Best Practices in Urban Freight Management

Lessons from an International Survey

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Freight movement is essential to the function of metropolitan areas, yet generates many externalities, including congestion, air pollution, noise, and greenhouse gas emissions. Metropolitan areas around the world are seeking ways to manage urban freight and its impacts. This paper presents the results from a comprehensive international survey of urban freight management strategies. The objective was to examine the effectiveness of alternative strategies and assess their transferability for U.S. implementation. Three categories were used to describe urban freight strategies: last-mile or first-mile deliveries and pickups, environmental mitigation, and trade node strategies. Many possibilities were found for the improved management of urban freight and its impacts; these possibilities included labeling and certification programs, incentive-based programs for voluntary emissions reduction, local land use and parking policies, and more stringent national fuel efficiency and emissions standards for heavy-duty trucks. More research is needed on intrametropolitan freight movements and on the effectiveness of existing policies and strategies.

Commercial transport is crucial to the functioning of metropolitan areas. Trucks and vans provide local last-mile deliveries and pickups as well as most medium-haul freight transport. In metropolitan areas that serve as trade hubs, trucks are a major part of wholesale, distribution, logistics, and intermodal operations. Commercial traffic in metropolitan areas generates significant externalities, including congestion, air pollution (small particulates, mononitrogen oxides, greenhouse gas emissions, etc.), noise, and traffic incidents. In addition, heavy duty vehicles affect pavements and generate additional demand for increased road capacity.

Metropolitan areas are seeking ways to better manage goods movements. Researchers and local stakeholders have explored a range of strategies, such as better routing algorithms, smaller or newer trucks, consolidated local delivery stations, alternative modes, off-peak deliveries, low emissions zones (LEZs), and freight partnerships. The purpose of this paper is to consider the state of research and practice in the context of transferability to the United States. Many interesting and innovative strategies are being developed in Europe and other parts of the world. The extent to which these strategies are transferable to the United States depends on the complex governance arrangements in which urban freight policy takes place in the United States.

This paper is organized as follows. It begins with a brief review of the urban freight literature. The sources of the research synthesis are then described. The key findings of the study are described, as are the lessons learned from experiments with various policy measures. Consideration is given to whether these experiments are transferable to the United States and could be identified as best practices. The paper closes with some recommendations and suggestions for future research.

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BACKGROUND AND LITERATURE REVIEW

Although there has been increasing experimentation in the solving of urban freight problems, the relevant literature is limited and fragmented. A major challenge for research is the lack of appropriate data; several studies have addressed data availability and promoted more comprehensive data collection (*1–3*). Data on truck and van movements in U.S. urban areas are almost nonexistent; consequently, the extent of the urban freight problem remains unknown. There is an extensive literature in logistics, with studies on truck routing, network optimization, and related topics (*4–6*). This literature is not "urban" in the sense of considering the urban context (freight–passenger conflicts, externalities, etc.) but instead addresses routing and allocation problems that are common in the urban environment. Transport economists have examined the economic structure of the drayage trucking industry, shipper behavior, and responsiveness to pricing policies (*7–9*). City logistics is an emerging field of study; it seeks to improve freight efficiency while minimizing economic costs and social externalities. The field of study looks at city logistics in a broader sense than just transportation (*10*). This scope was also defined by Wolpert and Reuter in a recent review of city logistics in the academic literature (*3*). Researchers have examined spatial dynamics in freight activities, the transport geography of industry networks, and urban freight distribution systems (*11–16*).

There is a growing literature on the externalities associated with urban freight. The truck and rail congestion studies sponsored by the U.S. Department of Transportation show that freight bottlenecks are most prevalent in metropolitan areas, particularly when trade flows are concentrated, as they are in Los Angeles, California; Atlanta, Georgia; Chicago, Illinois; and New York City (*17, 18*). Case studies document the local congestion associated with truck parking and loading (*19*). There is a growing number of studies on the health

impacts of small particulates associated with diesel truck emissions, notably the longitudinal children's health study in Los Angeles (*20*). Ports and intermodal terminals tend to be air pollution hot spots because of the concentration of truck traffic and the prevalence of older, more polluting trucks in local delivery fleets. Trucks are also significant contributors to greenhouse gas emissions and account for about two-thirds of the emissions from freight sources (*21*).

Much of the emerging literature on urban freight policy is focused on environmental impacts and regulations (*22, 23*). Studies of specific policy examples include off-hour deliveries in New York, LEZs, and the container fee program in Los Angeles (*7, 24, 25*). These studies have not reached a point of synthesis or general understanding of which policies are effective or which conditions are required for effective implementation (*26*).

