to improved operations as the same transportation needs can be met with fewer vehicles and drivers. Specifically using different people-based modalities for freight flows, i.e., using spare capacity in public transport systems (e.g., rail, bus, and subway) for retail store replenishment. In many cities, metro, buses and trams travel in a fine-mazed urban network: the start and end of their tours are usually in the middle of the city.

Bus schedules might be adapted to accommodate delivery of small boxes to urban retail outlets. Trains can replenish inventories of railway station based stores and restaurants. This can be quite effective, because railway stations are often located in time- and vehicle - restricted urban areas. Integration can already be found in long-haul freight transportation, e.g., passenger planes and ferries often carry freight as well. In short-haul transportation, however, people and freight rarely share transportation modes, although they largely share the same infrastructure.

In an integrated system, depending on the origin, destination, and availability and due time of freight, it is to be decided whether to use a pure freight transportation network, a combination of people and freight transportation networks, or a pure people transportation network. The use can be joint (i.e., people and freight share a resource) or separate (i.e., freight is moved during times that the people transportation network is normally inactive or during repositioning trips) (Savelsbergh&Van Woensel, 2016).

Examples:

Cleaner cargo distribution in Dresden:

http://www.eltis.org/discover/case-studies/cleaner-cargo-distribution-dresden-germany

Delivering goods by cargo tram in Amsterdam - CityCargo pilot:

http://www.eltis.org/discover/case-studies/delivering-goods-cargo-tram-amsterdam-netherlands

2.9. Management of logistics transhipment facilities

Competition for street space amongst cars, vans, delivery vehicles, public transport, pedestrians and cyclists is becoming more and more intense. Making better use of the capacity available for urban freight and finding smarter solutions to sharing space in cities is becoming increasingly important. Different measures and interventions for more efficient and effective management of loading/unloading areas, drop-off/pick-up points and transhipment areas are being implemented.

Examples:

Traffic lane/drop-off space reservation.

Creation of dedicated loading/unloading areas and traffic lanes for freight transport. Case example of Barcelona: multi-use lanes used as parking spaces (night time), unloading spaces (between peak hours) and as priority bus lane (in peak hours).

http://civitas.eu/content/multi-use-lanes-and-night-time-delivery

Loading/Unloading area Management (McLeod&Cherrett)

Implementation of managed, bookable loading bay systems, whereby advance bookings can be made by the users of the system and enforcement and control measures are used to ensure effective operation. Such systems offer guaranteed loading and unloading places, and discourage undesirable driver behaviour associated with unloading such as double parking, parking on the pavement and causing obstructions to pedestrians and other road users.

Several examples of loading/unloading area management:

https://coe-sufs.org/wordpress/ncfrp33/psi/parking_area_management/

Urban Transhipment Areas

Designated areas within urban centres where freight is transhipped from one vehicle/mode to another (usually from larger vehicles to smaller vehicles) for delivery without consolidation in between.

More measure can be found at VREF Centre of Excellence for Sustainable Urban Freight Systems

https://coe-sufs.org/wordpress/ncfrp33/psi/parking_area_management/

2.10. Direct Injection

Direct Injection (Van Audenhove et al., 2015) brings goods directly into the city using alternative mass transportation means (e.g. ships and freight trains), after which vans and other last mile delivery transportation means must cover only very short distances. This measure is not cost-effective for transporters at this moment due to the increased cost of the added transhipment, but it enables urban delivery of goods in restricted areas: by using much softer delivery modes (such as tricycles), where truck access to historical city centres is highly restricted, when strong urban congestion charges are imposed.

Example:

Paris case studies:

- *delivering via rail through central injection point - Monoprix case* *http://www.eltis.org/discover/case-studies/sustainable-deliveries-goods-paris-france*
- *delivering via waterway through river container terminal - Franprix case* *https://www.theguardian.com/cities/2016/mar/01/paris-french-retailer-franpix-delivers-goods-by-boat-river-seine-transport-water-future-urban-logistics*

3. Supply chain management & distribution

Supply chain encompass the following three functions: i. supply of materials to a manufacturer; ii. the manufacturing process; and, iii. the distribution of finished goods through a network of distributors and retailers to a final customer. Complexity of supply chain requires efficient planning and management of all activities involved in sourcing, procurement, warehousing and transportation. In essence, supply chain management (SCM) integrates supply and demand management within and across companies (CSCMP, 2016).

The primary objective of SCM is to fulfill customer demands through the most efficient use of resources, including distribution capacity, inventory, and labor. In theory, a supply chain seeks to match demand with supply and do so with the minimal inventory. Various aspects of optimizing the supply chain include liaising with suppliers to eliminate bottlenecks; sourcing strategically to strike a balance between lowest material cost and transportation, implementing just-in-time techniques to optimize manufacturing flow; maintaining the right mix and location of factories and warehouses to serve customer markets; and using location allocation, vehicle routing analysis, dynamic programming, and traditional logistics optimization to maximize the efficiency of distribution. (Wikipedia, 2016)

Supply chain management theories and methods mentioned above are seldom used when planning and evaluating urban logistics (Gonzalez-Feliu and Morana 2012). This is leading to fragmentation of urban freight flows, unutilized freight vehicles, empty running and is consequently considerably contributing to traffic congestion, noise, low air quality and large commercial road traffic in the cities. Logistics providers are still perceived as the one responsible for all those negative effects without understanding the role of customer that orders the delivery. Possibilities of vertical and horizontal collaboration are still not exploited.

