Strategies for Reducing the Impacts of Last-Mile Freight in Urban Business Districts

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Introduction

Nearly all economic activity in urban areas depends on the movement and delivery of goods through freight carriers. Thus, the freight system is directly implicated in the livelihood and liveliness of successful urban spaces. However, the great majority of urban freight is carried by trucks, which, for a variety of reasons, actually threaten the same urban space that they support. Trucks contribute to air pollution, are noisy and unsightly, and take up a large share of roadspace—both while moving and while parked for loading and unloading. Places that rely on freight the most, such as business districts—where there is a concentration of people and activities—may also be the most harmed by freight. Under the current paradigms, these problems can only be expected to worsen as the demand for urban freight increases.

In this paper, I review the challenges and consider policy and planning solutions for freight management and operations in urban areas (also known as urban logistics), especially business districts. Considering both the freight needs of a business district and the infrastructure needs of a freight system, what policies and innovations can help urban logistics tread more lightly? Drawing on urban logistics literature and real-world examples, I examine how to move freight over its “last mile” in ways that would benefit the overall livability of an urban area. Solutions generally either 1) regulate freight vehicles to decrease the impact of their presence, 2) improve on inefficiencies in the current system, or 3) move urban freight without the use of automobiles. I find that an integrated, multi-modal system, based on strategically-located distribution centers, is key for improving livability and urban freight efficiency in the long term.

Common Urban Freight Challenges

Much of the visible freight activity in urban areas is the movement of deliveries destined for local businesses and homes, or last-mile freight. It is a vital economic underpinning, but last-mile freight in urban areas competes for limited public space and creates a number of negative externalities which threaten livability. Thus, the last leg of the freight system is challenging both for the city, whose “concerns include optimizing capacity and safety of streets for all users,” and
for the shippers, who wish to “minimize logistics costs without adversely affecting customer service” (Seattle Urban Mobility Plan, 1). Of course, the specific conditions for urban freight vary depending on the location, layout, infrastructure, policies, trade activity, and consumer behavior of different cities. There is also surprisingly little recorded information about the characteristics of urban freight flows (Giuliano, 72). Still, major trends and challenges for urban freight in developed countries have been observed, and together these provide a useful starting point for remediation.

Typically about 80 percent of freight with a local destination is carried by truck. How much of all urban motor traffic is made up of freight vehicles varies depending on the city and time of day—I’ve seen estimates as low as eight percent and as high as 67 percent. The average share of freight vehicles on urban roads may be generally low (12 percent was the average in Rome, for example), but the impact of these vehicles on city spaces is significant (Danielis, 119). A truck in a traffic flow accounts for two to three passenger car units on “flat, straight road sections” and two to five at intersections (Giuliano, 73-74). This affects the overall traffic flow and level of service on urban roads and highways, and increases congestion. The loading and unloading (l/u) activities of delivery trucks also slow traffic and consume parking spaces or other potential street uses. This is a significant drawback from livability and economic perspectives—ground level unloading zones reduce space available for the retail and other business and pedestrian activity (such as outdoor seating) which can make an urban space thrive (Monami, Koojiman, and Duchâteau, 259). Additional livability problems caused by large delivery vehicles include “noise, visual intrusion, physical intimidation (of pedestrians and cyclists),” and traffic accidents (Allen and Browne, 285).

Most delivery trucks are diesel-powered and emit fine particulates and other pollutants into the air, which contribute to climate change and poor air quality. Especially along congested corridors, public health suffers when streets are choked with gas- and diesel-powered vehicles. The public health and environmental problems caused by emissions can likewise be seen as a barrier to livability.

Trucking in the city is no picnic for freight operators, either, as the urban landscape can be an inhospitable place for freight movement. Often, city and traffic planners show a general disregard for and misunderstanding of freight needs. Many cities lack adequate l/u space and surveys reveal that l/u bays are illegally occupied by non-freight vehicles up to half the time
Other problems that affect freight operators include a “fragmented goods flow,” receiver-related difficulties (like special delivery time requests, waiting in line to make deliveries/collections, or trouble finding the receiver), and a lack of coordination among urban freight actors (Allen and Browne, 286; Monami et al., 245-246). The latter problem in part contributes to “declining load factors” (that is, more empty trucks on the road), which was observed in a Tokyo freight traffic study and is regarded as a typical problem. Likewise, “circulation traffic”—meaning round trips, distribution, or pick-up trips—accounts for much of the urban freight movement. A study in Germany found that 60 to 65 percent of all freight trips (in this case, about 290,000 of 460,000 daily trips) were due to circulating traffic, which only carried 28 percent of the goods being exchanged (Giuliano, 72-73).

