CHAPTER

4

URBAN GOODS TRANSPORT

Urban goods transport, also known as urban freight distribution, concerns a vast range of activities insuring an adequate level of service for a variety of urban supply chains. While cities have always been important producers and consumers of goods historically, much of these activities were taking place in proximity to major transport terminals, with limited quantities of freight entering the city itself. The functional specialization of cities, the global division of production, the emergence of intermodal terminals, the rise of service activities, global consumerism, as well as increasing standards of living are all correlated with an increased demand for urban goods transport in cities. This is characterized by a higher frequency of deliveries, and larger quantities of freight shipments coming from, bound to or transiting through urban areas. The scale, intensity and complexity of urban goods transport necessitate additional forms of organization and management in many large cities, which is the realm of city logistics. City logistics concerns the means to enable goods transport in urban areas by improving the efficiency of urban freight transportation and mitigating the environmental and social impacts.

The need for city logistics is often a derived outcome of the new demands imposed by global supply chains on regional and urban landscapes.[1] Since most of the goods consumed in cities originate from outside locations, urban goods transport is commonly referred to as the 'last mile' along a supply chain. Urban goods transport is thus concerned with establishing an effective interface between the regional or global realms of freight transport and the last mile of urban freight distribution. While maritime shipping, air cargo or rail are the privileged modes for long-distance goods transport, the vehicle, particularly the truck, remains the dominant urban mode as it is perceived to be the most suitable to service specific origins and destinations within the complex urban grid of streets and highways. This last mile requires a shift to different distribution strategies more suitable to an urban context, often resulting in congestion, delays and additional costs proportionally higher than the distance concerned.

The sustainability of cities cannot be reviewed without due consideration to the role of goods transport.[2] Indeed, while a city can be perceived as an economic, social, political and cultural entity, urban freight distribution underlines the physical and managerial activities necessary to support all of the above. However, compared to passenger transport, urban freight distribution has to a large extent been neglected by urban transport policy-makers. Yet, it is extremely important for the social and economic viability of urban areas and has widespread ramifications for the environment, transport infrastructures and overall trends in mobility. The sector is also faced with a number of challenges such as congestion, parking for deliveries and reverse logistics (e.g. recycling and garbage collection).[3]

This chapter thus reviews the trends and conditions of goods transport in urban areas, both within the formal and informal sectors. It outlines the fundamental contribution of goods transport for urban life, and points to the externalities generated by the sector. The elaboration of goods transport processes, in both developed and developing countries, sheds light on the contrasts and similarities across countries. Importantly also, the chapter shows how goods movement interacts with, and is shaped by, the urban context in quite specific ways.

Urban goods transport, also known as urban freight distribution, concerns a vast range of activities insuring an adequate level of service for a variety of urban supply chains

Urban freight distribution has to a large extent been neglected by urban transport policy-makers

URBAN GOODS TRANSPORT: KEY COMPONENTS AND ACTORS

Urban goods transport, as it relates to cities and their populations, is the set of all activities ensuring that their material demands are satisfied. The focus is on the city as a place of production, distribution and consumption of material goods, but also the handling of waste as an outcome of these activities.

Globalization has enabled the expansion of the distribution sector as a more prevalent element of the urban landscape, with facilities such as terminals and distribution centres

Goods transport accounts for 10 to 15 per cent of vehicle equivalent kilometres travelled in urban areas, 2 to 5 per cent of the employed urban workforce, and 3 to 5 per cent of urban land use

Throughout history, cities have had to make provisions for distributing and storing goods to their populations. Commercial areas, including warehouses, tended to be located directly adjacent to facilities such as ports and main arterials. The industrial revolution and later suburbanization offered an extended range of options in the location of activities supporting urban freight distribution. These included rail yards and highway interchanges. The situation became inherently more complex as the intensity and variety of urban goods transport services increased. This in turn made the importance of goods transport more salient, to the point that concerted approaches were developed that led to the emergence of city logistics.

While the functions of production (e.g. manufacturing) and consumption (e.g. retailing) remain prominent forms of urban goods transport, globalization has enabled the expansion of the distribution sector as a more prevalent element of the urban landscape, with facilities such as terminals and distribution centres. City logistics have experienced significant changes, particularly with the concept of lean management, where demand-based supply-chain management has enabled a better management of inventories and less storage requirements. Under such circumstances, most of the inventory is in transit using transport modes and terminals as 'mobile warehouses'; this inventory is consuming valuable urban space either as land use or as vehicles circulating in the urban transport system.

Most of the early city logistics projects were undertaken in Japan and Western Europe[4] (e.g. Germany, France, Belgium, Netherlands, Luxembourg and the UK) as cities in these countries were more constrained by the lack of available land, and had well-established urban planning traditions. The approach was then adopted in other parts of the world, with the growing recognition that the metropolitan area should also be considered as a freight planning unit. Still, and in spite of a growing global awareness, the focus on urban goods transport remains limited, partially due to an enduring bias in urban planning concerning freight issues (Box 4.1).

An important technological change relates to intermodal transportation, which has considerably improved the capacity and efficiency of moving freight between modes such as maritime, rail and road. Of particular relevance is containerization, which has shaped transportation systems in a fundamental way by providing a load unit that can be handled almost everywhere, and by a variety of modes.[5] More recently, the application of new information and communication technologies for improving the overall management of freight distribution has received attention.

Components of urban goods transport

A city is provisioned by hundreds of supply chains servicing a wide array of economic sectors including grocery stores, retail, restaurants, office supplies, raw materials and parts (for manufacturing), construction materials and wastes. Depending on the circumstances, goods transport accounts for 10 to 15 per cent of vehicle equivalent kilometres travelled in urban areas, 2 to 5 per cent of the employed urban workforce, and 3 to 5 per cent of urban land use. A city not only receives goods but also ships them: some 20 to 25 per cent of truck-kilometres in urban areas are outgoing freight, 40 to 50 per cent are incoming freight, and the rest both originates from and is delivered within the city.[6]

There are three main components of city logistics: the modes that carry the freight, the infrastructures supporting freight flows and the operations

Box 4.1 Urban planning and freight distribution

The consideration of freight distribution within urban planning remains limited, leading to substantial biases in the analysis of urban mobility, which overly focuses on passenger issues. The main factors behind this oversight can be attributed to the following:

- Freight distribution is an activity predominantly controlled and operated by private interests, with limited oversight from the public sector. Thus, the public sector tends to have only minimal understanding about the commercial dynamics of freight distribution.
- Accordingly, the public sector tends to have direct control and oversight over public transport systems with planning endeavours focusing on these issues.
- Freight distribution is a profit-seeking activity (making goods available to customers), while public transport is more about maximizing utility (providing accessibility). The planning and operational objectives of stakeholders, including their mentality, are therefore different.
- There is a scale mismatch in the understanding of urban mobility, since passenger flows are predominantly the outcome of local processes (e.g. commuting), while freight flows reflect a dynamic often being driven by processes taking place at the global level (global supply chains).
- Urban transportation and mobility in academic and professional programmes mostly reflect the realm of public engagement, with freight issues remaining a marginal component. Programmes tend to focus on passengers, and planners receive limited exposure to freight issues in their training.

related to their organization and management (Figure 4.1). Each component has subcomponents with their own characteristics and constraints. For instance, transport terminals, roads and distribution centres are infrastructure subcomponents of city logistics. The same applies to scheduling, routing, parking and loading/unloading, which are operational subcomponents.

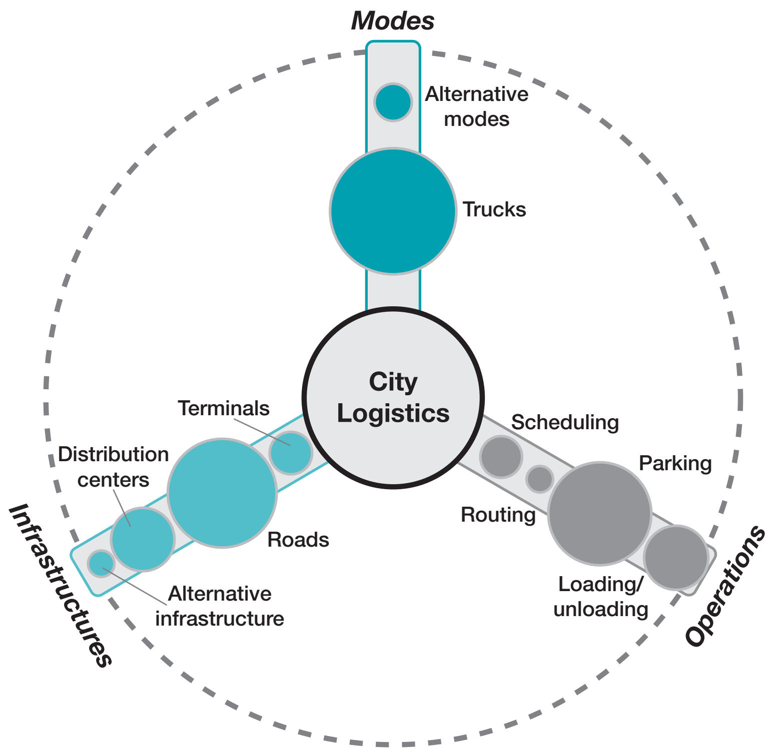

Figure 4.1
Components of city logistics and their relative importance

While trucks remain the dominant mode supporting city logistics, they face constraints mainly related to congestion and environmental externalities. This is in spite of the prominence that road infrastructure takes over urban land use, as well as parking and unloading (or loading) difficulties at the points of final delivery. The balance in the relative importance of the depicted subcomponents appears to be unsustainable in a growing number of urban areas. A major challenge for city logistics is therefore a rebalancing where alternative modes (such as electric vehicles) and infrastructure (such as local freight stations), improved by novel forms of operations, would play a more prominent role. Obviously, the nature and extent of this rebalancing is city specific.