METHOD

The synthesis described in this paper is based on a review of the domestic and international literature (*26*). The review includes journal publications, government reports, consultant reports, and unpublished papers and materials; the review includes 261 references, of which 108 are academic papers and scientific books. The authors believe this review to be fairly comprehensive of academic publications in English; the review includes results from a search in the main publication databases that cover transport engineering, transport geography, transport economics, and logistics, as well as transport planning. The review matches the recent literature review on city logistics by Wolpert and Reuter (*3*). The review described in the current paper is focused more on local sources, such as freight data collection in specific cities or national reports from ministries and institutions. These sources were identified from various contacts or previous work. The literature review was supplemented with communications from project sponsors and data collected from secondary sources. A full list of references is available in Giuliano et al. (*26*); only the most significant references have been cited here. The synthesis included (*a*) an assessment of the current knowledge on the impacts of freight in metropolitan areas; (*b*) a survey of the mitigation strategies proposed, planned, or implemented in metropolitan areas; (*c*) a discussion of the U.S. governance and regulatory context; and (*d*) an evaluation of freight management strategies and their potential for implementation. In this paper, an overview of the mitigation strategies is presented. Sixty-three practices were selected on the basis of their recurrence in the literature and, when available, their reported positive results. Half of the practices were from North America. The paper finally provides the authors' assessment of the most promising strategies for broad implementation in the United States.

RESULTS: BEST PRACTICES AND POLICY INITIATIVES

In response to growing urban freight problems, cities around the world have engaged in extensive experimentation. This section describes the findings of the review, discusses the effectiveness of various practices, and considers transferability to widespread implementation in the United States.

The discussion is organized around three general categories of the urban freight management problem: local last-mile or first-mile delivery and pickup, environmental impacts, and trade node problems. Last-mile strategies address local deliveries and pickups to or from urban businesses or residences (home deliveries). The strategies aim to make these trips more efficient. Strategies that reduce environmental impacts focus on the reduction of emissions and noise by regulation or through the offering of incentives to use less polluting vehicles. Finally, strategies related to trade nodes (i.e., cities that are hubs for national and international trade) are considered; in these cities there are large flows to and from ports, airports, or intermodal facilities.

Last-Mile Strategies

One-third of urban truck traffic is engaged in goods pickups. The last mile (or, rather, miles) represents the final haul of a shipment to its end receiver, be it a shop, a business, a facility, or a residence. (Collectively, these trips will be referred to as the "last mile.") The serving of local businesses and residences in cities is inefficient for several reasons. First, the product is often delivered from the vendor to an establishment, so a given establishment (say, a department store) may receive multiple deliveries each day. Small deliveries to many destinations generate complex routing problems. If deliveries could be consolidated between vendors, more efficient routing would be possible and fewer trips would be needed (*27*). Second, deliveries may be restricted to certain routes or time periods and therefore add constraints on routing and scheduling. Restrictions on night deliveries, or the reluctance of urban business owners to open at night, force more trips to take place during peak hours; these trips therefore add to congestion. Third, home delivery is inefficient because of the small size of the products, the spatial dispersion of the residences, the competition within the local delivery industry, and the frequency of failed deliveries (*28*).

European cities face more serious local delivery problems than U.S. cities because the European cities have older built forms, higher average densities, and greater shares of small and independent businesses. European cities also have the apparent advantage of more regulatory control over truck access and roads. It is therefore not surprising that the majority of last-mile experiments have come from overseas, Europe in particular. In the United States, the few domestic policy experiments that do exist (like clean truck programs and off-peak deliveries) come from one of the two largest trade node cities: New York and Los Angeles. Other North American cities' freight initiatives tend to center on new or improved infrastructure (such as grade separations, additional highway capacity, or logistics parks) rather than operational changes.

The main types of last-mile strategy and some examples of each are presented in Table 1. Several sources of information were consulted (*7, 23, 29–32*). Table 1 illustrates the preponderance of examples that come from outside the United States.

Labeling or Other Certification Programs

Certification and labeling programs are examples of voluntary regulation. The public sector negotiates with private industry to develop a set of voluntary targets or operating rules that confer either recognition or special benefits, such as flexible delivery hours. Certification and labeling programs include the various "green" certification programs that promote the use of cleaner vehicles and fuels or of operations during less congested periods of the day. The effectiveness depends on the extent to which the agreements change behavior. Certification programs that allow access to loading facilities or extended delivery hours offer a significant benefit to shippers and

