NCFRP

REPORT 33

NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

Sponsored by the Office of the Assistant Secretary for Research and Technology

Improving Freight System Performance in Metropolitan Areas: A Planning Guide

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NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

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Improving Freight System Performance in Metropolitan Areas: A Planning Guide

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NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

America's freight transportation system makes critical contributions to the nation's economy, security, and quality of life. The freight transportation system in the United States is a complex, decentralized, and dynamic network of private and public entities, involving all modes of transportation—trucking, rail, waterways, air, and pipelines. In recent years, the demand for freight transportation service has been increasing fueled by growth in international trade; however, bottlenecks or congestion points in the system are exposing the inadequacies of current infrastructure and operations to meet the growing demand for freight. Strategic operational and investment decisions by governments at all levels will be necessary to maintain freight system performance, and will in turn require sound technical guidance based on research.

The National Cooperative Freight Research Program (NCFRP) is a cooperative research program sponsored by the Office of the Assistant Secretary for Research and Technology under Grant No. DTOS59-06-G-00039 and administered by the Transportation Research Board (TRB). The program was authorized in 2005 with the passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). On September 6, 2006, a contract to begin work was executed between the Research and Innovative Technology Administration, which is now the Office of the Assistant Secretary for Research and Technology, and The National Academies. The NCFRP will carry out applied research on problems facing the freight industry that are not being adequately addressed by existing research programs.

Program guidance is provided by an Oversight Committee comprised of a representative cross section of freight stakeholders appointed by the National Research Council of The National Academies. The NCFRP Oversight Committee meets annually to formulate the research program by identifying the highest priority projects and defining funding levels and expected products. Research problem statements recommending research needs for consideration by the Oversight Committee are solicited annually, but may be submitted to TRB at any time. Each selected project is assigned to a panel, appointed by TRB, which provides technical guidance and counsel throughout the life of the project. Heavy emphasis is placed on including members representing the intended users of the research products.

The NCFRP will produce a series of research reports and other products such as guidebooks for practitioners. Primary emphasis will be placed on disseminating NCFRP results to the intended end-users of the research: freight shippers and carriers, service providers, suppliers, and public officials.

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FOREWORD

By William C. Rogers
Staff Officer
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NCFRP Report 33: Improving Freight System Performance in Metropolitan Areas: A Planning Guide provides a regional public planning guide that identifies potential strategies and practical solutions for public and private stakeholders to improve freight movement system performance in diverse metropolitan areas. The Guide is intended to serve as a comprehensive reference for all portions of a metropolitan area, from the urban core to more suburban and exurban areas (urban fringe). The Guide includes an Initiative Selector tool to aid in the selection of possible alternatives for various problems, and Freight Trip Generation (FTG) software that planners can use to identify main locations where freight is an issue based on freight trips produced and attracted. Links to access the Initiative Selector and FTG software appear in this report.

Many of the challenges affecting the freight system, from congestion to land use conflicts to community acceptance, arise in metropolitan areas. Often hubs in the supply chain and intermodal operations, metropolitan areas also frequently present higher costs and elevated risks to the provision of service. The lack of knowledge and experience with freight in metropolitan planning agencies has often precluded an effective response to the challenges, despite the direct economic importance of freight systems to the metropolitan areas and their sensitive positions in the global supply chains. These challenges require practical solutions, some of which need to be newly developed, and all of which must be effective for the community and governing organizations, and benefit the freight system.

In NCFRP Project 38, Rensselaer Polytechnic Institute (RPI) was asked to (1) synthesize the results of applicable NCFRP and NCHRP research that are applicable to regional metropolitan freight planning; (2) identify and summarize strategies (e.g., operations and maintenance, capital investment, policy and regulatory, and funding) that have been developed to enhance efficient and effective freight movement by any mode in metropolitan areas; (3) identify the obstacles encountered and successes achieved during the planning and implementation of the strategies and describe any unintended consequences, both positive and negative, that can be attributed to the strategies that were implemented; (4) identify stakeholders and discuss their roles, their impact on the success of the strategies, and how they measure success; and (5) develop a guide that identifies potential strategies and practical solutions for public and private stakeholders to improve freight movement system performance in diverse metropolitan areas, as well as a plan for users to maintain the relevance of the guide that includes application of sensitivity analysis (e.g., fuel cost, labor availability and cost, demographics, environmental, trade agreements, changes in supply chains), and how the guide can be adapted as conditions change.

The Initiative Selector is an HTML webpage developed by RPI that can be accessed from a link in this report. The FTG software is a three-module program that applies models developed by RPI at the zip-code and 2-digit NAICS code levels. The Appendix to *NCFRP Report 33* provides the user manual for the software, which can be downloaded from the link provided in the report.

CONTENTS

Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

SUMMARY

Improving Freight System Performance in Metropolitan Areas: A Planning Guide

Freight flows are physical manifestations of the manufacturing and consumer economies that are foundations of modern life. Transportation policy seeks to ensure that freight is moved as efficiently as possible, as hampering the flow of cargo is bound to have a negative effect on the economy. If freight shipments are delayed or unreliable, the economy accrues economic losses in the form of reduced economic output due to a lack of input materials, increased inventories to account for the unreliability of deliveries, and higher production costs due to inefficient or unreliable freight transport. At the same time, freight activity produces negative effects, given that freight-vehicle traffic creates congestion, pollution, noise, and infrastructure damage. Public policy strives to maximize the net social benefits of freight activity, maximizing the benefits of reliable freight flows while minimizing the negative externalities of freight-vehicle traffic.

Achieving this goal is a challenge, however: The functioning of the freight system is influenced by the decisions of multiple agents—most notably shippers and receivers—that are primarily concerned with the profitability of their businesses and not naturally inclined to participate in public policy making. The system is also very large and multifaceted. It is important to consider all available freight modes, as well as the infrastructure and operations carried by each of them. Analyses also need to account for multiple vehicle classes, including the delivery vans and small trucks that produce about 80% of freight traffic, and the complex interactions between freight activities in the urban core and those in the suburbs, where most deliveries originate. There is a chronic lack of data and fundamental knowledge about how the system works, and how best to induce behavior changes among the system's participants, in order to achieve public policy goals. The lack of research means that there is no accepted body of knowledge to help policy makers decide how best to tackle freight issues. Moreover, the research available is dispersed across a collection of reports and journal articles that are out of reach to many professionals. Complicating the matter further, no comprehensive catalog exists of public-sector initiatives that could be used to address freight issues.

Throughout this Planning Guide (the Guide), the term "initiatives" refers to the entire spectrum of mechanisms that the public sector can use to foster sustainable practices. Such initiatives include projects, programs, and policies. The main objective of the Guide is to help fill this void by (a) outlining the basic elements of an urban freight transportation decision-making (DM) process, (b) providing guidance on how to identify potential public-sector initiatives, and (c) introducing a complete catalog of those that could be considered by public agencies.

To develop the Guide, the research team identified the various initiatives that have been used or proposed for use in the near term, produced a comprehensive classification system, and

conducted a critical examination of evidence concerning the performance of the initiatives. During the review process, the team elected to include all of the initiatives identified, discussing in each case the potential pros and cons that the initiative could bring to the system. The review of more than 150 references led to the identification of 54 initiatives, which were then classified into eight major groups as follows:

- Infrastructure management
- Parking/loading areas management
- Vehicle-related strategies
- Traffic management
- Pricing, incentives, and taxation
- Logistical management
- Freight demand/land use management
- Stakeholder engagement

The groups were organized as part of a continuum, with supply initiatives at one end, demand-related initiatives at the other, and operational and financial strategies in the middle, under a constant interaction with the corresponding key stakeholders.

The Guide is designed to provide practitioners with general guidance and a framework for DM, together with a comprehensive list, information, and descriptions of public-sector initiatives. Case studies have been included to complement and add illustrative depth to decision frameworks and to provide real-life examples from a number of U.S. cities showing some of the intricacies involved in planning, from choice to implementation: costs and benefits, stakeholder groups and funding arrangements involved, unintended effects, and compromises in approach and effects.

The Guide has limitations worth mentioning. To start, the Guide is not a substitute for the due diligence required to properly analyze the potential of any particular initiative to address a given urban freight issue. In-depth analyses must always be conducted to ensure selection of the most appropriate path. Such analyses require an adequate diagnosis of the problem, an objective analysis of potential solution alternatives, careful consideration of the associated benefits and costs, assessment and consideration of trade-offs involved, and identification of potential unintended consequences. The Guide's main objective is to provide guidance regarding the alternatives that could be considered in a variety of common freight system situations/scenarios. It is intended to be general, as it is not possible to discuss the myriad, highly specific application environments that characterize freight practice in the United States.

The initiatives presented in this Guide have been adopted into practice or are on the verge of being adopted. Futuristic ideas are not presented, because there is not enough research on their applicability for improving the freight system. This Guide also focuses on changes that will directly impact freight performance within a metropolitan area.

Throughout this Guide, the terms *metropolitan* and *urban* are frequently used. Although the Guide is intended to focus on the metropolitan area, the bulk of the issues in freight system performance are in the urban area. The Guide is intended to serve as a comprehensive reference for all aspects of an urban area, from the urban core to more suburban and exurban (urban fringe) areas which, combined together, encompass the metropolitan area.

It is recognized that some improvements to outlying areas such as ports and terminals could also impact the freight performance. For purposes of this Guide, however, improvements to such outlying areas are not covered in detail. Other tools are available that could aid decision makers in making improvements at these other locations. For example, the American

Association of Port Authorities (AAPA) and the U.S. DOT Maritime Administration are developing a port investment plan toolkit (American Association of Port Authorities 2013). Such resources will supplement this Guide.

An electronic version of this Guide has been produced in an HTML format. The HTML version allows practitioners to navigate the Guide more easily. This electronic version can be found at https://coe-sufs.org/wordpress/ncfrp33/. Additionally, an "Initiative Selector" tool has been developed. The Initiative Selector is an HTML webpage that acts as a decision-support system to aid in the selection of possible alternatives for various problems. For a given set of inputs, the Initiative Selector provides practitioners with suggestions about potential initiatives that could be implemented to fix the given problem. The Initiative Selector is by no means a replacement for engineering and planning; rather, it offers solutions that might be considered for various situations and would help in minimizing the time devoted by planners to look for alternatives applicable to their local needs. The Initiative Selector can be found at http://coe-sufs.org/wordpress/InitiativeSelector/. Finally, this Guide is accompanied by Freight Trip Generation (FTG) software that serves as a tool for planners to identify main locations where freight is an issue in terms of freight trips produced and attracted. Uses and specifications for the FTG software are described in the Appendix.

The Guide contains three sections and some back matter: Section 1 provides a basic overview of key components of an urban freight DM process. Section 2 presents succinct discussions of public-sector initiatives that could be considered, including summary tables for each initiative presented in the Guide, together with planning and design considerations, and references for further reading. Section 3 describes nine case studies from diverse cities across the United States that offer lessons for transportation professionals. The back matter presents the references cited in the Guide as well as the supporting Appendix.

SECTION 1

Urban Freight Transportation Decision-Making Process

The initiatives presented in this Guide represent a wide range of potential solutions to the freight issues typically found in metropolitan areas. They could be used by transportation agency staff to perform two basic functions: (1) *management* of urban freight traffic—typically short-term efforts conducted by the city/county level Department of Transportation (DOT) or Public Works—and (2) *planning* of mid-term/long-term improvement exercises of the kind usually undertaken by the local Metropolitan Planning Organization (MPO). The initiatives related to the management function are typically small-scale efforts that could be implemented by the local DOT without MPO approval. The initiatives used in the planning function are typically larger in scope and, as such, require a more involved planning process. Although different in scope, these management and planning efforts are meant to complement each other.

These initiatives can be proactive or reactive. Compared to the smaller-scale initiatives, the larger ones often need to be implemented in a more proactive way to achieve the intended goal. For example, land use management will be most effective when the freight system has been integrated into the land use planning.

Although many different approaches to transportation planning exist (based, for example, on organizational size, resources, and structure), professional planners follow a basic planning process. Accordingly, this section describes the general process of public-sector transportation DM that underpins both management and planning of urban freight systems. It provides details on how each step, and the tasks within, can be used to find solutions to freight issues. It addresses how to integrate the public-sector initiatives into the urban freight transportation DM process to improve the overall performance of the system. By design, the descriptions here are general, as there could be cases where some steps may not be formalized.

This section of the Guide is intended not to prescribe a by-the-book methodology, but instead one that is flexible and practical, applicable to a variety of cases and settings. There are many ways to combine, divide, and ultimately describe the various steps in the DM process, and the tasks conducted for each step. The DM process is iterative; each step builds on knowledge gained through other activities, and all of the steps are revisited throughout the process.

In transportation DM, virtually every decision or recommended course of action can result in predictable and unpredictable, intended and unintended, immediate and long-term, positive and negative impacts. In most cases, the complex issues facing metropolitan areas have no perfect solutions. This reality forces transportation decision makers to accept compromises that require a proper understanding of the trade-offs involved. In the planning process, such trade-offs should be identified while evaluating and selecting alternatives.

The importance of this assessment should not be underestimated. For example, if a transportation agency is considering building a bypass to eliminate congestion within an urban area, there will be trade-offs involved. Local businesses inside the urban area may be negatively impacted

by a reduction in customers, while the increased access provided by the bypass may result in business relocations from the congested area to nearer the bypass, diminishing the vitality of the urban core. Moreover, given funding limitations, building the bypass may result in other projects not being funded.

The DM process typically includes some variation and/or combination of the following steps:

1. Define goals and objectives to be achieved.
2. Define performance measures (measures of success).
3. Identify root causes of the problems.
4. Identify potential initiatives.
5. Conduct performance analysis of potential initiatives.
6. Evaluate (based on identified measures of success) and select preferred alternative(s).
7. Create an Action Plan that:
   - Describes the preferred alternative, its trade-offs, and related recommendations.
   - Proposes an approach to implement the recommendations.
8. Implement and monitor the Action Plan.
9. Follow up, reassess, and (when necessary) modify the plan based on received feedback.

Each step is formed by a set of tasks that need to be executed to obtain the desired outputs. Such tasks include stakeholder outreach and agency coordination, data collection/information gathering, and assessment and analysis.

Figure 1 summarizes the urban freight transportation DM process described in this Guide. Each step of the process is presented with examples of potential activities that could be undertaken while moving through the step. This process is generally consistent with the transportation planning process summarized by FHWA in *Integrating Demand Management into the Transportation Planning Process: A Desk Reference* (the FHWA Desk Reference), which includes: (1) regional vision and goals; (2) setting objectives; (3) definition of performance measures; (4) assessment and selection of strategies and programs to support objectives; (5), integration of strategies into plans and funding programs; and (6) monitoring and evaluation of progress toward objectives (Federal Highway Administration 2012c). Many procedures, tools, and techniques are similar, and readers can refer to the FHWA Desk Reference for more details. The process described in this section supplements the general transportation planning process described in the FHWA publication by addressing the specific needs of freight transportation management, such as the more complex stakeholder engagement. This process also applies to short-term management efforts.

The DM process described in this section can be used for any size geographic area, jurisdiction, or specific location (e.g., statewide, regional, metropolitan, or site specific); various types of management and planning exercises (e.g., land use, bicycle, or freight); different challenges and issues (e.g., congestion, safety, or site); and, timeframes of various durations (e.g., short-, medium-, or long-range). At each step in the DM process, tasks (activities) need to be conducted, including stakeholder outreach and agency coordination, data collection, and assessment and analysis. Each task produces a set of outputs, typically used as inputs in subsequent stages.

It should be noted that these activities do not take place in a vacuum; the only successful way to foster change is to constructively engage all stakeholders to develop consensus-based strategies. Such a process of engagement is best conducted as part of a suitable process of collaborative DM and partnership.

This important aspect underpins successful freight transportation DM as a proper and constructive process of engagement of the multiple stakeholders involved in freight issues and their potential solutions. Two key factors relate:

1. Multiple stakeholders—private, public, and community—are impacted by freight issues and/or could potentially play a role in developing their solutions.

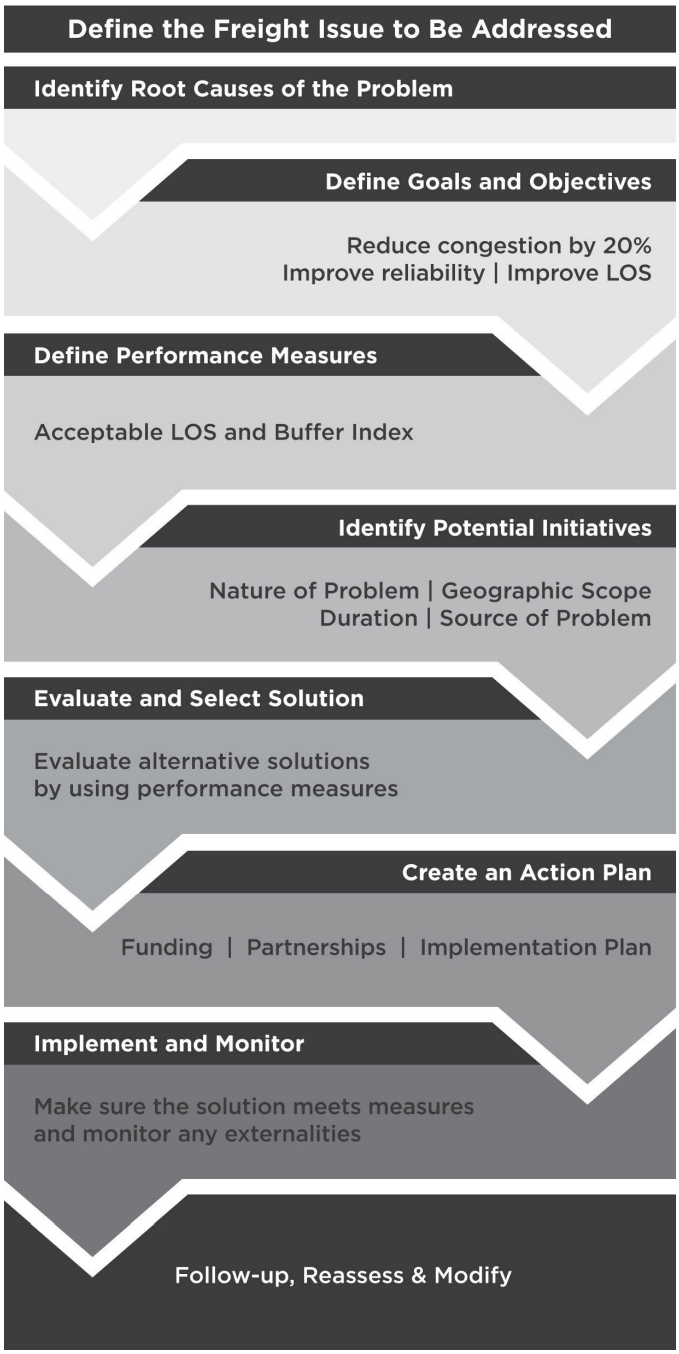


Figure 1. Urban freight transportation DM process.

2. No single stakeholder is capable of completely solving the most acute freight issues affecting metropolitan areas.

Given these two factors, **stakeholder cooperation and engagement** may be the only means to progress.

The main role of such an engagement effort is to create an environment and a management process whereby all stakeholders can be heard and can participate, in a constructive fashion, to improve the freight system. Public-sector agencies are bound to play a key role as conveners of the

effort. Some key stakeholders to bring to the table include large and prominent shippers, carriers, and receivers; the corresponding trade groups that represent key freight agents (local trucking associations, warehouse associations, retail sector groups, restaurant associations, and the like); the local Chamber of Commerce; public agencies with jurisdiction in the areas that impact the freight system; civic or neighborhood groups; researchers who could play a role in both research and outreach; as well as any other companies with the potential to contribute to the solution.

Many approaches and techniques are considered effective mechanisms for stakeholder engagement, such as conferences, workshops, and surveys. The FHWA document *Engaging the Private Sector in Freight Planning* (Wilbur Smith Associates and S. R. Kale Consulting 2009) is one of many documents that could be used to identify strategies and approaches for this step.

Definition of Freight Issue to Be Addressed

In many situations, the success of a DM process hinges on correct—and consistent—identification of the problem the process is meant to address. At any given time, many freight challenges compete for attention and resources. Too broad a focus may result in overly complicated DM and planning, which makes a successful outcome less certain. Too narrow a focus may result in unsatisfactory allocations of resources, as smaller issues may be addressed while larger but still-feasible challenges remain unsolved. One benefit of engaging stakeholders is that doing so encourages identification and examination of problems from multiple vantage points. The initial engagement of stakeholders and consensus-building efforts help ensure that each problem is carefully vetted, clearly defined, and agreed on so that all parties understand what the DM process will—and will not—address.

Identification of Root Cause(s)

The task of identifying the root cause of a freight challenge may be the most important part of the DM process. With the root cause identified, a planner/manager can begin to determine the spectrum of potential solutions. On the other hand, the wrong identification can take the entire effort in the wrong direction.

It is imperative that the process be as unbiased, objective, and accurate as possible. This is of great relevance in urban freight. Although trucks may be the visible expression of freight activity, the sources of a problem involving trucks may lie elsewhere. For example, truck idling frequently is the result of the inability or unwillingness of receivers to accept deliveries, and the congestion produced in the vicinity of large buildings is frequently aggravated by delivery-time restrictions that shorten the period of time when deliveries can be made. In these situations, fining the drivers or charging higher tolls during peak traffic hours may fail to reduce the congestion because carriers cannot change delivery times without the concurrence of the receivers. Recognizing the chief role played by the receivers (the root cause) leads to a different set of solutions, such as the establishment of appointment systems for deliveries, allowing delivery trucks to use off-street parking spaces, and an off-hour delivery (OHD) program to induce receivers to accept deliveries outside regular business hours. The careful identification of the root causes of a problem can help lead to more appropriate, and therefore more effective solutions. The *NCFRP Report 14: Guidebook for Understanding Urban Goods Movement* provides an effective guideline for planners to understand the movement of different types of goods and how to collect data to evaluate their impacts (Rhodes et al. 2012). Another publication, *NCFRP Report 23: Synthesis of Freight Research in Urban Transportation Planning* (Giuliano et al. 2013) provides a good starting point for planning staff to get an overview of freight impacts, problems, and existing strategies, and eventually, to identify the root causes.

To identify root causes of freight issues faced by the planning agencies, Freight Trip Generation (FTG) software has been created based on models developed by the Rensselaer Polytechnic Institute (RPI). The purpose of the FTG software is to recognize and categorize the level of freight trips produced and attracted by a particular study area of interest. A detailed description of how the FTG software works and a link to access the software are provided in the Appendix of this Guide. The careful identification of the root cause of the problem being addressed is the common key success factor in the case studies provided in Section 3.

The identification process typically involves technical analyses (e.g., traffic counts, capacity and level-of-service analysis, and travel time and delay studies), and consultations with stakeholders to develop a solid idea about the potential reasons behind the problem. These consultations are very important to provide public-sector professionals, who may lack familiarity with the underpinnings of the freight system, with insights into real-world cause and effects.

Key tasks involved in the identification process are.

- Stakeholder outreach and agency coordination.
  - Agency staff ask stakeholders, decision makers, and the agency leadership to identify what they view as a freight issue, as well as the factors that create it. Involvement at this stage will garner greater understanding and buy-in for the implementation of any ultimate solution.
- Data collection, assessment, and analysis.
  - To minimize the risks of misinformation or being influenced by biased views of an issue, the agency staff seek input from multiple individuals within the same stakeholder group. In-depth interviews with company representatives, focus groups with selected private-sector representatives, and interviews with staff from trade groups provide invaluable information about the root causes of the freight issue. This information is carefully filtered by the agency staff to account for any inherent bias that may be reflected in the opinions offered by some stakeholders.
  - It is important to collect information to analyze and assess future conditions because issues and problems change over time. This is especially true with freight that is market-driven; new products, technologies, population shifts, and infrastructure changes can alter the way freight is transported.
- Generation of outputs.
  - For each condition or issue of concern, agency staff develop a solid identification of the root causes that produce it and the analyses that support the conclusions.

Definition of Goals and Objectives to Be Achieved

Defining goals and objectives requires a shared vision among all stakeholders of what the urban freight system, or a specific aspect of it, should be in the short-term, mid-term, and long-term future. It also requires a clear idea of what roles and responsibilities the stakeholders will have in making that vision a reality. Developing such a shared vision requires working with stakeholders to identify their goals based on a clear understanding of (a) the problems and issues that are the focus of the effort and (b) the parameters that characterize the desired future state, or goal(s). For example, a freight goal may be "to reduce congestion to enhance freight mobility." A more specific description of an aspect or parameter of that goal may be "to improve travel

speeds at key arterials." Clarifying and defining the goal can delineate it into a series of component objectives.

Agency staff can work with stakeholders to help them understand the potential consequences of skipping this critical step. It is important to develop a consensus around the goals and objectives that should guide the effort. This almost always requires the public sector playing a key role in securing the support of the various stakeholders. If stakeholders are negatively impacted or inconvenienced by the goals of the freight initiative, the public sector could consider the use of incentives of various kinds to mitigate these impacts.

Tasks involved in defining the goals and objectives to be achieved are:

- Stakeholder outreach and agency coordination.
  - The individuals and groups that will define the goals take steps to include agency leadership and public- and private-sector stakeholders. Agency leaders are critical for winning and securing long-term support for the DM process, and the recommendations that may come from it. It is also critical to engage private-sector stakeholders, as they operate the system and could provide invaluable input regarding desirable and not-so-desirable goals and objectives.
  - Before defining the goals and objectives, the study area needs to be defined, recognizing that supply chains interconnect wide geographic areas. For example, restricting large trucks from entering a congested downtown may force carriers to use a larger number of small trucks—which, in turn, could increase congestion beyond the level that was produced by the large trucks.
  - In defining the goals and objectives, it is important to maintain ongoing interactions with all stakeholders. As the planning process proceeds, goals and objectives evolve and become more specific. Throughout the DM process, stakeholder positions, perceptions, and recommendations may change as more information becomes available and stakeholders gain a better understanding of each other's positions and concerns.
- Data collection/information gathering.
  - Data and information explaining current conditions helps stakeholders formulate goals and objectives. For example, traffic counts estimating the number and percent of trucks and passenger vehicles could be important to develop an unbiased idea of the relative role of each as contributors to congestion.
  - Ideally, information is gathered from all stakeholders, as different groups will view problems and define goals from their own perspectives. For example, the public may perceive the problem as being too many trucks on a roadway, whereas truckers may perceive the problem as being too many passenger vehicles, and railroads may perceive the problem as not having enough rail access.
- Assessment and analysis.
  - All goals and objectives are reviewed to confirm that they are reasonable given constraints of time, budget, environment, and regulations in place. For example, a goal to drastically reduce the number of trucks in an area may not be realistic without sufficient funding to provide alternative freight transport modes. When the goals and objectives are drafted, it is important to present them to the agency leadership and to public- and private-sector stakeholders to confirm that (a) they are appropriate and (b) they address all relevant issues and concerns. Additional information about existing and future conditions, as well as the opinions and perspectives of other stakeholders, may help in the review, refinement, and finalization of objectives.
- Generation of outputs.
  - Outputs from this task are a set of goals and objectives, agreed upon by all stakeholders, that will clearly specify the desired future state of the system. The objectives should follow the SMART criteria; that is, they should be Specific, Measurable, Attainable, Realistic, and Timely (Federal Highway Administration 2012c).

Definition of Performance Measures

Performance measures (PMs) are an important aspect of the DM process and are central to gauging the degree to which goals and objectives are achieved. During the planning stage, PMs are used to screen and select a preferred solution from among the possible alternatives. Once a solution has been implemented, PMs provide a method to evaluate the level of success that was attained in achieving intended goals.

With the passage of the latest transportation authorization (PL 112-141, the Moving Ahead for Progress in the 21st Century Act, called MAP-21, performance measurement has become a popular topic in transportation planning. Although MAP-21 requires the undertaking of systemic performance measurements, when this Guide refers to measuring performance, it particularly refers to measuring specific outcomes of interventions taken. These could range from a modeling result to more tangible data points such as safety, parking, use of alternative fuels, or reliability.

PMs can be defined in numerous ways, but practice shows that they work best when they are: (1) directly related to a single objective; (2) easily quantifiable; (3) able to gauge the entire range of levels of achievement (a PM that is defined as a continuous variable is better than one that takes only two values, like "achieved" or "not achieved"). Chapter 3 in the FHWA Desk Reference also provides a detailed list of PMs that can be used for various objectives (Federal Highway Administration 2012c).

Tasks involved in defining PMs are:

- Stakeholder outreach and agency coordination
  - Different stakeholders are likely to have different ideas about what PMs should be used, and how to measure them. For example, the delivery costs paid by receivers may be a good metric to measure the objective of "increasing the competitiveness of downtown." However, freight carriers may argue that delivery costs do not account for the full cost of a delivery given that carriers, typically, absorb parking fines and tolls due to the competitive pressures of the market.
  - Respecting the confidential nature of commercially sensitive data is crucial. Many useful PMs—such as the full cost of delivery just mentioned—could require the use of data that carriers may refuse to share, such as driver wages, indirect costs, and fringe benefits. Engaging private-sector associations and trade groups could enable the public sector to create solid cost estimates for use as input to the PMs. Gaining stakeholder support in the process of defining the PMs, and securing the corresponding input data, are essential.
- Data collection
  - PMs are by definition quantitative, and thus require data on the existing or base conditions and/or, in the case of planning efforts, estimates of their future values. Producing such estimates requires the use of planning models and/or simulations. It is suggested that freight planning staff work closely with the modelers at the MPO/state DOT to ensure that the available models can produce the desired PMs. If the models are not capable of providing the necessary PMs, either the PMs must be redefined to suit what the models can provide, or the models must be modified to provide the desired PMs. Careful consideration is needed to determine whether adjusting the PMs or adjusting the models will yield the most applicable and useful data.
  - Freight PMs may require data from all modes of transportation, and may include analysis of safety, mobility, system conditions, pavement conditions, travel times, congestion, accessibility, parking, or environmental conditions related to freight movements.
  - Freight data availability often is an issue in defining PMs. Engaging stakeholders in the definition of PMs and, at the same time, securing their support to get the necessary input data, can mitigate the data availability issue considerably.

- Assessment and analysis
  - PMs are used at several steps in the management and planning processes, such as to assess the base case conditions surrounding a freight issue, and to compare the results of the assessment to conditions in other jurisdictions. Such comparisons provide context to PMs that may otherwise be difficult to interpret.
  - PM analyses must account for such important factors as the variability of the input data used; the time it takes to collect the data and update the PMs; and the sensitivity (or lack thereof) of the PM to changes in the input variables. For example, PMs that use highly variable data (e.g., travel times), need to be analyzed with caution to ensure the robustness of the results. A PM that relies on data collected every 2 or 3 years will fail to capture rapidly changing conditions, whereas a PM that is too sensitive, or too insensitive, may be difficult to analyze. All of these factors need to be taken into account. Adjustments may be needed to the definitions of the PMs and the necessary input data to ensure that the PMs adequately fulfill their roles.
- Generation of outputs
  - Outputs from this task are:
    - A set of PMs that assess the degree to which goals and objectives are achieved at different points in time.
    - A data collection and/or modeling plan to assess the PMs.
    - A collaboration agreement that outlines the role and responsibility of each of the various stakeholders in providing data as needed to estimate the PMs.

Preliminary Identification of Potential Initiatives

This step addresses how to select, from the wide spectrum of initiatives described in the Guide, those that are most likely to be effective in solving a freight issue. Clearly, detailed planning and design exercises offer the best chance of identifying the most appropriate solutions to a freight issue. No guide can offer an estimation of the specific costs and benefits produced by a given initiative, or an assessment of the trade-offs inherent in the allocation of time required and the limited funding available. These factors are best reviewed through a formal DM process.

The Guide provides an initiative identification process, an approach designed to match needs-on-the-ground with a range of strategies, and a fuller picture of what those strategies can offer. The impacts of the various initiatives have been characterized in terms of the nature of the problem they are intended to mitigate or solve; the geographic and temporal scope of the impacts; and the target population(s).

Before considering which potential initiatives will best match their needs, transportation professionals will specify the following inputs:

- **Nature of the Problem to Be Solved:** Clearly identify the problem that needs solving and the rationale for a public-sector initiative. Examples include congestion, pollution, noise produced by causes other than congestion, and conflicts between truck activity and other users.
- **Geographic Scope of the Problem:** Identify the area(s) where the problem occurs in order to define the scope of the necessary public-sector initiative. Examples include citywide, area, corridor, or a point in the city.
- **Primary Source of the Problem:** Confirm whether the problem is produced by freight activity, then determine which segment of the industry is responsible. Examples include all or through-traffic, large traffic generators (LTGs), urban deliveries, large trucks, or specific industry segments.
- **Duration of the Problem:** Define the time/duration of the problem. Examples include a peak hour, a peak period lasting several hours, daytime, nighttime, or an entire 24-hour period.

Once these inputs have been defined (most come from the outputs generated by the tasks described so far in this section), the initiative summary tables presented in Section 2 in this

As part of NCFRP Project 38, the research team created an **Initiative Selector** decision-support system as a tool to aid in the selection of possible alternatives for various metropolitan freight problems. The Initiative Selector is an HTML webpage that, for a given set of inputs, provides practitioners with suggestions about possible initiatives that could be implemented to fix a given problem. The Initiative Selector is by no means a replacement for engineering and planning; rather, it offers possible solutions that might be considered for various situations. The Initiative Selector can be found at http://coe-sufs.org/wordpress/InitiativeSelector/. An expanded description is provided in the Appendix.

Guide can be used to help identify possible alternatives. Then public-sector decision makers, stakeholders, and transportation agencies can conduct detailed assessments of each initiative's pros and cons, with data relevant to their situation, to identify the most appropriate course of action.

Tasks involved in identifying potential initiatives are:

- Stakeholder outreach and agency coordination
  - Agency staff work with all stakeholders to confirm that all alternative solutions have been identified. If an alternative advocated by a stakeholder is not considered, even if that alternative does not prove entirely realistic or feasible, the selected approach may not garner the stakeholder's commitment.
- Data collection
  - Agency staff become familiar with the general features of the potential initiatives: advantages and disadvantages, political issues and constraints, applicability to local conditions, and so forth. Given that all of these elements will need to be considered at some point, it makes sense to start gathering information on each element early in the DM process.
  - The Appendix provides an initial list of data collection needs and assessment tasks that may be associated with the potential initiatives recommended in this Guide. The list is organized based on the major groups identified in the Guide.
- Assessment and analyses
  - Agency staff and stakeholders analyze the data collected to determine which initiatives are worthy of further consideration in the formulation phase. It is important to consider the widest range of potential initiatives during the formulation phase; only alternatives with virtually no chance of implementation should be eliminated from further analyses.
  - The initiatives suggested are analyzed to ensure that, as a whole, they support each other rather than conflict with each other or with any other needed transportation project. For example, redesigning an intersection to facilitate truck traffic could make a bicycle path impossible if the intersection is not designed with the bicycle path in mind. An intersection redesign that makes sense by itself may be counterproductive from a corridor point of view if it creates problems at other intersections downstream. With a broader analysis, comprehensive corridor-level solutions may make more sense than a single intersection redesign.
  - Transportation decision makers also need to be mindful of the long timeframes involved in many public-sector interventions, versus the shorter private-sector DM process that is driven by quarterly results. Because of this paradox, public-sector planners often must consider implementing short-term solutions while the correct long-term solution is being developed (e.g., relocation of some constraints like utility poles).

- Generation of outputs
  - Outputs from this task are a preliminary list of potential initiatives to address the freight issues to be solved or mitigated, along with descriptions of the initiatives under consideration, a qualitative assessment of their advantages and disadvantages, and an identification of the potential synergies to take advantage of, and/or conflicts to be avoided.

Formulation and Performance Analysis of Solution Alternatives

In this step of the DM process, agency staff further develop the potential initiatives identified so that both decision makers and the wide spectrum of stakeholders have a thorough appreciation of their potential impacts. For example, an initiative to reduce truck double-parking in a busy downtown area is the implementation of a delivery appointment system to ensure that delivery trucks are able to find off-street parking. As part of the formulation phase, important questions must be answered: What size buildings would be the focus of the initiative? Would the system be required, or encouraged? Would incentives be provided? If so, in what amounts? What geographic area would be the focus? What impacts would be produced by the initiative? The answers to these questions provide a fuller view of the benefits, costs, and level of effort associated with the initiative(s). Such information, both qualitative and quantitative, provides a solid foundation for DM.

In estimating the performance of the various initiatives it is important to be thorough but pragmatic. Essentially, the data collection and performance analysis need to be commensurate with the scope and potential impact of each initiative. The FHWA Desk Reference provides a detailed discussion of the process, tools, and techniques that can be used to analyze the performance of traffic management strategies (Federal Highway Administration 2012c). The behavioral microsimulation model (Silas and Holguín-Veras 2009) and the freight demand estimation model (Holguín-Veras and Aros-Vera 2014) are specifically helpful for analyzing alternatives involving freight demand management. However, large data collection and modeling exercises are best reserved for only the largest and most impactful projects.

Tasks involved in formulation and performance analysis of solution alternatives are:

- Data collection
  - Data are collected that relate to each possible alternative. The data collected include cost, time and effort required for implementation, complexity, and potential risks and benefits.
  - Agency staff lead a process to provide a clear picture of what each initiative would entail. Doing this allows an understanding of the full spectrum of impacts, including what will be required from the transportation agencies and all stakeholders for a successful implementation.
- Assessment and analysis
  - Agency staff assess the key impacts of the various alternatives. Traffic simulation models could be used to assess the local impacts of proposed initiatives (e.g., to assess how a new land use policy would impact freight traffic volumes, a regional planning model could be used to get a general idea about regional congestion impacts). These modeling endeavors are designed to ensure a reasonably solid understanding of the behavioral changes that a proposed public-sector initiative could induce. Possible methods include in-depth interviews with selected industry representatives, focus groups, or stated preference surveys. Guessing how the freight industry would react to any given initiative is a significant challenge, so outreach to those industry sectors that would be impacted is highly advisable. Projected unintended impacts of the alternatives (e.g., traffic increases in sensitive areas due to adding an extra lane or population shifts from building a bypass) need to be identified and evaluated.

  - Additional assessments of budget, staffing, and timing for the selected alternatives may be needed. For example, before recommending an OHD program, it is advisable to check with the private sector to determine the feasibility of the idea.
- Generation of outputs
  - Outputs from this task are:
    - Clear and solid descriptions of the initiatives being considered, together with technical assessments of their potential impacts.
    - Preliminary conclusions concerning the merit of each initiative.

Evaluation and Selection of Preferred Alternative(s)

The process of evaluating and selecting alternatives involves judging how each alternative would meet the goals and objectives defined in prior tasks. Too many evaluation and selection techniques exist to be reviewed in this Guide; however, These techniques can be broadly classified into two categories: (1) economic and (2) multi-criteria. Economic techniques transform meaningful impacts into monetary values as costs or benefits. Non-market impacts, such as environment-related impacts, are translated into monetary estimates using economic valuation techniques (Bateman et al. 2002). The benefits and costs produced during the project's economic lifespan are taken into account to produce economic indicators of performance such as net present value, internal rate of return, and benefit/cost ratio.

Multi-criteria techniques do not translate impacts into monetary units. This category of evaluation techniques often makes use of a matrix to compare the performance of each alternative with respect to identified objectives. If quantitative PMs have been produced, these can be placed in the corresponding criteria cells. If only qualitative analyses are available, agency staff try to make sure the estimates are as objective and unbiased as possible. The performance of each alternative usually is summarized according to the selected measures via colors, codes, or key words that explain the results depicted in the matrix, making it understandable to decision makers. An example of an alternatives comparison matrix can be found online at http://www.warner.nh.us/downloads/Rt103/WarnerRoute103ComparisonMatrix.pdf (Warner Town 2013).

Tasks involved in the evaluation and selection of preferred alternatives are:

- Stakeholder outreach and agency coordination
  - Public and private stakeholders need to be actively involved in the evaluation and rating of alternatives for several reasons:
    - They may rate one decision criteria as more important than the others.
    - Stakeholder agreement on the evaluation is needed to ensure their long-term support and to advance implementation of the initiative.
    - The agency leaders, not the agency staff conducting the analyses, will be the decision makers.
  - Planners usually recommend and explain the trade-offs among alternatives, as well as the consequences of inaction, to the actual decision makers. Group problem-solving processes, such as the Delphi method to prioritize and select the highest priority projects or initiatives (Linstone and Turoff 2002), and the nominal group technique (Delbecq et al. 1975), can be used to facilitate the coordination of stakeholder rating.
- Data collection
  - It is important to ensure that the stakeholders participating in the DM process provide specific information about the level of importance they attach to each of the various decision criteria, and that a consensus is reached about these valuations of importance. It is highly advisable to conduct such an exercise before the actual evaluation process takes place, as this reduces the possibility of any manipulation of the process to favor specific alternatives.

  - During the evaluation of alternatives, it may be necessary to supplement data/information collected to provide stakeholders with information about the alternatives that they need to make decisions.
- Assessment and analysis
  - Because of the trade-offs involved, often there is no clear best alternative. In such cases, it is important to get input from stakeholders about the relative importance of the different decision criteria, as this will help the selection process.
- Generation of outputs
  - Outputs from this task are a prioritized list of the alternatives to be recommended for implementation, together with estimates of the time and resources required, responsible agency and/or stakeholders, and any other information deemed useful to be included in the Action Plan.

Creation of Action Plan

An Action Plan that defines the recommended policies, programs, processes, and improvements to be conducted is one of the key products of the planning process.

Tasks involved in the creation of the Action Plan are:

- Stakeholder outreach and agency coordination
  - Plans typically are presented in draft form to stakeholders, advisory groups, and agency leadership for review and comment prior to finalization. This would be true of any freight plan, and is recommended for plans based on any of the initiatives identified in this Guide.
- Data collection
  - Agency staff collect information on the reactions to the draft plan to gather support and address any outstanding issues.
  - In the case of alternatives that require engineering design, additional data may need to be collected to support the design process.
- Assessment and analysis
  - Recurring concerns about the plan are noted and addressed.
  - Engineering designs may be needed for some initiatives. Agency staff ensure that the design teams have access to the data and design parameters needed.
  - Pilot tests could be planned to gain insight into the practicality and potential benefits and costs of proposed initiatives.
- Generation of outputs
  - Outputs from this task are:
    - A list of prioritized initiatives to be considered for implementation.
    - A plan of specific actions needed to implement these initiatives, including:
      - Sequencing
      - Key success factors
      - Key actors and critical partners in each action
      - Resources (time, facilities, equipment, and funding)
      - Timeline for completion
      - Plan and timeline for measuring the performance of the Action Plan

Pilot Testing and Implementation

The fundamental reason to conduct the urban freight DM process outlined in this Guide is to address specific freight issues by implementing policies, programs, or projects that could mitigate or eliminate the issues. Ideally, implementation of a public-sector initiative should proceed only

when the agency staff is certain that it is the best course of action. Such certainty necessitates careful assessment of the input provided by all stakeholders. In some cases, pilot testing of a novel concept may be highly advisable.

Pilot testing, particularly in urban freight management, could play a key role in demonstrating to the private sector that the public sector is interested in proceeding carefully with the implementation of new ideas, assessing the real-life impacts of potential initiatives, and implementing only those that successfully pass the pilot tests. Pilot tests provide an opportunity for all stakeholders to find out more about an initiative and mechanism so that they can decide whether to (a) move ahead with a full implementation phase or (b) stop. To fulfill that role, however, pilot tests need to be properly designed; a poorly designed pilot could lead to either a false success (a bad idea that performs well in the pilot), or a false failure (a good idea that does not perform well in the pilot).

Follow-up: Reassessment and Modification

Planning is a process that should be continuous, given that problems, issues, and needs in any region continually change. FHWA defines "monitoring and evaluation of progress toward objectives" as the last step of a transportation planning process, and describes several examples of successful monitoring programs in the United States and Europe (Federal Highway Administration 2012c). MAP-21 highlights the importance of freight and encourages the development of PMs to determine the impacts of the strategies, programs, and funding used to address freight issues. Agency staff need to continually revisit and reassess freight strategies—both those recommended and those in place—to determine what is working and what may need to be adjusted to successfully improve the performance of the freight transportation system. In urban freight, it is important to conduct honest and timely follow-up of programs and initiatives because an erroneous course of action can have long-lasting consequences to the vitality of the local private sector, and by extension, to the economy.

The benefits of follow-up and reassessment are similar to those for pilot testing. Both testing and follow-up convey to the private sector that the public sector is interested in careful consideration of the impacts of their initiatives. Also, it is said that "success breeds success." Being able to demonstrate the success of freight initiatives that have been recommended and implemented helps build support for future initiatives. If properly conducted, follow-up and reassessment foster an environment in which public and private-sector involvement is ongoing; then proactive freight planning can prosper.

SECTION 2

Overview of Public-Sector Initiatives

The main intent of this section is to describe how best to use the wide spectrum of initiatives described throughout this Guide. The initiative identification process is a codified approach that seeks to match immediate needs with what the various strategies offer. Agency staff in charge of finding ways to address a freight issue could greatly benefit from having the preliminary guidance offered by the set of initiatives discussed in this section. This guidance can point practitioners and researchers in the right direction; however, only detailed planning and design exercises can address important aspects of the selection process. An estimation of the costs and benefits produced by a given initiative, and an assessment of the trade-offs inherent in the allocation of scarce resources, are only possible through a formal planning process.

The term *initiative* is used throughout this Guide to refer to the set of public-sector actions that could be considered to address a freight issue. Such initiatives typically come in the form of policies, programs, and projects. An example of a policy could be to give delivery trucks preferential access to curb space in commercial areas; an example of a program might be an ongoing effort to incentivize carriers to purchase electric trucks; and an example of a project could be an intersection redesign effort. Selecting the appropriate combination is of great importance.

This section of the Guide provides a comprehensive catalog of such initiatives. The catalog is based on an in-depth analysis of public-sector initiatives used across the world, for which the section introduces a comprehensive classification system and provides a critical examination of the evidence concerning the performance of the initiatives discussed. The review that produced this Guide led to the identification of 54 measures. These measures were classified into eight major groups and organized as a continuum with supply initiatives at one end, demand-related initiatives at the other, and operational and financial strategies in the middle (see Figure 2). The measures also were tied to the active participation of the main stakeholders involved in the freight issue to be addressed.

The eight groups of urban freight initiatives are:

- Infrastructure management
- Parking/loading areas management
- Vehicle-related strategies
- Traffic management
- Pricing, incentives, and taxation
- Logistical management
- Freight demand/land use management
- Stakeholder engagement

More often than not, the process of selecting the most appropriate initiative to address a freight issue is far from straightforward. Most cases involve a great deal of nuance, including

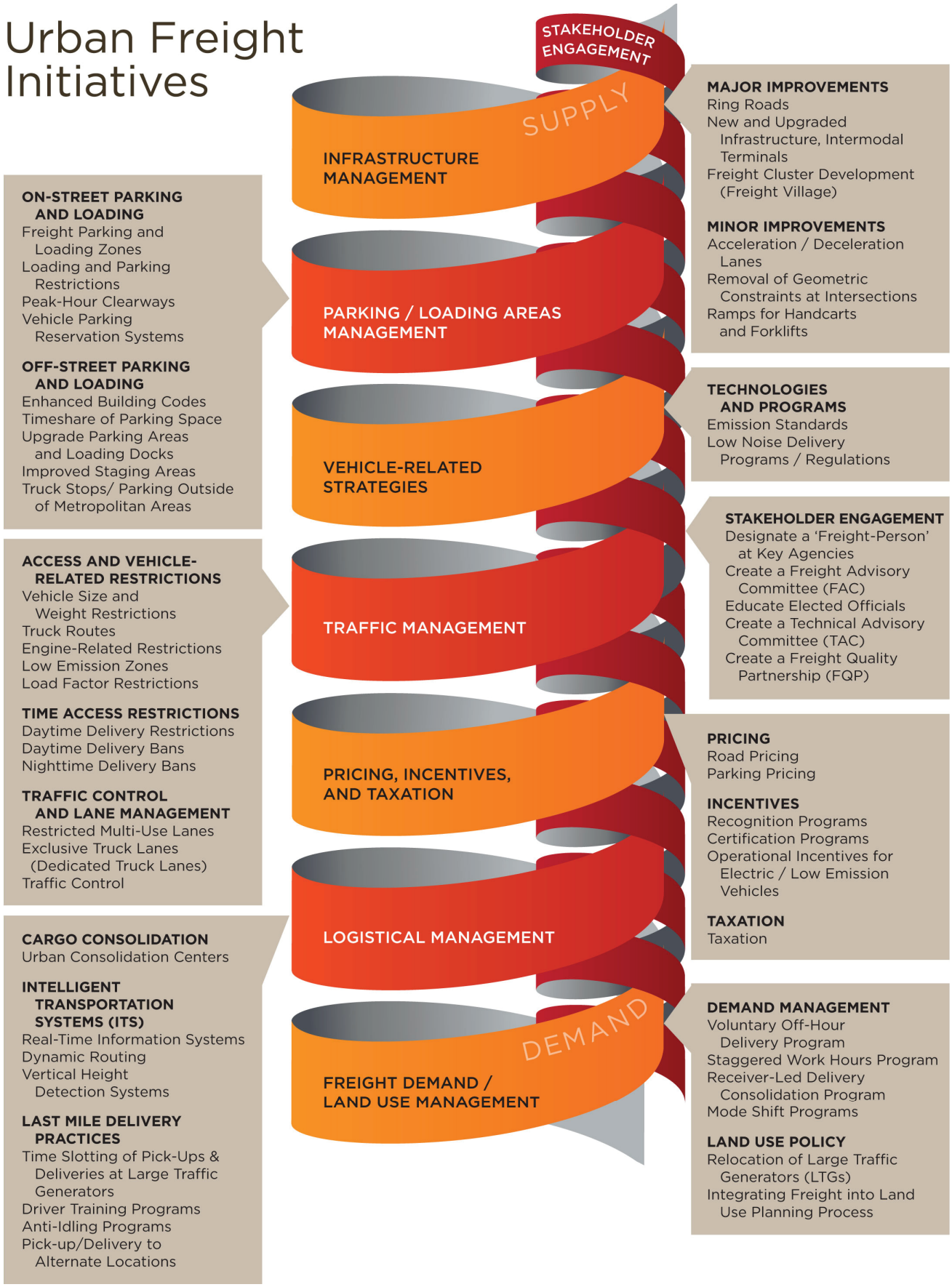


Figure 2. Urban freight initiatives.

conflicts to sort out and multiple factors, trade-offs, and the major constraints to be considered. Therefore, extensive stakeholder engagement and data collection often need to precede the selection of an initiative. The tasks discussed in Section 1 for the "definition of goals and objectives to be achieved," "definition of performance measures," and "identification of root cause(s)" provide more detail on this general process.

Key inputs required for reducing the set of potential alternatives should, at the least, include: (1) geographic scope of the problem; (2) main goals and objectives to be achieved; (3) key constraints; and (4) root causes of the problem. (For an expanded discussion of how to integrate the inputs into proposed public-sector initiatives to identify their impacts, see the Appendix.)

After selecting the most appropriate initiative to solve a given issue or problem, additional considerations need to be identified to ensure a successful implementation. In this Guide, these considerations are presented as questions that address planning, operations, stakeholder engagement, and risk management and integration. Each group of initiatives includes some questions planners should ask themselves to move the implementation process forward.

The next subsection lists questions that address key considerations in planning, operations, stakeholder engagement, and risk management and integration, and provides a brief description of the significance of each question. Later in Section 2, the key questions that should be answered for each group of initiatives are presented.

Planning Considerations

1. **Is there enough right-of-way available to complete the project?**
   Some initiatives require suitable space to be implemented; thus, their feasibility depends on the right-of-way available.
2. **Will other projects be required to fully complete the project?**
   Some initiatives cannot be fully functional without involving other, complementary projects. Not considering these other projects can lead to unintended consequences and added costs for the primary initiative.
3. **How will this project be funded?**
   A fundamental consideration when designing and planning any policy/project is to identify the funding source(s).
4. **What is the anticipated duration of the project/policy?**
   The lifespan or duration of a particular policy or project must be considered during the planning process. For example, if new infrastructure is built, how many years will it be expected to operate without needing major changes? Will a policy be in effect for a short, long, or indefinite time period? If the duration of a project or policy is indefinite, have provisions been planned for its periodic reevaluation to ensure it is still applicable?
5. **What is the geographic scope of the project?**
   Describing the geographic scope of a project or policy will define the area that will be impacted by that project or policy. For example, some projects may have an impact several hundred miles away, whereas others are more localized.
6. **Where is it located?**
   This question defines the physical location of the project or policy to be implemented. In some cases, alternative locations may be considered. The success of a project or policy can hinge on its location, given that the costs, operational requirements, community impacts, and other factors might differ according to the location chosen.
7. **What is the desired size/capacity/connectivity?**
   Consideration of the desired size, capacity, and connectivity is particularly important for infrastructure improvements and facilities construction. Size and capacity are defined by

the needs and scope of the project. Also important to consider is the connectivity from one system to another. For example, if a ring road is built, it is important to have sufficient access to the ring road from other roads.

Operational Considerations

8. **Will the policy/project be mandatory or voluntary?**
   Defining whether the policy or project will be mandatory or voluntary is important. Laws support mandatory policies and projects; for voluntary policies and projects, the target groups have the option to participate—or not.
9. **Is there any incentive for participation (or penalties for not)?**
   The effectiveness of some policies depends on participation from the target group. This participation can be fostered by providing incentives (e.g., tax incentives, reimbursements of initial expenses, or public recognition), or by enforcing penalties for nonparticipation, such as fines.
10. **What is the level of incentives?**
    If an incentive is being provided, the amount or magnitude of the incentive has to be determined. If the incentive is too small, it may not produce the intended effect; if the incentive is too high, it may lead to wasted resources.
11. **What is the level of price(s)/fine(s)?**
    The same considerations discussed for incentives apply to prices and fines. It is recommended that defining the levels of prices and fines follow basic economic principles. They should be large enough to deter undesirable behavior and aid in reaching the desired outcome, but small enough to be politically feasible.
12. **How will the policy/project be enforced?**
    Given that compliance with the policy or project will be enforced by the public sector, those mechanisms are best verified during the planning stage to ensure their consideration in the implementation of the policy or project.
13. **What is the target group?**
    The project's target group must be clearly identified to focus project resources in the right direction and ensure that the proper impact is achieved. The target group could include receivers, carriers, drivers, communities, large or small companies, large traffic generators, and a specific industry sector, among other possibilities. Because different industry sectors are likely to exhibit different behavioral responses to public policy, it is important to be certain which group is being targeted.
14. **What are the criteria for participation?**
    Ideally, identification of the target group occurs concurrently with establishment of the criteria for participation. There are cases (e.g., public recognition programs) in which the participants must meet specific eligibility requirements to receive an incentive. Companies that do not meet the requirements cannot participate in the program. Determining the criteria helps ensure the efficiency of the policy and prevents unintended consequences.
15. **Which agency will lead?**
    To ensure a successful outcome, the most relevant public-sector agency should be chosen to lead the project. Equally important is for the lead agency to collaborate with other agencies as needed throughout the course of the project or policy, from planning through implementation.
16. **What are the resources needed to operate the project?**
    It is necessary to identify the resources that will be required once the project or policy is operational to keep it functioning during its useful lifespan. These resources include operating costs, staff resources, and any physical resources such as equipment that might be required to keep the project or policy operational.

17. **What permits are required to initiate/complete the project?**
    It is necessary to include a list of all permits that are required to be processed before the initiation/completion of the project, along with any pertinent deadlines.

Stakeholder Engagement

18. **Who are the stakeholders?**
    It is important to identify and engage the proper set of stakeholders for each project and policy. The stakeholders can be any combination of public agencies, private companies, communities, trade groups, individuals, academia, and policy makers.
19. **Should the private sector be engaged? If so, how?**
    Private-sector businesses often are affected by the implementation of public initiatives. In such cases, engagement strategies should be planned to ensure that relevant private-sector representatives are engaged, and that they understand and support the project.
20. **Is there a need to engage and coordinate with public agencies? How?**
    Various public-sector agencies can be affected by, or have the power to implement, policies and projects. It is important to ensure that policies or projects proposed by one agency will not negatively affect a project or policy implemented by another agency.

Risk Management and Integration with Other Transportation Policies

21. **Is there a risk of the technology/project becoming obsolete?**
    The technologies used for a project should be planned and chosen according to the project's lifespan and duration. For long projects, it might be necessary to consider technology upgrade plans. In the case of infrastructure, a future obsolescence management plan may also be worth considering.
22. **Could benefits be provided to the community or pedestrians?**
    Although the first objective of these projects and policies is to address freight system issues, in some cases it is possible to design the projects or programs to benefit additional stakeholders and local communities. If so, such possibilities should be considered, as they will ease implementation.
23. **Are there any safety/security issues that should be resolved?**
    It is important to identify any safety or security concerns before project implementation. Identifying potential problems in the design phase will reduce costs and improve the safety of the overall system.

Once a preliminary list of relevant initiatives has been compiled, public-sector decision makers and transportation agencies are ready to conduct detailed assessments of each initiative's pros and cons, and decide on the most appropriate course of action following the process described in Section 1. The case studies presented in Section 3 of this Guide illustrate how numerous initiatives have been identified, selected, and implemented to address freight-related problems in different cities around the United States.

Succinct discussions and descriptions of each initiative included in the catalog are given in the rest of Section 2. These descriptions are organized into groups. The descriptions include discussions about advantages and disadvantages associated with implementation of each initiative, examples, related initiatives, and references for further review. Following the descriptions are corresponding tables that summarize essential characteristics of the initiatives (e.g., target mode, geographic scope, primary objective, expected costs, and level of effort for implementation). A group summary table also is included that lists each initiative and uses checkmarks to indicate the applicable planning and design questions (considerations) for each initiative.

Practitioners can use the summary tables as a quick reference for each initiative and consult the group summary table to relate the initiatives to the key design considerations. advantages and disadvantages associated with implementation of the initiative discussed, examples, related initiatives, and references for further review.

Infrastructure Management

Infrastructure management initiatives use infrastructure improvements to enhance freight mobility. Such enhancements are often necessary because both truck size and traffic have increased over the past few decades, making some roadways and buildings obsolete and unable to support current freight traffic volumes (Wilbur Smith Associates 2012).

Major Improvements

Initiatives considered for major infrastructure improvements often require large expenditures and fairly elaborate planning efforts.

Initiative 1: Ring Roads for Bypass Traffic

This initiative seeks to shift through-trucks that would otherwise travel through the city to ring roads in the urban periphery. Ring roads only work if they lead to cost savings to the carriers; without proper land use planning they can create excess sprawl, and they require large capital investments, elaborate needs assessments, and impact analyses. Studies to evaluate ring roads should analyze truck traffic, temporal patterns and their environmental impacts, and other complementary measures (PIARC 2011). The location of traffic generators also needs to be studied to determine where the proposed ring road and its potential interchanges would most effectively improve mobility. Table 1 summarizes essential characteristics of Initiative 1.