City logistics, as a last-mile distributional strategy, can take many forms depending on the concerned supply chains, as well as the urban setting in which it takes place. It involves two main functional classes: the first concerning consumer-related distribution and second producer-related distribution. Independent retailing, chain retailing, food deliveries and parcel and home deliveries constitute consumer-related distribution while producer-related distribution involves construction sites, waste collection and disposal, industrial and terminal haulage.

Actors and stakeholders in urban goods transport

Freight can be handled commercially by two types of actors: private and common carriers. For private carriage, freight is carried out by cargo owners (manufacturers or retailers) with their own employees and fleet, or by subcontracting to an independent carrier with its own vehicles. A common carrier sells its services to any customer on a contractual basis and will often consolidate their cargo and deliveries. There is a significant geographical variation in the role of private and common carriers in urban goods transport. While in developed countries private and common carriers tend to account for an equal share of urban deliveries, in developing countries private carriers tend to be dominant. This is reflective of an urban freight distribution market that is not well developed and assumed in part by an informal sector using motorized and non-motorized means.

The global production network concerns an array of manufacturing activities mostly organized by multi-national corporations in search of comparative advantages. This is associated with a growth in international trade, where cities assume the function of production zones for parts and finished goods bound to global markets. Intermodal terminals are the interfacing means to access the global distribution network. This network supports international trade that circulates over a global network of intermodal terminals linked by modes such as maritime shipping, air freight and for shorter distances by rail and trucking. In this frame, cities act as distribution nodes with their major port, airport and rail terminal facilities. In many instances, a city will play the role of a gateway granting access to a regional freight distribution system, implying that freight distribution will have a spatial imprint well above one justified by the level of urban consumption.

The global urban network is reflective of the intensity of material consumption, since from a material standpoint the main function of cities is to act as points of final consumption. The multitude of actors and supply chain concerned requires a growing level of organization and management of urban freight distribution. This is particularly problematic since cities are highly constrained areas, with a limited amount of space available for circulation, deliveries and warehousing. However, the differences between cities in developing and developed countries remain salient, particularly over freight flows.

In terms of stakeholders of commercial goods transport in urban areas, it is possible to identify four general groups that are shaping urban freight distribution: cargo owners (e.g. retailers, manu-

While in developed countries private and common carriers tend to account for an equal share of urban deliveries, in developing countries private carriers tend to be dominant

facturers, wholesalers); residents; distributors (mostly carriers, third party logistics companies and freight forwarders); and planners and regulators. The relations between the cargo owners who provide goods and the residents who consume them, with distributors acting on the cargo owners' behalf, are particularly important as cargo owners and distributors strive to fulfil consumers' needs. Planners and regulators try to set rules under which urban freight distribution takes place, with the multi-dimensional aim of satisfying their constituents as well as commercial, transport and distribution interests. Each stakeholder has its own objectives, and while there may be inherent conflicts between stakeholders, under normal circumstances the relations tend to be on the neutral side. However, when a challenge in city logistics requiring an intervention from either a public or private stakeholder emerges, the relationships between stakeholders are likely to change, which can lead to four possible outcomes (Figure 4.2):

The . . . growth in global distribution has reinforced the role of gateway cities, nodes interfacing with global economic processes, mostly through ports and airport terminals

- ***Conflicts***. Due to the scarcity of space, as well as the density and the complexity of the urban landscape, conflicts between stakeholders are common. These conflicts arise when the externalities of existing or proposed projects imposed by urban freight distribution on local communities are judged to be unacceptable by residents, planners and regulators. Sometimes conflicts arise between the residents and planners over specific issues triggering classic NIMBY (not-in-my-backyard) responses. Legal recourse is attempted to stop a development project (e.g. a new distribution centre) or to more strictly regulate a freight activity (e.g. access to a commercial district).
- ***Cooperation***. Usually achieved when additional mitigation strategies are added to a project (change in design) or to modes of operation. It is agreed by some form of consensus that the existing capacity is to be used and shared more rationally. Public–private partnerships are examples where private goals and public interests can be accommodated.[7]

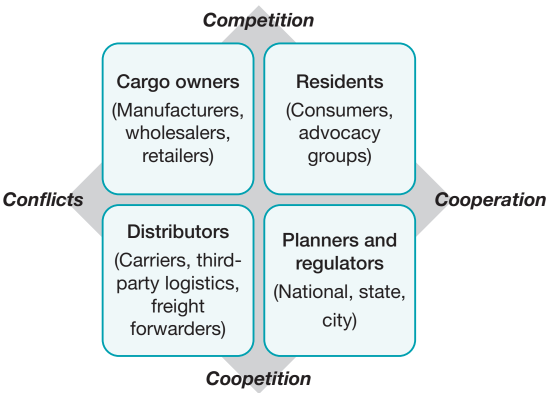

Figure 4.2

Main stakeholders and relationships in urban freight distribution

Source: Adapted from Taylor, 2005.

- ***Competition***. Standard relationships between private shippers and freight forwarders as they bid to access urban real estate and facilities for their operations. Freight forwarders compete to attract and retain customers over their freight distribution services. Commercial and residential developers are also competing within the land-use zoning framework for real estate projects.
- ***Coopetition***. A specific form of collaboration between private stakeholders, particularly when a stakeholder is unable to individually address an issue or is incited to do so by regulation. While they may compete for attracting and retaining customers, freight forwarders could be involved in shared operations. Activities related to the consolidation of urban freight distribution are particularly prone to coopetition with shared facilities (e.g. urban distribution centres) or deliveries (e.g. shippers pooling their demand to negotiate better terms with a freight forwarder).

TRENDS AND CONDITIONS OF URBAN GOODS TRANSPORT

Cities are concomitantly areas of production, distribution and consumption. The growth in global trade reflects growing levels of production and consumption taking place in urban areas. While specific figures are not readily found, it can be assumed that most of global trade either originates in, transits through, or is bound to, an urban area. The associated growth in global distribution has reinforced the role of gateway cities, nodes interfacing with global economic processes, mostly through ports and airport terminals (Box 4.2).

The city is also increasingly transnational. Depending on the economic and geographical context, some cities (such as London, UK; New York, US; Paris, France; and Tokyo, Japan) have a pronounced tertiary function (finance, administration, culture), implying that consumption accounts for the main share of the total goods being handled, with the functions of production and distribution assuming a more marginal role. Other cities (such as Bangkok, Thailand; Busan, Republic of Korea; Guangzhou and Shanghai, China) have emerged as manufacturing centres where production assumes the dominant share of goods flows. With the increasing use of the container and the growth of long-distance trade, several cities act as intermediaries for the goods flows bound to large market areas. For instance, gateway cities often fulfil the material requirements of whole regions by being a point of freight transit and distribution to service inland destinations.

Inasmuch as a majority of urban inhabitants do not interact with freight facilities or have little

Box 4.2 Gateway cities and global distribution

A gateway city is a pivotal point for the entrance and exit of goods in a region, a country or a continent. The global system of freight distribution is articulated by major gateway cities, often composed of a cluster of ports and airports within a metropolitan area. Altogether, the 39 largest gateway cities accounted for 90 per cent of the global containerized and air freight volumes (Figure 4.3). This underlines their fundamental importance in the handling of the world's trade and as intermediary (or final) locations within global distribution systems.

There is a substantial concentration of freight activity along the Tokyo–Singapore corridor in Asia. The world's largest gateway region is Hong Kong–Shenzhen; 14.8 per cent of the world's containerized and air freight traffic is in this region. Expanding this gateway to the Pearl River Delta (with Guangzhou), which can be considered a mega-urban region (Box 5.11), causes this share to reach 16.7 per cent. For Europe, the Rhine/Scheldt delta (from Amsterdam to Brussels) accounts for 7.5 per cent of the global containerized and air freight volume. The most important North American gateway system is the Los Angeles/Long Beach system. Some of the gateways are dominantly hubs transhipping freight from one system of circulation to the other, such as Colombo (Sri Lanka), Dubai (United Arab Emirates) or Singapore.