Data on regional/urban freight flows are seldom available. In that respect, we first need to identify freight intensive supply chains and understand their origin and destination pattern. Public policies have a very difficult task to provide measures for diminishing negative supply chain effects on urban environment without proper empirical data. Without being able to understand the process, they are forced only to the limitation of freight vehicles to urban areas. This, on the other side brings some controversial effects, like increasing congestion instead of optimizing freight flows.

3.1. Logistics industry consolidation

Consolidation is a dominant theme in every industry sector across the globe, and the transportation and third party logistics (3PL) industry is at the centre of that trend. In their "predicts" for global logistics for 2016, the analysts at Gartner said they expect that "By 2020, the top 10 global 3PLs will control 80% of the world's logistics volume." As a result, Gartner further expects a bifuracation in logistics service providers, as the market segments into a relatively small number of these huge global 3PL providers while at the other end of the spectrum, there will be niche players that will often end up working for the global 3PLs. "There will be limited room for mid-size generalists," Gartner notes (Morales, 2016). Consolidation of logistics providers will lead also to consolidation of freight flows and will have very positive impact on regional freight flows.

Example:

> Consolidation in the 3PL industry: Why is it happening, and what does it mean? http://www.supplychainquarterly.com/topics/Logistics/201501023-consolidation-in-the-3pl-industry-why-is-it-happening-and-what-does-it-mean/

3.2. Vertical and horizotnal collaboration

Cooperation is often seen as a fruitful path to consolidating freight volumes, leading to a higher and efficient utilization of resources. Cooperation can be done in two ways: vertically and horizontally. Vertical collaboration typically involves different partners in the supply chain (e.g. suppliers, manufacturers, 3PLs, logistics service providers, and customers) working together (Cruijssen et al. 2007), leading to concepts such as Collaborative Planning Forecasting and Replenishment (CPFR), Efficient Consumer Response (ECR), etc. By contrast, horizontal cooperation involves companies operating at the same level in the supply chain (freight forwarders, for example). Horizontal cooperation in logistics is receiving more and more attention. (SCL report, 2016).

With the “Internet of everything” concept expanding, there are more opportunities to connect supply chains (the trend of connected supply chains) and increase the visibility from order initiation to order delivery. Data coming from different sensors located at different suppliers from their production and transportation operations, carry a lot of information regarding the quality of production process and timeliness of delivery. At the same time, this data may indicate possible issues in the procurement process, regarding product quality and delivery. Monitoring and analysis of this data may provide opportunities to intervene before issues becomes major problems (Keskin, 2015).

Example:

> Kimberly-Clark helped to pioneer the concept of collaborative supply chains. The benefits have been so great that the practice is now sweeping through Europe.
>
> *http://www.supplychainquarterly.com/topics/Logistics/scq201102kimberly/*

3.3. Green supply chain principles

Besides the need for faster and individualized services, there is a growing movement towards fair and responsible logistics. Driven by megatrends such as sustainable consumption, digitalization, and globalization, companies are now increasingly focus on turning social and environmental challenges into opportunities by creating fair and sustainable solutions that generate social as well as business value along the supply chain.

Looking ahead, this trend will increase transparency within supply chains, and require new circular economy concepts in logistics. A report on the subject, recently published by DHL, illustrates the first specific use cases in logistics. These are trends that will impact or perhaps even disrupt the logistics industry over the coming years (DHL, 2016).

Example:

> *Top 10 green supply chains*
> *http://www.supplychaindigital.com/top10/2522/Top-10-green-supply-chains*

3.4. Omni-chanel logistics

One major trend that will make or break retailing and e-commerce in the future is omni-channel logistics. Omni-channel retailing foresees the integration of several on-line and off-line retail channels in which consumers can buy, pick up or receive goods and manage payments. Many retailers, as for example Walmart in the US, are adopting omni-channel retailing. This brings challenges to logistics activities in terms of stock management, number of deliveries and visibility in the supply chain among different retail channels.

Logistics, as the backbone of retail, needs to react and offer innovative omni-channel solutions that satisfy the demand for more personalized, dynamic delivery options as well as fulfilment services at a competitive price level. Over the past two years, this has led to the development of new solutions to facilitate last-mile delivery such as same-day and even same-hour delivery models (e.g., Amazon Prime), individual parcel lockers (e.g., DHL Paketkasten), and even delivery-to-car-trunk concepts. (DHL, 2016).

Example:

> *A DHL perspective on implications and use cases of Omni-chanel logistics for the logistics industry*
> *http://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/dhl_trendreport_omnichannel.pdf*

3.5. Freight Quality Partnerships - FQP

Freight Quality Partnerships are a means for local government, businesses, freight operators, environmental groups, the local community and other interested stakeholders to work together to address specific freight transport problems. They provide a forum to achieve best practice in environmentally sensitive, economic, safe and efficient freight transport. Important characteristic of an FQP is that it provides a mechanism for industry and local government to work together in partnership to produce tangible outcomes to localised freight transport problems. (Burns Rachel et al.)

Example:

Several examples of successful implementation of FQP

http://www.trb.org/Main/Blurbs/172487.aspx

3.6. Of peak hours deliveries

Off-Peak Delivery (OPD) programs may offer relief for traffic management problems in cities, which are often caused by last-mile deliveries. These deliveries make up more than 80 percent of all freight traffic in urban areas (LDL, 2015). Programs are being implemented that produce a shift of deliveries from the regular hours (6AM to 7PM) to the off-hours (7PM to 6AM). This travel demand management initiative targets receivers as the key decision makers, and seeks to convince them to accept deliveries during the less congested off-hours, through the use of incentives (CoE-SUFS, 2016).