Initiative 2: New and Upgraded Infrastructure

Initiatives of this type focus on enhancing the geometric design and physical characteristics of current roadways, railways, and intermodal terminals. Market studies must be performed to ensure that investments in these facilities would generate enough intended effects to justify the costs. New or upgraded roads often are considered to address the wider turning radii of trucks (Ogden 1992); trucks unable to make right turns without interfering with oncoming traffic, or cutting across sidewalks; and trucks unable to travel under overpasses (Wilbur Smith Associates 2012), among other issues. Some U.S. examples of this type of initiative are the Atlanta freight corridors included in the Georgia Freight Logistics Plan 2010–2050 (Georgia Department of Transportation 2011a).

Railway enhancements face the same obstacles as road-related improvements. Unlike roads and bridges, however, rail infrastructure is primarily owned by private-sector companies, which only make physical improvements if their return on investment can meet expected thresholds. An additional limiting factor is the lack of public funding available to build new or upgraded railways (though federal investments were used in the Alameda Corridor in Los Angeles and the Chicago CREATE project, among others). Nevertheless, new or upgraded railways often are discussed as part of supply chain and logistics improvement plans. An example of this kind of initiative appears in the freight action strategy for the Everett-Seattle-Tacoma Corridor case study in Section 3.

Similarly, upgrades of intermodal terminals could have beneficial effects on urban freight by fostering mode shifts to rail. Given that each mode independently strives to increase its market share in freight activities, cooperation is key to intermodal terminal success, and representatives

Innovative Design—San Antonio's US-281 Super Street

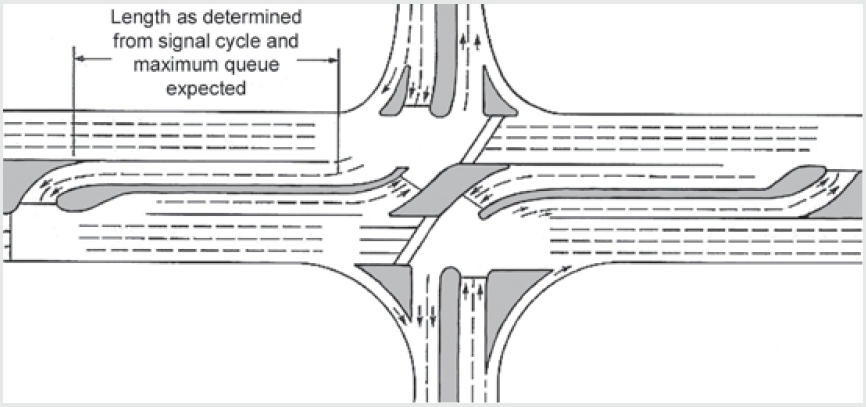
Today's transportation decision makers face increasingly complex issues even as transportation funding has steadily declined. Increasingly, decision makers must do more with less. This is particularly true in urban areas, where the major freight bottlenecks are often located in areas with tight rights-of-way and environmental constraints.

San Antonio's Challenge

In 2009, the San Antonio region confronted these challenges when the development of a proposed tollway to alleviate congestion on US-281 stalled because of complications in the environmental review process. As congestion increased, freight stakeholders began reaching out to the Texas Department of Transportation (Texas DOT) and the Alamo Regional Mobility Authority to find a short- to mid-term solution to the increasing congestion on US-281 while environmental concerns were being addressed by a larger, long-term solution.

A local engineering firm approached the Alamo Regional Mobility Authority with a proposal to transform one of the most congested portions of the US-281 Corridor into a "Super Street" (see Figure 3). A month later, the $5.2 million project was approved through a combination of funding from the Advanced Transportation District, the city of San Antonio, and the American Recovery and Reinvestment Act of 2009 (ARRA, often called the federal Stimulus program). Construction began 1 year later and was completed, despite weather delays, within 10 months (Alamo Regional Mobility Authority n.d.; Purcell 2014).

A Super Street is an innovative series of intersection improvements that limit and coordinate signal phases by redirecting left-turn phases. Essentially, minor-road drivers approaching an intersection with a major road physically cannot proceed straight through the intersection. The driver is directed to make a right turn onto the major road, turn around using a crossover, and then turn right onto the minor road (Figure 4). Similarly, left hand turns from the minor road are physically prohibited. All movements of the major road function as a normal intersection (Figure 5).

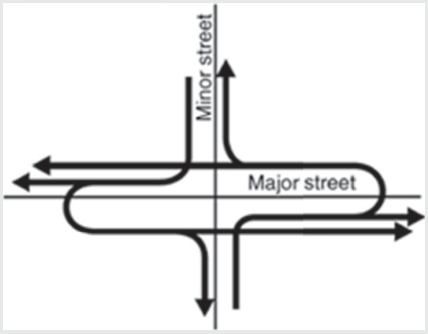


Source: FHWA 2004

Figure 3. Super street illustration.

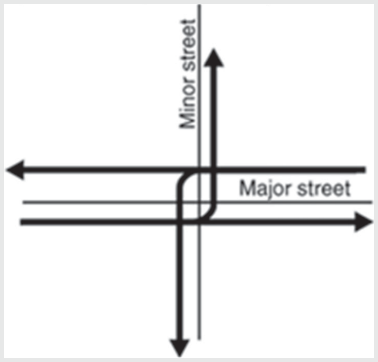
(continued on next page)

Innovative Design—San Antonio's US-281 Super Street (Continued)



Source: FHWA 2004

Figure 4. Minor road movements.



Source: FHWA 2004

Figure 5. Major road movements.

Each intersection functions as a two-phase signal, versus a traditional multiphase signal that requires significantly more red time; therefore, the Super Street design reduces delay. Additionally, because of the reduced signal complexity, the two signal phases can have different cycle lengths, increasing throughput on the higher-volume major road. Furthermore, the geometric changes to the intersection design also reduce conflict points by 37%, compared to a traditional four-leg signalized intersection (FHWA 2004).

Although reducing congestion and emissions and improving safety are clear benefits to innovative designs like the Super Street, other challenges could be compounded if this initiative is applied in urban areas. Design considerations need to ensure that trucks turning left from the minor road onto the major road can negotiate the U-turn with ease. According to local freight stakeholders, this has been accomplished in San Antonio, and trucks have been a primary beneficiary of the changes. Additional considerations are needed to maintain traffic flow during the construction process. This is true of most roadway projects, but Super Streets are frequently used in corridors with a tight right-of-way envelope.

In 2011, the US-281 team analyzed the effects of the improved US-281 Super Street Corridor. The team found that delay was reduced during a.m. and p.m. peaks by over 1 million vehicle hours annually (65% and 73% reductions, respectively). This reduction resulted in over $24 million saved annually by users of the corridor. The corridor's crash rate fell by almost 46%. The $5.2 million investment resulted in a 1-year benefit-cost ratio of 4.7 (Gaston and Gilmer 2011). In 2012, the project was recognized by the American Council of Engineering Companies with an Engineering Excellence Award (Pape-Dawson Engineers 2012).

Innovative solutions will be increasingly necessary as growth in both population and freight demand impact U.S. metropolitan areas. Low-cost projects that have a low geographical imprint while producing significant benefits—such as San Antonio's Super Street—will be critical to improving freight system performance in metropolitan areas.

must commit to the global operation and the overarching benefits that the terminal will return to the system. This is the case of a project the Port Authority of New York and New Jersey (PANYNJ) is pursuing to upgrade the Greenville Yard at the Jersey City waterfront with the main purpose of improving operations and reducing truck traffic in the region. Examples of coordination and required collaborative work of already-finalized projects are described in case studies from Kansas City and Los Angeles described in Section 3. Table 2 summarizes essential characteristics of several initiatives for new and upgraded infrastructure, intermodal terminals.

Initiative 3: Freight Cluster Development (Freight Village)

Freight cluster developments foster relocation of large freight users, such as distribution centers, manufacturers, truck terminals, and intermodal facilities to a specific area, typically at the urban fringe. Locating a freight cluster far away from the urban core means that small trucks have to travel longer distances to complete their deliveries, increasing vehicle-miles traveled on the last leg of the supply chain. The concept of freight clustering is a relatively recent development in the United States (Smart Growth Network and ICMA 2002), though it is common in Europe. Freight clusters could lead to small reductions in truck traffic given that a portion of the business-to-business freight traffic that normally takes place in the city would take place inside the facility (Allen and Browne 2010). The impact on overall congestion is very small however, as the business-to-business traffic in the clusters represents a minuscule proportion of the total truck traffic in the city. However, the noise and other negative effects generated inside and around the freight village are great disadvantages for local communities. (For a discussion of success factors in Europe, see European Freight Villages and their Success Factors (Nobel 2011). Freight clusters require large tracks of land, initial investments, and coordination efforts. The main benefits of freight clusters are to preserve space for freight-intensive activities inside the metropolitan area but outside the central business district. Table 3 summarizes essential characteristics of Initiative 3.

Minor Improvements

Initiatives associated with minor improvements are relatively less costly, though they still require analysis of the anticipated costs and benefits involved before implementation.

Initiative 4: Acceleration/Deceleration Lanes

Designed to accommodate the acceleration and deceleration profile of trucks, these improvements allow trucks to seamlessly merge into traffic. State and local agencies have made a variety of efforts to deal with issues arising from accelerating levels of truck traffic (Douglas 2003). A comprehensive report covering truck climbing lanes and including real-world experiences, lessons learned from previous implementation, typical issues planners face early in the planning process, and a framework and methods for evaluating the benefits and impacts of truck facilities can be found in the *Handbook for Planning Truck Facilities on Urban Highways* (Douglas 2004). Table 4 summarizes essential characteristics of Initiative 4.

Initiative 5: Removal of Geometric Constraints at Intersections

The geometry of intersections in the old sections of large cities poses tremendous challenges to delivery trucks. Although a wholesale redesign of intersections may not be appropriate, it is advisable to improve geometry at selected problem intersections. Restricting access to large trucks may offer a short-term solution, though it may not be appropriate for zones where heavy large-truck traffic is unavoidable. In those cases, a lack of adequate geometric design will significantly impact traffic and safety; removing geometric constraints may therefore be necessary. New developments must ensure appropriate street geometry for truck operations. An example

for the implementation of this initiative is presented in the Maspeth Truck Route Redesignation case study in Section 3. Table 5 summarizes essential characteristics of Initiative 5.

Initiative 6: Ramps for Handcarts and Forklifts

This program involves building ramps on sidewalks to accommodate forklifts or handcarts to improve the efficiency of loading and unloading activities (Ogden 1992). These ramps make it easy for drivers to deliver larger quantities of cargo, which significantly reduces the time spent in parking and loading areas, increasing the areas' capacity to accommodate freight vehicles. The ramps also allow a truck to park once to unload its goods for a general location, then to break up the load and distribute it to multiple nearby sites, such as having a single drop-off/pick-up location for multiple shippers or receivers, with self-pick-ups and drop-offs using handcarts. Table 6 summarizes essential characteristics of Initiative 6.

Table 1. Ring roads for bypass traffic.

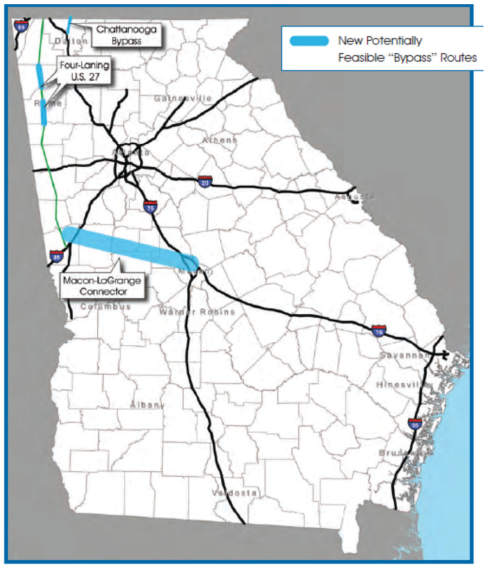
Initiative 1: Ring Roads for Bypass Traffic	
Description: The construction of bypasses (high speed ring roads, or beltways) to move through-trucks to the periphery of the urban area. Only viable if they lead to cost savings to carriers.	
Targeted mode: Through traffic	**Geographic scope:** Corridor
Type of Initiative: Infrastructure management: major improvements	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: The cost and effort to construct a new ring road can be very high, involving construction of a new roadway, roadway crossings, and interchanges. Such a construction project will involve long-term planning and implementation, elaborate needs assessments, and impact analyses.	
Advantages: • Reduce congestion • Enhance safety • Environmental sustainability • Reduce infrastructure damage	**Disadvantages:** • High probability for unintended consequences – May lead to new development outside urban core – Environmental impacts on the communities affected by the new road • Environmental impacts associated with new construction • Require very high capital investments • Require private-sector acceptance
Typical example: • Sydney Orbital Network, Australia (Transport for NSW 2012)	• "Through" Corridors in Atlanta, Georgia, United States (Georgia Department of Transportation 2011b)
 Source: OpenStreetMap Contributors 2010	 Source: Georgia Department of Transportation 2011b
Related alternatives: 1. New and Upgraded Infrastructure, Intermodal Terminals; 2. Truck Routes; 3. Exclusive Truck Lanes (Dedicated Truck Lanes)	
References: Marquez et al. 2004; PIARC 2011	

Table 2. New and upgraded infrastructure.

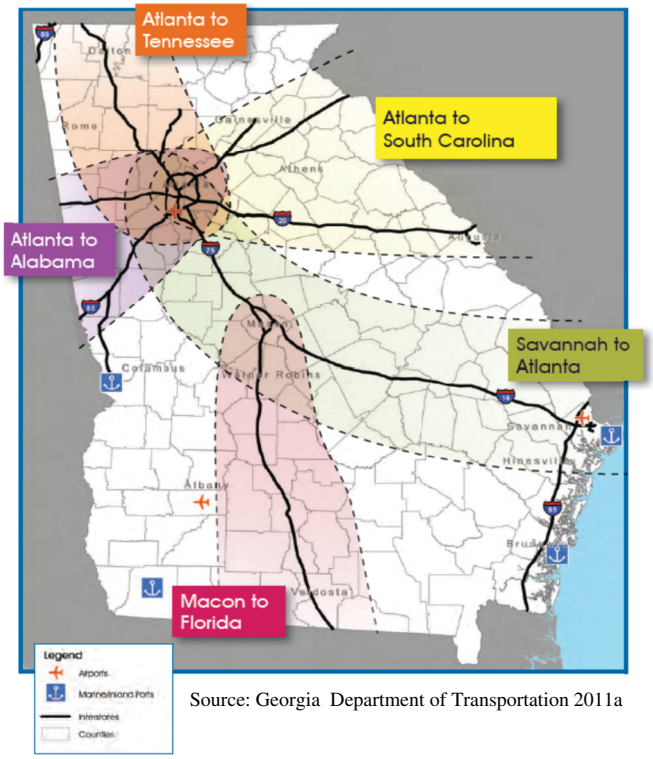
Initiative 2a: New and Upgraded Roads	
Description: Enhancements to the geometric design and physical characteristics of current roadways	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Infrastructure management: major improvements	**Primary objective:** Improve inadequate infrastructure/ enhance safety
Expected costs and level of effort to implement: Extensive stakeholder involvement and an assessment of all potential impacts (positive and negative), both inside and outside the study area, should factor into planning. Costs of implementation range from short-term, inexpensive maintenance to very high construction and reconstruction costs of new truck routes or lanes.	
Advantages: • Reduce congestion • Enhance livability • Enhance safety for bicyclists and pedestrians • Facilitate multimodal freight	**Disadvantages:** • Moderate probability for unintended consequences • Environmental impacts associated with new construction • Require very high capital investments • May increase traffic on improved roadway • May require private-sector investments
Examples: • Lorry Route Network, Suffolk County, England (Suffolk County Council 2013) • Atlanta Freight Corridors, Atlanta, GA, United States (Georgia Department of Transportation 2011a) • US-281 and Loop 1604 Super Street (San Antonio, TX, United States) • Alum Creek Drive Reverse Crossbow Interchange (Franklin County Engineer, OH, United States)	
 Source: Georgia Department of Transportation 2011a	
Related alternatives: 1. Ring Roads; 2. Freight Cluster Development (Freight Village); 3. Freight Parking and Loading Zones; 4. Truck Stops/ Parking Outside of Metropolitan Areas	
References: Ogden 1992; Woudsma 2001; Georgia Department of Transportation 2011a; Suffolk County Council 2011; Wilbur Smith Associates 2012	

Table 2. (Continued).

Initiative 2b: New and Upgraded Railways	
Description: The construction of new rail lines, or upgrades to existing rail lines	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Infrastructure management: major improvements	**Primary objective:** Improve inadequate infrastructure/ enhance safety
Expected costs and level of effort to implement: Costs will vary depending on whether a project modifies existing infrastructure or involves new construction. Generally, the costs associated with this type of initiative are very high. Planning should involve public and private sectors; projects will require availability of both types of funding, given that most rail infrastructure is privately owned and operated.	
Advantages: • Enhance safety • Facilitate multimodal freight • Reduce vehicle-miles traveled • Reduce congestion • Reduce infrastructure damage	**Disadvantages:** • May require very high capital investments • May require private-sector investments • Require extensive coordination and integration between stakeholders as the rail network is mainly owned by private-sector entities • Moderate probability for unintended consequences – May impact competitiveness of alternate modes
Examples: • CREATE Project implemented in Chicago, IL, United States (CREATE 2003) • Revitalizing rail freight in Wielkopolska, Slovenia (CASTLE 2009) • Alameda Corridor in California, United States (Alameda Corridor Transportation Authority 2013)	
 Source: Alameda Corridor Transportation Authority (ACTA) 2013	
Related alternatives: 1. Ring Roads; 2. Freight Cluster Development (Freight Village); 3. Freight Parking and Loading Zones; 4. Truck Stops/ Parking Outside of Metropolitan Areas	
References: CREATE 2003; Douglas 2003; Ballis 2006; CASTLE 2009; Department for Transport 2010b	

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Table 2. (Continued).

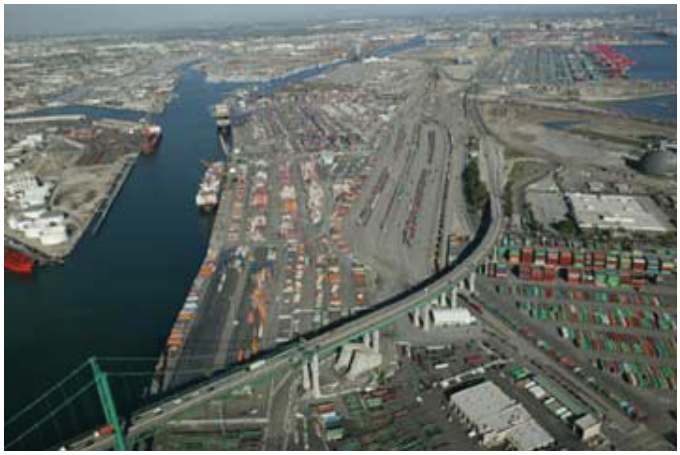
<table>
<tr><th colspan="2">Initiative 2c: New and Upgraded Intermodal Terminals</th></tr>
<tr><td colspan="2">Description: The use and construction of terminals and other transfer facilities to move freight between trucks and other modes of transportation</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Corridor</td></tr>
<tr><td>Type of initiative: Infrastructure management: major improvements</td><td>Primary objective: Improve inadequate infrastructure/ enhance safety</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Costs and effort depend on the type of project: a new intermodal terminal or improvements to an existing terminal. Creation of master plans to include intermodal conditions is less expensive than the very high cost of constructing a new facility. Extensive stakeholder engagement is necessary, as is an assessment of positive and negative impacts for all economic agents involved. The construction of new facilities may require a lengthy implementation period.</td></tr>
<tr><td>Advantages:
Reduce congestion
Reduce vehicle-miles traveled
Environmental sustainability
Enhance economic competitiveness
Facilitate intermodal freight</td><td>Disadvantages:
May require very high capital investments
Require long implementation times
Require cooperation between multiple stakeholders
Moderate probability of unintended consequences
Increase perceived noise in the surrounding areas
Increase traffic in the vicinity of terminal
Potential land use conflicts</td></tr>
<tr><td colspan="2">Examples:
Southern California Intermodal Terminals, California, United States (Southern California EDISON 2007)
Ohio’s Intermodal Railroad Terminals, Ohio, United States (Ohio Rail Development Commission 2012)
Motorways of the Sea in Europe (MOSES 2001) 
Source: The Port of Los Angeles 2013</td></tr>
<tr><td colspan="2">Related alternatives: 1. Ring Roads; 2. Freight Cluster Development (Freight Village); 3. Freight Parking and Loading Zones; 4. Truck Stops/ Parking Outside of Metropolitan Areas</td></tr>
<tr><td colspan="2">References: MOSES 2001; Southern California EDISON 2007</td></tr>
</table>

Table 2. (Continued).

Initiative 2d: New and Upgraded Railroad Grade Separations	
Description: The construction of railroad grade separations	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Infrastructure management: major improvements	**Primary objective:** Improve inadequate infrastructure/ enhance safety/reduce delays
Expected costs and level of effort to implement: Costs and efforts depend on the scope of the project and the complexity of the grade crossing. Due to the extensive planning and design considerations that should be taken into account, these projects are often expensive. Extensive stakeholder engagement is necessary, as is an assessment of positive and negative impacts for all economic agents involved. The reconstruction of grade crossings may require a lengthy implementation period.	
Advantages: • Reduce congestion • Reduce risk and maintenance for the railroads • Increase safety • Increase corridor reliability	**Disadvantages:** • May require very high capital investments • Require significant coordination with railroads • Require cooperation between multiple stakeholders
Examples: • Highway 307 Overpass of Norfolk Southern Railroad Outside of Port of Savannah Gate • Source: (The Port of Los Angeles 2013) • Grade separation of State Route 307 over the rail line outside the Port of Savannah (Pended 2012)  Source: http://saportareport.com/blog/2012/07/gdot-cuts-ribbon-on-bridge-as-georgians-vote-on-18-billion-transportation-tax/	
Related alternatives: 1. Ring Roads; 2. Freight Cluster Development (Freight Village); 3. Freight Parking and Loading Zones; 4. Truck Stops/ Parking Outside of Metropolitan Areas	
References: Pendered 2012; The Port of Los Angeles 2013	

Table 3. Freight cluster development (freight village).

<table>
<tr><th colspan="2">Initiative 3: Freight Cluster Development (Freight Village)</th></tr>
<tr><td colspan="2">Description: The concentration of freight users such as distribution centers, manufacturers, truck terminals, and intermodal facilities into a single location, typically at the urban fringe, to provide efficiency and economies of scale. Cluster development is a common land use approach that consolidates a single type of activity in an area to reduce that activity's negative impacts on other areas, such as residential developments.</td></tr>
<tr><td>Targeted mode: Large traffic generators</td><td>Geographic scope: City</td></tr>
<tr><td>Type of initiative: Infrastructure management: major improvements</td><td>Primary objective: Reduce congestion/land use planning</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Costs to construct a new freight village are very high, but most costs and effort are taken by the private sector. The cost of purchasing land for a freight village may be very high, and may possibly be assumed by the public sector. Because the intention is to concentrate freight activities in one location, coordinated efforts are required, involving the public sector, private sector, and the communities. The implementation and construction of freight cluster development takes a long time.</td></tr>
<tr><td>Advantages (inside the urban area):
Reduces congestion
Environmental sustainability
Enhances safety
Enhances operational efficiency
Enhances livability
Reduces freight activity inside urban areas</td><td>Disadvantages (area of impact of freight cluster):
Requires very high capital investment (land acquisition and construction)
Requires extensive cooperation between stakeholders
Environmental impacts associated with new construction
Moderate to low probability of unintended consequences
Increased perceived noise in surrounding areas
Increased traffic in the vicinity of terminal
Increased vehicle-miles traveled</td></tr>
<tr><td colspan="2">Examples:
Portland, Oregon, United States (Holguín-Veras et al. 2012a)
Seattle, Washington, United States (Holguín-Veras et al. 2012a)
Abertis Logistics Park in Santiago, Chile (Abertis 2010)
Frankfurt Freight Village (Oder), Germany (GVZ Frankfurt 2013) 

Source: GVZ Frankfurt 2013</td></tr>
<tr><td colspan="2">Related alternatives: 1. New and Upgraded Infrastructure, Intermodal Terminals; 2. Relocation of Large Traffic Generators (LTGs); 3. Integrate Freight into Land Use Planning Process</td></tr>
<tr><td colspan="2">References: Smart Growth Network and ICMA 2002; CASTLE 2009; Allen and Browne 2010; C-LIEGE 2010; Department for Transport 2010b; Nobel 2011</td></tr>
</table>

Table 4. Acceleration/deceleration lanes.

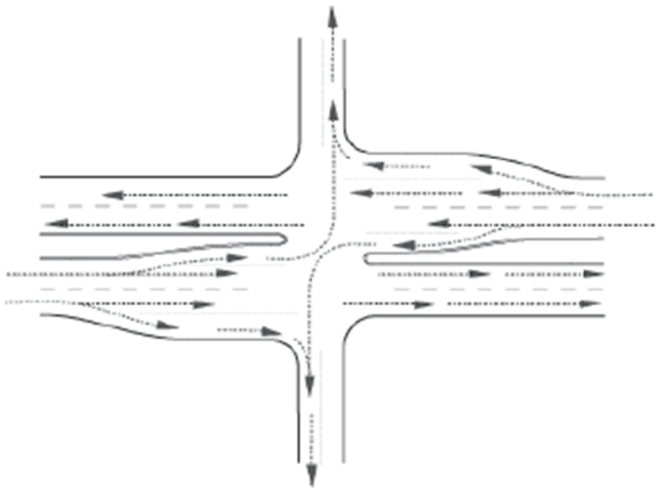
Initiative 4: Acceleration/Deceleration Lanes	
Description: Improvements to infrastructure designed to accommodate trucks' technical acceleration and deceleration specifications, especially when merging into traffic at intersections, interchanges, ramps, highways, and at traffic signals	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Infrastructure management: minor improvements	**Primary objective:** Improve inadequate infrastructure
Expected costs and level of effort to implement: The planning process should involve multiple stakeholders to account for the impacts and benefits of acceleration and deceleration lanes. Depending on the locations, high investments may be needed to acquire land to construct the lanes. Requires analysis of possible environmental impacts.	
Advantages: • Enhance safety • Improve mobility • Reduce congestion • Low probability for unintended consequences	**Disadvantages:** • May require high capital investments • Environmental impacts associated with new construction • May require moderate implementation times
Examples: • Minnesota Department of Transportation (Minnesota DOT) (Maze et al. 2005) • Acceleration Lane at I-81/I-70 Interchange. Maryland, United States (Keels 2011)  Deceleration lanes at the intersection of four-lane and two-lane highway Source: Maze et al. 2005	
Related alternatives: 1. Truck Routes; 2. Restricted Multi-Use Lanes; 3. Exclusive Truck Lanes (Dedicated Truck Lanes)	
References: Douglas 2003; Maze et al. 2005; Keels 2011	

Table 5. Removal of geometric constraints at intersections.

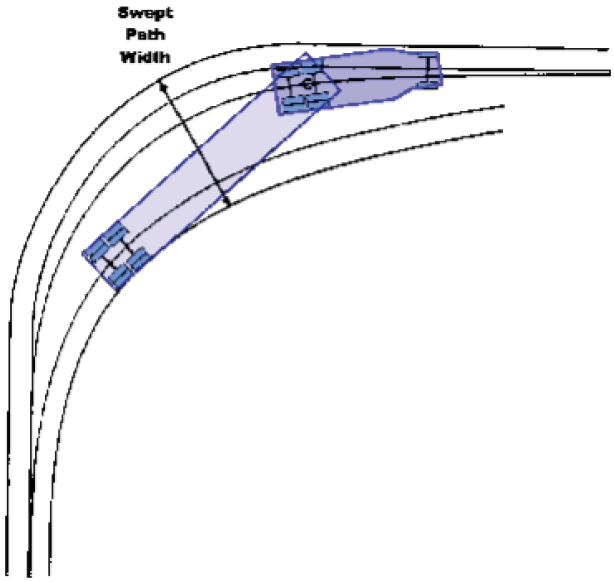
Initiative 5: Removal of Geometric Constraints at Intersections	
Description: Improvements to the geometric design at intersections to better accommodate trucks in areas with high truck traffic and in truck routes	
Targeted mode: All traffic	**Geographic scope:** Point
Type of initiative: Infrastructure management: minor improvements	**Primary objective:** Improve inadequate infrastructure/ enhance safety
Expected costs and level of effort to implement: A cautious cost-benefit analysis is required. Cost to update design standards at intersections is minimal. Implementation costs vary, but are often high.	
Advantages: • Enhances safety • Reduces congestion • Reduces infrastructure damage • Low to no probability for unintended consequences	**Disadvantages:** • Could require high capital investments • May require moderate implementation times • May conflict with pedestrian traffic • May impact private-sector locations
Examples: • AASHTO standards (AASHTO 2001) • Swept Path: Amount of roadway space that truck needs to make to turn without hitting something (U.S. Department of Transportation 2000).  Swept Path Source: U.S. Department of Transportation 2000	
Related alternatives: 1. Freight Parking and Loading Zones; 2. Vehicle Size and Weight Restriction; 3. Truck Routes	
References: Fambro et al. 1988; Hummer et al. 1988; Ogden 1992; Mason Jr. et al. 1993; Harkey et al. 1996; Harwood et al. 1999; AASHTO 2001; Fitzpatrick and Wooldridge 2001; Garber et al. 2008	

Table 6. Ramps for handcarts and forklifts.

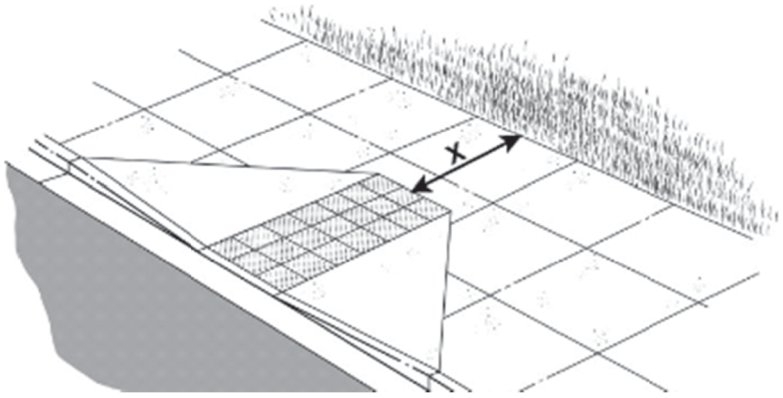
Initiative 6: Ramps for Handcarts and Forklifts	
Description: Additions to urban buildings and sidewalk ramps to accommodate forklifts or small handcarts to improve the efficiency of loading and unloading truck activities	
Targeted mode: Urban deliveries	**Geographic scope:** Point
Type of initiative: Infrastructure management: minor improvements	**Primary objective:** Improve inadequate infrastructure
Expected costs and level of effort to implement: Effort is required to coordinate multiple stakeholders involved from planning and transportation organizations, real estate developers, and landlords to update and modify current regulations, land use codes, and rezoning strategies. Implementation costs may involve the need to buy or rent additional space, or include costs to retrofit existing buildings, though these costs are generally low, and implementation times are short.	
Advantages: • Reduce congestion • Environmental sustainability • Enhance safety • Improve mobility • Low to no probability for unintended consequences	**Disadvantages:** • May conflict with pedestrian traffic
Examples: • For freight, a similar curb ramp improvement type of project, such as the projects conducted after the Americans with Disabilities Act (ADA).  Source: U.S. Department of Justice 2010	
Related alternatives: 1. Freight Parking and Loading Zones; 2. Enhanced Building Codes; 3. Upgrade Parking Areas and Loading Docks	
References: Ogden 1992	

Table 7 summarizes the planning and design considerations for the six initiatives listed under infrastructure management.

Table 7. Planning and design considerations for infrastructure management initiatives.

		INFRASTRUCTURE MANAGEMENT					
		Major Improvements			Minor Improvements		
	Questions	Ring roads for through traffic	New and upgraded infrastructure	Freight clusters (freight villages)	Acceleration/ deceleration lanes	Removal of intersection constraints	Ramps for handcarts and forklifts
Planning considerations							
1	Is there enough right-of-way available to complete the project?	✓	✓	✓	✓		
2	Will other projects be required to fully complete the project?	✓	✓	✓			
3	How will this project be funded?	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓	✓	✓	✓	✓
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓
6	Where is it located?	✓	✓	✓	✓	✓	✓
7	What is the desired size/capacity/connectivity?	✓	✓	✓	✓	✓	✓
Operational considerations							
8	Will the use of policy/project be mandatory or voluntary?	✓	✓	✓	✓		
9	Is there any incentive for participation (or penalties for not)?	✓	✓	✓			
10	What is the level of incentives?	✓	✓	✓			
11	What is the level of price(s)/fine(s)?	✓	✓	✓			
12	How will the policy/project be enforced?	✓	✓	✓	✓		
13	What is the target group?	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?	✓	✓	✓	✓		✓
15	Which agency will lead?	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓	✓	✓	✓	✓
Stakeholder engagement							
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies							
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓

Parking/Loading Areas Management

In many city centers and business districts, parking spaces are very limited, which translates into trucks double-parking or spending considerable time circling a block waiting for a parking space (Jaller et al. 2012), and trucks extending into sidewalks and roadways while docking in undersized loading areas. This is not only an enforcement issue. Frequently the number of parking spaces available is simply not enough to satisfy the needs of delivery trucks. On Manhattan Island in New York City, for example, there are 10 zip codes where the demand for parking from delivery trucks exceeds the linear capacity of the streets to accommodate them (Jaller et al. 2012). As a result, carriers are forced to double-park and pay large amounts in parking fines. In New York City, carriers typically pay between $500 and $1,000 per truck per month in parking fines (Holguín-Veras et al. 2007; Holguín-Veras et al. 2008b). Furthermore, because the parking spaces are also available to other commercial vehicles, such as limos and service vehicles, the amount of net parking available to freight vehicles reduces further. Although service trips are considered commercial, and refer to those trips in which the main purpose is to carry out a service activity at the premises, they do not share the same parking requirements as their freight counterparts. Service trips involve services such as maintenance, repair, document shredding, cleaning, and installations, among others. Because the amount of cargo or equipment that needs to be carried may be minimal, these trips do not necessarily need to park close to their destinations. In general, service trips also require longer service times, making for longer use of the curb space, which prevents access for freight vehicles to conduct loading and unloading activities.

On-Street Parking and Loading

Roadways in dense cities or old inner-city areas are not designed to handle large traffic volumes and the on-street parking generated. Appropriate curb allocation is essential to reduce congestion and improve environmental conditions (Nourinejad et al. 2013). The main challenge is that the demand for curb space exceeds capacity because cars, buses, and freight vehicles all need access to the curb. From a strictly economic point of view, however, freight vehicles and buses should have first priority for curb space. Freight vehicles need to park close to their customers, as the cost of walking freight from truck to customers is very high; parking further away reduces the size of the loads drivers carry, all of which increases delivery and parking times. Moreover, freight vehicles produce more congestion than smaller passenger cars do, so it makes sense to get them off the roads. Similarly, fostering transit use requires that bus stops be strategically placed in high-demand locations, and that single-occupant vehicle use be discouraged by making it less convenient. Obviously, however, political reasons may argue for exactly the opposite. The initiatives presented in this subsection deal with on-street parking and loading in a variety of ways.

Initiative 7: Freight Parking and Loading Zones

These programs focus on allocating curb space for parking and loading activities. In San Francisco, proposals have been made to widen sidewalks and designate (using textured pavement) shared use of the sidewalk for parking/loading activities. In Washington D.C., a curbside freight study has recommended providing longer parking/loading spaces, multi-space meters, and the pricing of loading zones (Jones et al. 2009). Other recommendations are to increase the size of loading zones to 100 feet where possible, and to move them to the end of the block.

Increasing the capacity of parking and loading areas is an obvious and low-cost way to reduce congestion and improve traffic. This was the chief finding of Nourinejad et al. (2013) in a traffic simulation study that assessed the impacts of alternative freight parking strategies. The New York City Department of Transportation (New York City DOT) increased the parking allocation for commercial vehicles and installed parking meters (New York City Department of Transportation 2012b; New York City 2012c). The freight industry has reacted very positively

to the new policy, as it has made it easier for them to do their job. Implementation of this initiative is presented as part of Case Studies 5 and 6, from New York City, described in Section 3. Other interesting alternatives that involve managing parking spaces include Green Loading Zones (New York State Department of Transportation 2014), which are discussed in Initiative 33. Table 8 summarizes essential characteristics of Initiative 7.

Initiative 8: Loading and Parking Restrictions

Parking and loading restrictions of various forms have been implemented in metropolitan areas in the United States and Europe. The city of San Francisco has a multi-layer parking policy with "commercial yellow zones," restrictions at "passenger white zones," and commercial parking restrictions in residential zones. Special truck-only loading zones are restricted to special freight vehicles. Other restrictions include time-of-day restrictions for parking, accommodating delivery trucks in "shared" or "flex" spaces, and creating and managing on-street loading bays (San Francisco County Transportation Authority 2009). New York City added loading bays and implemented a graduated rate structure: $2 for 1 hour, $5 for 2 hours, and $9 for 3 hours of parking (New York City Department of Transportation 2012b). Other initiatives that manage curb space by allocating specific time slots for delivery operations have been successfully implemented, such as the New York City DOT Delivery Windows program (New York City Department of Transportation 2009). The implementation of this initiative is presented as part of Case Studies 5 and 6 from New York City, described in Section 3. Table 9 summarizes essential characteristics of Initiative 8.

Initiative 9: Peak-Hour Clearways

Peak-hour clearways are streets with prohibitions for curbside parking or stopping during peak hours. Clearways facilitate the movement of all vehicles by increasing the capacity of the road, though they also affect the ability of carriers to service premises along the clearway, and can be inconvenient to businesses and residents wanting to access those businesses during peak hours (Ogden 1992). In London, England, part of the Red Route network is made up of clearways, where stopping is permitted only at designated locations (SUGAR 2011). Table 10 summarizes essential characteristics of Initiative 9.

Initiative 10: Vehicle Parking Reservation Systems

Vehicle parking reservation systems make it possible for drivers to reserve curbside parking space. The program requires stakeholder coordination as well as strict enforcement. Intelligent Transportation Systems (ITS) usually are needed to help with the allocation and use of parking spots. In Toyota City, Japan, a pilot test allowed truckers to reserve parking spaces using cell phones. The parking area was remotely monitored using cameras. The pilot was deemed a success because it led to a 56% reduction of parked vehicles on the street for loading/unloading (PIARC 2012). However, no information is available about any research that investigated the potential for unintended consequences of this program, such as increased congestion due to other vehicles without access to the system circling around searching for a parking spot. Table 11 summarizes essential characteristics of Initiative 10.

Off-Street Parking and Loading

These initiatives address parking in areas other than on the streets.

Initiative 11: Enhanced Building Codes

Many city buildings were not designed to handle current truck sizes and freight traffic volumes (Department for Transport 2010b). Building codes and regulations are needed that

can ensure new buildings have adequate loading docks to meet future demands (Wilbur Smith Associates 2012). However, such codes and regulations will require changes to existing regulations, such as those in New York City that limit the number of off-street parking spaces provided by new developments (New York City Department of City Planning 2011). Table 12 summarizes essential characteristics of Initiative 11.

Initiative 12: Timesharing of Parking Spaces

By recommending that off-street parking structures schedule shared use of parking spaces among various users, this initiative complements on-street parking policies. Scheduling use of parking spaces during certain times of the day allows the spaces to be shared among trucks and commercial and private vehicles (PIARC 2011). Table 13 summarizes essential characteristics of Initiative 12.

Initiative 13: Upgrade Parking Areas and Loading Docks

Shopping malls and large stores in central business districts have limited space for maneuvering, and often have insufficient or outdated loading docks. This initiative recommends redesigning docks to accommodate the geometric needs of current and future trucks. It also recommends adequate setbacks from roadways so that trucks do not extend into roadways when docking (Wilbur Smith Associates 2012). Access to and egress from these areas also is important, as distance away from intersections facilitates traffic maneuvers and minimizes traffic impacts. Truck access should be separate from car and pedestrian access for operational, aesthetic, and security reasons (Ogden 1992). Table 14 summarizes essential characteristics of Initiative 13.

Initiative 14: Improved Staging Areas

A lack of parking, curb space, and/or loading facilities at establishments receiving freight may require governmental agencies or planning organizations to mandate the use of staging areas. Such requirements should foster the development or implementation of on-site and off-street areas at businesses or facilities that regularly receive freight. However, there are locations where this may not be a feasible option; thus, the establishment of common loading areas for sites that are large traffic generators or for other multi-tenant facilities may be a viable option (Federal Highway Administration 2012b). Alternatively, municipalities might foster the development of nearby delivery or staging areas that could serve as urban transshipment platforms. These areas could be implemented at public or private parking lots, empty lots, or other spaces that could accommodate a number of freight vehicles to conduct loading and unloading activities. At these staging areas, cargo could be unloaded from the freight vehicles and loaded to trolleys, carts, or other vehicles for last-mile distribution. In Bordeaux, France, nearby delivery areas have been established together with additional services, such as dedicated personnel to assist in the dispatching of shipments. These areas can accommodate between three to five freight vehicles (about 30 meters wide) (BESTUFS 2007). The challenge involved in establishing these areas is securing the necessary space. The staging area design also needs to take into consideration possible conflicts with nearby residents. Table 15 summarizes essential characteristics of Initiative 14.

Initiative 15: Truck Stops/Parking Outside of Metropolitan Areas

This initiative is similar to the use of truck stops, rest areas, or parking facilities on highways, or other pieces of infrastructure. These facilities are designed and provided so that drivers can take mandatory or optional breaks to rest. The success of the facilities depends on their location, capacity, and other characteristics, such as availability of food, communication services, and other service facilities (New York Metropolitan Transportation Council 2009). The urban freight system also could benefit if similar facilities were constructed or allocated for freight vehicles

on the fringes of metropolitan areas. Instead of being used as rest areas, these facilities would be available for vehicles to wait for their delivery times without obstructing the curbside or double-parking inside the metro area. The facilities could also be used as temporary staging or consolidation areas, where transshipments could be made without the need for urban consolidation centers (UCCs). In addition, such truck stops could be used by freight vehicles as parking locations to avoid peak hours for vehicles participating in programs such as off-hour deliveries (OHD). Table 16 summarizes essential characteristics of Initiative 15.

Table 8. Freight parking and loading zones: location, number, and size.

Initiative 7: Freight Parking and Loading Zones: Location, Number, and Size	
Description: Initiatives to adapt existing street design and loading areas to accommodate current and future traffic and truck volumes. Parking places and loading zone-related strategies focus on designating and enforcing curbside parking, reallocating curb space, revising signage, and identifying potential freight traffic parking locations.	
Targeted mode: Large traffic generators/urban deliveries/all traffic	**Geographic scope:** Corridor
Type of initiative: Parking/loading areas management: on-street parking and loading	**Primary objective:** Improve inadequate infrastructure
Expected costs and level of effort to implement: This initiative requires effort to coordinate multiple stakeholders from planning and transportation organizations to update and modify current regulations, land use codes, and rezoning strategies. Careful planning is needed when allocating curb space or implementing fees or other parking constraints. Positive and negative impacts to road users should also be considered. Investment costs for updating parking regulations are low, and implementation times short. Constructing new parking facilities, or expanding existing truck parking facilities, may require high capital investments.	
Advantages: • Reduce congestion • Reduce miles traveled • Enhance safety • Reduce traffic/parking violations • Improve mobility • Improve operational efficiency • Environmental sustainability • Low probability of unintended consequences	**Disadvantages:** • May require retrofitting existing developments • May result in lack of curbside space • Require public and private-sector acceptance • May not be feasible at specific locations
Examples: • Freight Parking Zone, Orlando, Florida, United States (City of Orlando 2013) • Freight Zone Parking Enforcement in Salt Lake City, Utah, United States  Source: Salt Lake City 2013	
Related alternatives: 1. New and Upgraded Infrastructure, Intermodal Terminals; 2. Removal of Geometric Constraints at intersections; 3. Ramps for Handcrafts and Forklifts; 4. Peak-Hour Clearways; 5. Upgrade Parking Areas and Loading Docks; 6. Parking Pricing	
References: Rizzo Associates 2001; BESTUFS 2007; Cambridge Systematics 2007; Jones et al. 2009; New York City Department of City Planning 2011; Jaller et al. 2012; New York City Department of Transportation 2012b; New York City 2012(c)	

Table 9. Loading and parking restrictions.

<table>
<tr><th colspan="2">Initiative 8: Loading and Parking Restrictions</th></tr>
<tr><td colspan="2">Description: Implementation of parking and loading/unloading restrictions, prohibited parking on residential streets, and other time-related parking restrictions</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Point</td></tr>
<tr><td>Type of initiative: Parking/loading areas management: on-street parking and loading</td><td>Objectives: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Multiple stakeholders may be involved to update current regulations, land use codes, and rezoning strategies. Careful planning and a thorough evaluation of positive and negative impacts to road users, commercial companies, and residents are required. Investment costs are relatively low, and restrictions can be implemented in a short amount of time. Time restrictions may require funds to provide incentives to receiver companies to switch operations to alternate hours.</td></tr>
<tr><td>Advantages:
Reduce congestion
Enhance safety
Enhance livability
Improve mobility
Improve operational efficiency
Environmental sustainability</td><td>Disadvantages:
Require enforcement
Require public and private-sector acceptance
High probability of unintended consequences
May create confusion among drivers
May impact logistics operations
May require additional incentives to receiver companies</td></tr>
<tr><td colspan="2">Examples:
New York City, New York, United States (New York City 2012c)
San Francisco, California, United States (San Francisco Municipal Transportation Agency 2013) 

Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1.Timesharing of Parking Spaces; 2. Upgrade Parking Areas and Loading Docks; 3. Parking Pricing; 4. Time-Slotting of Pick-Ups and Deliveries at Large-Traffic Generators</td></tr>
<tr><td colspan="2">References: BESTUFS 2007; Cambridge Systematics 2007; Jones et al. 2009; New York City Department of Transportation 2009; San Francisco County Transportation Authority 2009; New York City Department of Transportation 2012b; The City of New York 2012c; San Francisco Municipal Transportation Agency 2013</td></tr>
</table>

Table 10. Peak-hour clearways.

Initiative 9: Peak-Hour Clearways	
Description: Peak-hour clearways are roadway corridors defined by clearway signs at each end, where parking and standing of vehicles is prohibited during peak hours	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Parking/loading areas management: on-street parking and loading	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: Peak-hour clearway restrictions require careful consideration of freight movements and land use in the target area. Implementation and enforcement by local authorities is required. Changing policy and adding appropriate signage will bring minor costs; enforcement of parking during peak hours will be additional costs. This type of initiative could be implemented in a short period of time.	

Advantages:
• Reduce congestion
• Environmental sustainability
• Enhance safety
• Improve mobility during peak hours
	Disadvantages:
	• May face private-sector opposition
	• Moderate probability for unintended consequences
	  • Reduce residential parking
	  • Reduce access to businesses during peak hours
	  • May create confusion among drivers

Examples: • Perth, Australia (Government of Western Australia 2013) • Red Route Network, London, England (SUGAR 2011) • New Zealand (New Zealand Transport Agency 2007)	
 Source: Government of Western Australia 2013	 Source: New Zealand Transport Agency 2007
Related alternatives: 1. Freight Parking and Loading Zones; 2. Timesharing of Parking Spaces; 3. Staggered Work Hours Program	
References: Ogden 1992; SUGAR 2011	

Table 11. Vehicle parking reservation systems.

<table>
<tr><th colspan="2">Initiative 10: Vehicle Parking Reservation Systems</th></tr>
<tr><td colspan="2">Description: An initiative that allows drivers to schedule or reserve curbside parking space</td></tr>
<tr><td>Targeted mode: Large traffic generators</td><td>Geographic scope: Point</td></tr>
<tr><td>Type of initiative: Parking/loading areas management: on-street parking and loading</td><td>Primary objective: Improve inadequate infrastructure</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: The planning process requires administrative and management coordination with freight carriers, shippers, and receivers; the implementation requires strict law enforcement. Moderate costs are associated with the intelligent transportation systems (ITS), web-cam monitoring, and enforcement. Changing policy and adding appropriate signage will be minor costs; enforcement of parking during peak hours will add costs.</td></tr>
<tr><td>Advantages:
Reduces congestion
Environmental sustainability
Reduces vehicle-miles traveled
Enhances safety
Low probability of unintended consequences</td><td>Disadvantages:
Requires enforcement
Requires private-sector acceptance
May require additional parking space due to high demand</td></tr>
<tr><td colspan="2">Examples:
I-5 Corridor, California, United States (Shaheen 2013)
Toyota City, Japan
Bordeaux, France   
Source: (PIARC 2012).</td></tr>
<tr><td colspan="2">Related alternatives: 1. Timesharing of Parking Spaces; 2. Improved Staging Areas; 3. Parking Pricing; 4. Real-Time Information System</td></tr>
<tr><td colspan="2">References: PIARC 2012; Shaheen 2013</td></tr>
</table>

Table 12. Enhanced building codes.

<table>
<tr><th colspan="6">Initiative 11: Enhanced Building Codes</th></tr>
<tr><td colspan="6">Description: The design of off-street parking and loading facilities in urban center buildings, and of parking lots in and at the fringe of metropolitan areas</td></tr>
<tr><td colspan="3">Targeted mode: Large traffic generators/urban deliveries/all traffic</td><td colspan="3">Geographic scope: City, area</td></tr>
<tr><td colspan="3">Type of initiative: Parking/loading areas management: off-street parking and loading</td><td colspan="3">Primary objective: Improve inadequate infrastructure</td></tr>
<tr><td colspan="6">Expected costs and level of effort to implement: Enhanced building codes for off-street parking and loading facilities require consideration of the characteristics of the network, building designs, existing regulations, and vehicle characteristics. The planning process should involve the private real estate sector as well as public planning and economic development agencies, as these changes may involve building codes, land use regulations, and the retrofitting of existing buildings and facilities. Changing design standards and building/zoning codes will carry a low cost. Retroactively updating existing developments for off-street loading facilities will carry a high cost.</td></tr>
<tr><td colspan="3">Advantages:
Reduce congestion
Environmental sustainability
Enhance safety
Increase operational efficiency
Improve inadequate infrastructure
Low probability for unintended consequences</td><td colspan="3">Disadvantages:
Require private-sector acceptance
Require high capital investment costs when constructing or retrofitting existing infrastructure
May require updating existing development regulations
May require political consensus on updating design standards
Require available space for off-street loading</td></tr>
<tr><td colspan="6">Examples:
Parking requirements examples (Ogden 1992)
<table>
<tr><th>Land use</th><th>Floor area</th><th>Minimum number of bays</th><th>Land use</th><th>Floor area</th><th>Minimum number of bays</th></tr>
<tr><td>Office</td><td>General
Minimum
e.g., 5000 m^2
e.g., 20000 m^2</td><td>1/5000 m^2
1 LR
1 HR
4 HR</td><td>Dept Store</td><td>General
Minimum
e.g., 2000 m^2
e.g., 4000 m^2</td><td>1/1000 m^2
1 HR
2 HR or 1A+1HR
1 A + 3HR</td></tr>
<tr><td>Shop</td><td>General
Minimum
e.g., 2000 m^2
e.g., 10000 m^2</td><td>1/2000 m^2
1 LR
1 HR
2 HR + 3 LR</td><td>Showrooms</td><td>General
Minimum
e.g., 5000 m^2
e.g., 10000 m^2</td><td>1/2000 m^2
1 HR
3 HR
4 HR + 1A</td></tr>
<tr><td>Supermarket</td><td>General
Minimum
e.g., 1000 m^2
e.g., 2000 m^2
e.g., 4000 m^2</td><td>1/1000 m^2
1 HR
1 HR
1 A + 1 HR
2 A + 2 HR</td><td>Warehouse and Industry</td><td>General
Minimum
e.g., 5000 m^2
e.g., 10000 m^2</td><td>1/1000 m^2
1A
1 A + 1 HR
2 A + 1 HR</td></tr>
<tr><td colspan="3">LR: Light Rigid Truck Bay
HR: Heavy Rigid Truck Bay
A: Articulated Truck Bay</td><td>Others</td><td>General
Minimum</td><td>1/2000 m^2
1HR</td></tr>
</table></td></tr>
<tr><td colspan="6">Related alternatives: 1. Ramps for Handcrafts and Forklifts; 2. Upgrade Parking Areas and Loading Docks; 3. Improved Staging Areas; 4. Integrate Freight into Land Use Planning Process</td></tr>
<tr><td colspan="6">References: Rizzo Associates 2001; Smart Growth Network and ICMA 2002; Department for Transport 2010b; PIARC 2011; SUGAR 2011; Wilbur Smith Associates 2012</td></tr>
</table>

Table 13. Timesharing of parking spaces.

Initiative 12: Timesharing of Parking Spaces	
Description: Scheduling the use of parking spaces among and between specific carriers, this initiative includes coordinating the timing of pick-ups and deliveries with freight carriers, shippers, or receivers, and in some cases freight and passenger vehicles. Timesharing of parking spaces requires the optimization of times for deliveries and other uses.	
Targeted mode: Large traffic generators/urban deliveries	**Geographic scope:** Point
Type of initiative: Parking/loading areas management: off-street parking and loading	**Primary objective:** Improve inadequate infrastructure
Expected costs and level of effort to implement: The planning process should involve extensive stakeholder engagement and coordination with local officials, shippers and receivers of goods, the road freight industry, and other users of parking space. Changing policy and adding appropriate signage will be a minor cost; enforcement (including cameras) and reservation measures could be costly.	
Advantages: • Reduces congestion • Environmental sustainability • Enhances safety • Improves mobility • Low probability for unintended consequences	**Disadvantages:** • Requires private-sector acceptance • Requires enforcement • Requires coordination with other parties
Examples: • Sendai, Japan (PIARC 2011)	
Related alternatives: 1. Loading and Parking Restrictions; 2. Peak-Hour Clearways; 3. Vehicle Parking Reservation Systems; 4. Time-Slotting of Pick-Ups and Deliveries at Large Traffic Generators	
References: PIARC 2011	

Table 14. Upgrade parking areas and loading docks.

<table>
<tr><th colspan="2">Initiative 13: Upgrade Parking Areas and Loading Docks</th></tr>
<tr><td colspan="2">Description: Redesigning docks to accommodate the geometric space needs of current and future trucks and to provide adequate parking. May involve updating or changing design standards to provide better access or egress to buildings to accommodate delivery vehicles.</td></tr>
<tr><td>Targeted mode: Large traffic generators/urban deliveries</td><td>Geographic scope: Point</td></tr>
<tr><td>Type of initiative: Parking/loading areas management: off-street parking and loading</td><td>Primary objective: Improve inadequate infrastructure</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Changing design standards and building/zoning codes will not be costly. Retroactively updating existing loading docks or constructing larger loading docks will be expensive.</td></tr>
<tr><td>Advantages:
Reduces congestion
Environmental sustainability
Enhances safety
Improves mobility
Improves inadequate infrastructure to accommodate geometric needs
Low probability of unintended consequences</td><td>Disadvantages:
Requires private-sector acceptance
May require high capital investment
May require additional space</td></tr>
<tr><td colspan="2">Examples:
New York City, New York, United States; Boston, Massachusetts, United States; San Francisco, California, United States (Wilbur Smith Associates 2012)
Urban Investment Research Corporation (UIRC), Chicago, Illinois, United States 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Ramps for Handcarts and Forklifts; 2. Freight Parking and Loading Zones; 3. Loading and Parking Restrictions; 4. Enhanced Building Codes</td></tr>
<tr><td colspan="2">References: Ogden 1992; START 2009; SUGAR 2011; Wilbur Smith Associates 2012</td></tr>
</table>

Table 15. Improved staging areas.

<table>
<tr><th colspan="2">Initiative 14: Improved Staging Areas</th></tr>
<tr><td colspan="2">Description: This initiative fosters the development and/or requirement of on-site off-street areas at businesses or other facilities to conduct loading, unloading, or other freight-related activities</td></tr>
<tr><td>Targeted mode: Large traffic generators/urban deliveries</td><td>Geographic scope: Point/area</td></tr>
<tr><td>Type of initiative: Parking/loading areas management: off-street parking and loading</td><td>Primary objective: Improve inadequate infrastructure</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Changing design standards and building/zoning codes will not be costly. Retroactively updating existing loading areas, however, or constructing larger areas for freight activities at establishments or facilities, will be expensive. Securing the area to establish public staging areas and operating them will be costly.</td></tr>
<tr><td>Advantages:
Reduce congestion
Environmental sustainability
Enhance safety
Improve mobility
Improve inadequate infrastructure</td><td>Disadvantages:
Require private-sector acceptance
May require high capital investment
Require additional space
May generate resistance from nearby residents</td></tr>
<tr><td colspan="2">Examples:
Bordeaux, France (Eltis 2003; BESTUFS 2007)
Rouen, France (NICHES 2006)
Urban Investment Research Corporation (UIRC), Chicago, Illinois, United States 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Vehicle Parking Reservation Systems; 2. Enhanced Building Codes; 3. Truck Stops/Parking Outside of Metropolitan Areas; 4. Time-Slotting of Pick-Ups and Deliveries at Large Traffic Generators</td></tr>
<tr><td colspan="2">References: NICHES 2006; BESTUFS 2007; Federal Highway Administration 2012b</td></tr>
</table>

Table 16. Truck stops/parking outside of metropolitan areas.

Initiative 15: Truck Stops/Parking Outside of Metropolitan Areas	
Description: This initiative involves the construction or installation of truck stops/parking facilities outside the metropolitan area. These facilities could be used by freight vehicles as staging areas to conduct transshipment activities, as temporary parking locations during peak times, or as waiting areas until designated delivery times.	
Targeted mode: Urban deliveries/all traffic	**Geographic scope:** City
Type of initiative: Parking/loading areas management: off-street parking and loading	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: The planning process requires administrative and management coordination with freight carriers to select the most appropriate locations. Securing the area to establish the stops and parking areas will be costly. Changing policy and adding appropriate signage will carry minor costs; providing security and other services will add costs.	

Advantages:
• Reduce congestion
• Improve mobility
• Improve inadequate infrastructure
• Reduce vehicle-miles traveled
• Environmental sustainability
• Reduce curbside occupation time
	Disadvantages:
	• Require high capital investments
	  – Require extremely large physical space
	  – May require public subsidies
	• Increase in traffic at/in the vicinity of the area/facility

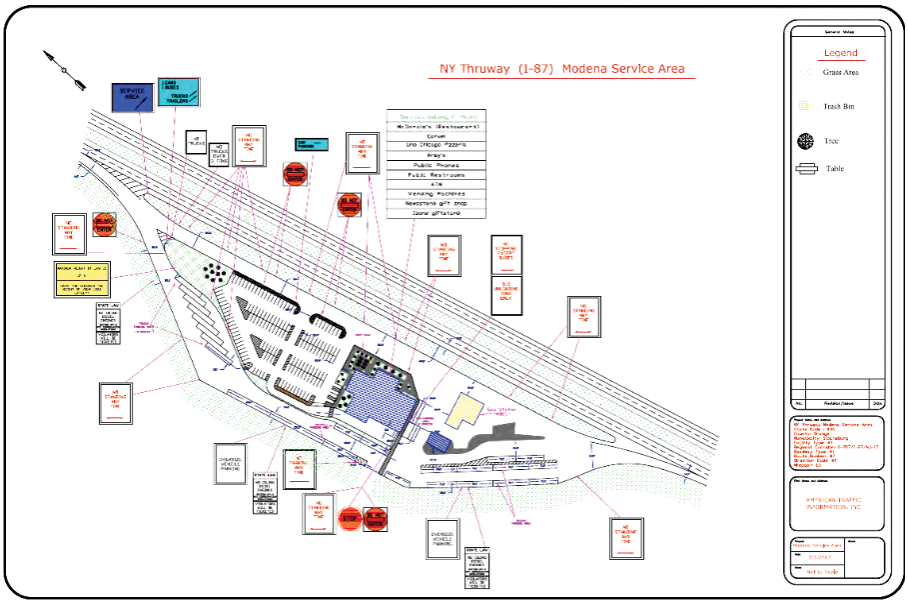
Examples: • New York City, New York, United States (New York Metropolitan Transportation Council 2009)  New York Thruway (I-87) Madena Service Area Source: New York Metropolitan Transportation Council 2009	
Related alternatives: 1. New and Upgraded Infrastructure and Intermodal Terminals; 2. Improved Staging Areas; 3. Integrate Freight into Land Use Planning Process	
References: Federal Highway Administration 2002; New York Metropolitan Transportation Council 2009	

Table 17 summarizes the planning and design considerations for the nine initiatives listed under parking/loading areas management.