Source: O'Connor, 2010.

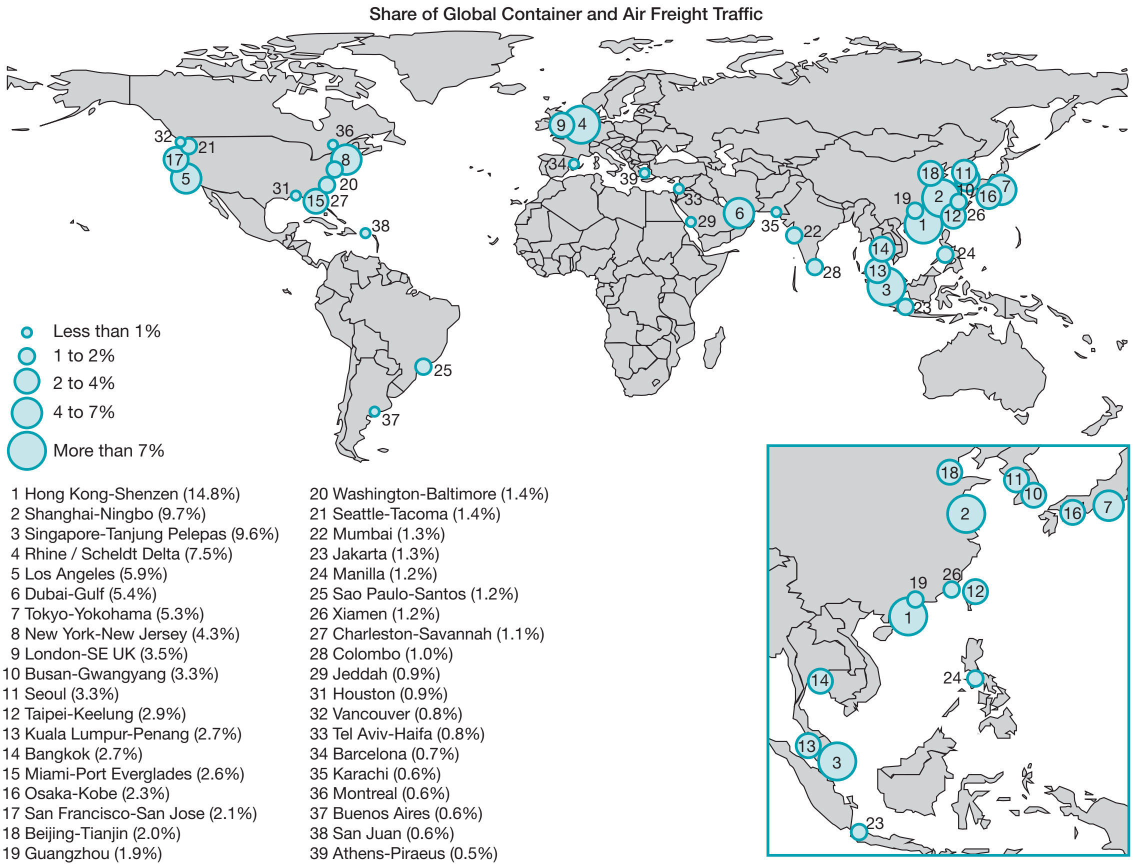

Figure 4.3

World's major gateways (sea and air freight) (2006)

Source: Based on O'Connor, 2010.

awareness of their existence, these play a fundamental role in the urban economy or a city's welfare. Urban freight activities support the supply chains in urban areas and there is a clear link between these activities and the level of economic development of cities as highlighted below. The following subsection also points out areas of convergence between the developed and developing countries with respect to urban goods transport, as well as describing key areas of divergence as dictated by the level of economic development priorities, among other factors.

Developed countries

The material intensiveness of urban freight distribution depends on local economic, geographic and cultural characteristics.[8] It is not surprising that cities in developed countries with high standards of living are coping with a high intensity of urban goods transport. Evidence from Europe suggests that a high-income city generates about one delivery or pickup per job per week, 300 to 400 truck trips per 1000 people per day, and 30 to 50 tonnes of goods per person per year.[9]

The material intensiveness of urban freight distribution depends on local economic, geographic and cultural characteristics

However, conditions vary significantly based upon local characteristics and the role cities play in global freight distribution. For example, Chicago has been preoccupied with maintaining its role as a major rail hub for North America, and is thus primarily concerned with rail freight transport between the numerous rail terminals and large distribution centres located within its metropolitan area, many of which are serviced by trucks.[10] Los Angeles as a gateway city to North America is primarily concerned with air pollution, and thus targets truck transport associated with port terminals and nearby major import-based distribution centres.[11] Paris, France, is concerned with limiting the environmental footprint of freight distribution in order to improve the quality of life of its residents and maintain its role as one of the world's leading cultural and tourism hubs.

Developing countries

The conditions in which urban goods transport takes place in developing countries show an impressive diversity. Several segments of economic activity have a high level of integration to global economic processes and their related freight distribution. Thus, it is not surprising to find state-of-the-art transport facilities such as port terminals, airports and distribution centres in developing countries. This aspect of city logistics is therefore on par with those of developed countries as the same modes, technologies and management techniques are used.

However, in addition to formal goods transport, an informal sector – that may rely on less advanced modes and management techniques – is also very active in supplying the needs of lower-income groups. These may include motorized means such as two-wheelers, and more significantly, non-motorized forms of goods transport (Box 4.3). While several basic consumption goods (apparel, electronic goods, batteries, etc.) enter a country through formal supply chains, a majority enter through informal distribution channels. The informal sector provides crucial city logistics services in developing countries, but tends to be more labour intensive, thus increasing the risk of damage, theft or injuries.

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The differences between formal and informal activities are also linked to gender and age. While workers involved in formal forms of transportation, such as delivery truck drivers, are predominantly male, retail workers dealing with the last segment of city logistics are predominantly female. In the least-developed countries, the transportation burden of household needs, such as fuel, water and food, and many other petty trades, is mainly assumed by women.[12] However, urban goods transport can also be a source of income, albeit subject to risks, for the urban poor and other lower-income groups. For children and teenagers, informal freight distribution is a common source of income, before attaining driving age.[13]

As in developed countries, the conditions and priorities in developing countries substantially diverge. For instance, Mexico City is coping with a complex mix of urban growth, rising consumption levels, congestion and environmental externalities where both modern and informal forms of city logistics are present (Box 4.4). With its function as a major transport hub supporting China's export-oriented economic strategies, Shanghai has become the largest cargo port in the world, with advanced logistics capabilities. This highlights the contrast between city logistics of the modern coastal cities of China, in comparison to a countryside that is much less integrated.

Box 4.3 Non-motorized informal goods transport in Asia and Africa

In Delhi, India motorized tricycles haul small loads requiring frequent delivery stops, and handle around 60 per cent of intra-city goods movement, transporting as much as a 5-tonne truck in a day via multiple trips. As well as courier services, deliveries of groceries, furniture, electronics, etc. are increasingly made by auto-rickshaws, vans and tricycles, while larger informal carriers – such as shared taxis, minibuses and light vans are used for longer distances. In most of South Asia, trip-chains involve intermodal connections between micro-vehicles and large-load haulers at railway stations, bus depots, distribution centres, etc. Although efficient and affordable, the limited income earned by indigenous goods haulers undermines capital investment in more efficient vehicles. Access to credit can thus be an important factor for improving city logistics in developing economies.

Non-motorized transport is also frequently used for goods delivery in African cities, due to it being cheap and readily available. In Mumbai, India, about 200,000 *tiffin* lunch boxes are delivered daily by a combination of non-motorized means, thereby generating employment for those involved. Forms of NMT transport for goods in African cities include three-wheel platform rickshaws (*gudrum matatu* in Dar es Salaam, Tanzania), waste cart pushers (*kayabola*) in Accra, Ghana, and animal-drawn carts in South African low-income townships for waste picking, scrap metal haulage and coal delivery.

Sources: Jain, 2011; McMillan, 2011; Howe and Bryceson, 2000; Metropolis, 2005; UN-Habitat, 2009; Langenhoven and Dyssel, 2007.

Box 4.4 Relationships between formal and informal city logistics, Mexico City

Mexico City, with a population of 20 million, typifies very large and fast-growing metropolises of emerging economies. The city is a logistics gateway of Latin America where many regional headquarters of multi-national companies and associated advanced services are located. It also accounts for a third of the country's manufacturing output. The informal sector is also a significant feature of Mexico City's economy, with a high number of very small businesses in operation. As an enormous urban centre whose activities and population generate a high and diversified demand for freight, its logistics features relate to both formal and informal processes.