TABLE 1 Last-Mile Strategies

Strategy	Location	Description
Consultation processes and certification schemes	London	Freight quality partnership
	London	Freight operator recognition scheme
	Paris	Delivery charter
	Netherlands, 25 cities	PIEK label program
Traffic and parking regulations	Paris	Daytime hours truck ban (over 29 m^2)
	Sao Paulo, Brazil	Access 2 days/week/vehicle
	New York City	Commercial vehicle parking plan
	Barcelona, Spain	Off-peak hours use of roadways for unloading and loading
	Los Angeles downtown	Increased enforcement of use of loading bays
	San Francisco, Calif.	Demand-dependent parking charges
Intelligent transportation systems	Several European and Asian cities	Automatic control systems for truck access regulation
	London	Transport for London freight website
	Europe and United States	DHL Packstation and U.S. Postal Service Gopost: automated self-service parcel delivery lockers
Planning strategies	Tokyo	Loading and unloading requirements for new commercial facilities of >2,000 m^2
	New York City	Loading and unloading requirements for new commercial facilities of >8,000 ft^2
	Barcelona	Minimum 5 m^2 storage for new bars and restaurants
	Paris	Technical guide to delivery bays for the design guide for on-street loading bays
Consolidation schemes and measures targeted toward urban supply chains	Paris	Urban logistics spaces: subsidized rental rates for freight storage in municipal parking garages
	Europe	Kiala network: pickup points for home deliveries
	Bristol, United Kingdom; Motomachi, Japan; Cityporto, Italy	Urban consolidation centers
	London	Construction consolidation center
Off-hour deliveries	New York City	2009–2010 experiment, focus on receivers
	Los Angeles and Long Beach, Calif.	PierPASS off-peak program

therefore make it easier to justify the purchase of new compliant vehicles. Certification programs are often the result of freight forums or participatory processes that include public and private stakeholders. Two well-known freight forums in London and Paris resulted in detailed freight plans.

The certification programs reviewed in this study were perceived as very successful both by the public sponsors and the private participants. One potential problem is the buy in and participation of all industry segments; for example, large shippers are more capable of negotiating program conditions with public sponsors, and therefore programs may be designed to the advantage of larger shippers. Certification programs may increase trust and foster more collaborative relationships between industry and government. Shippers may also enjoy a competitive advantage when bidding for contracts as more clients place value on doing business with green firms. Finally, certification programs are relatively low cost, and most of those costs are transactions costs (i.e., the communications and negotiations required to establish and maintain public–private relationships). Certification programs may also evolve as targets are reached or new targets are negotiated; the programs therefore can create significant improvements over time.

Voluntary regulation is a good fit within the U.S. context of decentralized governance and dispersed regulatory authority. In cases in which direct regulation is either impossible (because of a lack of authority) or infeasible, voluntary regulation may be the best available alternative.

Traffic and Parking Regulations

City efforts to manage last-mile problems have focused on local traffic and parking regulations because these tools are clearly within local authority. In theory, traffic and parking regulations are effective if they are enforced. However, cities have no control over demand for pickups and deliveries, and consequently traffic and parking regulations are limited tools for the management of last-mile problems. In practice, highly restrictive regulations are costly to enforce and may lead to other problems. The restriction of truck parking areas may result in trucks double-parking in the roadway or using curb space reserved for other purposes. When the demand for truck pickup and delivery greatly exceeds the supply of loading and parking areas, enforcement becomes costly and increasingly difficult; the risk of being cited becomes less costly than the delays incurred in waiting for a parking spot.

Traffic and parking regulations have mixed records of success. Restrictions on truck access or the limiting of truck deliveries to certain days of the week tend to shift truck traffic to smaller vehicles (generating a net increase in miles traveled by truck) or concentrate traffic into shorter time periods (generating more congestion). Regulations that seek to use road resources as efficiently as possible tend to be successful. The policy in Barcelona, Spain, of allowing the use of traffic lanes for pickup and delivery during off-peak hours is an example. The recent implementation of dynamic parking charges in San Francisco, California, is another. The lesson drawn from U.S. and international examples is that local freight demand must be accommodated; therefore, strategies that manage rather than restrict freight deliveries tend to be more effective.

Local Planning Policy

Local jurisdictions have land use planning authority and may set policies and guidelines for the incorporation of freight deliveries

into new developments, the design of loading docks, and parking and loading practices. With increased development in city cores and more frequent deliveries for each business, freight demand has increased, while the scarcity of road and curb space, as well as ever higher land values, increase the cost of demand management. New development or redevelopment offers the opportunity to implement planning standards for on-site freight facilities. Examples include Tokyo and New York's requirements for new commercial developments. Barcelona goes further and adds a requirement for minimum storage areas for new restaurants and bars. On-site facilities lessen the need for on-street loading zones and reduce conflicts with passenger demands. On-site facilities also add to building costs and therefore may be resisted by the development community.

Cities may also develop freight loading and parking standards for off-site activities (e.g., in a public right-of-way). There are more opportunities in developing areas, in which the road infrastructure is still being constructed. However, standards can have an impact over time even in already developed areas if the standards are tied to future development and redevelopment.

Experiences with on-site planning policies have been largely positive. Although such requirements add to development costs, the requirements also add to commercial property values by ensuring that freight deliveries are accommodated. Shippers and truck drivers benefit from having reliably available loading facilities. These policies are a good fit for the United States because the authority of local governments to develop and implement planning and building guidelines is clearly established. The ability to negotiate through the zoning and approval process allows for flexibility in enforcement and is widely accepted.