Example:

Potential For Off-Peak Freight Deliveries To Commercial Areas

https://www.dot.ny.gov/divisions/engineering/technical-services/trans-r-and-d-repository/C-02-15%20OPD%20Final%20Implementation%20Plan12-20-07.pdf

Quiet Deliveries Good Practice Guidance – Key Principles and Processes for Freight Operators

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/306851/freight-operators.pdf

The New York City Off-hour Delivery Project: Lessons for City Logistics

http://www.sciencedirect.com/science/article/pii/S187704281401492X

3.7. Unbundling of logistics services – on demand

Established supply chain services can be unbundled into singular solutions that can be delivered better through tech-savvy companies. One key area developing fast is asset-light, 'on-demand' brokerage platforms that easily match demand and supply for logistics services such as Uber Rush for on demand delivery services in cities. The ultimate vision for these platforms is a supergrid coordinating multiple marketplaces.

Beyond the recent hype, the degree of disruption to established players remains uncertain due to the complexity and fragmented nature of the logistics industry. Key questions still need to be answered: Is an unbundling of physical transportation and marketplaces really possible, and to what degree; and is it feasible to broker complex bundles (e.g., bundles from a forwarding product portfolio) through a standardized and automated interface? (DHL, 2016)

On demand delivery: Formerly named 'crowd logistics', this trend has significantly advanced over the last two years. Triggered especially by the entry of Uber Rush, this trend covers a broader variety of crowd-sourced delivery applications. (DHL, 2016)

Example:

Uber Rush – on demand delivery

http://lyftubernewsletter.com/uber-rush/

3.8. Delivery to the trunk of a car

Another opportunity to deliver to a more convenient location than the home of a customer is the ability to deliver to the trunk of the customer's car. The technology allows a customer to authorize a one-time keyless access to the car's trunk during a specific time period. Once the delivery is completed and the trunk is shut, access permission is automatically revoked. (SCL report, 2016)

Example:

Volvo's Solution for the Package Theft Epidemic: Your Car's Trunk

http://fortune.com/2016/05/10/volvo-urb-it-delivery/

Daimler begins testing Smart car trunk delivery service with DHL

https://techcrunch.com/2016/09/02/daimler-begins-testing-smart-car-trunk-delivery-service-with-dhl/

4. Technologies & equipment

Innovations in technology are changing how the world does business, and technology is dramatically changing how entities in the logistics industry function in nearly every aspect. From increased affordability and efficiency of the transportation management system (TMS) to the application of Bluetooth technology for superior tracking of product movements and to the new wehicles concepts and new propulsion systems (Robinson, 2016).

The use of electric vehicles (EVs) has been recognized as an efficient and promising strategy for urban freight and also successfully implemented for deliveries from the urban micro-consolidate center to customers. On the other side, the use of natural gas vehicles (NGVs) is still lagging behind, mainly due to restrictions caused by legal regulations on service stations, imperfect information and failure to coordinate complementary markets (Rosenstiel et al., 2016).

Regardless the used propulsion technology of vehicle for urban freight transport, vehicles can be used more efficiently with the application of advanced information and communication technologies (ICT). The logistics industry has already embraced a wide range of information and communication technologies and reaped environmental benefits through reduced travel distances, fewer vehicle movements, better matching of vehicles to work and improved levels of load consolidation. Application of ICT in freight transport enables transport users to identify the services most suited to their purposes, and logistics operators to strategically manage freight shipments and deliveries (EC, 2015).

Alongside the implementation of new vehicle propulsion, ICT and ITS, also several technologies to support automated road vehicles were developed, and some are operating in real-life applications (Parent, 2007). For example, dozens of driverless trucks are being used to haul materials in an iron-ore mine in Australia (Winston, 2014). On the other side, safety, reliability and robustness remain major issues for these new systems. Several legal and regulatory frameworks are presenting the limitation for wider implementation.

Lastly, not to be neglected, is also the users and societal acceptance of automated technologies which many times encounter on lack of trust and security, privacy concerns etc. Although several research has been made in the field of automated system and vehicles in recent years, additional efforts will be necessary for regulation and social acceptance of such technologies.

4.1. Clean vehicles

Environmental gains are in the future expected to come from the increased efficiency of internal combustion engine vehicles (ICEVs) on one side and the progressive deployment of alternative fuel vehicles (AFVs) on the other. Recent developments in AFVs is confirming significant potential for reducing the negative impact of freight in urban areas, especially in terms of energy savings achieved by using low-energy and low-emission vehicles.

Among alternative options, electricity seems to show the biggest advantages. Nevertheless, these reductions in emissions by electric vehicles (EVs) will be only possible within a scenario of low-carbon electricity production. Replacement of ICEVs by EVs is only reasonable if the electricity generation has a low level of carbon production (Juan, 2016). The implementation of AFVs will need to overcome also several other challenges and restrictions towards their widespread use, such as lack of infrastructure, high cost of introducing them, insufficient maintenance and servicing system (Yamada et al., 2016).

Example:

Electric Fleets in Urban Logistics - Improving urban freight efficiency in small and medium-sized historic towns

https://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emobil_urbanlogistics_broshure.pdf

Cyclelogistics electric cargo bikes

http://www.civitas.eu/sites/default/files/1212_epomm_enews_cyclelogistics.pdf

4.2. ICT and ITS systems

Advances in Information and Communication Technology (ICT) provide opportunities for improving the performance of urban freight systems. The implementation of ICT for city logistics leads to price reduction what causes the changes in behaviour of individual companies and consumers and city's logistics system.