The part of goods transport that is formal (and documented) represents about 400 million tonnes annually, and is mostly based on road transportation. The main and growing mode of freight supply is trucking, whose flows and characteristics are well surveyed. Despite recent private investments, congestion, the lack of space for loading and unloading, regulatory complexity (e.g. weight and access restrictions), public corruption, the risk of theft and the lack of safety, there are widespread concerns for freight distribution in the city. Congestion is an acute issue, as it can take up to four hours for trucks to cross the city. As a consequence, many companies are moving their logistics facilities to suburban areas, where several extensive logistics clusters have grown to accommodate distribution centres and private logistics facilities. Furthermore, inadequate infrastructure in Mexico City leads to poor regional accessibility, which hinders market extension and international integration, and keeps logistic costs high.

At the same time, informal means of transportation (foot, wheelbarrows, bikes, motorbikes) represent a significant share of freight transport, but are difficult to record. All these features make Mexico City a good example of the challenges facing urban freight management in very large cities in emerging economies.

Sources: Antún et al, 2010; Dablanc and Lozano, 2011; Jirón, 2011.

GOODS TRANSPORT IN AN URBAN CONTEXT

Goods transport systems are often specific to distinct urban built environments, implying that no city is alike with respect to the nature and challenges of its city logistics. In addition to broader factors shaping the conditions of urban goods transport such as geographical settings, history, levels of economic development and government policies, the urban context shapes goods transport trends in specific ways.

Urban density is closely associated with patterns of goods transport. While cities in developing countries tend to have higher densities than cities in developed countries, higher income levels in developed countries increase the generation of freight per density level.[14] High-density areas are associated with high absolute consumption levels, but adequately supplying such needs is not without challenges. This tends to be paradoxical, as high densities are commonly advocated as sustainable urban development goals. However, high urban densities can also result in congestion if mass forms of transportation (i.e. public transport) are not adequately provided. Still, high density provides additional opportunities to consolidate deliveries and use alternative modes.

The distribution of the density in relation to the street layout, or urban spatial structure, also influences goods transport. Many urban areas that were established before motorization have a street layout that is not suitable for goods transport, with narrow and sinuous streets. Up to some density levels, a motorized and grid-like street layout provides an efficient setting for urban deliveries but comes with externalities such as high energy consumption, noise and emission of pollutants.

The urban land-use structure relates to the organization of economic activities, which can be centralized, decentralized, clustered or dispersed, and impacts upon goods transport. Therefore, a decentralized and dispersed land-use structure is thus associated with a disorganized urban goods transport system, as it becomes problematic to reconcile origins and destinations in urban interactions. For instance, delivering the same quantity of goods in a decentralized and dispersed land-use setting generally involves longer trips and more frequent stops than in a centralized and clustered setting.

A decentralized and dispersed land-use structure is . . . associated with a disorganized urban goods transport system, as it becomes problematic to reconcile origins and destinations in urban interactions

The city scale in terms of population size may also influence urban goods transport trends. While there is no formal methodology to make such an assessment, empirical evidence in the US underlines that congestion starts to be a recurring issue once a threshold of about 1 million inhabitants is reached.[15] This obviously concerns cities having a high level of motorization, thus applying this threshold to a range of cities around the world is problematic, since each city has unique local conditions that influence the nature and intensity of congestion, such as the share of public-transport use and land-use density. For instance, Antwerp (Belgium) with a population of nearly a million appears to be well below the congestion threshold, but this overlooks the fact that it is one of Europe's main port cities. The amount of truck-based freight circulating within the metropolitan area, particularly on the ring roads, is well above any city of a similar size.

Freight distribution, as an activity fundamental to urban life, consumes a substantial amount of

Freight distribution . . . consumes a substantial amount of space in urban areas and competes with other activities for the use of land and infrastructure

space in urban areas and competes with other activities for the use of land and infrastructure. Land requirements for urban goods transport are significant as both transport modes and terminals consume space for the setting of their respective infrastructures.[16] Industrial land uses are also complementary to city logistics, as they are important generators and attractors of freight flows. Additionally, there are rights of way, mainly roads, that are often shared between goods and passenger transport.

The land used for freight infrastructure can be particularly extensive in metropolitan areas that are points of convergence for global material flows, and involve several stakeholders (Table 4.1). However, the amount of land devoted to freight is not necessarily related to the size or the level of consumption in a city. Some cities (such as Dalian and Ningbo, China) focus on production such as export-oriented economic development zones, while other cities (such as Singapore; Dubai, United Arab Emirates; Los Angeles, US; and Panama City, Panama) are major gateways or hubs managing regional systems of freight circulation.

Freight facilities such as intermodal terminals and distribution centres tend to be highly capital intensive and mechanized. The sections below highlight how the growing consumption of land by these facilities has led to new forms of dislocation within urban areas, in terms of terminal and distribution facilities. The discussion also describes the tendency for spatial de-concentration of these facilities in areas where there is severe land pressure.

The world's . . . largest container port terminal facilities . . . jointly account for 0.035 per cent of the total urban area. Although this figure represents a very small share of urban land use, . . . facilities occupy prime waterfront real estate, which is a scarce resource in coastal areas

Terminal facilities

Intermodal transportation places tremendous pressure on the land in metropolitan areas, particularly those with container terminals and their ancillary facilities (e.g. access ramps, container and chassis storage). The global urban footprint is estimated to account for 658,760 square kilometres, about 0.51 per cent of the total global land area.[17] A sample of the world's 453 largest container port terminal facilities reveals that they jointly account for 230.7 square kilometres of land take (0.035 per cent of the total urban area).[18] Although this figure represents a very small share of urban land use, container port terminal facilities occupy prime waterfront real estate, which is a scarce resource in coastal areas. The construction of new port facilities now requires extensive land reclamation projects as suitable sites are no longer readily available. For instance, the construction of the Maasvlatke II port terminal in Rotterdam (Netherlands) or the Yangshan container port near Shanghai (China) are examples of the massive land reclamation demands that new port terminal facilities require. The true transportation land take for freight distribution is difficult to assess as many infrastruc-

Table 4.1

Major actors in urban freight distribution and their land-use handhold

Transport sector	Function	Land-use handhold
Maritime shipping companies	Key actors in global trade, owning fleet assets that are capital intensive. Establish shipping networks composed of a sequence of ports of call.	Limited. Often through parent companies (e.g. terminal operators, third-party logistics providers).
Port terminal operators	Operate major port terminal facilities, mostly through concession agreements. Interface between maritime and inland transport systems.	Mostly lease terminal facilities with long-term bails.
Port authorities	Manage the port's land and its development, such as leasing terminal facilities. Interact with maritime and inland stakeholders.	Landlords controlling significant parcels of centrally located waterfront real estate.
Real estate promoters	Development freight-related activities on their real estate, such as logistics. Lease for distribution facilities.	Various private commercial real estate holdings depending on local regulations. Lease the facilities to private companies such as freight forwarders.
Rail and rail terminal operators	Responsible for moving freight inland, from raw materials to containerized shipments. Own and/or operate terminal facilities.	Significant handhold in central areas, including terminals and rights of way.
Trucking industry	Carry freight over short to medium distances. Provide and organize road transport services between terminals, distribution centres and final customers ('last mile').	Limited holdings (warehouses) but heavy users of road and terminal facilities.
Third-party logistics providers	Organize transport on behalf of their customers. Contract transport and distribution activities, sometimes with their own assets (e.g. trucking companies, air cargo, distribution centres).	Various, but mostly limited (some can own distribution centres).
Air freight transport companies	Provide air transport services for high-value and time-sensitive cargo.	Significant holdings (e.g. distribution centres) near airport facilities.
Freight forwarders	Provide services to cargo such as packaging as well as load consolidation (different small loads into one large load). Organize regional and international freight deliveries, either by contracting to transport operators (truck, maritime, rail) or third-party logistics providers.	Significant holdings in logistics zones. Many rent the facilities they use.

tures, such as roads and airports, are mainly used for passenger transport and can be considered as shared facilities.

Wherever there is an intermodal facility, there is a tendency to have an agglomeration of distribution facilities. This is particularly the case for large airports located near clusters of distribution centres and third-party logistics services providers; air freight being a time sensitive endeavour requiring supply chain managers to be in proximity. As a result, a new urban form, the 'aerotropolis' is taking shape around major airports.[19] It contains an inner zone of distribution centres, logistics complexes and just-in-time manufacturers. In addition, it includes a ring of office parks, hotels, restaurants and convention centres, and then a largely residential periphery, which serves as the home to those who work in the aerotropolis. High-capacity highways and rail lines provide access to the rest of the metropolitan area, within which an aerotropolis is set. These activities are competing at a global level, which commonly implies that the economy of the aerotropolis tends to be linked more to global processes than to regional ones. Dubai, United Arab Emirates, may be the best example of a planned aerotropolis, but several Asian airports (such as such as Bangkok, Thailand; Singapore; and Kuala Lumpur, Malaysia) have initiated this type of development. A few examples can also be found in the US and Europe, including Dallas-Fort Worth (US) and Schiphol (Netherlands).