City Logistics and Consolidation Programs

Consolidation programs seek to reduce truck traffic by combining the pickups and deliveries of different shippers and receivers. The programs often focus on changing the supply chain, rather than on the final (or initial) step of the chain. The simplest consolidation schemes (from a supply chain perspective) are those that focus on final delivery or pickup (e.g., on the end of the chain, such as pickup centers for online purchases). These common pickup points reduce home deliveries (truck trips), but the impact on private vehicle trips is unknown and depends on how consumers access these centers.

Another version of consolidation is shared logistics spaces, at which multiple shippers use an in-town facility to consolidate loads (typically from different, out of town logistics facilities) before final delivery. The intent is to reduce the miles traveled by truck through the more efficient routing of final deliveries (or initial pickups). The most ambitious version is the urban consolidation center, at which goods from multiple shippers or vendors are combined and delivered by third-party trucking firms. Although shippers may benefit from the lower costs of consolidated deliveries, whether these benefits offset the rental and added labor costs of transloading is unclear. In the many European experiments, consolidation centers were not feasible without public subsidies, and many closed.

The transferability of consolidation schemes to the United States is limited. The required subsidies to freight operators would be politically difficult, even if local jurisdictions had the funding to provide such subsidies. Any effort to force consolidation in the United States through regulations (as was done in several European cities) would be very difficult because of interstate commerce laws.

Off-Hour Deliveries

Off-hour deliveries seek to shift truck activity out of the peak traffic periods and therefore reduce congestion and emissions, yet few examples of off-hour delivery programs exist. Constraints on the trucking side include federal requirements for hours of service, premium pay for unionized drivers, and possible efficiency losses associated with the spreading of shipments across more hours of the day. Constraints for receivers include opening receiving facilities early, operating loading terminals for more hours of the day, paying premiums to terminal workers, and being prohibited by local zoning codes on truck activities in residential neighborhoods.

There is only one permanent off-hours program in the United States: the PierPASS program at the Los Angeles and Long Beach, California, ports. The program was implemented as a result of unique circumstances that do not exist in other U.S. metropolitan areas. A New York City demonstration was the first and only in-city program. That pilot demonstration reduced congestion, energy consumption, and emissions and therefore demonstrated the potential benefits of such programs. Off-hour deliveries may have potential as a voluntary regulation. Shippers might be incentivized to purchase and use quieter trucks and handling equipment in exchange for being able to deliver during the off-hours.

Intelligent Transportation Systems

The use of intelligent transportation systems (ITS) to monitor or manage urban freight includes technologies for the provision of real-time traffic and parking information, the automated enforcement of parking or traffic regulations, toll collection, or automated access control. The use of ITS to monitor truck traffic through license plate readers and other devices is extensive outside the United States. Automated monitoring systems involve high upfront costs and tend to be used either as part of road pricing systems or in limited-access zones. Once implemented, automated systems make possible the continuous, low-cost enforcement of tolls or access zones and can be very effective.

Transferability to the United States depends on the perceived acceptability of the policies to be implemented. So far, security at limited-access facilities has proven to be an acceptable justification for semiautomated monitoring. The use of tolls to manage congestion in metropolitan areas is not yet widely accepted. The New York City congestion pricing proposal is illustrative; it included truck tolls that could be discounted by the use of clean trucks, and studies indicated that congestion and emission reductions would be substantial. However, it is expected that tolls will become more acceptable as congestion increases and funding from traditional sources to support capacity expansion declines.

A second implementation challenge in the United States is the general resistance to automated monitoring by public authorities. An illustrative case is the conflict that surrounds cameras used to enforce red light violations at intersections. Monitoring could provide comprehensive data on truck movements; such data are greatly needed for the better analysis of urban freight problems. However, these data may be perceived as proprietary and resisted by trucking companies and shippers. The use of ITS for truck tolls or automated monitoring outside limited-access facilities appears to have limited transferability to the United States.

Strategies to Reduce Environmental Impacts

Strategies to reduce environmental impacts seek to reduce truck emissions and energy consumption by improving engine performance, shifting to cleaner (and quieter) conventional diesel trucks or alternative fuel trucks, or shifting freight to more energy efficient modes. The review in this paper makes it clear that strategies that address the entire commercial fleet have the most impact, even if the per vehicle impact is small. Strategies that impose substantial costs on private industry will not be adopted unless industry is forced to do so, and strategies that seek to shift freight from trucks to slower modes are not attractive to industry without large subsidies and may have little impact on emissions or energy consumption. The strategies to reduce environmental impacts are summarized in Table 2. The table contains information from numerous sources (*21, 24, 33–38*).

