The digital issues of urban logistics

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Abstract:
Urban logistics refers to all services that help to efficiently manage the shipping of merchandise in urban areas and innovatively respond to demands (from firms as well as private persons) while maintaining social and environmental conditions at the right level. It is now very efficient, since the large majority of customers are serviced by transportation firms; but the cost of this efficiency is not negligible, neither environmentally nor socially. The coordination and efficiency of deliveries in urban areas must be improved to limit the nuisances and negative externalities of freight transportation (congestion, pollution…). A new paradigm, which involves massively using digital technology to optimize the flow of merchandise, is visible in the innovative firms that can change the current situation. Besides adapting urban areas to the needs of these new logistics services (with, for example, the creation of hubs, or centers of distribution, in downtown areas), another stake is the knowledge brought via data, which must be more widely used.

The new urban logistics

We can define urban logistics as a service that helps us efficiently manage freight movements in cities and that innovatively responds to demand (from firms or individuals) while upholding relatively sound social and environmental conditions (DABLANC 2019).[1] It comprises several physical operations, such as preparing and packing orders, shipping and delivering them (including to households) as well as the short-term storage of merchandise and management of points for deposits, returns, empty pallets and packaging. These operations rely on a growing number of information and telecommunication systems. Urban logistics is rapidly evolving owing to the continual sophistication of global logistic chains, technological trends and changes in consumer behavior patterns. In effect, consumers ever more eagerly engage in e-commerce, which has become "omnichannel". Same day or even "instant" delivery has become common in global metropolitan areas (DABLANC *et al*. 2017).

The most innovative aspects of urban logistics rely on fine-tuned technology to improve the coordination and efficiency of urban delivery operations. Nonetheless, most operations for delivering and collecting merchandise in cities are still inefficient due to an excessive number of trips and a fleet of old, polluting vehicles. To lower costs and augment environmental performance, novel practices are emerging that involve several parties: shipping and transportation firms, software distributors, real estate developers, big retail chains and start-ups in all fields. New logistic services are cropping up in cities around the world, especially in zones where business is dense, such as downtown areas. They have opened the way toward a more sustainable supply chain management.

[1] This article, including quotations from French sources, has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few bibliographical references. All websites have been consulted in October 2019.

Entrepreneurial initiatives

Over the past ten years in Asia, Europe and United States, and more recently in all urban areas around the world, the digital revolution has ushered in new concepts; and new firms specialized in urban have emerged.

Some companies, like Shurgard, are innovating by offering urban storage facilities to businesses. Star Service, a French company with 2000 delivery agents, has invented a professional service for delivering groceries to households. In Germany, DHL/Deutsche Post was the first to install thousands of automated booths ("packstations") in cities for the delivery of online orders to customers at any time of day. In Japanese cities, the *takkyubins* (door-to-door delivery service companies such as Yamato Transport and Sagawa) reacted fast to changes in consumer behavior patterns and are now delivering anything (from ordinary packages to frozen food, not to mention bulky items like personal luggage); they have increased the size of their networks, the diversity of their services, and their efficiency in logistics.

Figure 1: **A freight bike making a delivery in Paris**.
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In Paris and London, companies using freight bikes deliver packages to end destinations (firms or inhabitants in urban areas). This has advantages for the environment. Petite Reine, a company belonging to the Star Service group, has forty electric bicycles in service in Paris, and thus saves an estimated two hundred tonnes of CO_2 per year compared with the previous use of vehicles with diesel engines.