Distribution facilities

Distribution land requirements include various facilities to hold freight in bulk storage facilities (e.g. oil reservoirs or grain silos) and warehousing facilities for break-bulk (e.g. consumer goods in containers). Distribution centres consume a lot of space, as a wide array of added-value activities are performed on a one floor design, including consolidation and deconsolidation, cross-docking and storage. The last of these can also require specialized facilities, such as cold storage for supporting urban food distribution. It was estimated that for England and Wales alone, warehousing was accounting for 0.8 per cent of non-agricultural and forestry land.[20]

The spatial distribution of industrial, commercial and logistics facilities has a direct impact on the number of vehicle-kilometres, and the average trip length that will be necessary to reach stores, industries and households. In cities such as Chicago, US, which emerged after the late nineteenth and early twentieth centuries, most of the freight-related activities such as industries, warehouses and terminals were located in close proximity to the central business district. A majority (more than two-thirds, in the case of European cities) of all shipments to and from urban areas are organized from terminals and distribution centres. As a result, a contemporary pattern where logistics are specialized and separated from other urban activities has emerged.

Global supply chains rely on novel forms of urban land use such as the logistics zone, which is a planned area entirely devoted to freight distribution. While in the past, the agglomeration of freight distribution activities would organically take place where land was available, and where (road) accessibility was suitable, logistics zones are often set by large transnational real estate promoters and some, labelled as 'freight villages', can include ancillary activities such as hotels, convention centres and restaurants. In some developing countries (Brazil, Malaysia), the export-oriented free trade zone has become a city within the city, with a value proposition based on foreign investments and access to global markets through port and airport facilities. China, with its special economic zones, epitomizes this type of development, which sheds light on Chinese urbanization processes along its coastal areas. In the last 30 years, employment opportunities in special economic zones such as Shenzhen (China), were a strong driver behind the migration of 100 to 140 million people from inland provinces.[21]

Logistics sprawl

Another key trend is logistics sprawl, or the spatial de-concentration of logistics facilities in metropolitan areas. Confronted with the severe land pressure in large cities, as well as with the large urban renewal projects that took place during the 1960s and 1970s, logistics and transport companies began to follow centrifugal locational patterns (Box 4.5). The physical moves were achieved through small-scale changes in their spatial organization, with the closing of urban distribution centres and the opening of new ones in the periphery. Greater land requirements and better accessibility to highways were two of the main driving forces.

While it results in the creation of new spaces, better fitting the functional and operational characteristics of freight distribution, logistics sprawl also creates challenges. With globalization, large terminal and warehousing facilities have generated demands for land to support urban goods distribution, but also conflicts and dislocations. Another impact of logistics sprawl concerns the patterns and the modes of commuting. Due to their low density and suburban settings, logistics zones are generally not well serviced by public transport and contribute to automobile dependency.

The spatial structure of metropolitan areas has led to forms of city logistics that seek to provide the most suitable distribution strategy, based upon the level of density. While higher density levels are associated with congestion and difficulties for urban deliveries, they also offer additional opportunities for alternative forms of urban distribution (Box 4.6).

Wherever there is an intermodal facility, there is a tendency to have an agglomeration of distribution facilities

Distribution centres consume a lot of space, as a wide array of added-value activities are performed on a one floor design, including consolidation and deconsolidation, cross-docking and storage

With globalization, large terminal and warehousing facilities have generated demands for land to support urban goods distribution, but also conflicts and dislocations

Box 4.5 Logistics sprawl, Paris, France

Paris can be considered one of the most active European cities in the field of urban freight management. The city-region has a population of 11 million, and is among the largest and most economically developed metropolitan areas in the world. Ile-de-France is an important logistics hub, concentrating 17 million square metres of warehouses, which represents a fourth of the French warehousing market. Paris has a very high commercial density; it hosts many independent retailers and food stores, and a high proportion of hotels, cafés and restaurants, due to Paris' role as one of the world's most popular tourist destinations.

An important feature of urban and regional freight transportation is referred to as 'logistics sprawl'; the relocation of freight facilities and distribution centres in remote suburban areas. During the 1970s and 1980s, terminals that were used for freight transport and logistics activities in Paris relocated to outlying municipalities (Figure 4.4). However, the economic activities have not dispersed as much as logistics facilities. This has increased distances for delivery trucks to reach destinations, adding a lot of vehicle-kilometres to the regional traffic.

Sources: Dablanc and Rakotonarivo, 2010; Dablanc, 2011; Browne et al, 2007.

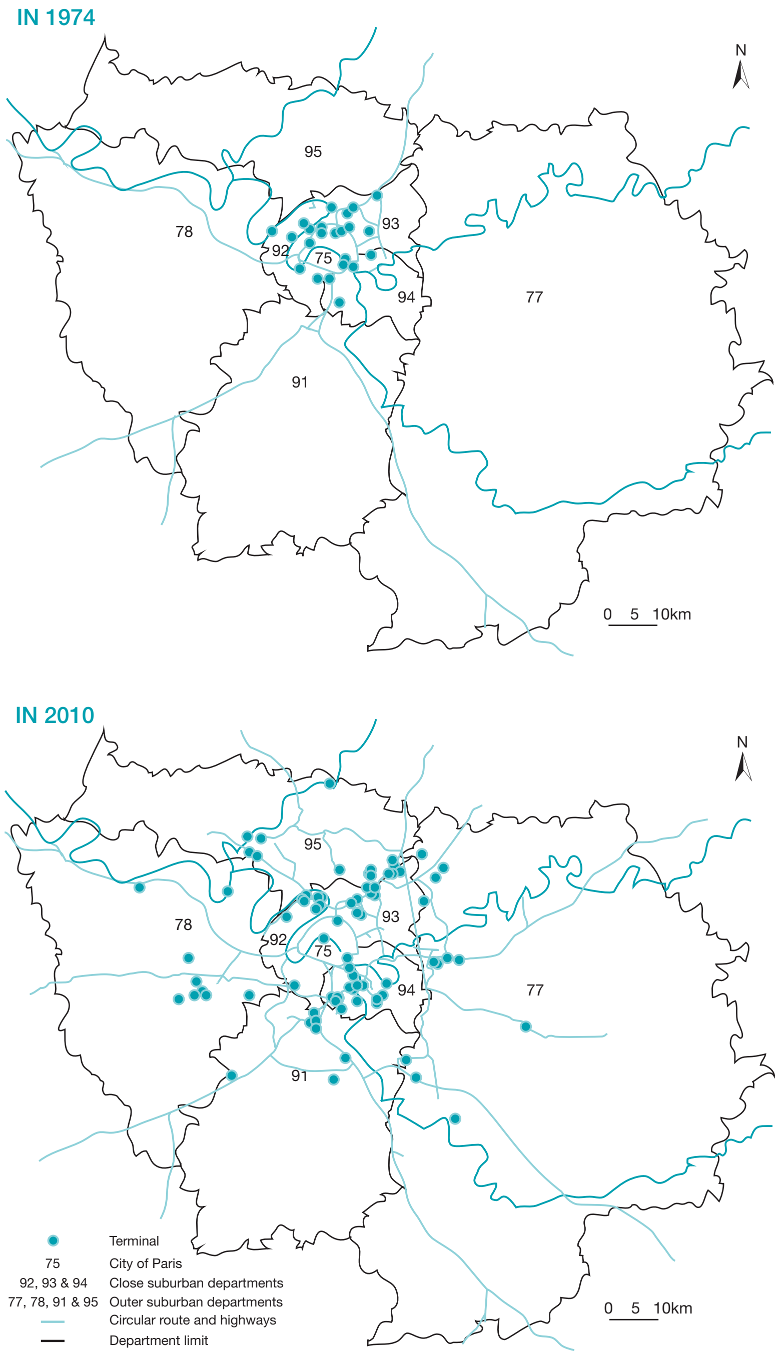

Figure 4.4

Logistics sprawl: Location of terminals of large parcel and express transport companies in the Paris region (1974 and 2010)

Source: Dablanc, 2011.

Box 4.6 Land use and forms of city logistics

A metropolitan area can be serviced through several freight distribution strategies that vary in scope depending on the level of urban density.[a] An urban freight distribution strategy that is frequently used in high and low urban densities alike is illustrated in Figure 4.5 and constitutes the following three elements:

- Urban logistics zones try to rationalize the multiplication of freight distribution transport, as well as their longer distances, by providing space in relative proximity to central areas. They are commonly developed over brownfield sites that can provide additional benefit if adjacent (co-located) to existing port, airport or rail terminal facilities. Users have the opportunity to consolidate their urban deliveries.
- Urban freight distribution centres are shared facilities interfacing with a set of distribution centres, each being connected to their respective supply chains.[b] Thus, a wide array of supply chains can achieve a better efficiency within the central city. In this case, the last mile' is assumed by shared vehicles operating on the behalf of the urban freight distribution centre's customers. On some occasions, urban freight distribution centres can combine several activities within the same facility, such as office and retail functions, to maximize revenue generation.
- Urban freight stations are small facilities where cargo can be dropped and picked up. A common problem in parcel delivery or pickup is that it requires both the customer and the carrier to be available at the same time and location. Urban freight stations near highly frequented locations offer the highest proximity level to customers, and can therefore mitigate the matching issue between the delivery vehicle and the customer.