Truck Fuel Efficiency and Emissions Standards

Truck fuel efficiency and emissions standards have been one of the most effective tools in the reduction of emissions. The recent changes in the corporate average fuel economy standards for light trucks will have a significant impact on the light truck portion of the freight vehicle fleet. The shift to cleaner diesel engines and fuels is having a similar impact on heavy duty trucks. The Los Angeles and Long Beach ports' Clean Truck Program is by far the most ambitious emissions reduction program in the United States and, in 4 years, has led to large reductions in diesel truck emissions. It is expected that fuel efficiency and emissions regulations will continue to be one of the most effective tools for the reduction of air pollution and carbon dioxide emissions in metropolitan areas.

Alternative Fuels and Vehicles

Alternative fuel vehicles (AFVs) have been widely promoted in the United States but have achieved little market penetration because of their higher capital and operating costs, the complexities of operating diverse fleets, the vehicles' limited range, and the lack of fueling infrastructure. In Europe, even large subsidies have not prompted the adoption of AFVs on any significant scale. AFVs are not yet sufficiently competitive with heavy duty diesel engines, and the progress being made to reduce diesel emissions may make it more difficult for AFVs to compete. However, the largest private delivery firms—FedEx, DHL, and UPS—are all experimenting with AFVs and operate small numbers of electric and hybrid electric trucks in various cities.

In Europe experiments have taken place with smaller AFVs, such as small vans and cargo cycles, for local deliveries. Niche markets for such vehicles may exist in the most dense U.S. city centers (New York, Chicago, and Boston, Massachusetts), depending on the costs (labor, new vehicles) compared with conventional vans or small trucks. The lack of a potentially large market suggests that these strategies would have little impact on emission reductions.

LEZs

LEZs limit the types of vehicle that may enter a given part of the city. The limitation is based on emissions and energy consumption. LEZs

TABLE 2 Strategies to Reduce Environmental Impacts

Strategy	Location	Description
Truck fleet emission standards	California	CARB truck, diesel particulate filter standards
	United States	EPA 2011 truck carbon dioxide emissions and fuel efficiency standards
Low emission zones	Greater London	Low emissions zone: access restrictions on old trucks and large vans
	Milan, Italy	Historic center truck regulations
	Swedish, Dutch, and Danish cities	Regulations based on European standards
Alternative fuels, electric delivery vehicles	London, Milan	Congestion charge exemption for alternative fuel vehicles
	U.S. cities	Delivery company use of alternative fuel trucks and vans
	European cities	Electrically assisted cargo cycles
	France	Program to group purchases of electric vans for commercial fleets for public administrations
	Los Angeles–Long Beach ports	CAAP technology advancement program
Promotion of alternative modes–cargo diversion	United States	U.S. DOT (MARAD) marine highways–short sea shipping grant program
	San Francisco Bay Area	FedEx BART pilot program
	Paris	Cargotram, Monoprix rail, and waterways deliveries projects
	Dresden, Germany	Cargotram
Restriction on truck idling	California	5-min limit on diesel truck idling
	United States	Truckstop electrification
Delivery noise reduction	Netherlands	PIEK research, development, and regulation program
	Atlanta	Atlanta strategic truck route master plan
Environmental justice, community mitigation measures	Greater Los Angeles	SCAG toolkit for goods movements
	County of Riverside, Calif.	Truck routing and parking study
	New York City	Truck route management and community impact reduction study
	Baltimore, Md.	Maritime industrial zone overlay district
	Europe	Freight villages
	Atlanta	Regional commission's freight studies
	United States	Environmental justice guideline publications (NCHRP Report 320, NCFRP Projects 13 and 14)

NOTE: CARB = California Air Resources Board; EPA = Environmental Protection Agency; CAAP = Clean Air Action Plan; DOT = Department of Transportation; MARAD = Maritime Administration; BART = Bay Area Rapid Transit; SCAG = Southern California Association of Governments; NCFRP = National Cooperative Freight Research Program.

have been established in several European cities. LEZs have some obvious advantages: to the extent that performance standards are imposed on all trucks, the entire urban fleet is affected, and emissions reductions can be significant. LEZs may generate secondary benefits by forcing the reorganization of the local trucking industry into larger and therefore more efficient operations. (Whether LEZs would generate net benefits is uncertain; the elimination of small operators would eliminate jobs and small businesses.)

Although a potentially effective strategy, the transferability of LEZs to the United States is low. In the absence of a jurisdictional authority, an LEZ would have to be established as a voluntary program.

Alternative Modes

Efforts to shift truck freight to slower but more energy efficient and cleaner modes have not been successful. Experiments in Europe that have used the regional rail system to ship goods to central areas for delivery show that large public subsidies are required. Studies of the use of commuter rail for package delivery failed to result in demonstrations or experiments. Efforts to shift freight to water have been similarly unsuccessful, both in the case of coastal shipping and river transport. Waterborne freight in the United States continues to lose market share.