Table 17. Planning and design considerations for parking/loading areas management initiatives.

		PARKING/LOADING AREAS MANAGEMENT								
		On-Street Parking and Loading				Off-Street Parking and Loading				
	Questions	Freight parking and loading zones	Loading and parking restrictions	Peak-hour clearways	Parking reservation systems	Enhanced building codes	Timeshare of parking space	Upgrade parking/loading areas	Improved staging areas	Truck stops/parking outside of metropolitan areas
Planning considerations										
1	Is there enough right-of-way available to complete the project?	✓						✓	✓	✓
2	Will other projects be required to fully complete the project?	✓						✓	✓	✓
3	How will this project be funded?	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓			✓			✓		
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓	✓		✓
6	Where is it located?	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	What is the desired size/capacity/connectivity?	✓		✓				✓	✓	✓
Operational considerations										
8	Will the use of policy/project be mandatory or voluntary?	✓	✓	✓	✓	✓	✓	✓	✓	
9	Is there any incentive for participation (or penalties for not)?	✓	✓	✓	✓	✓			✓	
10	What is the level of incentives?								✓	
11	What is the level of price(s)/fine(s)?	✓	✓	✓	✓					
12	How will the policy/project be enforced?	✓	✓	✓	✓	✓	✓		✓	
13	What is the target group?	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?	✓	✓	✓	✓	✓	✓	✓	✓	
15	Which agency will lead?	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stakeholder engagement										
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies										
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓	✓	✓	
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓	✓	✓	
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓	✓	✓	✓

Vehicle-Related Strategies

These initiatives seek to improve environmental conditions by fostering the use of technologies and practices that reduce the negative externalities produced by vehicles. The challenge of this type of strategy mainly relates to enforcement. In areas where these strategies are implemented, information regarding the process and level of enforcement is very limited.

Technologies and Programs

Initiative 16: Emission Standards

Emission standards have helped foster the use of vehicles that produce less environmental impacts. Although they improve environmental conditions, emission standards have resulted in the need for changes in vehicle fleets, thereby increasing investment, maintenance, and operating costs. Evidence exists that actual increases in operational costs are often higher than those noted in these analyses (ICF International et al. 2011). Various programs exist to accelerate the use of cleaner vehicles before the introduction of emission standards, or seek to voluntarily increase the uptake of these vehicles. The Hunts Point Clean Trucks Program is a voluntary clean truck program that provides rebate incentives to truck owners based in the South Bronx communities of Hunts Point and Port Morris, New York (New York City Department of Transportation 2012a). Truck owners can take advantage of available funding to assist them in replacing an older truck with a new EPA emission-compliant diesel truck or a new alternative-fuel vehicle. Funding is also available for the installation of exhaust retrofit technologies or vehicle scrap. Similar schemes include the Ports of Los Angeles and Long Beach Clean Trucks programs (Port of Los Angeles 2007), which have worked closely with the Coalition for Responsible Transportation to develop an initiative for truck replacement with sponsorship of the private sector (CRT and EDF 2010). The PANYNJ, on its side, has implemented the Truck Replacement Program. Table 18 summarizes essential characteristics of Initiative 16.

Initiative 17: Low-Noise Delivery Programs/Regulations

These programs and regulations specifically target noise pollution with regulations and low-noise delivery initiatives. In the United States, EPA provides basic guidelines, though noise policy is left to local agencies (e.g., New York City's Local Law 113 [The City of New York 2005]). Other noise programs intend to facilitate OHD by fostering adoption of low-noise technologies and practices (Holguín Veras et al. 2013a). In the Netherlands, for example, the PIEK Program subsidizes the acquisition of technologies that meet the new Dutch noise standards (Goevaers 2011). Table 19 summarizes essential characteristics of Initiative 17.

Table 18. Emission standards.

<table>
<tr><th colspan="2">Initiative 16: Emission Standards</th></tr>
<tr><td colspan="2">Description: Enforcement of emission standards for freight vehicles, which may involve the use of electric or low emission vehicles for urban deliveries. A number of vehicle renewal programs support this type of initiative.</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Nation</td></tr>
<tr><td>Type of initiative: Vehicle-related strategies</td><td>Primary objective: Environmental sustainability</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: This type of initiative involves minor costs to update policies and standards on emissions, but the public-sector cost of enforcement could be high. High private-sector capital investments in fleet renewal could be involved. The implementation of emission standards is expected to take moderate time.</td></tr>
<tr><td>Advantages:
Environmental sustainability
Enhance livability
Enhance efficiency
Reduce operational costs
Low probability for unintended consequences</td><td>Disadvantages:
Require high capital investments for the private sector
May require coordination, control and enforcement among municipalities
Depend on other public entities' standards
May require investments in additional infrastructure to support new technologies (e.g., charging stations, alternative-fuel supply)
Require private-sector cooperation</td></tr>
<tr><td colspan="2">Examples:
U.S. EPA Emission Standards
California Air Resources Board's (ARB) Transport Refrigeration Unit Airborne Toxic Control Measure (California Environmental Protection Agency 2012)
Euro VI standards (European Commission 2012)
Renewal Programs:
U.S. EPA SmartWay program
Plug In America (Plug In America 2013)
The Hong Kong Environmental Protection Department Program and Pilot Green Transport Fund (Hong Kong Environmental Protection Department 2011)
PIEK Program, the Netherlands (Goevaers 2011)</td></tr>
<tr><td colspan="2">Related alternatives: 1. Low Noise Delivery Programs/Regulations; 2. Engine-Related Restrictions; 3. Low Emission Zones; 4. Operational Incentives for Electric/Low Emission Vehicles; 5. Taxation</td></tr>
<tr><td colspan="2">References: City Ports 2005; BESTUFS 2007; TURBLOG 2009; C-LIEGE 2010; Hong Kong Environmental Protection Department 2011; ICF International et al. 2011; California Environmental Protection Agency 2012; Environmental Protection Agency 2012; European Commission 2012; Plug In America 2013; U.S. Environmental Protection Agency 2013</td></tr>
</table>

Table 19. Low-noise delivery programs/regulations.

Initiative 17: Low-Noise Delivery Programs/Regulations	
Description: Regulations and low-noise delivery initiatives to lessen noise pollution	
Targeted mode: All traffic	**Geographic scope:** City
Type of initiative: Vehicle-related strategies	**Objectives:** Environmental sustainability/reduce noise and pollution
Expected costs and level of effort to implement: The planning process should involve extensive stakeholder engagement to analyze the private and public-sector impacts. For the private sector, implementation may require high capital investment costs, such as fleet renewal. Costs to update policy and standards to incorporate these regulations will be fairly low. For the public sector, costs of providing the necessary incentives and enforcement programs could be high. The implementation of this type of initiative may require a moderate amount of time.	
Advantages: • Enhance livability • Environmental sustainability – Reduce noise pollution – Reduce emissions • Facilitate off-hour deliveries • Low probability of unintended consequences	**Disadvantages:** • May require high investments to support the programs
Examples: • New York City, New York, United States (The City of New York 2005) • London, England (London Noise Abatement Society 2008) • PIEK Program, the Netherlands (Goevaers 2011)  Source: Noise Abatement Society 2011	
Related alternatives: 1. Emission Standards; 2. Engine-Related Restrictions; 3. Certification Programs; 4. Driver Training Programs; 5. Voluntary Off-Hour Delivery Program	
References: The City of New York 2005; World Health Organization 2006; BESTUFS 2007; C-LIEGE 2010; Wieman 2010; Environmental Protection Agency 2011; Goevaers 2011; Holguín Veras et al. 2013a	

Table 20 summarizes the planning and design considerations for the two initiatives listed under Vehicle-Related Strategies.

Table 20. Planning and design considerations for vehicle-related strategies.

		VEHICLE-RELATED STRATEGIES	
	Questions	Emission standards	Noise programs/ regulations
Planning considerations			
1	Is there enough right-of-way available to complete the project?		
2	Will other projects be required to fully complete the project?	✓	
3	How will this project be funded?	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓
5	What is the geographic scope of the project?	✓	✓
6	Where is it located?	✓	✓
7	What is the desired size/capacity/connectivity?		
Operational considerations			
8	Will the use of policy/project be mandatory or voluntary?	✓	✓
9	Is there any incentive for participation (or penalties for not)?	✓	✓
10	What is the level of incentives?	✓	✓
11	What is the level of price(s)/fine(s)?	✓	✓
12	How will the policy/project be enforced?	✓	✓
13	What is the target group?	✓	✓
14	What are the criteria for participation?	✓	✓
15	Which agency will lead?	✓	✓
16	What are the resources needed to operate the project?	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓
Stakeholder engagement			
18	Who are the stakeholders?	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓
Risk management and integration with other transportation policies			
21	Is there a risk of the technology/project becoming obsolete?	✓	✓
22	Could benefits be provided to community or pedestrians?	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓

Traffic Management

Traffic management strategies aim to improve traffic conditions using techniques from traffic engineering and control, including access restrictions, lane management, and traffic control.

Access and Vehicle-Related Restrictions

These measures use restriction(s) to limit, grant, or deny access of freight vehicles to the target area. The nature of the restrictions varies in terms of vehicle type (e.g., size, weight, load factor, commodity type, or engine type), and time of travel.

These restrictions are not well received by most carriers, as they result in operational changes and higher costs. For example, the Ports of Los Angeles and Long Beach (California) have implemented a clean truck program by which trucks that do not meet certain engine configuration requirements pay a $35/TEU fee for accessing their container ports. The program expects to complete the transition to 100% clean vehicles by the end of 2013 (Port of Los Angeles 2013a; Port of Los Angeles 2013b).

Initiative 18: Vehicle Size and Weight Restrictions

Vehicle size and weight restrictions limit access on the basis of vehicle size, and often are implemented because of concerns about the perceived congestion or traffic accidents produced by large trucks. These restrictions have been recommended as a way to reduce congestion (Vleugel and Janic 2004), though noting that carriers could experience increases of about 5% in operating costs (Allen et al. 2003). Given that carriers' profit margins are typically less than 5%, it is not surprising that most carriers oppose these restrictions. However, a growing body of research suggests that, although the look of the target area is enhanced due to the restrictions, an increase in pollution and a drop in quality of life also can result (Maze et al. 2005; Wilbur Smith Associates 2012). Using transportation models, the research has proved that vehicle size restrictions increase congestion outside the target area, an effect that could be larger than the congestion reduction within the target area (Qureshi et al. 2012; Holguín-Veras et al. 2013b).

The chief conclusion about vehicle size choice is that the private goal of carriers is aligned with the social goals of reducing congestion and pollution (Holguín-Veras et al. 2013b). If carriers use large trucks, large trucks are almost certainly the better social choice. No rational carrier would use a large truck if a cheaper small truck would do the job. Thus, if carriers are forced to replace large trucks with multiple small trucks, they are likely to increase vehicle-miles-traveled and congestion. The implication is that, to minimize social costs, policy makers should foster the use of the largest vehicles that could safely use the network without excessive infrastructure damage. Although politically controversial, this assertion is backed by strong scientific evidence (Qureshi et al. 2012; Holguín-Veras et al. 2013b). However, access restrictions motivated by the need to protect pavements and structures not capable of handling large trucks are justified, because these are externalities not accounted for by the carriers. Vehicle size and weight restrictions should be enacted if, and only if, a careful evaluation of their impacts reveals benefits larger than the costs.

It is important to draw a clear distinction between the traditional vehicle size and weight discussion concerning state and federal limitations, and how metropolitan areas are impacted by vehicle size and weight regardless of their compliance with state or federal regulations. Simply, many local streets were not designed to handle the freight vehicles that are currently traversing urban areas. This creates negative externalities for both the vehicle drivers and local residents, as these vehicles slow traffic to get around obstacles or damage roadways never built to withstand the weight of freight vehicles. Table 21 summarizes essential characteristics of Initiative 18.

Failure to Remove Highway Restrictions

State departments of transportation (DOTs) typically have the massive task of keeping an inventory of every segment of roadway for which they are responsible. In keeping an up-to-date database, the DOT also must be aware of any restrictions that might prohibit trucks on their routes. Some restrictions might prohibit trucks of various sizes and configurations from using a certain road. These restrictions might be long term, because of problems with existing infrastructure, or they might be short term, as a result of temporary construction. DOT staff strive to maintain an accurate list of restrictions so the highways remain safe for all users. Likewise, when a problem is fixed in the field, it is important that the corresponding restriction be removed. When restrictions are not removed in a timely manner, it can create additional expenses not only to carriers, but also to other motorists and even to the end-users of the goods being transported.

An example of a restriction that was not removed in a timely manner is a bridge on New Karner Road (SR-155) over the New York State Thruway (I-90) in the Town of Colonie, New York. The bridge was the responsibility of Albany County. In Figure 6, the star shows the exact location of this bridge. In 1998, a restriction was put in place that limited use of the bridge to trucks of less than 80,000 pounds. The bridge was replaced in 1999, but the restriction was never removed from the system. Over the years, many carriers in the area contacted New York State DOT about why the restriction was still in place. Because the state DOT was not responsible for the bridge, they could not answer the question with certainty. Trucks weighing 80,000 pounds or more going between points A and B would have to bypass SR-5 because of existing restrictions. Trucks had to take SR-155 east to I-87 south. With the restriction removed, however, trucks could take SR-155 west to the Washington Avenue Extension and get to their destinations more quickly.

As shown in Figure 6, the alternative route is not a short detour, and the geometry is not as friendly to commercial vehicles. The route to bypass the restricted SR-155 bridge adds approximately 1 hour to the trip. This hour can easily cost a trucking company several hundred dollars in expenses, including wear and tear on the vehicle, fuel, driver's wages, and reductions in the drivers' effectiveness in relation to their hours of service. In addition, the extended route produces additional pollution, congestion, and safety impacts.

In 2013, nearly 14 years after the new bridge was placed in service, a representative from an Albany area trucking company contacted the engineer in charge of the bridge replacement project. The trucking company representative asked about the restriction, and the engineer said that to the best of his knowledge, the bridge was replaced to standard so no restrictions should be in place. The trucking representative began contacting others at the New York State DOT, and after approximately 4 months the restriction was removed. This example proves that properly documenting highway restrictions is necessary, but making sure outdated restrictions are removed in a timely manner also is important. In this situation, the representatives from the Albany County Department of Public Works were unaware that the restriction was never removed—and the state DOT was unaware that the restriction could be removed.

Failure to Remove Highway Restrictions (Continued)

Source: http://gis.dot.ny.gov/osowscreen2/

Figure 6. Failure to remove highway restriction.

Initiative 19: Truck Routes

Truck routes specify the links of the network that can be used by freight traffic, and could be statutory or advisory (California Department of Transportation 2012). Statutory truck routes mandate that trucks use specific segments of the network. Statutory truck routes are intended to minimize conflicts between truck traffic, pedestrians, bicycles, and local communities, as well as to protect pavements in local streets not ready for large trucks, and to discourage truck traffic in sensitive areas such as schools. Statutory truck routes should connect all major generators, allow for reasonable access to all points in the area, and minimize trucks' need to use local streets. Valid reasons to use statutory truck routes include: to avoid structural damage to sensitive facilities, to ensure that hazardous materials are transported far from population centers, and to transport over-dimensional cargo with permits that indicate the approved routes. However, improperly designed truck routes can lead to longer delivery tours and costs. Advisory truck routes, generally welcomed by the trucking industry, inform carriers about the geometric and structural conditions of the network, allowing drivers to select the most appropriate routes. An implementation of this initiative is described in Case Study 2 in Atlanta, and Case Study 7 in New York City, presented in Section 3. Table 22 summarizes essential characteristics of Initiative 19.

Initiative 20: Engine-Related Restrictions

Engine-related restrictions require freight vehicles to meet an environmental standard to access specific facilities. These restrictions have been used in combination with eco-loading zones and low emission zones (LEZs), among other measures. In eco-loading zones in Bremen, Germany, or Green Loading Zones in New York City, city authorities allocated a number of parking spaces for the exclusive use of freight vehicles that meet stringent standards of environmental performance (PARFUM 2009; New York State Department of Transportation 2014). The carriers that purchase the vehicles get access to choice parking places in areas where parking would otherwise be a major challenge. This practice translates into productivity increases, because less time is wasted trying to find parking, and cost reductions due to eliminated fines. Table 23 summarizes essential characteristics of Initiative 20.

Initiative 21: Low Emission Zones

LEZs are used in environmentally sensitive areas where vehicle access is restricted to reduce pollution levels. In some cases, all vehicular traffic is banned; in others, vehicles that meet a minimum environmental standard are allowed in. LEZs are relatively popular in Europe and have started to be implemented in other parts of the world, such as Mexico City. European cities with LEZs include Berlin, Amsterdam, Copenhagen, and London. LEZs typically lead to large reductions in trips, emissions, and noise, especially when combined with incentives or other policies that encourage the shift to alternative-fuel vehicles. Most European LEZs operate 7 days a week. Exceptions include Italy, where the LEZs are active during peak traffic periods, and Budapest, Hungary, where they are enforced during daytime hours during weekdays (LEEZEN 2010). All LEZs in Europe affect large trucks (over 3.12 tonnes in gross vehicle weight), and most buses and coaches (typically, over 4.45 tonnes). Some LEZs restrict vans, cars, and motorcycles (LEEZEN 2010). Table 24 summarizes essential characteristics of Initiative 21.

Initiative 22: Load Factor Restrictions

To reduce the number of freight trips, these restrictions require a minimum load factor (percent of truck capacity being used) (Quak 2008). Regrettably, these strategies have failed to live up to expectations. The low load factors observed in most cities are the result of market conditions, not carrier inefficiencies. Basically, market pressures force carriers to minimize cargo consolidation because doing so leads to delays that could upset customers and result in loss of business. Also, load factors naturally decrease as trucks makes deliveries. If the target area is at the end of the delivery route, it may be impossible for the carrier to meet the minimum load factor required by the city. These restrictions are also very difficult to enforce, as they require physical inspections which in themselves produce significant congestion. For these reasons, the European cities that implemented these restrictions have since phased them out. Table 25 summarizes essential characteristics of Initiative 22.

Time Access Restrictions

Time access measures impose restriction(s) on the times when freight activity can take place. The intent is to reduce freight traffic during congested times of day in specific sections of a city. The three main types of time access restrictions are daytime delivery restrictions, daytime delivery bans, and nighttime delivery bans. It is worth noting that building owners and receivers also impose delivery time restrictions that require deliveries to be made only during specific time windows. Relaxation of such delivery windows can reduce congestion by helping spread peak truck traffic.

Initiative 23: Daytime Delivery Restrictions

Daytime delivery restriction programs limit freight vehicle access to target areas during specific periods of time. The duration of the restriction, its geographic scope, and the type of freight vehicles affected vary from case to case. These strategies tend to produce unintended network effects because they can lead to longer routes and travel times in the network, which increases congestion and pollution.

Disagreement exists about the merits of daytime delivery restrictions. The experience of seven European cities suggests that delivery time restrictions are generally well received by citizens, as they reduce congestion at peak hours and increase the attractiveness of city centers. However, the restrictions are not well received by businesses in the private sector, as they make the delivery and reception of goods difficult. Some researchers suggest using time restrictions to reduce environmental impacts and accidents (BESTUFS 2007). In contrast, researchers who have quantified the impacts of the restrictions have concluded that delivery time restrictions reduce negative external effects inside the target area while increasing negative external effects in the wider area, given the longer distances driven (van Rooijen et al. 2008; Quak and de Koster 2009). Some researchers also have found an increase in the transportation costs for the participants, and increases in congestion and pollution (Quak and de Koster 2009). A careful assessment of spillover effects must be conducted before implementing these restrictions. Table 26 summarizes essential characteristics of Initiative 23.

Initiative 24: Daytime Delivery Bans

These initiatives ban freight activity during daytime hours. Typically, the ban applies to large trucks, though it could cover other vehicle types. These bans have been implemented in a number of large cities, and are bitterly opposed by receivers, who have to absorb the additional costs of receiving supplies during nighttime hours, and who consider the ban detrimental to the local economy. In response, city agencies such as those in Beijing, Shenzhen, and Changsha, China (Changsha Bureau of Public Security 2013; Shenzhen Bureau of Public Security 2013; Beijing Traffic Management Bureau 2014), and Rome, Italy, have enacted numerous exceptions to make the bans more palatable to the business sector. Feedback to the ban in Beijing indicates that carriers are unhappy because: (1) "the receivers required the shippers to deliver in the non-allowed time periods;" and (2) "they have to travel when they are told" (Beijing Traffic Management Bureau 2014). In most cases, the fines are paid by the carriers as part of the cost of doing business in the area. In Rome's Limited Traffic Zone, trucks with laden weights of less than 3.12 tonnes (35 q) are only allowed to transit and park from 8:00 p.m. to 10:00 a.m., and 2:00 p.m. to 4:00 p.m., while trucks with laden weights larger than 3.12 metric tons are only permitted from 8:00 p.m. to 7:00 a.m. As a result, congestion and pollution may worsen, as small trucks are less efficient than large trucks (Holguín-Veras et al. 2013b). Daytime delivery bans could lead to both congestion reductions during the daytime and productivity increases and cost savings to the carriers operating in the off hours. However, they also can lead to higher costs to receivers, which would reduce the net economic benefits. An implementation of these initiatives is described in the Case Study 1 in Atlanta, in Section 3. Table 26 also summarizes essential characteristics of Initiative 24.

Initiative 25: Nighttime Delivery Bans

Prohibitions on freight activity during nighttime hours are designed to protect local communities from night noise (Browne et al. 2006). However, they increase daytime congestion by forcing the 4–5% of deliveries that under normal conditions would take place during the off hours to be conducted during the daytime. To mitigate this problem, and allow companies to do night deliveries, the PIEK Program (Goevaers 2011) is fostering the use of low-noise truck technologies,

so that the night deliveries do not impact local communities. Table 26 also summarizes essential characteristics of Initiative 25.

Traffic Control and Lane Management

Traffic control and lane management strategies promote the effective use of available road capacity by trying to optimize the allocation of lane rights-of-way. In urban areas, where road capacity is limited, lane management often is used to improve lane utilization and mobility. By segregating trucks, which are often wider and heavier than other vehicles, mobility and safety for other road users are improved. At the same time, truck lanes reduce travel delays and improve reliability. Based on the types of users allowed in the lanes, the strategies can be grouped into restricted multi-use (shared) lanes, and exclusive truck lanes.

Initiative 26: Restricted Multi-Use Lanes

These lanes can only be used by a restricted set of vehicle types. Lane usage can be allocated to different users using time windows: it can be shared by all users at specific time periods or assigned only to certain users all day. For example, Barcelona, Spain, has created seven multi-functional lanes in its commercial center. The implementation has been very successful, leading to an estimated reduction of 12–15% in overall travel time (SUGAR 2011), though it could confuse drivers (Ogden 1992).

Other restricted multi-use (shared) lanes are not regulated by time and allowing mixed traffic at all times. Examples are bus and truck lanes (no-car lanes), and lanes that allow buses, trucks, and high-occupancy vehicles. No-car lanes are used to segregate wider vehicles from standard-size vehicles, hence improving lane mobility and safety. Because these strategies reduce travel delays, they are used as incentives for the implementation of other strategies. For example, the city of Gothenburg (Göteborg), Sweden, allows clean freight vehicles to use public transport lanes, which promotes the use of environmentally friendly trucks; in the United Kingdom, Bristol allows freight vehicles that use its consolidation center to use the bus lane to foster the use of its consolidation center (START 2009). The lanes must be designed properly to permit vehicles to safely interact. A key decision concerns the truck types allowed in these lanes. If all truck types are allowed, too many vehicles may use the lane, increasing congestion. On the other hand, restricting the use of the lane to only select types of trucks can be confusing to drivers, and enforcement is more challenging.

Another type of multi-use lane allows trucks to temporarily park in bus lanes to unload; truck travel is not allowed in the lane. An example of this type of multi-use lane is the "Lincoln" delivery bays implemented in bus lanes in Paris (BESTUFS 2007). Table 27 summarizes essential characteristics of Initiative 26.

Initiative 27: Exclusive Truck Lanes (Dedicated Truck Lanes)

Exclusive truck lanes often afford a significant improvement in truck operations, with better reliability of delivery times and lower environmental impacts and risk of accidents. Exclusive truck lanes often are adjacent to general-purpose lanes, typically separated by barriers. Proposals for exclusive truck lanes in metropolitan areas are relatively rare; one of the few is a truck-only toll lane network in the Atlanta region (Georgia Department of Transportation 2007; U.S. Environmental Protection Agency 2013) and the multi-state I-70 Dedicated Truck Lane study that proved a business case for building dedicated truck lanes on I-70 across Ohio, Indiana, Illinois, and Missouri, including the Columbus, Indianapolis, and St. Louis metropolitan areas (Indiana Department of Transportation 2011).

The *Handbook for Planning Truck Facilities on Urban Highways* (Douglas 2004) provides a comprehensive report covering truck climbing lanes, truck lanes and truck-ways, truck-only ramps, interchange bypasses, and truck roadways and guide-ways. This report includes real-world experiences, lessons learned from previous implementation, typical issues planners face early in the planning process, and a framework and methods for evaluating the benefits and impacts of truck facilities. Examples from both U.S. and international countries are presented.

Dedicated truck lanes/corridors within cities or mega-regions should be developed with a pavement management system or plan to counter the negative effects of heavy freight vehicle use. This could include a pavement plan to deepen and harden pavements on local roads that were not designed for their current uses. Many cities have managed pavement by limiting heavy vehicle access on roads that cannot support the traffic. A good example, New York City currently bans 53-foot trucks within the city. Although this theoretically would help maintain pavement quality, these policies can result in additional smaller trucks being used to meet the demand. In New York, this has created challenges for John F. Kennedy (JFK) International Airport's ability to shift air freight to the ground mode. Table 28 summarizes essential characteristics of Initiative 27.

Initiative 28: Traffic Control

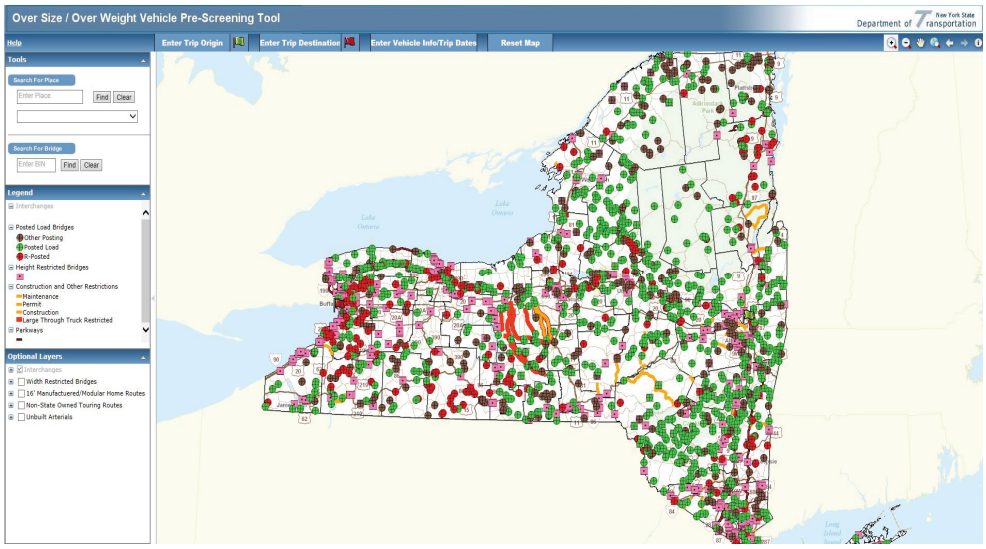
Traffic control initiatives monitor and control traffic with signs, equipment, and other devices. Signs that provide information about speed limits, access restrictions, loading zones, and other regulations have been used to assist truck drivers (BESTUFS 2007). The effectiveness of such signage can be enhanced with real-time traffic information and variable message signs. In Barcelona, variable message signs display real-time access regulations on multi-use lanes (SUGAR 2011). Signal coordination can also play a role, as most such systems are calibrated for passenger vehicles. In areas with heavy freight traffic, adjusting the signal timing and progression to account for the speed and reaction times of trucks could improve traffic flow (Ogden 1992). Table 29 summarizes essential characteristics of Initiative 28.

Table 21. Vehicle size and weight restrictions.

<table>
<tr><th colspan="2">Initiative 18: Vehicle Size and Weight Restrictions</th></tr>
<tr><td colspan="2">Description: Restrictions to prevent vehicles of a certain weight, size (length or width), or number of axles from using a particular road or area, often the result of concerns about the perceived congestion or traffic accidents caused by large trucks</td></tr>
<tr><td>Targeted mode: Large trucks</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Traffic management: vehicle size restrictions</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Vehicle size and weight restrictions require careful planning to consider freight movements and land use in the target area, involving extensive stakeholder engagement and coordination with other municipalities. A full analysis should be conducted of possible positive and negative outcomes for the entire system, not just the target area. Implementation and enforcement by local authorities may require control access stations, such as weighting stations. Other costs include the installation of sited traffic signs, and those associated with meeting local and other municipality requirements.</td></tr>
<tr><td>Advantages inside target area:
Enhance safety
Reduce congestion
Improve urban mobility
Reduce infrastructure damage
Reduce noise emissions</td><td>Disadvantages inside target area:
Difficult to enforce</td></tr>
<tr><td>Advantages outside target area:</td><td>Disadvantages outside target area:
High probability for unintended consequences:
Increase congestion
Increase operational costs
Increase environmental impacts
Decrease quality of life
Hamper economic activity
Weight and size regulations often conflict with those of other municipalities</td></tr>
<tr><td colspan="2">Typical example:
Implementation of commercial vehicle weight restrictions in California, United States (California Department of Transportation 2012)
Vehicle size and weight restriction in New York State (New York State Department of Transportation 2013) 

Source: Rensselaer Polytechnic Institute – CITE</td></tr>
</table>

Table 21. (Continued).



Source: New York State Department of Transportation 2013

Related alternatives: 1. Removal of Geometric Constraints at Intersections; 2. Truck Routes; 3. Daytime Delivery Restrictions; 4. Night time Delivery Bans; 5. Vertical Height Detection System; 6. Mode Shift Programs

References: Allen et al. 2000; Allen et al. 2003; Vleugel and Janic 2004; BESTUFS 2007; Dablanc 2007; Quak 2008; Holguín-Veras et al. 2011a; California Department of Transportation 2012; Qureshi et al. 2012; Wilbur Smith Associates 2012; Holguín-Veras et al. 2013b; New York State Department of Transportation 2013

Table 22. Truck routes.

<table>
<tr><th colspan="2">Initiative 19: Truck Routes</th></tr>
<tr><td colspan="2">Description: A special type of vehicle restriction that specifies the components of the transportation network that can be used by freight traffic; there can be multiple layers of truck routes. Truck routes are sometimes used to prevent freight vehicles from using unsuitable or sensitive routes.</td></tr>
<tr><td>Targeted mode: Large trucks</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Traffic management: truck traffic/route regulations</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Truck routes require careful planning to consider the freight movement, origins and destinations, characteristics of the road network, and land use patterns in a target area. The planning process should involve extensive stakeholder engagement, and assess both positive and negative impacts in the target and contiguous areas. The costs are mainly those associated with the installation of guide signs, and efforts to enforce the truck routes ordinance. These restrictions should be developed with a pavement management plan in order to negate any negative externalities of increased wear on these designated corridors.</td></tr>
<tr><td>Advantages:
Enhance safety
Ensure hazardous materials are transported far from population centers
Provide guidance to transport over-dimensional cargo
Discourage unnecessary truck movement in sensitive areas
Reduce infrastructure damage
Inform carriers about geometric and structural conditions of the network
Enhance livability
Improve State of Good Repair on previously used corridors</td><td>Disadvantages:
High probability for unintended consequences:
Increase operational costs
Increase vehicle-miles-traveled
Increase congestion
Challenging to ensure accessibility
Require proper communication, education, and enforcement by authorities
Require high coordination among jurisdictions</td></tr>
<tr><td colspan="2">Examples:
Advisory truck routes: legal advisory route system, California, United States (California Department of Transportation 2012)
Statutory truck routes: truck-route system, which categorizes truck routes into three classes with different constraints on truck weights and dimensions, Chicago, Illinois, United States (Illinois Department of Transportation 2014)
Truck routes have been implemented in Italian cities; Bremen, Germany; Athens, Greece; Crete, Greece; Palma de Mallorca, Spain; Usti, Czech Republic; Vratsa, Bulgaria; New York City, New York, USA (New York City DOT 2003; BESTUFS 2007) 

Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Ring Roads; 2. Acceleration/Deceleration Lanes; 3. Removal of Geometric Constraints at Intersections; 4. Vehicle Size and Weight Restrictions; 5. Real-Time Information System; 6. Relocation of Large Traffic Generators (LTGs)</td></tr>
<tr><td colspan="2">References: New York City DOT 2003; BESTUFS 2007; Quak 2008; Holguín-Veras et al. 2011a; Suffolk County Council 2011; California Department of Transportation 2012</td></tr>
</table>

Table 23. Engine-related restrictions.

Initiative 20: Engine-Related Restrictions	
Description: A special case of vehicle restriction granting access to a target area only for vehicles that meet a certain level of environmental standard. These strategies try to reduce the environmental externalities of freight traffic by fostering the use of environmentally friendly technologies.	
Targeted mode: All traffic	**Geographic scope:** Area
Type of initiative: Traffic management: environmental/vehicle restrictions	**Primary objective:** Reduce pollution
Expected costs and level of effort to implement: Engine-related restrictions require careful planning that should include stakeholder engagement, a full assessment of possible outcomes, and an analysis of the initiative's objectives. For efficient implementation, additional strategies may be required (e.g., dedicated loading/unloading zones, UCCs).	
Advantages: • Environmental sustainability • When combined with eco-loading zones: – May increase efficiency – May decrease operational costs	**Disadvantages:** • High probability for unintended consequences: – Increase operational costs • Require carriers to upgrade their fleets • Hard to enforce
Examples: • European cities: Copenhagen, Denmark; Amsterdam, The Netherlands; Berlin, Germany; and London, England (Quak 2008; PARFUM 2009; LEEZEN 2010) • Combined Engine Relate Restrictions with Eco-Loading Zones: Bremen, Germany (LEEZEN 2010) • Clean Truck Program Ports of Los Angeles/Long Beach, California, United States (Port of Los Angeles 2013a)  Source: Rensselaer Polytechnic Institute – CITE	
Related alternatives: 1. Emission Standards; 2. Low Noise Delivery Programs/Regulations; 3. Low Emission Zones 4. Operational Incentive for Electric/Low Emission Vehicles; 5. Anti-Idling Programs	
References: Quak 2008; PARFUM 2009; LEEZEN 2010; Port of Los Angeles 2013a; Port of Los Angeles 2013b; American Transportation Research Institute 2014	

Table 24. Low emission zones.

<table>
<tr><th colspan="2">Initiative 21: Low Emission Zones</th></tr>
<tr><td colspan="2">Description: Low emission zones (LEZs) are environmentally sensitive areas where vehicle access (both passenger and freight) is constrained. LEZs may ban all vehicular traffic, or just vehicles that do not meet a minimum environmental standard (engine-related restrictions)</td></tr>
<tr><td>Targeted mode: All traffic/large trucks</td><td>Geographic scope: Area</td></tr>
<tr><td>Type of initiative: Traffic management: environmental restrictions</td><td>Primary objective: Environmental sustainability</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: The planning process should involve extensive stakeholder engagement to analyze impacts both in and out of the impacted area, and should be done in accordance with environmental legislation. The main costs may be related to enforcement technologies, such as license plate recognition.</td></tr>
<tr><td>Advantages:
• Environmental sustainability
– Improve air quality
– Reduce noise
• Society support
• Reduce congestion inside the target area</td><td>Disadvantages:
• High probability for unintended consequences:
– Increase operational costs
– Increase congestion
– Hamper economic activity</td></tr>
<tr><td colspan="2">Examples:
• European cities: Stockholm, Sweden; Göteborg, Sweden; Malmo, Sweden; Lund, Sweden; Rome, Italy; Milan, Italy; Berlin, Germany; Amsterdam, The Netherlands; London, England; Madrid, Spain; Paris, France; Copenhagen, Denmark; and Budapest, Hungary (Quak 2008; TURBLOG 2009; C-LIEGE 2010; LEEZEN 2010; Transport for London 2012)
• Oregon, United States (Oregon Department of Transportation 2009)
 

Source: Oregon Department of Transportation 2009</td></tr>
<tr><td colspan="2">Related alternatives: 1. Emission Standards; 2. Engine-Related Restrictions; 3. Road Pricing; 4. Operational Incentives for Electric/Low Emission Vehicles; 5. Anti-Idling Programs</td></tr>
<tr><td colspan="2">References: Quak 2008; Oregon Department of Transportation 2009; TURBLOG 2009; C-LIEGE 2010; LEEZEN 2010; Transport for London 2012</td></tr>
</table>

Table 25. Load factor restrictions.

<table>
<tr><th colspan="2">Initiative 22: Load Factor Restrictions</th></tr>
<tr><td colspan="2">Description: To reduce the number of freight trips entering a target area, these strategies require a minimum load factor (percent of truck capacity being used) per truck</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Area</td></tr>
<tr><td>Type of initiative: Traffic management: vehicle restrictions</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: These restrictions require careful planning, stakeholder engagement, and a complete understanding of the markets, supply chain practices, and industries. A full assessment of possible outcomes is required, as is an analysis of the initiative's objectives. These types of restrictions are very difficult to enforce, as they require physical inspection of freight vehicles.</td></tr>
<tr><td>Advantages:
Induce cargo consolidation
Increase efficiency
Environmental sustainability
Reduce infrastructure damage
Improve accessibility
Enhance safety
Enhance livability</td><td>Disadvantages:
May not be reasonable; load factors are the result of market conditions, not logistic decisions
Target area may be at the end of delivery route, where the load factor is expected to be low
High probability of unintended consequences
Increase congestion (more smaller vehicles per large truck deterred)
Increase operational costs
Increase vehicles-miles traveled outside target area
Increase infrastructure damage
Very hard to enforce: require physical inspection of the vehicles
Increase congestion outside target area
Resource consuming</td></tr>
<tr><td colspan="2">Examples:
The cases of Ravenna, Italy (START 2009); Göteborg, Sweden, and Copenhagen, Denmark (BESTUFS 2007) 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Daytime Delivery Restrictions; 2. Daytime Delivery Bans; 3. Road Pricing; 4. Pick-ups/Deliveries to Alternate Locations</td></tr>
<tr><td colspan="2">References: BESTUFS 2007; START 2009; Holguín-Veras et al. 2011a</td></tr>
</table>

Table 26. Time access restrictions.

<table>
<tr><th colspan="2">Initiatives 23–25: Time Access Restrictions/Delivery Time Windows</th></tr>
<tr><td colspan="2">Description: Strategies that restrict the times at which freight activity can take place, including delivery time windows, daytime delivery bans, or nighttime delivery bans</td></tr>
<tr><td>Targeted mode: All traffic/large trucks</td><td>Geographic scope: Area</td></tr>
<tr><td>Type of initiative: Traffic management: access time restrictions</td><td>Primary objective: Reduce congestion/improve environmental sustainability</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Time access restrictions require planning that considers the characteristics of the area's freight movement, industries, and land use, extensive stakeholder engagement, and an assessment of both positive and negative impacts to all economic agents involved. The costs are associated with the installation of traffic signs, and efforts associated with meeting the requirements of local businesses.</td></tr>
<tr><td>Advantages (daytime delivery restrictions):
Improve parking availability during ban interval
Improve service time
Improve reliability
Decrease operational costs
Environmental sustainability
Enhance safety
Decrease congestion</td><td>Disadvantages (daytime delivery restrictions):
High probability for unintended consequences:
Increase idling
Increase vehicle-miles traveled
Increase congestion outside target area
Increase operational costs
Require high coordination among jurisdictions</td></tr>
<tr><td>Advantages (daytime delivery bans):
Reduce congestion
Decrease operational costs
Reduce congestion during daytime
Environmental sustainability
Enhance livability</td><td>Disadvantages (daytime delivery bans):
High probability for unintended consequences:
Increase receivers' costs
Increase congestion in the early morning or at end of working day
Increase noise impact
May require incentives to offset additional costs</td></tr>
<tr><td>Advantages (nighttime delivery bans):
Environmental sustainability: reduce noise emissions</td><td>Disadvantages (nighttime delivery bans):
Increase congestion during daytime
Increase operational costs
Reduce operational capacity</td></tr>
<tr><td colspan="2">Examples:
Time windows in Lucca, Italy; Toulouse, France; Paris, France; London, England (City Ports 2005; SUGAR 2011)
Time windows and loading restrictions in Göteborg, Sweden (START 2009) 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Staggered Work Hours Program; 2. Load Factor Restrictions; 3. Voluntary Off-Hour Delivery Program; 4. Vehicle Size and Weight Restrictions; 5. Urban Consolidation Centers; 6. Time-Slotting of Pick-Ups and Deliveries at Large Traffic Generators</td></tr>
<tr><td colspan="2">References: Allen et al. 2003; City Ports 2005; Department for Transport 2006; BESTUFS 2007; Quak and de Koster 2007; Quak 2008; van Rooijen et al. 2008; Quak and de Koster 2009; START 2009; C-LIEGE 2010; Holguín-Veras et al. 2011a; SUGAR 2011; Holguín-Veras et al. 2012c</td></tr>
</table>

Table 27. Restricted multi-use lanes.

<table>
<tr><th colspan="2">Initiative 26: Restricted Multi-Use Lanes</th></tr>
<tr><td colspan="2">Description: These initiatives promote the use of available road capacity by allocating restricted lane right-of-way to trucks, buses, and occasionally high-occupancy vehicles. The lane usage can be allocated to different users using time windows, shared among designated users all day, or restricted to special use for certain users. Restrictions can be by vehicle type, or they can allow mixed traffic during the restriction interval.</td></tr>
<tr><td>Targeted mode: All traffic/large trucks</td><td>Geographic scope: Area</td></tr>
<tr><td>Type of initiative: Traffic management: lane management</td><td>Primary objective: Optimize road capacity</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Lane management strategies and restrictions to multi-use lanes require thorough planning to consider the characteristics of the network and the needs of different users. Planning should involve extensive stakeholder engagement, and weigh both the positive and negative impacts to all agents that are part of the system. The costs are mainly associated with the installation of variable message signs or changeable message signs, and enforcement resources.</td></tr>
<tr><td>Advantages:
Reduce congestion
Enhance safety
Increase efficiency
Enhance livability
Can be used as incentive to foster other strategies</td><td>Disadvantages:
May confuse drivers
May conflict with other traffic users
May not be adequate for sensitive locations
Hard to enforce
Lane geometry may not be adequate for large trucks</td></tr>
<tr><td colspan="2">Examples:
Multifunctional lanes in its commercial center: Barcelona, Spain (City Ports 2005)
Clean vehicles are allowed to use public transport lanes: Göteborg, Sweden (START 2009)
Consolidation vehicles are allowed to use bus lanes: Bristol, England (START 2009)
Truck lane restricted to right lane: New York City, New York, United States (The City of New York 2012), North Carolina, United States (Federal Highway Administration 2011; North Carolina Department of Transportation 2013)
Ban on through-trucks on Interstate inside the perimeter freeway: Georgia, United States (Georgia Dept. of Public Safety 2010) 

Source: Federal Highway Administration 2011</td></tr>
<tr><td colspan="2">Related alternatives: 1. Acceleration/Deceleration Lanes; 2. Traffic Control; 3. Dynamic Routing</td></tr>
<tr><td colspan="2">References: Ogden 1992; City Ports 2005; BESTUFS 2007; START 2009; Georgia Department of Public Safety 2010; Federal Highway Administration 2011; SUGAR 2011; The City of New York 2012; North Carolina Department of Transportation 2013</td></tr>
</table>

Table 28. Exclusive truck lanes.

<table>
<tr><th colspan="2">Initiative 27: Exclusive Truck Lanes</th></tr>
<tr><td colspan="2">Description: Allocation of restricted lane right-of-way exclusively to trucks</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Corridor</td></tr>
<tr><td>Type of initiative: Traffic management: lane management</td><td>Primary objective: Decrease congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Exclusive truck lanes require careful planning, extensive stakeholder engagement (both private and public), and an assessment of the potential impacts to all agents of the freight and other relevant economic systems. This initiative requires a large capital investment.</td></tr>
<tr><td>Advantages:
For interstate areas
Increase efficiency
Improve reliability
Enhance safety
Environmental sustainability
Revenue stream using tolls can overcome investment and operating costs</td><td>Disadvantages:
Require high capital investments
Reduce road capacity for other vehicle types
May not be adequate for metropolitan locations</td></tr>
<tr><td colspan="2">Examples:
Georgia DOT Statewide Truck Lanes Needs Identification Study
Georgia DOT State Route 6 “Truck Friendly Lanes”
Georgia Managed Lane System Plan
I-70 Truck Lane Feasibility Study 

Source: Federal Highway Administration 2011</td></tr>
<tr><td colspan="2">Related alternatives: 1. Ring Roads; 2. Acceleration/Deceleration Lanes; 3. Traffic Control</td></tr>
<tr><td colspan="2">References: Texas Transportation Institute 2002; Holguín-Veras et al. 2003; Reich et al. 2003; Meyer 2006; Georgia Department of Transportation 2008; Burke et al. 2011; Federal Highway Administration 2011; Georgia Department of Transportation 2011c; U.S. DOT 2012a; Georgia Department of Transportation 2013</td></tr>
</table>

Table 29. Traffic control.

Initiative 28: Traffic Control	
Description: Strategies to monitor and control traffic with signs, equipment, and devices. Among the approaches used to assist truck drivers are signs that provide information about speed limit, access restrictions, loading zones, and other regulations. Another type of initiative focuses on the coordination of traffic signals.	
Targeted mode: All traffic	**Geographic scope:** Corridor
Type of initiative: Traffic management: traffic control	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: Traffic control strategies should consider road users, network characteristics, and traffic patterns. The planning should involve stakeholder engagement to assess the impacts to all relevant economic agents. This initiative requires investments in variable message signs (VMS), and the collection, analysis, and dissemination of real-life traffic information.	

Advantages:
• Decrease congestion
• Enhance safety
• Increase efficiency
• Coordination of traffic signals
  – Improve system performance
  – Reduce number of stops
  – Environmental sustainability
  – Reduce travel times
	Disadvantages:
	• Traffic signal coordination is often calibrated for passenger vehicles, not truck traffic
	• May produce adverse effects on other modes

Examples: • Variable Message Signs (VMS) are used in Barcelona, Spain to inform about access regulations (City Ports 2005, 23) • VMS are used in Oregon, USA for truck advisory (Oregon Department of Transportation 2013)  Source: Oregon Department of Transportation 2013	
Related alternatives: 1. Restricted Multi-Use Lanes; 2. Exclusive Truck Lanes (Dedicated Truck Lanes); 3. Dynamic Routing	
References: Ogden 1992; BESTUFS 2007; SUGAR 2011	

Table 30 summarizes the planning and design considerations for the 11 initiatives listed under traffic management.

Table 30. Planning and design considerations for traffic management initiatives.

		TRAFFIC MANAGEMENT										
		Access Restrictions					Time Access Restrictions			Traffic Control and Lane Management		
	Questions	Vehicle size and weight restrictions	Truck routes	Low emission zones	Engine-related restrictions	Load factor restrictions	Daytime delivery restrictions	Daytime delivery bans	Nighttime delivery bans	Restricted multi-use lanes	Exclusive truck lanes	Traffic control
Planning considerations												
1	Is there enough right-of-way available to complete the project?											
2	Will other projects be required to fully complete the project?		✓									
3	How will this project be funded?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Where is it located?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	What is the desired size/capacity/connectivity?		✓									
Operational considerations												
8	Will the use of policy/project be mandatory or voluntary?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	Is there any incentive for participation (or penalties for not)?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	What is the level of incentives?											
11	What is the level of price(s)/fine(s)?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	How will the policy/project be enforced?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13	What is the target group?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?			✓			✓					
15	Which agency will lead?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stakeholder engagement												
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies												
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Pricing, Incentives, and Taxation

These strategies use monetary signals to achieve such pre-defined public goals as revenue generation, fostering the use of emerging technologies, or demand management, among many others.

Pricing

Initiative 29: Road Pricing

Freight road pricing has been recommended to reduce freight traffic by promoting a better utilization of transportation capacity (Ogden 1992; City Ports 2005; BESTUFS 2007; Allen and Browne 2010; PIARC 2011). In theory, the increase in transportation costs produced by the toll would lead to a reduction in truck traffic. The empirical research conducted indicates, however, that in the case of cordon time-of-day pricing in competitive markets, this is not the case. Carriers cannot unilaterally change delivery schedules and have limited power to transfer the toll costs on to their customers. For example, following the 2001 toll increases enacted by the PANYNJ Time-of-Day Pricing Initiative, only 9% of the carriers were able to pass the toll costs on to the receivers (Holguín-Veras et al. 2006b). If no price signal reaches the receivers, cordon time-of-day pricing will not impact their behavior. In both the PANYNJ case and in London, England, cordon time-of-day pricing had no noticeable impact on peak-hour truck traffic. This reflects the highly competitive market conditions produced by truck over-supply. As a result, carriers tend to absorb the toll costs and to avoid any operational changes that could upset their customers and lead to loss of business.

Although cordon time-of-day tolls do not change freight demand—because the toll is a fixed cost that most carriers find difficult to pass on—time-distance-pricing tolls could be passed on to the customers as a variable cost that enters into their distance-based contracts (Holguín-Veras 2011). For time-distance-pricing tolls to change receiver behavior, however, the tolls have to be very high, which may not be politically acceptable.

The current thinking is that cordon time-of-day tolls road pricing is of limited effectiveness for freight demand management, though it could play a key role in revenue generation. Table 31 summarizes essential characteristics of Initiative 29.

Initiative 30: Parking Pricing

Parking pricing is intertwined with the allocation of curb space among all potential users. A proper amount of spaces, and the locations of the spaces allocated to freight vehicles are essential to program success. The main issue is that often cities fail to allocate enough parking for freight activity, which results in significant parking violations and fines (Jaller et al. 2012). In New York City, for example, most carriers spend between $500–$1,000/month per truck on parking fines (Holguín-Veras et al. 2007; Holguín-Veras et al. 2008b). Given a fair and proper allocation of curb space, parking pricing can play a key role in a sustainability initiative, protect historical areas, and improve traffic conditions (PIARC 2011) by increasing turnover, reducing parking dwell times, and generating revenues for infrastructure and mobility improvements (City Ports 2005).

In Copenhagen, Denmark, differential parking charges were set in the medieval part of the city to reduce pollution and foster the use of environmentally friendly vehicles. Similarly, the New York City DOT's Commercial Parking/Congestion Pricing program uses parking prices to foster turnover and a better use of curb space. Table 32 summarizes essential characteristics of Initiative 30.

Incentives

These programs seek to foster sustainable practices by incentivizing one or more participants in the supply chain, using both monetary and non-monetary incentives. In this context, combining the power of incentives and regulations is likely to have a meaningful impact on the behavior of freight agents. The public sector can provide incentives to foster adoption of environmentally friendly vehicles or engine replacement, while charging penalties to carriers using inefficient vehicles, and regulating minimum environmental standards.

Incentive programs can be enhanced by promoting sustainable practices among stakeholders. Citizens and end-users/consumers should be involved, as they have the power to reward best practices with their purchases, potentially influencing behavior throughout the supply chain. The "Carrotmob" concept provides an interesting model of a program that could play a transformative role, by using the power of consumers to foster change in the urban freight system (Diziain 2013).

Initiative 31: Recognition Programs

Recognition programs use the power of public acknowledgment of outstanding achievements to indirectly encourage others to follow suit. Unlike certification programs, however, recognition programs do not necessarily assist other companies with the means—advice, plans, or benchmarking systems—to achieve the level of performance necessary to receive recognition (Noise Abatement Society 2013). Not much literature exists on the effectiveness of public recognition programs or how to structure them. One of the very few research efforts is related to the Off-Hour Delivery (OHD) project in New York City (Holguín Veras et al. 2014), where econometric models have shown that public recognition does increase the likelihood of participation in unassisted OHD. Recognition of good behavior fosters good behavior. Moreover, such programs tend to improve relations between the private and public sectors, which can pave the way for other more challenging implementations and cooperation. Table 33 summarizes essential characteristics of Initiative 31.

Initiative 32: Certification Programs

These programs recognize participants that achieve a minimum level of performance and follow a clear path to certification. These schemes can be structured in various ways, depending on the metrics and attributes considered, and who is participating and/or included in the system. Comprehensive programs aim to address the majority, if not all, aspects of a company's operations (Transport for London 2013b), such as driver skills and driver management, vehicle maintenance, transport operations, and performance management. In most cases, these are voluntary programs that set specifications for reaching different achievement levels such as bronze, silver, or gold. Area-specific recognition programs often concentrate on environmental impacts. Other focus areas include managing driver skills, safety, and the use of information technology to enhance operations (Freight Transport Association 2013; U.S. Environmental Protection Agency 2013). Table 33 also summarizes essential characteristics of Initiative 32.

Initiative 33: Operational Incentives for Electric/Low Emission Vehicles

This group of strategies provides operational incentives to carriers, such as preferential access to restricted areas, to foster use of electric/low emission vehicles (BESTUFS 2007). For example, urban consolidation centers (UCCs) in Norway use "clean vehicles" for last-mile deliveries to take advantage of priority lane policies. In Germany, the city of Bremen provides preferential access to choice parking places to freight vehicles that meet the strictest environmental standards (PARFUM 2009). The allocation of a scarce public good, like parking, in such a way could foster

sustainability of urban freight operations. In New York City, Green Loading Zones are considered a solution to incentivize the adoption of electric vehicles, as they provide curb space exclusively to electric trucks (New York State Department of Transportation 2014). Table 33 also summarizes essential characteristics of Initiative 33.

Taxation

Initiative 34: Taxation

Taxation is routinely used to raise revenues and foster behavior changes that will lead to public benefits. Examples include tax incentives for consumers who buy electric vehicles or for companies that use energy efficient equipment (City Ports 2005; U.S. Environmental Protection Agency 2013). For the most part, because of compliance verification considerations, tax incentives or penalties are usually tied to purchases that are easy to verify. A central principle of these efforts is to ensure that the tax signals reach the key decision maker. In this regard, the important role of the receiver has often been overlooked. If properly designed, a mix of incentives and penalties could be more effective than solely punitive policies, and would be more likely to be accepted by the public and business community.

Tax-incentive programs geared to carriers could accelerate the adoption of electric/low emission vehicles, as has been seen in the Netherlands, the United Kingdom, and France (BESTUFS 2007). The Hong Kong Environmental Protection Department (2011) has a number of incentive programs: a $3.2 billion program to help operators replace non-compliant vehicles with new ones that comply with the latest emission standards; tax incentives by which carriers can deduct capital expenditures on environmental-friendly vehicles; and the "Pilot Green Transport Fund" to encourage freight carrier operators to test out green and low-carbon transport technologies. In the United States, some federal and state incentives exist for electric trucks (e.g., Plug In America 2013), including the Environmental Protection Agency's SmartWay finance program that assists small carriers by providing access to low-cost financing for SmartWay-verified technologies and clean trucks (U.S. Environmental Protection Agency 2013). Table 34 summarizes essential characteristics of Initiative 34.

Table 31. Road pricing/incentives.

<table>
<tr><th colspan="2">Initiative 29: Road Pricing/Incentives</th></tr>
<tr><td colspan="2">Description: A demand management tool in urban areas to reduce traffic, promote a better use of transportation capacity, and reduce environmental impacts. Pricing revenues often are used to finance the construction and maintenance costs of urban infrastructure, and often are implemented using (electronic) cordon tolls located at the fringe of the cities in tunnels and/or bridges.</td></tr>
<tr><td>Targeted mode: All traffic, large trucks</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Pricing, incentives, and taxation: road pricing/incentives</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: The planning process should involve thorough stakeholder engagement to analyze impacts both in and outside the impacted area. The differences between truck types should be considered to avoid overpricing large trucks. Pricing strategies are effective when implemented as part of a group of strategies (e.g., to finance freight-related programs, to foster the use of environmentally friendly vehicles). The costs are mainly those associated with the construction and operation of toll facilities.</td></tr>
<tr><td>Advantages:
Revenue generation
If implemented as part of a broader program involving incentives for receivers:
Reduce congestion
Environmental sustainability
Increase efficiency
Improve reliability</td><td>Disadvantages:
Limited effectiveness as a freight demand management tool: most truckers have to travel when customers demand it
Politically unfeasible: effective time-distance pricing would be extremely high
Difficult to define the optimal charge
Probability for unintended consequences:
Operators to relocate their economic activities
Decrease operational costs
Increase vehicle-miles-traveled (use of smaller vehicles)</td></tr>
<tr><td colspan="2">Examples:
London, England, congestion charging
New York City, New York, United States
Ports of Los Angeles and Long Beach, California, United States
SR 91 express lanes in Orange County, California, United States
Stockholm, Sweden, congestion charging 
Source: http://ops.fhwa.dot.gov/publications/fhwahop08039/images/ch5_1.jpg
 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">Related alternatives: 1. Low Emission Zones; 2. Load Factor Restrictions; 3. Taxation</td></tr>
<tr><td colspan="2">References: Ogden 1992; City Ports 2005; Holguín-Veras 2006; BESTUFS 2007; PierPASS 2007; Holguín-Veras 2008; Allen and Browne 2010; C-LIEGE 2010; Holguín-Veras 2011; PIARC 2011</td></tr>
</table>

Table 32. Parking pricing.