Sources: [a] Boudouin, 2006; [b] Browne et al, 2005; BESTUFS, 2005.

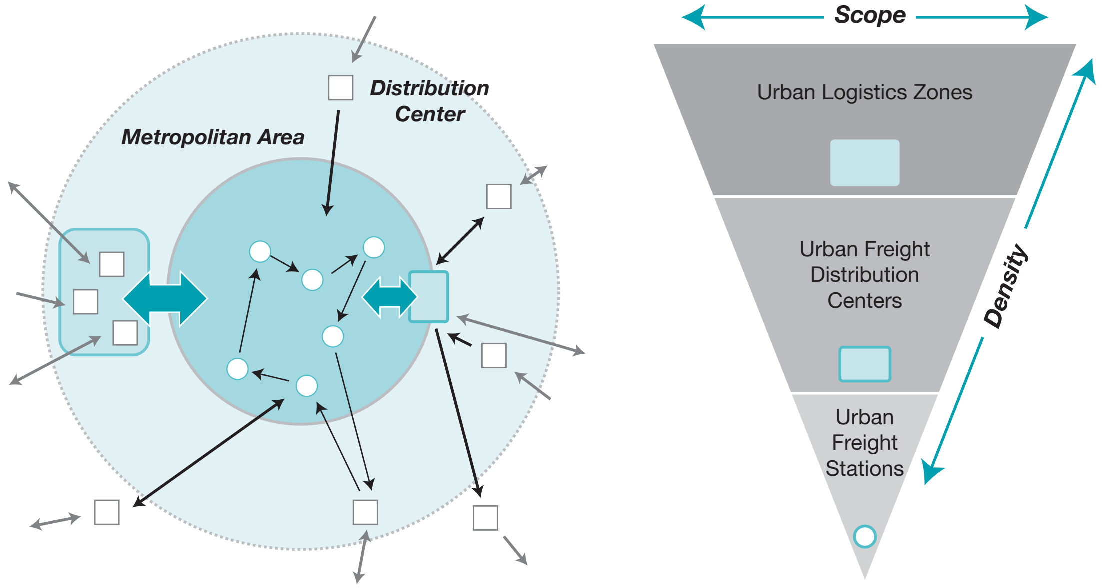

Figure 4.5
City logistics and land use

As the density of urban land use increases, specialization becomes more effective and enables a narrower scope of city logistics. However, a distribution centre servicing a low-density area often needs to carry a large variety of goods in its inventory for a longer period of time.

CHALLENGES OF URBAN GOODS TRANSPORT

The diffusion of modern freight distribution systems on the urban landscape generates environmental and social externalities, ranging from vehicle emissions, accidents and congestion to logistics sprawl. Addressing these externalities represents a set of environmental, economic, social and institutional challenges (Table 4.2).

Environmental challenges

Road transportation is the most polluting land transport mode per vehicle kilometre travelled, but urban freight distribution offers limited alternatives to roadways.[22] Air pollution has decreased with the gradual phasing out of leaded petrol and better engine design.[23] However, diesel trucks, the dominant mode of urban deliveries, remain a major source of particulate matter and nitrogen oxide emissions.[24] The share of urban freight depending on the informal sector is hard to evaluate, as are economic, environmental and social indicators for these unreported activities.[25] For the same number

Road transportation is the most polluting land transport mode per vehicle kilometre travelled, but urban freight distribution offers limited alternatives to roadways

Challenges	Dimensions
Environmental challenges	Mitigate environmental externalities (emissions, noise). Reverse logistic flows (waste and recycling).
Economic challenges	Capacity of urban freight transport systems (congestion). Lower driving speeds and frequent disruptions (reliability). Distribution sprawl (space consumption). E-commerce (home deliveries).
Social and institutional challenges	Health and safety (accidents, hazardous materials). Passenger/freight interferences (conflicts). Access (allowable vehicles, streets and delivery hours). Zoning (land use, logistics zones, urban freight distribution centres).

Table 4.2

Key challenges in urban goods transport

of tonne-kilometres, urban freight distribution tends to be more polluting, often twice as much as long-distance freight transport. The main reasons are as follows:

- ***Vehicle age***. Urban delivery vehicles are older than the average freight transport truck. It is common that trucks end their lifecycle in drayage operations[26] between port or rail terminals and urban distribution centres. The renewal of freight fleets is generally slower than that for non-urban road freight traffic, because urban freight involves numerous competing small operators that cut costs as much as possible. This problem is compounded in developing countries where vehicles are even older, and thus more prone to higher emissions and accidents.
- ***Vehicle size***. Urban delivery vehicles tend to be smaller than standard freight trucks, implying that some economies of scale advantages are lost. While smaller vehicles may be prone to fewer emissions per kilometre travelled, at an aggregate level, this may result in more emissions because of a greater number of vehicles required to carry the same amount of freight.
- ***Operating speeds and idling***. Urban operating speeds are slower due to congestion and traffic restrictions, implying that the engines of delivery vehicles are running at speeds consistently lower than the optimal speed. This results in higher fuel consumption and higher emission levels. Constant acceleration and deceleration due to traffic lights and traffic congestion result in an increase in fuel consumption, as well as the wear on vehicles. Vehicle idling is frequent either for deliveries or at stops, which contributes to emissions.

Trucks account for 22 per cent of the global greenhouse gas emissions generated by transportation, but due to circulation conditions in urban areas this share is higher

Greenhouse gas emissions and noise pollution are other environmental effects of urban freight transport. Trucks account for 22 per cent of the global greenhouse gas emissions generated by transportation,[27] but due to circulation conditions in urban areas this share is higher. For instance, in large European cities, freight transport is responsible for a third of transport-related nitrogen oxides and half of transport-related particulate matter emissions, mostly due to a higher reliance on diesel fuels for trucks. In London, freight distribution accounts for less than 10 per cent of urban traffic but contributes to 30 per cent of nitrogen oxide emissions and 63 per cent of particulate emissions.[28] In the metropolitan area of Mexico City, about 60 per cent of particulate matters generated by mobile sources were from freight vehicles.[29] While little is known about the potential vulnerability of urban goods transport to climate change, it is assumed that events such as floods, storms and heat waves will be as disruptive to urban goods transport as they are to urban activities in general.[30]

Since urban areas are large consumers of final goods, the issue of reverse logistics deserves consideration, as it involves the collection of wastes and recycling of materials.[31] City logistics and environmentally sustainable logistics (green logistics) are thus decisively linked. Most developed countries have formal recycling programmes, while in developing countries cities essentially leave a significant share of the recycling of goods to the informal sector. The recycling of used goods, packages and cardboard takes specific forms; scavengers and recyclers are an important feature of city life, with active informal supply chains. The urban landscape of developing countries also includes active street vending, providing a wide range of retail and food goods. Informal settlements are also an important component of the city landscape in many developing countries, and have specific characteristics and supply needs that are not well documented.

Economic challenges

The growth in the amount of freight circulating within urban areas has further exacerbated traffic congestion. Urban goods transport is usually subject to smaller volumes but with frequent deliveries, as inventory levels in urban stores tend to be low. Due to the limited availability of storage space in central areas, urban goods are delivered regularly from distribution centres at the periphery. However, despite peak-hour traffic congestion, a regular flow of deliveries must be maintained. This incites freight distribution activities to take place during the night if possible. Furthermore, many stores in high-density areas have limited capacity to accommodate deliveries, implying that delivery trucks must park along the street in the vicinity of the store, preferably in front. This induces the usage of smaller trucks better able to circulate within urban areas and find parking space for deliveries. It is not uncommon for trucks to double-park for short deliveries, thus seriously impeding local circulation.

Since real estate is at a premium in urban areas, stores tend to have limited warehousing space and are smaller in size. Urban freight distribution

Box 4.7 Cities and logistical performance

No international comparative analysis of the logistical performance of cities has yet been undertaken, but country-wide surveys have been compiled in recent years by the World Bank. The logistics performance index (LPI) is a composite index based on proxy measures for transport and information infrastructure, supply chain management and trade facilitation capabilities. These indicator scores are calculated using a world survey of international freight forwarders and express carriers. LPI values range from 1 (worst) to 5 (best) and show that building the capacity to connect firms, suppliers and consumers, is key, in a context where predictability and reliability are becoming as important as costs in supply chain management. An LPI value of less than 3 reflects an array of problems within a country's freight distribution system, causing undue delays and additional costs. For instance, a difference of one point lower in the LPI is related to two to four additional days of port hinterland access, and a 25 per cent higher physical inspection rate at customs. The performance metrics of the LPI do not capture the environmental and social externalities of logistics.