Intelligent transportation solutions (ITS) can increase transparency and integrity in the supply chain through innovative smart truck concepts (DHL, 2016). The internet and ITS will continue to provide efficiency in logistics, where multiple possibilities for e-commerce emerge in the near future. The internet and ITS do not only influence the logistics system, but also the B2C and B2B e-commerce, e-logistics, e-fleet management, amends S2L (Shipers to Logistics service providers) and L2L (among Logistics service providers) market for logistics services and it is an improvement of logistics operations of freight companies with ITS (Essay UK, 2016).

Example:

Recently on-demand brokerage platforms which easily match demand and supply of logistics services in cities were developed (eg. Uber Rush, Shyp, Shutl, BringBee ect..) (DHL, 2016).

http://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/dhl_logistics_trend_radar_2016.pdf

4.3. Internet of Things

Internet of Things (IoT) represents the next step towards the digitisation of the society and economy, where objects and people are interconnected through communication networks and report about their status and/or the surrounding environment (EC, 2016). It is estimated that by 2020, more than 50 billion objects will be connected to the Internet, presenting an immense $1.9 trillion opportunity in logistics (CISCO, 2013).

The Internet of Things (IoT) can provide a platform for decentralized management for city logistics (Yamada et al., 2016). Quickly transforming data into decisions may increasingly become a reality and a key technological enabler to improve city logistics operations and logistics providers' business strategies. The Internet of Things empowers smart objects to be active participants in self-steering, event-driven logistics processes. However, only a few logistics applications with a substantial business impact have materialized Internet of Things so far. This is largely due to a shortage of standards in the industry, security concerns, and the fact that recent IoT innovations have mainly been developed for the consumer market. Therefore, logistics will have to wait until similar ruggedized versions that meet business requirements come to market (DHL, 2016).

Although several benefits arising for using information technology for urban transport there is also downside related to the security awareness. Due to the high risk of data breaches and hacking of data systems, the adoption of such technologies is a slowdown, however several efforts are devoted to eliminating security risks (DHL, 2016).

Example:

TomTom, a well-known GPS manufacturer, started a Congestion Index in 2007 where they captured anonymous travel time information, particularly in urban areas. In the last few years, connected cars or smart cars have surged in popularity thanks to the IoT.

https://miovision.com/blog/the-internet-of-things-and-transportation/

4.4. Big data and data mining techniques

Thanks to the development and deployment of ICT (Information and Communication Technology) and ITS (Intelligent Transport Systems), we can easily collect "big data" of pickup-delivery truck movements or goods movements in urban areas at lower costs. The analysis of big data of truck movements in urban areas allows us to gain insights into the behavior of drivers (Yamada et al, 2016).

Logistics is being transformed through the power of data-driven insights. Unprecedented amounts of data can now be captured from various sources along the supply chain. Capitalizing on the value of big data offers massive potential to optimize capacity utilization, improve customer experience, reduce risk, and create new business models (DHL, 2016). Several data mining techniques were used in different areas of logistics in the urban environment as for example, finding the routing patterns of truck drivers (Lin et al. 2013), optimizing pickup-deliveries (Teo et al. 2015) or developing a city logistic model based on a cloud based platform (Xu et al. 2014). Future challenges in the field of big-data technologies for anticipatory logistics, remains the open data exchange between the logistics provider and customer, skills to understand and handle advance analytical tools, and issues of compliance with data security and privacy regulations (DHL, 2016).

Example:

Big data universe beginning to explode

http://www.csc.com/insights/flxwd/78931-big_data_universe_beginning_to_explode

4.5. Physical internet

Physical Internet in connection to city logistics will profoundly change freight transportation and logistics, especially in terms of increased economic, environmental and societal efficiency and suitability. In this sense, several ideas, among other also a vision of hyper connected city logistic system arises (Crainic & Montreuil, 2016). Today the Physical Internet is a vision for an end-to-end global logistic network, but there are plans to turn it into a reality by 2050.

Companies constantly strive to improve the efficiency of the logistics networks that move their goods worldwide. Although performance levels have increased significantly over recent decades, they are far from satisfactory. For example, too many containers and freight vehicles transport empty space or are idle because of operational delays. All too often, disruptions prevent products from reaching consumer markets, adding to the waste that pervades many logistics networks. The Physical Internet proposes to eliminate these inefficiencies in much the same way that the Internet transformed the flow of information around the globe (Saenz, 2016).

Example:

ITS for City Logistics and the Physical Internet

https://www.itscanada.ca/files/Reports/4%20MPF%20CVO%20CityLogistics-PhInternet-ITS_Canada2012.pdf

EU projects MODULUSCHA

http://www.modulushca.eu/

4.6. Automated systems & autonomus vehicles

The trends towards the autonomous logistics is already present at the time. Breakthroughs in the sensor and imaging technologies have resulted in a new generation of self-driving vehicles that are more flexible and reliable than ever before. From autonomous forklifts to driverless trucks, self-driving vehicles will transform logistics by unlocking new levels of safety, efficiency, and quality (DHL, 2016).

The highly automated vehicles are expected to be introduced to market by 2020-2025 and several impacts, especially in the cities are expected such as improvements in transport reliability and urban centres accessibility which would lead to evolving demands and request changes of the business models, requiring private companies and public authorities in charge of transport to assess and anticipate future needs (ERTRAC, 2015a).