Big courier companies, like La Poste, FedEx or UPS, ever more often use electric vehicles for urban deliveries. In American cities, micro-services of logistics, such as Amazon's "lockers", are being offered in residential estates, on university campuses and in Whole Foods supermarkets. Like many other entrepreneurs, Amazon is testing delivery by drone. JD, a Chinese e-retailer, has already deployed a drone delivery network around the city of Xi'an. Nuro's ground robots are being tested on regular lines for delivering groceries ordered from big retail chains to households in the exurbs of cities in Arizona and Texas. Other small ground robots, better adapted to urban areas, are circulating in California, Australia and the United Kingdom. In addition, driverless delivery vehicles are being designed (Renault EZ Pro), although very few have yet been deployed mainly because of regulatory requirements or technical problems related to the very high level of security required to protect other users of city streets from driverless vehicles.

"Instant" on-demand delivery now takes less than two hours after an order made by using smartphone applications. In this new market, regional companies (Meituan in China, Deliveroo in Europe, Swiggy in India, IFood in Brazil and Postmates in the United States) are competing with global firms such as Amazon Prime Now and UberEATS.

Because they use electric vehicles or unconventional modes of transport, some of these innovative services require, in order to keep the promise of fast deliveries, logistic centers close to consumers (especially in dense urban areas). These centers will range from "microhubs" (a few square meters) to warehouses (up to 30,000 m^2). A fundamental issue will, therefore, be to identify the lots and buildings available for these new facilities.

Timid municipal authorities

In pursuit of goals related to efficiency or the environment, many cities are backing innovations in urban logistics. Reykjavik, Iceland, has allowed Flytrex and the distributor Aha to organize a regular drone delivery line over one of the bays in the urban area. In a partnership with the cities of Zurich and Lugano, Swiss Post is using drone delivery for pharmaceutical products.[2] Freight bikes are a hit in several cities. Festivals of "cargo bikes" were organized with municipal backing in Groningen, Netherlands, in June 2019 and, a few days later, in Dublin, Ireland. Under the Parisian policy of innovation in logistics, Rolling Lab, a program for helping start-ups in this field, has been set up.

Innovation policies are wanting however. Most of the aid granted by European cities to innovation takes place under European or national programs oriented toward demonstrations, which are innovative but costly and have a limited diffusion. Meanwhile, cities realize that innovations in e-commerce are accelerating and now propose delivery services; but they still have not coordinated reactions to this change in business. Municipalities in Europe design their own regulatory policies about, for example, the online platforms that offer local delivery services or the installation of automated stations in public areas. In addition, the optimized management of urban logistics by public or private algorithms is still not well developed. Software for planning and optimizing itineraries fails to take into account, for example, information about the streets closed for road work or municipal regulations about vehicle access or deliveries.

Recent trends in regulations about delivery vehicles and their access to urban areas are pushing municipalities toward the most advanced traffic management technology. The rules and regulations taking shape in European cities mainly concern the age of delivery vehicles or fees (urban toll stations) (DABLANC *et al*. 2018). These two approaches can be combined, as in London's "congestion pricing": an "ultra low emission zone" (LEZ) with a toll of £12.50 for cars, motorcycles

[2] In January 2019, when a drone made an emergency landing on the lake, city officials in Zurich discussed whether to suspend the flight permit until an explanation (a short circuit) for the accident was found.

and small trucks but £100 for "large goods vehicles". Unlike this environmental zoning of areas as low emission zones, toll booths do not target utility vehicles alone. Since 2018, London forbids trucks built before 2001 (the Euro IV standard) from entering low emission zones. This regulation applies on the M25 motorway in a zone of approximately 1500 km^2. Camera surveillance has improved the enforcement of low emissions zone. Automatic control systems *(e.g.*, for reading license plates or monitoring vehicle movements and locations) and onboard equipment have been introduced in many in Asia and Europe. This technology not only comes at a cost but also has stirred up controversy about privacy protections. However, its efficiency is reason enough for cities to ask lawmakers to be allowed to use it (as exemplified by the French case discussed hereafter).