<table>
<tr><th colspan="2">Initiative 30: Parking Pricing</th></tr>
<tr><td colspan="2">Description: Charging for the use of curb space; some based on fixed rates, while others involve variable or differentiated pricing schemes.</td></tr>
<tr><td>Targeted mode: All traffic, large traffic</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Pricing, incentives, and taxation: parking pricing</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Stakeholder engagement should play a part in the planning process, to analyze potential impacts in and out of the target area. To avoid overpricing large trucks, the differences between truck types should be considered. These pricing strategies are effective when implemented as part of a group of strategies (e.g., to finance freight-related programs, to foster the use of environmental-friendly vehicles).</td></tr>
<tr><td>Advantages:
Revenue generation: finance construction and maintenance of parking facilities
Enhance livability: protect historical areas
Reduce parking dwell times
If implemented as part of a broader parking program:
Reduce congestion
Environmental sustainability
Increase efficiency
Improve reliability</td><td>Disadvantages:
Limited effectiveness as a freight demand management tool
Difficult to define the optimal charge
Increase operational costs: operational constraints often result in parking violations
May not induce a shift to alternative modes: lack of alternative modes in the United States
Require large curb space to be allocated for freight vehicles
Potential for unintended consequences:
Increase congestion</td></tr>
<tr><td colspan="2">Examples:
Copenhagen, Denmark: differential parking
Park Smart Program in New York City, New York, United States 

Source: http://www.nyc.gov/html/dot/images/motorist/parksmart-decal.jpg</td></tr>
<tr><td colspan="2">Related alternatives: 1. Freight Parking and Loading Zones; 2. Loading and Parking Restrictions; 3. Vehicle Parking Reservation Systems</td></tr>
<tr><td colspan="2">References: City Ports 2005; Cambridge Systematics 2007; Holguín-Veras et al. 2007; Holguín-Veras et al. 2008b; PIARC 2011; Jaller et al. 2012</td></tr>
</table>

Table 33. Certification/recognition programs/incentives.

<table>
<tr><th colspan="2">Initiatives 31–33: Certification/Recognition Programs/Incentives</th></tr>
<tr><td colspan="2">Description: Platforms implemented to encourage and reward sustainable practices throughout the supply chain. There are three main types: comprehensive, area-specific, and award programs.</td></tr>
<tr><td>Targeted modes: All traffic, waterways, rail, air</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Pricing, incentives, and taxation: certification/recognition programs</td><td>Primary objective: Environmental sustainability</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: All agents in the logistics chain should be included in the program, which may necessitate extensive outreach. These programs are often the product of partnerships between public agencies and freight transportation associations. Carriers generally have to pay to enter the certification program.</td></tr>
<tr><td>Advantages:
Environmental sustainability
Enhance economic competitiveness
Reduce congestion
Foster the use of alternative vehicles
Enhance safety</td><td>Disadvantages:
Require exceptional dissemination
Require training programs
Require high coordination among multiple jurisdictions and stakeholders
Appropriate for carriers serving large generators</td></tr>
<tr><td colspan="2">Examples:
The Noise Abatement Society John Connell Award: United Kingdom (Noise Abatement Society 2013)
Fleet Operator Recognition Scheme (FORS): England (Transport for London 2013b)
The U.S. Environmental Protection Agency SmartWay program: United States (U.S. Environmental Protection Agency 2013) 

Source: http://www.epa.gov/cleanschoolbus/sw-overview.htm</td></tr>
<tr><td colspan="2">Related alternatives: 1. Receiver-Led Delivery Consolidation Program; 2. Engine-Related Restrictions; 3. Operational Incentives for Electric/Low Emission Vehicles; 4.Driver Training Programs; 5.Voluntary Off-Hour Delivery Program; 6. Emission Standards; 7. Low Noise Delivery Programs/Regulations; 8. Low Emission Zones; 9. Recognition Programs; 10. Certification Programs</td></tr>
<tr><td colspan="2">References: Care4Air 2013; Cargonews Asia 2013; Foundation for Promoting Personal Mobility and Ecological Transportation 2013; Freight Transport Association 2013; Noise Abatement Society 2013; Transport for London 2013b; U.S. Environmental Protection Agency 2013</td></tr>
</table>

Table 34. Taxation.

Initiative 34: Taxation	
Description: Initiatives used to raise revenues and foster behavior changes that will lead to public benefits	
Targeted mode: All traffic, large trucks	**Geographic scope:** Nation, city
Type of initiative: Pricing, incentives, and taxation: taxation	**Primary objective:** Generate revenue
Expected costs and level of effort to implement: The planning process should involve extensive stakeholder engagement to analyze potential impacts. Care should be taken to ensure that the objectives of the taxation policy are clear, and that the type of taxation chosen will reach the intended decision maker. As with other types of taxation, this initiative may encounter political opposition.	
Advantages: • Revenue generation • Designed as a mix of incentives and penalties: – May be more effective than punitive policies – May gain society support	**Disadvantages:** • Low probability for unintended consequences: – Tax signals may not reach key decision makers – May induce undesirable behavioral changes • Difficult to define the optimal charge
Examples: • The U.S. Environmental Protection Agency SmartWay program (U.S. Environmental Protection Agency 2013) • Stockholm, Sweden electric vehicle program (Vittoriano et al. 2011) • Hong Kong Environmental Protection Department (Hong Kong Environmental Protection Department 2011)  Source: Nagurney et al. 2002 CleanTRUCK Source: Vittoriano et al. 2011	
Related alternatives: 1. Emission Standards; 2. Road Pricing; 3. Relocation of Large Traffic Generators (LTGs)	
References: City Ports 2005; BESTUFS 2007; Hong Kong Environmental Protection Department 2011; Vittoriano et al. 2011; U.S. Environmental Protection Agency 2013	

Table 35 summarizes the planning and design considerations for the six initiatives listed under pricing, incentives, and taxation.

Table 35. Planning and design considerations for pricing, incentives, and taxation initiatives.

		PRICING, INCENTIVES, AND TAXATION					
		Pricing		Incentives			
	Questions	Road pricing	Parking pricing	Recognition programs	Certification programs	Operational incentives for EV/LEV	Taxation
Planning considerations							
1	Is there enough right-of-way available to complete the project?	✓					
2	Will other projects be required to fully complete the project?	✓	✓				
3	How will this project be funded?	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓	✓	✓	✓	✓
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓
6	Where is it located?	✓	✓	✓	✓	✓	✓
7	What is the desired size/capacity/connectivity?	✓					
Operational considerations							
8	Will the use of policy/project be mandatory or voluntary?	✓	✓	✓	✓	✓	✓
9	Is there any incentive for participation (or penalties for not)?	✓	✓	✓	✓	✓	✓
10	What is the level of incentives?			✓	✓	✓	
11	What is the level of price(s)/fine(s)?	✓	✓				✓
12	How will the policy/project be enforced?	✓	✓	✓	✓	✓	✓
13	What is the target group?	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?			✓	✓	✓	
15	Which agency will lead?	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓	✓	✓	✓	✓
Stakeholder engagement							
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies							
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓

Logistical Management

The main objective of these strategies is to alter the way deliveries are undertaken to reduce the negative externalities produced. However, these strategies can also improve the efficiency of the last-mile delivery journey through appropriate fuel and driver management, reducing empty or low-volume journeys, and consolidation of delivery trips.

Cargo Consolidation

Initiative 35: Urban Consolidation Centers

UCCs are facilities that seek to reduce freight traffic in a target area by consolidating cargo at a terminal. In theory, carriers that might otherwise make separate trips to the target area with relatively low load factors will instead transfer their loads to a neutral carrier that consolidates the cargo and conducts the last leg of the deliveries. The carriers pay the UCC operator a fee per delivery made, and save money by not having to make the final leg of the delivery themselves (Holguín-Veras et al. 2008a).

During the 1940s, the PANYNJ implemented what would be the first modern UCCs (located in Manhattan in New York City and in nearby Newark, New Jersey), though these operations closed down in the 1950s because of union opposition and a lack of carrier participation (Doig 2001; Doig 2010). More recently, UCCs have been tried in a number of European and Japanese cities in response to government incentives (Taniguchi and Nemoto 2003; Browne et al. 2005; Panero and Shin 2011). Most UCCs are small operations that focus on a section of a city or on individual buildings, such as the Shinjuku UCC in Japan. UCCs can reduce freight traffic, and thus congestion and pollution levels. Nilsson describes the experience of the Swedish Convention Center in 2008, when deliveries destined there were rerouted instead to an outside terminal to be consolidated (Nilsson 2009). The total number of truck trips arriving at the Convention Center dropped from 400 per week to 20 per week.

Significant benefits have been estimated: a reduction in the total distance traveled, and thus in congestion; improvements in load factors; reductions in greenhouse gas emissions and in conflicts between freight vehicles and other users leading to greater safety; and in curbside occupation time (Tri-State Transportation Commission 1970; Transport & Travel Research Ltd. and Transport Research Laboratory 2010; Quak and Tavasszy 2011). The potential benefits of UCCs have led many to recommend them (City Ports 2005; BESTUFS 2007; START 2009; SUGAR 2011). It appears that sizable portions of the carrier industry would consider the use of UCCs. A survey conducted in the New York City area found that 16–18% of carriers would be highly/extremely likely to participate in such a consolidation program (Holguín-Veras et al. 2008a), while a separate survey in California reported an 18% likelihood of participation (Regan and Golob 2005).

UCCs have a mixed success record, however, because they have struggled to attract a sufficient number of users. Some obstacles UCCs face include: competitive pressures that push suppliers away from participation; overall costs that are frequently higher than direct deliveries, once the UCC's space costs are included (Kawamura and Lu 2008); and the difficulty finding enough suitable space for a UCC in urban areas, where property is at a premium and often unavailable (Browne et al. 2005; Transport & Travel Research Ltd. and Transport Research Laboratory 2010; van Rooijen and Quak 2010; Quak and Tavasszy 2011; Holguín-Veras et al. 2012b). As a consequence, public subsidies often are necessary, and if the subsidies do not materialize, most UCC operations come to an end. However, some analysts believe that UCCs could be financially viable if they attract a meaningful amount of cargo (Transport & Travel Research Ltd. and Transport Research Laboratory 2010).

Despite the challenges, a number of UCCs are in operation (Panero and Shin 2011). The consensus position among several researchers (Browne et al. 2005; Allen et al. 2012) is that UCCs are more likely to be successful when:

- Strong public-sector support exists via a regulatory mandate for use of the UCC
- Significant congestion/pollution problems are recognized within the area
- Complementary policies are in place, such as penalties for carriers that do not participate

In major metropolitan areas it may be difficult for some shippers and carriers to acquire enough real estate to properly conduct their operations. This might be particularly true if a company has grown and needs to expand. This problem is even more apparent for large distribution centers that require large plots of land. In some cases, businesses are forced to operate separate locations nearby, which can lead to congestion because trucks are forced to travel between the locations, contributing additional expenses to the company—and, in turn, to the customer.

A promising concept was pioneered by the Binnenstadservice, a network of UCCs in The Netherlands (van Rooijen and Quak 2010). The promoters of this project realized early on how critical the support of the receivers would be. Instead of trying to convince carriers to participate, the promoters convinced the receivers to ask their vendors to send deliveries to the UCC as a way to help the environment. The receivers were promised no increases in delivery rates. Once the receivers committed, the promoters approached the suppliers and offered to conduct the last leg of the deliveries in return for a small fee, which the carriers agreed to pay because it was smaller than their own costs of making the deliveries. Based on the fact that they have expanded to other cities, the Binnenstadservice operations have proved successful. Receivers' participation could be the key to counteracting market pressures, such as the desire to foster brand recognition that may deter shippers from participating in UCCs.

An important consideration when planning UCCs relates to insurance. Before operation begins it should be arranged who will be responsible for lost or damaged goods during the process. In a traditional delivery system it is more straightforward to determine where the damage occurred, but in a UCC—where additional layers of handling occur—it is necessary to have a system that assigns responsibility during the various stages of consolidation and delivery. Table 36 summarizes essential characteristics of Initiative 35.

Intelligent Transportation Systems

Intelligent transportation systems (ITS) could play a key role in increasing the efficiency and reliability of urban distribution (BESTUFS 2007). Several ITS programs have proven effective (SUGAR 2011). In Berlin, Germany; London, England; and Paris, France, urban traffic management centers provide route guidance to freight drivers regarding preferred routes, vehicle height and weight restrictions, access and loading regulations, and locations of truck parks. Slot booking systems are used to coordinate truck arrivals at major sites generating large flows and reducing congestion.

Initiative 36: Real-Time Information Systems

To facilitate planning and logistics responding to traffic changes, the freight sector needs real-time information in terms of (1) road safety (e.g., situational safety, accidents, vertical height information, weather information, road conditions, and roadwork zones); (2) congestion (e.g., congestion data, cost information, toll facilities, parking facilities, and kiosks at truck stops); (3) regulatory compliance (e.g., road restrictions, limit travel speed, and weigh station locations); and (4) supply chain information (e.g., loading and unloading information, delays, pick-up/delivery notification, pre-notification of truck arrival, real-time container status and gate activity,

wait times at intermodal facilities, and advanced notice of fees due) (U.S. DOT 2003; RITA 2011; Ranaiefar 2012; U.S. DOT 2012b; Butler 2013). An implementation example of a real-time information system (RTIS) is described in Case Study 8, from the city of Seattle, Washington, in Section 3. Table 37 summarizes essential characteristics of Initiative 36.

Initiative 37: Vertical Height Detection Systems

Vertical height detection systems (VHDS), also known as over-height vehicle detection systems, are ITS implemented to warn truck drivers when their vehicles surpass the maximum height of an upcoming road structure (e.g., bridge, tunnel, or sign gantry) (NZ Transport Agency 2011; International Road Dynamics Inc. 2014). VHDS have a detector with a transmitter that pulses a beam of infrared light or visible red light across the highway to a receiver. If an over-height truck is crossing the location of the VHDS, the truck will interfere with the beam, and a warning (audible alarm and/or visible sign) will be generated to make the driver aware of the hazard ahead. The system provides alternatives (e.g., a sign showing available road exits) to the driver to take an alternate route and avoid crashing into approaching infrastructure (International Road Dynamics Inc. 2014).

VHDS work well under conditions of normal weather, rain, fog, and snow, and they are capable of detecting an over-height truck traveling between low speeds (1 mph) to high speeds (75–100 mph) (Mattingly 2003; International Road Dynamics Inc. 2014). VHDS have been very effective in reducing damages to structures by over-height vehicles. For example, Mattingly (2003) analyzed VHDS in 29 states in the United States and found significant reductions in 73% of the states where VHDS were implemented. This type of system has been successfully implemented in London, England (SUGAR 2011). For example, in the Blackwall Tunnel in London, the use of VHDS reduced by 38% the number of over-height incidents (ITS International 2013). Although VHDS are often reliable, in some cases false positives (e.g., birds) have produced system failures. This has occurred in the United States in Pennsylvania, where in a road carrying 6,000 to 12,000 trucks every day, the system fails occasionally and generates on average one collision every 2 months (Mattingly 2003). Table 38 summarizes essential characteristics of Initiative 37.

Initiative 38: Dynamic Routing

The implementation of in-vehicle routing and navigation systems seeks to improve the safety and efficiency of commercial vehicle operations. The public sector's initial interest was to provide routing guidance and to implement ITS for commercial operations focused mainly on road safety, congestion reduction, and securing of efficient regulatory compliance (BESTUFS 2007; Wolfe and Troup 2013). Therefore, most of the dynamic routing systems managed by the public sector guide truck drivers to routes that comply with access regulations, and when RTIS are available the routing also seeks to deviate truck traffic from roads that are already congested. Dynamic routing systems rely on on-board technologies such as vehicle telematics, global positioning systems, and in-cab communication systems for real-time guidance.

Private sector in-vehicle routing and navigation systems often are part of a decision-support system to provide truck drivers with a route that minimizes travel costs while complying with customer constraints (Kritzinger et al. 2012). The efficiency of these systems and their ability to optimize the route depend heavily on the availability of high quality real-time traffic data provided by RTIS. The total cost savings and the reduction in vehicle usage when implementing dynamic routing have been estimated using both historical and real-traffic information from Southeast Michigan (Kim et al. 2005). The cost savings achieved using historical traffic data and real-time traffic data was about 4% and 7%, respectively, during the peak hours. The authors estimate that vehicle usage can be reduced by about 7% during peak hours when using historical data, and

by about 12% when using real-time data. In Vienna, Austria, researchers have estimated that the implementation of dynamic routing using historic travel times from GPS installed in taxis could save about 10% of travel time for commercial vehicles (Kritzinger et al. 2012). In Barcelona, Spain, an experimental study estimates that real-time traffic information could reduce travel times by 25% (Grzybowska and Barceló 2012).

Implementation of this initiative requires (1) that the public sector put in place an infrastructure for RTIS (where it is not yet in place); (2) a communication architecture to provide dynamic travel times, and (3) investment in fleet management software and equipment from the private sector. Some cities that have implemented this initiative include Berlin, Germany; London, England; Paris, France; and New York City, New York, United States (BESTUFS 2007; PIARC 2011). Table 39 summarizes essential characteristics of Initiative 38.

Last-Mile Delivery Practices

Initiatives that relate to last-mile delivery practices seek to improve the final section of the supply chain, where goods are delivered to their ultimate destinations, which is often one of the chain's most expensive components. To increase the effectiveness of public-sector initiatives, the private sector must also invest in efforts to improve their logistics activities. For example, effort is required to optimize the loading of vehicles at their origins in order to conduct effective and efficient offloading activities at the destinations. Cargo must be loaded in such a way as to minimize the time required for unloading, reception, and verification activities.

Initiative 39: Time-Slotting of Pick-ups and Deliveries at Large Traffic Generators

This initiative reduces the negative impacts of pick-ups and deliveries to large traffic generators (LTGs) such as government offices, colleges, hospitals, and large buildings housing hundreds of commercial establishments. Often located in high-value locations where space is at a premium, these properties tend to have minimal loading and storage space for deliveries. If drivers cannot find space in the loading dock, they often have to double-park or circle around to find a space. Reducing the externalities produced by LTGs is crucial, as they generate a sizable portion of the truck traffic in large cities. On Manhattan Island in New York City, just 56 large buildings generate 4% of the total truck traffic (Jaller et al. 2013). LTGs, and the associated parking and loading/unloading maneuvers around them, generate substantial congestion. Time-slotting of deliveries at LTGs provides an opportunity to efficiently use the delivery areas and avoid these problems. Table 40 summarizes essential characteristics of Initiative 39.

Initiative 40: Driver Training Programs

These programs seek to change driver behaviors and enhance driver competencies to improve delivery efficiency, energy consumption, environmental impacts, and the safety of all road users. Drivers can be trained to drive in eco-friendly ways that save fuel and reduce emissions, or to handle deliveries in a quiet manner so that night deliveries do not disturb neighborhoods (Goevaers 2011). Training includes presentations, vehicle checks, driving assessment, driver debriefs, demo drives, and driver knowledge tests. On completion of the training, participants receive written assessments and certificates (Department for Transport 2007). Experience suggests that driver training programs are a cost-effective approach to improving delivery efficiency; however, implementation of these programs requires close collaboration between the public and private sectors; clearly defined goals; professional instructors; well-organized training materials; and a carefully planned certification program to ensure success. Table 41 summarizes essential characteristics of Initiative 40.

Initiative 41: Anti-Idling Programs

These programs attempt to reduce the pollution caused by idling trucks. In the United States, various programs have been implemented that focus on technologies, economic incentives, regulations, and education. One important step toward the reduction of idling is truck stop electrification, and the 5-minute limitation on diesel truck idling implemented across the states (California Department of Transportation). The U.S. Department of Energy has sponsored research and development to produce new anti-idling technologies.

Although several implementations have been conducted in the United States (Skukowski 2012), these technologies are unfortunately underutilized, and they have not achieved their full potential. The EPA launched the SmartWay Transport Partnership in part to foster use of anti-idling technologies (U.S. Environmental Protection Agency 2013). The success of these programs relies on an integrated consideration of regulations, technologies, incentives, public education, and effective stakeholder coordination. Table 42 summarizes essential characteristics of Initiative 41.

Initiative 42: Pick-ups/Deliveries to Alternate Locations

These initiatives foster the use of alternate locations for pick-ups and deliveries, such as delivery lockers and post offices, which are used as local freight collection and distribution mini-depots (Augereau and Dablanc 2008). Instead of trucks making the final deliveries, customers travel to the pick-up area to retrieve their goods. These practices are believed to reduce delivery costs and the number of delivery attempts. However, some researchers argue that compared to home deliveries, having customers pick up the orders using their own cars may increase the overall traffic. To be socially beneficial, the alternate locations need to be located at places where customers only need to make short deviations from their daily routines (BESTUFS 2007). Table 43 summarizes essential characteristics of Initiative 42.

Table 36. Urban consolidation centers.

<table>
<tr><th colspan="2">Initiative 35: Urban Consolidation Centers</th></tr>
<tr><td colspan="2">Description: Urban consolidation centers (UCCs) are operational concepts that reduce freight traffic circulating within a target area by fostering consolidation of cargo at a terminal. In most cases, carriers that otherwise would make separate trips to the target area with relatively low load factors instead transfer their loads to a neutral carrier that consolidates the cargo and conducts the last leg of the deliveries. Conceptually, this may include “joint delivery systems,” “cooperative logistics,” and “urban distribution centers,” although strictly speaking, these operations are not necessarily equivalent to a UCC.</td></tr>
<tr><td>Targeted mode: Urban deliveries</td><td>Geographic scope: Area</td></tr>
<tr><td>Type of initiative: Logistical management: urban consolidation centers (UCCs)</td><td>Primary objective: Reduce freight traffic</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: UCCs require large physical spaces located at the fringes of cities or urban areas. These properties are usually unavailable, or available only at a premium, so costs associated with UCCs are almost always high. The planning process should involve extensive stakeholder engagement to reduce opposition from unions and suppliers. UCCs are most likely to be successful if they can be imposed, controlled, and complemented with supporting policies.</td></tr>
<tr><td>Advantages:
Improve load factors
Reduce congestion
Reduce vehicle-miles traveled
Environmental sustainability
Reduce curbside occupation time</td><td>Disadvantages:
Low probability for unintended consequences:
May face opposition from unions and suppliers
May require public subsidies
May increase the operational cost
Require high capital investments
Require extremely large physical space
Difficult to enforce
Increase in traffic at/in the vicinity of the area/facility</td></tr>
<tr><td colspan="2">Examples:
The Binnenstadservice in Nijmegen, The Netherlands (van Rooijen and Quak 2010; Quak and Tavasszy 2011)
Stadsleveransen in Göteborg, Sweden (Stadsleveransen 2013)
UCCs at La Rochelle and Monaco, France (BESTUFS 2007)   binnenstadservice nederland
Source: Hensher and Figliozzi 2007</td></tr>
<tr><td colspan="2">Related alternatives: 1. Daytime Delivery Bans; 2. Nighttime Delivery Bans; 3. Pick-Up/Delivery to Alternate Locations; 4. Mode Shift Programs; 5. Relocation of Large Traffic Generators (LTGs); 6. Integrate Freight into Land Use Planning Process</td></tr>
<tr><td colspan="2">References: Tri-State Transportation Commission 1970; Wood 1970; Doig 2001; Ieda et al. 2001; Taniguchi 2003; Taniguchi and Nemoto 2003; Crainic et al. 2004; Kohler 2004; Nemoto 2004; Browne et al. 2005; City Ports 2005; Regan and Golob 2005; Holguín-Veras et al. 2006b; Patier 2006; BESTUFS 2007; Holguín-Veras et al. 2008a; Kawamura and Lu 2008; Nilsson 2009; START 2009; TURBLOG 2009; Allen and Browne 2010; Doig 2010; Transport & Travel Research Ltd.and Transport Research Laboratory 2010; van Rooijen and Quak 2010; Holguín-Veras et al. 2011a; Panero and Shin 2011; Quak and Tavasszy 2011; SUGAR 2011; Allen et al. 2012; Holguín-Veras et al. 2012b</td></tr>
</table>

Table 37. Real-time information systems.

Initiative 36: Real-Time Information Systems	
Description: Real-time information systems (RTIS) are a set of technologies and strategies that can help monitor and manage traffic based on real-time traffic information in terms of (1) road safety, (2) congestion, (3) regulatory compliance, and (4) supply chain information. RTIS rely on a computer system that responds to activities/facts (captured data) generating an immediate response (information to user). RTIS have a direct impact on real-time decision making for freight transportation system users and managers.	
Targeted mode: All traffic	**Geographic scope:** City, area
Type of initiative: Logistical management: intelligent transportation systems (ITS): real-time information systems (RTIS)	**Primary objective:** Improve logistic operations
Expected costs and level of effort to implement: RTIS are based on ITS; they require careful planning to consider the freight movement, road network, and land use in the area. The planning process should involve the engagement of stakeholders and the participation of the government (e.g., DOTs). The costs are mainly those associated with the operational cost of the management system, data collection, analysis, and dissemination. There are different RTIS, ranging from low-cost technology installations (e.g., toll and parking facilities) to large-scale networks of systems (e.g., intermodal facilities).	
Advantages: • Increase efficiency • Reduce operational costs • Improve reliability • Reduce congestion • Environmental sustainability • Reduce fuel consumption	**Disadvantages:** • Require management of data • Require real-life traffic information • Require very high/high capital investments
Examples: • In the United States: – The PANYNJ implemented the Freight Information Real-time System for Transport evaluation (FIRST) (U.S. DOT 2003) – The U.S. DOT implemented the Freight Advanced Traveler Information System (FRATIS) in the Los Angeles-Gateway Region, Dallas-Fort Worth, Texas and South Florida (U.S. DOT 2012b; Butler 2013) – Some 65 travel management centers inform motorists of any incidents that occurs on the highway displaying travel time messages on dynamic message signs during non-incident periods (U.S. DOT 2013) – The Washington State DOT uses the Commercial Vehicle Information Systems and Networks (CVISN) to obtain real-time travel information, monitoring, and enforcement for commercial vehicles (Washington State Department of Transportation 2012; Washington State Department of Transportation 2014b; Washington State Department of Transportation 2014a) – There are 45 active locations (38 states and 7 metropolitan areas) that use the "511: America's Traveler Information Telephone Number System" to obtain a safer, more reliable, and efficient transportation system (Federal Highway Administration 2014) • In Barcelona, Spain, variable message signs (VMS) display real-time access regulations on multi-use lanes (SUGAR 2011)  Source: Iowa Department of Transportation 2014	
Related alternatives: 1. Vehicle Parking Reservation Systems; 2. Truck Routes; 3. Dynamic Routing; 4. Vertical Height Detection System	
References: Taniguchi and Thompson 2002; U.S. DOT 2003; Marquez et al. 2004; BESTUFS 2007; CASTLE 2009; Department for Transport 2009; START 2009; C-LIEGE 2010; PIARC 2011; Reynolds 2011; RITA 2011; SUGAR 2011; Ranaiefar 2012; U.S. DOT 2012b; Ben-Akiva et al. 2013; Butler 2013; U.S. DOT 2013; Federal Highway Administration 2014; Iowa Department of Transportation 2014	

Table 38. Vertical height detection systems.

<table>
<tr><th colspan="2">Initiative 37: Vertical Height Detection Systems</th></tr>
<tr><td colspan="2">Description: Vertical height detection systems (VHDS) detect over-height trucks moving toward road structures, warning the truck driver to avoid collision with the structure</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Logistical management: intelligent transportation systems (ITS): Vertical height detection systems (VHDS)</td><td>Primary objective: Reduce damage to structures by over-height vehicles</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: VHDS are based on ITS; they require careful planning to consider the freight movement, road network, and land use in the area. The planning process should involve the engagement of stakeholders and the participation of the government (e.g., DOTs). The costs are mainly those associated with the initial capital investments and operational costs. (Some VHDS use solar energy as the power source.)</td></tr>
<tr><td>Advantages:
Decrease damage to infrastructure
Reduce damage to trucks/trailers and occupant injuries
Decrease traffic backups due to a reduction of vehicle
Collisions with overhead structures
Reduce accident claims due to a reduction of truck-overhead structure accidents
Automatic notification of incident/violation</td><td>Disadvantages:
Require real-life traffic information
Require very high/high capital investments
Presence of false positives (e.g., birds)</td></tr>
<tr><td colspan="2">Examples:
Over-height vehicle detection on the Blackwall Tunnel, London, England (ITS International 2013)
Over-height vehicle detection system at the Duhail Interchange of the Doha Expressway (Qatar) (Traffic Tech Group 2013)   Sources: ITS International 2013; Traffic Tech Group 2013</td></tr>
<tr><td colspan="2">Related alternatives: 1. Vehicle Size and Weight Restrictions; 2. Real-Time Information Systems; 3. Dynamic Routing</td></tr>
<tr><td colspan="2">References: Mattingly 2003; BESTUFS 2007; NZ Transport Agency 2011; SUGAR 2011; ITS International 2013; International Road Dynamics Inc. 2014</td></tr>
</table>

Table 39. Dynamic routing.

<table>
<tr><th colspan="2">Initiative 38: Dynamic Routing</th></tr>
<tr><td colspan="2">Description: Dynamic routing systems are used by public authorities to enhance safety and prevent violations of access regulations. The private-sector uses are in-vehicle routing as part of a decision-support system to enhance the efficiency of fleet management.</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Logistical management: intelligent transportation systems (ITS): dynamic routing</td><td>Primary objective: Improve traffic flow/improve efficiency, enhance safety</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Truck routing and the decision-support system are based on ITS; they require high quality real-time traffic data, information on the road network, and land use in the area. Large benefits can be expected when the guidance system is connected to commercial vehicle operation (CVO) systems to optimize fleet management. The planning process should include extensive stakeholder and government involvement. The costs are mainly those associated with the operational cost of the management system, data collection, analysis, and dissemination. There are different CVOs, ranging from low-cost technology installations to large-scale networks of systems.</td></tr>
<tr><td>Advantages:
Increase efficiency
Reduce operational costs
Improve reliability
Reduce congestion
Environmental sustainability
Reduce fuel consumption</td><td>Disadvantages:
Require real-life traffic information
Require very high/high capital investments</td></tr>
<tr><td colspan="2">Examples:
Examples of CVOs for truck guidance and coordination include Berlin, Germany; London, England; and Paris, France (BESTUFS 2007, 27)
New York City, United States; Paris, France; and London, England, have successful freight traffic management centers (PIARC 2011) 
Source: Dong et al. 2004</td></tr>
<tr><td colspan="2">Related alternatives: 1. Restricted Multi-use Lanes; 2. Traffic Control; 3. Real-Time Information Systems; 4. Vertical Height Detection Systems</td></tr>
<tr><td colspan="2">References: Taniguchi and Thompson 2002; Marquez et al. 2004; BESTUFS 2007; CASTLE 2009; Department for Transport 2009; START 2009; C-LIEGE 2010; PIARC 2011; Reynolds 2011; SUGAR 2011; Ben-Akiva et al. 2013</td></tr>
</table>

Table 40. Time-slotting of deliveries at large traffic generators.

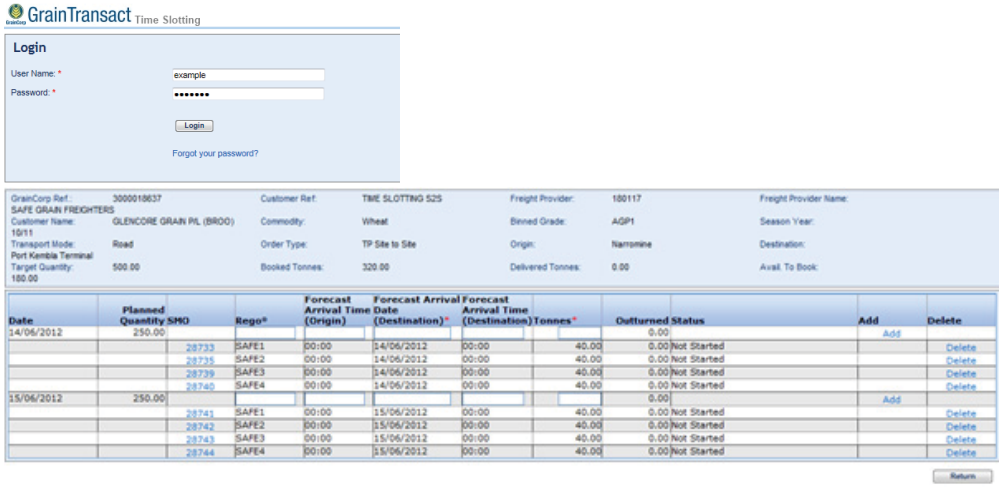
Initiative 39: Time-Slotting of Deliveries/Pick-ups at Large Traffic Generators	
Description: Designed to be used at LTGs, time-slotting of deliveries/pick-ups allows drivers to book their space before arriving to the delivery/pick-up place. Given that LTGs are usually managed by property management firms, managers are responsible for the daily operations of the facilities and they coordinate time slots, depending on the availability of the delivery/pick-up area.	
Targeted mode: Large traffic generators (LTGs), urban deliveries	**Geographic scope:** City, area
Type of initiative: Logistical management: last-mile delivery practices/time-slotting of deliveries/pick-ups for large traffic generators (LTGs)	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: Time-slotting of deliveries requires extensive collaboration between receivers, LTG managers, and carriers. Costs are those associated with the platform/technology used to manage the appointments, bays, and spaces.	
Advantages: • Increase efficiency • Reduce congestion • Improve parking availability • Reduce vehicle-miles traveled • Environmental sustainability	**Disadvantages:** • Low probability for unintended consequences: – Some carriers may claim the booking system would increase their work load • Require high/moderate coordination among multiple stakeholders/jurisdictions • Require high/moderate capital investments
Typical example: • Implementation of delivery space booking in Bilbao, Spain (C-LIEGE 2010) • Implementation of off-peak gate program at the Port of Vancouver in Canada (Dablanc et al. 2013) • Implementation of truck booking and time-slotting at GrainCorp in Australia (Regan and Garrido 2001)  Source: Regan and Garrido 2001	
Related alternatives: 1. Loading and Parking Restrictions; 2. Timesharing of Parking Spaces; 3. Improved Staging Areas; 4. Nighttime Delivery Bans; 5. Staggered Work Hours Program	
References: Regan and Garrido 2001; TURBLOG 2009; C-LIEGE 2010; FREILOT 2010; Holguín-Veras et al. 2010; Dablanc et al. 2013	

Table 41. Driver training programs.

<table>
<tr><th colspan="2">Initiative 40: Driver Training Programs</th></tr>
<tr><td colspan="2">Description: Programs to improve deliveries by altering driver behaviors and enhancing driver competencies. Drivers' attitudes and behaviors can directly affect delivery efficiency, energy consumption, environmental impacts, and the safety of all road users. Driver training programs vary according to their specific goals, which may include noise reduction, energy efficiency, or economic driving (also known as eco-driving, which is more environmentally friendly and fuel efficient). Training can include presentations, vehicle checks, driving assessment, driver debriefs, demo drives, and knowledge tests. On completion, participants receive written assessments and certificates.</td></tr>
<tr><td>Targeted mode: All traffic</td><td>Geographic scope: Nation, area</td></tr>
<tr><td>Type of initiative: Logistical management: last-mile delivery practices/driver training programs</td><td>Primary objective: Improve efficiency</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Driver training programs require coordination of public and private sectors; they should have clearly defined goals, professionally trained instructors, well-organized training materials, and a carefully planned certification program. The costs are those associated with developing training sessions, and with the intelligent transportation systems (ITS) required to monitor driver behavior (on-board, on the road).</td></tr>
<tr><td>Advantages:
Increase efficiency
Reduce vehicle-miles traveled
Improve load factors
Environmental sustainability
Reduce fuel consumption
Enhance safety</td><td>Disadvantages:
Require moderate capital investments
May require additional systems to be installed on vehicles or on the road network
Require moderate coordination among multiple stakeholders/jurisdictions</td></tr>
<tr><td colspan="2">Typical example:
Safe and Fuel Efficient Driving (SAFED) training program implemented in Bristol, United Kingdom, as part of the management of operations to reduce mileage and increase load factors (Department for Transport 2007)
FREILOT Eco-Driving program, European Union (FREILOT 2010) 


Sources: FREILOT 2010; Yushimito et al. 2013</td></tr>
<tr><td colspan="2">Related alternatives: 1. Low Noise Delivery Programs/Regulations; 2. Certification Programs; 3. Anti-Idling Programs</td></tr>
<tr><td colspan="2">References: Department for Transport 2007; C-LIEGE 2010; FREILOT 2010; Goevaers 2011; American Transportation Research Institute 2014</td></tr>
</table>

Table 42. Anti-idling programs.

Initiative 41: Anti-Idling Programs	
Description: Programs to reduce the pollution caused by idling truck engines. The most popular anti-idling technologies are fuel-operated coolant heaters, auxiliary power units, and truck stop electrification.	
Targeted mode: Large trucks	**Geographic scope**: City, area
Type of initiative: Logistical management: last-mile delivery practices/anti-idling programs	**Primary objective:** Reduce environmental impacts
Expected costs and level of effort to implement: Anti-idling programs will play a more critical role as gas prices and environmental awareness increase. The main costs may be anti-idling technologies and environmental awareness campaigns. The success of these strategies, however, depends on an integrated consideration of regulations, technologies, financial incentives, public education, and an effective coordination between all involved stakeholders.	
Advantages: • Reduce fuel consumption • Environmental sustainability	**Disadvantages:** • Difficult to implement broadly • Require high/moderate capital investments
Examples: • All six New England states in the United States have anti-idling regulations: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont (U.S. Environmental Protection Agency 2013) • Hong Kong Environmental Protection Department (Hong Kong Environmental Protection Department 2011)  Source: Hong Kong Environmental Protection Department 2011	
Related alternatives: 1. Engine-Related Restrictions; 2. Low Emission Zones; 3. Driver Training Programs	
References: Perrot et al. 2004; Hong Kong Environmental Protection Department 2011; PIARC 2011; U.S. Environmental Protection Agency 2013; American Transportation Research Institute 2014	

Table 43. Pick-ups/deliveries to alternate destinations.

Initiative 42: Pick-ups/Deliveries to Alternate Destinations	
Description: Strategies based on a change of pick-up/delivery destinations to either a central pick-up/drop-off point or delivery lockers, instead of to homes. Staffed pick-up/drop-off sites and locker banks are two complementary ways to optimize the final leg of deliveries.	
Targeted mode: All traffic, large trucks	**Geographic scope:** Area
Type of initiative: Logistical management: last-mile delivery practices/pick-ups/deliveries to alternate destinations	**Primary objective:** Reduce failed delivery attempts
Expected costs and level of effort to implement: Staffed pick-up/drop-off sites and locker banks can be considered, based on careful examination of specific local conditions. The main costs may be related to security assurance and inventory reorganization. In addition, when staffed, labor costs are involved; for unassisted strategies, such as locker banks, initial investment may be high.	
Advantages: • Reduce operational costs • Environmental sustainability • Reduce vehicle-miles traveled • Increase efficiency • Locker banks can be used to replace post offices in rural areas	**Disadvantages:** • Low probability for unintended consequences: – May cause security and liability issues – May induce an increase in traffic at/in the vicinity of the area/facility • Require economies of scale on the vendor's side – Require warehouse management and inventory reorganization • Require very high/moderate coordination among multiple stakeholders/jurisdictions
Examples: • Belgium, Luxemburg, the Netherlands, France, Germany (Dortmund and Mainz), the United Kingdom, and Benelux (BESTUFS 2007) • FedEx in the United States (Apivatanagul and Regan 2008; FedEx 2010)	
 Source: Downs 2004	 Source: Apivatanagul and Regan 2008
Related alternatives: 1. Load Factor Restrictions; 2. Urban Consolidation Centers; 3. Staggered Work Hour Program; 4. Receiver-Led Delivery Consolidation Program	
References: Siikavirta et al. 2003; BESTUFS 2007; Apivatanagul and Regan 2008; Augereau and Dablanc 2008; FedEx 2010	

Table 44 summarizes the planning and design considerations for the eight initiatives listed under logistical management.

Table 44. Planning and design considerations for logistical management initiatives.

	Questions	LOGISTICAL MANAGEMENT							
			Intelligent Transportation Systems			Last-Mile Delivery Practices			
		Urban consolidation centers	Real-Time Information Systems	Vertical Height Detection Systems	Dynamic Routing	Time slotting of pick-ups/deliveries	Driver training programs	Anti-idling programs	Pick-up/delivery to alternate locations
Planning considerations									
1	Is there enough right-of-way available to complete the project?	✓							✓
2	Will other projects be required to fully complete the project?	✓	✓	✓	✓				✓
3	How will this project be funded?	✓	✓	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓	✓	✓	✓	✓	✓	✓
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓	✓	✓
6	Where is it located?	✓		✓		✓	✓	✓	✓
7	What is the desired size/capacity/connectivity?	✓	✓	✓	✓				✓
Operational considerations									
8	Will the use of policy/project be mandatory or voluntary?	✓	✓		✓	✓	✓	✓	✓
9	Is there any incentive for participation (or penalties for not)?	✓				✓	✓	✓	✓
10	What is the level of incentives?	✓				✓	✓	✓	✓
11	What is the level of price(s)/fine(s)?	✓				✓	✓	✓	✓
12	How will the policy/project be enforced?	✓		✓		✓	✓	✓	✓
13	What is the target group?	✓	✓	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?								
15	Which agency will lead?	✓	✓	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓	✓	✓	✓	✓	✓	✓
Stakeholder engagement									
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies									
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓	✓	✓
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓	✓	✓

Freight Demand/Land Use Management

Negative externalities produced by truck traffic are addressed in these strategies by modifying the underlying demand as opposed to modifying the logistical activities or the vehicle traffic. Two families of strategies are considered: the first seeks to modify the nature of freight demand; the second focuses on land use.

Demand Management

Initiative 43: Voluntary Off-Hour Delivery Programs

To reduce congestion and pollution during daytime hours, this program induces a shift to deliveries made during the off hours (7:00 p.m. to 6:00 a.m.) by providing incentives to receivers for their commitment to accept off-hour deliveries (OHD). This concept is fundamentally different from pricing and regulation strategies. First, its voluntary nature guarantees an increase in economic welfare simply because those businesses that decide to do OHD do so only if it benefits them. Second, it focuses on the receivers as the key decision makers.

It could be argued that a congestion charge to receivers would also be effective (as in the PierPASS Program in California's Alameda Corridor), but there are substantial differences in political acceptability. Whereas the receiver congestion charge is bound to provoke stiff opposition from the business sector, the use of incentives as part of a voluntary participation program will likely engender substantial business support, as the New York City experience clearly demonstrated. The central element of the New York City OHD program is the use of incentives to convince receivers to accept OHD. Once the participation of receivers is secured—given that receivers are the ones who might initially oppose the program—the support of suppliers will be forthcoming because they stand to gain from the lower costs of OHD. Financial incentives are needed to overcome the market failure that prevents the urban freight system from reaching its most efficient outcome: OHD.

Due to the potentially large reductions in truck travel during regular hours, OHD has been used very effectively as a demand management measure for special events, during which crippling congestion could lead to a paralysis of business activity. OHD was identified as one of the key factors in the success of the Games of the XXX Olympiad (2012 Summer Olympics) in London, England, where urban congestion was kept at a manageable level (Hendy 2012).

OHD has been the subject of significant research on the effectiveness of incentives and pricing in changing behavior (Holguín-Veras et al. 2007; Holguín-Veras et al. 2008b); the necessary conditions for OHD and pricing to succeed; formulations to estimate participation in OHD; market conditions that limit the effectiveness of freight road pricing (Holguín-Veras 2011); and the impacts of the pilot test conducted in New York City (Holguín-Veras et al. 2011b). The pilot revealed that the provision of a one-time-incentive could lead receivers to agree to receive unassisted OHD. Essentially, for some receivers, there is no need for an ongoing incentive, making it easier for the public sector to implement OHD. Moreover, the research indicates that a willingness to accept unassisted OHD can be influenced by a variety of factors, including the one-time incentive, carrier discount, business support, public recognition, and the availability of trusted vendors (Holguín Veras et al. 2013c). An interesting concept worthy of further study is a self-supported freight demand management system that uses the revenues raised by a small toll surcharge to finance an unassisted OHD program, and other freight-specific enhancements (Holguín-Veras and Aros-Vera 2013). Table 45 summarizes essential characteristics of Initiative 43.

Off-Hour Deliveries in New York City

The New York City Off-Hour Delivery (OHD) program is an example of freight demand management, an emerging field that endeavors to increase the sustainability of freight activity by modifying the nature of the demand that generates freight vehicle traffic. The OHD project has been implemented through collaboration between the Rensselaer Polytechnic Institute (RPI) and the New York City DOT. Freight carriers travel during congested hours (slower trips, higher costs, parking fines, etc.) *only* because their customers (the receivers of the supplies) demand it. The OHD program exploits this fact by inducing receivers to accept deliveries during the off hours (7:00 p.m. to 6:00 a.m.). Incentives were offered to receivers in exchange for their commitment to accept OHD. A proactive voluntary program, OHD leads to a range of beneficial impacts for congested urban environments: reduced congestion and air pollution; increased economic productivity; and enhanced sustainability and quality of life, with fewer conflicts between freight traffic and passenger vehicles, pedestrians, and bicyclists.

The New York City OHD project has gained the support of the private sector, which is cooperating in its implementation. Leading partners include: the Manhattan Chamber of Commerce, New York State Motor Truck Association, New Jersey Motor Truck Association, SYSCO, Whole Foods, Wakefern, Duane Reade, the Waldorf-Astoria, Beverage Works, and others. More than 200 New York City companies have switched to OHD. The project has wide ranging potential impacts on the economy, environment, and quality of life in urban areas. OHD's focus is on urban deliveries, which dwarf all other freight trips; deliveries to restaurants in Manhattan alone attract and produce more daily truck trips than do deliveries to the combined Ports of New York and New Jersey. It has been estimated that the New York City OHD program has produced economic savings of $100–$200 million per year to carriers, shippers, and receivers. Given that it could influence large numbers of deliveries, the program could lead to reductions of: 202.7 metric tons (t) per year of carbon monoxide; 40 t/year of hydrocarbons; 11.8 t/year of nitrogen oxide; and 69.9 kg/year of particulate matter (Holguín-Veras et al. 2011b). By removing the interferences produced by freight deliveries, OHD programs could facilitate the implementation of other sustainability initiatives, such as bus rapid transit systems, bike lanes, and enhanced pedestrian walkways that also need curb space. Most of all, the OHD project has dramatically confirmed the potential of public-private sector and academic cooperation in solving urban congestion.

Consider two sets of estimates: The first set of estimates represents the congestion and pollution savings accrued by all regular-hour travelers as a result of switching freight deliveries to the off hours. The savings were estimated using the Best Practice Model (the federally approved transportation network model used by the New York City area's MPO). The second set of estimates represents the pollution impacts accrued by the OHD trucks when they travel in lighter traffic. Together, these estimates provide complementary views of the program's congestion and pollution impacts.

1. **Congestion and Pollution Savings Accrued by Regular-Hour Travelers:** Different levels of pollution savings were estimated based on the percentage

Off-Hour Deliveries in New York City (Continued)

of deliveries shifted to the off hours. For example, if 20.9% of the deliveries in Manhattan were shifted to the off hours, each receiver would be responsible for a reduction of about 551 vehicle-miles traveled, and 195 vehicle-hours traveled, and a reduction in CO of 12 kg. One could obtain an estimate of total congestion and pollution savings by multiplying these numbers by the number of receivers accepting OHD.

2. **Pollution Savings Accrued by OHD Trucks:** Using GPS data collected from the participating companies, the team computed fuel consumption and emissions using the Comprehensive Modal Emission Model (CMEM) (California Department of Transportation; De Jong 2009; Lloret-Batlle and Combes 2013). The results shown here correspond to three key segments of the network that were used in both regular deliveries and OHD. Given the second-by-second speed profiles, the fuel consumption rate and emissions rates (in terms of CO2, CO, HC, NOx) are estimated by CMEM. The emissions results were tabulated for both fuel consumption and emissions. Total emission reductions and emission reductions per receiver per year are shown in Figure 7. The "difference" row in the two tables shows the improvement of the two measures for off hours versus regular hours. (Negative values indicate reductions.)

It was also found that the average fuel consumption rate and total emission rate during the off hours were significantly lower than the rates during regular hours for the same segment. The exception was the fuel consumption for a particular highway segment that seemed to be anomalous. The differences were generally larger than 20% for highway and toll road segments, and larger than 50% for urban arterial road segments, because: (1) traffic is generally much smoother during off hours than regular hours, leading to reduced fuel consumption and emissions for off-hour deliveries; and (2) for toll roads and urban arterials, such a smoothing effect is more significant (e.g., vehicles stop less frequently at toll booths or signals), leading to more dramatic reductions of fuel consumption and emissions. The results confirmed that OHD do help reduce fuel consumption and emissions during urban freight activities.

Average fuel consumption rates.

Average Fuel Consumption Rate (FR)	Highway (grams/mile)			Toll Road (grams/mile)			Manhattan (grams/mile)		
	Segment 1	Segment 2	Segment 3	Segment 1	Segment 2	Segment 3	Segment 1	Segment 2	Segment 3
Off-hours	823.8	467.6	695.3	699.6	905.9	811.8	601.1	1259.3	675.7
Regular hours	801.8	752.3	1051.5	1251.5	1127.1	1143.4	2417.6	7109.6	2642.8
Difference	+2.7%	-37.80%	-33.90%	-44.10%	-19.60%	-29.00%	-75.10%	-82.30%	-74.40%

Average CO_2 emission rates.

Average CO_2 Emission Rate (ER_{CO2})	Highway (grams/mile)			Toll Road (grams/mile)			Manhattan (grams/mile)		
	Segment 1	Segment 2	Segment 3	Segment 1	Segment 2	Segment 3	Segment 1	Segment 2	Segment 3
Off-hours	2566.2	1496.2	2225.4	2232.4	2899.6	2286.8	1921.5	4028.8	2160.5
Regular hours	2636.8	2408	3365.9	4006.4	3607.9	3660	7747.8	7036.3	8458.7
Difference	-2.70%	-37.90%	-33.90%	-44.30%	-19.60%	-37.50%	-75.20%	-42.70%	-74.50%

Figure 7. New York City OHD program fuel consumption and emission results.

(continued on next page)

Off-Hour Deliveries in New York City (Continued)

Projected Financial Impacts on Carriers

Based on the research, one could estimate that for every delivery tour that switched from regular to the off hours, carriers save on average $212.50 per day or $42,500/year/OHD-tour (assuming 200 days/year). The parking fines in New York City average about $750/truck-month. Because it is easier for truckers to find legal parking spaces near their delivery locations during off hours, every OHD route that replaces a regular-hour route saves about $9,000/year/OHD-tour in parking fines. Essentially, the total savings to carriers amounts to about $51,500/year/OHD-tour. It is estimated that approximately 40–50 daily delivery tours in Manhattan have been switched to the off hours, equaling a total savings to all participating carriers of over $2,250,000 per year.

The New York City OHD program is sustainable on all fronts. Economically, by removing the market failure (the receivers' reluctance to accept OHD) that restricts OHD from taking place naturally, the program allows entire supply chains to switch to their most efficient outcome. The ensuing increases in productivity enhance the economic competitiveness of congested urban areas, reducing the cost of doing business for both the receivers and the carriers. The program allows for lasting, sustainable economic shifts through entire supply chains, and the resultant potential for realizing sustainability goals. The OHD program is a win-win solution that benefits carriers, receivers, and urban communities at *all* hours, enhancing quality of life, economic development, and environmental sustainability.

Initiative 44: Staggered Work Hours Programs

In passenger transport, there is a long history of staggered work-hour programs, which were originally intended to redistribute workers' demand for public transportation. Such programs were considered as early as the 1920s. Formal experiments started in the 1950s, with interest increasing in the 1960s, 1970s, and 1980s, though their use has declined since then. A similar concept can be applied to freight demand management by staggering receivers' delivery hours, which could lead to reductions in truck traffic during peak periods. However, this idea has not yet been pilot tested. Table 46 summarizes essential characteristics of Initiative 44.

Initiative 45: Receiver-Led Delivery Consolidation Programs

Delivery consolidation is closely related, yet subtly different from UCCs, as it does not require the use of terminals. The deliveries are often consolidated at one of the shippers' facilities rather than at a consolidation center (Nemoto 1997). At the receiver's request, one supplier delivers its goods to another supplier, and has the latter make the final delivery to their common customer. Instead of shipping goods separately to their customers, suppliers combine their delivery services and make consolidated shipments. Such practices have been implemented by Transport for London in the form of delivery servicing plans by which LTGs, and receivers in general, assess their delivery patterns to identify areas that can be improved to mitigate impacts of those deliveries on traffic and the city (Transport for London 2013a). Other improvements, such as consolidating purchases to reduce the number of vendors and independent deliveries and delivery time changes to mitigate impacts on peak traffic, could also be considered.

The lower the number of deliveries received, the more productive the business becomes without damaging profitability. A pilot test in London led to a reduction of 20% in the total number of deliveries made to a building (Transport for London 2013c). From the receiver's perspective, such a practice helps save time spent receiving goods, and it minimizes interruptions to business. From the suppliers' perspective, it increases truck load factors, and it reduces the number of deliveries and their costs. This combination of benefits could lead to a win-win solution. Table 47 summarizes essential characteristics of Initiative 45.

Initiative 46: Mode Shift Programs

The aim of a mode shift program is to encourage the use of alternative modes to reduce the number of trucks in the city center. Although appealing to many, this initiative faces major obstacles in urban areas, where finding modal alternatives that effectively compete with trucks is seldom possible. However, some pilot tests and small implementations suggest that it is possible to induce small changes to mode shifts in niche markets, where conditions allow. The Petite Reine UCC in Rouen, France, which uses electrically assisted tricycles for deliveries, is a successful demonstration project. Truck drivers unload their parcels at the special delivery areas, and the parcels are then loaded onto "cargocycles" for last-leg delivery (SUGAR 2011). Another example of a mode shift program is the Cargotram in Zurich, Switzerland. A tramway is used to collect goods, such as bulky waste and electronic equipment, which are then forwarded to a waste collection center in the suburbs (SUGAR 2011). In the United States, New York City is evaluating the feasibility of using freight-tricycles as part of the Hazard Analysis and Critical Control Points certified supply chain (Kamga and Conway 2012). Table 48 summarizes essential characteristics of Initiative 46.

Land Use Policy

The spatial concentration and distribution of economic activities that produce and consume freight—often called "land use" by economists—play a large role in freight-trip generation. This is a very important and frequently overlooked fact. Although LTGs, such as marine ports and truck terminals, frequently are considered the key traffic generators, most urban truck traffic is produced by small establishments in the food and retail sectors. For example, in New York City, the roughly 6,800 restaurant and drinking establishments in Manhattan produce more truck traffic than do the Port Authority of New York and New Jersey—though hardly anyone would list such establishments as being among the top producers of congestion (Jaller et al. 2013). Moreover, more than half of the industry sectors that produce and consume freight in conjunction with their primary activities have constant freight-trip generation that does not depend on business size (Woudsma 2001; Holguín-Veras et al. 2012a). Thus, in proportion to size, small establishments generate proportionally more traffic than large ones. These effects, which are only now beginning to be understood, could have major implications on Smart Growth and other emerging concepts like Complete Streets. These important interconnections have not yet been studied in depth.

Initiative 47: Relocation of Large Traffic Generators

In considering the relocation of LTGs to improve traffic conditions, misconceptions abound and the potential for unintended effects is very high. Although it is natural for local communities in close proximity to a LTG to want it relocated because of the externalities it produces, experience suggests that careful consideration should be given to the potential unintended impacts of this initiative.

New York City, where port activity was left to wither in the 1950s, offers a dramatic example, given that the demise of the port on the New York City side, along with the development of the

port on the New Jersey side, led to massive amounts of cargo destined for New York City being unloaded in New Jersey. From there, this cargo must be trucked over a handful of congested bridges and tunnels to its final destinations in New York City. Over the decades, the cost of the additional congestion produced by this traffic is likely to reach tens of billions of dollars. In essence, the disappearance of the New York City port opened the door to urban redevelopment, though at a monumental cost to the regional economy in terms of congestion and pollution.

During the last several decades, because of land costs, regulations, and traffic conditions, many cities have experienced *logistics sprawl.* For example, Dablanc and Rakotonarivo mapped the locations of the 17 largest companies that provided parcel and express transport service to the city of Paris, France, between 1974 and 2008 (Dablanc and Rakotonarivo 2010). Over those 35 years the companies' freight terminals moved, first from the urban core to the inner suburban ring, and later to the greater metropolitan area. On average, these terminals have moved about 6 miles away from the city center. As a consequence of the additional distance traveled, more than 13,000 tons of carbon dioxide are generated every year (Dablanc and Rakotonarivo 2010; Dablanc 2013). Another example is the relocation of the South Water Produce Market in Chicago, Illinois, to the Chicago International Produce Market. The original market was constructed when horse-drawn vehicles brought the produce to market, and evolved as trucks were introduced. Over time, as the trucks grew in size, the efficiency of the market declined. In an effort to improve conditions, the market was relocated to a brand-new, more spacious facility that could manage the freight-vehicle traffic in the zone more comfortably (Chicago Produce Market n.d.). The relocation has been successful in that the efficiency of the trucks has been improved, but some negative consequences also have been observed, such as an unexpected growth in the market because retailers have been able to expand their operations beyond what they had established at the South Water Produce Market location. Table 49 summarizes essential characteristics of Initiative 47.

Initiative 48: Integrating Freight into the Land Use Planning Process

A proactive approach is to incorporate the consideration of freight in the urban land use planning process. To achieve this, it is first important to understand the sources of conflict between freight and other land uses based on which strategies enabling compatible development can be selected. *NCFRP Report 13: Freight Facility Location Selection: A Guide for Public Officials*, *NCFRP Report 16: Preserving and Protecting Freight Infrastructure and Routes*, and *NCFRP Report 24: Smart Growth and Urban Goods Movement* can all provide helpful guidelines for agencies to achieve the integrated planning (Steele et al. 2011; Christensen Associates et al. 2012; Bassok et al. 2013). Some local authorities have already put this initiative into practice successfully. For example, the Chicago DOT accommodates site expansion associated with a rail terminal into city planning, and takes proactive measures to coordinate surrounding land use and the freight infrastructure. Table 50 summarizes essential characteristics of Initiative 48.

Table 45. Voluntary off-hour delivery programs.

<table>
<tr><th colspan="2">Initiative 43: Voluntary Off-Hour Delivery Programs</th></tr>
<tr><td colspan="2">Description: Programs that produce a shift of deliveries from regular hours (6:00 a.m. to 7:00 p.m.) to off hours (7:00 p.m. to 6:00 a.m.). As opposed to pricing and regulation schemes, this travel demand management initiative targets receivers as the key decision makers, seeking to convince them to accept deliveries during the less congested off hours through the use of incentives.</td></tr>
<tr><td>Targeted mode: Urban deliveries, large traffic generators (LTGs)</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Freight demand management: voluntary off-hour deliveries (OHD) program</td><td>Primary objective: Reduce congestion and pollution</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: OHD programs require raising funds to provide incentives to receivers. Potential exists to implement a self-supported freight demand management system that uses the revenues raised by a small toll surcharge to finance the incentives. The implementation of the program—whether self-supported or not—requires a multi-layered, multi-stakeholder, collaborative approach to gain substantial business support and to accomplish a large shift to off hours.</td></tr>
<tr><td>Advantages:
Reduce congestion
Increase efficiency
Environmental sustainability
Improve reliability
Enhance livability</td><td>Disadvantages:
Low probability for unintended consequences:
May increase perceived noise impact
Increase operational costs
Require fundraising to provide the incentives
Require very high/high coordination among multiple stakeholders/jurisdictions</td></tr>
<tr><td colspan="2">Examples:
The City of New York OHD Program, New York, New York, United States (Holguín Veras et al. 2013b; Holguín Veras et al. 2014) 

Source: Glaeser 2011</td></tr>
<tr><td colspan="2">Related alternatives: 1. Low Noise Delivery Programs/Regulations; 2. Daytime Delivery Restrictions; 3. Daytime Delivery Bans; 4. Recognition Programs; 5. Certification Programs</td></tr>
<tr><td colspan="2">References: Dessau, 1892; Churchill 1970; Ancient Worlds 2003; Holguín-Veras et al. 2005; Holguín-Veras et al. 2006a; Holguín-Veras et al. 2007; Holguín-Veras 2008; Holguín-Veras et al. 2008b; NICHES 2008; Silas and Holguín-Veras 2009; Brom et al. 2011; City of New York 2011; Federal Highway Administration 2012a; Hendy 2012; Silas et al. 2012; Holguín Veras et al. 2013c</td></tr>
</table>

Table 46. Staggered work hours programs.