Unmanned aerial vehicles (UAVs) or 'drones' could change tomorrow's logistics by adding a new form of express delivery via carefully coordinated air networks. While UAVs won't replace traditional ground-based transportation, they will provide value in areas of high traffic congestion and in remote locations. While self-driving vehicles already reached the level of maturity for commercial use in warehouse operations, the more newly technology, unmanned aerial vehicles (UAVs), or drones, are still limited by several restrictions. At the moment, the commercial use of UAVs is still very heavily regulated in most countries (DHL, 2016).

Example:

Drone Delivery is About to Disrupt the Trucking Industry

https://www.trucks.com/2016/06/21/drone-delivery-reshape-trucking/

Transport Drones & Autonomous Vehicles: The Transportation Mode Dance Card is Getting Full

http://cerasis.com/2016/04/07/transport-drones/

4.7. Transport/logistics optimization (tools):

Truck routing and the decision support system are based on Intelligent Transportation Systems; they require high quality real-time traffic data, information on the road network, and land use in the area. Large benefits can be expected when the guidance system is connected to commercial vehicle operation (CVO) systems to optimize fleet management. The planning process should include extensive stakeholder and government involvement. The costs are mainly those associated with the operational cost of the management system, data collection, analysis and dissemination. There are different CVOs, ranging from low cost technology installations to large-scale networks of systems.

With the rise of competitive online freight marketplaces, more information will be exposed, including prices and customer satisfaction. Thousands of well-run local and regional carriers will be able to compete against the larger firms with larger sales forces. Smaller companies can offer lower rates and better service in the specific market niche they serve.

Dynamic routing systems are used by public authorities to enhance safety and prevent violations of access regulation. The private sector uses in-vehicle routing as part of a decision support system to enhance the efficiency of fleet management (CoE-SUFS, 2016).

Example:

5 Benefits of TMS (Transportation Management System)

http://cerasis.com/2013/06/13/benefits-of-tms/

4.8. Tube underground and long distance systems

The system consists of special, dedicated freight pipeline networks that are either newly built or integrated into modified and existing pipes. It enables high-volume movement of freight into highly congested areas with no impact on surface transportation systems. It can also reduce noise and air pollution (DHL, 2016).

The spread of long-distance systems could one day enable ultra-express delivery between major cities (e.g., for medical deliveries). The system is based on the tube using magnetic propulsion technology to potentially reach speeds of up to 1,200 kilometers per hour (DHL, 2016). Several tube logistics solutions are already used, such as Mole Solutions – underground freight pipeline system, Hyperloop Technologies – conceptual high-speed transportation system could change passenger and goods transport, Loglay – underground cargo system (DHL, 2016).

4.9. Other frontier technologies

Low-cost Sensor Technology enable new applications within the logistics industry. With access to low-cost sensors, logistic is likely to increase the use of sensors, like sensors-equipped mobile devices, creating smart infrastructures for monitoring, inspecting, and volume scanning in the supply chain (DHL, 2016).

Digital identifiers enable more mature management of supply chains by providing new levels of transparency, traceability, and authentication. Several new technologies have been developed like invisible barcodes, NFC, and QR codes, which enabled the adoption of smart printing/tagging and biometric devices. Currently there is still lack of international standards, privacy policies and acceptance and data protection issues, which would enable wider use of such technologies (DHL, 2016).

Augmented reality (AR) will provide new perspectives in logistics planning, process execution, and transportation. By adding virtual layers of contextual information onto a heads-up display, AR empowers workers by providing the right information, at the right time, and in the right place. In the area of machine-human interaction and collaboration in logistics a lot of improvements has been carried out influencing the efficiency of logistics processes. Augmented reality (AR) accessed via smart glasses have exceeded predicted levels of impact. So far mainly adopted for order picking in logistics (also known as 'vision picking'), smart glasses enable intelligent, hands-free operations (DHL, 2016).

Bionic enhancement technologies have the potential to support the logistics workforce in areas such as communication, process execution, optimization and, most importantly, minimizing health and safety risks in the supply chain. Such technologies like smart wearables and exoskeletons, have revolutionary potential for hands-free task execution. Although such technologies are currently immature for commercial use (DHL, 2016).

Automation technologies like collaborative robotics will significantly rise in order to meet increasingly complex customer needs and to cope with the aging workforce and skills shortages. Robotics and automation technologies support zero-defect logistics processes and enable new levels of productivity. The new generation of collaborative robots and automated solutions with significantly improved performance and enhanced sensing capabilities offers a genuine alternative to manual handling (DHL, 2016).

C. Possible future scenarios

In the previous chapter identified trends will definitely have an important impact on FUAs freight transport activities in the future. It is therefore very important to understand expected impact of these changes and include them into the regional and urban planning strategies.

In order to make this a bit easier, identified trends are summarized and shortly described in the following tables, with additional assessment on their potential impact on FUA freight transport. Impact assessment is made based on indications identified in the literature and is ranged from low, medium to high impact and divided into short term (less than 5 years) and long term (more than 5 years) category. Division on short term and long term impact is in this report considered also as a short term and long term scenario. Each of the following table is describing trends on a specific topic coherent with 4 different chapters in the report.