These problems show no sign of abating. By all accounts, the volume of urban freight is growing in most cities, and that growth is primarily being channeled into more trucks. This means more trucks on highways, many of which are routed through cities, as well as more cargo destined for cities, which intensifies last-mile trucking. Additionally, modern production technologies, shorter production development cycles, and the growth of online shopping and just-in-time delivery\(^1\) call for “high frequency transport of smaller shipments” (Jopson, 136; Giuliano, 73). These conditions and trends conspire to create an urban freight system which is functional but inefficient, disruptive, and bound to get worse if no one intervenes.

**Solutions**

The urban freight system represents a diversified set of stakeholders, goals, and physical places. Because of its complicated nature, the urban freight problem will be solved piecemeal. The solutions depend on cooperation or an explicit partnership between the two parties who are capable of making changes to the system: public policymakers (including city planners) and freight transport companies (Allen and Browne, 286). Different measures may be more or less apt based on a city’s geography, culture, political and financial circumstances, and other factors. But the goal is consistent: reduce freight truck traffic in business districts without upsetting the economic viability of these areas.

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\(^1\) Just-in-time delivery is a production strategy which minimizes inventory and replenishes stocks frequently.
The policy and planning solutions I explore in this section are intended to improve some measure of livability in business districts, either by shifting or decreasing truck activity. A livability lens is useful for approaching urban freight problems, because it naturally implicates other perspectives, such as economic or environmental, and takes into account system-wide trade-offs.

**Vehicle Size and Delivery Time Regulations**

A simple policy approach to reducing the impact of freight is to regulate when, where, and which freight vehicles are allowed. Municipalities can regulate vehicles according to dimension, weight, loading factor, and emission factor or fuel type (Danielis 132). Certain vehicles may be allowed in specified zones only at specified times, or they may simply be excluded from an area all together. Some degree of freight truck regulation is common in car-free places, where delivery vehicles are usually allowed, but often only within a limited time frame or on certain streets. For example, Boston’s Downtown Crossing regulates freight and other delivery vehicles according to commercial plates or permits, hours of the day, and specific streets (City of Boston).

Even places that aren’t car-free, especially business districts, benefit from shifting peak delivery hours to non-peak traffic times. Los Angeles and Long Beach, for example, incentivize off-peak delivery times with a program called PierPASS OffPeak, which established new shifts during nighttime and weekend hours. To make the new shifts more attractive, the program also requires a “traffic mitigation fee” for delivering during peak hours (Monday through Friday from 3:00 AM to 6:00 PM) (Seattle Urban Mobility Plan, 3). A policy which incentivizes off-peak delivery should also encourage or mandate “unattended delivery systems,” which allow businesses to receive shipments even when they are closed. Systems include electronic drop boxes and “designated off-site collection locations such as post offices or convenience stores” (Seattle Urban Mobility Plan, 2).

One problem with off-peak delivery times in mixed-use business districts is that the noise from deliveries could be disruptive to a sleeping local populace. This problem can be countered with personnel training, streamlined deliveries, and “noise-adapted” equipment and infrastructure such as quiet paving (NICHES, 7). For example, a successful night-delivery

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2 A car-free place is an area where private cars are prohibited or severely restricted.
scheme in Barcelona uses “low noise equipment” and concentrates deliveries into fewer trucks (NICHES, 4).

Regulating freight vehicle access is a good starting point for shifting or dispersing the public burden that delivery trucks impose. In order to create positive conditions for freight carriers and businesses as well as the public, these regulations must be crafted using input and feedback from the groups affected by them. Monami et al. warn that banning or imposing severe limitations on trucks in city centers is unlikely to solve the problems of urban freight if alternatives are not properly explored (Monami et al., 245). Thus, policies which confine the freight system should be matched with planning measures for better systemic efficiencies.

**Load Consolidation and Load Factor Efficiency**

An important potential downside to regulating vehicles by size is the reduced opportunity for load consolidation (Danielis 132). Load consolidation, or co-loading, allows a firm or multiple firms to consolidate shipments, cutting the number of trucks needed for last-mile shipping. While this may mean larger trucks on the road, it also means less total driving time. Both freight operators and receiving businesses could benefit from the efficiencies afforded by co-loading. For example, high-end restaurants receive multiple shipments a day from various specialty food and beverage suppliers. In a successful co-loading scheme, these restaurants would receive just one or two shipments per day, containing all of their orders (Seattle Urban Mobility Plan, 3). To permit greater load consolidation, some vehicles may have to be specially designed to handle a variety of cargo. For instance, trucks could be compartmentalized to allow different temperatures (Danielis, 132).