Initiative 44: Staggered Work Hours Programs	
Description: Programs to diminish truck demand during peak periods by distributing the receiving hours throughout the day. This initiative targets receivers as the key decision makers and seeks to convince them to spread out the reception of deliveries.	
Targeted mode: Urban deliveries, large traffic generators	**Geographic scope:** City, area
Type of initiative: Freight demand management: staggered work hours program	**Primary objective:** Improve delivery efficiency
Expected costs and level of effort to implement: Staggered work hours programs involve the engagement and collaboration of multiple stakeholders. Business support is key to accomplishing the main goal of smoothing congestion during peak hours.	

Advantages:
• Reduce congestion
• Environmental sustainability
  – Reduce noise emissions
• Increase efficiency
• Improve reliability
• Low to moderate implementation costs
	Disadvantages:
	• Require very high/high coordination among multiple stakeholders/jurisdictions
	  – May require the inclusion of incentives to convince businesses to participate

Typical example: • The initiative has not been tested or implemented in any projects.	
Related alternatives: 1. Peak-Hour Clearways; 2. Daytime Delivery Restrictions; 3. Time-Slotting of Pick-ups and Deliveries at Large Traffic Generators; 4. Pick Up/Delivery to Alternate Locations	
References: O'Malley and Selinger 1973; Maric 1978	

Table 47. Receiver-led delivery consolidation programs.

Initiative 45: Receiver-Led Delivery Consolidation Programs	
Description: Efforts initiated by receivers or shippers to consolidate their deliveries. Delivery consolidation or delivery bundling programs often take place at one of the shippers' facilities rather than at a facility provided by the public sector (as opposed to a UCC). This initiative aims to increase the productivity and cost-efficiency of deliveries. Given that its successful implementation requires the commitment of all the agents involved, it is more effective when suppliers for the same receiver are located in close proximity to each other.	
Targeted mode: Large traffic generators	**Geographic scope:** Area
Type of initiative: Freight demand management: delivery consolidation program	**Primary objective:** Improve load factors
Expected costs and level of effort to implement: The planning process should involve extensive stakeholder engagement. Business support is the cornerstone for the implementation of this policy, and complementary strategies (e.g., additional parking spaces) can also catalyze implementation.	
Advantages: • Improve load factors • Reduce congestion • Reduce vehicle-miles traveled • Environmental sustainability • Low to moderate implementation costs	**Disadvantages:** • Low probability for unintended consequences: – May increase operational costs • Require high/moderate coordination among multiple stakeholders/jurisdictions • Lack a firm financial base
Examples: • Tenjin, a central business district in Fukuoka, Japan (Nemoto 1997) • Delivery & Servicing Plans, London, England (Transport for London 2013a)  Source: Transport for London 2013a	
Related alternatives: 1. Recognition Programs; 2. Pick-ups/Deliveries to Alternate Locations; 3. Mode Shift Programs	
References: Nemoto 1997; Transport for London 2013a	

Table 48. Mode shift programs.

<table>
<tr><th colspan="2">Initiative 46: Mode Shift Programs</th></tr>
<tr><td colspan="2">Description: A shift of cargo flows from road to intermodal transport, using a combination of road and short sea shipping, inland waterways, rail, or tricycles</td></tr>
<tr><td>Targeted mode: Urban deliveries</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Freight demand management: mode shift program</td><td>Primary objective: Reduce congestion</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: Mode shift programs require the management and facilitation of information access and exchange among large, small, public, and private stakeholders across all business sectors and transport modes. Public-sector capital investments are required to provide sufficient facilities to support flexible multimodal transport. Depending of the scope of the program, the implementation cost could be moderate to high.</td></tr>
<tr><td>Advantages:
Energy savings
Reduce congestion
Reduce fuel consumption
Environmental sustainability
Enhance safety
Facilitate multimodal freight
Particularly appropriate for heavy and non-perishable goods</td><td>Disadvantages:
Low probability for unintended consequences:
May increase operational costs
Require specific city and regional conditions
Require integration of freight deliveries with current transportation system
Only feasible where additional modes are present
Require very high/high coordination among multiple stakeholders/jurisdictions
Require incentives to foster a mode shift</td></tr>
<tr><td colspan="2">Examples:
B-Line Sustainable Urban Delivery, Portland, Oregon, United States
Freight-Tricycle Operations in New York City, United States (Kamga and Conway 2012)
“Cargo cycles”—electrically powered tricycles with a container implemented by La Petite Reine in Paris, France (TURBLOG 2009; C-LIEGE 2010)
“MOVEBYBiKE” in Göteborg, Sweden
Urban rail used by Monoprix in Paris, France, to distribute their goods to the stores (C-LIEGE 2010)
Public transit used to move cargo: Greyhound Courier Express, Canada and United States; Matkahuolto, Finland; ic:kurier, Germany; A Way Express, Canada; Dabbawalas, India; CarGo Tram, Germany; Cargotram, Switzerland; Guterbim, Austria; Tramfret, Paris (Vert chez vous), France; City Cargo, The Netherlands; Garbage Subways, USA; San Diego Imperial Valley Railroad, USA (Cochrane 2012)   
Sources: (Kamga and Conway 2012)
  
Source: Rensselaer Polytechnic Institute – CITE
   
Source: Cochrane 2012</td></tr>
<tr><td colspan="2">Related alternatives: 1. Vehicle Size and Weight Restrictions; 2. Urban Consolidation Centers; 3. Receiver-Led Delivery Consolidation Program</td></tr>
<tr><td colspan="2">References: MOSES 2001; C-LIEGE 2010; SUGAR 2011; Cochrane 2012; Kamga and Conway 2012</td></tr>
</table>

Table 49. Relocation of large traffic generators.

Initiative 47: Relocation of Large Traffic Generators	
Description: Moving large traffic generators (LTGs) to proper locations to change the pattern of freight generation and optimize the overall functioning of the urban freight system. LTGs are specific facilities that house a significant number of businesses that collectively receive a large number of daily deliveries, such as airports, ports, container terminals, government offices, colleges and universities, hospitals, and large buildings.	
Targeted mode: Large traffic generators	**Geographic scope:** City, area
Type of initiative: Freight demand management: relocation of large traffic generators	**Primary objective:** Reduce congestion
Expected costs and level of effort to implement: The implementation of this program requires a multi-layered, multi-stakeholder collaborative approach to gain substantial business support. The policy may be easily accepted because the cost (e.g., land cost) of locating big companies outside of the city is less than at city center. However, to implement, public incentives or other taxation strategies may be needed. Besides the relocation costs, LTGs must allocate areas for parking and loading/unloading zones.	
Advantages: • Reduce congestion • Reduce operational costs • Less cost in terms of land use • Reduce curbside occupation time	**Disadvantages:** • Very high/high probability for unintended consequences: – Environmental impacts associated with new construction – Induce urban sprawl • Land regulations may not allow for LTG relocation • May require developing incentive or other taxation policies
Examples: • Belo Horizonte, Brazil (TURBLOG 2009) • Paris, France (C-LIEGE 2010) • Relocation of the South Water Produce Market to the Chicago International Produce Market in Chicago, Illinois, United States  Source: Rensselaer Polytechnic Institute – CITE	
Related alternatives: 1. Freight Cluster Development (Freight Village); 2. Truck Routes; 3. Taxation; 4. Urban Consolidation Centers	
References: Woudsma 2001; Smart Growth Network and ICMA 2002; TURBLOG 2009; C-LIEGE 2010; Dablanc and Rakotonarivo 2010; Jaller et al. 2013	

Table 50. Integrating freight into the land use planning process.

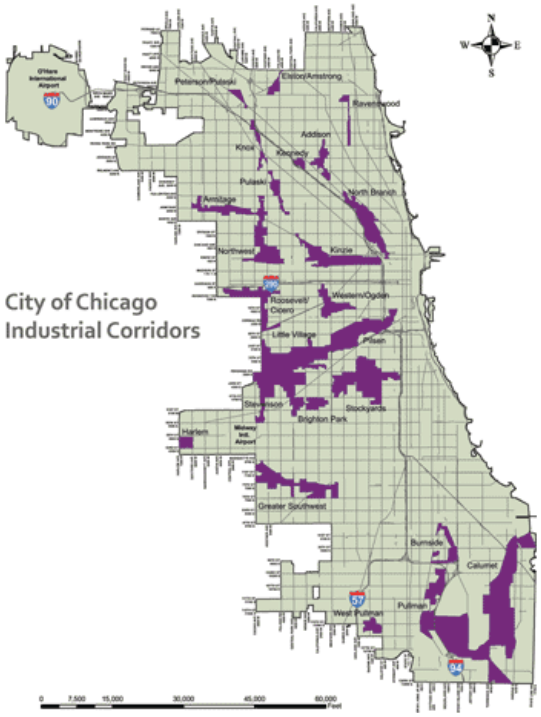
Initiative 48: Integrating Freight into the Land Use Planning Process	
Description: Incorporate freight consideration in the land use planning process to timely identify the sources of conflict between freight and some land uses.	
Targeted mode: Urban deliveries	**Geographic scope:** City, area
Type of initiative: Freight demand management: integrating freight into land use planning process	**Primary objective:** Reduce congestion, enhance safety, improve delivery efficiency
Expected costs and level of effort to implement: The implementation of this initiative requires a multi-layered, multi-stakeholder collaborative approach and cooperation among different public agencies.	
Advantages: • Improve urban planning • Enhance livability • Reduce unintended consequences • Reduce congestion	**Disadvantages:** • Require moderate/high coordination among multiple stakeholders/jurisdictions
Examples: • Chicago DOT included in the city planning the implications of expanding a rail terminal • Chicago's designated industrial corridors and planned manufacturing districts  Source: Hartshorn and Lamm 2012; original from city of Chicago	
Related alternatives: 1. Freight Cluster Development (Freight Village); 2. Enhanced Building Codes; 3. Truck Stops/Parking Outside of Metropolitan Area; 4. Urban Consolidation Centers	
References: Steele et al. 2011; Christensen Associates et al. 2012; Hartshorn and Lamm 2012; Bassok et al. 2013	

Table 51 summarizes the planning and design considerations for the six initiatives listed under freight demand/land use management.

Table 51. Planning and design considerations for freight demand/land use management initiatives.

		FREIGHT DEMAND/LAND USE MANAGEMENT						
	Questions	Voluntary off-hour delivery programs	Staggered work hours programs	Receiver-led delivery consolidation	Mode shift programs	Land use policy	Relocation of large traffic generators	Integrating Freight into Land Use Planning Process
Planning considerations								
1	Is there enough right-of-way available to complete the project?						✓	✓
2	Will other projects be required to fully complete the project?				✓		✓	✓
3	How will this project be funded?	✓	✓	✓	✓	✓	✓	✓
4	What is the anticipated duration of the project/policy?	✓	✓	✓	✓	✓	✓	✓
5	What is the geographic scope of the project?	✓	✓	✓	✓	✓	✓	✓
6	Where is it located?						✓	
7	What is the desired size/capacity/connectivity?						✓	
Operational considerations								
8	Will the use of policy/project be mandatory or voluntary?	✓	✓	✓	✓	✓	✓	✓
9	Is there any incentive for participation (or penalties for not)?	✓	✓	✓	✓	✓	✓	
10	What is the level of incentives?	✓	✓	✓	✓	✓	✓	
11	What is the level of price(s)/fine(s)?				✓			
12	How will the policy/project be enforced?	✓	✓	✓		✓	✓	
13	What is the target group?	✓	✓	✓	✓	✓	✓	✓
14	What are the criteria for participation?	✓	✓	✓	✓		✓	✓
15	Which agency will lead?	✓	✓	✓	✓	✓	✓	✓
16	What are the resources needed to operate the project?	✓	✓	✓	✓	✓	✓	✓
17	What permits are required to initiate/complete the project?	✓	✓	✓	✓	✓	✓	✓
Stakeholder engagement								
18	Who are the stakeholders?	✓	✓	✓	✓	✓	✓	✓
19	Should the private sector be engaged? If so, how?	✓	✓	✓	✓	✓	✓	✓
20	Is there a need to engage and coordinate with public agencies? How?	✓	✓	✓	✓	✓	✓	✓
Risk management and integration with other transportation policies								
21	Is there a risk of the technology/project becoming obsolete?	✓	✓	✓	✓	✓	✓	
22	Could benefits be provided to community or pedestrians?	✓	✓	✓	✓	✓	✓	✓
23	Are there any safety/security issues that should be resolved?	✓	✓	✓	✓	✓	✓	✓

Stakeholder Engagement

Increasing the understanding of freight issues among public-sector and agency leadership, and outreach to the private sector, are the critical defining tenets of effective stakeholder engagement. The public sector cannot address freight issues without understanding the underlying phenomena involved. Often, policy decisions relating to zoning, urban design concepts, parking regulations, and restrictions on truck routes can result in unintended problems (Jones et al. 2009).

Effective engagement of the private sector requires creating mechanisms to discuss freight issues with the private sector and with communities to identify potential solutions, establish the roles of the various stakeholders, and secure commitments to a strategy of improvements. The reader is referred to *A Guidebook for Engaging the Private Sector in Freight Transportation Planning* (Wilbur Smith Associates and S. R. Kale Consulting 2009) for further reading about mechanisms for engaging the private sector in freight transportation planning. Multiple ways are available to accomplish these goals; the initiatives listed in this section offer a useful starting point (Holguín Veras et al. 2013b).

Initiative 49: Designate a "Freight Person" at Key Agencies

Having a designated "freight person" in place will likely significantly impact outreach efforts because, in time, this individual will become the focal point of communications between the public and private sectors. In addition to training in transportation planning, this person should have a basic background in urban design concepts, logistics, and most importantly, in communications skills. As is often done for other focal positions, establishing procedures to identify and prepare a successor should the designated freight person leave the agency can help ensure that institutional history and connections are not lost in the transition. Table 52 summarizes essential characteristics of Initiative 49.

Initiative 50: Create a Freight Advisory Committee

The freight advisory committee (FAC) will ideally become the forum for discussion of freight issues, where critical input is provided and received. As trust is developed, the relationship between the public and private sectors will improve, and this will facilitate implementation of novel solutions. It is good practice to complement FAC input with targeted outreach efforts to ensure that the public sector receives feedback from all segments of the industry. Table 53 summarizes essential characteristics of Initiative 50.

Initiative 51: Educate Elected Officials About Freight

Members of the FAC and freight staff are in an excellent position to educate elected and appointed officials about freight. The goal of this initiative is not to train the officials in freight planning; rather, it is to create an overall understanding of the importance of freight to their metropolitan areas and how they might contribute to enhancing system performance. Several MPOs (Philadelphia, Pennsylvania; Columbus, Ohio; and Seattle, Washington, to name a few) have succeeded at this by holding site visits, at which officials can see with their own eyes how important freight is to their region. Educational tools and presentations also can be useful. Table 54 summarizes essential characteristics of Initiative 51.

Initiative 52: Create a Technical Advisory Committee

A technical advisory committee (TAC) is a forum at which the public-sector staff at the various agencies with jurisdiction on subjects that impact freight activity meet to discuss freight

Community Engagement

Several years ago in a suburban town near Albany, New York, the county government designed a project to reconstruct County Route (CR) 52 (Cherry Ave./ Elm Ave.). CR-52 is a 2-lane suburban road with residential development on both sides of its entire length. During the public meetings for the project, the residents who lived along CR-52 complained strongly about the large trucks using CR-52 to travel across town between the Selkirk Rail Yards in the southeastern section and the intersection of I-87 and I-90 in the northwest section. Large car carriers (empty and full) and other tractor-trailer units would travel the road at all times of day and night. The residents complained about the noise (trucks hitting potholes, bumps, sewer grates, and manhole covers; down-shifting, etc.) and the safety impacts (truck conflicts with school children, children riding bikes, and senior drivers). Because CR-52 is a state-designated truck route, however, trucks could not be prohibited from using it.

As a result of the public meetings and stakeholder engagement, town and county officials met with the trucking companies located near the Selkirk Rail Yards. Some of these companies did not even realize that their drivers were traveling CR-52. Because of these discussions, the company owners agreed to re-route their trucks onto State Route 32 (the Delmar Bypass), and then onto the intersection of I-87 and I-90 in downtown Albany, completely avoiding CR-52 and the residents alongside it.

Before the road reconstruction project—and its stakeholder engagement process—it was normal to see large trucks using CR-52 throughout the day. Today, it is a rare occurrence. This change has been successful for both the community and the truckers.

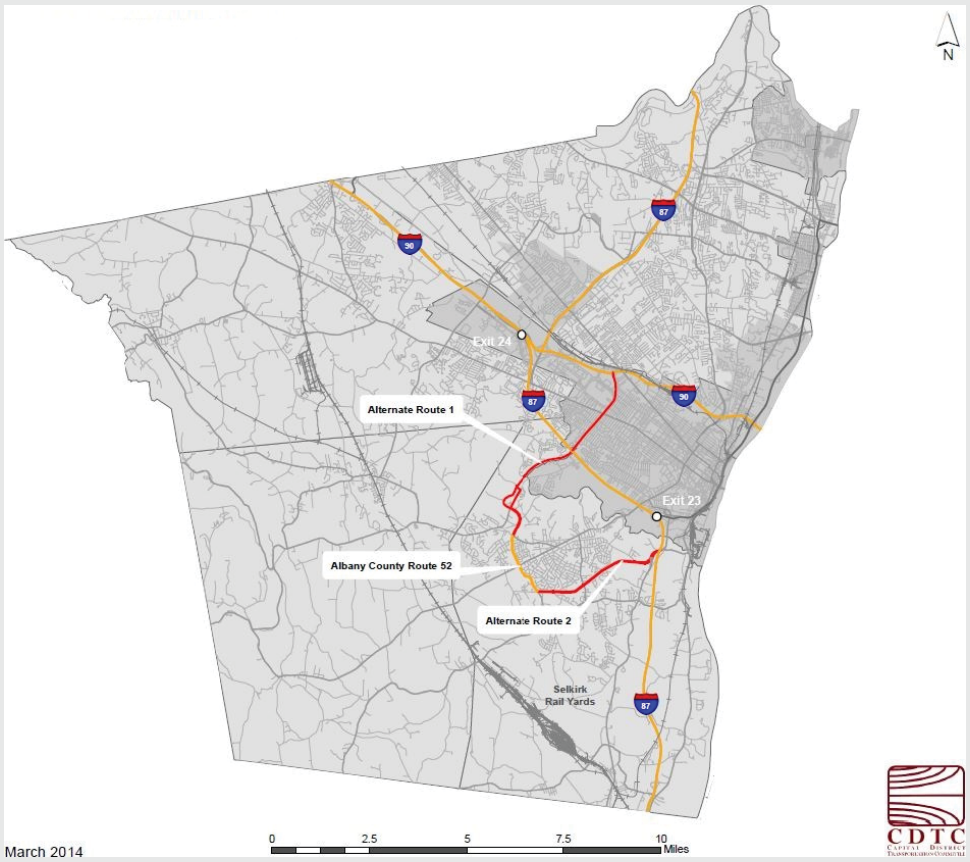
Freight Advisory Committee

The Capital District Transportation Committee (CDTC) is the MPO for the Albany, New York, region, and the FAC is made up of a wide variety of freight stakeholders. At one recent FAC meeting, a representative of the Owner-Operator Independent Drivers Association complained about parking and access for trucks in the area around I-90 (the New York State Thruway) Exit 25A (see Figure 8). This area, just southeast of Albany, has a successful truck stop and several freight generators, including the Rotterdam Industrial Park and the Golub Distribution Center (a large grocery distribution center). The local highways in this area are narrow with very tight turning radii, and company owners do not allow trucks to park on their property while waiting for their delivery time. As a result, very few parking options are available for these trucks.

After this meeting, CDTC began working with several area municipalities to conduct a study to determine strategies to improve truck access and parking. As part of the study, CDTC plans to discuss these issues with local stakeholders, state and local road owners, and company owners to find the optimal solutions.

(continued on next page)

Community Engagement (Continued)



Source: CDTC

Figure 8. Area map of truck routes.

policy. Having such a forum is important in complex metropolitan areas, where the need for coherent public-sector coordination is the highest. Table 55 summarizes essential characteristics of Initiative 52.

Initiative 53: Create a Freight Quality Partnership

A freight quality partnership (FQP) creates an environment that fosters formal working relationships between private-sector and public-sector groups with the specific intent of implementing practices that ameliorate the negative impacts of freight activity (Department for Transport 2010a). The earliest use of the term is from work in the UK by the Freight Transport Association (FTA) in 1996. Public-private partnerships to tackle freight problems have been growing in recent years, and there are now some very good examples in Europe, North and South America, and Japan. The development of FQPs has been most pronounced in Europe; the examples presented in the text boxes in this section have been drawn from there (Lindholm and Browne 2013). For implementations in the United States, please refer to Case Studies 3, 4, 8, and 9 in Section 3. Table 56 summarizes essential characteristics of Initiative 53.

London, England

The Central London Freight Quality Partnership (CLFQP) is a partnership between local governments (the seven boroughs of Central London: the City of London, Westminster, Camden, Islington, Southwark, Kensington and Chelsea, and Lambeth); local businesses; the freight industry; and others with an interest in freight issues within Central London. The aims of the partnership are to develop an understanding of freight transport problems and to develop constructive solutions. The partnership was initiated in 2005 after a recommendation from a public-private collaboration. Membership is free of charge and has no formal responsibility or mission from the local or national government.

The CLFQP has ordinary meetings four times per year, plus four to five meetings regarding special issues. The meetings are open to anyone with an interest. Normally, attendance is about 20–25 people, divided more or less equally among public-sector and private-sector participants. After each ordinary partnership meeting there is a steering group meeting. The steering group consists of 12 people: six from the boroughs and six key stakeholders from industry. (One borough participates in the partnership but chose not to be represented on the steering group.) The partnership and the steering group are managed and chaired by the University of Westminster.

FQPs in London, including the Central London partnership, were initially funded by Transport for London (TfL), but TfL funding ceased in 2011. Since then, funding has been replaced by a mix of support from the public and private sectors. Operating costs are low, and the FQPs are seen as a good way to ensure an exchange of information and ideas regarding freight transport initiatives in Central London.

The members of the partnership welcome the opportunity to interact and exchange information with other stakeholders, and the regular meetings make this possible. The authorities and the different stakeholder groups cite the opportunity to discuss problems and possibilities with others as the main reason for attending the meetings. According to the participants, the most important outputs from the meetings have been specific projects, such as: a loading and unloading code of practice, reduction in penalty charges for loading offences, and an electric vehicle charging point initiative (Lindholm and Browne 2013).

Göteborg, Sweden

Göteborg introduced a local freight network during the EU START project (2005–2009). This freight partnership continued after the START project ended, and now has three meetings every year with about 20 to 25 participants representing a range of stakeholder groups: trade associations in the inner city, large shopping centers, a variety of transport operators and haulers, commercial property landlords, a transport association, university, the vehicle industry, and civil servants from the traffic and public transport authority, the city planning authority, and the department of exemptions and permissions. Stakeholders have shown ample interest and support for the partnership.

The chairman of the partnership puts a lot of effort into making the group work, focusing on collaboration and cooperation. Because participation is voluntary, it is acknowledged that there must be good reasons for people to give up their time to attend. The meetings are well organized and well run, so participants can count on them to be productive. It is estimated that the total time required to organize and chair the meetings represents about 10% of a full-time post. An important benefit of the partnership for the city authority is that such involvement and cooperation with stakeholders—particularly those from the private sector—is essential to achieving higher-level strategic objectives (for example, complex access considerations for a pedestrianized zone). Other key outcomes of Göteborg's partnership approach include a better exchange of information between participants, and an increased understanding of each other's issues.

Concrete effects of the partnership have been a higher level of successful enforcement of regulations within the urban area; a brochure on parking restrictions for heavy vehicles; increased numbers of "walking-speed areas" that enable deliveries to be made as long as vehicles drive at "walking speed"; and a length limitation for vehicles in the inner city.

Initiative 54: Foster an Industry-Led Best Practices Dissemination Program

These initiatives could play a key role in sensitizing and teaching private-sector companies how to conduct their activities in ways that mitigate the negative impacts produced. They provide a solid foundation for private-sector engagement, which can be modified and improved as demanded by circumstances. Adapting the governance structure of such dissemination programs to local conditions is fundamental to the success of improving urban freight in metropolitan areas. Table 57 summarizes essential characteristics of Initiative 54.

Table 52. Designate a "freight person" at key agencies.

Initiative 49: Designate a "Freight Person" at Key Agencies	
Description: Designating a freight person at key agencies facilitates outreach efforts because, in time, this individual becomes the focal point of communications between the public and private sectors. In addition to training in transportation planning, the designated person should have a basic background in urban design concepts, logistics, and most importantly, communications skills. As for any focal position, succession planning is advisable.	
Targeted mode: All modes	**Geographic scope:** City, area
Type of initiative: Stakeholder engagement: designate a freight person at key agencies	**Primary objective:** Stakeholder engagement
Expected costs and level of effort to implement: The main cost of this initiative is related to hiring an analyst with a background in freight transportation, or training a member of the staff in urban design concepts and logistics.	
Advantages: • Facilitates the implementation of freight initiatives • Creates communication channels between different stakeholders • Improves outreach efforts • Reduces probability of unintended consequences	**Disadvantages:** • Requires high coordination among different stakeholders
Examples: • Office of Freight Mobility at the New York City DOT, New York City, New York, United States • Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, Pennsylvania, United States • City of Seattle Department of Transportation, Policy and Planning Division, Seattle, Washington, United States • Mid-Ohio Regional Planning Commission (MORPC), Columbus, Ohio, United States • Chicago Metropolitan Agency for Planning (CMAP), Chicago, Illinois, United States	
References: Holguín Veras et al. 2013b	

Table 53. Create a freight advisory committee.

<table>
<tr><th colspan="2">Initiative 50: Create a Freight Advisory Committee</th></tr>
<tr><td colspan="2">Description: A freight advisory committee (FAC) is composed of a group of different freight stakeholders and serves as a forum in which novel solutions for urban freight problems are discussed. It is a good practice to complement the FAC input with targeted outreach efforts to receive feedback from all segments of the industry.</td></tr>
<tr><td>Targeted mode: All modes</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Stakeholder engagement: create a freight advisory committee (FAC)</td><td>Primary objective: Stakeholder engagement</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: This initiative requires coordination among the multiple stakeholders involved.</td></tr>
<tr><td>Advantages:
Facilitates the implementation of freight initiatives
Creates communication channels between different stakeholders
Improves outreach efforts
Reduces probability of unintended consequences</td><td>Disadvantages:
Requires high coordination among different stakeholders</td></tr>
<tr><td colspan="2">Examples:
National Freight Advisory Committee (NFAC), Washington, District of Columbia, United States (for the entire country)
FAC of the Capital District Transportation Committee, Albany, New York, United States
Columbus Region Logistics Council, Columbus, Ohio, United States
North Central Texas Council of Governments (NCTCOG), Arlington, Texas, United States
New York City DOT Industry Advisory Group (IAG), New York City, New York, United States
Seattle Freight Mobility Advisory Board, Seattle, Washington, United States 
Source: Rensselaer Polytechnic Institute – CITE</td></tr>
<tr><td colspan="2">References: Columbus Chamber of Commerce; North Central Texas Council of Governments; Holguín Veras et al. 2013b</td></tr>
</table>

Table 54. Educate elected officials about freight.

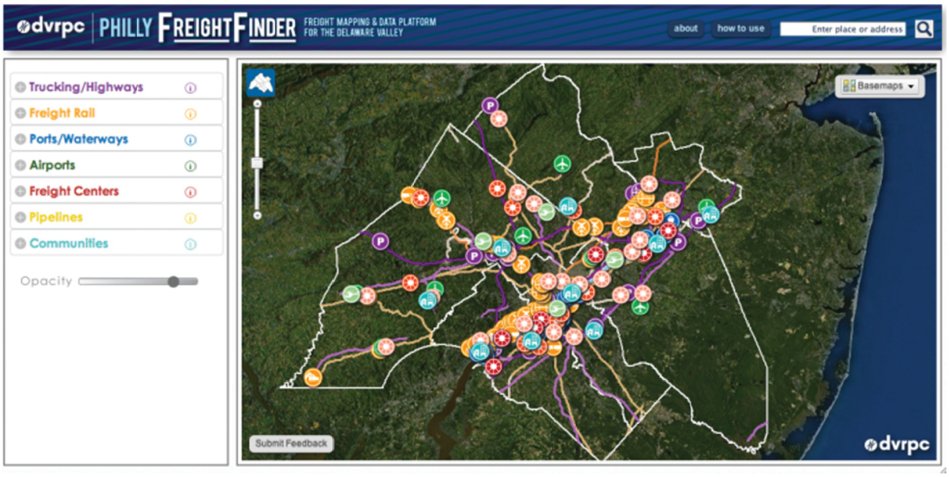
Initiative 51: Educate Elected Officials About Freight	
Description: The main goal of this initiative is to create an understanding among elected officials of the importance of freight for metropolitan areas, and their potential role in enhancing system performance. Ideally, members of the FAC and freight staff from MPOs should be responsible for the training.	
Targeted mode: All modes	**Geographic scope:** City, area
Type of initiative: Stakeholder engagement: educate elected officials about freight	**Primary objective:** Stakeholder engagement
Expected costs and level of effort to implement: This initiative requires coordination among the multiple stakeholders involved.	
Advantages: • Facilitates the implementation of freight initiatives • Creates communication channels between different stakeholders • Improves initiatives' efficiency • Reduces probability of unintended consequences • Improves engagement of stakeholders	**Disadvantages:** • Requires high coordination among different stakeholders
Examples: • Metropolitan planning agencies, Philadelphia, Pennsylvania; Columbus, Ohio; Seattle, Washington, United States • City of Philadelphia, Mayor's Office of Transportation and Utility (MOTU), Philadelphia, Pennsylvania, United States • Economic Development Corporations (various locations) • Trade groups, such as the American Trucking Associations (ATA) and New York State Motor Truck Association, United States • Philly Freight Finder, Philadelphia, Pennsylvania, United States  Source: Delaware Valley Regional Planning Commission	
References: Delaware Valley Regional Planning Commission; Steele et al. 2011	

Table 55. Create a technical advisory committee.

Initiative 52: Create a Technical Advisory Committee	
Description: A technical advisory committee (TAC) is a forum in which the public-sector staff at the various agencies with jurisdiction on subjects that impact freight activity meet to discuss freight policy. This is important in complex metropolitan areas, where the need for coherent public-sector coordination is the highest.	
Targeted mode: All modes	**Geographic scope:** City, area
Type of initiative: Stakeholder engagement: create a technical advisory committee (TAC)	**Primary objective:** Stakeholder engagement
Expected costs and level of effort to implement: This initiative requires coordination among the multiple stakeholders involved.	
Advantages: • Facilitates the implementation of freight initiatives at all levels • Provides technical support for initiatives implementation • Facilitates the coherent public-sector coordination in complex metropolitan areas • Improves outreach efforts • Reduces probability of unintended consequences	**Disadvantages:** • Requires high coordination among different stakeholders • Differences in points of view among jurisdictions
Examples: • Southern California Association of Governments (SCAG) • Hampton Roads Transportation Planning Organization, Freight Transportation Advisory Committee (FTAC)	
References: Hampton Roads Transportation Planning Organization; Southern California Association of Governments	

Table 56. Create a freight quality partnership.

Initiative 53: Create a Freight Quality Partnership	
Description: A freight quality partnership (FQP) is a voluntary partnership between private and public-sector groups to foster the implementation of practices that ameliorate the negative impacts of freight activity. Partnerships between the public and private sectors to tackle freight problems have been growing in recent years, and there are now some very good examples in Europe, North and South America, and Japan.	
Targeted mode: All modes	**Geographic scope:** City, area
Type of initiative: Stakeholder engagement: create a freight quality partnership (FQP)	**Primary objective:** Stakeholder engagement
Expected costs and level of effort to implement: This initiative requires coordination among the multiple stakeholders involved.	
Advantages: • Creates formal working environments between private and public-sector groups • Facilitates the implementation of freight initiatives • Creates communication channels between different stakeholders • Improves outreach efforts	**Disadvantages:** • Requires high coordination among different stakeholders
Examples: • The Central London Freight Quality Partnership (CLFQP), London, England (Lindholm and Browne 2013) • Local freight network, Göteborg, Sweden (Lindholm and Browne 2013)  Source: http://www.dft.gov.uk/rmd/project.asp?intProjectID=10987	
References: Department for Transport 2010a; Lindholm and Browne 2013	

Table 57. Foster an industry-led best practices dissemination program.

<table>
<tr><th colspan="2">Initiative 54: Foster an Industry-Led Best Practices Dissemination Program</th></tr>
<tr><td colspan="2">Description: This initiative provides a solid foundation for private-sector engagement in sensitizing and teaching them how to conduct their activities in ways that mitigate the negative impacts produced. These best practices can be modified and improved as demanded by circumstances.</td></tr>
<tr><td>Targeted mode: All modes</td><td>Geographic scope: City, area</td></tr>
<tr><td>Type of initiative: Stakeholder engagement: foster an industry-led best practices dissemination program</td><td>Primary objective: Stakeholder engagement</td></tr>
<tr><td colspan="2">Expected costs and level of effort to implement: This initiative requires the coordination among the multiple stakeholders involved.</td></tr>
<tr><td>Advantages:
Facilitates the implementation of freight initiatives at all levels
Provides support to private-sector companies in how to minimize the negative freight externalities
Improves outreach efforts
Reduces probability of unintended consequences</td><td>Disadvantages:
Requires high coordination among different stakeholders
Requires adapting the governance structure to local conditions</td></tr>
<tr><td colspan="2">Examples:
Council of Supply Chain Management Professionals Roundtables (UK Freight Transport Association)
UK Freight Transport Association Logistics Carbon Reduction Scheme (UK Freight Transport Association)
UK Freight Transport Association Van Excellence Programme (http://www.vanexcellence.co.uk/about/) 

Source: UK Freight Transport Association</td></tr>
<tr><td colspan="2">References: Council of Supply Chain Management Professionals; Freight Transport Association 2013</td></tr>
</table>

SECTION 3

Case Studies

This section of the Guide presents nine primary case studies that document implementations of freight initiatives in six metropolitan areas of varying sizes across the United States: Atlanta, Georgia; the Kansas City area; Los Angeles, California; New York City, New York; Seattle, Washington; and Toledo, Ohio. The case studies represent a sample of the initiatives that have been implemented across the country to improve the freight system performance in metropolitan areas. Table 58 summarizes the initiatives presented in each location. Each case study includes the following parts:

- Overview
- Economic impacts
- Regional approach/initiative
- Stakeholder engagement
- Emerging issues
- Concluding remarks

The overview summarizes the background and current conditions of the freight activity in the selected city and provides a brief description of the characteristics of the issue affecting the productivity of the system. The discussion of economic impacts describes the effects of not implementing any initiative to improve the freight system in terms of monetary units or in major impacts to the region's economy. The regional approach followed by the public agency is presented by relating the planning process followed and initiative selected. In most of the cases, the public agency's approach included the participation of key stakeholders, whose role is explained in the stakeholder engagement section. Concluding remarks address lessons learned and identification of emerging issues after the implementation of the selected initiative.

Table 58. Case studies and initiatives discussed.

Case Study Location	Initiatives Discussed			
Atlanta, Georgia	Daytime delivery bans	Truck routes		
Kansas City Region	Freight quality partnerships	Upgraded infrastructure		
Los Angeles, California	Freight quality partnerships	Truck routes	Upgraded infrastructure	
New York City, New York	Freight parking and loading zones	Loading and parking restrictions	Removal of intersection constraints	Truck routes
Seattle, Washington	Freight quality partnerships	Upgraded infrastructure	Real-time information systems	
Toledo, Ohio	Freight quality partnerships	Upgraded infrastructure		

Atlanta, Georgia

Atlanta Truck Congestion: Daytime Delivery Bans and Truck Routes

Introduction

The Atlanta, Georgia, region has had extensive planning and practical experience in the field of urban freight movement. Planning efforts to accommodate the Games of the XXVI Olympiad (1996 Summer Olympics) included the introduction and implementation of a temporary off-hour delivery (OHD) program for local businesses. This case study revisits that implementation, its results, and private-sector responses to its effects on current conditions. Existing conditions in the region provide a potential opportunity to reintroduce the program. Planning efforts that originate from the local and regional jurisdictions also are explored.

Initially a crossroads for early railroads, in the early days Atlanta was called the "Town of Terminus." Since then, however, the region has become a center of trade and goods movement and evolved into a domestic and international logistics hub for the Southeastern United States. The demand for freight in this region relates in part to the local population's needs for goods and services. Figure 9 illustrates the rapid growth in population for the Atlanta region from 1970–2012.

Today, the region is defined in numerous ways, but the Atlanta Regional Commission (ARC) defines it in terms of the 18 county metropolitan planning areas (MPAs) and 10 county regional planning commissions (RPCs) that serve the highly urbanized portions of the region (see Figure 10).

The Atlanta region is served by a significant freight transportation system that includes complex Interstate and local road networks and extensive modal availability. The Hartsfield-Jackson International Airport (ATL) is the world's busiest airport. Home to hubs for both air cargo flights and passenger (with associated belly freight) flights, ATL serves as a major generator for time-sensitive freight.

Railroads have always had a significant presence in the Atlanta region, with significant facilities inside the urban area serving both local and through-freight rail traffic. Extensive transportation systems serve as attractors for distribution activities that may be independent of local manufacturing. The region is host to numerous significant distribution centers, promoting extensive truck trips.

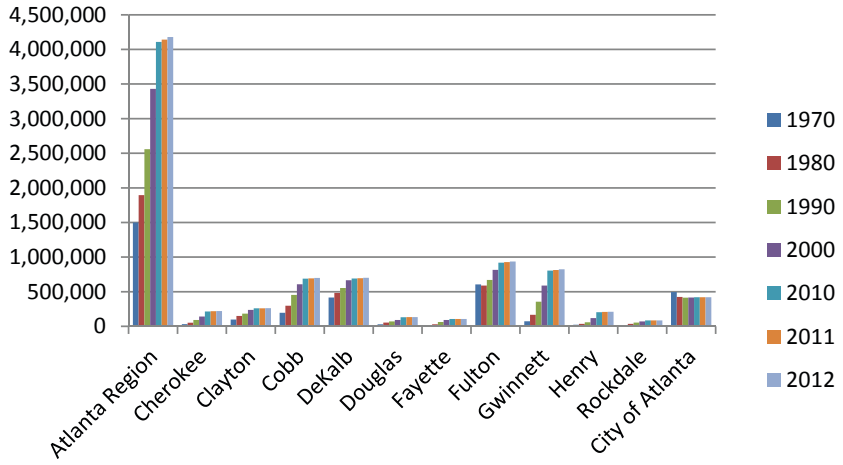


Figure 9. Population growth, 1970–2012.

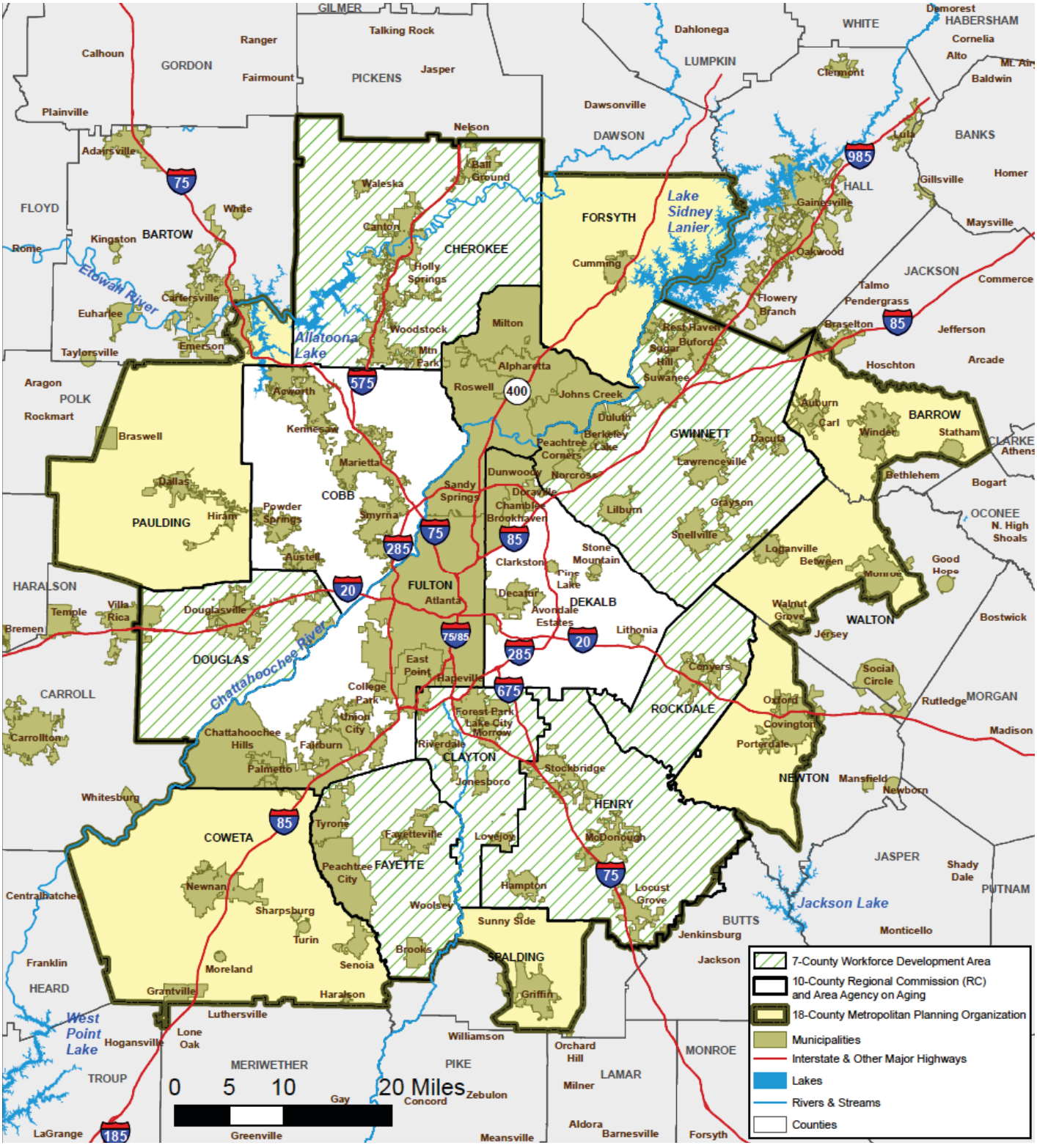


Figure 10. ARC MPO regions.

Case Study 1: 1996 Summer Olympics Delivery Experiment

The 1996 Summer Olympics took place in the Atlanta area. This sudden influx of traffic created peak-level congestion throughout the region during daylight hours. The region successfully planned for and implemented daytime delivery bans to mitigate congestion levels. After the games concluded, the majority of deliveries returned to daytime.

Planning Guide Strategies Discussed

- Initiative 24: Daytime Delivery Bans

Overview

As Atlanta prepared to host the 1996 Summer Olympics, traffic volumes were projected to increase substantially, as did concerns over safety, congestion, and the ability of freight carriers to conduct business to support increased demand. Numerous travelers to the events would not be familiar with the region's roadways, and increased automobile mass transit and pedestrian traffic were expected to add to the congested transportation network. Congestion levels that normally appeared only during peak periods were expected to occur throughout the day.

With the sudden influx of visitors, urban freight demand would substantially rise, as deliveries to hotels, restaurants, and tourists spots increased. These additional truck trips would add to the congestion and cause delivery delays, reducing productivity and increasing the need for additional trucks on the roadway. Decreases in productivity would result in rising costs for the carriers, which would be transferred to the shippers and receivers of the goods, and ultimately to the customers.

Economic Impacts

Lost wages and increased labor costs are two of the economic impacts generated by congestion and delays. The American Transportation Research Institute (ATRI), in its 2013 update of annual marginal costs, calculated the routine cost to operate a commercial vehicle in the United States at $65.29 per hour. To accurately capture the impact of delays, it is important to consider that this cost may be expanded by the addition of many other hourly costs. In illustration:

- A delay in delivering a shipment of materials or parts for an assembly line may produce a work stoppage. This results in additional costs associated with wages paid to the assembly line workers awaiting the shipment.
- A delay in shipping may extend the shipment's loading or processing beyond normal operating hours of the shipper. The costs for additional time and wages paid by the shipper must also be considered.
- Known delays may require one or more additional vehicles and operators to service a series of shipments. This results in additional charges for each additional truck trip and hourly operating costs.

The expansive nature of the Atlanta region amplifies the effects of congestion and delay on the freight industry. It speaks to the need for additional distribution centers to service the region, as opposed to companies having only a single terminal. With the introduction of a second facility (or possibly more), carrier capacity productivity can be regained; however, this regained productivity comes with the additional capital costs of buildings, vehicles, equipment, and wages.

Narrow roadways—present in urbanized areas where land costs and aged infrastructure curtail expansion—combined with additional traffic, parked automobiles, and lack of off-street parking, result in the need for specialized equipment to move goods. If operations typically involve larger tractor-trailer combinations, a carrier may be required to purchase smaller units. Distribution centers also are affected as they engage these smaller units. The lowered capacity of each truck results in additional loading activity, increased truck trips, and potentially slower responsiveness to outlet or receiver locations.

Regional Approach/Initiative

To help mitigate the anticipated impacts of the Summer Olympics, a temporary OHD program was instituted in Atlanta. The program required all commercial vehicle-based pick-up and delivery services to take place during overnight hours, when overall traffic volumes were decreased.

By alleviating daytime truck trips, normal traffic levels were maintained throughout the games. Motor carrier operational productivity was impacted to a lesser degree than if freight operations had continued during the day. Operational changes were experienced beyond those in the local area. Because many carriers used the same equipment—usually during the day—to support nighttime over-the-road or line-haul operations between other cities and markets, significant changes had to be made to patterns of equipment utilization and work force scheduling outside the region and state.

Transit times between cities were affected, disrupting supply chains. The business models adopted by carriers vary, as they support the necessary amount of time required to transport a shipment from one location to another. Transit time is one component of modal selection within the practice of supply chain management. Calculating the inherent and indirect costs for the transportation of goods and materials, a supply chain adopts appropriate modes to minimize those impacts. As carriers responded to concurrent local and over-the-road operations, temporary transit standards were adopted. The temporary nature of these made it possible for supply chains to make corresponding temporary changes. When conditions returned to normal, supply chains made a sharp return to normal operations.

Stakeholder Engagement

Local jurisdictions hold much of the decision-making authority to improve local roadways and the built environment to enhance urban freight performance. As the MPO for the region, the ARC provides guidance and encourages programs, regulations, land use, and design features conducive to efficient goods movement at the local or regional level. Leading planning efforts at the regional level, the MPO serves as a resource to assist the local jurisdiction.

Local jurisdictions observe local conditions, forecast future needs, and respond through regulations and policies to meet the needs of goods movement. With limited funding levels, the city establishes design standards (such as 11-foot travel lanes), evaluates access-management requirements, and maintains and protects industrial land use designations, especially where these meet the combined needs of the local citizenry and freight. In Atlanta, freight stakeholders were involved with local jurisdictions throughout this process to ensure that supply chains could adequately shift during the short period of the 1996 Summer Olympics. When the games were over, however, there were significant challenges to overcome regarding permanently altering supply chains.

Emerging Issues

Interviewed freight system users and service providers identified the lack of sufficient capacity and resulting congestion as the leading freight impediment in the Atlanta region. The increased presence of automobiles and other vehicles on the roadway, traveling or parked, decreases mobility for commercial trucks. This translates into reduced access, and the inability to service businesses without additional cost. This issue is further influenced by the lack of infrastructure support to provide loading or unloading off-street, or at a dedicated dock or dedicated on-street delivery-only parking area. As a result, commercial vehicles stop in the roadway, generating congestion and delays to the overall traffic flow.

Concluding Observations

OHD programs require participation across the users and providers of the freight transportation system, with sufficient volumes of goods to warrant the disruption of business models and to offset costs and the inconvenience of conducting operations outside standard business hours. These factors challenged the extension of the program beyond the duration of the 1996 Summer Olympics. Key supporters of the program, such as Coca-Cola, found receivers and shippers available in greater numbers during hours with less congestion and street-side parking, and realized significant productivity gains. Prior to the OHD program, many of these carriers had implemented numerous incremental improvement processes, and they supported other similar strategies but without sufficient participation by the shipping and receiving community.

Because providers and the driving public are seen as the beneficiaries of such programs, even the calculated or operational benefits, such as lower operational costs, that are enjoyed by carriers have not induced them to change staffing and other operational functions to support off-hours programs. Users of the freight system generally view higher operational costs as the cost of doing business, similar to the costs of tolls. Increased costs of doing business are expected to be factored into the invoiced price for the services provided by the carrier or supplier. A concurrent potential belief of system users is that a reduction in cost, experienced by the carrier or supplier at the user's expense, will not be reflected in decreased pricing. The reduction in cost will be realized as profit by the provider. With shippers and receivers establishing when goods are shipped and received, carriers lack the ability to significantly alter these conditions or to promote a program of this type.

Case Study 2: Regional Truck Routing

The ARC discovered that a major source of freeway congestion was the abundance of local trucking trips taking place on the freeways. Further investigation uncovered that, in many local communities, truck routing regulations were not harmonized and significantly constrained truck drivers' abilities to use the local roadway network. Ultimately, this led the ARC to pursue a regional truck routing plan.

Planning Guide Strategies Discussed

- Initiative 19: Truck Routes

Overview

Local truck trips that were taken on the Interstate to bypass local roadway constraints were seen as a significant contributor to congestion in the Atlanta region. The ARC's MPO conducted a planning study to designate a regional truck-route network to coordinate truck movement throughout the region. This designated network would identify non-Interstate roadways to be

used for local commercial vehicle movements. The proposed system, the Atlanta Strategic Truck Route Master Plan, was developed in collaboration with the local jurisdictions within the region. The plan was adopted in July 2010.

Economic Impacts

The ability to accurately identify projects as having freight components has the potential to shift local match percentages between federal or jurisdictional sources, though it will not increase the overall funding amounts. Recently the MPO identified the lack of education and experience in freight planning at the local level as a factor in the lack of projects and subsequent project funding by the MPO. Freight-designated projects can assist in other areas of transportation. An investment in a truck route, such as the widening of travel lanes or improved technologies, can advance a roadway to accommodate other forms of traffic in a more efficient manner. This may improve capacity, or it may provide for other improvements on roadways that may not directly affect trucks, such as pedestrian-bicycle improvements or landscaping. Funding for these freight-related projects improves the overall economic condition of the jurisdiction.

Regional Approach/Initiative

Local jurisdictions were engaged as part of the overall truck-route planning process by providing policies, regulations, and existing plans. Many jurisdictions lacked a comprehensive plan for truck-route designation and enforcement. Most of the existing plans were significantly dated. During interviews with each jurisdiction, the need for a comprehensive system for regional movements was frequently voiced, as was significant endorsement for its establishment. Many county-level jurisdictions noted that a regional effort was needed before initiating a more detailed system encompassing local roads. Several jurisdictions had begun development of similar systems—and then ceased the development as a result of community or political resistance. Adoption of a regional system was viewed as a first step toward promoting greater support for local systems.

Private-sector incorporation was a key factor in the planning process. As with the local jurisdictions, large motor carriers and suppliers with significant private fleets were invited to participate in the process. Because they were experiencing current and increasing challenges from the congestion and prohibited routes in the region, several key private-sector participants accepted. These participants (e.g., UPS, FedEx Freight, and Coca-Cola) all provided open access to drivers and dispatching staff, and hosted on-site meetings at local terminals for the planning staff.

Stakeholder Engagement

In their comments and their involvement in the planning effort, local jurisdictions supported the benefits and values of a designated system. The system was placed before the ARC board (which consisted of representatives of the same local jurisdictions) and unanimously adopted. Following the adoption of the regional plan, three jurisdictions pursued initial discussions of more localized networks, forming a development team for a regional plan. However, limited funding was applied to other priorities. Other jurisdictions viewed the central plan as providing sufficient route designation to support local truck movements, and they envisioned potential future planning efforts with increased truck volumes and economic development in their areas.

The stakeholder engagement plan relied on a high degree of public-sector and private-sector participation, which presented challenges to gaining participation and the project's schedule. The plan's scope included a project life cycle of 18 months from initial outreach to final network presentation for board approval. With 18 counties, the city of Atlanta, and four independent municipalities for public-sector outreach, and 30 days to solicit policy and plan expectations, presenting

a valid value proposition statement and a continuing engagement schedule was necessary. An added complexity of the task was the desire to include municipal involvement within each of the county discussions for greater detailed expectations and develop ownership at the broader base.

The initial effort to promote participation built on the goodwill from jurisdictional involvement activities as part of the Regional Freight Mobility Plan, which had been completed 2 years earlier. The MPO staff, consultant team, and select private-sector leaders with local jurisdictional ties approached those with extensive freight-related challenges. With commitments from participants that had greater investment in the plan, the employment of an "if me, then you" strategy proved successful.

The lack of desire to include specified commercial vehicle routings within jurisdictions by local citizenry, the significant level of mixed land use within each area, and the varied levels of education among the jurisdictions on the "business and benefits of freight" required a value proposition with a broad appeal. Using materials prepared by other jurisdictions to educate the public on the importance of freight, preparatory education was provided before scheduling discussions.

The project team extended the preparation process used in the public-sector outreach to the private-sector effort. The variances in planning horizons, lack of engagement on other topical plans with freight implications, lack of knowledge about the public-sector planning process, and limited advertisement of public-sector project responses to previous private-sector inputs were initial challenges to the project. A further area of private-sector reluctance was the manner in which they had historically been engaged. Typical efforts had included large concentrations of public-sector participants at the sessions, to the extent that public-sector participants sometimes outnumbered the private-sector participants; the use of public-sector venues; and scheduling the sessions during times that limited private-sector involvement. An advance effort in providing relevant education to address each of these obstacles assisted greatly in gaining private-sector support.

Emerging Issues

The regional adoption of plans, and the preparation for investment in future planning and funding for freight enhancements, continues at the MPO level. The ARC sponsors three goals in preparing the MPO's future freight efforts to promote MAP-21 objectives:

- Identifying, scoping, and costing innovative freight projects that can be implemented through the Freight Operations and Safety Program
- Supporting economic development by identifying issues adversely impacting the vital logistics industry
- Helping support "Freight as a Good Neighbor"

Supporting these goals, in a presentation to the region's technical committee on March 7, 2013, the ARC presented the following activity schedule for freight programs:

2013

- Identify Regional Facilities to Include on the National Freight Network
- Freight Study Program Pilot Project
- Enhance Freight Planning Tools
  - PIERS Export Data
  - Speed Data (ATRI/INRIX)

2014

- Begin Major Update of Regional Mobility Plan
- Emphasize the Economic Development Impacts of Freight in Post-PLAN 2040 RTP

As part of a collaborative funding project with the Georgia DOT, a call for projects was announced in 2012. The projects were to be submitted for local jurisdictions, and were intended to have a freight focus and support local and regional goods movement. This identification of the projects as "freight" projects was later determined to be an influencing factor in a general lack of response.

The designated system, communicated via the ARC website, has not been implemented. The plan to support education, signage, and other necessary actions to produce a usable system are being supported by subsequent actions of ARC and the Georgia DOT, as they collaborate to promote freight-friendly policies and projects.

Long-range, local planning efforts in the area of freight are limited by funding and by social-political support to specific freight planning activities. Individual efforts that target specific areas are ongoing. For example, reviews of alternative roadways designation for use as connectors to freight generators is one area where local planning efforts continue to occur.

Concluding Observations

The continuing efforts to promote a plan with varying degrees of detail and jurisdiction are subject to funding limitations, community priorities, and the observed need to promote projects of this type. Jurisdictional responsibilities and shared strategies influence whether regionalized systems get implemented. The degree of implementation impacts the local jurisdictional priorities for the development of more localized plans.

Discussions with the involved private-sector participants on the lack of observable implementation of the regional plan have found:

- Reluctance to respond to further planning efforts on this scale
- Desire to have the system realized (e.g., signage), to halt further prohibitions in local jurisdictions
- Continuing efforts for local jurisdictions to respond with local truck routes conducive to freight needs
- Observed local projects that reflect those improvements identified in the regional plan

Kansas City Metropolitan Area

Kansas City Rail Bottlenecks: Freight Quality Partnership and Upgraded Infrastructure

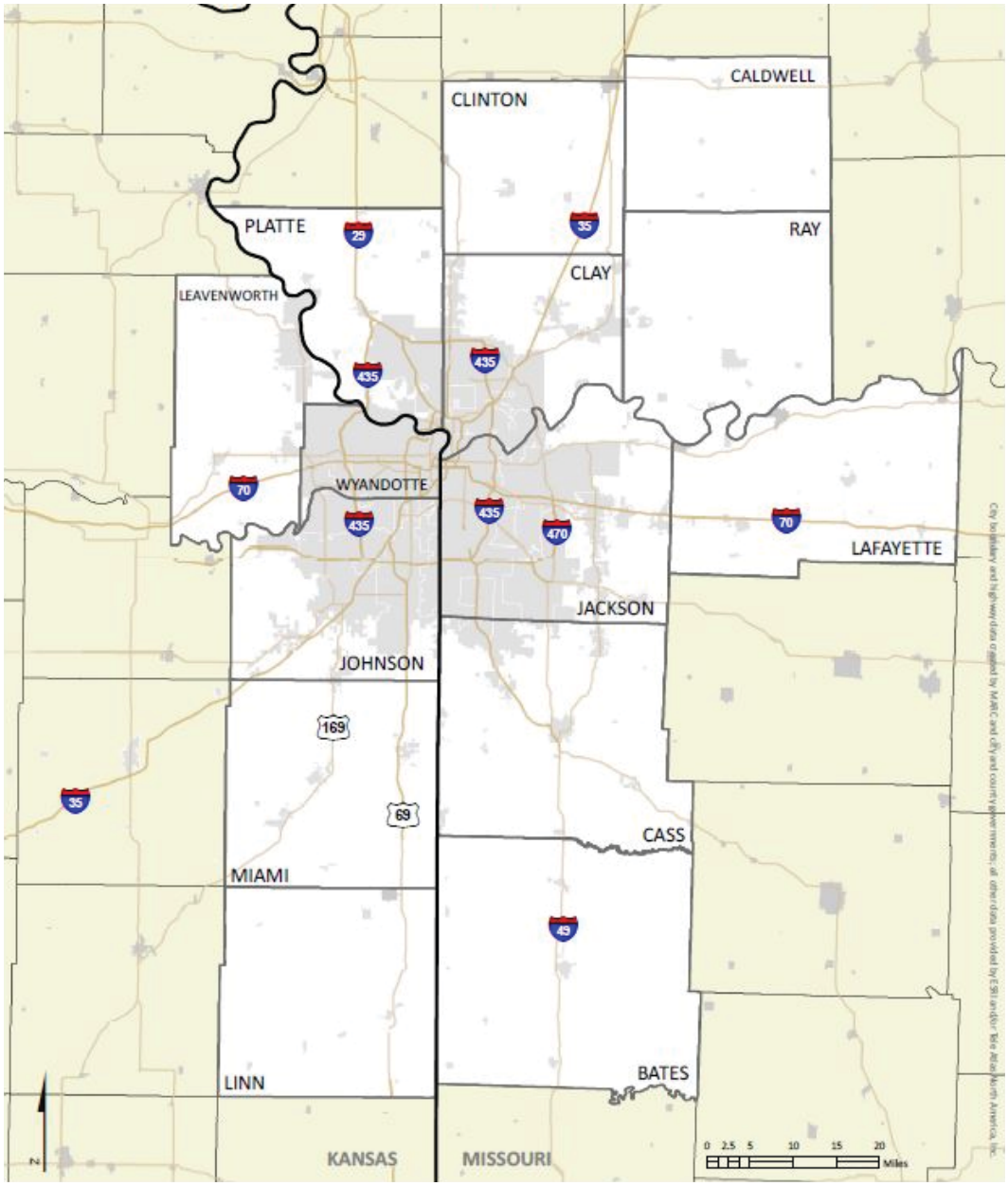
Introduction

From its early days as a trading post, location of major cattle stock yards, and site of the first permanent rail crossing over the Missouri River, the Kansas City area has been a historic link to the development and evolution of the transportation and distribution sectors in the region and the nation. Today, the region continues as a crossroads for freight transportation. Freight moving in and out of the region has access to all modes of transportation. The area is served by 10 railroads, including four Class I's (NS, BNSF, KCS, and UP); four Interstate highways (I-35, I-70, I-29, and I-49); ports on the Missouri River; and four airports providing international commercial and air cargo services. Kansas City's logistical advantage as a freight transportation hub is strengthened by its geographic location in the center of the nation. Goods traveling by truck can reach 90% of the U.S. population within a 2-day drive.