Mode shifting has large impacts on the supply chain. To use a slower mode, cargo owners must hold the inventory longer, and these inventory costs tend to exceed the higher costs of faster modes. In addition, mixing modes adds to the number of times shipments must be handled and therefore increases labor and facility costs. The most promising segments for mode shifting are through freight traffic (port or airport imports and exports) in large volumes by, for example, increasing on-dock rail facilities to eliminate either short drayage trips or large volume, longer distance deliveries (e.g., to distant distribution and warehouse centers) for which rail is close to competitive with trucking.

Community Environmental Mitigation

The United States has taken the lead in the incorporation of environmental justice as a performance measure for new freight projects. This consideration has in part been a result of the sociogeography of U.S. cities, in which poor and minority populations tend to be concentrated near major freight facilities. The environmental review process provides a venue for environmental justice concerns. More recent research on the relationship between emissions and health has created an imperative for industry to find solutions to problems that might otherwise prevent it from securing the support of elected officials and regulatory agencies. Environmental justice considerations are therefore widely institutionalized in the transportation planning process and often involve industry–government partnerships. Examples include the Southern California Association of Governments' toolkit for goods movement, New York City's truck impact study, and Baltimore, Maryland's, industrial overlay zone study.

U.S. ports have been particularly proactive in addressing environmental justice concerns. In addition to the extreme case of Southern California, clean truck programs, freight rail investments, and the elimination of at-grade rail crossings are part of programs in New York and New Jersey; Seattle, Washington; Oakland, California; and two intermodal hub cities, Chicago and Atlanta.

Trade Node Strategies

Trade hubs and gateways—places with large ports or airports, intermodal transfer points, or border crossings—are the focus of freight flows associated with national and international trade. Trade hubs share the same last-mile issues addressed in previous sections, such as truck and van delivery and access issues, evening and weekend vehicle movements, and incompatible land uses. However, trade hubs are further defined by the scale and scope of the operations that take place within them, particularly in the port, warehouse, and distribution sectors. A combination of rising trade volumes, demand for larger facilities, and land costs has pushed distribution centers and warehouses to the periphery of metropolitan areas. These facilities generate freight-related activity that, on its way from ports and airports to markets outside the region, may pass through the urban core.

Unlike the last-mile and environmental strategies outlined above, the majority of trade node strategies have been developed and tested in the United States. The largest trade nodes, in particular in Southern California, have had the greatest influence in the development of strategies to address environmental problems. In the Southern California gateway, the threat of legislative mandates and rising trade volumes created a unique set of conditions that favored an industry-driven response to environmental pressures. The question is whether the same conditions exist in other places in the United States. Political pressure and competitive pressures exist in other parts of the world, but it is apparent from the research that the two in combination drive the environmental agenda at trade gateways. In the United States, in which good intermodal connections encourage the development of pass-through traffic through transload centers, the gateway plays a pivotal role in framing the debate on the environmental impacts of trade. The trade node strategies are summarized in Table 3; the table includes information from a number of sources (*7, 25, 39–47*).

Appointment and Pricing Strategies at Ports

Appointment and pricing strategies attempt to spread the flow of truck traffic through terminal gates across more hours of the day. Appointments have been implemented at several ports. The appointments have the potential to increase the efficiency of port operations and therefore reduce truck turn times and truck idling, but to date there is little evidence that such efficiencies are being realized. Appointments require operational changes by terminal operators and are therefore likely to be used effectively only when yard congestion makes it worthwhile.

The sole example of pricing-based terminal gate operations is the PierPASS program in Southern California. PierPASS was intended to reduce road congestion, and it proved successful at shifting a significant amount of eligible cargo to the evening (approximately 40%). No other U.S. metropolitan area has the severity of congestion and air pollution to motivate the use of peak fees, and no other port is inclined to take the risk of losing business in response to a fee. The shifting of truck traffic at the ports generates changes along the rest of the supply chain, including at distribution centers and retail establishments, which presumably operate on more traditional work schedules. The net benefits at the system level have not yet been proved.

Road Pricing and Dedicated Truck Lanes

Despite the demonstrated effectiveness of congestion pricing in the few places in which it has been implemented, pricing strategies in the

TABLE 3 Trade Node Strategies

Strategy	Location	Description
Congestion pricing: marine terminal gates	Los Angeles–Long Beach ports	PierPASS off-peak program
	Vancouver, British Columbia, Canada	Off-peak gate program
	Busan, South Korea	Evening gate program
Congestion pricing: road pricing	New York City	Proposed pricing
	Europe	Truck VMT pricing
Truck reservation and appointment system	Ports of Los Angeles, Long Beach, and Oakland	Assembly Bill 2650
	Port of Vancouver	Reservation system
Lane separation–truck-only lanes	Georgia	Statewide truck-only lanes (proposed)
	South Boston, Southern California, Port of New Orleans, La.	Short-distance truck-only access roads
Elimination of at-grade crossings	Los Angeles	Alameda corridor
	Greater Los Angeles	Alameda corridor east
	Chicago	CREATE
	Seattle	FAST program
Border crossing delays	Washington State	FAST corridor
	U.S.–Mexico border crossing	Pilot program
Accelerated emissions reduction	Los Angeles–Long Beach ports	CAAP clean trucks program
	Port of Vancouver	Truck licensing program
	New York and New Jersey, Seattle, Oakland	Voluntary truck emissions programs
Equipment management	New York and New Jersey, Oakland	Virtual container yards
	Worldwide	Industry-driven chassis pools

NOTE: VMT = vehicle miles traveled; CREATE = Chicago Region Environmental and Transportation Efficiency Program; FAST = Freight Action Strategy (for the Everett–Seattle–Tacoma Corridor).

United States continue to be difficult to implement. There is more use of pricing strategies in Europe and Asia than in the United States, and at least a few examples of truck pricing, notably the weight–distance fees in Switzerland, Austria, and Germany and the cordon pricing scheme in London. There are numerous proposals for truck tolls in the United States, including the New York bridge toll plan and proposed tolled truck lanes in Atlanta and Los Angeles, but none of the proposals have reached the stage of being an accepted project.

Truck pricing may be more difficult than passenger car pricing because of the competition between trucking and rail. The trucking industry argues that it already pays its fair share for the use of roadways and that additional charges would reduce the industry's competitiveness with rail. From an environmental perspective, if trucking generates more emissions per ton of freight carried, this shift would be socially beneficial despite the negative impact on the trucking industry. Despite the potential for the management of congestion, the implementation of pricing strategies will require extensive education and political leadership.

A second strategy (often linked with tolls to offer a funding mechanism) is truck-only lanes. They have been proposed in major metropolitan areas (most notably Atlanta) and included in regional transportation plans. The planned lanes have failed as a result of lack of funding and scarcity of land. Truck lanes are costly to build because of their pavement and geometry requirements and can rarely be justified on the basis of truck volumes. Given the fiscal constraints that face the U.S. highway system, truck-only facilities do not appear to be a promising option for dealing with truck traffic.

Accelerated Truck Emission Reduction Programs

Given the success in the United States of national regulations to increase fuel efficiency and decrease emissions, a logical extension is to accelerate the introduction and use of cleaner vehicles at trade nodes. Several U.S. ports have clean truck programs, which are intended to accelerate the use of cleaner diesel and AFVs in drayage trucking. The most aggressive effort is the Clean Truck Program at the Los Angeles and Long Beach ports (*47*). Seattle, Oakland, and New York and New Jersey have programs with more flexibility and less aggressive targets. These programs are examples of voluntary regulation: the targets are reached through negotiation and are beyond regulatory requirements. As voluntary, negotiated programs, they are a good fit in the United States.

Equipment Management

Another potential source for the reduction in miles traveled by truck is to use port-related freight equipment—chassis and containers—more efficiently. Ownership practices result in many extra trips for truckers because they are required to match containers with the owner's chassis. If management practices were modified by the owners, it would become possible to share containers and chassis and therefore reduce the mileage associated with these movements. Equipment owners are motivated to experiment with different models as a result of the growing standardization of equipment characteristics (and therefore the declining value of branding one's own equipment), the costs of owning equipment that is idle much of the time, and the costs of storing equipment at land facilities. Public sector assistance may be necessary to assist with land assemblage for shared equipment facilities and to sponsor studies.

Shared equipment offers a promising way to reduce truck trips while increasing the efficiency of port-related freight operations. Because it is industry motivated, shared equipment is a good fit for the United States.

Rail Strategies

Efficient rail and intermodal facilities are critical to international trade. High-volume rail corridors conflict with surface road traffic at at-grade rail crossings, as well as with passenger commuter rail traffic. The main strategy to address these problems in trade node cities is capital investment to increase rail capacity and eliminate at-grade rail crossings.

The major challenge to capital investment strategies is the lack of an obvious funding source. Railroads have little incentive to incur costs to solve a problem for road transport and are therefore typically unwilling to pay. Local jurisdictions have no authority to force railroads to incur these costs. The local jurisdictions also have little incentive to pay because rail traffic is viewed as a national responsibility. At the national level there is no specific funding source for such projects.

Border Crossings

Border crossing regions are a unique subset of trade nodes. Like port regions, border crossings generate truck traffic destined for local distribution or transfer facilities as well as markets beyond the immediate metropolitan area. Border crossings therefore have last-mile impacts as well as pass-through impacts. Border crossings provide a unique challenge for the management of regional freight capacity because of their international context.

The U.S.–Canadian border has provided a useful test bed for researchers to investigate the institutional and technological frameworks for freight flows across borders. In Washington State, the Freight Action Strategy Corridor was designed and supported by the U.S. Department of Transportation, the State of Washington, the Puget Sound Regional Council, three ports, three private freight carriers, 12 cities, and three counties. The corridor members identified highway–rail crossings as the most pressing concern and proposed, as a first phase, 15 projects: 12 grade separations and three truck access projects. The projects totaled $470 million.