Consumption and production scenarios

Topic	N.	Trend	Short description	Impact on FUA freight transport * low; ** medium; *** high	
				Short term < 5 years	***Long term > 5years***
1. Consumption and production	1.1.	*Production closer to end user*	*Bringing the production closer to the end user results in fewer transportations, shorter lead times and easier planning of logistics flows as well as making corrections to shipping plans.*	x	xxx
	1.2.	*Regional food supply*	*The rise in farmers markets shows that demand for a trusted local and regional food supply is growing. Regional food supply is growing and is expected to increase in the future.*	x	xx
	1.3.	*3D printing*	*3D printing is an emerging manufacturing technology that can be used to create specialized products at distributed locations such as retail outlets or even within households.*		xx
	1.4.	*Bach size one production*	*Batch size one (i.e., only one item is produced) requires highly automated production sites and imposes complex new requirements on supply chains.*	x	xx
	1.5.	*E-commerce*	*With the trends of e-commerce the consumer is allowed, more and more, to take part in defining the e-logistics that suits him or her, in terms of price, quality, time, green and/or fair.*	xx	xxx
	1.6.	*Sharing economy*	*Two important aspects of sharing economy: collaborative consumption (consumer to consumer networks) and collaborative business (sharing logistics infrastructure and services with competitors).*	x	xxx
	1.7.	*Circular economy*	*Growth of capacities for regionally recyclable materials and growth of collecting points and capacities for non-regionally recyclable materials.*	x	xx
	1.8.	*Grey power logistics*	*Grey power logistics is the logistics for an aging society. Population ageing will become one key driver of demographic trends in Europe and is likely to drive consuming and logistics.*	x	xx

Expected scenarios for "Production & Consumption:

- **E-commerce is going to heavily influence FUAs freight flows in the future**

More consumers (also at age over 60) are buying stuff online instead of visiting the physical stores. As the e-commerce is growing, so are the home deliveries. Based on that we can expect an increasing number of urban freight vehicles, which will additionally contribute to traffic congestion.

The growth in the home delivery channels and the increasingly comprehensive range of services offered by retailers (such as click & collect) all lead to changes in the pattern of urban/regional freight flows and vehicle movements in cities.

- **Regional/local production and regional food supply is expected to grow**

Increasing amount of production (manufacturing) will be brought closer to the end users. This will result in fewer transportations, shorter lead times and easier planning of logistics flows as well as making corrections to shipping plans.

The demand for a trusted local and regional food supply will grow. This will change regional supply chain and effect intra and inter FUA transport /logistics processes.

3D printing will be used to create specialized products at distributed locations such as retail outlets or even within households. 3D printers will on a long run reduce freight transport particularly the distribution of goods. They will also reduce storage at warehouses and retail outlets as well as waste such as packaging.

- **Sharing and circular economy is expected to change consumers and logistics providers behaviour**

Consumers will share access to products or services, rather than having individual ownership. Collaborative business will involve in sharing logistics infrastructure and services with competitors. Sharing assets and capacities will result in increased consolidation and higher capacity utilization, which will reduce the number of freight movements, the fleet size, and empty travel for collaborating logistics services.

Circular economy will evolve. Growth of capacities for regionally recyclable materials and growth of collecting points and capacities for non-regionally recyclable materials are expected. Logistics will need to offer customers unique value by helping to incentivize greater participation in the circular economy through a seamless and convenient take-back model. Offering pre-paid shipping labels, smart packaging and convenient take-back mechanisms will fuel market demand.

Spatial organization scenarios

Topic	N.	Trend	Short description	Impact on FUA freight transport * low; ** medium; *** high	
				Short term < 5 years	*Long term > 5years*
2. Spatial organization	2.1.	*Logistics sprawl*	*Relocation and concentration of logistics facilities (warehouses, cross-dock centres, freight terminals etc.) towards suburban areas outside city centre boundaries*	xx	xx
	2.2.	*Spatial concentration / stocking*	*Use of fewer, large-scale national and regional distribution centres that serve a far larger geographical area.*	xx	x
	2.3.	*Spatial planning*	*Spatial planning determines business site locations and it need to be coupled with transport policy. FUA-level planning and strategy development needs trust between stakeholders.*	x	xxx
	2.4.	*Distribution/consolidation centres*	*Urban distribution/consolidation centre collects shipments in a specialized warehouse at the edge of the city, where they are consolidated before being shipped into the city for last mile delivery.*	x	xx
	2.5.	*Construction consolidation centres*	*A 'Construction consolidation Centre' is specifically located and geared to service the needs of an urban area with tight logistical constraints (housing developments, in-city developments and renovations).*		x
	2.6.	*Multi-story logistics facilities*	*Multi-story logistics facilities mixing logistics activities and other types of activities (data centre, offices, sport, urban agriculture) located within dense urban areas.*		x
	2.7.	*Pick-up point networks*	*Locations where customers can pick up their orders. They can be unattended, e.g. locker boxes, or attended, e.g. fuel stations.*	x	xxx
	2.8.	*Integration of public and freight transportation networks*	*Combining people and freight flows using different people-based modalities for freight flows, i.e., using spare capacity in public transport systems (e.g., rail, bus, and subway)*	x	xx
	2.9.	*Management of logistics transhipment facilities*	*Making better use of streets' capacities available for urban freight and finding smarter solutions for sharing space in cities including management of loading/unloading areas, drop-off/pick-up points, transhipment area, mixed-use lanes.*		x
	2.10.	*Direct Injection*	*Transporting goods directly into the city using alternative mass transportation means (e.g. ships and freight trains), after which vans and other last mile delivery transportation means must cover only very short distances.*		xx

Expected scenarios for "Spatial organization":

- **Logistics sprawl and spatial concentration / stocking will have important short term impact un urban/regional freight flows**

Growth in the population living in the central city areas, rising land prices and increasing traffic congestion in urban areas will continue to force companies to relocate warehouses to suburban areas (outside city centre boundaries). Logistics sprawl is expected to increase the distance travelled by freight vehicles who service retail, commercial and residences in inner city areas.