The Kansas City metropolitan area spans the border between the states of Missouri and Kansas. The regional area includes nine counties, with a land area of 4,358 square miles. The total area, including water, is 4,423 square miles. Based on the 2010 Census, the population

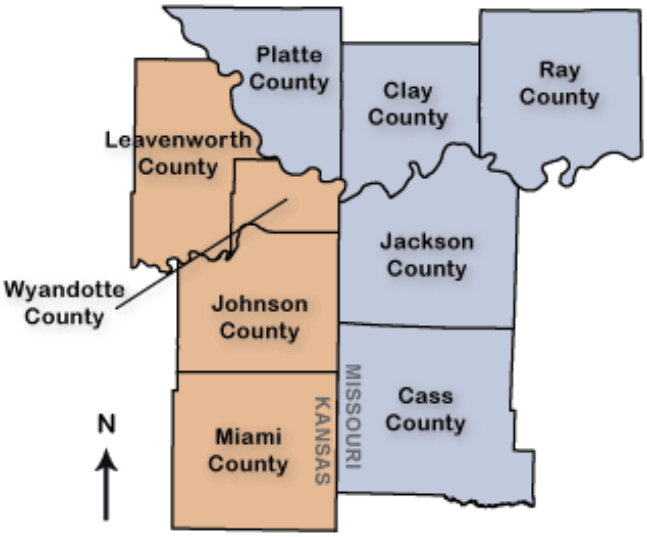
is estimated at 2,086,771. Kansas City is the 29th largest city in the United States, the second-largest metropolitan area in Missouri (St. Louis is larger), and the largest metropolitan area in Kansas. Figure 11 provides a map of its general location.

The MPO for the region is the Mid-America Regional Council (MARC). MARC serves the nine-county Kansas City metropolitan area, including Cass, Clay, Jackson, Platte, and Ray Counties in Missouri, and Johnson, Leavenworth, Miami, and Wyandotte counties in Kansas. There are 120 separate city governments within the region. The nine-county MPO region is illustrated in Figure 12. Figure 13 shows the metropolitan area, the MARC counties, and the city boundaries for Kansas City.



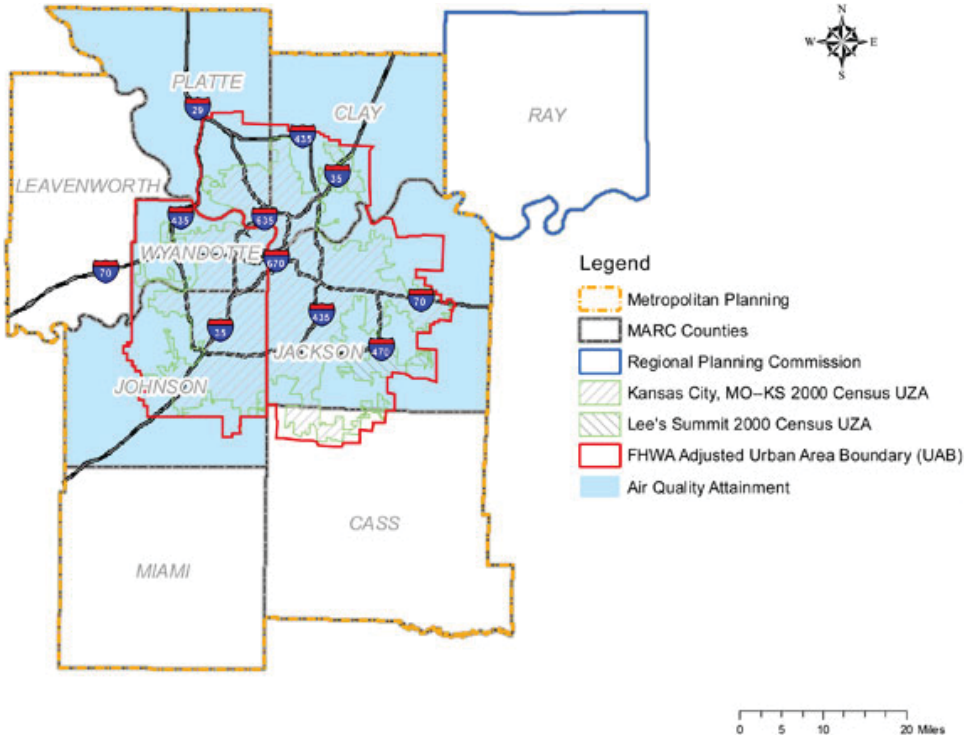
Source: Mid-America Regional Council

Figure 11. Kansas City metropolitan area.



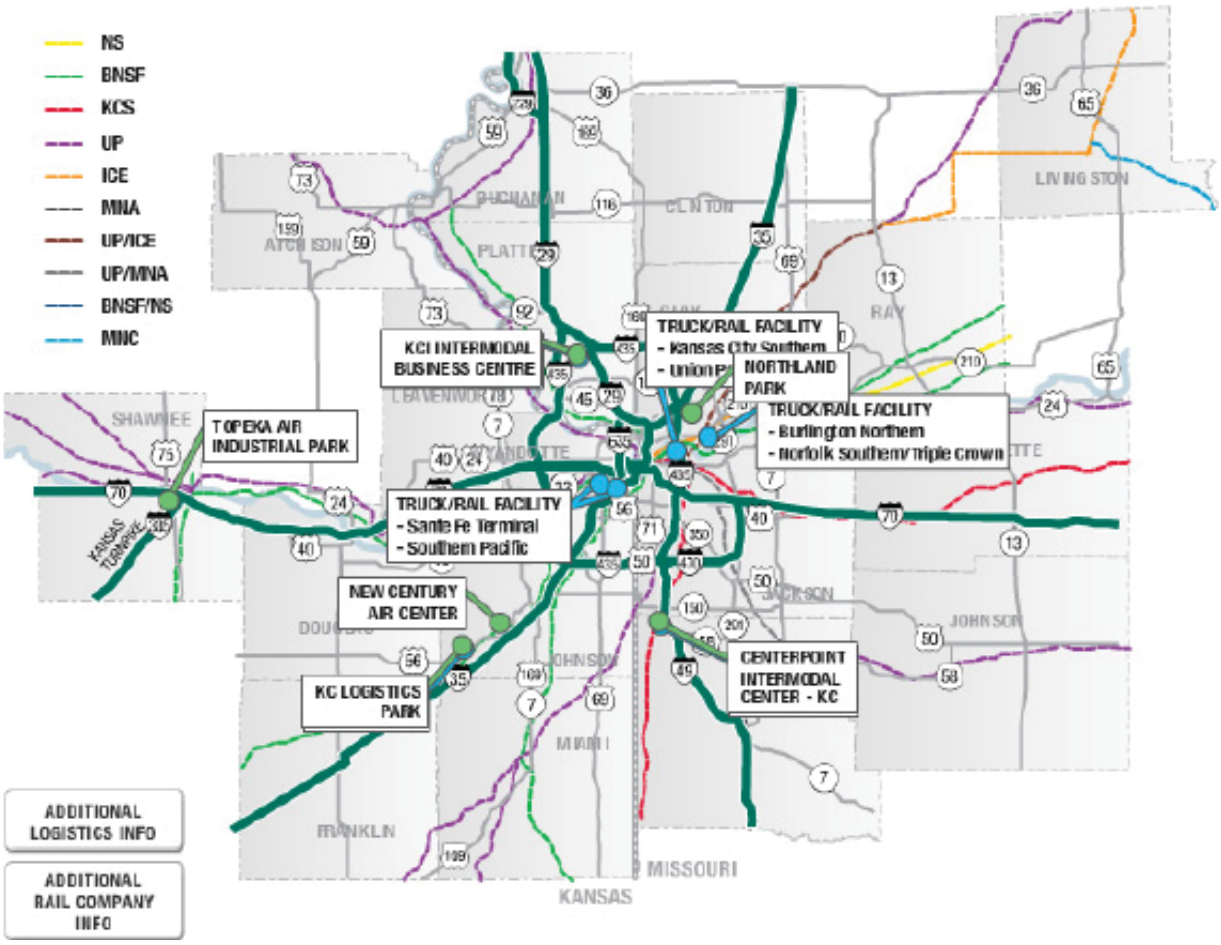
Source: http://www.marc.org/transportation

Figure 12. MARC MPO region.



Source: http://www.marc.org/transportation

Figure 13. Kansas City regional area.



Source: http://www.kcsmartport.com/site-location-center/trade-corridors/trade-corridors.php

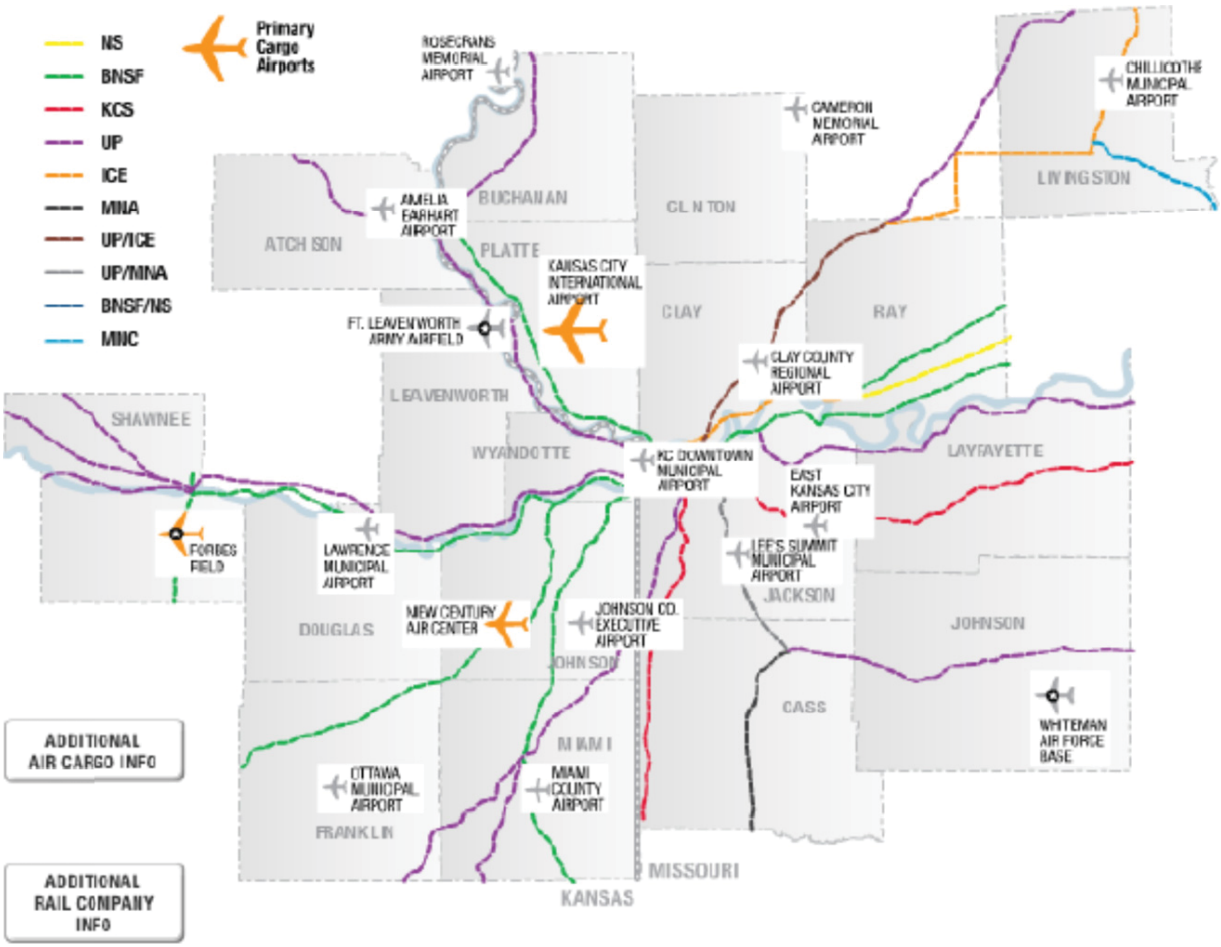
Figure 14. Kansas City's trade corridor network and intermodal facilities.

MARC has an active Goods Movement Committee that seeks to integrate freight issues and concerns with the overall metropolitan planning process. The committee grew out of the 1995 Intermodal Freight Strategies Study.

In addition to growth in manufacturing and distribution centers, four large intermodal projects are being developed in the region. International trade has also emerged as an important interjurisdictional issue in the Midwest. The 1998 Mid-Continent TradeWay Study conducted by MARC reinforced this reality. This study found that a significant amount of international cargo is processed in, or passes through, the Kansas City region. Trade in Kansas and Missouri traveling on I-35 from Texas to Chicago as a result of the North American Free Trade Agreement (NAFTA) is growing. Opportunities exist to provide value-added services for NAFTA goods, and processing brings more freight into the Greater Kansas City area. Figure 14 and Figure 15 show the multimodal transportation system serving the area.

Case Study 3: Freight Rail Bottlenecks

Approximately 15 years ago, the four Class I railroads that intersect in the Kansas City area were dealing with major bottlenecks. MARC conducted several intermodal freight studies that brought to light regional freight issues. The passage of NAFTA raised concerns about its impacts to the region.



Source: http://www.kcsmartport.com/site-location-center/trade-corridors/trade-corridors.php

Figure 15. Significant intermodal rail and airports in the Kansas City area.

Planning Guide Strategies Discussed

- Initiative 53: Create a Freight Quality Partnership
- Initiative 2: New and Upgraded Infrastructure

Overview

The Kansas City region is a major junction point for freight movements in North America. Kansas City is one of the two major locations where freight shifts from the West Coast to the East Coast on Class I railroads (the other location being Chicago). Kansas City also serves as the junction for railroad traffic from Texas and Mexico to points east and west in the United States. To complicate these movements further, the region also contains several major rail/truck transfer points (intermodal, grain, etc.), and a major river port. Both historically and more recently, freight movement patterns have resulted in rail congestion and conflicts between rail and trucks, with each trying to complete quick modal shifts before continuing to their destinations.

Approximately 15 years ago, this situation, combined with the passage of ISTEA (and its freight-related federal focus) and NAFTA, gave rise to a regional dynamic that motivated the public and private sectors to work together to improve regional freight movements. In

particular, the four Class I railroads approached the Missouri and Kansas DOTs and local government officials to request improvements to help alleviate the congestion. This resulted in efforts to alleviate critical rail bottlenecks with public/private projects like the Sheffield and Argentine fly-over rail crossings.

Economic Impacts

A major reason for the new regional dynamic was the passage of NAFTA and its effect on Kansas City. NAFTA was intended to eliminate trade barriers, increase investment opportunities, and establish procedures for resolution of trade disputes. Most importantly, it was intended to increase the competitiveness of the three participating countries in the global marketplace. What this meant for the Kansas City region was more pass-through traffic on I-35 between Texas and Chicago, and increased rail traffic from Mexico.

Responding to ISTEA's guidance that MPO plans should address freight, MARC conducted its first Intermodal Freight Initiative Study (1993–95). This study identified many of the issues and concerns voiced by the railroads, and included strategies and recommendations for addressing these problems. The studies also identified regional transportation resources, including the recently de-commissioned Richards Gebauer Air Force Base.

Soon after this initial study, a Missouri U.S. senator secured an earmark for an international trade study, the TradeWay Study, to be conducted by MARC and the Greater Kansas City Chamber of Commerce (1998–99).

Regional Approach/Initiative

From these studies and partnerships with the railroads; the state DOTs; local governments; local businesses and the chamber of commerce; and, significantly, the MPO, a regional freight initiative was developed to improve freight movements and grow a thriving regional economy. The studies had identified a number of projects and recommendations, including:

- The need to include modal projects on the regional list of priority projects.
- Identification of critical infrastructure projects, including major improvements and "low-hanging fruit"–type projects that were relatively inexpensive and quick to complete. (Interviewees said most of the major infrastructure work has been completed or was underway; the quick projects were designed to demonstrate to the private sector that improvements could be made quickly.)
- The creation of new, and improvements to existing, intermodal facilities.
- The concept for the Kansas City SmartPort.
- Several ITS solutions that addressed freeway management, smart signalization, trade data, and cross-town movements.
- The creation of a regional goods movement committee at the MPO.

With regard to the Kansas City SmartPort, discussion had demonstrated that the area needed a new, single organization with a focus on coordinating and expanding the transportation/logistics industry. Given that this was not the primary mission of MARC, the Kansas City Development Council, or the local chamber of commerce, the concept for the Kansas City SmartPort was born.

Kansas City SmartPort, Inc. is a nonprofit investor-based organization supported by both the public sector and the private sector. Kansas City SmartPort investors play an important role in all of their activities and programs, both local and international. As a nonprofit economic development organization, Kansas City SmartPort promotes and enhances the

region's status as a leading North American logistics hub. Kansas City SmartPort has two main missions:

1. To grow the Kansas City area's transportation/logistics industry through the retention/growth of current businesses and the attraction of new businesses with significant transportation and logistics elements.
2. To make the industry and the region more competitive in the movement of goods into, out of, and through the Kansas City area.

Stakeholder Engagement

Interviews with eight local public-sector and private-sector leaders involved in Kansas City–area freight planning, studies, strategies, facility operations, partnerships, committees, and economic development efforts provided insights not typically found in the literature as to why the Kansas City freight strategies and SmartPort have been successful. Key factors included:

The Right Time

The almost simultaneous combination of severe railroad congestion, the passage of NAFTA, the prospect of increasing truck traffic on I-35 to the region, and the development of the region's first freight planning studies that identified the same issues that had been identified by the private sector brought the issue of freight to the attention of local and state officials.

Freight-Focused Studies

The regional freight studies proposed solutions that could benefit both the public sector and the private sector and laid out a clear strategy for the future. These studies gave public-sector and private-sector leaders a shared message and a direction that they could rally behind, as well as a foundation for freight improvements.

Champions

Regional champions, including leaders of the local chamber of commerce, the Missouri Department of Transportation (Missouri DOT), and MARC, kept momentum behind freight issues, promoting the need to move the study recommendations ahead and get projects implemented. The project was created when the railroads approached government to help mitigate the rail conflicts. The local chamber of commerce and Kansas City SmartPort served as the vehicle for larger private-sector involvement throughout the project.

Private-Sector Partnership and Funding

Cooperation from the railroads, both in demanding that the government pay attention to the freight congestion problems and in their willingness to provide funding for improvements, won support from the public and local governments for freight improvements.

Government Funding

State DOT and MPO funding for freight infrastructure projects helped correct some of the congestion problems and won the support of the private sector.

Creating a New Agency

Creating a new agency that could focus on selling the concept of Kansas City as a cutting-edge logistics hub made a difference. Each of the other agencies involved had other primary responsibilities, and they would not have been able to provide such a direct and concerted branding effort.

Interviews with local government officials indicated that initially there was a mixed reaction to the freight strategies, and even to the formation of the SmartPort. Not all local governments in the metropolitan area had freight-related traffic problems. Many felt their biggest issue with freight was the impact of trucks on their pavements.

This attitude began to change when the railroads invested money in the improvements, and when local residents began to see the benefits to the region. The location of new freight facilities near the Interstate limited the negative impact on local governments and made them more supportive of the projects. Today, local government reaction to freight projects and the SmartPort is generally positive, as they are seeing spin-off benefits. Many local governments have freight assets such as docks, have major freight employers in their local area, and believe that what benefits one facility or location will have spin-off benefits for them.

Local governments are seeing the DOTs continue to make infrastructure improvements, and all cite good highways as a benefit of the emphasis on SmartPort. Several interviewees indicated concern that their small city/region is not high on the regional priorities list. However, they are beginning to recognize that even trucks running through their towns translates into economic improvements in their area and jobs for their citizens.

Branding

Branding made a big difference. The name "SmartPort" provided developers with a concept that was new, fresh, and interesting to sell, and that harmonized with other efforts to brand the Kansas City metropolitan area. Several interviewees pointed to the name as a critical success factor.

Emerging Issues

Discussions with local motor carriers and governments indicated that freight problems still occur in the region. A local drayage carrier reported that certain area trucks are waiting hours to cross the tracks. Additional rail grade separation is needed, and the northeast quadrant of the region still needs work to improve freight mobility. Nonetheless, all interviewees acknowledged that they had seen improvements over the last decade, they know that more improvements are coming, and regional infrastructure is well maintained.

Economic development agencies and SmartPort staff discussed the importance of keeping up with changes in supply chain movements and staying ahead of freight shippers' and carriers' needs. They indicated that this is the value of having an agency like SmartPort, whose primary role is to focus on retaining, growing, and attracting freight and logistics businesses to the area. Some of the future trends, needs, and directions they identified include:

- The need for more ready-made/ready-to-rent distribution centers. With the increase in e-commerce, freight shippers are seeking large distribution facilities to concentrate and sort inventories, and to ship them across the United States from the Kansas City region.
- Selling the area as "vertically ready" versus "shovel ready"—in other words, as a region where the infrastructure is in place for companies to locate to the area. (The term "vertically ready" was coined as another way of branding the area.)
- Recognition that Central American and South American markets are growing, and that distribution patterns are changing from the previous east-west patterns to north-south patterns.
- Recognition that more rail grade separations are needed, and that maintaining infrastructure is critical to marketing the area as freight-friendly.
- Recognition of the importance of strong partnerships, and making sure that all investors understand that each project brings in employers and jobs, with spin-off benefits to all.
- The need for continued work to bring residents, government, and industry officials together to successfully locate future intermodal and freight development sites.

Concluding Observations

Metropolitan freight strategies and programs need to be nimble to address changes in freight trends and markets. Not all freight strategies work in every metropolitan area. As an inland city, Kansas City is not the end of a line. Kansas City's freight problems and issues are not the same as those of a New York City or a Los Angeles, and will not be concentrated in the downtown area.

Kansas City's success in creating a freight-friendly region with improved freight access and mobility was a result of public-private partnerships, cooperation among freight champions and leaders, studies that produced bold strategic recommendations, willingness to prioritize and fund freight-focused infrastructure improvements, an ongoing commitment to identifying trends in freight supply chains and movements, and a willingness to modify the approach accordingly, through branding and creative marketing. In general, Kansas City treats freight as an economic development issue, and is positioning itself to create freight-related business opportunities for the region.

Los Angeles, California

Los Angeles Corridors: Freight Quality Partnerships, Truck Routes, and Upgraded Infrastructure

Introduction

The Los Angeles metropolitan area consists of Los Angeles and Orange Counties in California. The area spans over 4,850 square miles (12,562 square kilometers). Based on the 2010 Census, it is the second-largest metropolitan area in the country, with a population estimated at 15.4 million. In addition, more than 2.3 million people live within its metropolitan commuter shed, which is considered as the Census Combined Statistical Area (CSA).

The Southern California Association of Governments (SCAG) serves as the MPO for the Greater Los Angeles area. It serves the region north and east of San Diego, including the six counties of Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura, an area that also encompasses 191 separate cities. More than 18 million people live within the SCAG region, making it the largest MPO in the nation. The MPO region is illustrated in Figure 16.

The role of SCAG is critical, integrating transportation planning activities across one of the most institutionally complex settings of any region in the United States. The six SCAG–region county transportation commissions (CTCs) and authorities have responsibility for programming and funding transportation projects in their respective counties. The SCAG region also has 14 sub-regions, each represented by a council of governments or sub-regional planning agency that works with SCAG and the CTCs to provide the transportation planning for the region. There are also joint power authorities with control over such freight facilities as the Alameda Corridor. Other public agencies with a role in the region's freight transportation system include the seaport and airport operators, the California Air Resources Board (CARB), and the regional air quality management and water quality agencies. In addition, four different district offices of the California Department of Transportation (Caltrans) have responsibility for the design, construction, maintenance, and operation of the region's state highways.

As the regional MPO, SCAG leads the coordination across all of these agencies in providing the ongoing goods movement, or freight planning, element of the comprehensive Regional Transportation Plan and Regional Transportation Improvement Program. The goods movement element is included among other plans that attempt to balance the many demands and priorities of individual agencies as they consider improvements to the regional transportation system for households and businesses. This function is one of several that SCAG performs.

Source: http://www.SCAG.org/transportation

Figure 16. SCAG MPO region: six-county complex of planning regions.

SCAG is mandated by federal and state law to research and draw up plans for transportation, growth management, hazardous waste management, and air quality. Additional mandates exist at the state level, meaning that freight is only one of several priorities for SCAG and the board that oversees it.

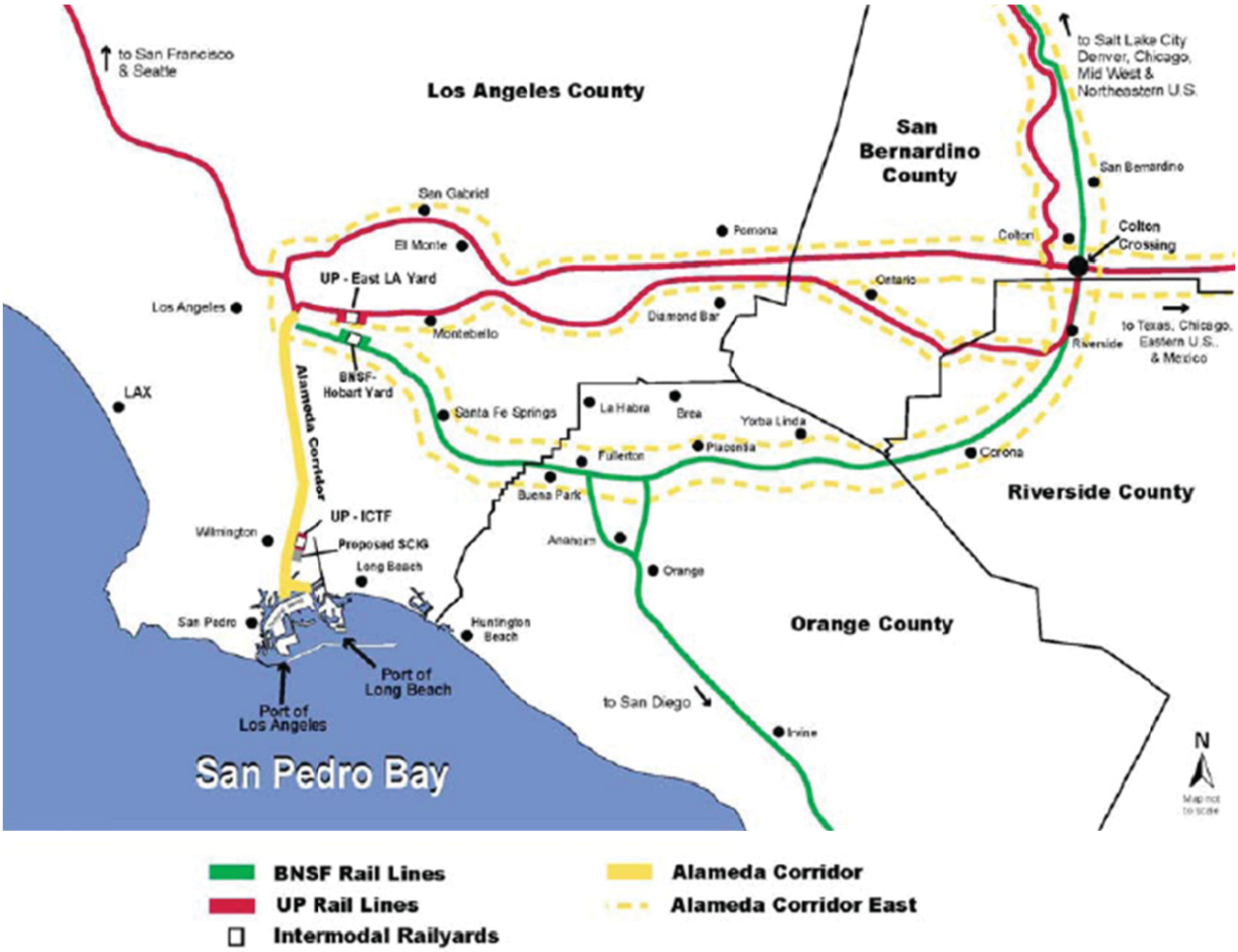
The SCAG Regional Council has an active Goods Movement Subcommittee. The subcommittee seeks to integrate freight issues and concerns within the overall metropolitan planning process. There is also a Goods Movement Task Force that works to provide policy guidance in developing a more efficient goods movement system across the region. SCAG works with many other public-sector and private-sector stakeholder groups on goods movement.

The Greater Los Angeles area is among the largest distribution center hubs, international maritime and air cargo gateways, and intermodal cargo hubs in the nation. With a very large and dispersed population, the numerous urban areas within the region suffer from congestion. The area is served by inadequate and aging infrastructure, and it is physically limited by the Pacific Ocean to the west, and the San Gabriel Mountains to the east. The region's population density has increased as it has grown, adding pressure on transportation capacity for both passenger and goods movement. Transportation challenges identified in regional transportation planning activities extend beyond capacity and infrastructure conditions to complicated issues such as air quality, transportation safety and security, environmental justice, and economic redevelopment needs throughout the region.

Freight users have access to all modes of transportation. The area is served by the two Class I railroads (Figure 17); 10 Interstate highways; ports in the city of Los Angeles, the city of Long Beach, Oxnard (Hueneme), and El Segundo (for oil tankers); and five airports providing air cargo services (Figure 18).

Combined, the Ports of Los Angeles and Long Beach, California (Ports of Los Angeles/Long Beach) make up the largest container port gateway in the western hemisphere. The Los Angeles International Airport is the fifth largest in scheduled air freight tons in the country. This great connectivity and location provide Greater Los Angeles with logistical advantages as a freight transportation hub, which have been strengthened in the last few decades by its role as the primary national gateway for rapidly growing Asian commerce. Despite a significant percentage of freight ultimately passing though the region, the economic benefits associated with value-added services in the logistics and distribution sector compel regional leaders to focus on goods movement performance.

Although trade activities may be the most visible freight generator, the manufacturing sector is critical to the economy of the Greater Los Angeles area. The once-strong aerospace manufacturing sector has experienced weakness over the past two decades and with the recent recession,



Source: http://www.acta.org/; Final_3-19-07_Alameda_Corridor_Trade_Impact_Study.pdf

Figure 17. Los Angeles's trade rail corridor network and intermodal facilities.

Source: George Huang, San Bernardino County Economic Development Agency

Figure 18. Southern California airports, highways, and railroad logistics corridors.

but the Greater Los Angeles area is still number one among U.S. metropolitan areas in manufacturing output.

For 30 years, planning studies across the region have addressed various aspects of freight growth on transportation system demand and performance. Substantial investment has been made to expand the freight network in the region, but SCAG estimates that over $58 billion of improvements will be needed by 2035. Among the projects identified are expanded seaports, air cargo facilities, freight corridors, and new rail intermodal yards.

Geography poses a particular challenge to the region's freight transportation network. The largest international gateways, Los Angeles International Airport (LAX) and the Ports of Los Angeles/Long Beach, are located on the western edge of the region. The region's primary rail and highway routes follow the network geography established in the middle of the nineteenth century. Consequently, freight destined for eastbound locations travel through the heaviest congested portions of the region, including downtown Los Angeles.

Case Study 4: Corridor Development

Tremendous freight volume and projected future demand will significantly impact the Los Angeles region. The region is using a series of strategies to mitigate the local impact of the freight industry, while capturing economic development opportunities and serving the nation as a major gateway for freight.

Planning Guide Strategies Discussed:

- Initiative 53: Create a Freight Quality Partnership
- Initiative 19: Truck Routes
- Initiative 2: New and Upgraded Infrastructure, Intermodal Terminals

Overview

Despite more than 25 years of progress and innovative approaches addressing increased freight transportation demand, growth in international trade and related truck and rail traffic has continued to contribute to roadway network congestion and poor regional air quality in Los Angeles.

The rail network serving the Ports of Los Angeles/Long Beach could no longer handle the amount of cargo needing to be shipped across the region from the ports to the rail yards on the east side of the region. This resulted in significant impacts on local communities as trains idled and blocked more than 200 grade crossings across the region daily. The environmental and economic impact on local areas spurred the ports to begin to work with their partners throughout the region and in Washington, D.C., to develop what ultimately became the Alameda Corridor (Federal Highway Administration, n.d. b).

Following the success of the Alameda Corridor rail corridor project, which connected the Ports of Los Angeles/Long Beach with downtown Los Angeles intermodal rail yards, the region has continued to advance plans for freight corridor development within the region.

Concerns have been raised about the region's ability to handle additional annual volumes of cargo given forecasted freight volumes from the growth of Asian economies, the introduction of larger maritime vessels, advances in trade relationships such as the passage of the U.S. Korean Free Trade Agreement and steps toward a comprehensive Trans-Pacific Partnership agreement.

Los Angeles is the major gateway for goods imported from Asia. As a result, a significant amount of freight transverses the metropolitan area from the Ports of Los Angeles/Long Beach and LAX, where freight is transferred to rail or truck for inland movement. This historic movement pattern has resulted in significant congestion where the modes transverse several confliction points as they complete their intermodal moves. Given an outdated highway system with numerous grade crossings and outdated designs, the region's 15 million people regularly overwhelm its roadways for extended periods of time.

In 1997, the public and private sectors came together to alleviate some of the major rail/street confliction points. The three Class I railroads implemented a container fee to pay the debt service on a Transportation Infrastructure Finance and Innovation Act (TIFIA) loan to build a trench along Alameda Street between Long Beach and the downtown Los Angeles rail yards. This Alameda Corridor consolidated rail lines below grade level, eliminating 180 grade crossings, freeing up surface street passenger and freight truck traffic, reducing emissions, and increasing train speeds between the ports and downtown. The project successfully alleviated congestion from this portion of the network.

The success of the Alameda Corridor and its benefits to the entire region provided the momentum for regional partnerships on freight issues in one of the most institutionally complex settings in the country. Despite the success, however, leaders recognized the Alameda Corridor project as only a partial solution to the much larger freight challenges in the region. Improving connections between the ports and the downtown intermodal rail yards was very beneficial, yet it left a large segment of the rail and truck corridors through the Greater Los Angeles area to the east from downtown inefficient and congested.

Economic Impacts

Challenges with the freight network in the Greater Los Angeles area have the potential to pose significant problems for the region, for California, and even for the nation. SCAG estimates that more than $2 trillion/about 1.5 billion U.S. tons of freight was moved across the region in 2010. The freight industry supports more than 2.9 million jobs and has an economic impact on the

region of more than $249 billion. Nationally, freight originating from the region supports more than 3.37 million jobs outside of the Los Angeles area (Southern California Council of Governments 2012). More importantly, however, freight congestion and the emissions that result have significant health repercussions; CARB estimates that more than 1,200 premature deaths result directly from goods movement activities in the Greater Los Angeles area (California Air Resources Board 2006). These public health impacts affect the economy by increasing healthcare costs and lowering the productivity of the population.

Regional Approach/Initiative

As the Alameda Corridor was being constructed, the region began planning for what would follow the corridor's completion in 2002. The freight studies acknowledged the new challenges that the Alameda Corridor presented; as an efficient corridor, it ended downtown. The relationships that developed out of the Alameda Corridor and subsequent studies have continued today, as the region works to address its ongoing freight needs.

SCAG has become the conduit for the development of a regional freight initiative. The municipal governments, through SCAG and the port authorities, railroads, motor carriers, CTCs, the California Transportation Commission, air quality agencies, and local businesses and groups such as the Goods Movement Subcommittee of the Los Angeles Area Chamber of Commerce, have contributed to a regional freight initiative that has been incorporated into the SCAG Regional Transportation Plan, the most recent version of which was released in 2012. The latest Regional Transportation Plan identifies a number of projects and recommendations that address, directly and indirectly, the remaining regional trade corridor needs, including:

- The identification of projects that serve as regional priorities for goods movement
- Quick-start projects, created to both boost employment and rapidly improve system performance
- New intermodal facilities and improvements to existing facilities
- Development of expanded truck corridors in the Greater Los Angeles area, especially an assessment of specific alternatives for a new east-west corridor
- Research on the potential for toll lanes, improved ITS systems, dedicated truck lanes, and cordon pricing to help with system performance
- The continuation of the outreach work of the long-standing regional goods movement task force for the MPO, with its many constituent stakeholders
- The active pursuit of new major rail and highway corridor improvements

The plan focuses on the completion of the Alameda Corridor East (ACE) and the creation of a new east-west highway corridor. The ACE is a set of grade separation and rail safety projects along 70 miles of railroad mainline, running east from downtown Los Angeles through the San Gabriel Valley to San Bernardino County. An authority created by the sub-regional San Gabriel Valley Council of Governments is overseeing the project.

Increasingly, logistics and distribution facilities are locating east of downtown Los Angeles in an area commonly referred to as the Inland Empire. This development pattern is further exacerbating the challenge of moving freight from the ports on the west side, through downtown, to the east side of the region. Discussions with freight stakeholders clearly identified the creation of a new east-west highway route to improve capacity as a major freight issue for the region. The development of such a corridor could relieve truck volume pressure on parallel elements of the network, and some of the key north-south connecting corridor elements of the roadway network. As with the Alameda Corridor, development requires multi-agency collaboration with several jurisdictions and the private sector, so the region as a whole can benefit.

Stakeholder Engagement

Interviews with local agency managers confirmed that the obstacles to successful freight planning across jurisdictions are quite significant. Such temporary localized impacts as construction and the ongoing concentration of traffic into designated corridors have been a source of potential opposition from affected municipalities. With so many individual cities within the region, agency-to-agency level outreach efforts are critical. Perceived negative reactions to freight in general have been impediments to cohesive regional planning. Although this is not unique to goods movement planning, local officials who see freight as only damaging roads, polluting the air, and contributing to congestion are not always supportive of regional freight plan development.

Another challenge identified by public-sector stakeholders was some individual agencies focusing on their own narrow agendas, holding out for attention to their specific local issues and projects (which risked overwhelming a regional plan with smaller tactical considerations rather than the larger strategic needs affecting a greater portion of the system). An additional challenge was continuity in representation over time as personnel changed jobs in both government and in the private sector. The continuity challenge was addressed partially through complete written minutes of meetings, records of decisions, and the history of studies and reports conducted previously, to preserve institutional knowledge and minimize duplication of issue consideration.

When industry and labor unions have spoken up about project benefits, however, attitudes have generally changed. Also, when the private sector has funded a share of system improvements with demonstrated improvements to environmental and other public concerns, local agency officials have been more willing to offer support for regional freight plans. Some local government opposition remains to individual elements of regional plans, but the incorporation of goods movement projects into a broader comprehensive transportation plan, one that addresses all elements of the region's transportation needs, has greatly increased support for goods movement projects.

A challenge to stakeholder engagement was the varied levels of receptiveness to agencies' approaches regarding the projects. The initial enthusiasm to collaborate to address well-documented freight system problems was difficult to maintain when the time requirements to work through the process and the number and nature of compromises necessary became clearer. The planning process takes time, and even with the inclusion of some relatively short-term, quick-fix system improvements, some stakeholders did not perceive these as useful enough to justify their ongoing commitment of time. This was especially the case for some private-sector companies, for whom the regional freight system challenges were just one obstacle in operating profitably.

The private-sector stakeholders represented a broad variety of industries and roles within the transportation system, which often led to quite different perceptions of the projects, depending on what the private-sector entities were most interested in or what they perceived as affecting them. Larger transportation carriers were more likely to have a longer-term perspective and an understanding of the institutional planning process, which more realistically constrained initial expectations for how their companies and their customers would benefit from improvements to the freight system. The larger carriers were those in the private sector most likely to benefit directly and substantially from major operational efficiency improvements. Shippers and third-party non-asset operating intermediaries were less likely to see direct benefits that would affect their operational efficiency or cost structures, which influenced their perceptions of the usefulness of projects. In many cases, the private sector was likely participating partly out of

fear of what might happen, either from a regulatory or operational perspective, if they did not contribute to the planning dialog.

The packaging and branding of projects together helped facilitate private-sector support for the projects, though not uniformly. Some small businesses affected by construction or diversions of business from new freight operational efficiencies were not uniformly supportive of projects. Some private stakeholders might be best described as apathetic, as they described themselves as not sufficiently affected by the projects either way.

Local governments view the regional partnership and the continued infrastructure improvements as a benefit. Interviews reveal that even as governmental dealings with the individual cities remain critical, the level of general collaboration has much improved over the past 20 years. In addition, there has been an increased appreciation for freight as an essential and important part of the region's business and economy.

Interviews with several local public-sector and private-sector leaders involved in Greater Los Angeles planning, studies, strategies, facility operations, partnerships, committees, and economic development have provided compelling insights as to why corridors have worked in the region. Key factors include timing, goods movement studies, regional leadership, private-sector partnerships and funding, government funding, bundling and branding, and creating a new agency.

Timing

The costs of delays and bottlenecks as congestion worsens puts pressure on the private sector to support cooperation, and brings political pressure to address the problems. In Los Angeles, several factors made political DM easier: the combination of air quality improvement initiatives, growing delays to goods movement, and labor desires to support improved system performance and infrastructure-related jobs. The region's goods movement plans established solutions to address documented problems in private-sector freight traffic so that local and state politicians could act.

Goods Movement Studies

The regional goods movement studies proposed solutions that could benefit the public and private sectors sufficiently for each to support the plans. Perhaps even more critical, strategies were established to give current leaders directions and programs that they could support immediately, while still advancing long-term needs for freight.

Regional Leadership

Regional leaders from each of the critical public agencies, business, labor, and environmental groups worked together on freight issues, moving planning recommendations ahead and continuously updating and advancing the plans as some projects were completed.

Private-Sector Partnerships and Funding

The unprecedented partnership between the multi-faceted public sector and the private sector to address the region's goods movement congestion problems and to provide support for innovative funding solutions has resulted in non-traditional funding sources like congressional appropriations, local governments, and railroads.

Government Funding

Gaps in private-sector funding to address congestion problems and air quality were filled by voter-approved infrastructure bond funding and special tax measures, Caltrans program funding, and regional transportation agency funding.

Bundling and Branding

With so many discrete elements of the system needing improvement, plans that bundle individual projects into larger-scope sets of projects, and provide interdependent performance improvement benefits under one name, have helped to generate public acceptance and support. Branding sets of projects with names such as the Alameda Corridor or Goods Movement Action Plan has provided public officials and the media with a tool for communicating concepts more easily when looking for support at the state and federal level. Interviewees identified project bundling and naming as important success factors in a region with so many individual goods movement project needs.

Creation of a New Agency

When it is logical to do so, the creation of a new agency with joint powers has proven an effective mechanism for approval, funding, and management of goods movement projects. The establishment of the Alameda Corridor Transportation Authority was essential to this project's successful funding, construction, and administration.

Emerging Issues

The relationship between freight growth and air quality in the Greater Los Angeles area was identified by all major freight partners as a growing challenge. CARB is an active member of the larger Los Angeles regional freight partnership. Statutorily, CARB is a regulatory agency; however, it attempts to act as a facilitator, working with the private sector to create mutually beneficial solutions that mitigate air quality impacts of the freight industry in the Greater Los Angeles area.

CARB's efforts started in the 1990s when the state of California adopted anti-idling regulations for commercial vehicles. In general, commercial vehicles cannot idle for more than 5 minutes without risking fines of between $300–$1,000. Similarly, CARB executed enforceable agreements to limit idling of railroad locomotives. Although this was a major step forward, it provided only a modest improvement in air quality. Interviewees at CARB stated that the largest air quality improvement comes from diesel engine improvements to truck fleets.

Relative to the rest of the nation, the Greater Los Angeles area has a much older truck fleet due to short drayage lengths and the Southern California climate. This presents a unique problem in regard to air quality. New trucks are built with engines that produce 90% less emissions. The Ports of Los Angeles/Long Beach and CARB have launched several programs to incentivize improvements (e.g., engine filters) to the aging truck fleet. These projects have been funded both through bond issuances and through fees imposed on trucks that enter the region's ports and rail yards without the required emissions-reduction equipment. CARB estimates that these programs will effectively create a fleet that meets 2010 diesel engine emission standards by 2023.

Much controversy has surrounded the planned development of a new east-west highway route, and the Burlington Northern Santa Fe (BNSF) Railroad's Southern California International Gateway (SCIG). The SCIG is a proposed new near-dock intermodal yard, designed to take container traffic off of the existing major highway corridor between the ports and downtown (the I-710 Freeway). A subsequent major freight challenge for the region will be balancing the economic benefits of these projects versus the localized environmental consequences.

Discussions with freight carriers, trade associations, and local governments also have identified challenges that, while geographically smaller, could have a huge impact on everyday freight

movements. For example, a local drayage carrier indicated that restrictive truck routes are not coordinated between all of the individual cities, creating difficulty and added risk to their operations. In addition signal timing, including ramp meters, does not always accommodate truck acceleration or deceleration requirements. However, all interviewees acknowledged that they saw improvements over the last decade, and they know that additional improvements take time to implement. All said that additional regional infrastructure improvements are required because freight traffic continues to grow.

The regional planning agencies are very engaged in freight planning, yet conditions make rapid progress difficult. No matter how comprehensive the plan or how much consensus is achieved, uncertainties around economic/fiscal conditions and environmental permits add to the difficulty of making progress. With the very long lead time infrastructure projects require for development, planning also is made more difficult because funding availability is sometimes jeopardized during lengthy delays. Private-sector interviews revealed an impatience with the planning process to yield results that will make a difference for their businesses, even for medium-term planning such as site selection and service planning, especially when the uncertainty of project schedules is taken into account.

Long-term transportation planning can have difficulty keeping current with more-rapidly changing private-sector practices that are driven by industry trends external to the region. For example, changes driven by the growth of e-commerce affect air cargo, while also shifting demand in trucking toward more time-sensitive parcel deliveries.

Another issue identified was the need for additional modern distribution centers. With the increase in e-commerce and individual product count proliferation, freight shippers are seeking larger distribution facilities to concentrate and sort inventories, and to ship them across the country. There is a desire for recognition that tolling of trucks can be an acceptable cost of doing business and an effective demand management initiative as long as the toll revenues are used for the transportation system, and not punitive to favor other modes. In addition, planning must take into account added security costs for operations in less secure areas, especially if time-of-day shifting to night hours is adopted as policy.

Concluding Observations

Metropolitan area goods movement strategies and programs need to balance public-sector and private-sector needs to improve freight mobility more quickly. Small-scale improvements and operational changes completed in the shorter term can help build acceptance for larger scale projects bundled together in the long-term planning context.

Freight strategies for such a complex community as the Greater Los Angeles area may not be needed or appropriate in other metropolitan areas. As a gateway city, Los Angeles is both the start and the end of the domestic portion of many international supply chains. Its freight problems and issues are not the same as those of inland cities such as Chicago, Illinois; Kansas City, Missouri; or Dallas, Texas. In addition, its freight problems involve a complex mix of affected urban areas in which challenges that have a smaller scope may not command as much attention as they would from MPOs facing less massively complex systematic planning.

The region's success in improving freight mobility is a result of public-private partnerships; goods movement advocates and thought leaders; studies that have produced innovative strategic recommendations; a willingness to prioritize and fund freight-focused infrastructure improvements; and an ongoing commitment to identifying emerging trends in freight logistics and to modifying their approaches accordingly, through project bundling, branding, and outreach.

New York, New York

New York City Truck Movement: Freight Parking and Loading Zones, Loading and Parking Restrictions, Removal of Intersection Constraints, and Truck Routes

Introduction

New York City is the most populous city in the United States, with a resident population of 8.4 million, and an additional 52 million visitors per year. New York City is a global finance and banking center, and has significant activities in media, fashion, entertainment, real estate, construction, manufacturing, and commercial property. As one indication of this business activity, the city hosts more Fortune 500 company headquarters than any other city in the United States. All of these residents, visitors, and businesses vie for space within the 302 square miles that comprise New York, New York.

New York City and its five Boroughs (Manhattan, Bronx, Brooklyn, Staten Island, and Queens) also form part of the wider New York Metropolitan Transportation Council (NYMTC) region, which includes Long Island and the Lower Hudson Valley. The NYMTC region planning area covers 2,440 square miles and has a population of 12.4 million, which is approximately 64% of New York State's population, based on 2010 Census counts.

The lead transportation agency within the city is the New York City Department of Transportation (New York City DOT). Its mission is to provide safe, efficient, and environmentally responsible movement of people and goods, and to maintain and enhance the transportation infrastructure.

With a budget of more than $2 billion and with 4,700 employees, the New York City DOT is responsible for the operation and maintenance of 6,300 miles of streets and highways, nearly 800 bridges, 1.3 million street signs, 300,000 street lights, and 12,000 signalized intersections, as well as the nation's busiest commuter ferry service, the Staten Island Ferry, which carries more than 22 million passengers annually.

To achieve its transport mission, the New York City DOT works with the New York State DOT and other regional bodies, such as the Port Authority of New York and New Jersey (PANYNJ) and the New York City Metropolitan Transportation Authority (MTA), as well as with other New York City government departments and agencies such as the Department of City Planning, New York City Economic Development Corporation, and the Department of Environmental Protection.

In 2007, the New York City DOT established an Office of Freight Mobility to improve public safety; provide a high quality of life for residents; balance goods movement with other uses of curb, street, and highway space; and support the city's economy. This office manages the New York City truck-route network, which mitigates the impact of truck movements on residential communities.

New York's highway network is constrained. Significant elements of the network, such as the parkways and the lower Manhattan street network, were not designed for today's large freight vehicles, nor for the volume of traffic. The New York City–Newark region was ranked Number 1 in the Texas Transportation Institute's 2012 Urban Mobility Report for the most congestion experienced by the freight industry, with nearly 33.5 million hours of congestion, costing $2.5 billion annually. The New York–Newark region also had the second highest number of corridors (nine) ranked for truck delay.

Trucks account for 81% of all goods movement in the New York City region, with barge, rail, and pipeline traffic carrying the remainder. The New York City area also is served by freight rail,

though capacity and infrastructure constraints limit the amount of goods carried by this mode. A unique cross-harbor rail float bridge is used to facilitate the movement of rail cars between New York, Long Island, and New Jersey. Barge traffic is largely focused on the movement of bulk supplies, particularly fuels and aggregates. A number of the city's aggregate and concrete plants are adjacent to navigable waterways and receive their materials by barge, thereby reducing the number of trucks on the city's roads. Figure 19 illustrates the city's major road and rail network.

Such geographic features as the Hudson River also dictate that the city's traffic volume is funneled through Manhattan's 20 river crossings. Many of these are major crossings, such as the George Washington Bridge, which carried an average of 20,790 trucks per day in 2011. Significant concentrations of warehouses and logistic facilities are located around the periphery of New York City, including those across the Hudson River in New Jersey, and those in close proximity to PANYNJ facilities. New York's port is the third-largest seaport in North America, and John F. Kennedy Airport (JFK) is the eighth largest air cargo airport in the United States.

The city streets host cars, buses, taxis, cyclists, and pedestrians, in addition to the freight activity that is vital for the prosperity and livelihood of its residents and businesses. Approximately 180,000 truck trips are generated daily by Manhattan's 37,000 freight-related business establishments. The Hunts Point Terminal Produce Market (the largest food distribution center in the United States) generates approximately 3,800 truck movements to and from the market each day, serving the city's 6,800 food establishments. Studies suggest that truck and commercial traffic in Manhattan accounts for 8% of peak period vehicle miles traveled.

The New York City DOT has implemented several freight initiatives during the last several years. Some of these initiatives have addressed specific issues, such as truck routing and the adaptation of freight activity into new transportation plans and studies. Three cases are summarized here, along with highlights of the major issues, selected solutions, implementation information, project impacts, and lessons learned. Figure 20 shows the locations of each project.

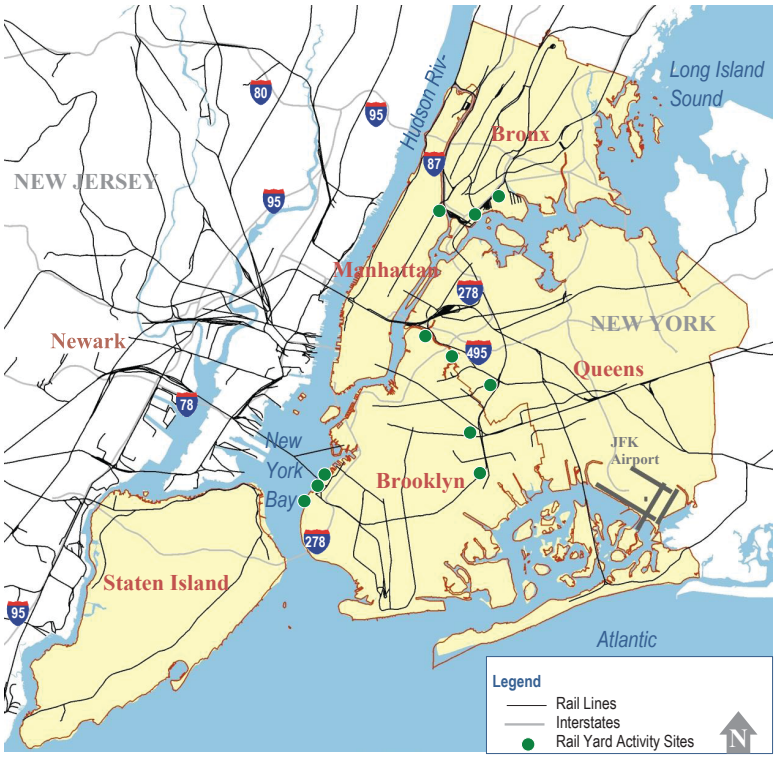


Figure 19. New York City's major road and rail network.

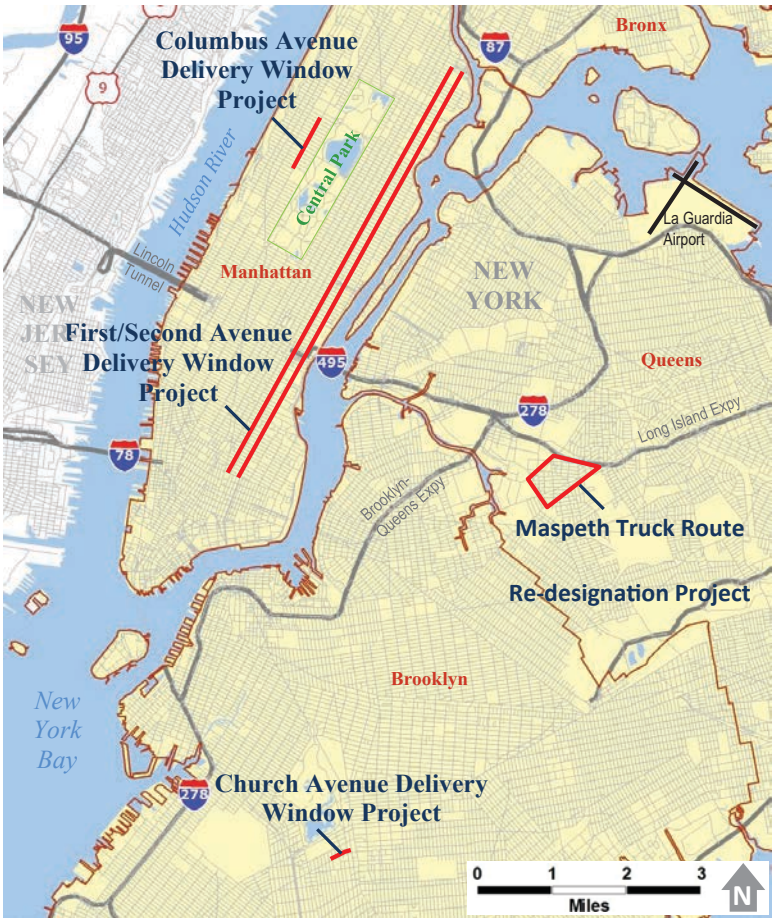


Figure 20. Project Locations in New York City.

The issues addressed by these projects include:

- **Church Avenue Delivery Window Project:** Traffic and parking congestion, combined with conflicting demands from a wide variety of users leading to the need for an improved freight delivery system, including the use of time-specific freight parking and loading zones (i.e., delivery windows).
- **Columbus Avenue Bicycle Path and Mobility Enhancements Project; First Avenue/Second Avenue Select Bus Service (SBS) Implementation Project:** A reduction in parking spaces, resulting from the implementation of larger scale projects geared toward improving conditions for transit and/or non-motorized users, leading to the need for specialized freight delivery allowances, including the use of time-specific freight parking and loading zones combined with loading and parking restrictions (i.e., delivery windows).
- **Maspeth Truck Route Redesignation and Intersection Improvement Project:** A heavy flow of truck traffic through a residential and local commercial district, leading to the need for a bypass study and truck-route redesignation with associated infrastructure upgrades, including the removal of intersection constraints.

The decision to implement freight projects like these is typically determined by the responsible public agency, such as the New York City DOT. That decision, and the scope of the initiative, may be based on a range of factors and considerations, including: the scale of the issue the project is seeking to resolve; alignment with the agency's plans, policies, and strategies; community and stakeholder feedback; number and type of road users using the street; congestion impacts; compliance with road and parking regulations; ease of implementation; and cost and available budget.

Case Study 5: Church Avenue Project Corridor, Brooklyn, New York

Traffic and parking congestion, combined with conflicting demand from a wide variety of users, led to the need for an improved freight delivery system, including the use of time-specific freight parking and loading zones (i.e., delivery windows).