Urban freight policies are now setting objectives for reducing the noise caused by deliveries and boosting deliveries in the late evening, night or early morning hours. According to a survey conducted in New York, the firms most likely to switch to off-hour services are retail businesses that make their own deliveries (shipping on their own) and, on the receiving end, businesses that open late, such as restaurants (HOLGUIN-VERAS 2008). In the Netherlands, the national government offers financial aid to operators who invest in relatively silent delivery equipment (vehicles as well as shipping and handling equipment with a noise exposure limit below 65 dB) for nighttime deliveries to supermarkets. Tests have shown that nighttime delivery firms save 30% on delivery costs and 25% on diesel fuel consumption (SANCHEZ-DIAZ *et al*. 2017).

Freight couriers need easy access to zones reserved for loading and unloading, whether public or private, on or off the street. When such zones are lacking, delivery operations have to be made in the street or on the sidewalk with, as a result, congestion and accidents. In urban and downtown areas with heavy traffic, adequate loading and unloading zones must be identified in public areas; and their use, better supervised. If these zones are shared following a schedule, more trucks and utility vehicles can load and unload. In Barcelona, the municipality has reserved the two side lanes on major boulevards for traffic during rush hour, for deliveries outside rush hour and for residential parking overnight. Since 2018 under the AreaDUM system, deliverers have to register via a smartphone application. Once the delivery vehicle arrives in the zone, the application locates it and opens a time window of thirty minutes for the delivery.

A French bill of law touches on urban logistics

A French bill of law on mobility barely broaches the topic of urban logistics, even though a few articles (*e.g.*, about driverless vehicles) do have implications for freight transportation. Article 17, as it now stands,[3] calls for the security of the platforms on which individuals offer transportation services to other individuals. These services for "*co-transporting packages*" are defined as the "*use in common, for a private purpose, of a private car on a for-free basis except for the sharing of costs, to transport packages in the course of a trip that a driver makes for his own account*". This article would allow the government to issue executive orders about the activities of these platforms, which are brokers between a party who has merchandise and a party who will transport it. Article 20 would allow instant delivery platforms to draft a charter that states their liability in relation to delivery agents. Article 28 would allow the municipalities that establish "*low emission zones*" (ZFEs, which replace the former "restricted circulation zones") to set up "*fixed or mobile means for the automated control of vehicles' identifying data*".

[3] Version of 23 May 2019 following discussions in the National Assembly.

Among the big countries in Europe, France and Germany do not allow cities to use surveillance cameras to automatically collect license plate numbers, whereas this system has proven its mettle in London and in Italian and Spanish cities. The French bill of law would limit the use of such systems to controlling no "*more than 50% of the daily average number of vehicles circulating in the zone*" per day.

Improving knowledge by using big data and analyzing data from satellites

In many cities around the world, not enough effort is being devoted to collecting data and using them for model-building about urban freight logistics. Despite much progress during the last decade, we can hardly compare results among cities because such different methods have been used in the studies made. In France, the FRETURB model has a methodology well adapted to urban economies (TOILIER *et al*. 2018). By using exhaustive but expensive surveys, it identifies the needs of urban establishments with regard to the shipping and delivery of merchandise. These surveys have brought to light a key ratio in French cities: there are as many B2B (business-to-business) urban deliveries weekly as their are jobs in the metropolitan area (TOILIER *et al*. 2018). According to estimates from Rensselaer Polytechnic Institute, there are now as many home (B2C: business-to-consumer) deliveries in New York as deliveries to companies. The B2C/B2B delivery ratio might be less in European cities, but we lack the data for corroborating this. Out of 750,000 loading and unloading operations per week in the Lyon urban agglomeration, 20% were B2C: 55% home deliveries; 40% deliveries at pick-up points; and 5% store deliveries (GARDRAT & CORDIER 2018).