Spatial centralisation of stockholding will be further adopted by manufacturers and retailers in order to achieve cost savings in their supply chains resulting in an increase in the use of fewer, large-scale national and regional distribution centres that serve a far larger geographical area. Consequently the urban areas will be supplied from these large centres thus increasing deliveries to urban centres whereas smaller distribution centres within urban areas will discontinue.

- **Spatial planning is going to be coupled with coherent spatial and transport policy**

Improving accessibility for different modes of transport will be a basic requirement for further economic development of a FUA. FUA-level planning and strategy development will need to evolve and gain trust between the municipalities, special cooperation instruments and promise on proportionate use of development means. Spatial planning will determine business site locations (in various qualities and for different target groups, thus creating favourable conditions for private investments). This will have a major contribution to a region's attractiveness.

- **Urban distribution/consolidation centres and pick up points**

Further implementation of urban consolidation centres (UDCs) is expected with new business models able to cover the investment in the infrastructure. Due to difficulties to gain critical mass of users, only medium long term impact is expected.

Variety of pick up points (unattended, e.g. locker boxes, or attended, e.g. fuel stations) are expected in the future. Impact of pick up points on FUA freight transport is expected to be very high, especially in city centres.

- **More intense integration of public and freight transportation networks is expected in the future**

Sustainability issue will foster integration of public (passenger transport) and private (freight) transport networks. Spare capacity in public transport systems (e.g., rail, bus, and subway) will be used for retail store replenishment. Bus schedules might be adapted to accommodate delivery of small boxes to urban retail outlets. Trains can replenish inventories of railway station based stores and restaurants.

- **Direct Injection brings goods directly into the city using alternative mass transportation means**

In that case, vans and other last mile delivery transportation means will cover only very short distances. This measure is expected only in the biggest CE cities with extensive congestion problems.

Supply chain management & distribution scenarios

Topic	N.	Trend	Short description	Impact on FUA freight transport * low; ** medium; *** high	
				Short term < 5 years	*Long term > 5years*
3. Supply chain management & distribution	3.1.	*Logistics industry consolidation*	*Small 3PL service providers will merge and work for the global 3PLs. "There will be limited room for mid-size generalists,"*	x	xxx
	3.2.	*Vertical and horizontal collaboration*	*Vertical and horizontal collaboration. Leading to concepts such as Collaborative Planning Forecasting and Replenishment (CPFR), Efficient Consumer Response (ECR).*	x	xxx
	3.3.	*Green supply chain principles*	*Increasing focus on social and environmental challenges in supply chain. transparency within supply chains, and require new circular economy concepts in logistics.*	x	xx
	3.4.	*Omni-chanel logistics*	*Omni-channel retailing foresees the integration of several on-line and off-line retail channels in which consumers can buy, pick up or receive goods and manage payments.*	xx	xxx
	3.5.	*Freight Quality Partnerships - FQP*	*Stakeholders (local government, businesses, freight operators, environmental groups, the local community) are working togather to address specific freight transport problems.*	x	xxx
	3.6.	*Of peak hours deliveries*	*Shift of deliveries from the regular hours (6AM to 7PM) to the off-hours (7PM to 6AM). Of peak delivery programmes (incentives)*		x
	3.7.	*Unbundling of logistics services*	*Established supply chain services can be unbundled into singular solutions. On-demand brokerage platforms like Uber rush.*	x	xxx
	3.8.	*Delivery to the trunk of a car*	*Ability to deliver to the trunk of the customer's car. One-time keyless access to the car's trunk during a specific time period.*	x	x

Expected scenarios for "Supply chain management & distribution":

- **Collaboration and logistics industry consolidation is expected to decrease FUA transport flows**

With the "Internet of everything" concept expanding, there are more opportunities to connect supply chains (the trend of connected supply chains) and increase the visibility from order initiation to order delivery. Logistics providers (3PL) will merge and all the rest will increase their readiness for collaboration. Consolidation of logistics providers will lead also to consolidation of freight flows and consequently have very positive impact on regional freight flows.

- **Collaboration among different SC stakeholders and public authorities will become a standard**

Establishment of Freight Quality Partnerships, Living labs and other means will help local government, businesses, freight operators, environmental groups, the local community and other interested stakeholders to work together to address specific freight transport problems.

- **Implementation of new technologies will lead to on demand services and unbundle logistics services into singular specialised options.**

On-demand brokerage platforms will match demand and supply for logistics services such as Uber Rush for on demand delivery services in cities. The ultimate vision for these platforms is a supergrid coordinating multiple marketplaces.

- **Omni-channel retailing foresees the integration of several on-line and off-line retail channels in which consumers can buy, pick up or receive goods and manage payments.**

Logistics, will become the backbone of retail and will need to react and offer innovative omni-channel solutions that satisfy the demand for more personalized, dynamic delivery options as well as fulfilment services at a competitive price level. Over the past two years, this has led to the development of new solutions to facilitate last-mile delivery such as same-day and even same-hour delivery models (e.g., Amazon Prime), individual parcel lockers (e.g., DHL Paketkasten), and even delivery-to-car-trunk concepts.

- **Green supply chain principles will become more and more important**

Companies will increasingly focus on turning social and environmental challenges into opportunities by creating fair and sustainable solutions that generate social as well as business value along the supply chain. This trend will increase transparency within supply chains, require new circular economy concepts in logistics and will impact or perhaps even disrupt the logistics industry over the coming years.