Planning Guide Initiatives Discussed

- Initiative 7: Freight Parking and Loading Zones
- Initiative 8: Loading and Parking Restrictions

Overview

In 2011, the New York City DOT implemented a successful time-specific freight parking and loading zone (i.e., delivery window) project along the Church Avenue corridor from East 16th Street to East 21st Street (see Figure 21). Church Avenue is a major east-west corridor though the center of Brooklyn. It is a two-lane arterial with curbside parking on both sides of the street. The corridor includes significant commercial, residential, and retail development. Truck delivery operations in the larger Church Avenue area range from 150 to 700 per day. In addition to autos and delivery vehicles, the transportation system serves pedestrians, bicycles, and transit riders (subway and bus). The city's sixth busiest bus route, with 38,000 weekday riders, is along this corridor.

The project was developed in conjunction with the local community board, business improvement district (BID), and the New York City DOT. Traffic studies and surveys were conducted

Figure 21. Church Avenue Corridor.

prior to the development of this block-by-block plan, which balances the need for deliveries with the demand for parking. The project resulted in improved conditions for businesses, residents, shoppers, truckers, and others in the corridor.

Conditions Before Implementation

In advance of the delivery window implementation, studies of the corridor were completed to quantify the levels of congestion and parking supply and demand. An extensive community outreach effort also was conducted to help identify issues and potential solutions.

The results showed that the main issues were:

- **Chronic Congestion:** Daily traffic on this two-lane street (one lane in each direction) was approximately 14,000 vehicles/day in 2010. Travel speeds varied between approximately 6 mph and 10 mph during weekday and weekend peak periods, and were projected to decline further in the future. High delay, poor traffic flow, and recurring congestion were issues in the corridor (see Figure 22).
- **Lack of Loading/Unloading Spaces:** Most businesses in the corridor do not have off-street loading spaces. Street parking typically is occupied by cars. Curbside parking occupancies were observed to be 50% during the weekday a.m. peak, 91% during the weekday midday peak, 83% during the weekday p.m. peak, and 103% during the Saturday midday peak. This situation left little room for commercial loading/unloading.
- **Double-Parking:** At least one travel lane was blocked or partially blocked by a double-parked delivery vehicle about 25% of the time on a typical weekday, from 6:00 a.m. to 6:00 p.m. The double-parking caused significant congestion, with drivers having to edge into the opposing lane to pass the double-parked vehicles. This was a particular issue during the midday and afternoon time periods, as shown in Figure 23. On each observation day, more than 30 double-parked vehicles were observed, resulting in a total of 4.5 hours to 6 hours of lane blockages.
- **Sidewalk Congestion:** Pedestrian volumes are high in the Church Avenue corridor, with some areas experiencing sidewalk congestion.
- **Pedestrian Safety:** A 3-year crash inventory indicated a total of 296 crashes within the larger Church Avenue corridor, over 100 of which involved pedestrians.

Figure 22. Chronic congestion.

Figure 23. Typical double-parking activity.

Economic Impacts

The congestion on Church Avenue affected freight carriers, local businesses, the local population, and through travelers (bus and auto modes). Freight carriers were impacted by increased citations and delivery times, including time spent looking for a place to park.

In New York City, the majority of the $550 million paid per year in parking tickets is borne by commercial firms, with some delivery firms paying well over $4 million per year. Local businesses are affected through increased delivery costs and reduced customer convenience, which potentially translate into higher costs and lower revenues.

Impacts on the local population include additional time costs as drivers search for parking spaces, and potentially higher parking costs if they choose to pay more for parking or park illegally (with the strong possibility of tickets). The road and bus user costs center around increased travel times through the corridor. Without action by the New York City DOT, these various costs would not just continue, they would increase over time.

Regional Approach/Initiative

The implementation of freight parking and loading zones as well as loading and parking restrictions (i.e., delivery windows) along Church Street between East 16th Street and East 21st Street was selected as one of the main solutions to the issues identified. That portion of the corridor has 90 metered parking spaces (including some on side streets). The new parking regulations reserve 40 of these metered spaces for weekday truck deliveries during the hours of 7:00 a.m. to noon.

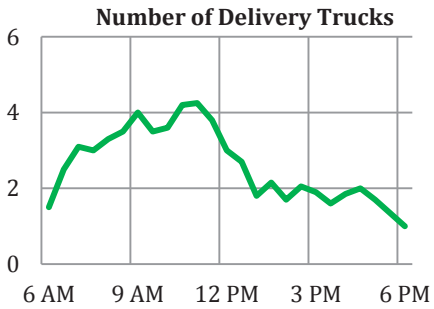


Figure 24. Commercial delivery activity.

Surveys indicated that 65% of deliveries to the area were already occurring before noon, which was one reason for selecting the morning hours for the primary delivery window (see Figure 24). In addition, many of the retail businesses needed customer parking primarily in the afternoon, making the afternoons the most congested time period. For businesses that need deliveries after noon, truck loading and unloading spaces are available until 3:00 p.m. on weekdays on the north side of the street between East 18th and 19th Streets. After the designated loading periods, normal 1-hour metered parking resumes for all vehicles. Figure 25 presents a map of the designated time-specific loading zone (delivery window) spaces. These delivery window spaces are identified by curb regulation signs and parking meter decals, as shown in Figure 26.

The project was developed in close coordination with the community, including residents, businesses, transportation providers, community board members, elected officials, local government agencies, and various interest groups. Due to the continued involvement of these groups and individuals during the development phase, implementation was well supported.

Information on the new parking changes was well advertised on the following websites, both before and after the January 17, 2011, implementation date: New York City DOT website, the Church Avenue BID website, the Brooklyn Community Board 14 website, and streetsblog.org.

An important part of the implementation process was to step up enforcement of traffic laws and regulations through coordination between the New York City DOT, New York Police Department (NYPD), the MTA, and other key agencies to ensure that maximum benefits would be achieved. The freight parking and loading zones and loading and parking restrictions were

Figure 25. Map of delivery windows.

Figure 26. Delivery window signs.

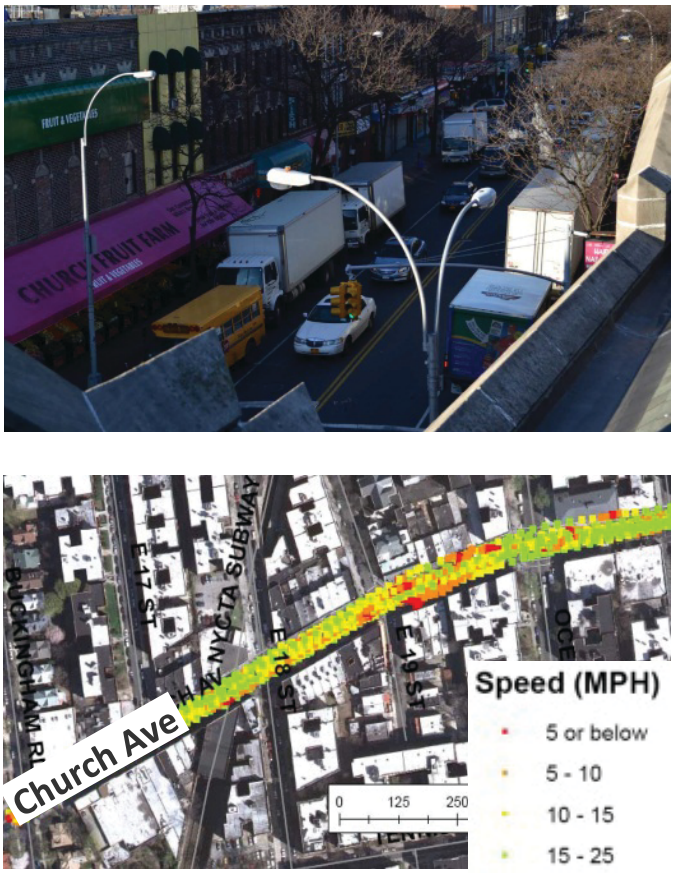


Figure 27. Travel speeds after delivery window implementation.

implemented along with other corridor traffic and street improvements, so it is difficult to isolate the benefits of the delivery window project with respect to traffic flow and travel speeds (see Figure 27). However, for the overall corridor improvement project, corridor travel speeds improved substantially.

- Between 8:00 a.m. and 9:00 a.m., travel speeds increased from 7.5 mph in January to 9.1 mph in April; a 21% increase. Figure 27 shows the higher speeds in the corridor after implementation.
- Travel times are also more reliable, with a 19% lower standard deviation.

The construction cost of the Church Avenue delivery window project is estimated to have been less than $10,000. There were additional soft costs, such as 1 year of planning and outreach, consultant costs related to a curb utilization survey, and printing costs related to outreach and initial implementation.

Stakeholder Engagement

New York City DOT was responsible for implementing the delivery window program, including the study, design, signs, striping, and public coordination. The NYPD was responsible for enforcement of the new regulations, including ticketing and towing. The local community board and other public or nonprofit entities assisted the DOT with publicizing the changes, so that all businesses were aware of the changes in advance. This project presented the DOT with challenges that included extensive local stakeholder engagement, identifying the correct

operational issues, and developing and implementing a low-cost feasible solution. One of the most significant challenges, however, was to develop a solution that balanced the needs of the various stakeholders: business owners, delivery drivers, local residents, transit riders, pedestrians, passenger car drivers, and others. These stakeholders all competed for use of the available roadway and curb space. The solution had to take these different users into account, balancing their interests to successfully reallocate curb space among them while improving safety and traffic flow. Accomplishing these goals was both a technical challenge and a public engagement challenge.

Business owners, residents, and commercial drivers were very pleased with the outcome of the project. "We are delighted that this important and thorough study has come to fruition, thanks to the Department of Transportation's very close collaboration with Community Board 14, the merchants on Church Avenue, and the community at large," said Doris Ortiz, district manager for Community Board 14. "Now the city of New York is delivering exactly what Church Avenue needs to keep it thriving!" Other comments received included:

- "I can't say enough about it" (truck driver)
- "One of the finest programs" (MTA bus manager)
- "Best thing done east of Flatbush" (traffic agent)
- "Pedestrian crossings [are] not blinded by congestion" (MTA bus manager)

Emerging Issues

BID staff spoke with several merchants and store employees after implementation of the delivery windows project. In general, they felt that the windows had improved delivery access, positively impacted delivery employees, and had little or no impact on their customers. However, a few issues were mentioned:

- **Non-Commercial Delivery Vehicles:** This was the most common complaint. Many stores receive deliveries from non-commercial vehicles, including stores whose owners have several stores and use personal vehicles to deliver goods between those stores. The non-commercial delivery vehicles were getting tickets for using parking spaces during the delivery window.
- **Impacted Customers:** Although most businesses did not report any negative impacts on their customers, a few who had a higher proportion of customers arriving by car noticed that their customers were receiving tickets for parking during the delivery window, and were concerned that they might not return.
- **Continuing Congestion:** According to a few merchants, congestion continues to be an issue between 18th and 19th Streets after delivery windows end. Deliveries continue to occur throughout the day, and trucks are still double-parking (even though the delivery window is extended to 3 p.m. on this block).

Concluding Observations

Some of the lessons learned from this case study include:

- Collecting detailed freight activity information, including vehicle loading type, location, and duration data, is valuable for accurately assessing problems and developing the best solutions.
- Involving a wide range of stakeholders through early and ongoing public involvement can create project partners and advocates, and can improve project outcomes.
- Developing a simple, focused solution that addresses the critical issues and key geographic area can improve the chances of project success.

Case Study 6: Columbus Avenue, First and Second Avenues, Manhattan, New York

A reduction in parking spaces, resulting from the implementation of larger scale projects geared toward improving conditions for transit and/or non-motorized users, led to the need for specialized freight delivery allowances, including the use of time-specific freight parking and loading zones, combined with loading and parking restrictions (i.e., delivery windows).

Planning Guide Initiatives Discussed

- Initiative 7: Freight Parking and Loading Zones
- Initiative 8: Loading and Parking Restrictions

Overview

As multimodal projects are implemented along commercial corridors, a common outcome can be a reduction in parking spaces. Although the intent of such projects is to encourage travelers to use other modes besides the personal automobile, an unintended consequence is a reduced capacity for delivery vehicles. This case study describes two such projects designed to address these issues.

Columbus Avenue Bicycle Path and Mobility Enhancements Project

Columbus Avenue is a major north-south corridor on the west side of Manhattan. In 2010, a parking-protected bike path was installed from West 77th Street to West 96th Street. The project placed great emphasis on providing a safe environment for bicyclists while maintaining vehicular traffic capacity. The proposed concept maintained, but narrowed, the existing moving lanes, and created a "floating" parking lane with a 5-foot buffer and a 6-foot bike lane between the parking lane and the curb (see Figure 28). As a result of moving parking away from the curb, well over 50 of the existing 257 parking spaces were repurposed as turn lanes, mixing zones, or pedestrian islands, essentially reducing the parking capacity by more than 20%. Time-specific freight parking and loading zones (i.e., delivery windows) were implemented to minimize the impact of this loss of parking space. Subsequently, in 2013, the bike path project was extended north to West 110th Street and south to West 59th Street. With the extension project, some parking spaces were gained (because of the conversion of a rush-hour travel lane to parking north of West 96th Street), while other spaces were eliminated, mainly south of West 77th Street.

Figure 28. Columbus Avenue configuration with added bike lane.

Again, delivery windows were part of the initiative to minimize delivery impacts on businesses, with new delivery windows implemented in both extension areas.

First Avenue/Second Avenue Select Bus Service Implementation Project

On the east side of Manhattan, First Avenue and Second Avenue are parallel roads, 1 block apart. First Avenue traffic is one-way northbound, Second Avenue traffic is one-way southbound. The study area extended 8.5 miles along both avenues between South Ferry Station and 125th Street. The primary issues driving the overall SBS project were the need to improve bus travel times and customer service. One of the main components of the project was to provide a continuous bus-only lane along First Avenue and Second Avenue between Houston Street and 125th Street. Before that, bus lanes were only present along certain segments of each street. Along some blocks in these corridors, the newly designated bus lane replaced an existing vehicular travel lane. On other blocks, however, the bus lane replaced the curbside parking area. To help mitigate the loss of parking, delivery windows were designated in certain areas.

Conditions Prior to Implementation

In both project locations, but particularly along the First Avenue/Second Avenue corridor, due to its length, land uses can vary significantly from commercial to residential, and many areas are mixed. Thus the transit, traffic, parking, and delivery demands vary throughout the corridors. Furthermore, most of the businesses and residential buildings do not have off-street loading areas, so access to curb space for delivery vehicles is vital.

Data collection performed before implementation indicated that parking and loading space demand is high in both project locations. Survey results reported that business owners along the Columbus Avenue corridor receive from eight deliveries to more than 60 deliveries per week. In addition, a parking inventory, conducted before construction of the First Avenue/Second Avenue project, indicated a total of just over 1,800 spaces on each avenue. The inventory also collected usage data. Table 59 shows, by community district (CD), the busiest hours of the day and how many spaces were occupied during those hours. As shown in the table, some areas had available parking capacity, while two areas exceeded their legal capacity during peak demand hours.

Economic Impacts

Along both corridors, some business owners viewed the respective projects as potentially negative. Reductions in parking would limit delivery vehicle and shopper parking options, with

Table 59. Peak weekday parking demand.

	Time	Demand	Supply	%
First Avenue				
CD 3 (south of 14th)	12:00 noon	165	215	77%
CD 6 (14th to 59th)	11:00 a.m.	440	668	66%
CD 8 (59th to 96th)	11:00 a.m.	510	502	102%
CD 11 (north of 96th)	12:00 noon	430	424	101%
Second Avenue				
CD 3 (south of 14th)	1:00 p.m.	155	196	79%
CD 6 (14th to 59th)	12:00 noon	375	679	55%

possible impacts on both revenues and costs. Fewer spaces would likely mean increases in freight delivery parking violations as well, increasing parking ticket costs for freight delivery firms. Time spent looking for parking would increase for both commercial and non-commercial drivers. Therefore, time-specific freight parking and loading zones (i.e., delivery windows) combined with parking and loading restrictions were considered to limit the potential impacts of the proposed changes in both of the project corridors.

Regional Approach/Initiative

In both corridors, the project sponsors recognized that providing sufficient freight parking and loading zone space, coupled with loading and parking time restrictions, was very important to achieving the desired project outcomes. Extensive outreach efforts were undertaken for both projects to collect data and information from businesses.

Columbus Avenue

The Columbus Avenue time-specific parking and loading zone (i.e., delivery window) program seeks to restrict the parking spaces along particular blocks to commercial vehicles only during certain times of the day, as shown in Figure 29. The time allotted per delivery vehicle is 30 minutes. The exact regulations, including which hours and days are restricted, vary by location, as noted in the figure.

To implement the delivery window/loading zone portion of the project, New York City DOT staff collected detailed before-implementation data, including parking and loading space inventory and usage information. Site visits took place with Columbus Avenue businesses and the American Museum of Natural History (AMNH) in May 2010. New York City DOT staff specifically visited businesses in the corridor to review their need for loading and delivery spaces. Overall, New York City DOT spoke with 189 businesses before implementing the project. A Truck Loading Delivery Initiative was developed, as well as an AMNH draft-loading plan. The delivery window/loading component was implemented with the overall bike lane restriping project.

When the implementation was complete, the New York City DOT collected after-implementation data. For the overall bike lane project, 6-month and 12-month assessments were completed to determine the impact of the project. The after-implementation data showed that the majority of vehicles using the delivery window spaces were single-unit trucks (>60%), followed by a smaller number of commercial vans (30%). Tractor-trailers also were observed using the spaces, but in far fewer numbers (<10%). The average duration for commercial vehicles using the delivery window spaces ranged from 15 minutes to 40 minutes, depending on the location. (The maximum legal duration is only 30 minutes).

Based on the before-and-after data, the first phase of the bike path project appears to have encouraged increased cycling activity without substantially impacting traffic flow. In fact, average corridor travel times decreased. The safety-related findings did not appear to be conclusive.

The project also seems to have reduced the total number of commercial vehicles parking in the study area, with a 20% decrease (from more than 180 to approximately 140) for a six-block area (Figure 30). The vast majority of this reduction was in vehicles that were illegally parking in travel lanes. With the new delivery windows, the percent of commercial vehicles parked in a travel lane (or mixing zone) decreased by nearly half, while the number of legally parked vehicles remained relatively constant.

Given that a number of changes were made in the corridor, the decreased travel time likely resulted from numerous factors. The delivery windows are, however, considered to have been a contributing factor. The improved travel times are illustrated in Figure 31.

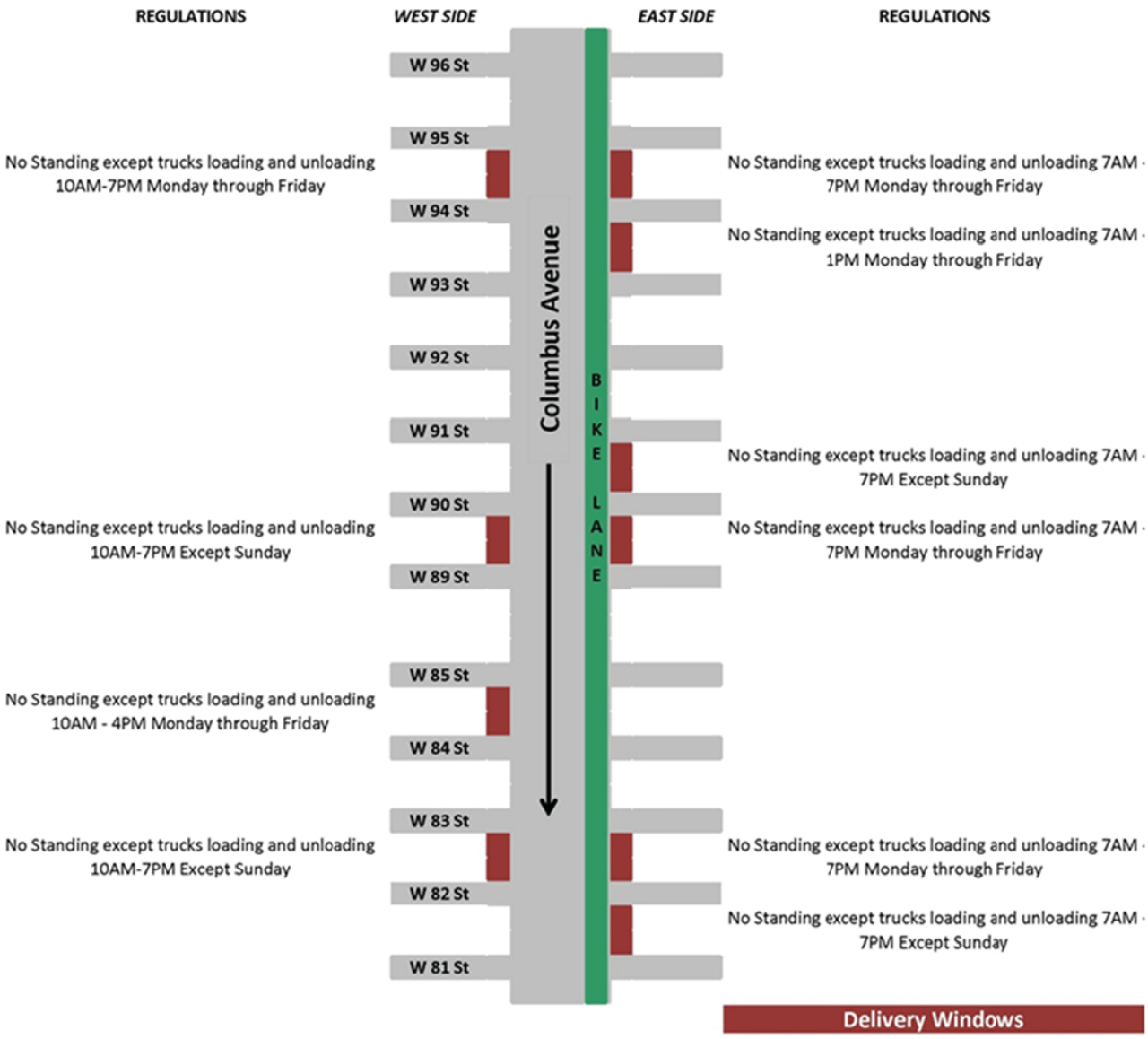


Figure 29. Delivery windows.

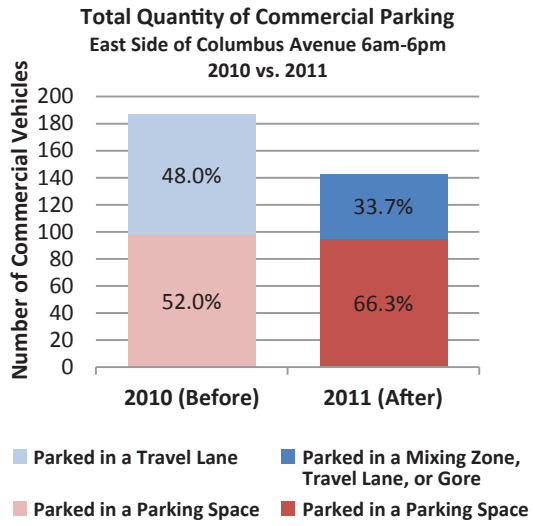


Figure 30. Decrease in commercial parking.

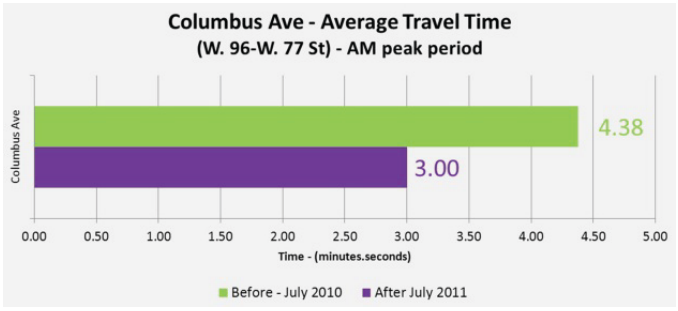


Figure 31. Improvement in travel times.

Table 60. Daytime loading zones.

Block	Business
107th–108th	WS Movers
106th–105th	Adel Wine; 99 Cent Store
98th–97th	Duane Reade
76th–75th	Duane Reade
74th–73rd	Pioneer Supermarket

The Columbus Avenue BID that overlaps with the project area was also found to have 100% occupancy in March 2012, approximately 1 year after the project was completed.

The second phase of the parking-protected bike path project included two sections, one to the north and one to the south. To the north (West 110th Street to West 96th Street), the right-most lane was used as a through lane during the weekday a.m. peak period. Because of low usage, it was determined that this lane could be converted to full-time parking, returning 105 parking spaces to that part of the corridor.

In both the northern and southern bike path extension sections, loading zones were incorporated into the design. Certain locations were identified where these zones should be implemented. Approximately 30 regular parking spaces were eliminated to add these loading zones; however, the zones are available for overnight and weekend community parking. Table 60 identifies the blocks where the loading zones were implemented and the main business served by those zones.

Based on data from the New York City DOT, the cost of implementing delivery window projects is approximately $2,500 for 6 to 30 signs. The number of signs that can be installed depends on how many signs must be mounted on new posts, and how many can be mounted on existing poles and posts. This does not include the soft costs of planning, public outreach, data collection, and so forth.

First Avenue/Second Avenue Project

Using the information gathered during the business outreach effort, time-specific freight parking and loading zones (i.e., delivery windows) were viewed as a potential measure to counter the loss of delivery/parking spaces. Weekday delivery windows were created within the curbside bus lanes to provide adequate curb space for loading and deliveries. The curbside bus lanes are in effect as bus-only lanes from 7:00 a.m. to 10:00 a.m. and 2:00 p.m. to 7:00 p.m. on weekdays (Monday through Friday; see Figure 32). During the midday time period (10:00 a.m. to 2:00 p.m.), selected portions of the curbside bus lanes are available for loading and deliveries only. These same areas are generally available for parking from 7:00 p.m. to 7:00 a.m. on weekdays, as well as on weekends. These restrictions are enforced by both video and police presence. Fines for violations vary from $115 to $150. The locations of the commercial loading zones are shown in context with the other parking regulations along the corridor in Figure 33. Some segments of the SBS used offset bus lanes, which maintained a curb parking and/or delivery lane. Where these offset lanes were used, delivery windows were not required.

Stakeholder Engagement

The New York City DOT was responsible for implementing both projects (along with the MTA in the case of the First Avenue/Second Avenue Project), including the delivery window program components. The NYPD was responsible for enforcing the new regulations, including

Figure 32. Bus regulation sign.

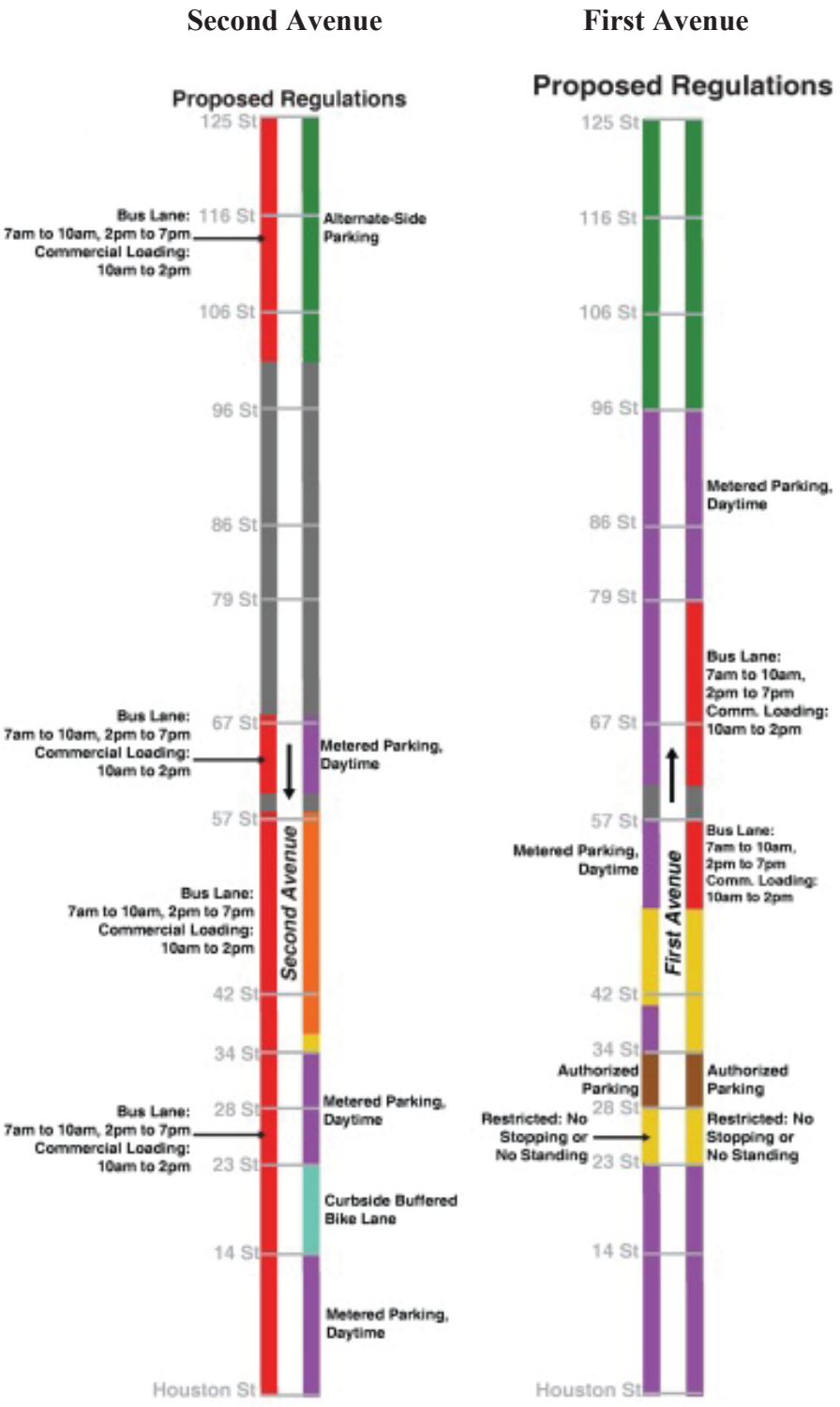


Figure 33. New parking regulations on First Avenue and Second Avenue.

ticketing and towing. Local community boards also were involved in the development and implementation of both projects.

The major challenge associated with the First Avenue/Second Avenue project was how to achieve the project's objective of significantly improved bus service against a background of a reduction in available curb space that could be assigned to loading and parking. Stakeholder engagement also proved challenging, especially with regard to the freight industry. Issues and challenges with this project resembled those present for the Columbus Avenue bike lane project. For that project, one-on-one interviews with truck drivers and business owners had provided feedback on specific issues. On both projects, city staff made numerous presentations and reached out to a wide range of constituencies.

To date, little feedback has been received on the delivery window component of the First Avenue/Second Avenue project. On the Columbus Avenue project, despite seemingly positive results, a number of concerns have been identified related to the project, as well as some criticism from local business owners. For example:

- Complaints from business owner interviews
  - The 30-minute delivery limit is seen as too short.
  - Business has declined due to bike lane and delivery windows.
  - Business has been hurt by loss of parking and increase in tickets.
  - Deliveries are "slower."
- Complaints from truck driver interviews
  - Delivery window spaces are being used by cars with placards.
  - Delivery window signs do not specify the 30-minute time limit.
  - Double-parking is faster than trying to use the delivery window spaces.

Emerging Issues

Both delivery window projects seemed to address the issues related to the loss of delivery spaces; however, there were some unresolved issues. Notably, the delivery window maximum duration did not seem to match the delivery demands on some blocks. In addition, the maximum duration was not posted on the signs, leading to confusion on the part of some delivery drivers. Feedback highlighted additional issues that were still perceived as unresolved.

As New York City develops its SBS program throughout the city, delivery windows have been considered one potential initiative for providing sufficient access for business loading and delivery activity. For example, midday delivery windows were incorporated into the retail core of the new SBS corridor on Fordham Road to facilitate pick-ups and deliveries during the late morning and early afternoon. These delivery window times and locations were set up in coordination with the local businesses. Delivery windows have also been considered for the Nostrand Avenue SBS project. In each case, the delivery window implementation concepts have been slightly different with regard to time and location, but the general principles have remained the same.

Concluding Observations

The major lessons learned from these projects include:

- Designing time-specific freight parking and loading facilities into street improvement plans from the beginning can yield improved outcomes and increased effectiveness.
- Working closely with local businesses and community groups to identify the specific delivery and parking needs provides better information for assessing potential problems, developing plans, and implementing improvements.
- Involving the public and corridor stakeholders extensively can benefit the project, but it does not guarantee that all parties will be pleased with the final plan or project.

- Quantifying delivery activity through surveys and other data-gathering activities provides the information necessary for project development with regard to delivery window locations, timeframes, and allowable loading durations.
- Developing and signing delivery window times and durations to meet the observed local freight loading needs is very important.
- Post-implementation data gathering is useful for assessing the effectiveness of a parking and loading zone plan.
- Publicizing the delivery window guidelines/regulations is vital, and partner organizations can help with this effort.

Case Study 7: Maspeth Truck Route Redesignation, Maspeth, New York

A heavy flow of truck traffic through a residential and local commercial district led to the need for a bypass study and truck-route redesignation with associated infrastructure upgrades.

Planning Guide Strategies Discussed

- Initiative 19: Truck Routes (Redesignation)
- Initiative 5: Removal of Geometric Constraints at Intersections

Overview

The New York City DOT commissioned a study of the truck activity within the Maspeth area of Queens, New York. The study findings supported the need to design and implement strategies to improve traffic circulation, alter truck routing, and enhance safety in the industrial and residential neighborhoods bounded by Grand Avenue, the Queens-Midtown Expressway (commonly referred to as the Long Island Expressway, I-495), and the Brooklyn Queens Expressway (I-278) (See Figure 34). After completion of the study, the New York City DOT

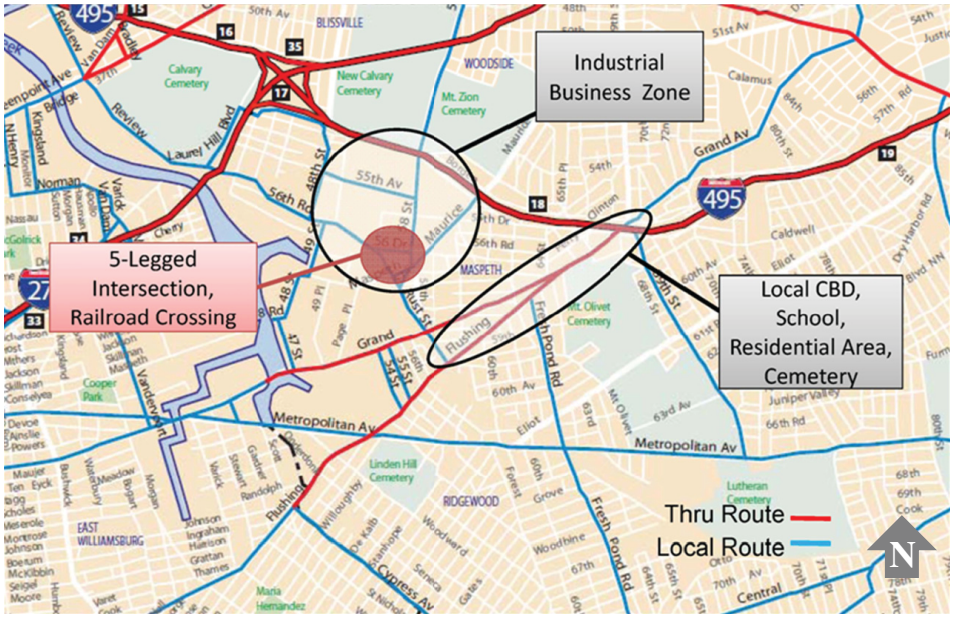


Figure 34. Location map and areas of interest.

worked closely with the local community and stakeholders to implement the recommendations, including a truck-route redesignation and the removal of intersection constraints along the new truck route.

Conditions Prior to Implementation

Maspeth is a community in central/southern Queens that has a mix of commercial districts, local shops, residential neighborhoods, and industrial/warehousing facilities. The area also falls within two community boards: Queens Community Board 2 in the north, and Queens Community Board 5 in the south. At the beginning of the New York City DOT study, Grand Avenue served as a major truck route in Community Board 5, given its direct connection between the industrialized areas of Maspeth and the Queens-Midtown Expressway, despite traversing through predominately residential and light commercial land uses close to the Interstate (see Figure 35).

The conflict between the heavy truck traffic and the local commercial and residential land uses along the Grand Avenue corridor was the main issue to be addressed by a potential truck-route redesignation project. The challenge was to find a more acceptable alternate truck route in terms of adjacent land uses that would not negatively impact truck travel times. Cost was also a factor, as was the input from multiple stakeholders, including both residents and local business owners.

Economic Impacts

The current condition had negative economic impacts for local residents and some businesses. Higher-than-average accident rates on the existing truck routes impacted both local residents and through travelers. Residents suffered the costs of parked cars being struck by trucks. Traffic congestion and blocked roadways also affected all road users.

Figure 35. Diverse land use.

Regional Approach/Initiative

The goals of the study were to (a) identify and recommend a solution based on existing conditions analyses, (b) develop and implement conceptual plans, and (c) assess the effects of the roadway changes. These goals were undertaken in a multiphase process.

In Phase I, the existing conditions and issues were identified. The identification involved extensive advance data collection, including a truck origin/destination survey. Multiple opportunities for public and stakeholder involvement were also used, including: three open houses (one for the general public, two for industries), seven presentations to community boards and committees, and 15 site visits (11 with business stakeholders, four with civic groups). The following key issues were identified by stakeholders:

- Cut-through and off-route trucks
- Accidents, safety, trucks hitting parked cars
- Air/noise pollution
- Bypass feedback
- Enforcement issues
- Suggested changes to traffic operation

In Phase II, the analysis from Phase I was furthered, leading to a final recommendation for the proposed truck-route redesignation, including the removal of intersection constraints. The New York City DOT and its team developed innovative tools and solutions to aid in the DM process. Video-based data collection and GPS recorders were used, and a website was developed and deployed to share data among departments; phone apps were used to collect travel time and delay information, and to respond as quickly as possible to any issue identified at any of the public meetings. These methods proved effective in overcoming the project challenges.

The final recommendation advanced from Phase II was to reroute trucks off Grand Avenue on to 58th Street/Maurice Avenue. The new truck route was carefully analyzed and determined to be the best solution despite one key issue: the re-routing would force additional trucks through a complex and potentially unsafe five-legged intersection at Maspeth Avenue/58th Street/56th Terrace/Maurice Avenue (shown in Figure 36). The New York City DOT was concerned that drivers unfamiliar with the intersection might have issues navigating through the complex intersection, which could create an unsafe condition.

Figure 36. Five-legged intersection.

As a consequence of this issue, the New York City DOT would not approve the proposed truck-route redesignation unless the constraints posed by this intersection were eliminated and other traffic impacts associated with the proposed re-routing of traffic from Grand Avenue to the Maspeth industrial area were addressed. Multiple options were considered for the normalization of the intersection; the preferred option is shown in Figure 37. The selected option was a low-cost but highly effective option that did not require new roadway construction. It used signing and striping changes to successfully address a number of vehicle and pedestrian operational and safety issues.

Phase III focused on implementing the concept plans developed during Phase II. Detailed comprehensive signage plans, pavement-marking plans, and geometric plans were developed to implement the truck-route redesignation project and construct the intersection improvement project.

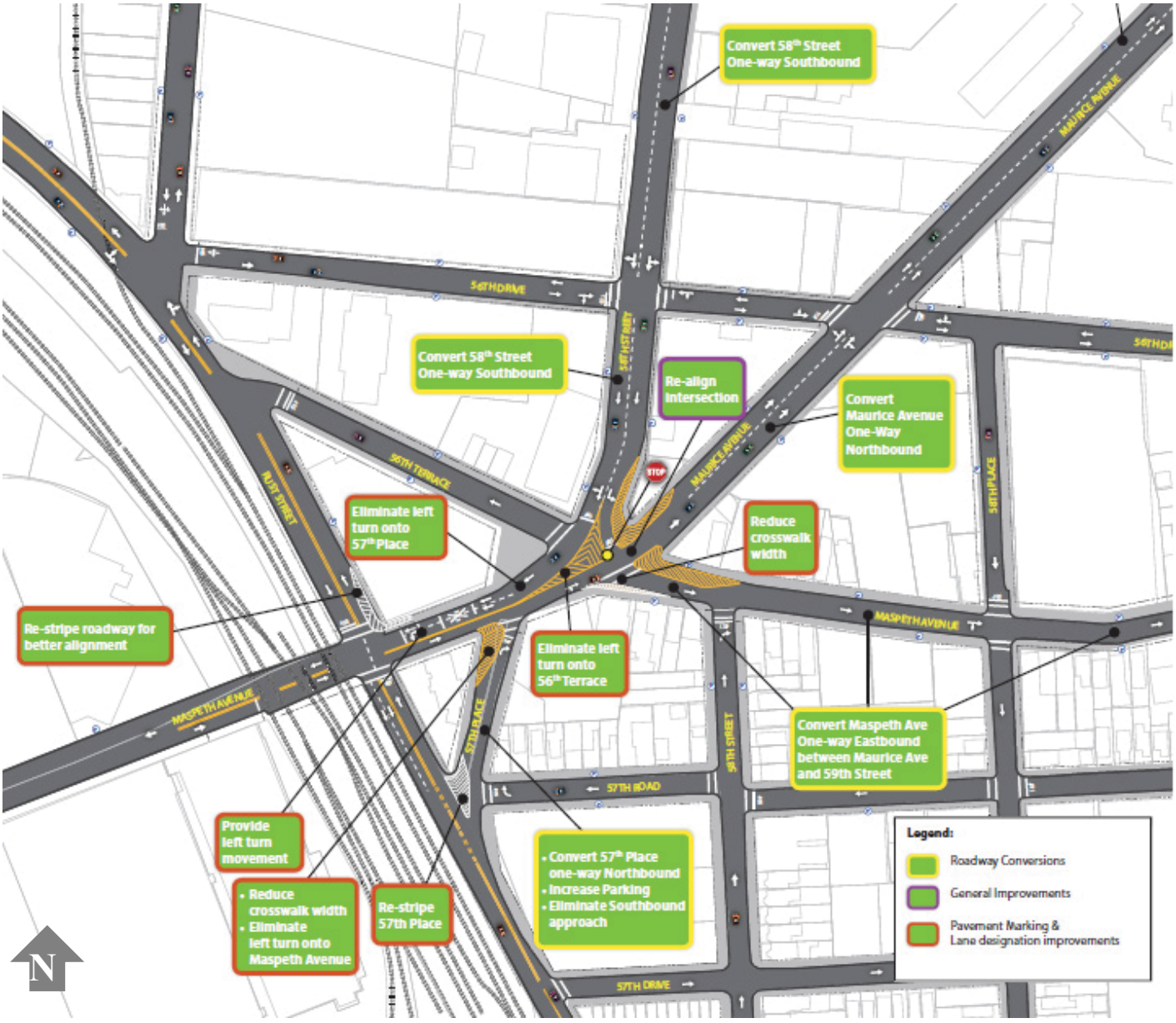


Figure 37. Preferred normalization option.

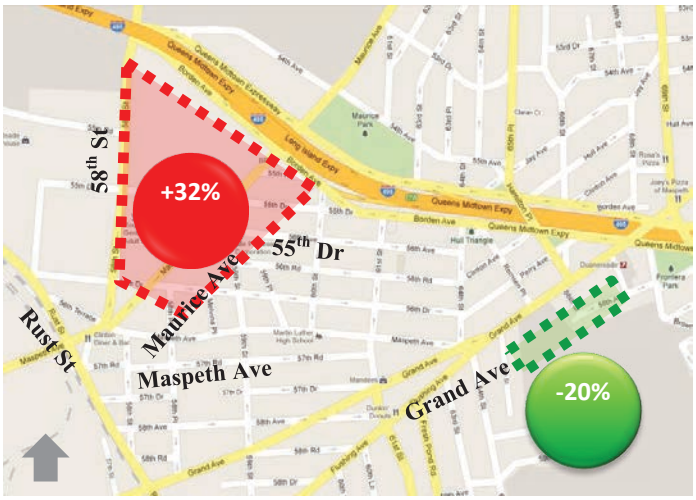


Figure 38. Impact of bypass project on truck traffic.

Phase IV involved monitoring of the redesignation after implementation. The average weekday street-segment volumes were compared before and after the implementation. A comparison of weekday traffic counts along Maurice Avenue, 58th Street, and Grand Avenue illustrates that an overall decrease occurred in traffic along Grand Avenue in both the northbound and southbound directions.

In addition, the peak-hour truck volumes were compared before and after the implementation of the redesignation project. Overall, truck traffic decreased along Grand Avenue and Borden Avenue and increased along 58th Street and Maurice Avenue (the new truck route). Additionally, truck traffic increased along 55th Drive because of the conversion of Maurice Avenue from a two-way to a one-way roadway. Figure 38 illustrates the shift in truck traffic.

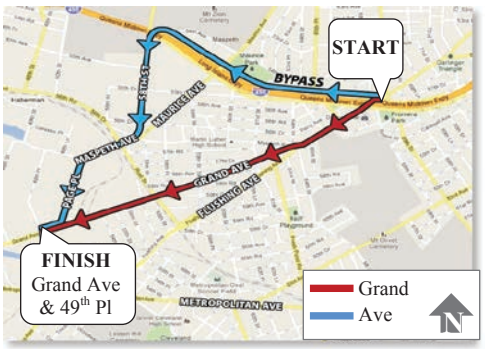
As shown in Figure 39, travel times along the new westbound truck route were approximately 1 to 1.5 minutes longer than the Grand Avenue route during the a.m. and midday periods, but about 20 seconds faster during the peak p.m. hour. In the eastbound direction, the observed travel times were faster on the new route during all three peak-hour conditions. In the westbound direction, the approximately 60- to 90-second increase in overall travel time during the a.m. and midday peaks is comparable to missing a green light at a signalized intersection in the corridor.

Overall, the proposed truck-route redesignation either maintained similar travel speeds in the westbound direction or significantly improved travel speeds in the eastbound direction. Local traffic flows along both Maurice Avenue and 58th Street also improved.

As part of improving the intersection of 58th Street/Maurice Avenue/Maspeth Avenue, the proposed truck-route change required the conversion of multiple two-way streets into one-way streets. The newly created one-way streets have provided opportunities for loading and unloading zones to access local businesses along the bypass. In addition, reduced delays were observed along the bypass, as vehicles can now bypass any double-parked vehicles, improving traffic flows within the Maspeth industrial area (see Figure 40).

Stakeholder Engagement

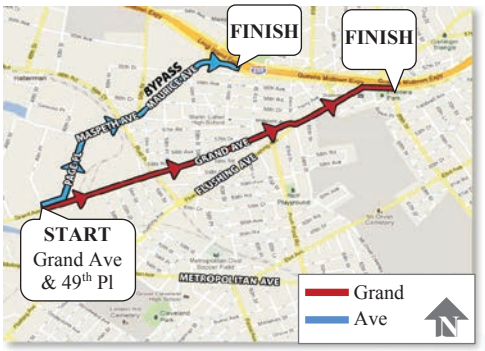
The project was approved by all stakeholders in mid-July 2011. The truck-route redesignation was implemented, along with the intersection normalization changes, starting October 1, 2011. Given the nature of the improvements selected, there was no need for a separate funding plan; the installation could be completed under existing maintenance contracts. This project faced



Westbound

Two-Day Average Travel Time Comparisons

Route	AM 8-9 AM (min)	Midday 12-1 PM (min)	PM 5-6 PM (min)	Dist (mi)	# of Traffic Signals
Bypass	7.0	6.3	5.5	2.0	8
Grand Ave	5.4	5.3	5.8	1.4	11
% Diff	30%	19%	-5%	---	---



Eastbound

Two-Day Average Travel Time Comparisons

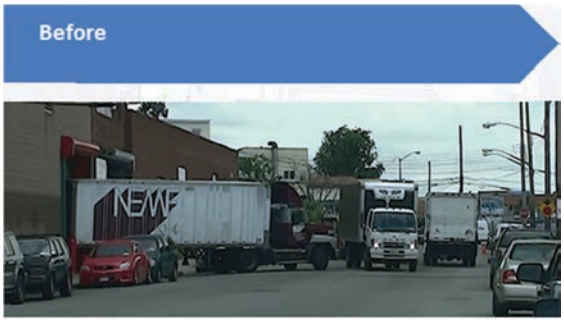
Route	AM 8-9 AM (min)	Midday 12-1 PM (min)	PM 5-6 PM (min)	Dist (mi)	# of Traffic Signals
Bypass	3.5	3.8	3.3	1.1	3
Grand Ave	6.0	6.5	8.0	1.4	10
% Diff	-42%	-42%	-59%	---	---

Figure 39. Impact of bypass project on travel speeds.

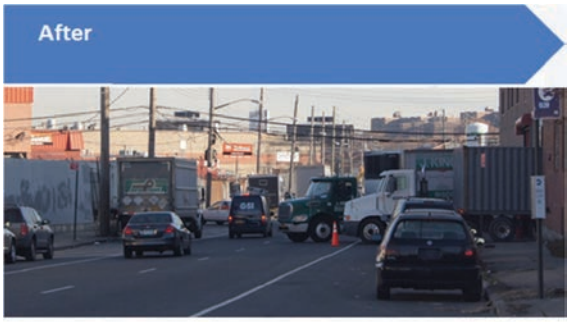
the challenge of engaging with numerous stakeholders that often had conflicting viewpoints and goals. This included coordinating with different agencies, including the NYPD, on enforcement matters and with local community boards to deliver an outcome that was suitable to local residents and businesses. Other challenges included limited funding, difficult technical issues (e.g., safety and traffic capacity needs), and a requirement that the team continue working until a feasible and affordable solution was achieved.

Emerging Issues

Since March 2011, the New York City DOT has coordinated with the NYPD to enforce the new truck-route rules with two goals: (1) to show the community that there is a commitment to

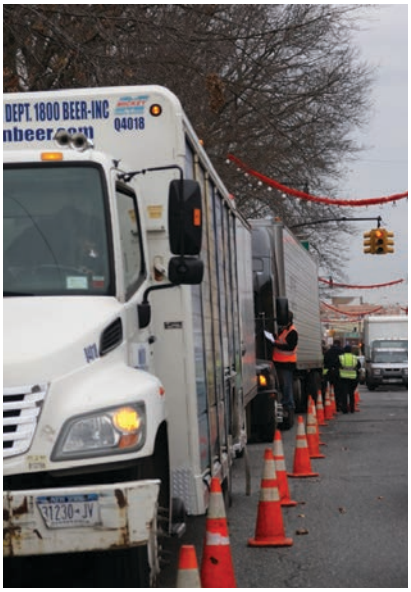


Maurice Avenue looking southbound. Northbound traffic is traveling in southbound lane to bypass truck loading activity.



Maurice Avenue looking northbound. One-way designation minimizes traffic conflicts near loading bays and provides additional parking capacity and loading/unloading areas.

Figure 40. Impact of bypass project on parking.



Date: March 15, 2012 Specify Survey Time: AM

Survey Location: Remsen Place and Grand Avenue

A. Survey - Direction of Travel? Please select one.
- ☐ Northbound (towards LIE)
- ☐ Southbound (towards Brooklyn)

A1. Type of vehicle? Please select all that apply.
- ☐ Box Truck (Specify Long or Short)_____
- ☐ Courier (FedEx, USPS, UPS, DHL, Other)
- ☐ Tractor-Trailer
- ☐ Van/Pick-Up Truck
- ☐ Dump/Waste Truck
- ☐ Other, specify_____

A2. Where are you coming from?
- ☐ Westbound I-495 (From Long Island)
  - ☐ If yes to above, did you use Exit 19 (Grand Avenue)?
  - ☐ Other, specify_____
- ☐ Eastbound I-495 (From Queens or Brooklyn)
  - ☐ If yes to above, did you use the Maurice Avenue Exit?
  - ☐ Other, specify_____
- ☐ Maspeth,
  - ☐ Specify_____
- ☐ Fresh Pond Road,
  - ☐ Specify_____
- ☐ 69th Street north of the LIE (from Queens)
- ☐ Grand Avenue north of LIE (from Queens)
- ☐ Grand Avenue south of Rust Street (from Brooklyn)
- ☐ Flushing Avenue south of Metropolitan (from Brooklyn)
- ☐

Additional Notes/Information

Figure 41. Truck intercept survey.

changing truck behavior; and (2) to encourage the truck drivers to use the bypass route. Between April 2011 and February 2012, 254 trucks were stopped on Grand Avenue within Community Board 5, and over 375 summonses were issued. Truck drivers were interviewed while they were pulled over, and asked to take a short survey on their knowledge of the bypass route and the origin and destination patterns (see Figure 41). Drivers also were provided with New York City truck-route maps and other regulation information. The results of the surveys indicated that the truck drivers were unaware of the bypass, and based upon the travel time savings and reduced number of signals, the drivers indicated that they would utilize the bypass for future deliveries.

Concluding Observations

The major lessons learned from this project include:

- Work closely with the local community and stakeholders to identify the critical issues and best possible solutions. Continue working with these groups through the implementation phase.
- Carefully identify and address issues that could arise due to shifting truck routes.
- Consider a variety of low-cost options; sometimes low-cost options can be very effective. They also offer opportunities for quick implementation.
- Persistence is important in a project that involves diverse and outspoken stakeholders.
- Enforcement and education are important to project success. Sufficient resources need to be allocated to these aspects of proposed projects.

Seattle, Washington

Puget Sound FAST Corridor Initiative: Freight Quality Partnerships, Upgraded Infrastructure, and Real-Time Information Systems

Introduction

The Freight Action Strategy for the Everett-Seattle-Tacoma corridor (FAST) program was developed more than 15 years ago in the Puget Sound region in Washington State to address

growing freight needs. In January 1994, Puget Sound business leaders created a Regional Freight Mobility Roundtable, which included private freight companies and public-sector transportation leaders. The group identified freight mobility issues and solutions. The group also created what they called a Recommended Regional Freight Mobility Action Package. The package was submitted to regional transportation leaders and ultimately became the FAST Corridor Initiative.

The region developed a strategy for prioritizing projects to proactively enhance regional freight mobility instead of waiting to address them when freight volumes increased. By emphasizing the functionality of the region's freight mobility at a corridor level, the region has been able to make significant progress toward a regional program made up of strategic local investments that have regional results. The program has focused on projects that were too small for the Washington State DOT but too large for municipalities to handle alone. During the past 15 years, the FAST partnership has completed 20 of the original 25 projects on their strategy list. The FAST Corridor Initiative is a case study of how long-term freight quality partnerships can improve the long-term freight performance of a region. It is important to note that these projects did not directly involve improving throughput at the international border crossing located just north of the region.

The Puget Sound Regional Council (PSRC) is the MPO for the Seattle-Tacoma-Everett metropolitan area. This region includes the counties of King, Kitsap, Pierce, and Snohomish, and 82 municipalities. It spans more than 6,300 square miles, and is home to 3.5 million people. The PSRC is charged with planning for regional transportation, land use, and economic development. The FAST Corridor is an area defined within the PSRC region, as exhibited in Figure 42.

The PSRC classifies freight in their region as either locally derived or discretionary (pass-through) freight. Although many regions use these classifications, the distinction is important for the Seattle area because of the region's projected population growth and the location of two major ports in the area. Both local and discretionary freight are projected to grow significantly.

PSRC estimates that, by 2040, the Seattle-Tacoma region will grow to 5 million residents holding more than 3 million jobs. This represents an addition of 1.5 million residents, which will have a significant impact on urban freight movement and performance, as each new resident will be dependent on freight to deliver food, clothing, and other day-to-day needs. Additionally, the region's manufacturing, construction, warehousing, and mining industries depend on freight transportation.

Case Study 8: Everett-Seattle-Tacoma Corridor

In the 1990s, a freight quality partnership was formed to improve freight infrastructure in the region, both to accommodate local freight traffic and to expedite and mitigate the impact of increasing pass-through freight. During the past 15 years, most of the infrastructure improvements initially identified by the partnership have been completed. The partnership has grown into a seasoned Freight Advisory Council (FAC) for the region's MPO.

Planning Guide Strategies Discussed

- Initiative 53: Create a Freight Quality Partnership
- Initiative 2: New and Upgraded Infrastructure
- Initiative 36: Real-Time Information Systems

Discretionary freight is not affected by local supply or demand triggers. Trade that comes to the Ports of Tacoma and Seattle destined for points eastward is not *required* to go through those ports.

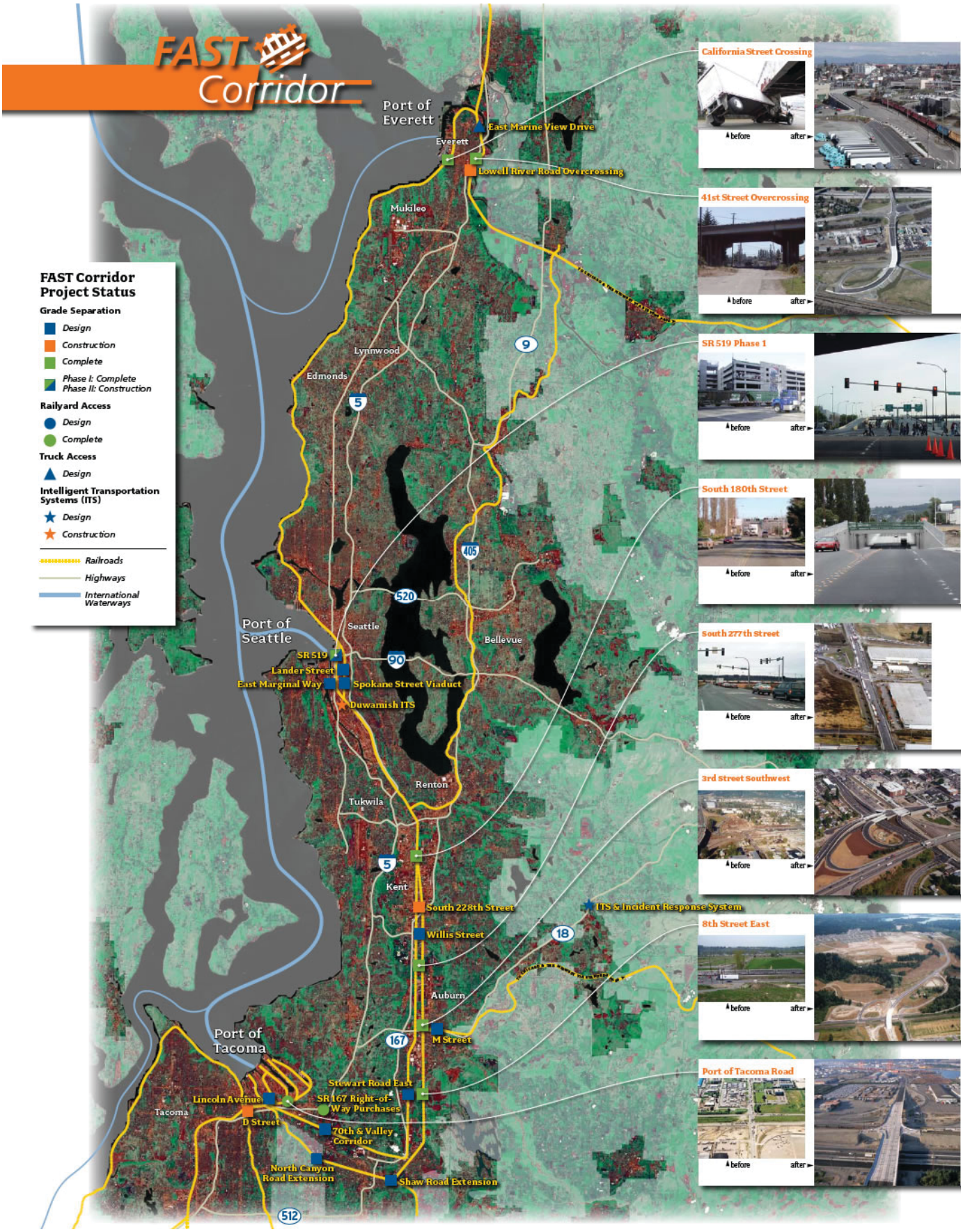


Figure 42. FAST Corridor project map.