The United States–Mexico border crossings, in many ways, operate in a more complex and uncertain environment. Although the North American Free Trade Agreement and other institutional and regulatory reforms have been designed to improve cross-border freight flows for the United States, Canada, and Mexico, the lack of a truly open border results in further delays at crossings as goods are unloaded and reloaded on to different vehicles on opposite sides of the gate. This situation has created a demand for technology-based solutions.

RECOMMENDATIONS

Urban Freight Management Strategies

The review and assessment outlined in this paper suggest some promising options for the better management of freight in U.S. cities and metropolitan areas. The findings are summarized in Table 4. The second column gives a rating of effectiveness based on the literature as discussed in previously in the paper (*26*). The last column gives a rating of the applicability of the strategy to the United States: Given U.S. institutional and governance structures, to what extent could such a strategy be implemented? The ratings for applicability are based on the authors' judgment. The U.S. context is quite different from that of Europe and other developed parts of the world. For

TABLE 4 Summary of Strategies, Their Effectiveness and Applicability to the United States

Strategy	Effectiveness	Applicability to United States
Last Mile		
Labeling or other certification programs	High	High
Traffic and parking regulations	Medium	High
Local planning policy	High	High
City logistics and consolidation programs	Low	Low
Off-hour deliveries	High	Medium
ITS	Medium	Medium
Environment		
Truck fuel efficiency and emissions standards	High	High
Alternative fuels and vehicles	Low	Medium
LEZs	High	Low
Alternative modes	Low	Low
Community environmental mitigation	Medium	High
Trade Node		
Appointments and pricing strategies at ports	Medium	High
Road pricing and dedicated truck lanes	High	Low
Accelerated truck emissions reduction programs	High	Medium
Equipment management	Medium	Medium
Rail strategies	Medium	Medium
Border crossings	Medium	High

example, many aspects of urban freight are protected by interstate commerce, and the ability of local or state governments to regulate urban freight is therefore limited. There are also different perspectives on the extent to which private industry should be subsidized to achieve social benefits. Among the last-mile strategies, labeling and certification programs, land use planning (in the longer term), and off-hour deliveries are the most effective strategies. However, off-hour delivery programs are less transferable because of the many changes these programs require within the supply chain. Traffic and parking regulations are less effective because they do not have an impact on the underlying demand for freight movements. The effectiveness of ITS strategies is rated as medium because of their limited feasibility for implementation and the need for more development of some of the most potentially beneficial applications, such as truck parking and loading information systems.

Within the category of environmental strategies, global fuel efficiency and emissions regulations have proved their effectiveness over several decades. LEZs are the most effective method to address local hot spots but do not appear to be feasible under current national and state policies in the United States. AFVs may prove to be very effective in the long term, but the technology and market penetration are not sufficient to achieve significant reductions in emissions or energy consumption. Environmental justice efforts are more advanced in the United States than in other countries; however, environmental justice problems are challenging to solve.

Among the trade node strategies, pricing and accelerated emissions programs are among the most effective. Despite the effectiveness of pricing, it is rated low on applicability because of the continuing strong political opposition from various stakeholder groups. Accelerated emissions reduction programs based on negotiation and voluntary targets have proved to be effective and are a better fit for the United States. Rail strategies can be effective but involve high costs, for which funding sources are not obvious.

Future Research Needs

There are many opportunities for further research. First, most cities cannot answer the following questions: How many vehicles (be it a heavy duty truck, a light duty truck, a van, a car, or even a bike) are engaged in freight transport activity? How many deliveries and pickups occur in a day or a week? Data accessible to planners and researchers on delivery characteristics are almost nonexistent. Without these data it is hard to confirm or refute conventional wisdom such as, the rise of e-commerce means a net increase in commercial vehicle miles traveled.

Additionally, there is much research on system optimization but little on how optimization methods work in practice. Better data are needed on, for example, real time route optimization that is based on actual fleet movements. Border crossings are a case in point. Similarly, the need for field tests in the area of technology deployment is great.

Second, one of the biggest problems associated with urban freight is truck emissions, and the review showed the many approaches being taken to address this problem. There is limited information on the relative benefits and costs of certification systems or LEZs. Research is needed to better understand the effectiveness of these strategies. For example, in the case of LEZs, what are the associated costs for the government and the logistics firms? What is the impact on the trucking industry? Are LEZs legally possible in the United States? And if so, at what level of government?

Finally, there is a need for the careful and systematic evaluation of existing policies and experiments. There is a lack of analysis on the impacts of certification schemes, truck access restrictions, and requirements for alternative fuel trucks. Ongoing experimentation provides a rich resource for discovering whether these efforts have the expected results or have unintended consequences that reduce the benefits of the effort.

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