Paradoxically, detailed data about B2C deliveries are abundant, since, on the business side, shippers, distributors and logistic services have fully digitized these operations. However firms or their trade associations are still reluctant to open these data to public officials and for research. Detailed surveys cost too much for budgets in the public sector and have to be completed with automated systems for collecting and processing big data.[4]

Optimizing urban space for the new logistics

Some municipalities accept, even support, the building of installations with multiple activities — logistical services at street level or underground and other business on the upper storeys. Some warehouses have several storeys. For a long time now, the developer Prologis has been building logistic centers seven to ten storeys high in the center of Tokyo. Multistorey warehouses were opened in Seattle in 2017 and in Gennevilliers in January 2019. Sogaris's "logistics hotel" (multibusiness, multistorey, multimodal) was inaugurated in Paris in 2018. The acceptance of such projects increasingly hinges on environmental factors, and special attention is paid to integrating the buildings in the urban setting.

[4] Bates *et al*. (2018) have made an interesting proposal and tested it in a London neighborhood.

Figure 2: Plans for the multimodal freight center of logistics, Sogaris "Chapelle International". ©SOGARIS PARIS-LES ESPACES LOGISTIQUES URBAINS & SAGL-Architectes Associés

"Centers of urban distribution" have often been presented as an interesting strategical element for reducing the impact of urban freight. These installations offer grouped, pooled delivery services. There were as many as two hundred such centers in European cities in the 1990s and first decade of the new century. Since they had high operating costs, most of them shut down when municipalities were no longer able to subsidize them. However a few are still in operation, mostly in middle-sized cities: Bristol in the United Kingdom, La Rochelle in France, Modena and Padua in Italy, and Yokohama in Japan. These centers are onerous, and it is hard to ventilate their operating costs.

Private or private-public programs have been launched to develop small logistics centers (microhubs). In the United States, the startup CloudKitchens/City Storage System has converted abandoned buildings in urban areas into places for "food tech" and the digital economy. Several French cities, in particular Paris and Lyon, have programs that provide space for services of logistics, small installations for transshipments located in dense urban neighborhoods (*e.g.*, underground parking). Rent for space of this sort is low for operators who offer environmentally friendly delivery services. Among the projects accepted as part of the programs "Réinventer Paris" or "Inventons la Métropole du Grand Paris", some will convert "forsaken urban spaces" to logistics: abandoned service stations (Porte de Champerret), spaces under the ring road (Porte de Pantin) and underground parking (Grenier-Saint-Lazare).

Conclusion

Despite traffic difficulties and the costs stemming from drawbacks in urban areas, firms are providing logistical and transportation services to the large majority of their urban customers. In this respect, urban logistics has become very efficient — an efficiency with an environmental and social cost. Freight accounts for from 10% to 15% of all transportation (vehicle-kilometers) in urban areas; and for up to a third (or even more) of local pollution and CO_2 emissions (COULOMBEL *et al*. 2018). The digital economy's new delivery services often rely on a self-employed workforce with very inadequate protection under social security but a very high risk of accidents (AGUILÉRA *et al*. 2018).

To address these issues a new urban logistics has emerged that relies heavily on digital technology. It tries to respond to the demand from urban firms and consumers for new services while finding solutions to cities' concerns with the environmental and social effects of deliveries in urban areas. However the pace for introducing this innovative logistics is slow, varying considerably

from city to city. Some cities (like Tokyo) have an efficient urban logistics with equipment and facilities in very dense urban zones. Some cities (as in Europe) with "smart logistics" in neighborhoods and historical downtown areas are conducting high tech experiments and organizing mass delivery services, including home deliver, that are cleaner and less noisy. Nonetheless, there are many neighborhoods outside the center in these cities (and many big cities around the world) where freight transportation still causes too much congestion and too many emissions, where the fleet of delivery services using two-wheeled vehicles is increasing and where, as a consequence, delivery agents are running major risks of accidents. Thanks to a much more systematic collection of data (which are, at present, insufficient), advances in digital technology will probably help us better understand freight flows and their impact on the environment. These better statistics, along with advances in the models of urban freight flows, will contribute to the formation of local organizations and policies better adapted to the urban environment.

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