Sharing vehicle capacity among firms would be a natural solution to the problems of declining load factors and circulation traffic, but first requires careful planning, coordination, and likely a special facility for consolidation activities. Load factor efficiency—that is, how much can be fit into a single load—can also be improved to allow for more consolidation or, at least, lighter (less energy-intensive) shipments. Using “more efficient handling systems and packaging” and adopting more transport-efficient order cycles would improve the load factor efficiency of any given shipment (Danielis, 132). Both improved load factor efficiency and co-loading are elements of comprehensive, long-term urban freight efficiency.
Urban Distribution Centers

Load consolidation may offer the most hope in terms of reducing overall truck activity, but it would scarcely be possible without a devoted location for consolidating shipments (Seattle Urban Mobility Plan, 3). Indeed, the crux of efficient and unobtrusive urban freight in the long term appears to be urban distribution centers. I use the term “distribution center” as a catch-all for any facility that intercepts freight before its last mile. At a distribution center, freight is reorganized, possibly stored, and redistributed to its final destination in an efficient, low-impact manner.

While large container terminals and cross-docking facilities are common for international and intercity trade, few such options exist for smaller-scale intercity and intracity freight. Yet those that do exist (mostly in Europe) show that logistics centers don’t have be major operations with large land uses to be successful. A review of the transport activity in 17 relatively small European distribution centers found that the facilities reduced freight vehicle trips by 30 to 80 percent, distance traveled by 30 to 45 percent, and vehicle emissions from 25 to 60 percent, and that they improved vehicle load factors by 15 to 100 percent (Allen and Browne, 291).

Existing urban distribution centers are diverse and highlight different intervention strategies. In Tampere, Finland, a small and somewhat ad hoc logistics center for combining municipal service deliveries has proved to be a great success and shows promise as an exportable concept. Among other efficiency benefits, the consolidation system has “allowed city employees to spend more time on their primary missions” (Monami et al., 253). In Bordeaux, where the construction of a new tramway line in the city center made some deliveries almost impossible, the municipality created a new freight distribution scheme called the Proximity Delivery Space (PDS). The PDS has an open-air platform from which goods are delivered to businesses via wheeled, non-motorized carts. Parcel and express delivery systems have been the primary users of the PDS, but the concept may serve as a template for a more permanent, widespread, and environmentally friendly distribution system (Monami et al., 252). The PDS system is an especially valuable model for demonstrating how to transfer freight in business districts without the use of automobiles. A similar model can be found in Brussels, where retail delivery stations accept large deliveries and then transport them to individual businesses via pallet truck, small carts, or wheeled stands (Seattle Urban Mobility Plan, 3).
There are lessons to be learned from unsuccessful distribution center initiatives as well. In 1998, the city of La Rochelle, France, funded a project to encourage freight delivery by small electric vehicles and to regulate large “non-environmentally friendly trucks” in the city center. The city built an urban l/u platform for the exclusive use of small electric vehicles, but “without due consideration for the actual problems to be tackled and the volumes to be handled.” Consequently, the center has not yet proved to be an effective or profitable enterprise (Monami et al., 254).

Establishing an urban distribution center often means an ambitious shift in local freight operations. Cities would be remiss not to thoroughly scope out and understand the local freight scene before supporting one, especially given the high set-up costs. Understanding businesses’ needs and freight capabilities is crucial for planning the placement and design of an urban distribution center, as well as for setting up the policies that affect it.

As a concept, the urban distribution center can be variously used and adapted to suit different urban freight schemes. In any scenario, it intervenes to lessen the impacts of last-mile urban freight. A single distribution center can revolutionize a segment or segments of the urban freight system, but it is unlikely to serve the entire system. However, a network of specialized distribution nodes—perhaps as part of an urban freight master plan—may be able to do just that. Such a large-scale, coordinated urban freight system offers an enticing vision for the future. Of course, this vision is complicated by the plural nature of its users, which include third-party freight companies, own-account operators, and small intracity operators—themselves each tending to various markets—and furthermore by the technologies needed to coordinate and consolidate their shipments. Therefore, such a system would need to be developed slowly, one facility at a time, with feedback from stakeholders.

**Freight Villages**

Different from urban distribution centers, but similar in concept, are freight villages. Freight villages are planned unit developments specifically designed for multi-modal freight transfer within a secured perimeter. They achieve efficiencies by being located near transportation connections and co-locating with supporting services. The concept has been launched in Europe, where there are about 40 freight villages. Recently the New York Metropolitan Transportation Council assessed the viability of freight villages for locations in New York City metropolitan area (Seattle Urban Mobility Plan, 3; Mann, 31). Potentially, a freight village could serve as the
regional mother ship to local distribution centers, coordinating different freight actors, and taking a large stride toward an integrated whole freight system. However, as large land uses, they may be best suited to suburban or industrial environments.

**Delivery Tunnels**

In Helsinki, freight tunnels for underground trucking are under construction, some of which are built as part of underground parking facilities. The project as a whole represents a partnership between the real estate owners and leaseholders, planners, and private and public financers. The new tunnel routes planned for freight are longer than the current surface routes, but are faster. Another improvement that the underground delivery system would bring “is the possibility for the property owners to update and enlarge their maintenance facilities” (Monami et al., 259). I did not find much information about these freight tunnels, but they at least provide another useful concept for approaching last-mile urban freight. The delivery tunnels concept would seem to approach the theoretical metro-freight system discussed below.

**Truck-Free Freight**

Many small retail businesses, offices, and cafés regularly receive only small shipments which can be carried without the use of gas or electricity. Therefore, human-powered vehicles (often with electric assistance modes) can do a hefty share of last-mile carrying, replacing diesel trucks and making business districts cleaner and more livable. For example, Venice—maybe the world’s foremost car-free place—relies on human-powered logistics to a great degree. Freight is carried by boat through Venice’s comprehensive network of canals, and then carried by dollies or pushcarts to final destinations (Crawford, 195). A Boston-area company, Metro Pedal Power, uses pedal-trucks (bicycles with trailers attached) to haul up to 500 pounds of localized freight. Metro Pedal Power’s “eco-friendly solutions for last mile delivery in urban areas” fill a not-insignificant niche in the urban freight world, primarily moving small loads from a local origin to a local destination. Businesses and organizations such as bakeries, retail shops, and non-profits use these human-powered logistics services in place of fossil-fueled services for local hauling, including recycling and compost pick-up (Metro Pedal Power).

Any urban distribution center should incorporate platforms for truck-free fleets handling small, short-distance shipments. These human-powered freight processes are clean, nimble, and
act as the capillaries in a healthy system. However, by themselves, they are not a feasible replacement for the mainstream urban freight system, as they are labor-intensive and simply do not have the capacity.

J.H. Crawford, the author of *Carfree Cities*, admits that a practical and modern method for delivering freight without the use of automobiles “is the greatest challenge in the development of a carfree city” (Crawford, 195). However, he has developed a reference design and system for delivering freight without the use of trucks. His plan is largely based around “metro-freight,” an urban rail system plugged into the containerized shipping network. His system runs in rail lines in open cuts parallel to central boulevards. Sophisticated metro-freight trains are loaded with standard shipping containers at loading docks, then ride into the heart of the city on metro-freight lines to make deliveries. These deliveries can go either directly into the basements of adjacent buildings or, when the final destination does not abut the metro-freight line, to distribution centers (or “freight depots,” as he calls them). From the distribution centers, deliveries are made via “relatively simple means.” Though “nothing like this has ever been built,” extant technology could make such a system possible (Crawford, 196, 199, 203).

Crawford is right to emphasize capacity and overall efficiency when most truck-free solutions are labor intensive, slow, or too similar to the current system. Of course, his design is ambitious and expensive, and would probably require either sweeping top-down governmental action or a city in its nascent stages. Still, metro-freight’s concept of freight corridors could be instructive for urban freight efficiency. A concentration of freight activities along just a few designated corridors could relieve other streets from diesel truck activity. Like in the metro-freight scheme, pedal-trucks and pushcarts could complete the freight grid by running perpendicular routes. Such corridors could work in conjunction with (or possibly as an alternative to) local distribution centers.

**Conclusions**

In most cities, the last leg of the freight system is an awkward meeting of large diesel trucks and public spaces ill-suited to them. This last-mile freight is economically necessary, but in its current form it presents several problems for livability, urban freight efficiency, the environment, public health, and other interests. Of these, I find that an overall livability perspective permits a
comprehensive approach to urban freight problems. From this angle, I identified some key challenges for last-mile urban freight, and reviewed strategies for reducing its impacts.

Regulating freight vehicle access and incentivizing off-peak delivery hours can shift or disperse the public burden caused by delivery activities, and may prompt freight companies to improve the efficiency of their operations. Human-powered delivery vehicles such as pedal-trucks and pushcarts fill an important niche in the urban freight world. They relieve business districts of at least some disruptive truck activity and provide an environmentally-friendly option for transporting small shipments over short distances, a common need. Other strategies seek to eliminate inefficiencies in the system by fitting more into a single truck, or establishing freight corridors (ideally underground) for concentrating freight activity. Consolidating loads or otherwise integrating freight activity may depend on the establishment of specialized nodes such as urban distribution centers. Aptly designed and scaled distribution centers can be located near business districts and accommodate a range of activities for optimizing local freight.

With the participation and input of freight actors, policymakers can string together some of these varied solutions to make their cities more livable in both the short and long term. As more and more trucks enter city streets—satisfying an economic need but in a cumbersome and wasteful way—the need to look the urban freight system in the eye is increasingly important.
References