Shippers "choose" to have this freight come through the Seattle-Tacoma region. The decision to have freight come through the region largely depends on factors outside of the region's control, such as global shipping patterns and trade growth. All the same, discretionary is expected to grow significantly. The Ports of Tacoma and Seattle expect their intermodal traffic to almost triple by 2030. Similarly, the region's rail system is expected to see significant intermodal container growth of 65 million intermodal tons by 2040.

Overview

Unlike the other case studies detailed in this Guide, the Seattle region's FAST Corridor Initiative was started by the private sector. In 1992, the Washington State DOT formed a FAC to provide input to their state transportation plan. One member of the FAC also was a board member on the PSRC's Transportation Policy Board. This member began to champion freight concerns with the MPO board and throughout the overall agency process. Together with a PSRC staff member, this FAC member began to build in freight planning as part of the PSRC planning process. This included development of an initial freight plan and a freight quality partnership that ultimately led to the creation of the FAST Corridor Initiative.

Active members of the FAC who were involved in the PSRC began to urge the MPO to pursue a way to be more inclusive of freight concerns in their business. In 1994, the PSRC created one of the first MPO-based freight quality partnerships in the nation. With its partners in the Economic Development Council of Seattle and King County, they created the Regional Freight Mobility Roundtable. At its first meeting, the roundtable established the private sector's three biggest transportation concerns in the Seattle-Tacoma region:

- Problems posed by the public-sector DM process
- Constraints in the physical networks of roads and other facilities
- Operating difficulties stemming from traffic management strategies and service levels (Federal Highway Administration, Case Study, n.d. a).

Economic Impacts

Although there has not been any analysis of the economic impact of the FAST partnership, the Seattle-Tacoma region's economy is clearly dependent on the freight industry. In 2011, freight-dependent industries like mining, construction, manufacturing, retail, and wholesale trade were responsible for over 30% (approximately $73.9 billion) of the region's GDP (Bureau of Economic Analysis 2013). PSRC estimates these dependent industries support about 700,000 jobs in the region, which is about 37% of regional employment. The region's air and maritime ports are estimated to be responsible for over 200,000 direct and indirect jobs. Combined, the ports generate almost $1 billion in local and state tax revenue (Puget Sound Regional Council 2010).

The success of freight in the Seattle-Tacoma region has a much broader impact, however: combined, the ports of Seattle and Tacoma represent the third-largest container port in the nation. Although an important statistic in itself, this has a much more critical role in terms of regional resiliency. The busiest container port in the nation is the Ports of Los Angeles/Long Beach, in California. The next busiest—the Ports of New York/New Jersey—is on the East Coast. If an event restricted traffic through the Ports of Los Angeles/Long Beach, the Ports of Seattle/Tacoma would be the only major container port serving the western United States.

Regional Approach/Initiative

In 1994, during a local freight conference, the initial idea of the FAST Corridor was created, and a working group was established to formalize the concept. It is important to note that the

FAST Corridor is not a traditional highway or rail corridor; instead it is an initiative for improving freight in the region. Over the next 2 years, the concept was formally adopted in the PSRC Regional Transportation Plan and the program was staffed by the PSRC and Washington State DOT. In 2006, PSRC took over formal program administration for the FAST Corridor Partnership (Transportation Research Board 2003, 95–96).

The partnership is not simply between PSRC and the Washington State DOT; it includes "26 local cities, counties, ports; federal, state, and regional transportation agencies; railroads, and trucking interests, intent on solving freight mobility problems with coordinated solutions" (Puget Sound Regional Council, n.d.). The FAST partnership has completed 20 out of the 25 projects on its initiative list in the past 15 years.

The overall FAST strategy is divided into four categories:

- Railroad grade crossings
- Port improvements
- Highway construction/reconstruction
- Improvements to rail that serve both passenger and freight trips

Initially the FAST partners focused on supply-side infrastructure management projects and traffic management strategies like truck routes. Many of the 20 projects completed were railroad grade separations along critical freight highway routes in the region, as well as clearing up of constraints along the major intermodal connectors linking the ports and major truck routes through the region. More recently, the group has focused on demand-side projects like the use of intelligent transportation systems (ITS) to expedite freight movement. These strategies are often much more cost-effective than traditional highway projects, and they are becoming more common in programs with declining revenues like FAST. Some of the more recent FAST projects include:

- **The Duwamish ITS Project:** The Duwamish area is home to the Port of Seattle. All three phases of this project focused on moving truck traffic through the area more effectively. The most recent/final phase focused on feeding real-time traffic data into the algorithms that control signal timing, and on providing truck drivers real-time traffic information. This information is particularly useful to truck drivers because of the extensive use of movable bridges in the area. This project was completed in 2010 (City of Seattle, n.d.).
- **ITS and Incident Response Expansion to Key Puget Sound Freight Corridors and Interchanges Project.** This project has represented a more holistic approach to improving 200 centerline miles throughout the region using various technological improvements, including traditional loop/video detection, dynamic messaging signs, and various communications tools to communicate conditions to drivers. Smaller projects, like weather stations and ramp metering, also have been added to the network; these types of projects are currently under development (Puget Sound Regional Council 2013).

Stakeholder Engagement

What makes the FAST partnership different from other case studies is the fact that so many jurisdictions worked together for the better part of two decades to develop more than $560 million of supply-side and demand-side freight improvement strategies. The representatives of these local cities, counties, ports, federal, state, and regional transportation agencies, railroads, and trucking interests worked as a cohesive group to achieve overall freight performance improvements.

Jurisdictions whose projects were delayed commonly shifted their allocations to another jurisdiction's project if it was ready to progress. Simply, the group thought as a region, and that focus helped sustain the partnership for more than 15 years. Additionally, from the beginning, representatives from the private sector have largely driven and focused the efforts to successfully overcome many transportation challenges.

The larger strategy is built around a Memorandum of Understanding (MOU) that details the specific projects in the strategy. The MOU itself does not include any legal duties or rights for the jurisdictions involved; rather, it serves as a framework for the group. Each implementing agency (Washington State DOT, city of Seattle, and so forth) is responsible for the overall design and construction of projects. Similarly, projects undertaken within the FAST strategy have funding allocated to them individually (Transportation Research Board 2003).

Emerging Issues

The Everett-Seattle-Tacoma FAST Corridor was designated as a high priority corridor by ISTEA (P.L. 102-240 § 1105(c) as amended through P.L. 112-141). Subsequently, in 1998, the FAST Corridor was included in the National Corridor Planning and Development Coordinated Borders Infrastructure program in TEA-21. The TEA-21 designation came with funding to the Washington State DOT and PSRC for the "coordinated planning, design, and construction of corridors of national significance, economic growth, and international or interregional trade" (Federal Highway Administration, online reference, n.d.).

The next authorization bill, SAFETEA-LU, continued funding projects in designated corridors like this one (Federal Highway Administration, online reference, n.d.). Thus, SAFETEA-LU indirectly funded the FAST Corridor through its continuation of funding projects designated under ISTEA's High Priority projects (see Figure 43). The main bill authorized funding as necessary to cover Congressional High Priority projects; however, no funding was ever appropriated for this.

The most recent authorization, MAP-21, took a very different approach. One of the major changes in MAP-21 was the significant consolidation of highway programs at U.S. DOT. In addition, several programs were repealed—including the High Priority Project program, which had been the main funding source for FAST. Although MAP-21 carries the same larger authorization to fund Congressional High Priority projects like SAFETEA-LU, no appropriations have been made, nor is there any indication that appropriations will be made in the future.

Where does that leave the remaining five FAST projects? Discretionary corridor-related money was just one part of a larger recipe for funding projects in the FAST strategy. Many projects in fact had six or more funding sources. Even so, the loss of the discretionary funding is a significant setback that has indefinitely delayed at least two of the five remaining projects.

Today, the FAST Corridor Partnership has begun to serve more as a FAC for the region. Utilizing members' institutional knowledge about FAST Corridor development, this group has technical and policy-level experience that will be beneficial to future freight mobility efforts.

Concluding Observations

Researchers have compared the success of the freight quality partnerships in Los Angeles (mainly the work leading up the Alameda Corridor) and the FAST partnership. Although both groups worked to significantly enhance their metropolitan areas' freight networks, they had significantly different approaches and purposes. In Los Angeles, the group responded to an immediate need, whereas the FAST partnership worked to enhance the network in anticipation of future growth. The FAST partners saw an opportunity to capitalize on potential business opportunities that might result from congestion or potential service interruptions at the Ports of Los Angeles/Long Beach. Essentially, their goal was to create opportunity for the Ports of Tacoma and Seattle through improving the region's freight resiliency.

The multijurisdictional group worked together to proactively enhance the region's freight network, instead of waiting to act when freight volumes increased. In addition, the group focused on

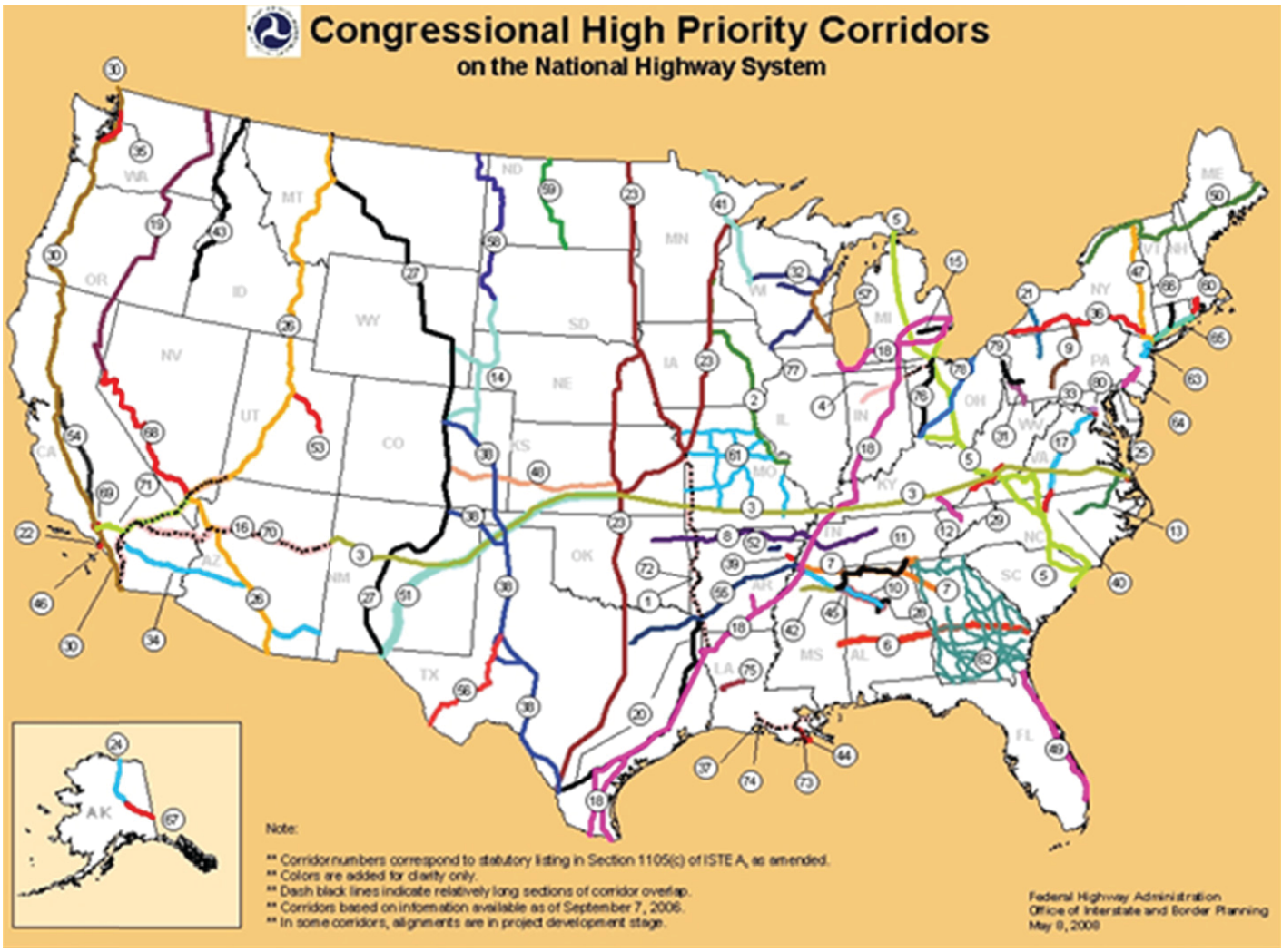


Figure 43. High priority corridors.

projects that were too small for the Washington State DOT to focus on, but too large for municipalities to handle alone. As a group, they were able to handle problems that no single entity could resolve, which provided real results and increased buy-in from their private-sector partners.

The lessons learned from the FAST partnership apply directly to regions looking to improve the position of their community to capture future freight opportunities. Although the project's initial "wins" came from being able to fund projects through the former Borders and Corridors program, the group was strategically positioned to also pursue non-traditional highway funding like that available through the American Recovery and Reinvestment Act of 2009 (ARRA).

Toledo, Ohio

Ohio's Proactive Approach to Improving Freight Performance: Freight Quality Partnerships and Upgraded Infrastructure

Introduction

Toledo's public and private freight stakeholders identified the economic potential of improving freight performance in their region. Their work ultimately led to public and private investments in

Table 61. Lake Erie West demographics.

Metropolitan Statistical Area (MSA)	2011 GDP (millions)	Population
Ann Arbor, Michigan	$ 18,689	344,791
Detroit-Warren-Livonia, Michigan	$ 199,378	4,296,250
Fort Wayne, Indiana	$ 18,278	416,257
Jackson, Michigan	$ 4,971	160,248
Lima, Ohio	$ 4,865	106,331
Monroe, Michigan	$ 3,738	152,021
Sandusky, Ohio	$ 3,190	77,079
Toledo, Ohio	$ 28,037	651,429
Total	$ 281,146	6,204,406

Sources: Bureau of Economic Analysis GDP by Metropolitan Area; September 2013 & 2010 U.S. Census SF1 File

the rail network around Airline Junction Intermodal Yard, which allowed the facility to quickly double annual lifts and provide further economic development opportunities for the region.

This case study is unique in that the initiative was not a response to a specific freight issue. Instead, the region proactively formed a freight quality partnership that went through a DM process similar to the one described in this Guide to select an initiative (upgraded infrastructure) to improve the overall freight performance in their region. The impetus for action was to support and strengthen the entire local freight system as a means of economic expansion, rather than to address specific system issues.

Located in Northwest Ohio, the Toledo region is situated roughly between the Detroit, Michigan, and Fort Wayne, Indiana, metropolitan areas. By itself, the Toledo metropolitan statistical area (MSA) is home to 651,429 people, and it is the 81st largest MSA in the United States. There are eight neighboring MSAs within 100 miles, however. This larger area, which local experts call "Lake Erie West," is home to over 6.2 million people. If Lake Erie West were a state, it would be the 18th largest, with a combined GDP of $281 billion (see Table 61).

It is important to note that these figures do not include Ontario, Canada, which falls within the 100-mile radius of Toledo, Ohio. Strong bi-national manufacturing and supply chain relationships account for a significant volume of the goods moving within and through the region. Given the multijurisdictional nature of freight, this larger area is more telling of the region's potential as a freight center.

The Toledo region serves as a major freight junction for highway, rail, and maritime freight. Located on the southwest corner of Lake Erie, it serves as a hub for freight moving east-west from New York State to Chicago, Illinois, and for traffic moving north-south from Detroit, Michigan, and Canada to the states of Texas and Florida. Similarly, the Port of Toledo is the westernmost port on Lake Erie. The port's location, effectively at the end of the Saint Lawrence Seaway, coupled with its connections to both north-south and east-west land-based freight modes, resulted in it becoming the second largest on the Great Lakes.

Case Study 9: Airline Junction Yard

Regional efforts to improve economic development through the capitalization of Toledo's location at the intersection of freight between Chicago and the East Coast, and Canada and the South, led to rail infrastructure improvements that improved rail velocity and doubled lifts at an intermodal facility.

Planning Guide Strategies Discussed

- Initiative 53: Create a Freight Quality Partnership
- Initiative 2: New and Upgraded Infrastructure

Over the past two decades, state and local officials in Ohio have noticed the growing importance to the state's economy of the logistics and distribution industry. Several Toledo-area groups began to realize that, because of its strategic location and multimodal freight assets, the area had the potential to become the anchor of the larger economic engine of the Lake Erie West region. The intermodal concept began to be included in the region's Transportation Legislative Agenda, a biennial statement of consensus on transportation policy priorities produced by a coalition of stakeholders and spearheaded by the Toledo Metropolitan Area Council of Governments.

Overview

In 2008, the Joint Intermodal Task Force for Transportation and Logistics (JITF) was formed. Like many freight quality partnerships, JITF's members included public-sector and private-sector leaders. What made this group unique, however, was its extensive inclusion of former high-level public officials who had the deep understanding and the political roadmap to overcome bureaucratic challenges. The private-sector members' focus balanced out this strong public-sector presence. JITF is "staffed" by the University of Toledo's Intermodal Transportation Institute.

Shortly after its formation, the group developed a vision and a series of project recommendations for the region. The process began with an identification and analysis of the region's key assets. JITF's October 2008 report to the city of Toledo identified these assets as:

- Location at the junction of three major Interstate highways
- Location within a day's drive of 60% of the U.S. population and manufacturing capacity
- Presence of three Class I railroads, each linking Toledo to larger metropolitan areas
- Access to the Saint Lawrence Seaway via the second-largest port on the Great Lakes
- Availability of an air cargo hub capable of handling the world's largest aircraft (Intermodal Transportation Institute 2008, ii)

JITF evaluated five different locations in the Toledo region that had potential to expand or develop intermodal facilities (see Figure 44). The task force met with representatives of the three Class I railroads that serve the Toledo region: Canadian National and CSX both had intermodal facilities near Toledo that were meeting their needs. The Port of Toledo's recently rehabilitated dockside facility was evaluated for a facility that would expedite ship/rail transfers. Two Norfolk Southern facility locations were evaluated. The first, creating a site near the airport, proved to be a long-term project. The second, an existing Norfolk Southern intermodal yard (Airline Junction), showed potential (Intermodal Transportation Institute, 2008, 1–5).

Airline Junction is located in a well-urbanized area within the city of Toledo. Unlike many intermodal terminals, its growth was inhibited by operational challenges outside of the yard. Its location on the Norfolk Southern Chicago mainline next to the wye with the Detroit mainline decreased its effective capacity from 60,000 container lifts to around 30,000. After analyzing projects for their viability, fundability, and private partner willingness to participate, the group made five specific project recommendations (see Table 62 and Figure 45).

Economic Impacts

In May 2009, the University of Toledo's Intermodal Transportation Institute, in partnership with the University of Tennessee Center for Transportation Research, evaluated the economic

Source: Toledo Metropolitan Area Council of Governments

Figure 44. Potential intermodal project sites.

Table 62. JITF project recommendations

1. Airline Junction	Expand the Norfolk Southern intermodal yard in Toledo, Airline Junction.
2. Airline Junction strategies	Build regional economic development strategies to capitalize on the improved Airline Junction. In particular, redevelop 2,000 acres of available industrial land within the city limits.
3. Regional corridor initiative	Develop corridors in terms of infrastructure and economic development between the various MSAs.
4. Air cargo expansion	Expand the U.S. Customs area at the Toledo Express Airport.
5. Improvements at Port of Toledo	Improve crane and stacker facilities to improve intermodal movement efficiency.

Source: Intermodal Transportation Institute (2008), p. 6.

impact of doubling the existing capacity of the Airline Junction Yard. The partners used IMPLAN (and its RIMS II multipliers) to calculate the overall regional impact. The Institute found that, over 5 years, the project would have a total regional benefit of more than $112.27 million. These benefits included the creation of nearly 900 direct and indirect jobs, which would create $25.6 million in salaries annually. Over 5 years, more than 1.5 million square feet would be developed, worth approximately $25 million. Overall, the state of Ohio would gain $1.49 million, and local governments would gain $1.29 million in additional tax revenues annually. Additionally, the study cited benefits to consumers due to increased competition between the (then) soon-to-be-opened CSX intermodal yard just 40 miles south of Toledo and Airline Junction. Numerous multi-state distribution centers have located in the Lake Erie West region (e.g., UPS, FedEx, Home Depot, Lowes, Walgreens).

Source: Intermodal Transportation Institute, Airline Junction Economic Impact Study, p. 10.

Figure 45. Norfolk Southern network near Airline Junction Yard.

Regional Approach/Initiative

Norfolk Southern ultimately described this project as a reverse public/private partnership. Normally, the railroad would identify an improvement as beneficial to the public but not meeting the return threshold that would justify the railroad's complete capital investment. The railroad's government affairs team would work with their public-sector partners to exhibit the benefits of the project to gain public support, and ultimately funding. In this case, however, the city of Toledo and JITF approached Norfolk Southern about the potential of expanding Airline Junction Yard with a firm business case detailing why the project would be a win-win for the railroad and the region.

The yard originally was developed as a Conrail trailer-on-flat-car (TOFC) facility. Over the past 30 years, however, the yard has grown into a modern intermodal yard that handles container-on-flat-car (COFC) and container-on-well-car traffic. Unlike many intermodal sites located within urban areas, Airline Junction Yard has had room to expand without creating neighborhood conflicts or requiring additional property. Instead, its expansion has been inhibited by its location along the wye between two heavily used mainlines. Essentially, trains accessing the yard tied up the mainline between Chicago and New York, a line that can see more than 100 trains daily (Intermodal Transportation Institute 2008). The true potential of the yard was limited because many trains could not stop at the yard.

To alleviate these geometric and operational challenges, Toledo and the JITF proposed a series of small improvements to upgrade rail network infrastructure and nearby highway grade crossings. The largest among them was the extension of the yard's lead tracks to allow trains to pull into the yard without disrupting traffic on the mainline. The project cost $12.75 million to effectively double the yard capacity. While they were initially skeptical, Norfolk Southern analyzed the project's viability and potential benefits, ultimately calculating that the improvements justified a $3.5 million investment from the railroad.

Stakeholder Engagement

In 2008, while the local partners were working with Norfolk Southern, Ohio's unemployment rate topped 10%. In reaction, the state of Ohio created several stimulus programs that focused on creating jobs in the state's targeted industries. Among the projects was the Logistics and Distribution Forgivable Loan program. The program provided loans to governmental entities to build infrastructure that would support job creation in the industry. The program was administered by the Ohio Department of Development (ODOD), and once the agreed-upon number of jobs were created, the loans were forgiven.

Adequately positioned from JITF's and Norfolk Southern's analysis (and private-sector funding), the city of Toledo (assisted by JITF) approached ODOD to formally apply for the Distribution and Logistics stimulus program. Following an extensive application and interview process, the project was awarded a $2.75 million forgivable loan. This left a $6.5 million gap in the project that was quickly closed with $6.5 million from the Ohio Rail Development Commission (ORDC) as part of ARRA.

Norfolk Southern completed the project, because it is their privately owned railroad yard. However, ORDC served as the primary liaison between the local partners and Norfolk Southern, given their experience in working with the railroads and in administering public funding. There was one exception: the city of Toledo was contractually obligated to administer its portion of the funding, given that the city was legally liable for the loan. According to interviewees, this created some duplication and confusion between the Norfolk Southern, ORDC, and Toledo on overall project roles and responsibilities. These issues were quickly overcome given continued facilitation by JITF and ORDC. The project was completed in December 2010.

Concluding Observations

The Toledo region's economy has historically been tied to the automotive industry. Although Toledo has fared better than most of its rust-belt neighbors, area stakeholders recognized the risk of having their economy tied to one industry. The region recognized the increasingly borderless nature of business, especially in the freight industry. As such, they realized that they functioned much more as a three-state, multijurisdictional region, than just the Toledo MSA. By taking a collaborative approach, stakeholders developed a successful initiative to transform a freight facility. In the process, they created redevelopment opportunities with the potential to benefit the entire region.

Initially, there were many independent freight-related partnerships. However, the region came together to support the JITF, which was formally organized by the Mayor of Toledo and facilitated by the University of Toledo. The group proactively approached Norfolk Southern about opportunities to expand intermodal operations in the region; however, they took a very different approach from many other communities that want a yard. The JITF approached Norfolk Southern with a solid business case for why improvements to Airline Junction Yard were good for both the railroad and the region. This approach took the railroad by surprise. Their reactions to the proposal were mixed (they did not see much of an intermodal market in Toledo), but they agreed to take a look.

After analyzing the proposal, the railroad decided that the operational improvements at the wye between their two mainlines (and as a consequence, at Airline Junction Yard) were worth investing more than $3.5 million. Since then, traffic has picked up at the intermodal yard so much that Norfolk Southern is now offering an origin/destination pair (direct service) between the West Coast and Toledo. Essentially, this means there is enough traffic to justify an entire train—or at least a large block of railcars—between the pair. The operational improvements also added fluidity on the Norfolk Southern system throughout the Toledo metropolitan area. This means decreased costs and increased opportunities to utilize rail in the region.

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APPENDIX

Freight Trip Generation (FTG) Software

The Freight Trip Generation (FTG) software applies FTG models developed by the Rensselaer Polytechnic Institute (RPI) at the zip code and 2-digit NAICS code levels. This software is broken up into three modules. The first module preprocesses the "County Business Pattern" data obtained from the Bureau of the Census and generates a database with information at a zip code and 2-digit NAICS code level. The second module applies the FTG models and produces estimations of freight trip attraction (FTA) and production (FTP). Finally, the third module allows modifying the coefficients used in the estimation of FTG models. Advanced features in the software include applying four types of models and the option of selecting a set or a range of zip codes to be analyzed.

This software is available to download from https://coe-sufs.org/wordpress/ftgsoftware.

The balance of this Appendix presents the user manual for Version 3.1.

Manual for Freight Trip Generation Software

Table of Contents

Database Information

Download County Business Patterns Data, for the year you need.

File type: "Complete Zip Code Industry Detail File"

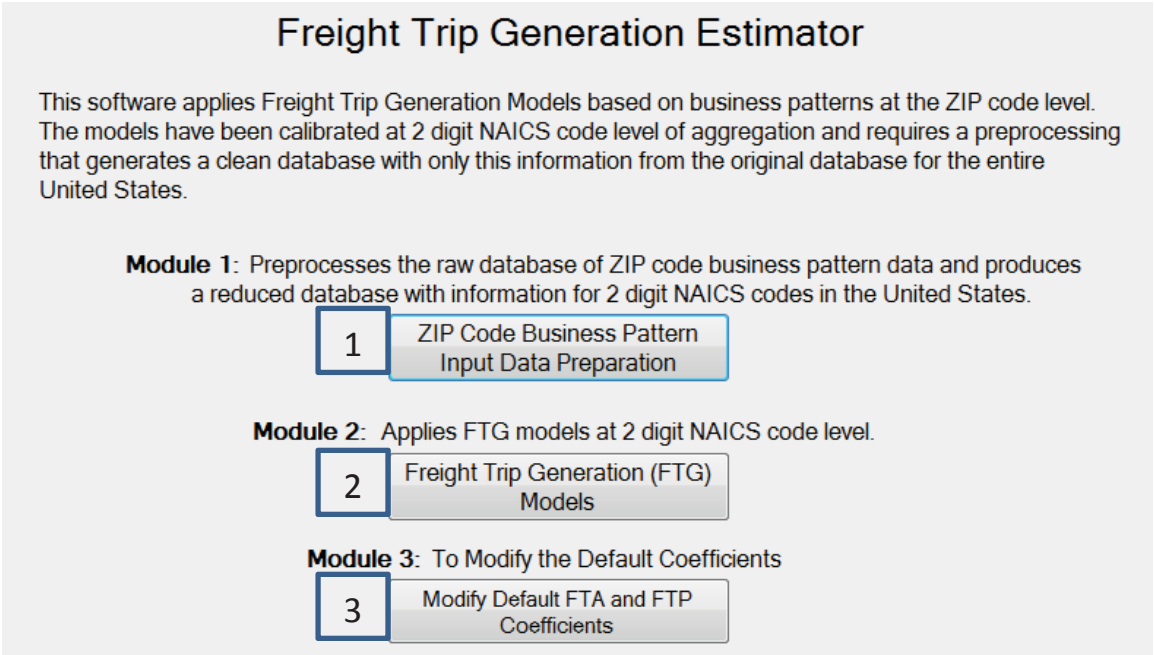
Website: http://www.census.gov/econ/cbp/download/

Open the file in WordPad and save it as text file with an appropriate name, which would be used for Zip Code Business Pattern Input Data. Make sure the data corresponds to Zip and NAICS code and that it comes in a single line.

Freight Trip Generation Estimator Home Page

Purpose: This is the home page, which breaks up the program into three parts.

1) The first part of the program is the Zip Code Business Pattern Input Data, which takes in information from the raw database to reformat the text file.
2) The second part is the Freight Trip Generation (FTG) Models, which uses the saved text file from the first part to estimate FTG using one of the four models the user can select.
3) Module 3 is used to modify the default FTA and FTP coefficients, which are used when estimating the FTG Models

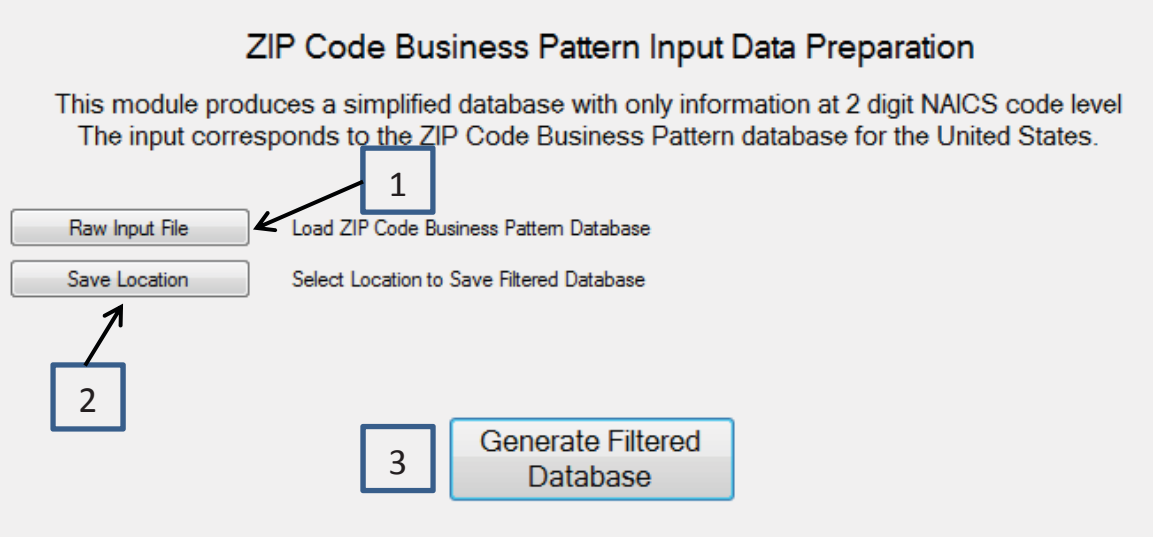


Module 1: Zip Code Business Pattern Input Data Preparation

Purpose: Takes the information from raw database and generates a new database containing only NAICS 2 digit level information for which 'Freight Trips Generation' can be estimated. The data corresponding to 2 digit NAICS code is saved as new text file to estimate FTG in further steps.

Process:

1. *Load File:* Input the raw database so it can be pre-processed by clicking the load file button and then browse for the saved raw database and open the input file saved from WordPad.
2. *Save File:* Need to save a file that would be exported from the program by clicking the save file button and then enter an appropriate file name (the default extension for saving the exported file is .txt, so you do not have to add it in the save dialog box)
3. *Generate Database*: After loading and entering the appropriate file names when you click 'Save File', click on the 'Generate Filtered Database' button to run the program and create a new text file with pre-processed data.



Module 2: Freight Trip Generation (FTG) Models

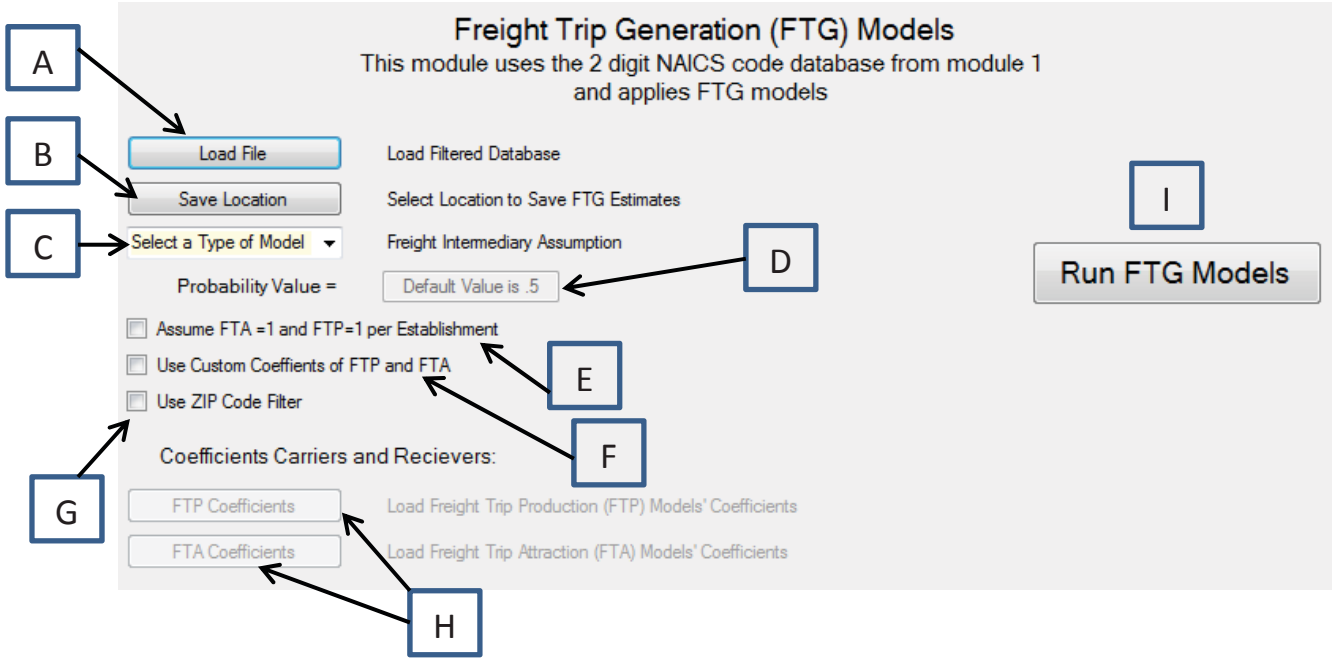
Purpose: To estimate the Freight Trip Generation (FTG) Models. FTG is the summation of Freight Trip Attraction (FTA) and Freight Trip Production (FTP) models. The output of the software will include two new columns added to the file loaded: FTA and FTP. Run any one of the four different types of models in the program to calculate and analyze data depending on what you want to analyze.

Process:

A. *Load File:* Input the preprocessed database so it can generate freight trips by clicking this button and then browse saved output from preprocessing.
B. *Save File:* Need to save a file that would be exported from the program by clicking this button and then enter an appropriate file name (the default extension for saving the exported file is .txt, so that you do not have to add it in the save dialog box).
C. *Select a Type of Model*: This drop down menu is used to select which model to apply in the program. The equations available in the FTG are as follows:
   1. *Independent FTA and FTP* - This a default model in the program, which calculates FTA and FTP, it creates two new columns for each line of output in a new text file
   2. *Binary Logit Model* - Outputs a corrected FTP by calculating the probability from an equation that depends on the NAICS code and FTA and multiply it by the FTP
   3. *Simple Shares* - Outputs a corrected FTP by using a default probability value that depends on the NAICS code and multiply it by FTP
   4. *User Defined* - Outputs a corrected FTP by using a probability value you would input in the text box below the drop down box and multiply it by FTP
D. *Probability Value*: Only applies for the User Defined model, where you have to input a probability value.
E. *Assume FTA and FTP are Equal to One Per Establishment Checkbox:* If the FTA and FTP are equal to zero then FTA and FTP are equal to the establishments
F. *Use Custom Coefficients of FTA and FTP:* This allows you to input your own custom FTA and FTP coefficients to use for the models, instead of using the default coefficients. Read “Input Custom FTA and FTP Coefficients” for more information.
G. *Use Zip Code Filter:* Allows you to add a zip code filter to specify which zip codes the user wants to analyze (for more information read page A-6)

H. *Input Custom FTA and FTP Coefficients:* For uploading custom coefficients text files, so the program will use these coefficients rather than the default ones. Read "Input Custom FTA and FTP Coefficients" for more information.

I. *Run FTG Models:* This will run the program and output the calculations

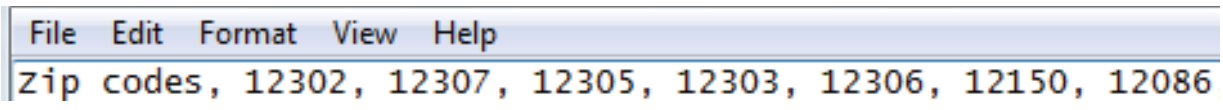


Zip Code Filter

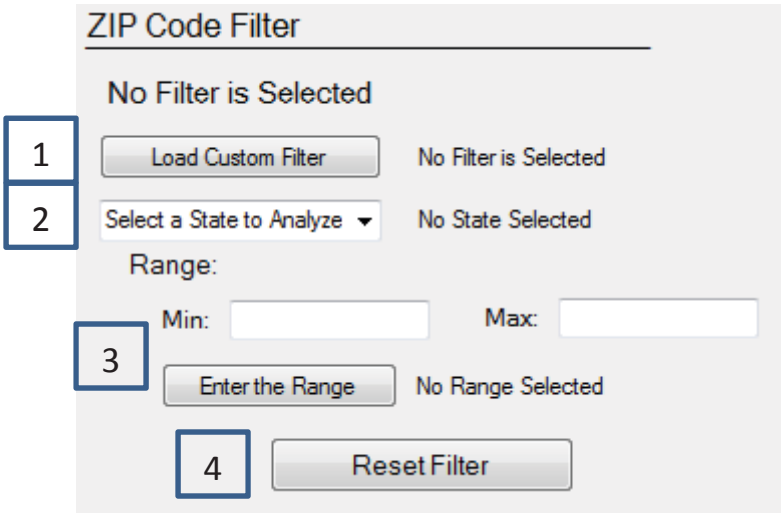
Purpose: This filter is a useful tool to be able to select and analyze certain Zip Codes. Listed below are different methods you can use to filter information using Zip codes:

- Use a Custom Zip Code Filter
- Enter a range of Zip Codes to filter
- Analyze by state

1. *Custom Zip Code Filter*: You are able to import the provided zip code list or a custom zip code list by clicking the load custom filter button. This custom zip code list must be a text file and have the same format as the example below, with commas and spaces dividing the zip codes and the words "Zip Codes" at the beginning of the document.



2. *Select a State to Analyze:* Where you are able to select any of the 50 states from the drop down list and the program will only analyze the Zip Codes that are in the provided state you have selected.
3. *Range:* This function allows to output database corresponding to zip codes between the ranges that you have entered and by clicking the "enter the range" button, so the program knows you want to use the range function. Enter the min and max values and there is no need to include the zero's at the beginning of the zip code. For example if a value you want to input is "00640", you should just input 640.
4. *Reset Filter:* Resets the filter to the orginal settings.

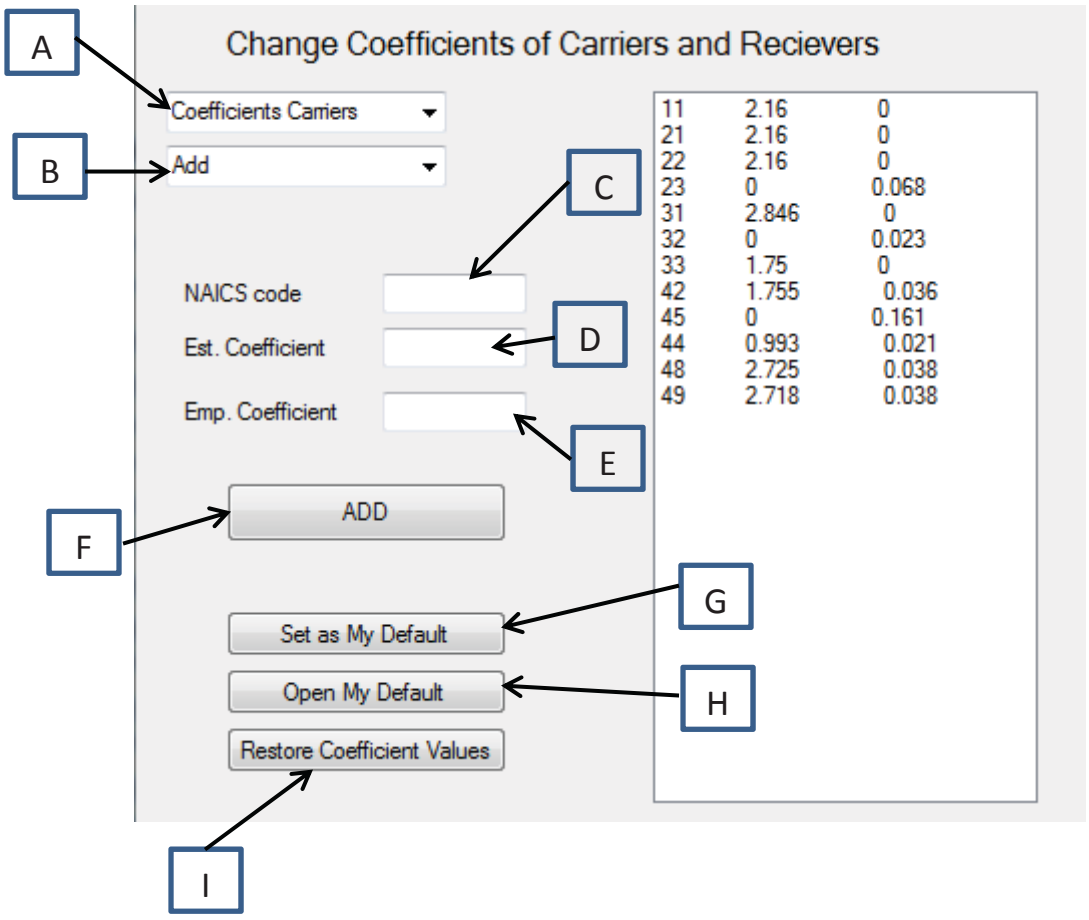


Module 3: Modify Default FTA and FTP Coefficients

Purpose: To be able to modify the default coefficient values, which are used in Module 2. This allows the user to make corrections to the coefficients in a seamless way. You are able to add and delete coefficients from the default values, allowing you to modify and use it in Module 2.

A. *Select Coefficient Type:* Select what type of coefficient you like to modify
B. *Select Command:* Select what type of action to perform on the default coefficients
   - *Add*- To add to the default list, you have to enter a NAICS code with its respective establishment and employment (Step C, D, E and F)
   - *Delete*- To delete a NAICS code from the list, you have to enter in the NAICS code (Step C and F)
C. *NAICS code:* Input NAICS Code you which to add or remove from the current list

D. *Establishment Coefficient:* Enter this value if you wish to add a NAICS code to the default list
E. *Employment Coefficient:* Enter this value if you wish to add a NAICS code to the default list
F. *ADD or DELETE:* Click on the button to add or delete a NAICS Code with its respected coefficients from the list
G. *Set up My Default:* Allows you to create a saved file that you are able to upload to default list
H. *Open My Default:* Upload the saved file to the current coefficient list
I. *Restore Coefficient Values:* This is the original coefficient value that can restore the default list to the original values



Additional Information

The next sections of the Appendix provide additional information not directly part of the FTG User Manual.

Initial Data Collection Assessment

This part of the Appendix provides additional information not directly part of the FTG User Manual. Sample data collection needs and assessment tasks that may be associated by groups of initiatives discussed in this Guide.

Initiative/ Freight Problem Area	Data Collection Needed	Assessment and Analysis
Infrastructure Management	• Roadway, intermodal and modal facilities inventory, including traffic counts and capacity • Origin/Destination of travel • Condition of infrastructure, including related roadway geometrics	• Level of Service, Volume to Capacity by time of day; pavement ratings; types of vehicles using the facility • Infrastructure condition • Locations of freight generators (shippers and receivers)
Parking/Loading Areas Management	• Number and locations of on- and off-street parking spaces and use • Number and location dedicated to trucks and delivery zones, including time restrictions • Number of parking violations • Design and access to loading docks • Parking-related regulations and enforcement • Freight-trip generation	• Parking analysis: needs and availability • Focus on freight generator and receivers, such as retail establishments
Vehicle-Related Strategies	• Vehicle emissions and noise regulations • Number of low-emission freight vehicles registered in region • Air quality data • Noise data	• Comparison of air and noise regulations and incentives to other parts of US and abroad • Analysis of incentive programs available
Traffic Management	• Summary of freight vehicle restrictions in the region • Location of truck routes • Location of roadways with and without signal timing	• Congestion analysis including intermodal connection access issues, and identification of problem locations
Pricing, Incentives, and Taxation	• Current freight-related regulations, taxation, and incentive programs in the region	• Analysis (possibly through private-sector interviews/surveys) of the impact of these to local businesses
Logistical Management	• Locations and volume of freight coming from, and going to businesses, industries and manufacturing in the region • Summary of current ITS programs operating in the region	• Freight-trip generation locational analysis • Origin destination analysis • Congestion and mobility study, including time-of-day analysis
Freight Demand/Land Use Management	• Current land use map and regulations • Locations and volume of freight coming from, and going to businesses, industries and manufacturing in the region	• Freight-trip generation locational analysis • Origin destination analysis • Congestion and mobility study including time-of-day analysis

Initiative Selector

The Initiative Selector is an HTML webpage that, for a given set of inputs, return suggestions of potential initiatives that could be implemented for a given problem. The Initiative Selector can be found at http://coe-sufs.org/wordpress/InitiativeSelector/.

Figure A-1 shows an example screen from the Initiative Selector. On the left side of the screen there are three categories a user can choose from: (1) Nature of the Problem, (2) Geographic Scope, and (3) Problem Source. The user can select multiple choices for each criterion. As the user enters their criteria identifying the problem, the table in the center of screen is populated with possible initiatives that could be used to solve the problem, along with some key identifiers about the initiative, such as the investment level, length of time for implementation, risk of unintended consequences, and the group and sub-group the initiative belongs to.

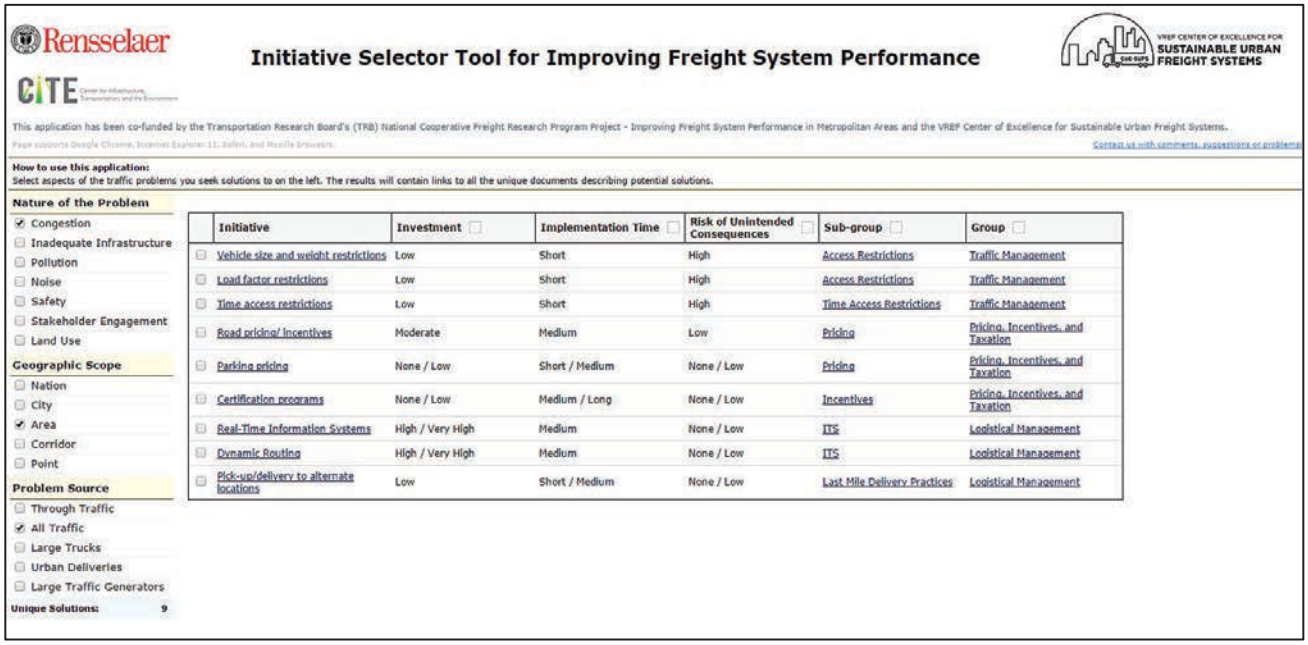


Figure A-1: Sample output from the Initiative Selector tool

Consider the following examples:

1. A neighborhood in an urban area has a large concentration of restaurants and retail establishments (mixed large and small). Currently, the area experiences a high level of congestion due to the number of deliveries made, and delivery vehicles double-parked.
    - Initiatives suggested (for a Congestion problem, impacting an Area, and produced by Urban Deliveries) are: urban consolidation centers, time slotting of deliveries/pick-ups for large traffic generators, staggered work hours program, and mode shift program.
2. A large volume of freight traffic generated at City A travels to City B but has to cross City C. The traffic uses corridor XYZ which passes through City C. As a result, City C is experiencing congestion due to this through traffic. In addition, the traffic is damaging the city roads.

- Initiatives suggested (for a Congestion problem, impacting a corridor, and produced by Through traffic) are: Ring Roads, Acceleration/Deceleration Lanes, New and Upgraded Roads

3. An intersection in a city has a poor level of service due to a high volume of large trucks. The intersection was designed before a number of warehouses and manufacturing facilities expanded operations. Quite often, these trucks hit utility poles and create unsafe situations

    - Initiatives suggested (for a Congestion problem, impacting a point, and produced by large trucks) are: removal of intersection constraints, Truck Routes, New and Upgraded Infrastructure

These examples demonstrate how the Initiative Selector can lead to a range of sensible recommendations. Obviously, further planning, stakeholder engagement, economic and engineering studies are needed to identify the best way(s) to proceed in any given situation. The alternatives identified using the Guide must be subjected to a rigorous process of vetting and analysis by all key stakeholders, which will provide feedback concerning the relative worthiness and effectiveness of the alternatives, and possibly additional initiatives to consider.

Evaluation Matrices for Public Sector Initiatives

This section presents a decision matrix for the identified public sector initiatives proposed in this Planning Guide based on inputs identified in Section A. The key inputs to produce such matrices should at least include:

- **Geographic scope of the problem:** This output should define the area(s) where the problem is taking place, which will help define the scope of the potential public sector initiative, such as: citywide, area, corridor, or a point in the city. Again, when defining the geographic scope, it should be recognized that supply chains often interconnect wide geographic areas.
- **Main objectives to be achieved:** It is necessary to clarify the nature of problem, and define corresponding objectives, such as reduction of congestion, pollution, and conflicts between truck activity and other users.
- **Key constraints:** The analyst should have a preliminary estimate of the financial, time, and institutional constraints to which the initiatives will be subject.
- **Root causes of the problem:** The analyst must confirm that the problem is indeed produced by freight activity, and determine which segment of the industry is creating the situation, such as: all or through traffic, large traffic generators (LTGs), urban deliveries, large trucks, or specific industry segments. It is also important to define the time-duration of the problem, such as during: a peak hour, a peak period lasting several hours, daytime, nighttime, or an entire 24-hour period. As discussed previously, identifying the sources and duration of the problem may require further analyses involving freight-trip generation techniques, traffic counts, or interviews with key stakeholders. The more thorough this analysis, the more likely it is that appropriate solutions can be identified.

Based on these inputs, a preliminary set of potential initiatives could be identified by scanning Table A-1 and Table A-2, which show summary matrices of the wide spectrum of initiatives.

Table A-1. Decision matrix for supply-related initiatives.

Initiative	Geography: Nation, State, City, Corridor, Area, Point	Investment: Very High, High, Moderate, Low, None	Implentation time: Long, Medium, Short	Target: Through Traffic, Urban Deliveries, Large Traffic Generators, All Traffic, Large Trucks	Major impacts: Congestion, Pollution, Noise, Inadequate Infrastructure, Safety, Land Use	Potential for unintended consequences: Very High, High, Moderate, Low, None
INFRASTRUCTURE MANAGEMENT						
Major Improvements						
Ring roads for through traffic	Co	VH	L	TT	C	H
New and upgraded infrastructure	Co	VH	L	AT	II/S	M
Freight clusters (freight villages)	C	VH	L	LTG	II/C/P/LU	M/L
Minor Improvements						
Acceleration/deceleration lanes	Co	H / L	M	AT	II	L
Removal of intersection	P	H / L	S	AT	II	L/N
Ramps for handcarts and forklifts	P	L	S	UD	II	L/N
PARKING / LOADING AREAS MANAGEMENT						
On-Street Parking and Loading						
Parking places and loading zones	Co	L	S	LTG/UD/AT	II	L
Loading time restrictions	P	L	S	AT	C	H
Peak-hour clearways	Co	L	S	AT	C	M
Parking reservation systems	P	M	S	LTG	II	L
Off-Street Parking and Loading						
Enhanced building codes	C/A	L	M	LTG/UD	II	L
Timeshare of parking space	P	L	S	LTG/UD	II	L
Upgrade parking/loading areas	P	H	S	LTG/UD	II	L
Improved staging areas	P/A	H	M	LTG/UD	II	M
Truck stops/parking outside	C	VH	M	UD/AT/LT	C	M
VEHICLE RELATED STRATEGIES						
Emission standards	N	L	M	AT	P	L
Delivery programs/regulations	C	H / L	M	AT	N/P	L
TRAFFIC MANAGEMENT						
Access Restrictions						
Vehicle size and weight	C/A	L	S	AT	C	H
Truck routes	C/A	L	S	LT	C	H
Low emission zones	A	L	S	AT/LT	P	H
Engine-related restrictions	A	L	S	AT	P	H
Load factor restrictions	A	L	S	AT	C	H
Time Access Restrictions						
Daytime delivery restrictions	A	L	S	AT/LT	C	H
Daytime delivery bans	A	L	S	AT/LT	C	H
Nighttime delivery bans	A	L	S	AT	N	H
Traffic Control and Lane Management						
Restricted multi-use lanes	A	L	S	AT/LT	II	L/N
Exclusive truck lanes	Co	L	S	LT	C	L/N
Traffic control	Co	L	S	AT	C	L/N

Notes: Geography: N: Nation, S: State, C: City, Co: Corridor, A: Area, P: Point, Po: Ports. Investment: VH: Very High, H: High, M: Moderate, L: Low, N: None. Implementation time: L: Long, M: Medium, S: Short. Target: TT: Through Traffic, UD: Urban Deliveries, LTG: Large Traffic Generators, AT: All Traffic, LT: Large Trucks. Major impacts: C: Congestion, P: Pollution, N: Noise, II: Inadequate Infrastructure, S: Safety, LU: Land Use. Potential for unintended consequences: VH: Very High, H: High, M: Moderate, L: Low, N: None.

Table A-2. Decision matrix for demand-related initiatives.

Initiative	Geography: Nation, State, City, Corridor, Area, Point	Investment: Very High, High, Moderate, Low, None	Implentation time: Long, Medium, Short	Target: Through Traffic, Urban Deliveries, Large Traffic Generators, All Traffic, Large Trucks	Major impacts: Congestion, Pollution, Noise, Inadequate Infrastructure, Safety, Land Use	Potential for unintended consequences: Very High, High, Moderate, Low, None
PRICING, INCENTIVES AND TAXATION						
Road pricing	C/A	M	M	AT/LT	C	L
Parking pricing	C/A	L/N	M/S	AT/LT	C	L/N
Incentives						
Recognition programs	C/A	L/N	M/S	AT/LT	P	L/N
Certification programs	N/C/A	L/N	M/L	AT/LT	P	L/N
Operational incentives for E/LEV	N/C	VH/H	M	AT/LT	P/N	L/N
Taxation	N/C	VH/H	M	AT/LT	P/N	L/N
LOGISTICAL MANAGEMENT						
Urban consolidation centers	A	H	M	UD	C	L/N
Intelligent transportation systems						
Real-time information systems	C/A	VH/H	M	AT	C	L/N
Vertical height detection systems	C/A	VH/H	M	AT/LT	II	L/N
Dynamic routing	C/A	VH/H	M	AT	C/S	L/N
Last mile delivery practices						
Time slotting of deliveries	C/A	L	M/S	LTG/UD	C	L/N
Driver training programs	N/A	M	M	AT	P	L/N
Anti-idling programs	C/A	M	M/S	LT	P	L/N
Pick-up/delivery to alt. locations	A	L	M/S	AT/LT	C	L/N
FREIGHT DEMAND / LAND USE MANAGEMENT						
Freight demand management						
Voluntary off-hour delivery	C/A	H/M	M	UD/LTG	C	L/N
Staggered work hours program	C/A	H/L	M	UD/LTG	C	L/N
Receiver-led consolidation	A	H/L	M	LTG	C	L/N
Mode shift program	C/A	H/L	M	UD	C	L/N
Land use policy						
Relocation of large traffic generators	C/A	VH/H	L/M	LTG	LU	VH/H
Integrating freight into land use planning process	C/A	L	M/L	UD/AT	LU	L

Notes: Geography: N: Nation, S: State, C: City, Co: Corridor, A: Area, P: Point, Po: Ports. Investment: VH: Very High, H: High, M: Moderate, L: Low, N: None. Implementation time: L: Long, M: Medium, S: Short. Target: TT: Through Traffic, UD: Urban Deliveries, LTG: Large Traffic Generators, AT: All Traffic, LT: Large Trucks. Major impacts: C: Congestion, P: Pollution, N: Noise, II: Inadequate Infrastructure, S: Safety, LU: Land Use. Potential for unintended consequences: VH: Very High, H: High, M: Moderate, L: Low, N: None.

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation