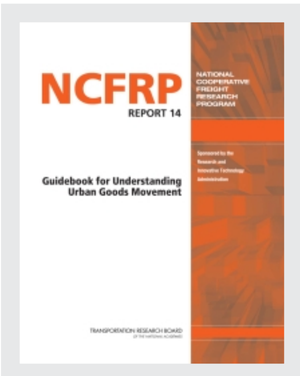


Guidebook for Understanding Urban Goods Movement

DETAILS

107 pages | | PAPERBACK
ISBN 978-0-309-21387-5 | DOI 10.17226/14648

AUTHORS

Peter Plumeau; Mark Berndt; Paul Bingham; Roberta Weisbrod; Suzann S Rhodes; Joe Bryan; Thomas J Cherrett; Transportation Research Board

NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

NCFRP REPORT 14

Guidebook for Understanding Urban Goods Movement

Suzann S. Rhodes
WILBUR SMITH ASSOCIATES/CDM
Columbus, OH

Mark Berndt
WILBUR SMITH ASSOCIATES/CDM
Minneapolis, MN

Paul Bingham
WILBUR SMITH ASSOCIATES/CDM
Arlington, VA

Joe Bryan
HALCROW, INC.
Boston, MA

Thomas J. Cherrett
UNIVERSITY OF SOUTHAMPTON
Highfield, Southampton, England

Peter Plumeau
RESOURCE SYSTEMS GROUP, INC.
Burlington, VT

Roberta Weisbrod
PARTNERSHIP FOR SUSTAINABLE PORTS
New York, NY

Subscriber Categories
Freight Transportation • Planning and Forecasting

Research sponsored by the Research and Innovative Technology Administration

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2012
www.TRB.org

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 Research and Innovative Technology Administration (RITA) 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 RITA 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.

NCFRP REPORT 14

Project NCFRP-15A
ISSN 1947-5659
ISBN 978-0-309-21387-5
Library of Congress Control Number 2012931341

NOTICE

The project that is the subject of this report was a part of the National Cooperative Freight Research Program, conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council.

The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research and are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

The Transportation Research Board of the National Academies, the National Research Council, and the sponsors of the National Cooperative Freight Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of the report.

Published reports of the

NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

are available from:

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

and can be ordered through the Internet at:

http://www.national-academies.org/trb/bookstore

Printed in the United States of America

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

www.national-academies.org

C O O P E R A T I V E   R E S E A R C H   P R O G R A M S

CRP STAFF FOR NCFRP REPORT 14

Christopher W. Jenks, *Director, Cooperative Research Programs*
Crawford F. Jencks, *Deputy Director, Cooperative Research Programs*
William C. Rogers, *Senior Program Officer*
Charlotte Thomas, *Senior Program Assistant*
Eileen P. Delaney, *Director of Publications*
Hilary Freer, *Senior Editor*

NCFRP PROJECT 15A PANEL
Freight Research Projects

Diane Davidson, *Oak Ridge National Laboratory, Knoxville, TN* (Chair)
Miguel Andres Figlozzi, *Portland State University, Portland, OR*
Barbara A. Ivanov, *Washington State DOT, Olympia, WA*
Janet F. Kavinoky, *US Chamber of Commerce, Washington, DC*
Peter A. Rutski, *The Tioga Group, Ponte Vedra Beach, FL*
Edward L. Strocko, *FHWA Liaison*
Ann Purdue, *TRB Liaison*

FOREWORD

By William C. Rogers
Staff Officer
Transportation Research Board

NCFRP Report 14: Guidebook for Understanding Urban Goods Movement presents information and suggestions for improving public decisions affecting urban commercial motor vehicle movements for goods delivery. While many aspects of urban goods movement have been thoroughly documented, no single report provides a comprehensive, concise guide for public decisionmakers to accommodate and expedite urban goods movement while minimizing the environmental impact and community consequences of goods movement. The guidebook and cases studies will help decisionmakers understand the potential impacts of their decisions on urban goods movements among the following categories: transportation infrastructure and operations; land use and site design; and laws, regulations, and ordinances applicable to urban areas.

The guidebook, with an accompanying overview for local officials and CD-ROM (*CRP-CD-105*) containing the contractor's final report and appendices (unedited by TRB), includes case studies of urban supply chains and how they connect to the urban economy, infrastructure, and land use patterns; the impacts of land use codes and regulations governing metropolitan goods movement on private-sector freight providers; and planning strategies for improving mobility and access for goods movements in urban areas. The CD-ROM also includes two PowerPoint presentations with speaker notes that transportation planners can use to educate local decisionmakers on how they can improve mobility and access for goods movement in their area.

The efficient flow of goods is essential for the economic well-being of the vast majority of Americans who live in urbanized areas. The performance of the freight flow system also has direct implications for the productivity of the nation, the costs of goods and services, and the global competitiveness of industries. Land use and zoning decisions at the local level, by determining the location of the origin or destination of goods, as well as restrictions on time and routes followed, often occur without a full understanding or consideration of urban goods movement by commercial motor vehicles. As a consequence, the logistical needs of businesses and consumers may be degraded, opportunities for economic development may be missed, and freight movements may unnecessarily detract from the quality of life through congestion or emissions.

Under NCFRP Project 15A, Wilbur Smith Associates was asked to (1) review the literature on urban goods movement by trucks, with particular emphasis given to describing the impacts on such movement of local zoning regulations regarding off-street parking and loading, street standards and roadway design, and ordinances relating to parking permitting and enforcement; (2) describe the fundamentals of urban goods movement from the private perspective; (3) describe public-sector entities that are involved in land use, economic development, and transportation, and their current practices and decision-making criteria; (4) develop detailed descriptions of several urban supply chains that have significant impacts on the economy and make up a large share of total truck trips; and (5) develop a guidebook that supplies the foundation for understanding and focusing on the local actions, codes, ordinances, regulations, policies, and management that influence freight performance thereby accommodating and expediting the growing demand for urban goods movement, while mitigating its environmental impact and community consequences.

Note: The online PDF of this report presents the contractors' art as originally submitted in color.

CONTENTS

Note: Many of the photographs, figures, and tables in this report 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.

CHAPTER 1

Introduction and Purpose

Most of us have been in a bakery. We remember the wonderful aroma, perusing display shelves full of goods, our attention drawn to making selections for an upcoming meal, and mingling with other patrons doing the same. Depending on how observant we are, we might notice wheeled carts stacked with trays of fresh product emerging from the kitchen behind the store. Aside from the carts, the aroma, and the warmth of the ovens, there are few signs of the intense activity back in the kitchen where the production of goods on display has been underway since early morning. Anyone who bakes at home knows the work required to obtain ingredients and assemble recipes, while tending to the oven and cleaning up the mess. However, in the bakery storefront these activities become invisible. The baker's labors make it possible for modern consumers to concern themselves with other things, like the vital matter of acquiring nourishment (delicious no less).

In today's economy, the baker's concerns about having the necessary ingredients readily at hand are likely to be addressed by a bakery supply company. Like any efficient company in the modern economy, the baker uses very little space for inventory or long-term storage of ingredients. With the high price of urban real estate, retailers and other shop owners use their most valuable square footage to sell products. To support the wide variety of product selection and quality freshness consumers demand, bakeries and other retailers in urban settings receive deliveries from warehouses at least several times a week and, in many cases, every day of the year.

Most modern American households get their food and other supplies through retail grocery stores. One of America's top grocery chains interviewed for this research indicated that their fleet of trucks makes over 40,000 deliveries each week. They provided the following estimate for how many days' worth of product they keep on store shelves:

- Produce and frozen foods (e.g., meat and fish): 1 to 3 days
- Eggs and dairy: 2 days
- Dry goods: up to 7 days

For an urban grocer, if deliveries are disrupted, fresh and frozen food products will be gone in 1 to 3 days, eggs and milk in 2 days, and store shelves would be empty in a week. City residents who have endured a hurricane or blizzard know that a run on supplies can empty the shelves even faster, sending prices through the roof. In everyday life, we simply stop by the store and get what we need, affordably. The simplicity of shopping we enjoy masks the reality that an elaborate 24/7 system of supply sustains it—in the same way that a bakery is sustained by the work back in the kitchen and its supply chain. The success of the system creates the illusion of effortlessness; residents can ignore the mechanics, but they depend on the results.

As cities become increasingly dense, congested, and complex—those who make decisions about development, land use, and commercial transport regulation need to understand and support the

What Is a Supply Chain?

A supply chain is a group of human and physical entities including procurement specialists, wholesalers, logistics managers, manufacturing plants, distribution centers, and retail outlets, linked by information and transportation in a seamless, integrated network to supply goods or services from the source of production through the point of consumption.

goods movement system. There is a need for local decisionmakers to understand how, for example, the links of a bakery supply chain affect the certainty citizens enjoy, that when they stop by the bakery on their way home, they will find the perfect loaf of bread for that upcoming meal. The research results, supply chain, and best practice case studies presented in this guidebook are intended to raise the level of understanding so that decisions made by urban governments support both the needs of freight service providers and the quality of life their citizens expect. The sections on regulations affecting urban goods movement and putting it all together are intended to provide insights and direction on what local decisionmakers can do to improve access and mobility in urban settings.

In today's global economy, virtually anything anyone consumes comes whole, or in part, from somewhere else. To make this possible, U.S. companies collectively spend a trillion dollars a year on freight logistics; nearly 10 percent of the nation's GDP, or nearly 10 cents for every dollar, in the economy.

—20th Annual State of Logistics Report, *prepared by Rosalyn Wilson of Delcan for Council of Supply Chain Management Professionals and presented at the National Press Club, July 17, 2009.*

More than four out of five people in the United States live and work in urban areas (U.S. Census 2009). The Commodity Flow Survey (CFS), the primary source of national- and state-level data on domestic freight shipments by American establishments, finds that 65 percent of American goods originate or terminate in major urban areas, indicating that the purpose of most trips is somehow created or satisfied in cities (USDOT RITA, BTS). Cities are metropolitan statistical areas (MSAs) and combined statistical areas (CSAs). Originations and terminations include gateway traffic. Intercity distances are long, suggesting that the freight miles traveled between urban areas are more than the freight miles traveled within them. However, according to the IHS Global Insight Transearch® freight database, most (55 percent) 2008 U.S. empty truck miles occurred in MSAs. The proportional value of goods originating or terminating in metropolitan areas is even higher—81 percent according to the CFS—underscoring the key link between freight flows and urban economies. Various studies have reinforced the economic contribution of freight activity to urban areas. In Atlanta, the transportation and logistics cluster is the fifth largest in the nation, the second fastest growing, and a principal pillar of competitiveness in the regional economy (Porter et al. 2002). In Chicago, the rail-freight industry sector accounts for entire percentage points of the metropolitan economic product, and ports frequently justify their existence based on economic impacts to regional economies. Cities that are not big freight generators or shipping hubs may attribute less importance to freight activity, but nationwide logistics accounts for between 9 and 10 percent of gross domestic product (GDP) in normal conditions, making it an activity that should always be worthy of attention (Wilson 2010). Even so, statistics and numbers can understate the importance of goods movement in our lives, because the freight system does two related but distinct things: (1) it enables economic activity of the sort often reported in statistics and (2) it delivers supplies to the citizenry that support their existence. It is the latter aspect that is taken for granted so easily, whose inefficiencies are swallowed as part of the high cost of city living, and whose disruptions become matters of urgency in just days.

The efficient movements of goods in urban areas occupy a crucial position in the functioning of cities, and are an appropriate concern for the public agencies that manage them. This guidebook is designed to help public agencies address such responsibilities.

For the purposes of this guidebook, the terms "freight" and "goods movement" are used interchangeably. At times there have been attempts to distinguish between the different freight needs of "goods" (property, merchandise, or wares being transported) and the freight needs of "services" (transportation of materials supplying service industries like construction, or activities associated with services like waste management, utilities, and healthcare). This guidebook touches briefly on distinctions between goods and services, but in general the term freight should be interpreted as meaning the transportation of both goods and services.

It is worth recognizing at the outset of this discussion that "goods movement" in a metropolitan context is likely to mean very different things to different members of society that make up the urban fabric, as follows:

- To a business, metropolitan regions are highly concentrated production/consumption environments. Consumer demands for goods and services are transmitted to facilities that source,

supply, and distribute the products and services customers want. Seamlessly integrated transactions are the essence of modern supply chains. Businesses expect urban transportation systems to work well with limited engagement on their part.
- To urban transportation planners, freight represents just a small portion of the traffic volume they must accommodate in network planning. Nonetheless, commercial truck traffic often exhibits disproportionate social costs and divergent trip patterns.
- To a carrier or freight service provider (e.g., trucking firm, railroad, package courier, municipal waste hauler, etc.) the metropolitan region is a highly competitive market. Trucks are the most prominent carriers of goods moving within the urban environment. Trucking company success and profitability is dependent upon performance and productivity, using facilities infrequently designed for the operating requirements of modern trucking equipment.
- To community planners, urban goods movement is higher maintenance costs, specialized enforcement requirements, noise, and airborne emissions. The real and social costs related to goods movement are often imposed by activities and companies outside the community planners' jurisdiction, moving in vehicles whose content and purpose are probably obscure, and whose function seems outside the residentially oriented priorities that consume their attention.
- To private developers and landlords, accommodating the movement of goods is often an afterthought, and, whenever possible, a cost that should be borne by others.
- To elected officials, freight is one element of an essential public service that often collides with other public transportation services that voting citizens support. It is often said that "freight doesn't vote." Politically, freight interests gained clout in some locations, and at some levels, but organized freight interests remain a rarity at the local level.
- To urban citizens, freight is an impediment to a faster, safer commute home, and is characterized by noisy, dusty activity centers that diminish the urban experience and release harmful emissions that raise health risks. Goods moving in and through the urban environment are carried by menacing vehicles competing for lane space and impose long waits at railroad grade crossings. In short, citizens view freight operations as a nuisance and a threat to their health. To citizens, the quality-of-life benefits from moving goods efficiently and reliably are largely invisible.

As these perspectives make plain, views regarding urban goods movement are highly divergent and largely negative. This guidebook is intended to improve the understanding of goods movement, strengthen its value in public planning, and improve its perception among public decisionmakers. This guidebook discusses methods for integrating freight issues into metropolitan planning and regulatory processes and describes techniques and tools that are of practical use to local decisionmakers.

Why Read the Guidebook

According to USDOT, both population and the freight needs of that population will continue growing in the future. The annual tons of freight moving per capita are expected to increase from 55 tons in 2010 to 70 tons in 2040—an increase of 27 percent. The American Association of State Highway and Transportation Officials (AASHTO) forecasts that for every two trucks on the road today, by 2030 there will be an additional truck to carry the expected growth in food, consumer goods, and manufacturing equipment.

Although freight logistics is a key component of the economy today, like the baker labors at the back of the store—it is largely invisible to citizens and the people they elect. Previous research has noted the need for building public awareness about the key role that freight plays in everyday lives, and working together and organizing to craft solutions (Strauss-Wieder 2003). The guidebook is intended to help public policymakers understand the reasons for raising public

Just as perceptions of goods movement differ among various stakeholders, the term freight *conveys different meanings to different people. In the most general sense,* freight *is the term applied to moving goods from one place to another, by any mode—highway, rail, ocean or air. It is also a term associated with the money paid for transporting goods. Within the logistics industry, the term freight most often refers to the long-haul component of a supply chain. The long-haul linkages of a supply chain are nominally intercity, port to transport terminal, terminal to terminal, interplant, plant to distribution center (DC),DC to DC, port to rail intermodal yard, or airport to DC.*

Freight is defined as goods or cargo carried by a commercial means of transportation or, the ordinary method or class of commercial transportation for goods, slower and cheaper than express.

awareness, by discussing common problems and seeking common solutions for moving goods in urban environments.

The primary focus of this guidebook is on planning actions that if started today, can prevent goods movement from being an overly costly, hazardous, or polluting activity in the future. Moving goods and services within dense urban environments will always convey unwanted social costs upon citizens. However, cities that have recognized the social and economic benefits of accommodating freight through proper land-use planning, regulation, and public education have made advancements toward reducing the negative social impacts often associated with freight. This guidebook uses case studies to illustrate "how to" steps and share the knowledge gained by local planners and elected officials working to integrate city logistics into their future vision.

The Guidebook's Intended Audience

The primary audience for this guidebook includes local elected officials who have the authority to enact land-use regulations, zoning ordinances, and codes within their jurisdictions. Secondary audiences for the guidebook are appointed planning commissioners and officials, as well as public- and private-sector planners and metropolitan planning organizations (MPOs) that work in urbanized areas (city and county) and advise the local elected officials who are the decisionmakers. Many private- and public-sector professionals define themselves as planners. The American Planning Association (APA) defines planners as individuals who work with, or for, elected and appointed officials, such as mayors and planning commissioners, to lead the planning process with the goal of creating communities of lasting value. Planners help civic leaders, businesses, and citizens envision new possibilities and solutions to community problems. Most of them perform their work in one or more specialized fields such as community development, land use, transportation planning, historic preservation, and community outreach, just to name a few.

Taken together, these audiences form a fairly broad group that includes public agency decisionmakers and officials, both elected and appointed. It is often true that elected or appointed officials, and sometimes planners, come from varied backgrounds and may not always be familiar with freight transportation terminology. Therefore, in developing this guidebook, care is taken to use common terminology, or provide definitions for freight industry terms.

Academic instructors and researchers and private-sector stakeholders are also potential audiences for the guidebook.

How the Guidebook Is Organized

The guidebook covers

- How urban supply chains function and how freight delivery services operate in urban settings,
- How they connect to the urban economy-infrastructure, and land-use patterns,
- The impacts of land-use codes and regulations governing metropolitan goods movement on private-sector freight service providers,
- Planning strategies and methods for improving mobility and access of goods movements in urban areas, and
- Case studies to illustrate application in practice.

By supplying a foundation for understanding and then focusing on the local actions, codes, ordinances, regulations, policies, and management that influence freight performance, this guidebook aims to accommodate and expedite the growing demand for urban goods movement while mitigating its environmental impact and community consequences.

The guidebook has the following seven sections:

1. Introduction and Purpose,
2. Background: The Importance of Goods Movement in the Urban Environment,
3. Moving Urban Goods: It's All about Supply Chains,
4. Using Freight Data for Planning,
5. Regulations Impacting Urban Goods Movement,
6. Putting It All Together: A Process for Evaluating and Addressing the Impacts,
7. Case Studies.

A resource CD-ROM accompanies this guidebook. It contains

- PowerPoint presentation (approximately 10 minutes) with speaker notes for use in educating decisionmakers about urban goods movements;
- PowerPoint presentation with speaker notes for use by planning staff to conduct up to a 4-hour workshop on the content of this guidebook;
- PDFs of TRB and FHWA presentations on urban goods movements;
- A literature review including an annotated bibliography, searchable database, and articles on urban goods movements;
- PDFs of the urban supply chain drawings;
- Information on freight data;
- An extensive freight glossary and list of acronyms; and
- Sample brochures on freight supply chains produced by the Coalition for America's Gateways and Trade Corridors (CAGTC).

An eight-page, color overview accompanies this guidebook and is on the CD-ROM. It is intended as a quick and easy read to capture the attention of local elected officials, decisionmakers, and potential guidebook users.

CHAPTER 2

Background: The Importance of Goods Movement in the Urban Environment

The relationship between urban development and freight transportation is a chicken-and-egg question. Do commerce and transportation lead to urban development or do concentrated populations beget commerce and transportation? In fact, the answer to these questions has changed over the history of America's urban evolution.

A Brief History of Urban Development and Freight in America

The first American urban settlements were based on the available means to transport merchandise and foster trade (i.e., coastal ports and river towns). Early settlements (and later the first true U.S. cities) followed the trade routes enabled by water transport gateways and later by railroad expansion. In early America, city centers were the fashionable location to live, offering easy access to tradesmen, shops, warehouses, and ship docks. In colonial America's large cities (e.g., Boston, Philadelphia, and New York), the urban core also offered amenities such as entertainment, water pumps, refuse collection, and postal services. Because early freight and service delivery modes were pedestrian or horse-powered, prominent citizens tended to live near services in the city center.

In the span of 50 years (1870 to 1920), the number of Americans in cities grew from 10 million to 54 million. By 1920, more Americans lived in cities than in rural areas.

In the late 1800s, the Industrial Revolution changed the face of American cities. Industry developed alongside transportation gateways, fostering trade routes for agriculture and natural resources. New industries lured people to cities with the promise of jobs. As the industry of city centers became noisier and more polluted, technology advancements in passenger travel allowed citizens to move out of the urban core and still access jobs. Trains, trolleys, street cars, and later cars, allowed urban areas to expand beyond walking distance to employment centers—resulting in the rise of suburbs.

Following World War II (WWII), the GI bill made suburban housing affordable, allowing suburban populations to explode. The Interstate Highway System (IHS) gave workers an easy commute between downtown and the burgeoning suburbs. Employers now followed their employees, because the suburbs offered cheap land, lower taxes, and less crime. Suburban truck trips also grew as factory supplies from distant suppliers flowed through traditional urban gateways via rail hubs or ports then traveled the "last mile" to factories by truck. As a result, urban traffic and traffic congestion exploded as well, signaling the beginning of a growing problem that continues to plague many American cities today—congestion.

In WWII, logistics (having the right materials in the right place at the right time) played a key role in the Allied victory. After the war, logistics management entered the mainstream of American business practice. Early logistics management focused on delivering finished products to consumers, most now living in cities. By 1990, three-quarters of Americans lived in an urban location. Today, in the 20 largest U.S. metropolitan areas, on average, 41 percent of the population live in the city and 59 percent live in the surrounding suburbs.

Urban Goods Movement in the Twenty-First Century

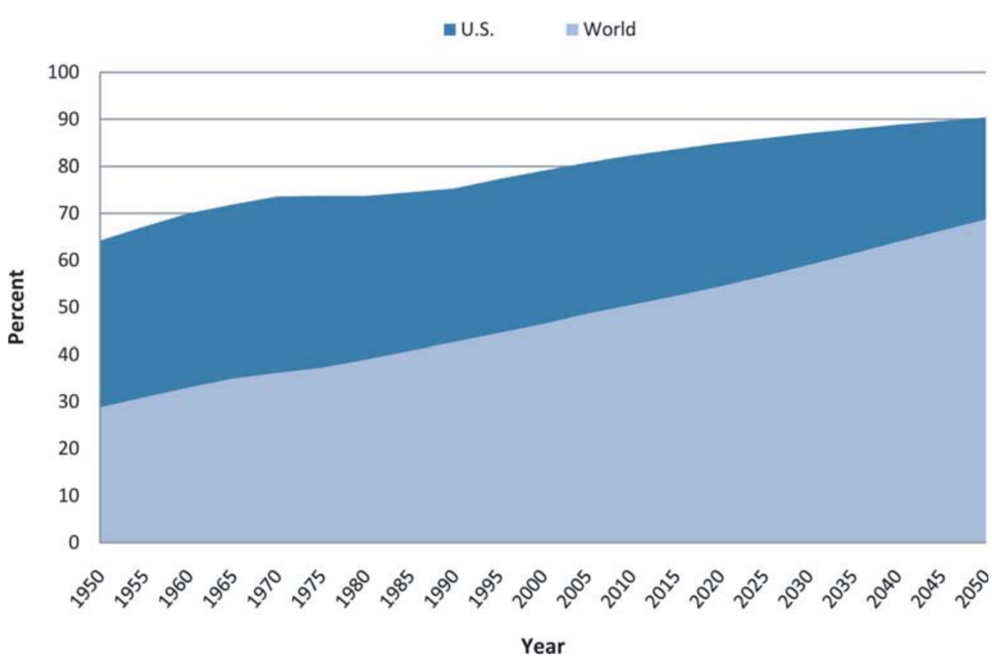
The world has becoming highly urbanized. Humanity is in the midst of a long-term migration leading to greater concentrations of people in compact, densely populated urban areas. In the United States, the Census Bureau defines an urbanized area as

> An area consisting of a central place(s) and adjacent territory with a general population density of at least 1,000 people per square mile of land area that together have a minimum residential population of at least 50,000 people. The U.S. Census Bureau uses published criteria to determine the qualification and boundaries of urban areas.

In the rest of the world, the definition of *urban* varies, but regardless of how urban is defined, the migration to more concentrated areas is a significant trend that poses huge societal challenges, not the least of these being how to efficiently accommodate the need to move both people and goods in densely populated, compact environments. It is worth noting that the United States, while far from the most urbanized country in the world, is well ahead of the world average, see Exhibit 2-1. Today over 83 percent of the U.S. population live and work in urbanized areas. In the next 40 years, U.S. urban areas are expected to grow by 80 to 100 million people.

Cities are quickly becoming the most concentrated, dense consumer markets in history (Laeser, Kolko, and Saiz 2000). Meanwhile, the capacity of urban transportation infrastructure has increased only modestly. Urban design and regulations affecting how freight moves in modern cities have failed to keep pace with the growing demand for goods and services, and the transportation systems that support modern logistics and supply chain management.

Exhibit 2-1. World and U.S. population—percent urban.



Source: Data from United Nations World Population Prospects, 2009 Revision. Data online at http.//www.un.org/esa/population/unpop.htm. Graphics by Wilbur Smith Associates.

How Goods Move

In the latter half of the twentieth century, logistics management became a legitimate business function that continued to evolve toward a more integrated chain linking previously separate functions: material sourcing and procurement, manufacturing, inventory management, distribution, and transportation. As the science of logistics evolved into what is today supply chain management, businesses refocused from just delivering products to reducing inventory and contributing to a company's bottom line.

With the emergence of worldwide production markets for consumer products, supply chains have taken on more prominence in business strategy. Today, businesses define how goods move by the nature of their supply chains: people, processes, and physical entities linked together by information and transportation. This "logistics revolution" over the past three decades has redefined many business sectors. Wal-Mart is an often noted example of a business that redefined the retail industry primarily because of its superior supply chain management practices.

> Supply-chaining is a method of collaborating horizontally—among suppliers, retailers, and customers—to create value. Supply-chaining is both enabled by the flattening of the world and a hugely important flattener itself, because the more they grow and proliferate, the more they force the adoption of common standards between companies (so that every link of every supply chain can interface with the next), the more they eliminate friction at borders, the more they encourage global collaboration.
>
> —Thomas Freidman, *The World Is Flat: A Brief History of the 21st Century*

One step undertaken for this project involved research about urban supply chains. Additional information about urban supply chains, including product supply chain illustrations, is provided at the end of this chapter. (See Exhibit 2-2.)

Who Is Moving Your Goods?

Most goods and services are moved by private-sector companies; however, some government-supplied services include the transport of goods such as waste removal and military operations. The first distinction for private-sector freight services is private and for hire. Businesses that operate their own transportation fleets to carry their own products or services are classified as private carriers. Most private carriers operate truck fleets; however, some industries (such as mining companies, agricultural businesses, or producers of time-sensitive products) may also operate their own railroad assets, barges, or aircraft. Some of the largest private truck fleets are operated by utilities, food services, business or home services (e.g., cable providers), and construction and sanitation businesses. Many of these large private carriers also operate primarily in urban environments.

Businesses that exist for the sole purpose of providing transportation services are classified as for-hire carriers. For-hire carriers include trucking companies, railroads, ship or barge operators, and air cargo providers that move freight for various businesses and industries.

The trend in the United States of moving toward a trade-based economy also shaped public policy toward freight transportation. Intermodalism—the ability to smoothly transition freight shipments from one mode to another—became a centerpiece of U.S. transport policy when Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991.

The success of intermodal freight transportation results from economic synergies gained by integrating the best attributes of each individual mode. Working together, each mode performs most efficiently the task it does best. Typically, railroad or barge transportation costs less and is more fuel-efficient than trucking over long distances (e.g., the movements between

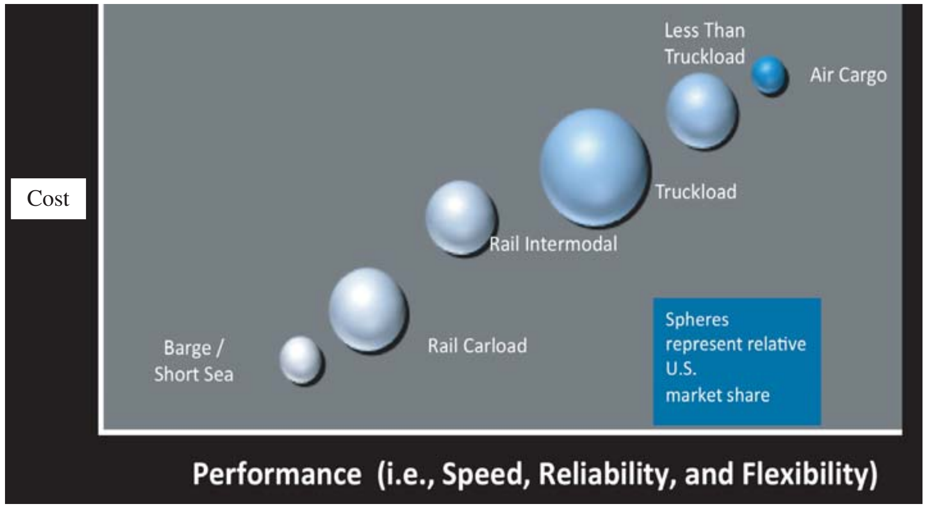
Exhibit 2-2. Supply chain process.

Source: Wilbur Smith Associates.

seaports and the urban area). Railroads frequently move shipments between urban centers, or between an international gateway and an urban center. Trucks then deliver the shipment directly to the receiver's facility. Motor carriers, with their greater flexibility and universal access to industrial and commercial locations, are used for the last mile of the journey. Joint services offered by more than one mode take advantage of each mode's inherent economy but are much more complicated than single-mode movements because of the specialized equipment, terminals, and coordination among multiple parties. Exhibit 2-3 illustrates the relationship between costs and service levels associated with a spectrum of common freight transport modes.

Speed to market is one of the most important factors in supply chain design and execution, as it influences mode selection by commodity type. Every supply chain differs in its need to economize on cost while at the same time arranging to consistently deliver the freight at the right time to the right destination in good condition. Some commodities must get to the market very fast before the product's perishable lifespan expires. Usually, the higher the price and the fresher the product, the faster it must get to market. Fresh food must get to market while it is fresh and safe for consumption, usually just a few days. A pharmaceutical must arrive in days before its potency date expires. Furthermore, sometimes seemingly plain commodities have high speed to market goals; for example ready-mix concrete must be poured within hours of being mixed at the plant.

Exhibit 2-3. Modal services versus cost continuum.



Source: Adapted from Lanigan, Zumerchik, and Rodrigue, "Automated Transfer Management Systems to Improve Intermodal Efficiency of Rail Freight Distribution."

The changes at work in the American economy are profound. The agricultural and manufacturing economy of the twentieth century has evolved. Services are now the fastest growing sector of the economy. Logistics and transportation sectors are second. The American economy demands increasing volumes of trade if it is to continue to grow. The economic sectors that remain robust will require far more trade and travel per unit of output than was required 30 years ago.

—Transportation Investment in Our Future: America's Freight Challenge, *AASHTO, May 2007.*

What Moves: Supplying Urban Populations

The 2007 Commodity Flow Survey (CFS) was summarized to examine information on goods moving to and from major urban areas across the U.S. CFS isolation of commodity types for urban areas is limited to outbound (originated) traffic, whereas much of the complexity in urban activity is in the more fragmented inbound deliveries, which are heavily oriented to trucks. However, understanding this limitation, outbound commodities carried by truck were ranked by weight and value and are presented in Exhibit 2-4. The data from the CFS is presented for commodities grouped by Standard Classification of Transported Goods (SCTG) groupings. At the 2-digit level, there are 42 SCTG categories.

Exhibit 2-4 shows that, by weight, the top 10 SCTG categories account for 75 percent of all urban outbound truck volume. By value, a largely different top 10 account for 62 percent of all outbound truck volume. Gasoline, prepared foods, mixed goods, and semi-finished metals are commodity groups included in the top ten by both weight and value. Other important commodity groups include construction materials, electronics, vehicles, and pharmaceuticals.

Mixed freight includes shipments for grocery and convenience stores and supplies for restaurants and other retail establishments that receive trucks containing a mix of goods from various suppliers. Often, full lots of a particular good are delivered to a distribution center by train or truck, then broken and mixed with other goods to be delivered by truck to a specific retail destination.

Why Freight Moves: Supporting the New Economy

In recent decades, the make-up of the U.S. economy has undergone a significant structural shift: In the early 1980s, manufacturing was the leading sector of the U.S. economy. By 2007, manufacturing accounted for less than 20 percent of the economy, while the services sector accounted for 79 percent. The ability to efficiently transport goods and services has played a significant role in this transformation. The logistics revolution described earlier, combined with public and private transportation investment, has allowed American business to reduce inven-

Exhibit 2-4. Top urban truck commodities—outbound by tonnage and value.

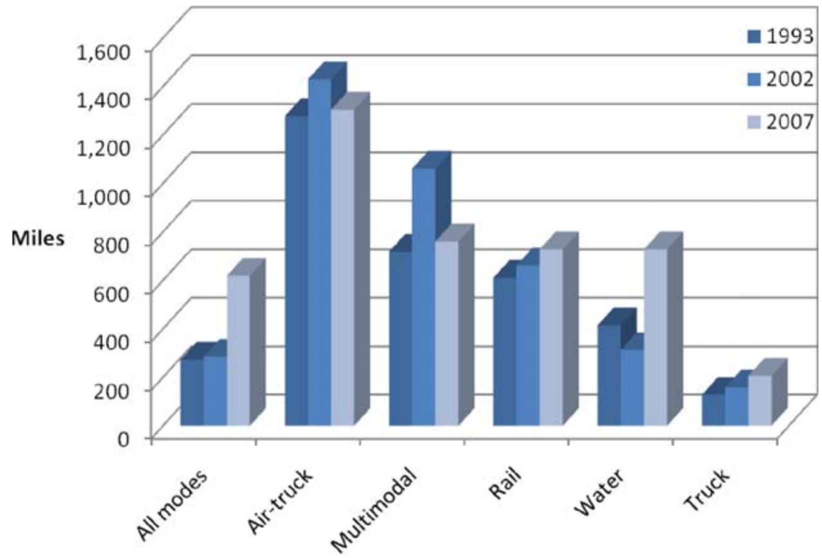
SCTG Code	Commodity Description	Tons (000)	Cumulative % of Total	Rank by Tons	Value ($ Mil)	Rank by Value
12	Gravel and crushed stone	779,127	20%	1	$8,730	32
31	Nonmetallic mineral products	646,897	37%	2	$108,723	15
17	Gasoline and aviation turbine fuel	294,769	45%	3	$225,504	9
7	Other prepared foodstuffs and fats and oils	227,273	51%	4	$249,878	7
43	Mixed freight	196,949	56%	5	$529,597	1
19	Coal and petroleum products	179,002	60%	6	$81,138	21
32	Base metal in primary or semi-finished forms/shapes	175,495	65%	7	$263,623	6
18	Fuel oils	139,133	69%	8	$86,340	18
11	Natural sands	131,760	72%	9	$1,912	36
26	Wood products	104,701	75%	10	$82,378	20
SCTG Code	**Commodity Description**	**Value ($ Mil)**	**Cumulative % of Total**	**Rank by Value**	**Tons (000)**	**Rank by Tons**
43	Mixed freight	$529,597	11%	1	196,949	5
35	Electronic & other electrical equip & components & office equip	$384,523	19%	2	23,358	27
36	Motorized and other vehicles (including parts)	$365,873	26%	3	61,193	17
21	Pharmaceutical products	$316,624	33%	4	6,790	34
34	Machinery	$274,449	38%	5	26,188	25
32	Base metal in primary or semi-finished forms/shapes	$263,623	43%	6	175,495	7
7	Other prepared foodstuffs and fats and oils	$249,878	49%	7	227,273	4
24	Plastics and rubber	$235,417	53%	8	80,394	11
17	Gasoline and aviation turbine fuel	$225,504	58%	9	294,769	3
33	Articles of base metal	$196,247	62%	10	60,399	18

Source: 2007 Commodity Flow Survey.

tories, while simultaneously achieving greater economies of scale in a global trade environment. These dual efficiency gains for American business have relied on efficient transportation services: Inventory reduction typically requires more frequent shipments to reduce the possibility of stock shortfalls, leading to more transportation services. Lower transportation costs also allow firms to consolidate production and distribution facilities from many to fewer, but consolidation implies a longer average length of shipment haul and the economies of scale are achieved only at the cost of more transportation services (Lakshmanan and Anderson 2002).

Exhibit 2-5 displays the trend in average length of haul by mode from the past three Commodity Flow Surveys (CFS). Overall, more goods are traveling longer distances. According to the 2007

Exhibit 2-5. Average length of haul of selected modes.



Source: USDOT, Research and Innovative Technology Administration (RITA), Bureau of Transportation Statistics (BTS). Notes: The Commodity Flow Survey (CFS) is a partnership between BTS and the U.S. Census Bureau. (Data compiled by Wilbur Smith Associates.)

CFS, the average length of haul in trucking has increased nearly 24 percent over 2002. Currently, the average truck shipment moves 206 miles. While long-haul trucking services skew this statistic, in many cases urban land-use decisions also have pushed motor carrier terminals and delivery hubs further out on the urban fringe, increasing the distance required to supply businesses in the urban core.

Transportation planners typically characterize how freight moves by the mode or modes used to get goods from a gateway or point of production to the point of consumption. Urban goods travel by air, water, pipeline, and rail, but most often by truck. Selecting the mode for how freight moves is a function of time requirements, network availability, and total logistics costs. To determine total logistics cost, several factors come into play: length of haul, weight, packaging and product handling, number and size of shipments, customer preference, and shipment value.

Much of the freight moving in urban areas is characterized by short lengths of haul. Operationally, urban delivery services are challenged with making just-in-time (JIT) deliveries while navigating congested highways, parking restrictions, and route restrictions. To accommodate these operational challenges, many businesses and industries place warehouses or distribution facilities in or near urban areas in order to meet delivery schedules and employ smaller vehicles that can negotiate urban streets and docking sites. Zoning and land-use restrictions have significant influence on the location of these facilities.

Most freight transportation within urban areas is provided by trucks and vans, especially for the final stages of goods moving to consumption. Manufacturing plants and distribution facilities in metropolitan areas may receive large shipments by rail, ship, barge, jet, or pipeline, which are then delivered by truck for the so-called “last mile” of the delivery. Similarly, while downtown office buildings may be reached by package couriers using cars, bikes, or transit, these couriers are often operating from depots supplied by trucks. Urban truck traffic is composed of various movement types:

- Long-haul trucks with both origins and destinations outside the urban area, that are simply passing through the urban highway network;
- Long-haul trucks with a pick-up or delivery in the region, to the opposing delivery or pick-up point outside the region;
- Truck drayage—the short-haul truck port of intermodal container movements to and from railroad intermodal yards and marine container ports;
- Local trucks moving goods among facilities on pick-up and delivery (P&D) runs within the region;
- Construction vehicles (e.g., cement mixers, dump trucks, construction cranes);
- Utility and other residential service vehicles (e.g., refuse trucks);
- Van lines delivering freight and goods with special requirements; and
- Package services.

Generally, many of these movements are business-to-business activities involving the arterial route networks in the urban environment. However, there is an increasing trend toward home deliveries brought about by the rise in e-commerce. Home deliveries require trucks to access the smaller thoroughfares and neighborhood streets.

Freight movements in urban areas also correlate directly to the type and level of economic activity in a region. Population density is one of the primary drivers of freight density and geography, plus connectivity drives many of the modal service options available to a community. Urban areas are characterized by high densities of residents and employment centers for service industries, warehouses, distribution centers, retail establishments, hospitals, and institutions. As urban areas grow, they tend to evolve from being producers of goods to being consumers of goods. Goods intended for personal consumption account for a large number of urban freight movements. Internal urban trade between warehouses, distribution centers, retail stores, and, ultimately, to residents who consume the goods also contributes heavily to traffic. Urban businesses require office products and supplies, and they in turn send materials and products to local, domestic, and—sometimes—international markets.

Originally, the primary east-west orientation of both the Interstate Highway System and Class I railroad network followed the pattern established by Manifest Destiny and the westward expansion of the U.S. population. In 1959, the first containerized cargo called on the Port of Los Angeles, marking the start of the containerized cargo revolution. During the 1960s, as containerization grew and large ships were unable to pass through the Panama Canal, the San Pedro Ports of Los Angeles and Long Beach became the primary gateway for consumer goods being delivered to cities across America by train and truck. The highway and railroad "landbridge" from West Coast ports to the rest of the country further opened Asian economies to U.S. consumer markets.

In 2001, the Panamanian government embarked on an expansion of the Panama Canal to remain competitively positioned to capture increased international trade between Asia and U.S. East Coast ports. Currently, container ships passing through the canal are classified as "Panamax" and are limited to 965 feet in length, 106 feet in width, with a 40-foot draft. Panamax container ships carry approximately 4,500 to 5,000 twenty-foot equivalent unit (TEU) containers. The Panama Canal Expansion Project is estimated to cost $5.2 billion and is expected to be completed in 2014. Once finished, the new locks will accommodate ships up to 1,200 feet long, 160 feet wide, with a draft of 50 feet. Super post-Panamax container ships will be able to carry 13,000 TEUs. It is anticipated that the Panama Canal Expansion Project will be a game changer that will re-route significant volumes of container traffic from West Coast gateways to East Coast gateways.

Congestion and Cost

The ability to transport various consumer goods in huge quantities, in a timely fashion, conveniently positioned near urban populations is one of the exceptional quality-of-life attributes of living in a twenty-first-century urban environment. Whether in New York City, NY, or New London, WI, most urban consumers can travel just a short distance in time and space to find a vast selection of goods from around the world.

However, with convenience and choice, come congestion and cost; and, typically, the higher the population density, the greater the congestion and cost. The annual Urban Mobility Report by the Texas Transportation Institute (Lomax et al. 2010) estimated that congestion in the largest urban areas of the United States during 2009 cost the trucking industry $33 billion in delay time and wasted fuel.

Where Freight Moves in the City—"The Last Mile"

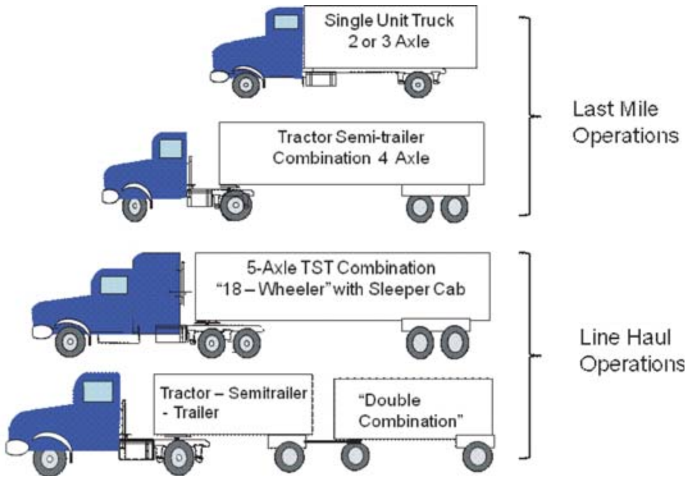
Materials and goods move from a place of origin to a place of production, processing, warehousing, or distribution, and then to a place of consumption. What distinguishes urban goods movement from other freight movement is the "last mile"—or more correctly the first, last, and transfer miles, all heavily concentrated in metropolitan areas. Urban freight movements are about making efficient trips with frequently smaller shipments and smaller vehicles to dense mixed-use areas. These movements include pickups and deliveries that are vertical as well as horizontal; goods must travel vertically to high-rise office buildings and rooftop restaurants, and they travel horizontally on cross-town trips to meet delivery and pick-up schedules through the most difficult congestion in the country.

Urban freight deliveries to inner city businesses, restaurants, residences, offices, and department stores share similar patterns. Getting the goods to their final destination often means negotiating dated high-rise buildings with limited docking sites, delivery bays, and freight elevators, many constructed in the nineteenth century. Narrow streets, tight turning radii, and low clearances are common obstacles for delivery drivers.

From a planning perspective, both horizontal and vertical "final mile" inefficiencies should be quantified and addressed. Common horizontal inefficiencies include the lack of curbside space that increases congestion as delivery trucks circle or block traffic while waiting for a parking space. City parking ordinances that restrict the length of time a vehicle can park at busy commercial curbsides, enforcement of commercial parking zones, and variable time of day parking fees can help address these issues. Updating design standards to match loading docks to modern truck configurations can also improve delivery vehicle access. Vertical obstacles (such as inadequate freight elevators) can be addressed by updating and enforcing these standards.

To accommodate the often tight confines of road geometrics in dense "last mile" urban areas, trucking companies often use smaller or more agile truck configurations. Maybe the most well-known truck configuration in the United States today is a 5-axle tractor-semi-trailer (TST) combination vehicle, or so-called "18-wheeler." The typical 5-axle TST has a gross vehicle weight capacity of 80,000 pounds with a 53-foot semi-trailer, and is often equipped with a sleeper cab. The 5-axle TST is commonly used in line-haul operations, where goods are moved from an origin to a warehousing facility in or near the urban area. For last-mile deliveries, companies often transload goods to delivery vehicles like those shown in Exhibit 2-6, single-unit trucks of two or three axles with a relatively short wheelbase, or 4-axle TST combinations with 45- or 48-foot semi-trailers.

Exhibit 2-6. Conventional truck configurations.



Source: Wilbur Smith Associates

CHAPTER 3

Moving Urban Goods: It's All about Supply Chains

The character of economic activity and concentration of residential populations largely determine what is moving in an urban area. Much of what is transported to, from, and within metropolitan regions are goods needed to support residents and service businesses. As described earlier, while the U.S. economy continues to employ a significant number of people in manufacturing, the base economy has evolved from manufacturing to services. "Over the past three decades, the United States has lost almost 5 million manufacturing jobs. As a result, the share of the nation's workforce employed in this sector has dropped sharply, from 20 percent in 1979 to about 11 percent today" (Deitz 2006). As more manufacturing has moved offshore, urban regions have increasingly become centers of consumption rather than centers of production.

Twelve different goods and services supply chains characteristic of many urban environments were examined for this guidebook. Four are presented as case studies in this chapter; the other eight are provided in Appendix A. These 12 case studies cover a wide range of freight movements and illustrate common constraints in the urban environment. Together, they incorporate a spectrum of multimodal activity, but particular attention is given to the truck mode because the last link in the supply chain often is a truck moving through metropolitan streets.

The dozen supply chain illustrations are organized into three channels of goods movement. Distribution channels are the paths used by businesses to bring goods to market. They can intersect and overlap, and they embody the dynamic nature of goods movement and supply. The three principal channels for urban goods are defined as follows:

- **Industrial Production:** Comprises manufacturing of heavy and light goods bound for businesses and retail outlets. Product shipments range from chemicals, petroleum, and motor vehicles to packaged goods. Two examples appear in this chapter (on soft drink beverages and gasoline). One more for pharmaceuticals and biotechnology can be found in Appendix A.
- **Retail Distribution:** Comprises businesses that distribute consumer products like food, electronics, publications, and housewares through wholesale and store-front facilities. One example appears in this chapter (on retail apparel). Five more can be found in Appendix A, for food services, urban wholesale food, supermarkets, big box retail, and retail drug stores.
- **Service Provision:** Comprises service-oriented businesses supplied with, or handling, goods for their engagements, such as constructing facilities, caring for health, mounting exhibitions, moving household goods, and removing waste. One example appears in this chapter (on aggregate-based construction materials). Two more can be found in Appendix A, for hospitals and waste and recyclables.

Each illustration has three components: a narrative overview of the steps in the supply chain, a flowchart depicting those steps, and an account of performance issues for the chain in urban environments, which underscores concerns for public planners. Following the illustrations is a comparative discussion that begins with a table of comparisons for all 12 chains in terms of their major elements. The table identifies

- The supply chain, its channel, and types of goods;
- Geographic features, main types of facilities, and modes of transportation;
- Patterns in the staging of goods and urban delivery; and
- Performance features, including expectations, common risks, and enhancement strategies.

After the table, short discussions of each of these elements, their differences and shared traits, and significant factors for planning are presented.

Case Illustration 1: Soft Drink Beverages

Overview

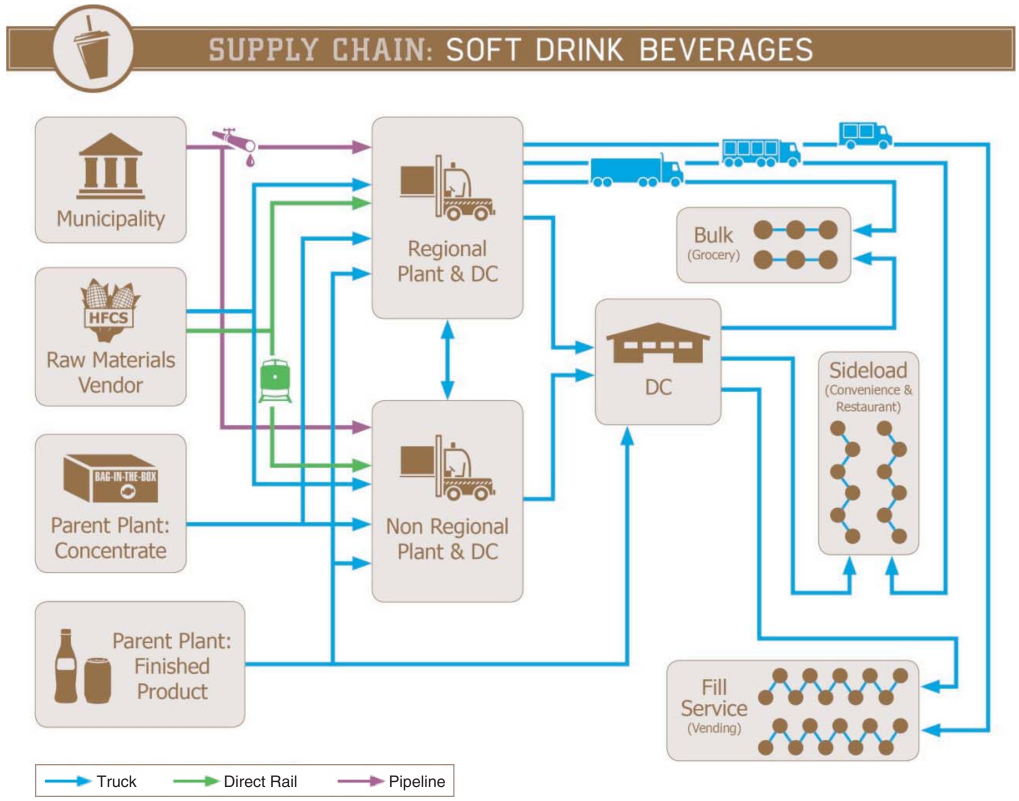
Consumer soft drink beverages are produced in two steps. First is the manufacture of concentrate by a parent company, which is also responsible for branding and marketing. Second is the manufacture and packaging of the finished product by a bottling subsidiary or company, which is also responsible for distribution. The major concern for urban goods movement is the second step, which is the focus of the supply chain illustrated here.

Each geographic region has a collection of company production and distribution facilities working together to provide a broad range of beverage products to various customers, including stores, restaurants, and vending facilities. Production facilities receive raw materials for beverages and packaging entirely from domestic sources, including concentrate, sweetener, water and gasses, and empty bottles and cans. Water is city water piped in locally; some chemicals and liquid sweetener may arrive by rail; everything else arrives by truck, mostly in full loads. There are full distribution functions at all production facilities, and there is an additional set of dedicated distribution centers (DCs) that exclusively perform warehousing and delivery. The two facility types work together, and production plants are coordinated as to beverage and packaging types, resulting in a significant amount of cross-shipping of product between locations. Thus, a distribution point—whether located in a dedicated facility or a bottling plant—will receive finished product in the form of various beverages packaged in glass, plastic bottles, and cans, from multiple plants as well as from producers of specialty beverages the parent company controls. Customer deliveries then originate either from a production facility or a dedicated DC, are handled entirely by the company truck fleet, and are organized and programmed for optimal fleet use within customer service requirements. Different truck vehicle types are employed for different delivery sizes and functions, broken broadly into bulk (high-volume stores), side loader (convenience store and restaurant), and fill service (vending machine) retail channels. Each truck runs a stem route, typically with multiple stops over the course of a trip, optimized around the customer delivery scheduling needs. The stem runs to the far end of the route, and then works its way back to the plants or DC with deliveries along the way, and the truck finishes empty. See Exhibit 3-1.

Performance

Time schedules are set by routing software that optimizes the delivery sequence within customer time windows, in order to minimize delivery costs. Most customers prefer day deliveries, but windows can be flexible as long as delivery occurs by close of business. Nevertheless, some customers specify early morning delivery, bars and restaurants may prefer afternoon, and warehouse stores demand specific delivery appointments. Schedules are sensitive because delivery windows have specific lengths and deliveries are set in sequence, which can cause delays to cascade from one stop to the next. The goal of the route design is to achieve full use of each vehicle

Exhibit 3-1. Soft drink beverages flowchart.



while meeting all customer delivery times. Consequently, trucks are sent out completely full only if there is time to deliver the entire load, and a significant percentage of load capacity is not used because of this constraint. (This gives rise to an interest in night deliveries, which allow more efficient use of scheduling time.)

To maintain schedule, drivers in difficult downtown locations will judge whether to (1) rely on close-by legal parking spots, (2) hand cart the delivery to the door from a legal spot farther away, or (3) take the risk of a parking fine with an illegal parking spot. (The company pays large amounts annually in parking fines and regards them as a cost of doing business.) When missed windows occur—most often caused by traffic or parking lot congestion—the driver will attempt to arrange redelivery later in the day's route. If the product must be brought back to the distribution facility and the delivery re-set, the company's added operating cost for doing so runs approximately $50 per order.

Case Illustration 2: Gasoline and Petroleum Fuels Supply Chain

Overview

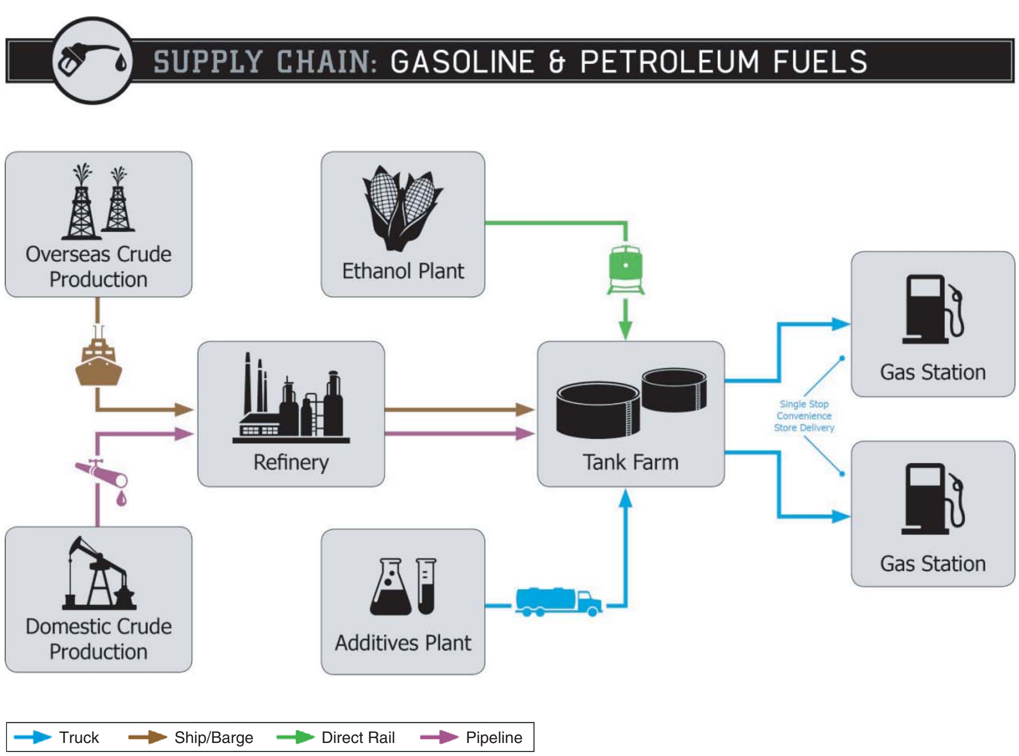
Petroleum fuels are derived from crude oil, which originates in a variety of worldwide locations and arrives at U.S. refineries principally by ship, and also by crude oil pipelines from domestic and offshore oil wells. The majority of U.S. refining capacity is concentrated on the Gulf Coast between New Orleans and Houston, and most gasoline is produced and distributed from there, although there are important but smaller clusters of refining facilities in the North-east, Midwest, and on the West Coast. Gasoline and other petroleum fuels are carried from refineries to consumption regions mainly by product pipeline or by water in barges or ships; rail is used to land-locked regions with low population densities, and truck occasionally for very short distances. Products are transferred into large holding tanks at storage terminals (commonly called tank farms), which are located at pipeline termini or at waterside; terminals belonging to several producers normally are clustered around a single pipeline or harbor. Ethanol and fuel additives also come into tank farms for blending, the former chiefly by rail from agricultural regions, and the latter by truck from a few national producers. The final transfer of blended product from tank farm to convenience store or gas station is by motor carrier delivering a full truckload in a single stop—a transport stage that is controlled by a highly automated monitoring process to ensure sufficient inventory at the point of consumption. See Exhibit 3-2.

Performance

The petroleum supply chain is not particularly sensitive to time performance until the final stage of delivery to retail outlets. At that point, a significant degree of precision is needed for efficient replenishment, and the process is largely automated based on usage rates and future forecasts. Most gas station storage tanks have metering, which feeds to a central location and is monitored. The goal is to predict when the tanks at a station can take a full truckload of gasoline, with product orders registering automatically. Producers strive to minimize two undesirable results in delivery performance: (1) retains (i.e., a truck that expected to deliver a full load instead returns to the tank farm with product still aboard) and (2) run-outs (i.e., the station ran out of gasoline). The consequence is that the supply chain at the final stage of urban retail delivery is exceptionally just-in-time, because it attempts to optimize both objectives.

Apart from delivery efficiency, vehicular accident, injuries, environmental risk from overfill (spillage) or leaks, and passenger vehicle access to the loading point area all are common

Exhibit 3-2. Petroleum fuels flowchart.



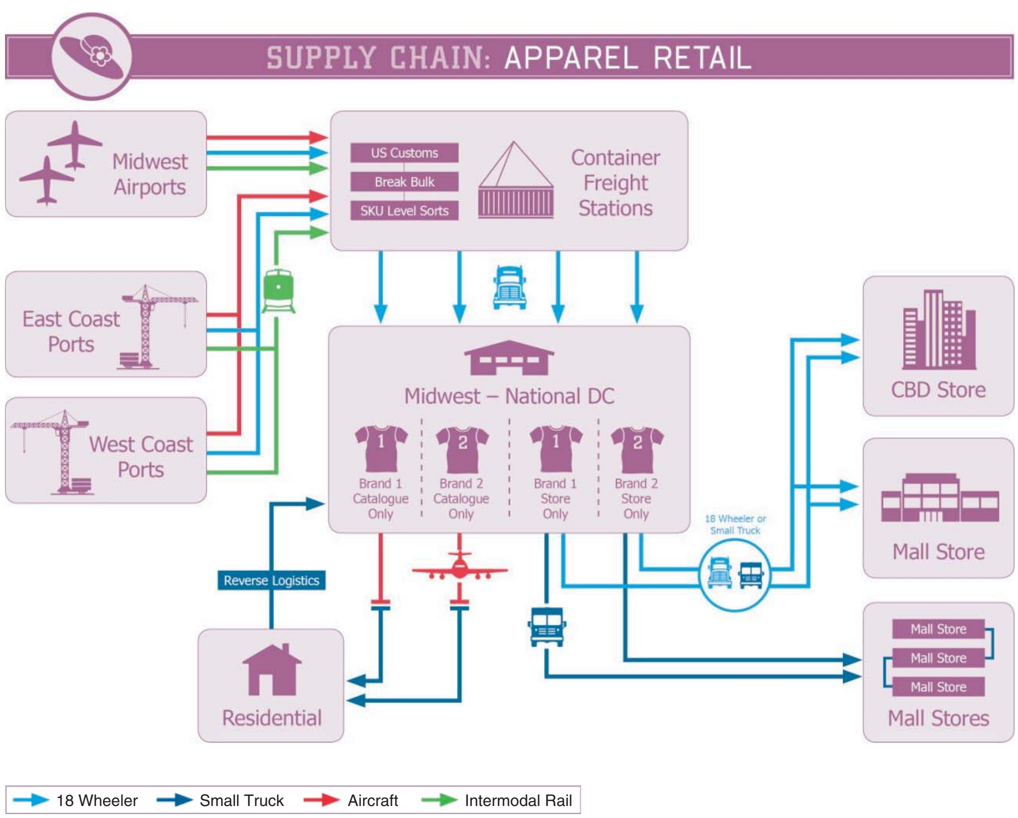
safety-related risks to performance. For these reasons, proper design of the physical layout of gas stations is crucial. The ideal station configuration places storage tank delivery access as far away as possible from the retail pumps, and facility ingress is separated from egress, so a delivery truck does not need to back up while surrounded by automobiles or other traffic. Older stations in urban markets may lack these features. Access restrictions typically concern noise and time of day. Although stores usually accept delivery 24 hours a day, there can be neighborhood delivery limitations at night or during rush hour. Greater flexibility for delivery windows results in better service, because the system already functions under tight constraints.

Case Illustration 3: Apparel Retail Supply Chain

Overview

Within the U.S. clothing store industry, the very large apparel companies, each encompassing some specialty brands, account for a dominant share of the total market. Each individual specialty brand can have a national chain of retail locations, sometimes numbering in the hundreds. The products of each specialty brand also often are available for catalog and online purchase. Much of the apparel sold by these companies is manufactured overseas and transported to the United States by either ocean container or aircraft. After arrival in the United States, shipments are transferred to a container freight station, cleared through customs, and sorted into truck deliveries bound for regional DCs. From these DCs, product is transported by outbound truck either to specific retail locations or, in the case of online or catalog orders, directly to the consumer. Delivery is a multi-stop trip to stores, or to a mixture of commercial and residential locations. See Exhibit 3-3.

Exhibit 3-3. Apparel flowchart.



Performance

The primary issues for the company's urban logistics include traffic congestion (both general and related to construction), timely access to loading docks, and maneuvering space. Megastores are located in major metropolitan areas and deliveries are constrained by limited delivery times. Often, deliveries must be made within less than an hour's time at a specific time of day. Because of prolonged morning and evening rush hours and schedule constraints, the company is often forced to operate simultaneous deliveries to megastores, which increases logistics costs.

Docks at delivery locations are rarely sufficient in number, and maneuvering areas are nearly always confined. These space limitations exist at both shopping malls in suburban areas and megastores in the central business district. Older shopping malls often have a common loading dock area shared by many stores, which complicates and constrains deliveries. The most optimal loading facilities are newer malls that provide load doors or docks for each store or for a small group of stores. Although late night or early morning deliveries may be an option, trailers and cargo trucks are seldom left loaded and unattended in store loading docks overnight because of security and product theft issues.

Case Illustration 4: Aggregate-Based Construction Materials Supply Chain

Overview

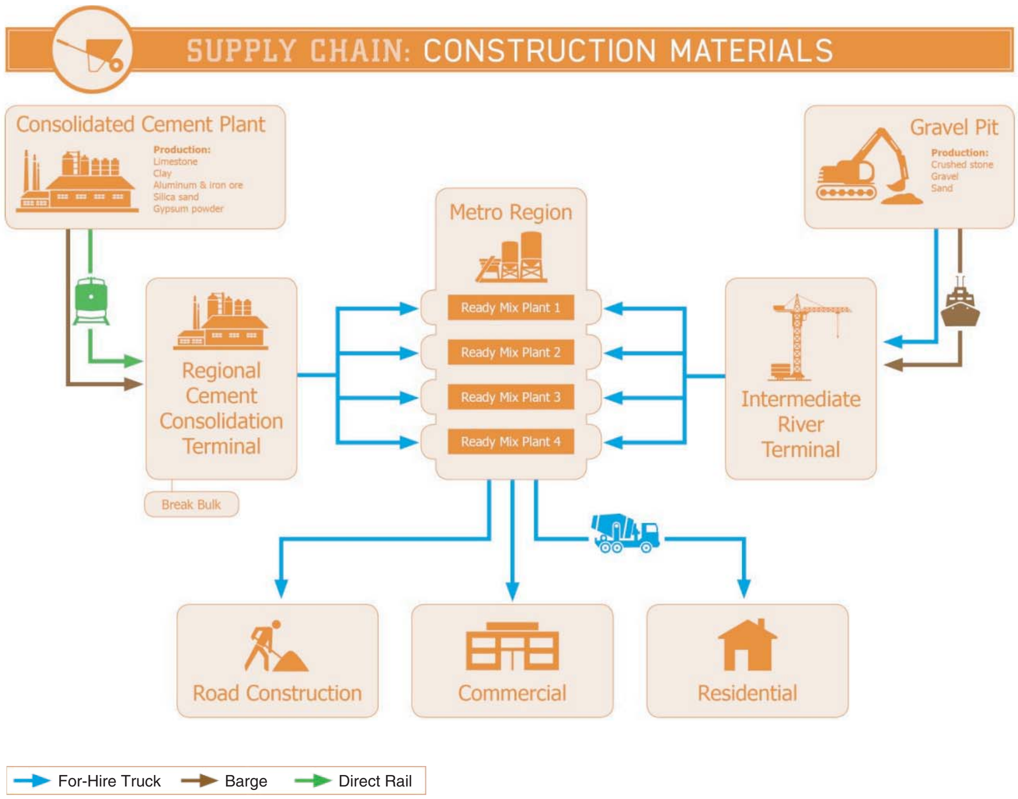
The aggregate-based construction materials supply chain includes multiple inputs, sources, consolidation points, and transportation modes. The interrelated processes of cement and ready-mix concrete production and transport illustrate this complexity. Cement production occurs in a limited number of locations in the United States and must be sited close to a limestone source. The powdered cement product is typically transported to cement terminals by rail or barge and then brought onward to ready-mix concrete plants by truck. At the same time, aggregate materials are transported to ready-mix concrete plants as another production input. The cement and the aggregates are combined to produce ready-mix concrete: a highly perishable substance. Once a batch is mixed at the production plant, mixer truck drivers have only a few hours to get ready-mix concrete to the construction site and poured in place. See Exhibit 3-4.

Performance

Supply chain performance is highly dependent on facility siting. Cement production plants are always situated near a limestone supply that ideally is near barge or rail access, for ease of bulk transport. It is also ideal for ready-mix concrete production sites to be located close to aggregate deposits, also to reduce bulk transport costs. Simultaneously, the time-sensitive nature of the final product makes it necessary for ready-mix production sites to be close to destination construction sites. Typically, transport of ready-mix should take no longer than 1 hour for road construction and no longer than 2 hours for residential and commercial construction. This requires that ready-mix concrete plants (which are relatively mobile) be established near points of use and that each facility has a very precise approach to final production and delivery scheduling.

Local regulations have become high barriers to efficient production and transport of aggregate products. It is becoming increasingly difficult to obtain conditional use permits for the many processes involved. Siting potential facility locations typically requires preventive company actions including street sweeping, dust control measures, backup alarms, pollution controls, and covered stockpiles. As a result, construction of new facilities in optimal locations is both time-consuming and expensive. For instance, because of the increasing complexity of environmental

Exhibit 3-4. Construction aggregates flowchart.



regulations, one cement plant required 8 years to move through the permitting process, and the delay imposed great costs. Given that delivery to the construction site of highly perishable concrete is so time-sensitive, supply chain performance is also significantly degraded by local and regional freight bottlenecks, maintenance activities, and general congestion of freight-dependent roadways.

Supply Chain Comparisons

The supply chains in the 12 case studies (including four in this chapter and the eight in Appendix A) represent a cross-section of urban supply chain models. Exhibit 3-5 provides an overview of the key elements of each chain. Across this diverse set of businesses, the chains display contrasts but even more similarities. This section highlights the major points of comparison among them, in the categories of types of goods, facilities and geography, modes, staging and urban delivery, and performance.

Types of Goods

Manufacturing processes are transformative, turning raw materials or components into different, finished products. Distribution functions mainly deliver the same products they take in. Many times they will be packaged or unitized or labeled, but the commodity handled is not substantially changed. For supply chains involving a particular manufacturing process, there may be multiple product types, but all have a comparable form. Supply chains illustrating this include soft drink beverages and pharmaceuticals and biotechnology. Similarly, the supply chains for bulk products, including petroleum, aggregate-based construction materials, and waste, all involve

Exhibit 3-5. Supply chain comparison.

Supply Chain & Channel	Goods	Facilities & Geography	Modes	Staging & Urban Delivery	Performance
Soft Drink Beverages (Industrial Production)	Broad range of beverage products in different packaging types, including soft drinks, juices, and purified and flavored water.	• Production Facilities • Distribution Centers • Retail Destinations (Supermarkets, Convenience Stores, Restaurants, Vending Machines)	• Truck • Rail • Pipeline	✓ Production ✓ Potentially some cross-shipping of product components ✓ Transfer to regional DC ✓ Delivery to retail destinations along a stem route	Performance Expectations • Achieve full utilization from each vehicle while meeting all customer delivery time windows Common Risks to Performance • Lack of available parking in urban locations Performance Enhancement Strategies • Greater time flexibility, allowing for more nighttime operations
Gasoline & Petroleum Fuels (Industrial Production)	Products include gasoline of various grades, plus diesel, jet fuel and kerosene.	• Origins • Refineries (Manufacturing Point) • Tank Farms (Staging Point) • Convenience Stores/ Gas Stations	• Truck • Pipeline • Ocean Carrier • Rail	✓ Inbound transport from refinery to tank farm ✓ Transfer from tank farm to delivery truck ✓ Outbound delivery to final product destination (convenience store/gas station)	Performance Expectations • Replenishment precision to avoid retains and runouts Common Risks to Performance • Inefficient/unsafe siting of gas station loading point access • Nighttime delivery restrictions Performance Enhancement Strategies • Highly automated reordering process • Proper design of physical layout of gas stations that allows for separation of uses and separation of access/egress • Greater time flexibility, allowing for more nighttime operations
Pharmaceuticals & Biotechnology (Industrial Production)	The broad category of pharmaceuticals and biotechnology. The pharmaceutical industry is comprised of brand-name drugs and manufacturers of generic drugs. A few pharmaceutical companies provide both the branded and generic drugs.	• Production Plants • Distribution Centers • Wholesalers • Customer Locations	• Truck • Air	✓ Manufacturing/transport between plants for various manufacturing stages ✓ Purchase by wholesaler ✓ Distribution by wholesaler to customers locations, including pharmacies and hospitals	Performance Expectations • Speed of delivery, security, transparency and minimal exposure to environmental risks such as temperature extremes are all crucial for drug transport Common Risks to Performance • Traffic congestion in urban areas slows the delivery of product to customer facilities • Constrained truck maneuvering space in dense urban environments Performance Enhancement Strategies • Using air transport for most long distance hauls • Moving product from larger delivery vehicles to smaller configurations before entering more dense urban environments

Food Services (Retail Distribution)	Distribution has two main types: broadline, which offers a comprehensive line of restaurant supply products, or specialized distribution, which supplies meat and produce or gives dedicated service to certain chain restaurants.	• Source Material Origins
		• Warehouse Facilities
		  ○ Satellite Warehouses
		• Distribution Centers
		• Restaurant Customers
			• Truck
			• Rail
			• Ocean Carrier
				✓ Inbound transport of vendor supplies to company warehouse facilities.
				OR
				✓ Inbound transport of vendor supplies to regional DC
				✓ Outbound transport of goods to restaurant customers
				  • Multi-stop deliveries during early morning hours
					Performance Expectations
					• Efficient routing and completion of multi-stop delivery routes, accounting for customer time delivery windows
					Common Risks to Performance
					• Congested traffic conditions cause delays
					• Lack of adequate, available parking near customer delivery locations
					Performance Enhancement Strategies
					• Early morning departures
					• Nighttime deliveries
					• Use of satellite yards

Urban Wholesale Food (Retail Distribution)	Wide variety of fresh fruits and vegetables from international and national origins, sold in	• Product Origins • Terminal Markets • Customer Destinations	• Truck • Rail • Ocean	✓ Inbound transport of product from supplier to terminal market ✓ Sorting and storage at terminal market	Performance Expectations • Perishable nature of product necessitates on-time delivery of inbound produce, careful monitoring and storage of product, and prompt

(continued on next page)

Exhibit 3-5. (Continued).

Supply Chain & Channel	Goods	Facilities & Geography	Modes	Staging & Urban Delivery	Performance
	bulk.	(restaurants, etc)	Carrier • Air	✓ Direct purchase by customers during evening ✓ Outbound transport directly by customers at night OR ✓ Outbound transport managed by wholesalers during early morning	delivery of outbound produce to customers. Common Risks to Performance • Traffic and weather delays • Terminal market facility accessibility
Supermarket (Retail Distribution)	Approximately 2,000 different product lines. Primary products handled are "dry goods" (canned goods and boxed product), as well as frozen foods such as meats, pizza, other prepared items. Bread, chips, and beverages are exclusively private label.	• Regional Facilities/Distribution Centers • Retail Stores • Wholesale Customers	• Truck	✓ Supplier products delivered to regional facilities ✓ Transported from regional facilities to specific distribution centers via one-way over the road service ✓ Distributed outward to local retail and wholesale destinations	Performance Expectations • Consistently low fleet idle run times Common Risks to Performance • Traffic congestion in metropolitan areas cause delays • Lane closures, ramp closures and merging lane issues cause delays and additional truck miles • Physical access to store or customer delivery locations may be blocked by structures • Lack of rest stops makes it hard for drivers to take breaks when needed
Big Box Retailer (Retail Distribution)	An extremely wide variety of consumer products, ranging from food and household goods to electronics and prescription medications.	• Vendors • Distribution Centers • Retail Stores	• Trucks	✓ Inbound transport of vendor supplies to regional DC facilities OR ✓ Inbound transport of vendor supplies to consolidation/deconsolidation center and then onward to DC. ✓ Outbound transport of goods to retail locations • Typically one delivery per trip, planned to fit at least one round-trip in a day ✓ Sometimes empty delivery truck will transport vendor inbound goods back to DC on backhaul	Performance Expectations • Prompt inbound delivery from vendors • Minimize vehicle miles traveled • Minimize petroleum usage • Prompt outbound delivery to retail stores Common Risks to Performance • Unreliable vendor supply deliveries • Traffic congestion encountered during store delivery trips • Inconsistent laws and restrictions, including bridge regulations, size/weight restrictions, and noise ordinances. Performance Enhancement Strategies • Constantly seek greater efficiencies in product packaging, loading of goods in trucks and trip routing • Split large metropolitan areas into two separate service areas to enable more access to key locations • Piloting and fully implementing transport energy efficiency innovations
Retail Drug Store (Retail Distribution)	In addition to pharmacy are extensive selections of consumer goods: cosmetics, personal care items, cleaning products, stationery, magazines and books, candies and snacks, seasonal specialties, convenience foods and beverages.	• Product Origins (Domestic & International) • Distribution Centers • Retail Stores	• Truck • Rail • Air	✓ Inbound transport of goods from vendors to DC ✓ Outbound transport of goods from DC	Performance Expectations • Prompt inbound delivery from vendors with tight unload time windows • Prompt outbound retail store deliveries with tight unload time windows • Avoid significant oversupply or undersupply of products at a retail location

Supply Chain & Channel	Goods	Facilities & Geography	Modes	Staging & Urban Delivery	Performance
Retail Apparel (Retail Distribution)	Specialty apparel through several different brands.	• Container Freight Station • Distribution Centers • Product Destinations (Retail Stores, Direct to Customers)	• Truck • Ocean Carrier • Air • Rail	✓ Unload containers at port/airport ✓ Transfer through CFS ✓ Transfer to regional DC ✓ Sorted for customer delivery ✓ Outbound delivery to standalone stores, stores in malls, or directly to online/catalogue customers	<u>Common Risks to Performance</u> • Traffic congestion • Constrained delivery times • Limited dock space at store delivery locations
Aggregate-based Construction Materials (Service Provision)	Broad range of aggregate-based materials for the residential, commercial and road construction industries, including cement and ready-mix concrete.	• Cement Production Plant • Cement Terminal • Ready-Mix Concrete Plant • Construction Site	• Truck • Rail • Barge	✓ Transport of cement from production plant to cement terminal ✓ Transport of cement from cement terminal to ready-mix concrete plant ✓ Transport of aggregates to ready-mix concrete plant ✓ Combine cement and aggregates to produce ready-mix concrete ✓ Time-sensitive delivery of ready-mix concrete to construction sites	<u>Performance Expectations</u> • Optimal siting of production facilities to both (1) keep bulk transport costs low and (2) enable extremely rapid delivery of the final ready-mix concrete product <u>Common Risks to Performance</u> • Local regulations and mitigation requirements constrain facility siting options • Freight bottlenecks and general congestion, particularly during the time-sensitive delivery of ready-mix concrete

Hospital (Service Provision)	Four major types: general medical care supplies ranging from IV solution to bandages and diagnostic equipment, pharmaceuticals, food, and a miscellaneous group of which laundry is a major component.	• General Supplies 3PL Distribution Center
		• Pharmaceutical Supplies 3PL Regional Distribution Center
		• Hospital Facility
			• Truck
			• Rail
			• Air
				✓ Hospital supply orders
				✓ Supply delivery via 3PL
				  • General supplies
				  • Pharmaceuticals
				  • Food
				  • Miscellaneous
					<u>Performance Expectations</u>
					• Established fill rate target that implies that hospital should almost never be out of stock of medical supplies
					• Supply deliveries expected on a fixed schedule
					<u>Common Risks to Performance</u>
					• Traffic congestion in the dense urban areas surrounding the hospital causes delays and affects maneuverability
					• Neighborhood opposition to truck traffic and noise during all hours of the day
					<u>Performance Enhancement Strategies</u>
					• 3PLs periodically re-examine hospital's handling process and inventory procedures

Waste & Recyclables (Service Provision)	All types of household and commercial waste are collected, often organized into the broad categories solid waste and recyclable waste.	• Waste Collection Location (Residential & Commercial)
		• Waste Transfer Station
		• Final Disposal Site
		  o Landfill
		  o Mixed Waste Recycling Facility
		  o Waste-to-Energy Facility
			• Truck
			• Rail
			• Barge
				✓ Waste collection
				✓ Transport directly to landfill, recycling facility, or waste-to-energy facility
				OR
				✓ Transport to waste transfer facility and then onward to landfill, recycling facility, or waste-to-energy facility
					<u>Performance Expectations</u>
					• Keep vehicles moving constantly through route, with minimal collection and disposal wait times
					<u>Common Risks to Performance</u>
					• Weight restrictions
					• Impeded access to collection sites
					• Nighttime restrictions
					<u>Performance Enhancement Strategies</u>
					• Greater time flexibility, allowing for more nighttime operations

the handling of very large quantities of relatively homogenous materials. In contrast, distribution and retail supply chains typically involve a much broader range of products, often numbering in the hundreds of stock keeping units (SKUs), but most products within a specific supply chain will fit into common or related categories. For example, the food service distribution supply chain includes an extensive list of items, but most can be categorized as either food or general restaurant supplies.

Facilities and Geography

The principal facility types are production and distribution operations, although either type may have some features of the other. There are several kinds of production plants, ranging from national petroleum refineries to regional bottling plants to local makers of ready-mix concrete. The regional and local facilities especially share a distribution function for their surrounding territory; in soft drink beverage manufacturing, for example, a significant amount of cross-hauling between facilities is fundamental to the production and distribution process. DCs can be national, but a regional orientation was more common, in part because companies with substantial urban delivery operations are receiving product from the DCs of others upstream in the supply chain. In some cases, regional facilities feed into local facilities within the same company, before final distribution to customers. For transfer of products between very distinct supply chain stages, specialized transition facilities such as container freight stations or tank farms can become necessary.

Most supply chains serve urban markets from either local or regional facilities. This reflects the design of the chain and its requirement for reliable and productive service to end-customers. Outbound delivery routes typically are designed to keep truck trips within several hundred miles of these distribution hubs, meaning that most delivery roundtrips can be completed within a day or a single driving shift. In many cases, the regional DC of a supplier is feeding into the regional DC of a distributor; this is a common pattern that exists in some form across a wide range of interrelated industries. For bulk products, such as petroleum and aggregate-based construction materials, a variation on this basic pattern relies on very local distribution facilities to keep final delivery leg distances particularly short (typically no more than 30 to 40 miles).

Modes

A rich mix of modes is used, spanning pipelines, ocean shipping and barge transport, air, carload and intermodal rail, as well as a great variety of truck types in a wide selection of fleet configurations, for handling full loads, less-than-loads, and packages. Virtually all supply chains become dependent on trucks at some point, particularly as they reach the final delivery miles. Trucking is also the chief mode in the regional transport stage. This includes the commonplace movement of inbound goods to retail DCs from vendor regional DCs. The design features of the supply chain are reflected in this, because both the vendor and the distributor are placing goods within an overnight drive or a same-day turn for a truck, for the sake of ensuring service.

Most urban delivery is handled by truck and frequently by private or dedicated fleets. The type of equipment employed varies by product, volume, and delivery types. A 53-foot tractor-trailer may be the favored option for a customer receiving large quantities of goods, and the trailer may even be dropped on site; or a 28-foot pup trailer may be used because it can be doubled into a set for linehaul service and then split up for urban delivery; or side-loaders and step vans may be used because they are faster for offloading case product or for streetside parking. Trucking equipment is specified to be efficient for the services it is expected to perform. Individual companies attempt to standardize their fleets for economies in purchasing and maintenance, but will use multiple types if their business and operating environment require it.

Staging and Urban Delivery

Effectively, all goods are handled through at least a couple of distinct stages, which may incorporate production, consolidation, deconsolidation, change of direction or mode, and storage. Sometimes, multiple functions occur within a single location, as in the case of production facilities that also serve as regional DCs. At other times, a staging point along the supply chain exists strictly for cross-dock movement, and involves no processing or storage of goods. Overall, staging patterns are organized to provide competitive service levels to the receiving markets, meaning that there is a strong service performance feature embedded in all supply chain designs.

Typically, a supply chain is more spatially concentrated at its production end and becomes more fragmented as it moves toward the delivery stage. As a result, modes that support consolidation or high-volume movement, such as barge and rail, are most useful during early phases and become significantly less useful in the later, more dispersed phases of the supply sequence. For many supply chains, a clear modal shift can be traced through the stages of distribution.

Delivery Trips

For the delivery stage, there are at least three types of standard patterns exhibited by the case studies. In one type, a truck will depart the DC or serving facility with a full load for one specific destination and will return to the facility empty. In another, a truck will set off in a long stem and pocket pattern, making multiple deliveries in a zone at some remove from the DC, and then return an equivalent distance back to the DC empty. In the third pattern, a truck will set out on a long, loaded stem pattern and make deliveries as it works back to the DC. In this case, the final return miles empty will be shorter, but the pattern can only be used if customer dispersion and delivery windows support it. A variant pattern is one that unloads a full truck over a few standard stops, which can be scheduled in efficient sequence.

The loaded stem in delivery has some particularly interesting characteristics for the planner. This beginning phase of the trip is typically longer than the distances between subsequent stops, because the truck is traveling crosstown to its first delivery. In this crucial segment, the truck is going the longest continuous distance through the metropolitan area and simultaneously initiating adherence to a set schedule, making this the section of the trip with the highest risk to service. The on-time performance for all subsequent stops depends on how well the first stop is executed. Truck fleets commonly depart DCs very early in the morning to protect this first delivery.

Performance

A strong commonality across supply chains is the incorporation of service sensitivity in their design. Most supply chains share the ultimate goal of fulfilling end-user needs, with as little inventory investment by all parties as possible. Along any particular chain, each stage has its own set of service expectations. For instance, a DC may require that inbound goods are delivered from vendors within a specific "must-arrive-by date," as illustrated by the big-box retailer example. Customer destinations, such as retailers served by the grocery wholesale functions, often designate a constrained window of time for deliveries. Even in waste removal, the supply chain is sensitive to the dual service requirements of timely and thorough collection of all waste materials within a given geographic area. Many companies maintain statistics on how inbound and outbound stages adhere to performance requirements and will tailor supply chain strategies accordingly. Although specific requirements vary along the length of each supply chain, there is rarely a stage that is considerably less sensitive to overall supply chain service needs. This is indicative of a goods movement system that seeks to minimize excess inventory at all stages of the chain.

Although service sensitivity is a constant, there is more built-in flexibility for longer than shorter haul transport stages—and distances tend to shrink as goods near final delivery. If a disruption arises during a longer haul stage, such as the transport of aggregates to a ready-mix concrete plant, it is relatively easy to make up for lost time and still deliver the materials when needed. However, during a shorter haul stage, such as the delivery of highly perishable ready-mix concrete to a construction site, there is less buffer time for handling hurdles like traffic jams. As a result, it is much more challenging to meet stage service requirements during shorter hauls, especially in the dense metropolitan areas that are frequently the environment for final delivery.

Not surprisingly, congestion is one of the most common obstacles to supply chain performance. Given that service deadlines are often geared around customer time-of-day preferences—such as delivery at the start of the work day, and pick-up at the end—shipment windows tend to fall during peak travel times when the transportation network is most congested. Even though a truck on a multi-stop route may plan an early crosstown stem leg before peak hours, it will start encountering traffic delays as the morning wears on. If the traffic is particularly slow, a truck may fall so far behind schedule that it runs the risk of returning undelivered items to the DC. This is a costly outcome that drivers make every effort to avoid by rescheduling same-day delivery—and local drivers nurture relationships with their customers to facilitate this option.

In addition to compromising service performance, congestion affects supply chain productivity. Not only are trucks at greater risk of not making their deliveries on time, they are also at risk of supplying fewer customers. Within the constraints of customer receiving requirements, fleet schedules are designed to complete as many deliveries in a workday as possible, and this is built into performance metrics and driver incentives. Maintaining high per-truck productivity should also be of particular interest to public planners trying to reduce overall numbers of truck trips. When a single truck can dependably serve a multi-stop territory, companies are less likely to assign multiple trucks for performance assurance on the route.

A further challenge to both supply chain service and productivity performance is urban facility access. Without adequate and reliable parking facilities and unloading docks, metropolitan delivery trips are significantly less efficient. Urban deliveries tend to require live unloading, which necessitates time and space to be completed effectively. Facility access can even be a challenge for supply chains that control their own retail networks if stores are in dense urban districts. Access issues arise as well from efforts to work large delivery trucks, such as gasoline tankers, into tight destinations, such as older filling stations, particularly when competing for space with passenger vehicles. The difficulties with urban facility access can be partially mitigated by nighttime or dawn delivery, which many supply chains employ to some degree and some trend toward strongly.

Transport regulations, especially those that are inconsistent across jurisdictions, are potential barriers to optimal urban delivery performance; weight limits are a typical example. Finally, sustainability is an increasingly important supply chain performance goal.

CHAPTER 4

Using Freight Data for Planning

Many factors contribute to the capacity challenges facing urban freight transportation networks. The challenge of planning investments within an evolving system of both public and private facilities across multiple modes—and across local, state, interstate, and global geographies—is made more difficult because timely, accurate freight data is often fragmented, not compatible across sources, or simply not available.

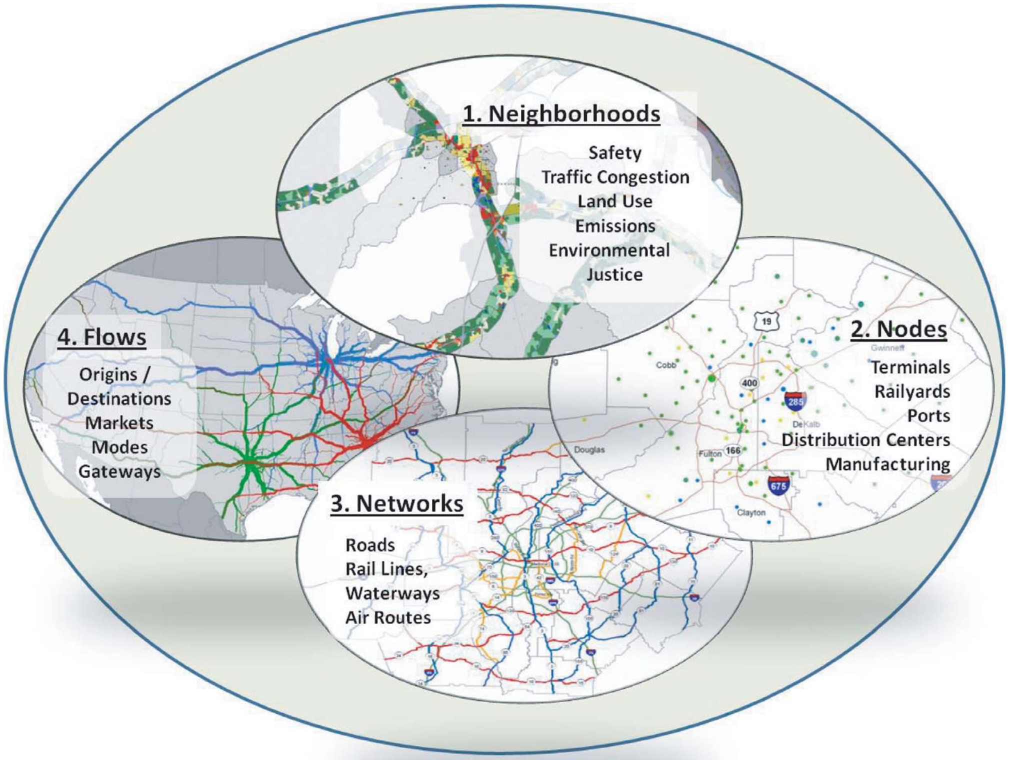
As freight planning has become more important to public agencies, freight data has become a topic of intense interest. The landscape of available public and private freight data resources is intricate and growing. Between 2006 and 2010, NCFRP funded 40 projects, with approximately one-fourth devoted to freight data and related topics, such as

- NCFRP 03: Performance Measures for Freight Transportation,
- NCFRP 06: Freight Demand Modeling to Support Public-Sector Decision Making,
- NCFRP 11: Identification and Evaluation of Freight Demand Factors,
- NCFRP 12: Specifications for Freight Transportation Data Architecture,
- NCFRP 16: Representing Freight in Air Quality and Greenhouse Gas Models,
- NCFRP 20: Guidebook for Developing Sub-national Commodity Flow Data,
- NCFRP 25: Freight Trip Generation Land Use,
- NCFRP 26: Freight Transportation Cost Data Elements,
- NCFRP 27: Promoting Environmental Goals in Freight Transportation through Industry Benchmarking,
- NCFRP 31: Overcoming Barriers to Sharing Freight Transportation Data.

This chapter of the guidebook is intended only as a brief overview of freight data and its uses in a local planning context. The CD-ROM that accompanies this guidebook contains links to additional materials on freight data resources and more information about how these data sources can be used to address freight issues at a local level. The discussion here presents a geographic framework for freight data categories, as well as general protocols for using primary and secondary data sources to address freight issues at the local planning level.

For the public sector, reliable urban freight data can lead to better infrastructure and policy decisions that may improve urban freight operations and the livability of neighborhoods. For the private sector, supply chain reliability is crucial to business strategies that create competitive advantage. Multimodal transportation activities undertaken by MPOs strive for equilibrium between transport demand and community goals such as economic development, sustainable land use, environmental protection, and livable neighborhoods. Reliable data that addresses urban goods movement issues from multiple perspectives such as land use, infrastructure investment, traffic operations, safety, and economic development is often difficult to obtain because much of the most useful information resides with private-sector businesses providing transportation services or producing the products being delivered.

Exhibit 4-1. Geographic dimensions of urban freight data.



Source: Wilbur Smith Associates, adapted from *The Geography of Transport Systems* (Rodrigue, Comtois, and Slack 2009).

Primary and secondary data sources have strengths and limitations for supporting planning activities. Primary sources such as surveys or truck counts can provide the level of detail often needed for urban level planning but they can also require significant resources. Secondary freight data sources, both public and private exist, but often do not capture the levels of detail needed for urban freight planning (e.g., routing details). Used together, secondary freight data sources, supplemented with primary data often can be integrated to provide value to public planners addressing urban goods movement issues.

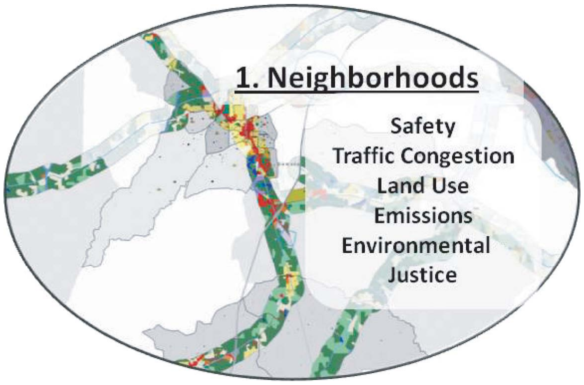
The guidebook discussion of freight data is presented in a simple framework shown in Exhibit 4-1.

Most public agencies that have undertaken a programmatic approach to freight planning have learned that there is seldom a "one size fits all" solution to urban freight data needs. Addressing multi-faceted issues typically requires multiple data sources and a variety of techniques. For example, remedies for congestion-related problems may require a combination of strategic projects pertaining to capacity enhancements, system preservation, operational improvements, demand management, and maintenance policies. The requisite data could encompass truck volumes, service performance, structural conditions, and cost information, not all of which may be limited to freight.

Neighborhood Freight Data

In *NCHRP Synthesis Report 320: Integrating Freight Facilities and Operations with Community Goals,* the author notes that integrating freight operations with the vision that most of us have for livable communities is a complex and multifaceted issue (Strauss-Wieder 2003). Just some

Exhibit 4-2. Freight data issues affecting neighborhoods.



Source: Wilbur Smith Associates.

of the complex issues of concern to urban planners at the neighborhood level are outlined in Exhibit 4-2.

In *NCFRP Report 8: Freight-Demand Modeling to Support Public-Sector Decision Making* (Cambridge Systematics, Inc. and GeoStats, LLP 2010) the authors reported that interviews and surveys conducted with public decisionmakers identified "existing routing" as the primary freight data need identified by those surveyed. At the neighborhood level, route choices can often be complex and non-intuitive, requiring at least some level of primary data collection to understand truck driver decisions. Traffic counts and trip diaries are two traditional means of understanding route choices made by truck drivers, but new methods such as GPS vehicle tracking also are gaining prominence (GPS data collection methods are discussed more in the section on Freight Network Data). One issue with all such approaches is that they reveal the result of routing decisions but not the reasons for them. Because many truck fleets rely on stop-sequencing software to construct their routes, familiarity with such tools can help interpret the primary data findings.

Safety is an important consideration for both citizens and freight operators. Freight vehicles are not necessarily more unsafe than other vehicles, but because of blind spots, slower vehicle reaction times, larger loads, or loads of hazardous materials, freight should always be considered in the planning process. In a neighborhood, it may be especially important to understand how freight vehicles interact on local streets where pedestrians and children are present. For example, truck drivers often complain that tree trimming and landscaping blocks the line of sight for drivers sitting high off the road. Safety issues can also arise when large trucks using local streets encounter construction or inadequate infrastructure such as low or narrow bridges. Understanding safety issues at the local level typically requires data and information about actual conditions, such as route preferences, truck counts, and vehicle speeds.

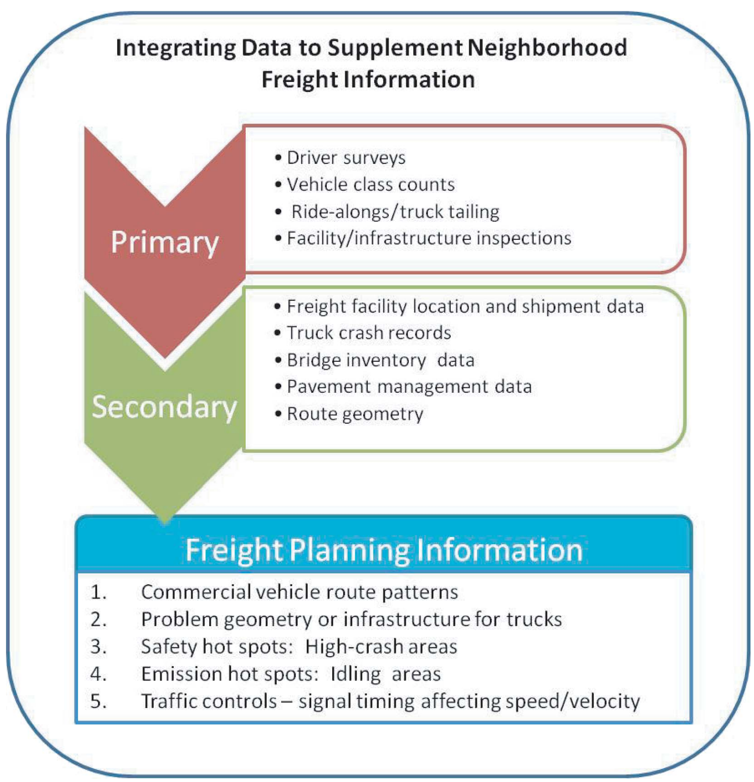
Given that freight operations often generate large volumes of truck traffic, air quality and emissions has become an increasingly important safety issue to many communities. Many states and communities have adopted idling regulations for residential areas. The American Transportation Research Institute (ATRI), the non-profit research arm of the American Trucking Associations has compiled a compendium of these regulations, which can be found on the resource CD. Some communities also are becoming more active in monitoring neighborhood emissions. For instance, the Port of Los Angeles has installed four monitoring stations that continuously measure air quality in the port complex and in communities downwind of the port.

The EPA has developed the Smartway® Program to encourage the adoption of new engine technologies and other activities to reduce diesel emissions. Finally, the dispersion of emissions can be as much, or more, important than their originating points, in terms of where effects are felt and how to alleviate them. Modeling that captures topography and meteorology in addition to traffic is required for this, and some is accessible through EPA.

Another issue gaining prominence in freight planning is the need to address environmental justice. Environmental justice (EJ) refers to the concept that over time, geographic areas with larger-than-average concentrations of minority populations or populations at or below the poverty line suffer disproportionately negative environmental impacts from transportation-related development. Since 1994, federal agencies have been required to identify and address potential or actual disproportionately adverse environmental effects on minority and low-income populations. For example, when the Atlanta Regional Commission defined a regionwide truck route plan, it conducted a demographic analysis of the region, with a special emphasis on identifying EJ populations. EJ census blocks were mapped in relation to the proposed truck routes, in order to address environmental justice issues concerning existing and potential future freight traffic impacts during subsequent outreach sessions.

For each of the neighborhood freight issues described there are likely some sources of secondary data collected for traffic monitoring, land-use compliance, or travel demand modeling that can be adapted to address safety, air quality, or environmental justice issues. However, to better understand the actual conditions in a neighborhood, some primary data collection will be required. Exhibit 4-3 provides a framework for how primary and secondary data sources might be integrated to address common freight issues at a neighborhood level.

Exhibit 4-3. Integrating freight data to address neighborhood issues.



Freight Node Data

Freight nodes represent the consolidated or individual endpoints that generate or receive freight flows. Nodes are also the key points of production, consumption, or intermediate handling for goods. Freight facility/node information can be useful in a planning context for travel demand modeling, land-use planning, and environmental analysis. *Quick Response Freight Manual II,* (Beagan et al. 2010) a freight modeling resource published by FHWA, points out that the first step in traditional four-step travel forecasting is to understand trip generation rates. There are two approaches for understanding trip generation rates at a local level: (1) conduct local surveys of vehicles generated by major freight nodes in a given travel analysis zone (TAZ) or (2) apply national default generation rates based on industry employment by TAZ. The former are more expensive, but the latter suffer from a variety of problems affecting industry specificity, productivity, mode usage, and supply chain design. Exhibit 4-4 shows GIS mapping of the estimated tons produced by individual freight nodes within a TAZ.

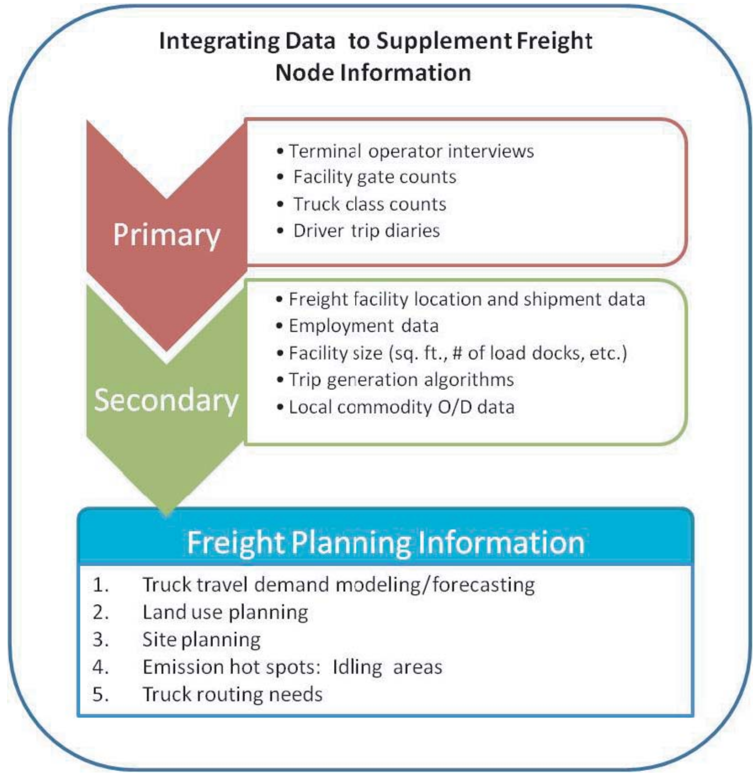
Freight facility/node information can be useful for site planning (i.e., understanding the traffic impacts of a new or expanded freight facility). Finally, node data also is important in a planning context for understanding "last mile" needs for designating truck routes, and for use in travel demand modeling, land-use planning, and environmental analysis.

ISTEA placed new emphasis on developing inventories of nodes where freight or people transitioned from one mode to another. Specifically, the planning regulations that were promulgated as a result of ISTEA required states to develop Intermodal Management Systems (IMS), a database requirement that was later dropped because of the onus it placed on state planning agencies. Although MPOs were not required by ISTEA to develop comparable IMS datasets at the urban area level, they were encouraged to work with states and utilize information from state IMS data in developing their own transportation plans. When IMS data became an option as opposed to a requirement, some states continued to maintain IMS data for freight and some MPOs have also developed freight facility datasets. At the federal level, an intermodal terminal facilities database has been created that is now available through the National Transportation Atlas Database (NTAD) series through the Bureau of Transportation Statistics (BTS). The NTAD file for 2009 contains 3,280 records of facilities nationwide.

Exhibit 4-4. Freight node data—tonnage production by facility.

Source: Wilbur Smith Associates.

Exhibit 4-5. Integrating node data for travel demand modeling and other planning issues.



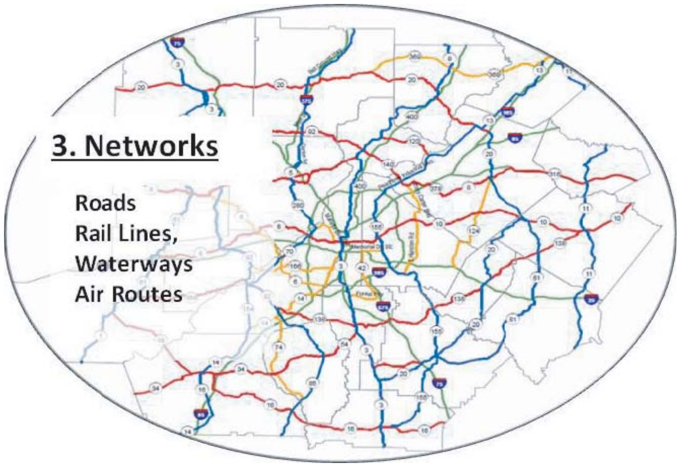
Proprietary sources of freight facility data also are available and include specific estimates about the volume of shipments produced and received at each facility. Typically these datasets are modified versions of business establishment data from sources such as InfoUSA™, Harris InfoSource, or ThomasNet®.

Typically, secondary data sources about facilities can be supplemented through online, phone, or mail surveys. There are field examples of study efforts wherein the largest facilities (top 20 percent by number) produced 80 percent or more of the total freight flow volumes for a given study area. These instances of the Pareto principle (the 80/20 rule) suggest that concentrating survey efforts on the very largest commodity producing facilities in an urban area is an efficient, cost-effective manner for improving the quality of freight facility data. Large freight facilities also can be productive locations for conducting surveys to determine local bottlenecks or other operational issues affecting truck movements in a local area. Agency studies have had success conducting break-room surveys at local truck terminals to hear from drivers about operational issues they face in making regional deliveries. Exhibit 4-5 provides some guidance on how primary and secondary node data can be integrated to address urban freight planning needs.

Freight Network Data

Freight network data helps define major route patterns and critical infrastructure being used to convey freight shipments through the various modal systems. Truck counts are probably the most common data element collected by public planning agencies that contribute network information about freight. Heavy truck counts can provide information about the key network elements used for freight movements and the associated infrastructure demands on various

Exhibit 4-6. Freight network data.



Source: Wilbur Smith Associates.

highway segments. Other elements of network data include rail line capacity, inland waterway capacity (including locks and dams), port throughput capacity, posted speeds, and weight and dimension limitations on bridges and pavements. See Exhibit 4-6.

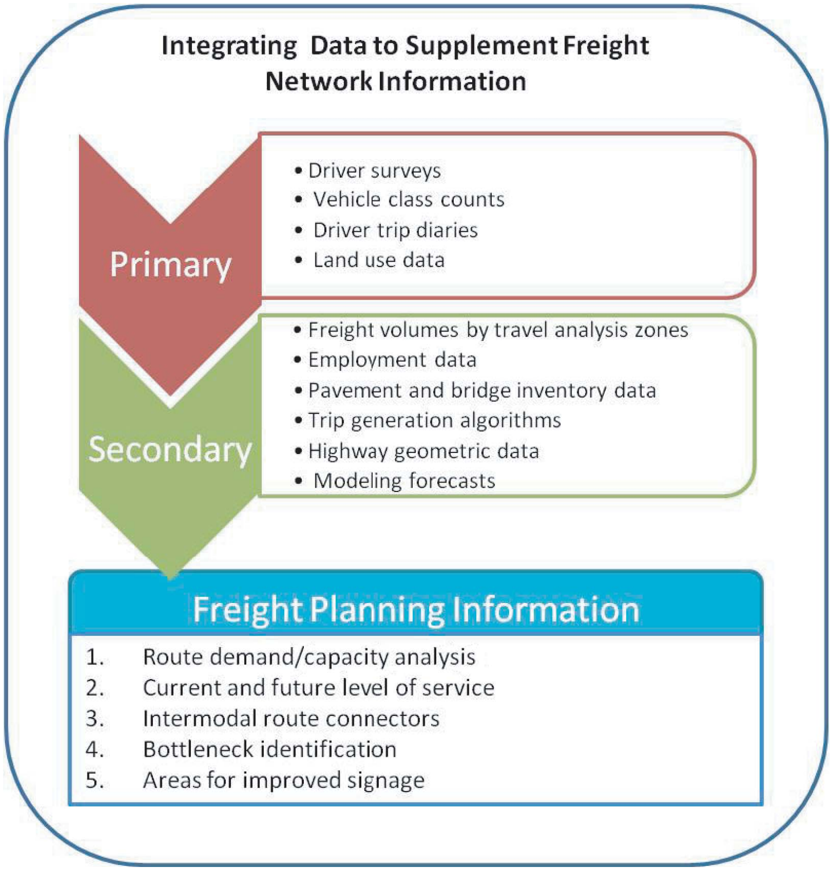
In the urban context, it is likely that freight network data is most pertinent to highway networks that service the key freight nodes across all modes, such as rail intermodal yards, ports, airports, manufacturing facilities, and distribution centers. From a freight movement standpoint, network roles should be a central part of planning a region's transportation system and should be managed both developmentally and operationally.

Developmentally, freight networks should be protected by proper zoning, building permits, and enforcement, so that key network elements are capable of sustaining truck traffic volumes efficiently. Road geometry, pavement structures, and bridge designs should be planned to accommodate large or heavy vehicles, with appropriate turning radii, height clearances, and passing points. Operationally, freight networks should be managed for productive freight movements. In urban areas traffic signals on freight network routes should be timed for truck movements from known freight generators and receivers. Construction activities should avoid disrupting primary and relief routes simultaneously, and construction, as far as practical, should be coordinated with industry, avoiding commercially sensitive time periods (like month's end) and understanding the time patterns of line-haul and city freight schedules. Exhibit 4-7 provides an example of how primary and secondary data sources can be used to help identify bottlenecks on urban freight networks.

To support the developmental and operational elements of freight networks requires data such as average speed by route, time of day, and seasonal truck traffic. Most of this data is collected by planning agencies through roadside data collection, surveys, or increasingly through advanced technology. A new form of network data has emerged on the market because of such technological changes. Today, many trucking companies and private carrier fleets use global positioning systems (GPS) to keep track of driver and equipment movements. Vendors of GPS and fleet management software are packaging the data in formats that allow public agencies to examine the network choices made by truck drivers operating in urban areas and across the country. FHWA has been working with ATRI to present truck performance data on some of the nation's key Interstate highways. The FHWA/ATRI "Freight Performance Measures" (FPM) project now provides access to online performance data that can be accessed at http://www.freightperformance.org.

Private sources of vehicle tracking data also are emerging as GPS data become more available via cell phone networks. INRIX® is one example of a proprietary vendor that can develop customized

Exhibit 4-7. Example of integrated data sources for evaluating urban freight networks.



Source: Wilbur Smith Associates.

datasets from a variety of cell phone and other GPS devices from vendors who supply GPS services to the trucking industry.

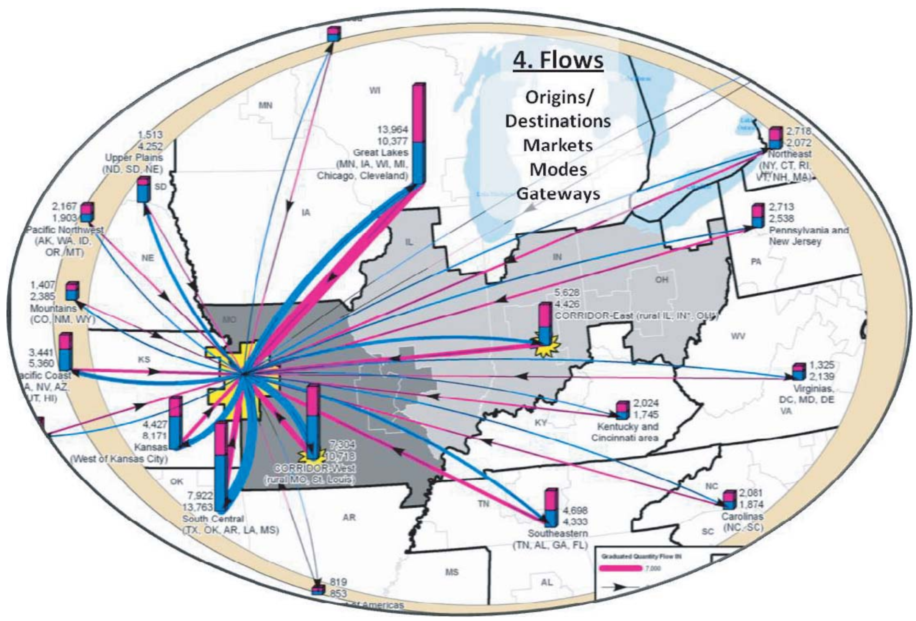
Information gained from network data can be used to identify current truck routes as well as potential alternatives that may serve additional destinations or facilitate a faster trip. Network data can also include critical information regarding routes that are inaccessible to trucks because of weight limits, vertical clearance, truck prohibitions, or other reasons.

Freight Flow Data

Commodity flows are typically used in freight planning to provide insights about the economic and trade environment of a region. Commodity flow attributes help tie goods movement to economic development by providing information about urban consumption dependencies such as raw material or service input markets (imports), and markets for finished manufacturing products (exports). As such, commodity flow information also is used to generate trip estimates in some traffic modeling applications. Commodity data at the urban level can provide insight about interdependencies between goods and services such as retail trade and food services.

Commodity flow data also can help identify those industries in a regional economy that are highly dependent on transportation (e.g., those industries producing high-volume movements and/or high-value products). When combined with other economic and demographic informa-

Exhibit 4-8. Freight flow data.



Source: Wilbur Smith Associates.

tion, freight flow data can help depict how an urban area is connected through trade to other regions of the nation or the world.

Freight flow data is origin-destination information about commodity shipments (see Exhibit 4-8). The typical commodity flow record will contain an origin-destination, type of commodity, weight and/or value of the commodity shipment, and mode of shipment. There are secondary sources of freight flow data from both public and commercial sources. Examples include

- Commodity Flow Survey (BTS);
- Freight Analysis Framework, Version 3 (FHWA);
- Railroad Waybill (Surface Transportation Board [STB]); and
- TRANSEARCH® (IHS Global Insight).

The Commodity Flow Survey (CFS) is conducted as an element of the Economic Census conducted by the U.S. Census Bureau every 5 years. The CFS is produced by surveying business establishments in mining, manufacturing, wholesale trade, and selected retail industries. The CFS provides estimates of tons shipped and dollar values for all major modes and covers the entire United States. However, the CFS has a number of well-researched weaknesses. For example, not all commodities are covered by the CFS—the survey does not survey establishments classified as government, farms, forestry, fisheries, construction, or transportation. The CFS does not capture the first leg of imports. Although the CFS plays an important role in providing data on domestic freight movements, gaps in shipment and industry coverage, and a lack of geographic and commodity detail, limit the direct usefulness of the CFS data, especially at the urban level.

The Freight Analysis Framework (FAF) dataset produced by FHWA, now in its third generation, uses the CFS as a starting point, and then uses statistical modeling methodologies to remedy most of the deficiencies associated with the CFS. The FAF-3 database includes measurements of freight flows by weight and value between 131 unique geography zones. The United States is divided into 123 domestic zones while areas outside the United States are represented in 8 distinct foreign zones. The database yields freight flow origin and destination (O/D) pairs, identifying three underlying movement pairs (foreign to domestic, domestic to domestic, and domestic to foreign) and each type of O/D pair is further described by seven types of modal movement or combination of modes. In addition, the database provides forecast matrices out over 2 decades. Even with the greater detail in geographic zones, the database must be further disaggregated and supplemented with local data for use in many urban planning applications. However, given the robust promise of the FAF-3 for planning applications, research into techniques for disaggregation continues, and some additional tools and techniques are readily available for planners to begin commodity analysis for their area. NCFRP Project 20, "A Guidebook for Developing Sub-National Commodity Flow Data," a project in progress at the time of this report, will provide additional resources and methods for local planners seeking to use freight flow data. Additional information about FAF-3 can be found at http://faf.ornl.gov/fafweb/Default.aspx.

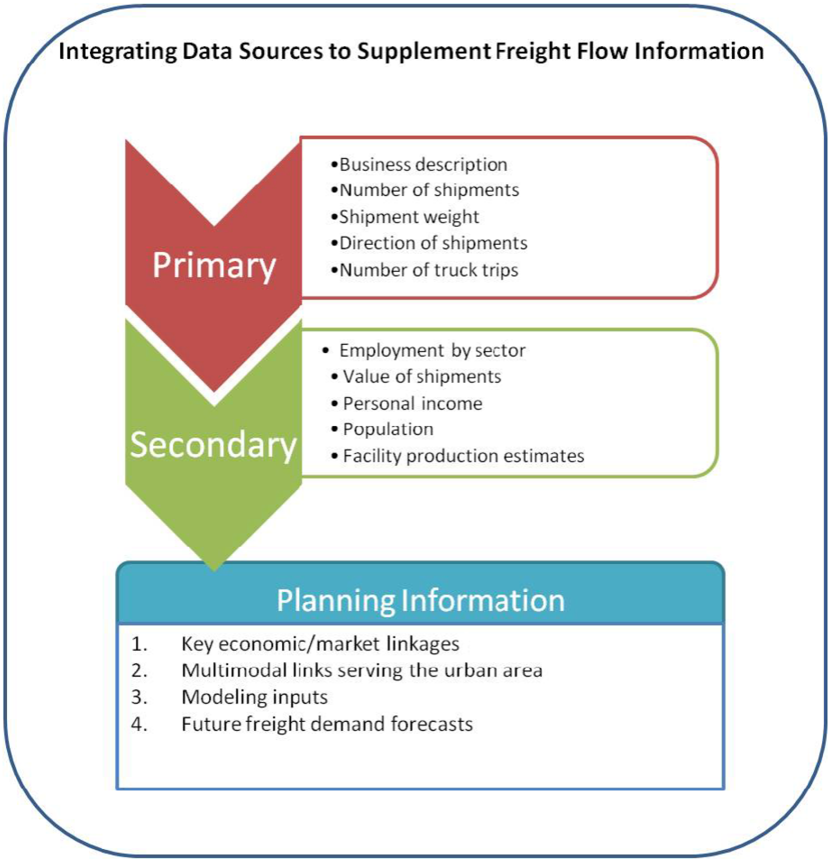
TRANSEARCH® is a proprietary database produced by IHS Global Insight. TRANSEARCH® is a nationwide commodity O/D database produced on an annual basis for freight flows between U.S. geographies at the county, Bureau of Economic Analysis (BEA) area, or state level. TRANSEARCH® employs the CFS but also various primary and secondary data sources covering commodity volume, value, and modal flow, including a long-term, proprietary motor carrier traffic sample, railroad waybill samples, and numerous commercial and federal government surveys. The comprehensive geographic, commodity, and modal coverage of this database has made it a popular source of freight flow information for state and metropolitan transportation planners. TRANSEARCH® data is not free, and the price varies with the level of customization and coverage. One benefit of TRANSEARCH over FAF-3 is that if errors or inaccuracies in the O/D matrix are discovered, they are corrected in a timely manner. Nonetheless, as many governments struggle with budgetary issues, many find data purchases for freight flows difficult to justify.

Whether public or private, secondary sources of freight flow information can be enhanced by primary data collection activities, such as truck intercept surveys or shipper interviews. Because the prominent freight flow data sources are based on periodic national survey samples and data modeling techniques, localized surveys can serve to validate flows at a more localized level. Techniques such as truck intercept surveys can be used to examine the validity of O/D data, length of haul, and other attributes of third-party datasets. These data sources and methods for disaggregation to smaller geographic areas will be discussed further in the next section. See Exhibit 4-9.

Freight Data Protocols

As discussed at the beginning of this chapter, freight data has become a topic of intense interest. Many planners, analysts, and academics hold strong opinions about freight data sources, techniques for applying freight data to planning issues, and the usefulness of products resulting from freight data and analysis. Freight data is a complex subject requiring information about both public and private facilities. Unlike passenger travel, a freight trip is far more likely to cross multiple modes and journey through multiple geographic jurisdictions. Although methods for collecting passenger information have become highly standardized, freight data sources are often fragmented and incompatible. For instance, the primary sources of commodity flow data use different industry classification schemes: FAF-3 and CFS use the Standard Classification of Transported Goods (SCTG), and TRANSEARCH® and the Rail Waybill Sample use the Standard Transportation Commodity Classification (STCC) system. Both FAF-3 and TRANSEARCH® produce statistics for seven transportation modes or movement types; however, FAF movement types include modal combinations representing intermodal movements, while TRANSEARCH® movement types disaggregate specific modes like trucking into truckload, less-than-truckload, and private fleets.

Exhibit 4-9. Example of integrated data sources for customizing freight flow data.



Source: Wilbur Smith Associates.

Given the complexity of freight data and its applications, the following protocols are offered for selecting and using freight data in planning applications:

- Clearly define the issue(s) to be addressed: While planners always start with a plan, it cannot be overstated that in the case of freight data, clearly defining specific data needs to support the planning effort will save considerable time and resources. A good first step in identifying the data needed to support a larger planning effort is the creation of a data synthesis and collection plan. Putting together the issues to be addressed, and the specific data needed to support those efforts, allows for greater interaction (and potentially buy-in) from the planning team and colleagues. The data plan should be a flexible document that is modified as conditions change or new information is identified.
- Collect only the information you need (and can support): Although "only collect the data you need" is a common rule, there is often a tendency to extract "nice to know" as opposed to "need to know" information from private-sector freight stakeholders. It is also a good idea to assess internal capabilities for data analysis and maintenance, so that efforts made to collect freight data don't go unused or become outdated if the planning effort requires periodic updates to the supporting information.
- Seek out partners who can open doors for your data collection efforts: Many successful freight data efforts result from public agencies partnering with business groups, trade associations, or economic development agencies. Chambers of commerce and industry associations like state trucking or rail associations can be crucial partners for data collection. Getting the support of industry groups can provide access to their membership and often these groups will

assist in disseminating surveys and add legitimacy to your efforts. In addition, they can be a source of expert advice and rules of thumb, which may substitute when data is inaccessible. Public or quasi-public economic development agencies also can be of great help identifying appropriate stakeholders for primary data collection efforts with various industry groups.

- Remember the 80/20 rule: Pareto's principle suggests that for many things a few (20 percent) are vital and many (80 percent) are trivial. Because freight is often consolidated at significant nodes, getting good information for the most vital facilities (i.e., largest 20 percent) can provide information about a majority of volume.
- There is no "one size fits all" data solution for most freight planning efforts: Once your data needs are identified there are likely to be local-, regional-, and state-level data that can help support your efforts. There are also a growing number of national-level secondary freight data sources available online, as well as documentation and research through FHWA and TRB that can identify and explain secondary freight data sources. With a comprehensive list of secondary data that can support your project, conduct a gap analysis to identify where primary data collection may be needed to address your specific issues.
- Design a data program that fits your needs, and be creative: There are many opinions about what constitutes good freight data. Often opinions have been formed by using inappropriate data sources for the problem being addressed, misguided expectations, or personal biases. Before using secondary freight data sources do the research required to understand potential shortcomings and be realistic about what data gaps may need to be filled. Be prepared to think outside the box in seeking ways to collect primary data.

CHAPTER 5

Regulations Impacting Urban Goods Movement

Prior sections of this guidebook explain the importance of efficient freight movement to the local and regional economy, the urban quality of life, and livability; describe who, how, where, and why freight moves; detail urban supply chains; and discuss how to find, collect, and analyze freight data. This chapter assumes the guidebook user is an urban planner or planning official with an understanding of basic planning concepts and the planning process. Its focus is limited to identifying urban planning codes, ordinances, regulations, and policies found to affect mobility and access for urban goods movements and explaining their impacts. This focus includes

- Design standards,
- Infrastructure design,
- Land use and zoning, and
- Urban truck regulations.

Overview

Urban land-use codes, ordinances, and regulations—including zoning—are designed to protect public health, safety, and welfare. They minimize conflicts between incompatible land uses within the jurisdictions that adopt them and are intended to create adequate separation between uses, and allow for the highest and best use of the land. Zoning regulations also protect adjacent properties from harm or infringements related to noise, light, air quality, safety, and property value. Conventional land-use and zoning regulations address density, lot size, dimensions, building size and setbacks, street geometrics, access points and driveways, parking standards, roadway and sidewalk design, layout, truck loading facilities, and use of the land. Overall, they protect properties and their values by ensuring livability and the quality of life of those who live and work in the area.

Local governments (including city, township, and county governments) throughout most of the United States have the authority and responsibility for land use and zoning. Local governments also develop and enforce local regulations relating to building codes, design standards, and building permits. In most states, the responsibility and authority over local roadways and bridges also rests with local governments.

In urban areas, mobility and access for all vehicles, especially trucks, is constrained by the dense proximity of buildings and limited space for parking (see Exhibit 5-1). Land is valuable, and often roadways that had been alleyways for freight deliveries or service provisions such as trash collection are increasingly being converted to store fronts, sidewalk cafés, or alternate access points for pedestrians. In high-rise buildings, uses are stacked vertically, and access means not only the need to find parking space for deliveries, but freight elevators as well. The impacts summarized have consequences to both the quality of life of residents and the economic "bottom line" of companies doing business in the urban area.

Exhibit 5-1. Truck unloading in alleyway.

Source: Photo by Halcrow.

Design Standards

Local government planning agencies typically regulate building codes and design standards. Building codes deal with how a building is constructed. These codes focus on establishing requirements to ensure that a building is safe in terms of structural capacity. Included are codes for electrical, heating, ventilation, fire safety, plumbing, and so on inside buildings. Design standards relevant to urban goods movements deal with issues such as the number, location, and design of loading docks and freight elevators, as well as parking lots and related facilities on the site.

Loading Docks

Older buildings were not designed with loading docks and freight elevators to accommodate recent truck designs or the increased consumer demand for goods. In many, but not all, jurisdictions, design standards have been updated for current needs. Inadequate design of loading docks servicing urban buildings may result in

- Blocking roadways: Limited docking space; inadequate turning bay radii; and docking spaces that do not match the height, width, or length requirements of current trucks can have several unintended impacts. These may result in trucks spending more time on the streets waiting to dock and adding to congestion. They may also result in trucks not being able to back completely off a street to load or unload, and thereby blocking the street (see Exhibit 5-2).
- Increased congestion: Lack of adequate dock space and freight elevators inside buildings can result in trucks requiring additional time for pickup and delivery of goods and increase congestion. If building dock space is too small for current trucks (see Exhibit 5-3), this may force the use of more, smaller vehicles that add to congestion. This also affects the economic efficiency of the businesses delivering to the building.

Parking Areas

Another design issue relates to urban truck parking areas and parking lots. Local design standards may require all parking areas to be paved to control dust and related air pollution from vehicles driving on these surfaces. The cost to pave large areas for truck parking is high, and urban land owners may want to limit this expense and request a variance. These competing needs to balance cost and air quality may not impact mobility and access; they have been identified as

Exhibit 5-2. Limited docking space and blocked streets.

Source: Photo by Wilbur Smith Associates.

Exhibit 5-3. Docking space with height mismatch (note position of dock against mud flaps).

Source: Wilbur Smith Associates.

a conflict area between planners and industry. Their economic impact on the freight industry should be acknowledged and considered by local decisionmakers.

Urban Infrastructure Design

Depending on state law and the functional classification of a roadway, the authority and responsibility for the design of local roadways may rest with a local government. It is recognized that some state DOTs (West Virginia, Virginia, and a few others) have authority over local roadway design. Federal and most state roadway design regulations are intended to accommodate trucks. Unfortunately, in some cases older roadways and bridges and local roadways do not meet these design standards (see Exhibit 5-4). Older urban intersections, narrow streets, and alleyways may restrict truck mobility causing trucks to hit poles or signs located on corners or to drive over sidewalks to make turns. In some urban areas, trucks entering a railyard, port, or other private-sector intermodal facility must travel through privately owned parking lots and local facilities over old urban roadways that are difficult to negotiate. Outdated or insufficient infrastructure design can impact urban freight mobility and access to buildings and facilities and result in

- Increased congestion: The additional time trucks may require negotiating turns, avoiding low bridges, and so on may result in congestion and backups on the roadways.

Exhibit 5-4. Urban infrastructure design: inadequate curbside parking and inadequate turning radii at intersections.

Source: Wilbur Smith Associates.

- Economic impacts: Trucks traveling through infrastructure with height restrictions, weight restrictions, inadequate turning radii, and along narrow roadways results in reduced efficiency and limits growth and development of urban businesses.

Land Use and Zoning

Many, but not all, local jurisdictions enact zoning regulations. Zoning classifies uses to provide compatibility and minimize impacts of land use within and adjacent to each zone. Typical zoning categories include: residential, commercial, business or employment center, industrial, office, institutional, agricultural, mixed use, planned unit development (PUD), and other. Each zoning category may include various densities and types of uses. Urban areas are made up of a variety of land uses covered by various zoning regulations, each with unique goods movement needs and impacts. Impacts on goods movements for the following four types of urban areas are discussed:

- Urban city center/central business district (CBD),
- Urban residential area,
- Urban manufacturing district, and
- First-ring suburb.

City Center/CBD

An urban city center/CBD is characterized by dense, mixed-use development. CBDs typically include high-rise structures that (1) are occupied and used individually or (2) include a combination of uses such as apartment and condominium housing, business offices, restaurants, markets, entertainment venues, and retail establishments.

Impacts of goods movements in urban city centers include congestion, noise, air quality, and safety. Mobility for all vehicles, but especially large ones, is constrained by the dense proximity of buildings and limited space for parking. Because CBDs are often the oldest sections in a city, they may have narrow streets, limited docking space, limited turning radii, and height restrictions.

Urban Residential Area

Urban residential areas, such as the Bronx and Queens in New York City or Georgetown in Washington, D.C., are primarily residential areas with multi-story apartment buildings, row houses, condos, and single-family homes with limited setbacks or space between them. These areas include a mix of uses such as restaurants and shopping areas, schools, libraries, medical facilities, and neighborhood parks.

Truck routing, parking, and delivery time restrictions are often enacted in these areas to separate truck traffic impacts from residents and to reduce noise and improve air quality.

Impacts include congestion, noise, air quality, and safety issues. Because the area is primarily residential in use, aesthetics, safety, and the desire to protect land values are priorities. Residents do not want trucks driving past their homes or parking in front of their homes. Mobility is limited because of the proximity of buildings and the limited space and time permitted to park while handling goods. The intended effect is to improve the quality of life for the residents of the area. The unintended effect is more small commercial vehicles making more deliveries to the increasing demands of modern consumers.

Urban Manufacturing District

Urban manufacturing districts include warehouses, distribution centers, and waterfront and port areas. Manufacturing, warehousing, and distribution businesses were common industries

Exhibit 5-5. Milltown lofts adjacent to Hulsey intermodal railyard, near downtown Atlanta.

Source: Wikimapia.

that made up the core of early urbanized areas. Prior to the construction of urban Interstate highway facilities, people tended to live near industrial facilities to be close to jobs. Many older urban areas still include active manufacturing centers with nearby residential housing and businesses that support them. Today, the attraction of waterfront living is pushing upscale residential and commercial development into working port areas like Cleveland, Ohio; Baltimore, Maryland; and Savannah, Georgia. Also, the simple desire to be close to the city core continues to place new residential high-rise construction adjacent to warehousing and terminal facilities in many urban areas (see Exhibit 5-5).

Urban manufacturing operations typically need large trucks to have access to industrial facilities. Congestion, noise, pollution, and safety are major concerns, and the mobility for tractor-semi-trailer combinations with 53-foot vans is often challenged by old infrastructure with low clearances and short turning radii. As a result, large trucks may travel through residential areas raising conflicts between residents and businesses.

Planners and local decisionmakers recognize the conflicts between these competing, and somewhat incompatible, uses. They may impose truck routing restrictions in these areas as well as limitations on delivery times and idling. These restrictions add to peak-hour congestion, noise, and air pollution.

For manufacturing and distribution businesses located inside urban areas, restrictions on the expansion or development of complementary facilities adjacent to existing manufacturing or distribution businesses can limit potential growth and business productivity. High land prices are one reason freight service providers do not locate new facilities in or near urban core areas. There may also be land-use restrictions against freight terminal operations. Zoning restrictions may result in trucks making longer trips to deliver their goods, thereby raising costs, increasing fuel use, and increasing emissions.

First-Ring Suburb

Older suburbs, often referred to as first-ring suburbs, began to develop as motor vehicles and trolleys offered people the option of living away from the noise and pollution of the manufacturing and warehousing that existed in central cities. Today, these older suburban areas have continued to grow by increasing density. Many first-ring suburbs have continued to grow to include office centers, shopping malls, and big-box retailers.

As residents migrated from the central cities to suburbs for a quieter lifestyle, many commercial activities soon followed. Noise, pollution, and safety related to trucks and rail grade crossings continue to be issues in many urban areas. Although dock space for businesses located in suburbs may be less of a problem, truck routing and delivery time restrictions can be issues. To accommodate the concerns of residents, prohibitive truck routing and delivery time restrictions are often adopted to retain quiet neighborhood characteristics and preserve the quality of life for residents.

Urban Truck Regulations

At the urban level, regulations over commercial vehicle operations fall into several categories:

- Route restrictions,
- Commercial vehicle parking regulation/curbside access,
- Delivery windows/time-of-day restrictions,
- Size and weight regulation, and
- Emission controls.

Although some cities also may enforce safety regulations, by and large, truck safety compliance is handled by state and federal jurisdictions through the Federal Motor Carrier Safety Assistance Program (MCSAP).

Prior to discussing various forms of commercial vehicle regulations, it is important to note that commercial vehicles are defined differently across jurisdictions. A consistent definition for a commercial vehicle is a necessary prerequisite to a regulatory framework for enforcing truck regulations. Within an urbanized area, the potential for conflicting commercial vehicle definitions among neighboring cities and counties is not uncommon.

Trucks are defined in a number of different ways, depending on the regulating entity. Generally, trucks are defined in one or more of the following ways:

- Vehicle purpose: Trucks can be defined as commercial vehicles that haul goods, generally used in the context of defining other commercial vehicles, such as buses and taxis.
- Vehicle dimensions: Federal and state laws typically regulate commercial vehicles according to length, width, and height. Urban areas with restrictive roadway geometry or low clearances also may impose dimensional restrictions on some routes.
- Number of axles/tires: Many urban areas define trucks as commercial vehicles designed to carry property and having more than two axles or more than four tires.
- Vehicle weight and capacity: Trucks conforming to federal regulations are typically registered with a maximum gross vehicle weight that includes the weight of the truck plus the weight of the cargo. Many definitions identify trucks as any cargo-carrying commercial vehicle rated at a particular gross weight or higher.

Truck Routing

Historically, many urban areas in the United States have designated truck routes as a means of keeping trucks out of residential neighborhoods. However, from the perspective of facilitating freight movements, truck routes should be designated, designed, operated, and maintained to accommodate trucks. The designation of local truck routes should serve the following purposes:

- Increase freight transit reliability,
- Reduce congestion and provide congestion relief from incidents on major arterials,
- Improve safety, and
- Reduce truck emissions.

In 2008, the NYCDOT petitioned the FHWA to conduct a truck route signage pilot program that would allow the city to experiment with new truck route sign designs to make signs more identifiable to truck drivers. The first generation of experimental truck route signs incorporated a green circle, the universally accepted symbol for positive guidance, into the existing conventional sign. A prohibitive route sign incorporated the red circle and diagonal line. The pilot signage program was implemented in the Hunts Point area of the Bronx in 2010, and NYCDOT is now monitoring truck route compliance in the project area and a control area adjacent to it.

Traffic design issues often contribute to a less reliable freight network. By developing a defined truck route network and understanding the specific roles played by key "last mile" routes, highway improvement strategies are likely to be successful. From a design standpoint, designated truck routes should have adequate turning radii at intersections and adequate horizontal and vertical clearances, as well as bridge and pavement integrity to handle heavy loads. Operationally, signal timing plans on truck routes should account for trucks' slower acceleration speeds to prevent repeated stopping once up to speed.

Failing to designate truck routes, or providing inadequate signage, may result in

- Trucks on residential streets: Many designated truck routes have been instituted to keep trucks out of residential neighborhoods. If regulations or signs are not adequate, or if roadway sections where trucks are permitted do not connect to each other, this can increase circuitry and may result in trucks inadvertently winding through streets that are primarily residential.
- Increased environmental impacts: Restrictions on what roadways trucks may use could result in additional miles traveled and increases in fuel use, noise, and air pollution. In some cases, these inefficiencies are increased by a lack of good signage directing truckers to permitted routes. In some jurisdictions, only non-truck roadways are designated and the lack of a clear and direct route that a truck may use to get from one point to another results in additional miles traveled and increases in fuel use, noise, and air pollution.

Parking and Loading Zones

CBDs and urban corridors with high commercial activity often experience significant parking challenges, especially for trucks. This includes on-street parking (curbside) as well as off-street parking (on commercial properties). The inability to find parking near the delivery point slows down delivery for multiple-stop routes, the penalty being higher cost and diminished service (delivery services only serve areas that are viable from an economic standpoint). The decline in service ultimately impacts downtown business vitality. Ill-managed curbside access also raises the cost of goods to consumers; in many large urban areas delivery fleets pay millions of dollars each year in parking fines—a cost of doing business.

On-Street Parking and Curbside Management

Most curbside parking, even for commercial purposes, is designed for small vehicles such as pickup trucks, vans, and single-unit trucks. Curbside management can be enhanced using a variety of methods, including strict enforcement of designated commercial parking zones for use by commercial vehicles only, providing larger curbside parking spaces, increasing the frequency of commercial curbside spaces, designating commercial curb parking during peak periods, and peak-hour pricing mechanisms to regulate parking behavior.

Off-Street Parking

Parking on commercial properties that attract significant truck traffic can be a concern in many urban areas. Retail strip malls, shopping malls, hotels and recreational areas, convention centers, and office parks often do not plan for truck parking needs. Building codes for urban commercial properties should include specifications for truck parking and loading/unloading.

Typically, designated loading zone locations and times curbside truck parking is permitted are determined by the local jurisdiction. Lack of an adequate number of spaces for loading or curbside parking, parking time limits, and idling time limits may result in

- Increased congestion: Inadequate curbside parking spaces and/or parking restrictions for loading and unloading can result in more congestion as trucks circle the block looking for curbside access to park near their delivery locations.

- Double parking: Increasingly, overnight couriers guarantee delivery services that require trips to central city offices during peak work hours. It is common for delivery drivers who cannot find space at the curb to double-park to avoid missing delivery schedules committed to by their business models. In some urban areas like New York, carriers routinely pay more than a million dollars per year in parking tickets for double parking. This also adds to urban congestion.

Delivery Windows/Time-of-Day Restrictions

City codes and regulations may restrict the time of day that trucks may stop to pick up and deliver goods, or in some cases raise the cost of parking during peak periods. Most cities that apply time-of-day restrictions do so to prevent deliveries during hours when pedestrian traffic is heaviest or during peak commuter periods. Some cities have applied daytime delivery bans on specific types of goods such as hazardous materials, or during special events such as the 1996 Summer Olympics in Atlanta. Some communities have started using retractable bollards, a practice started in Europe to restrict trucks from pedestrian ways and other areas during daytime hours (see Exhibit 5-6). Restrictions on delivery times may result in

- Impacts on congestion and emissions: If executed properly, delivery time-of-day restrictions have shown to increase the speed and efficiency of delivery routes given that deliveries are restricted to times when congestion is at its lowest, resulting in lower congestion and emissions. However, some communities have implemented mid-day or nighttime restrictions that potentially move more truck traffic to peak hours, increasing congestion and emissions. Similar to parking restrictions, time-of-day delivery restrictions may also result in trucks "staging" or waiting outside downtown areas.
- Increases to receiver costs: One of the biggest objections to nighttime delivery schemes has been the additional costs for nighttime staff, and off-hour security for businesses receiving goods.

Truck Size and Weight Regulation

Congress and FHWA have defined the nation's primary truck networks from a policy standpoint for encouraging interstate commerce: The National Highway System (NHS) includes the

Exhibit 5-6. Delivery restriction bollards.

Source: www.bollard.info.

Interstate Highway System and other highways designated by U.S.DOT, in cooperation with the states, local officials, and MPOs. This comprises approximately 160,000 miles of roadway important to the nation's economy, defense, and mobility. Off the NHS, states, counties, and municipalities have the authority to set load limits on roadways under their jurisdictions. Most often, state authorities establish the governing weight limits and vehicle dimensions that apply in each state. Local authorities may impose additional limits, typically on individual routes or seasonal restrictions (e.g., spring load limits), or to protect critical infrastructure (e.g., bridge postings).

Pavement Wear

Pavement wear is determined primarily by axle loads—or more precisely, the weight "footprint" of the vehicle's tire contact with the pavement. Traditionally, enforcing truck weight laws has involved using static roadside scales or mobile enforcement scales. For many urban areas, the space required to pull over and weigh trucks prohibits efficient enforcement. However, studies have shown that the cost of overweight trucks can significantly outweigh the cost of greater enforcement resources. Truck weight data from urban areas suggests violations most often occur among single-unit trucks such as refuse and construction vehicles.

Bridge Stress

Bridge stress is primarily impacted by the total weight of the vehicle—i.e., the total suspended weight on the bridge structure. On short bridges, long vehicles will likely not transfer the total weight of the vehicle to the bridge at one time, while shorter vehicles transfer more weight to individual bridge members. Given the types of trucks that typically operate in urban environments, overweight, short trucks can cause premature bridge deterioration.

One of the most frequent causes of bridge damage in urban areas results from commercial vehicles striking bridges and overpasses (see Exhibit 5-7). An investigation by New York DOT and the City of New York found that in 2008 there were 98 incidents of commercial vehicles striking bridges in New York City alone. Bridge strikes can result in death or injury, infrastructure damage, road closures, and other operational disruptions (e.g., strikes to rail bridges can close rail lines). NYCDOT is addressing bridge strike problems through enforcement of truck routes, education and outreach, reflective signing of low bridges, and the use of technology to monitor those bridges most prone to strikes.