- **Innovative delivery concepts will emerge**

Off-Peak Delivery (OPD) programs may offer relief for traffic management problems in cities, which are often caused by last-mile deliveries. These deliveries make up more than 80 percent of all freight traffic in urban areas.

Another opportunity to deliver to a more convenient location than the home of a customer is the ability to deliver to the trunk of the customer’s car. The technology will allow a customer to authorize a one-time keyless access to the car’s trunk during a specific time period.

Technologies & equipment scenarios

Topic	N.	Trend	Short description	Impact on FUA freight transport * low; ** medium; *** high	
				Short term < 5 years	*Long term > 5years*
4. Technologies & equipment	4.1.	*Clean vehicles*	*Reducing the impact of freight in urban area. Energy savings due to higher fuel efficiency.*	xx	xxx
	4.2.	*ICT and ITS systems*	*Providing oppoprtunities for improving the performance of urban freight systems. Management, monitoring, enhancing efficiency, reducing the impacts of goods movement in urban areas.*	xx	xxx
	4.3.	*Internet of Things*	*Providing a platform for decentralized management for city logistics. Improving city logistics operations and logistics providers' business strategies.*	x	xxx
	4.4.	*Big data and data mining techniques*	*Capitalizing on the value of big data offers massive potential to optimize capacity utilization, improve customer experience, reduce risk and create new business models. Data mining techniques enables optimisation of logistics and urban freight.*	x	xxx
	4.5.	*Physical internet*	*Physical Internet will profoundly change freight transportation and logistics, especially in terms of increased economic, environmental and societal efficiency and suitability. It will eliminate an inefficiencies of logistics networks.*		xx
	4.6.	*Automated systems and autonomous vehicles*	*Automated system and vehicles have potential to improve transport reliability and urban centres accessibility . Leading to: changes of the business models, requiring private companies and public authorities in charge of transport to assess and anticipate future needs.*		x
	4.7.	*Transport/logistics optimization (tools)*	*Optimisation of transport in urban freight enviroment. Imporving transport decision support systems.*	xx	xxx
	4.8.	*Tube underground and long distance systems*	*Reducing the impact of passenger and good transport on the surface transportation system. Reducing noise and air pollution. Enabling ultra-express deliveries.*		x
	4.9.	*Other frointier technologies*	*Intorducing new applications within logistic industry. Providing transparency, traceability and authentication of supply chain managment. New perspectives in logistics planning, process execution, and transportation.*		x

Expected scenarios for "Technologies & equipment":

- **Increasing share of clean vehicles for urban distribution**

  Alternative fueled vehicles (AFVs) will gain its place in urban freight deliveries. Improved internal combustion engine vehicles (ICEVs) will still play a predominant role on short run while on a longer perspective mainly hybrid of electric driven vehicles will take its major share.

- **Information and communication technologies (ICT) and intelligent transport systems (ITS) will disrupt urban logistics**

  The implementation of ICT for city logistics will lead to price reduction and influence changes in behaviour of individual companies and consumers and city's logistics system. The internet and ITS will not only influence the logistics system, but also the B2C and B2B e-commerce, e-logistics, e-fleet management and collaboration possibilities for customers and logistics providers.

- **Internet of Things (IoT) represents crucial element towards the digitisation of logistics services**

  IoT can provide a platform for decentralized management for urban logistics. Quickly transforming data into decisions will increasingly become a reality and a key technological enabler to improve city logistics operations and logistics providers' business strategies. The Internet of Things empowers smart objects to be active participants in self-steering, event-driven logistics processes.

- **Big data and data mining techniques will enable to increase logistics efficiency beyond todays expectations**

  Based on ICT and ITS, we will easily collect “big data” of pickup-delivery truck movements or goods movements in urban areas at lower costs. The analysis of big data of truck movements in urban areas allows us to gain insights into the behavior of drivers and identify potential for improvements.

  Unprecedented amount of data will be captured from various sources along the supply chain. Capitalizing on the value of big data will offer massive potential to optimize capacity utilization, improve customer experience, reduce risk, and create new business models.

- **Transport optimization tools and services will improve efficiency of urban deliveries**

  Based on IoT and Big data, real time optimization of transport services will be possible. Dynamic rescheduling and redistributing of freight vehicles and packages will allow higher load factor and lower number of empty trips and empty kilometres.

- **Phisical internet is a vision that will lead research and attempts to solve urban freight deliveries in the future**

  Today the Physical Internet (an open global logistics system founded on physical, digital, and operational interconnectivity, through encapsulation, interfaces and protocols) is a vision for an end-to-end global logistic network, but there are plans to turn it into a reality by 2050. Once implemented it will have important consequences for urban deliveries.

D. Conclusions

To date, significant consideration is being focussed on promoting sustainable (urban) mobility – walking, cycling, public transport, car sharing, electric vehicles, speed reduction and road safety measures etc. – with varying degrees of success. The question of including freight transportation in such integrated mobility management systems has proved more difficult, in a context where many actors and multiple decision makers are involved and where urban goods and service movements are extremely complex.

When deciding to develope Sustainable Urban Logistics Plan we don‘t need only to allign our expectations with different stakeholders but we need to understand also development trends that will have an important impact on future FUA freight flows. This report summarised these trends in order to provide a basis for understanding the situation and based on that tried to provide scenarios of future development.

Not only the trends, also the existing strategic and political documents will contribute to future developments. For example, the White Paper on transport is setting very ambitious target to achieve "essentially CO2-free city logistics in major urban cities by 2030". This will heavily affect also expectations for regional supply chain and tending towards e-mobility for freight deliveries.

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