While the LPI reflects global trade and supply chains, it can also be reflective of the logistical capabilities of cities. For instance, a low LPI is reflective of inefficient customs procedures, including governance that does not appropriately regulate and mitigate urban freight distribution. Of the world's cities with more than 1 million inhabitants, 334 million inhabitants lived in cities within countries with a low LPI (less than 3), and 593 million lived in cities with below average LPI conditions (between 3 and 3.5). Only 330 million people were living in cities of more than 1 million inhabitants, with good LPI conditions (more than 3.5). It can thus be inferred that more than half of the world's urban population are living in cities where the logistical capabilities are deficient. This assessment should be interpreted with caution, as significant national differences exist, for example, between coastal China, which has efficient export-oriented freight distribution systems, and its interior provinces where the quality of transport infrastructures is more inadequate. Port and airport cities tend to have more capabilities for city logistics, because of the availability of international trade infrastructures and a concentration of third party logistics service providers.

Source: Arvis et al, 2010.

is subject to smaller volumes, with time-sensitive freight necessary to replenish a constant demand. This requires a high frequency of deliveries, particularly considering high sales volumes, which imposes a contradiction in the cargo load. Stores in central areas would benefit from the economies of scale of larger deliveries, but the setting does not permit this advantage. This is one of the reasons why retailing has emerged in suburban areas. Large stores with ample parking space can have their own cargo docking bays that can accommodate the largest delivery trucks available; the benefits of economies of scale are multiplied with economies of distribution.

The tendency of large urban areas to have high congestion levels poses a challenge towards the reliability of freight distribution. This is particularly the case for the disruptions and lower driving speeds that urban congestion imposes, making urban freight distribution prone to inefficiencies, compared to circulation taking place in a suburban or non-urban setting. Although there have been some attempts to assess countries' performance on trade logistics (see for example Box 4.7), the logistical performance of cities remains problematic and difficult to assess. However, evidence shows that port and airport cities tend to have more capabilities for city logistics because of the availability of international trade infrastructures and a concentration of third-party logistics service providers. A share of these capabilities is used for urban freight distribution.

The diffusion of e-commerce has also created new forms of demands and new forms of urban distribution with a growth in home deliveries.[32] The parcels industry has been booming, largely because of e-commerce, and in some cases has been proactive at establishing novel forms of last-mile deliveries.

The tendency of large urban areas to have high congestion levels poses a challenge towards the reliability of freight distribution

Social and institutional challenges

From a social standpoint, the interactions between people and freight in cities create many disturbances related to health, safety (accidents) and the quality of life (Table 4.3). Urban goods transport can have substantial impacts on the communities they originate from, are bound to or are transiting through. This is particularly the case when large freight facilities such as a port, airport, rail yard or distribution centres are operating. Passenger and freight transport do not mingle well, particularly during commuting around peak hours where both systems seriously impair their respective capacity and performance. In developing countries, traffic congestion is a significant operational problem for city logistics, with slow non-motorized vehicles sharing urban roads with motorized traffic.

Freight-intensive activities such as terminals, container storage areas, warehouses and truck depots can be an aesthetic blight on the urban landscape, and are associated with lower property values. As many freight facilities operate on a 24-hour basis, lights can be an annoyance and a source of potential sleep disruption. Furthermore, living or working in proximity to roads or terminals with substantial freight activities exposes residents, particularly

Freight-intensive activities such as terminals, container storage areas, warehouses and truck depots can be an aesthetic blight on the urban landscape, and are associated with lower property values

Table 4.3

Social externalities of freight distribution

Dimension	Hazard	Externality
Air pollution (regional and local)	Particulate matter; Carbon monoxide; Nitrogen dioxide; Living in proximity to roads or terminals.	Healthcare costs; Productivity losses; Quality of life impairments.
Noise	Emissions from trucks and terminal activities.	Stress; Quality of life; Lower property values.
Health and safety	Accidents; Contingent employment; Working conditions (vehicles and facilities); Dangerous goods.	Occupational risks; Limited work benefits.
Community	Industrial blight; 24-hour lighting; Congestion; Rights of way; Eminent domain.	Disruptions; Longer commuting time; Lower property values.

women and children, to harmful pollutants such as particulate matters emitted by diesel engines. Other disadvantages include associated healthcare costs, productivity losses for workers and general impairments in the quality of life. Noise emissions by urban freight distribution, including terminal operations, are also a salient issue, as trucks are noisier than other vehicles.

Actors involved in urban goods transport are . . . prone to more regulatory pressures than freight forwarders operating outside major urban areas

Safety is an important consideration for both citizens and freight operators. Freight vehicles are not necessarily more unsafe than other vehicles, but because of blind spots, slower vehicle reaction times, larger loads or loads of hazardous materials, freight should always be considered in the planning process. It may be particularly important to understand how freight vehicles interact with motorized and non-motorized passenger transportation. Therefore, the risk of accidents by heavy freight vehicles and the reconciliation of truck traffic with non-motorized transport is an emerging policy concern. This is mainly due to the safety issues that arise when heavy freight vehicles encounter pedestrians on local streets. Given that freight contributes to traffic congestion, it has a negative impact on the social cohesion of communities, resulting in lower levels of social interaction.[33]

Workers in the freight distribution sector, from drivers to warehouse workers, have a higher occupational risk than most professions.[34] A majority of freight-related jobs offer low wages and limited benefits to their employees, in a work environment that is fast paced and prone to accidents and injuries. Safety issues can also arise during the frequent shipment and transportation of hazardous materials taking place along urban corridors. Also, the prevalence of sexual risk behaviour among truck drivers along urban corridors and in some cities has had negative social impacts and exacerbated the spread of HIV/AIDS and other sexually transmitted diseases in many developing-country cities. In Brazil, for instance, high levels of sexual risk behaviour were recorded among truck drivers in two port cities, Santos and Itajai.[35]

From a regulatory standpoint, urban areas are highly constrained with a variety of rules related to zoning, emissions and even access conditions to roads and terminals. High population densities imply a low tolerance for infringements and disturbances brought by freight distribution.[36] Actors involved in urban goods transport are thus prone to more regulatory pressures than freight forwarders operating outside major urban areas. This represents an additional risk of having urban freight activities deemed a nuisance, which could result in costly mitigation strategies. For example, several major airports within metropolitan areas have had their night operations curtailed due to noise emissions over nearby residential districts.

Furthermore, compensation and resettlement mechanisms are often not adequate, particularly in developing countries where the state and local governments use the power of eminent domain to create spaces for transportation infrastructures, thus increasing the vulnerability of the poor in cases of involuntary resettlement. Another issue gaining prominence in urban goods transport is the need to address environmental justice, since concentrations of the poor and minority populations suffer disproportionately from negative social impacts from transportation-related developments.[37] This is far from being a recent phenomenon, as the siting of communities with lower economic status was historically associated with proximity or adjacency to terminals and industrial areas. Often, communities are caught in a vicious circle of deriving limited benefits from activities integrated in global and national supply chains that generate strong externalities. In this context of growing conflicts between freight and the city, port authorities tend to be more proactive in mitigating the social impacts on adjacent

Table 4.4

Main city logistics policies

Strategy	Advantages	Drawbacks
Rationalization of deliveries		
Night deliveries	Less traffic congestion and faster deliveries. No conflicts with commuting.	Organization of labour and work shifts. Potential disruptions to communities and family household dynamics (due to noise and night work).
Extended delivery windows	More delivery options and fewer impacts during peak hours.	Organization of labour and work shifts.
Freight facilities		
Urban freight distribution centres	Better usage of delivery assets. Less traffic congestion.	Additional costs and potential delays due to consolidation. May not well service consignee delivery requirements (e.g. time).
Local freight stations	Less delivery parking. A single consolidation/ deconsolidation location.	Deliveries from freight station to consignee. Management costs for the freight station.
Designated delivery parking areas	Better access to consignees. Less disruptive deliveries.	Fewer parking spaces for passenger vehicles.
Modal adaptation		
Adapted vehicles	Less impact on local traffic congestion. Easier to find a parking spot. Environmentally friendly vehicles.	More journeys for shipments larger than the load unit. Additional costs.

communities, as they generally are public entities. For instance, in 2010 the Port of Los Angeles (US), after pressures from adjacent communities, established the Port Community Mitigation Trust Fund, where capital derived from port operations was set aside to be invested in social and environmental mitigation efforts.[38]

EXISTING POLICY RESPONSES

Urbanization and its associated growth in material consumption have reached a point where a more concerted approach to freight distribution is advocated.[39] This requires an understanding of the key challenges in urban freight distribution and the dissemination of practices and methods, notably data collection, to enhance urban mobility and sustainability.[40] As stated earlier, urban areas are constrained and subject to a complex regulatory framework. Thus, the urban space is prone to conflicts between different stakeholders, but there are also opportunities for collaboration as space for urban logistics must be recognized as a fundamental element of urban planning.[41] It can be complex for a distributor to adapt homogeneous freight distribution practices to a specific urban environment with its particular regulations.

Furthermore, priorities diverge. In Europe and Japan, an enduring concern relates to the circulation of heavy vehicles in urban areas, as density and the physical characteristics of streets challenge urban freight distribution. In North America, due to lower densities, the focus has been on load consolidation as urban deliveries are commonly less than a truckload. In many developing countries, the lack of resources often hinders adequate policy responses. Still, an array of policies have been considered to mitigate urban freight distribution problems, most of which are related to traffic congestion (Table 4.4).[42]

Rationalization of deliveries

Night deliveries are emerging as a preferable strategy for city logistics since they take place at a time when there is less traffic congestion and fewer conflicts as a result of commuting. However, night deliveries impose important changes in the organization of labour, for both the freight forwarder and the consignee. Distribution centres must be open at night, even intermodal terminals, while the consignee must have labour available to receive deliveries. For smaller stores, night delivery could impose prohibitive additional labour costs. In such a setting, carriers tend to prefer night deliveries, since their vehicles can operate in a less-congested setting, with the possibility of using larger vehicles, while retailers would prefer daytime deliveries that correspond to the availability of their workforce. In high-density areas, night deliveries can also result in local disturbances such as noise at a time when families are at home.

Night deliveries are emerging as a preferable strategy for city logistics since they take place at a time when there is less traffic congestion and fewer conflicts as a result of commuting

Extended delivery windows provide additional options, particularly outside peak hours. Like night deliveries, they impose challenges in the organization of labour with longer and irregular hours. Developing countries are better placed to see the implementation of this form of rationalization as labour conditions are more ‘flexible’,[43] but operational margins for activities such as retail are tight.

Carriers tend to prefer night deliveries, . . . while retailers . . . prefer daytime deliveries that correspond to the availability of their workforce

Freight facilities

Freight facilities can be designed and adapted to suit the requirements of city logistics. An important aspect is to achieve a level of consolidation of loads, many of which are less than a truckload, so that more

Appropriate design of bus stations – i.e. with a section allocated to freight (e.g. delivery areas and warehouses) – is a strategy that could help mitigate city logistics problems in several developing countries

cargo can be placed per delivery vehicle. One such facility is labelled the urban freight transhipment centre, where deliveries bound to specific commercial districts are grouped even if for different customers. It is similar to cross-docking facilities used by retailers to organize their regional distribution. These facilities encourage a better usage of delivery assets, resulting in less traffic congestion in central areas. This is linked with higher costs, as an additional consolidation stage takes place at the urban freight distribution centre. This again involves additional delays and undermines the potential profitability of such a strategy. It is also likely that the common delivery service does not necessarily meet the requirements of the consignee in terms of delivery time and frequency.

Local freight stations are an additional alternative in high-density areas, by offering a local point of consolidation or deconsolidation for pickups and deliveries. Cargo is delivered by trucks to local freight stations, with the final deliveries from the freight station to the consignee commonly done on rolling carts. The implementation of local freight stations has received limited attention, particularly due to its higher costs and lack of flexibility to accommodate the needs of specific supply chains. Automated locker banks are a type of local freight station that is gaining momentum, since it fits well the needs of e-commerce. In Germany, the Deutsche Post (DHL) has installed thousands of 'PackStations' at strategic locations, so that consignments can be delivered at any time of the day. In the US, the giant online retailer Amazon initiated a similar initiative with the setting of delivery lockers in the central areas of large cities, mostly in collaboration with pharmacies and convenience stores that have long opening hours.

Using bicycles as cargo vehicles is particularly encouraged when combined with policies that restrict motor vehicle access to specific areas of a city

An important element of urban freight distribution in developing countries is the bus station, which doubles as a nexus for regional passengers' transportation and a common point of entry for freight.[44] These stations are particularly relevant since vehicle ownership tends to be low, with the population relying on intercity bus services. Small freight forwarding companies and distribution centres, often informal, are filling an important role in city logistics. Appropriate design of bus stations – i.e. with a section allocated to freight (e.g. delivery areas and warehouses) – is a strategy that could help mitigate city logistics problems in several developing countries, particularly since bus stations tend to be centrally located.

The existing public transport system could also be used to move freight, but this implies numerous challenges: in terms of the adaptation of modes, the usage of existing passenger terminals and scheduling issues

Another strategy concerns the implementation of designated delivery areas, ensuring that delivery vehicles have better access to consignees, and that deliveries take place in a less disruptive fashion (e.g. avoiding double-parking). However, reserving parking space for deliveries implies that less parking space is available for passenger vehicles, which can lead to conflicts with residents (even if freight parking spaces are available during the night). Despite the availability of delivery areas, the intensity of freight distribution may create a parking demand beyond the capacity of available delivery areas.

Modal adaptation

Urban delivery vehicles can be adapted to better suit the density of urban distribution, which often involves smaller vehicles such as vans, including bicycles. The latter have the potential to become a preferred 'last-mile' vehicle, particularly in high-density and congested areas. In locations where bicycle use is high, such as the Netherlands, delivery bicycles are also used to carry personal cargo (e.g. groceries).[45] Due to their low acquisition and maintenance costs, cargo bicycles convey much potential in developed and developing countries alike, such as the *becak* (a three-wheeled bicycle) in Indonesia.[46] Services using electrically assisted delivery tricycles have been successfully implemented in France[47] and are gradually being adopted across Europe for services as varied as parcel and catering deliveries. Using bicycles as cargo vehicles is particularly encouraged when combined with policies that restrict motor vehicle access to specific areas of a city, such as downtown or commercial districts, or with the extension of dedicated bike lanes.

Efforts can also be made to have less polluting and more energy-efficient vehicles, including CNG and electric vehicles, which can reduce energy consumption and lower environmental impacts. However, these vehicles tend to be more expensive, which can be prohibitive in developing countries. Furthermore, greener vehicles and alternative fuels cannot mitigate the increasing traffic levels worldwide. Information technologies that are actively used by parcel carriers, such as vehicle tracking, load management and navigation, have the potential to improve the usage of distribution assets such as warehousing space and vehicles. The introduction of such technologies can lead to new forms of urban distribution, such as collaborative distribution (competing activities, such as stores, hotels and restaurants, using the same distribution services) with better trip sequence matching (better order of pickups and deliveries to minimize travelling distance). Since information technologies are increasingly low cost and ubiquitous (e.g. cellular data networks), such applications are suitable in both developed and developing countries.

The existing public transport system could also be used to move freight, but this implies numerous challenges: in terms of the adaptation of modes, the usage of existing passenger terminals and scheduling issues. One particular point of concern is that the mandate of public transport authorities does not involve freight. As a result, many agencies either have little incentive or do not have the legal authority to develop freight initiatives. Fares can also be an issue, since public transport fare systems are per passenger with no equivalent for freight. From a logistics perspective, the rationale behind using public transport is limited, as it involves load-break and potential breaches in integrity. Many attempts at developing 'cargo-trams' (tramways adapted to carry cargo) have failed, such as the ambitious cargo-tram project in Amsterdam (the Netherlands) that went bankrupt in 2009.[48] The expansion of passenger rail services in suburban areas often raises conflicts, due to the dominance that freight assumes in interurban services. For instance, passenger rail services and freight trains that share the same track segments are likely to result in delays and schedule integrity issues. Outside building new rail infrastructures, the options are limited to stringent infrastructure sharing agreements between passengers and freight rail services.

CONCLUDING REMARKS AND LESSONS FOR POLICY

The city of the twenty-first century is a city of intense flows of people, material and information. As such, goods transport is a fundamental component of the urban environment, an issue that until recently was neglected in the planning process. The challenge is to balance the need to ensure efficiency of goods transport, while minimizing externalities such as congestion, the emission of pollutants, noise and accidents.

As new strategies and practices are implemented, and also because of a trend towards higher energy prices, more efficient urban freight distribution systems will emerge as part of a transition towards greener forms of city logistics. Such strategies are centred mostly around the rationalization of deliveries; the development of freight facilities better adapted to the urban environment; and a modal adaptation (vehicles, including non-motorized modes, better adapted to urban circulation). While these strategies are likely to reflect the unique modal and infrastructural lattice of each city, it remains uncertain if advances in city logistics will be sufficient to cope with growing levels of congestion and the related socioeconomic externalities, particularly in developing countries. Accordingly, unique forms of city logistics are emerging in developing countries, due to significant differences in levels of income and density. However, these cases are far less documented.

Goods transport remains a fundamental element of urban sustainability. Thus, it is essential that the role and impact of goods transport in the urban context is taken into consideration, if planning accessible mobility for passengers is to be effective. This is especially so when considering the close interactions between urban land use, form and goods transport within an increasingly contested landscape.

Passenger rail services and freight trains that share the same track segments are likely to result in delays and schedule integrity issues

It is essential that the role and impact of goods transport in the urban context is taken into consideration, if planning accessible mobility for passengers is to be effective

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