Truck size and weight regulations were conceived originally as a means of maintaining the integrity of quality roadways. However, truck weight and dimension also affect vehicle handling characteristics such as stability and control. Operating a truck beyond limitations established in law can severely degrade stopping ability and put excess wear on vehicle components such as brakes, tires, and suspension systems. Overloads also degrade the ability of a heavy truck to accelerate into traffic or through intersections or railroad crossings, or to maintain vehicle stability in high-speed, tight curves.

Truck Idling Regulations

Since passage of the Clean Air Act in 1963, U.S. federal emissions standards over light-, medium-, and heavy-duty trucks have become increasingly strict. In the past decade, new diesel engine standards, as well as EPA standards for low-sulfur diesel fuels, have continued to cut emissions despite the growth in commercial vehicle miles of travel. Although stricter federal regulations on trucks serve to lower emissions on new vehicles, these improvements often filter more slowly to urban truck operations. Because of the short nature of urban truck trips, urban fleets turn over more slowly, and once over-the-road trucks are retired, they often see service in urban truck operations.

Exhibit 5-7. Truck and bridge damage.

Source: NYCDOT.

To lower emissions in urban areas, an increasing number of state and local jurisdictions are imposing additional restrictions on trucks such as idling regulations and engine compliance rules. The American Transportation Research Institute (ATRI) has assembled a compendium of truck idling regulations that cites 22 states and more than 50 city and county jurisdictions that impose engine idling restrictions (see http://www.atri-online.org/research/idling/ATRI_Idling_Compendium.pdf).

CHAPTER 6

Putting It All Together: A Process for Evaluating and Addressing the Impacts

This chapter suggests steps to help local planning officials evaluate goods movement issues in their urban areas. The process outlined is intended to assist planners in identifying impacts and determining whether existing regulations may be producing unintended consequences such as higher congestion, air or noise pollution, or lower competitive conditions for businesses. This section also presents ideas, solutions, and strategies for integrating freight into the planning process and changing local regulations to support efficient goods movement operations.

Recognize the Political Environment

As with any planning process, it is important to acknowledge that changes to policies, goals, and the regulations intended to implement them require buy-in by elected officials and the public. Affecting the impact of urban goods movements through both policy and regulatory changes begins with an understanding of the political complexity of moving goods into, and within, urban areas.

Urban goods movement issues may create challenges for local elected officials and decisionmakers who must balance competing demands between citizens who vote and businesses that create jobs. For example, if a business located in a residential area generates a significant amount of truck traffic, residents are likely to complain about trucks on residential streets. Even if the business provides jobs, voters from the neighborhood command attention. The economic effects from losing the company are less likely to be apparent to the voters in the neighborhood.

As discussed earlier in this guidebook, as urban areas grow in population and density, demands for consumer goods grow as well. High urban populations and similarly high demands for goods and services are increasing levels of urban highway congestion. Modern supply chain management practices such as just-in-time delivery have become the norm for competing in the new economy. Regulations imposed by local agencies intended to combat congestion (e.g., time-of-day delivery restrictions) may have the unintended result of creating increased tension between freight delivery needs and the quality of life residents expect. An increasing number of consumers are ordering products via the Internet for home delivery, yet many do not want trucks in their neighborhood. Trucking companies and others responsible for delivering goods and services in urban areas find it increasingly challenging to operate in urban environments.

Receiving Support or Authorization to Integrate Freight Analysis into the Planning Process

The specific work conducted by most local governments and planning agency staff is based on answering questions or addressing issues, principles, or policies identified by local elected officials and decisionmakers. Therefore, the decision, directive, or authority to conduct freight analysis may require that local elected officials or decisionmakers acknowledge urban goods movements as something that is important on which to spend staff time. In other words, to conduct an evaluation and address freight issues, support—or a directive—may need to come from a local official to the staff. It is possible, that by reviewing this guidebook (or its overview), gaining insight from other freight-related materials, or hearing a presentation on freight, a local decisionmaker might direct staff to begin this work. If this is not the case, and the desire to conduct urban goods movement analysis comes from the staff, it is advisable to educate local decisionmakers and officials about the importance of freight and impacts and conflicts. Several resources are available to help with this. The overview to this guidebook is intended to capture the attention of local elected officials and decisionmakers. The associated CD-ROM includes several PowerPoint presentations that can be used to explain the importance of urban goods movements to local elected officials and decisionmakers. Although this support may not be critical to conducting a study, having their support is critical to integrating freight into the planning process and implementing needed changes identified through it.

Get Organized

Select a Project Manager

As a first step in evaluating the impacts of urban planning codes, ordinances, regulations, and policies on urban goods movements, it is recommended that an appropriate staff person be designated as a project manager. This individual will be responsible for all actions, activities, and deliverables described in the process outline that follows. Their first step will be to determine the scope, timeframe, tasks and deliverables expected. A helpful resource for the project manager may be *NCHRP Report 570: Guidebook for Freight Policy, Planning, and Programming in Small- and Medium-Size Metropolitan Areas* (Cambridge Systematics, Inc. et al. 2007).

Contact Local MPO

The project manager should contact the local MPO or state DOT. Many MPOs and DOTs now employ freight planners who can provide information, contacts, and additional technical assistance for this effort.

Network with Industry

One of the most important activities the project manager should undertake when attempting to initiate changes affecting the businesses involved in delivering or receiving goods and services, is to build relationships. Planning staff assigned to address goods movement issues should attend industry meetings (e.g., local roundtable meetings of the Council of Supply Chain Management Professionals), get involved in local Chamber of Commerce activities, etc. Building relationships and communicating the issues that are being addressed are the first steps toward building trust. This is discussed more in the following section on field surveys and interviews.

Perform Background Research

The project manager should review and understand in general the current local regulations and policies including, at a minimum, those discussed in previous sections, as follows:

- Truck routing,
- Parking and loading zones,
- Time-of-day delivery,

- Truck size and weight,
- Design standards,
- Infrastructure design,
- Land use and zoning, and
- Enforcement policies.

Develop Baseline Information: Field Surveys/Inventories

The designated freight project manager will need to assemble baseline data. Field surveys or interviews are a reasonable starting point from which to observe or otherwise gain an understanding of regional truck movements and truck-related congestion in the urban area. A practice that has been used successfully by several local communities is truck driver break room surveys. This technique calls for permission to post a regional map in truck driver break rooms of regional truck terminals, along with a set of simple instructions for identifying bottlenecks and congestion on the map (see Exhibit 6-1). Detail on this topic can be found in the *Guidebook for Engaging the Private Sector,* available through FHWA at http://www.fhwa.dot.gov/freightplanning/guidebook/guidebook.pdf.

Gathering baseline information about freight mobility issues is important for the following reasons:

1. The baseline information provides a starting point for addressing key issues, and
2. Baseline data also allows before-and-after evaluations of programs implemented.

Having solid performance feedback about improved conditions can be critical to future support from private-sector partners.

An initial summary of findings, including maps showing areas of concern (such as truck congestion areas, bottlenecks, and trucks on non-truck-route roadways) can be prepared and presented to local decisionmakers. Both the local MPO and state DOT may be able to assist with identifying locations and mapping.

Identify Stakeholders and Conduct Interviews

The project manager should identify a variety of local stakeholders including businesses, shippers, and major motor carriers in the area. Working with the local MPO may be useful in identifying stakeholders who should include individuals connected to the types of businesses described in the 12 supply chain case studies identified in Chapter 2. These individuals should be interviewed to understand their issues, problems, and concerns. *CRP-CD-105,* which accompanies this guidebook, includes examples of the types of businesses to contact. The CD also includes a copy of the FHWA guidebook, *Engaging the Private Sector in Freight Planning* (Wilbur Smith Associates and S. R. Kale Consulting, LLC 2009). This document provides extensive guidance on how to identify and engage freight shippers and carriers in discussions about local goods movement problems.

Summarize the Issues, Problems, and Their Locations

Using the findings from the surveys and interviews, prepare a revised draft summary of the problems and issues discovered, and update the draft maps prepared after the field surveys/inventory.

Exhibit 6-1. Sample truck driver break room survey.

The Atlanta Regional Freight Mobility Plan

Truck Driver Survey

Identifying Truck Traffic Bottlenecks/Issues in the Atlanta Region

GOAL: We are looking for truck driver input regarding bottlenecks, and impediments that make it difficult to drive a truck within the 20 county Atlanta Region displayed on this map.

INSTRUCTIONS: Using the numbered, colored dots below, place the appropriate colored dot in the area you encounter mobility problems as you navigate the city in a commercial vehicle.

The types of problems we are looking for:

Geometric Constraints, for example:

- **Insufficient turning radius**
- **Insufficient lane width**
- **Low overhead clearances**
- **Short or no acceleration lanes**

Traffic Issues, for example:

- **Traffic signals closely spaced and ill-timed for commercial vehicles**
- **Poor or inadequate signage**

Infrastructure Problems, for example:

- **Pavement rutting or potholes**
- **Restricted bridges**
- **Rough or high at-grade rail crossings**

Safety Hotspots:

- **Sites of frequent crashes or near-misses involving commercial vehicles**

Once you have placed your numbered dots on the map, use the space with the corresponding number and color below to indicate the physical location of the problem site (intersection, highway route and/or milepost), and give a brief description of the problem.

Examples of problem sites identified through a Chamber of Commerce survey conducted in 2004 are provided as examples.

Source: Wilbur Smith Associates.

Education, Outreach, and Gaining Support

Changing regulations is not always easy. Before identifying and proposing solutions, an effort should be made to understand how the public, private sector, and decision leaders feel about existing regulations and conditions. Determining what might be acceptable in the way of new or revised regulations before proposing and presenting solutions is recommended.

Research conducted for this guidebook explains how and why there is a need to educate both local decisionmakers and the public on the significance of urban goods movement and its relationship to the local economy. This guidebook and *CRP-CD-105* include information and materials geared to local elected officials who need suggestions for how to support both the residents and businesses within their jurisdiction. Outreach meetings, workshops, and charrettes may help to educate and define the types of solutions that will be politically and publicly acceptable. Gaining support for solutions is also strengthened by developing partnerships with businesses that should benefit from the changes.

Conduct Workshops

A workshop is different from a meeting. It is a working session in which information is presented, followed by a facilitated discussion of issues identified through baseline data collection and stakeholder outreach. It provides a forum for a broad range of stakeholders to provide their perspectives on issues identified, discuss alternatives, and reach consensus about the best means of resolving issues.

Conduct Charrette

A charrette is another workshop format for collaboratively developing solutions, issues, or problems. Charrettes have become a popular practice in urban planning, because they provide a technique for consulting a broad array of stakeholders. Charrettes with different stakeholder groups are often held over multiple days to accommodate feedback loops. The small group or individual session inputs are then brought together for a comprehensive solution at the conclusion of the charrette. This option will require the planning staff to identify the topic for the charrette, prepare materials, and conduct and record comments.

Developing Partnerships

Collaboration and consultation between planners, economic development groups, local Chambers of Commerce and freight shippers and carriers can be an effective way to effect change. The project manager should identify and contact these groups about this effort.

These relationships would help vet which ordinances and regulations should be the key focus for the effort. Some MPOs already have established freight industry groups such as freight advisory councils to provide feedback on planning and regulatory developments. Asking to become a member of the freight council is advisable.

Review and Evaluate Current Regulations

Based on the findings from the surveys, interviews, outreach and partnership activities, and freight analysis, relevant regulations should be evaluated. Exhibit 6-2 provides a starting point for evaluation. It can be used to identify the types of effects resulting from various codes and regulations.

Exhibit 6-2. Regulation evaluation matrix.

	Potential Impacts					
Regulation	Increased Congestion	Increased Air, Noise, Pollution	Reduced Business Competitiveness	More Trucks on the Roads	Double Parking	Trucks on Residential Streets
Truck routing						
Parking and loading zones						
Time-of-day delivery						
Truck size and weight						
Building codes, design regulations						
Infrastructure design						
Land use and zoning						
Enforcement policies						

Source: Wilbur Smith Associates.

Identify Potential Solutions and Strategies to Improve Urban Goods Movements

The following potential solutions and strategies provide ideas and suggestions for addressing specific types of impacts. Suggestions may include revising codes, ordinances, or regulations; developing new programs; or changing policies. The case studies following this section and the accompanying CD include other suggestions. Exhibit 6-3 provides a matrix summarizing potential problems and solutions.

Truck Routing

Problems or Issues

- Trucks on residential streets or routes where they are not permitted, and
- Trucks not having direct routes or access to pickup or delivery destinations.

Analysis/Evaluation

- Has a dedicated truck route network been clearly defined? When has it last been updated?
- Are the signs indicating truck routes well placed and clear of obstructions?
- Do roadways designated as non-truck routes isolate facilities or locations?
- Are truck routes designed and managed to accommodate heavy truck traffic?

Exhibit 6-3. Urban goods movement problems and potential solutions.

	Potential Solutions												
	Designate truck routes	Improve signage	Designate or add truck parking spaces	Enforce parking and truck routing regulations	Review and revise design standards for new construction to better accommodate freight needs (e.g. dock space, location, freight elevators)	Work with businesses to schedule pick-up/ delivery times	Modify local regulations designating the hours pick-ups/ deliveries are permitted	Use cell phones and other technology to schedule or direct pick-up/ delivery times	Improve roadway and bridge infrastructure to meet current design standards that accommodate trucks	Evaluate "last mile" needs	Work with freight industry stakeholder, local chamber or economic development staff	Work with MPO or state DOT freight staff	Conduct education and outreach on importance of freight
Problem													
trucks on residential streets	x	x		x	x	x			x	x	x		
trucks cutting through private property or parking lots to access pick-up/delivery locations	x	x		x					x	x	x	x	
trucks not having direct routes for pick-up or delivery	x	x	x					x	x	x	x	x	
trucks circling blocks; no parking available				x	x	x	x	x					
double parking		x	x	x	x	x		x					
passenger cars/dumpsters in truck loading zones		x		x									x
congestion	x		x	x	x	x	x	x		x			
trucks driving over curbs, hitting items near corners	x			x				x	x				
trucks having inadequate space to back up or turn	x			x	x			x	x				
conflicts—business and industry uses	x				x					x	x		
noise, dust, light pollution from freight uses	x			x							x		x
freight improvement projects not receiving priority										x	x	x	x

Potential Solution

- Identify common origins and destinations that trucks need/want to access,
- Create a plan for communicating existing truck routes,
- Improve truck route signage,
- Provide online resources for comments on truck routes and truck route violations,
- Work with the MPO and adjacent jurisdictions to conduct a truck route study and develop truck route maps for the urban area, and
- Work with local law enforcement on "how to" and "why" truck route enforcement is important.

The Atlanta case study in Chapter 7 provides an example.

Parking and Loading Zones

Problems or Issues

- Trucks circling blocks to find curbside parking for pick up or delivery,
- Trucks double parking,
- Passenger cars in truck loading zones,
- Waste disposal bins/dumpsters in loading zones, and
- Congestion.

Analysis/Evaluation

- Is signage for the loading zones clear?
- Are passenger vehicles and other items such as waste containers blocking loading zones?
- Are there an adequate number of spaces for the types of businesses on the street?
- Which curbside areas are in the highest demand at various times of the day?

Potential Solution

- Work with local businesses to schedule deliveries to avoid conflicts,
- Use technology or even cell phones to contact and coordinate with drivers,
- Extend the hours or times of day that trucks are permitted to load and unload,
- Strictly enforce truck loading zones; ticket passenger vehicles and other items that park in, or are placed in, these spaces,
- Install variable pricing parking meters,
- Add more curbside truck parking,
- Require new construction and renovation projects to include adequate dock space (see the Resource CD for examples), and
- Require new construction and renovation projects to include an adequate number of freight elevators (see the Resource CD for examples).

The Toronto case study in Chapter 7 provides an example.

Time-of-Day Delivery Restrictions

Problems or Issues

- Congestion from trucks trying to access pick up or delivery destinations during peak hour traffic.

Analysis/Evaluation

- Is truck congestion greater at specific hours of day?

Potential Solution

- Work with local businesses to accept deliveries in off-peak hours,
- Work with local businesses to schedule deliveries to avoid conflicts,

- Use technology or even cell phones to contact and coordinate with drivers,
- Change time-of-day operating regulations to alter or extend hours when trucks may pick up or deliver goods,
- Determine if there is a need to simultaneously revise noise ordinances,
- Possibly test this initially with waste collection trucks serving businesses, and
- Allow trucks to park (with a turned off engine/not idle) overnight for early morning delivery.

The London case study in Chapter 7 provides an example.

Building Codes

Problems or Issues

- Trucks extending onto roadways while picking up or delivering, and
- Trucks blocking traffic or parking at the curb because of a lack of adequate docking space.

Analysis/Evaluation

- Do building codes need to be updated to address new truck design and increases in consumer goods volumes?

Potential Solution

- Review and update building codes for new construction or require retrofitting to provide adequate docking (space, design, number) and elevators dedicated to freight movement inside buildings.

The New York City case study in Chapter 7 provides an example.

Infrastructure Design Requirements/Operating Structure

Problems or Issues

- Trucks driving over curbs, hitting poles and signs at intersection corners,
- Trucks not having adequate space to back up or turn,
- Trucks not having access to facilities because of bridge height and weight limits,
- Trucks needing to drive through privately owned roadways and parking lots to access intermodal facilities or pick up and delivery locations (referred to as the "last mile"), and
- Trucks not having direct routes or access to pick up or delivery destinations.

Analysis/Evaluation

- Do bridges and roadways meet current standards to accommodate the needed height and turning radii for modern trucks?

Potential Solution

- Identify common origins and destinations that trucks want to access,
- Determine if the infrastructure adjacent to the origin and destination meets current state and federal design standards,
- Determine the ownership of the infrastructure,
- Work with local MPO and state DOT, economic development organizations, and the trucking industry to seek funding to improve the infrastructure to upgrade truck access and mobility, and
- For infrastructure serving major goods movements facilities, work with city or county engineering office to revise local bridge and roadway design standards to those needed to accommodate trucks.

Zoning

Problems or Issues

Conflicts and complaints between residents and businesses relating to

- Truck traffic, noise, and air pollution,
- Light and noise "spill-over" from urban manufacturing and distribution facilities, and
- Reduction in property values because of adjacent business uses.

Analysis/Evaluation

- Have interviews with stakeholders or stakeholder workshops identified areas of potential conflict?
- Will zoning changes reduce the economic competitiveness of the region?

Potential Solution

- Potentially review current zoning codes to include buffer zones between business, industrial, and commercial uses,
- Require light screening, including limiting height of lights, directional covers on light fixtures, walls, and times of day lights can be on to avoid lighting spilling into residential areas,
- Require noise screening with vegetation, fences, walls, or restricting hours of operation to avoid noise spillover,
- Consider developing overlay zones to protect industry, and
- See also, Green Initiatives below.

The Baltimore case study in Chapter 7 provides an example.

Zoning/Green Initiatives

Problems or Issues

- Conflicts and complaints between residents and businesses relating to urban goods movements.

Analysis/Evaluation

- Have industrial-commercial, business/manufacturing facilities and distribution centers that are major freight generators in the local area been identified?
- Have vacant Brownfield sites in the area been identified?
- Have clusters of major freight generating activities been identified?

Potential Solution

Both potential solutions below involve working with local business and economic development groups. Both solutions may need to be accompanied by tax incentives and infrastructure improvements needed to support increased freight movements.

- Urban consolidation center/freight village: create a zone in which a cluster of industrial, intermodal, distribution, and logistics buildings can be located within a secure perimeter. This zone would permit all activities relating to transport, logistics, and the distribution of goods carried out by various operators. It should be able to include uses that provide a range of support services to tenant firms and their operations. Additional details on consolidation centers and freight villages are provided on the Resource CD.
- Brownfield redevelopment: identify and zone a Brownfield site to be used as an urban consolidation center/freight village. Provide assistance to deal with environmental permitting, incentives to the site, and infrastructure to accommodate freight movements.

The Buffalo, New York, case study in Chapter 7 provides an example.

Project Prioritization Processes

Problems or Issues

- Infrastructure projects being funded and advanced do not address goods movement inefficiencies.

Analysis/Evaluation

- Has a report summarizing the findings from the local goods movement evaluation study been prepared?
- Has a briefing or executive summary of the goods movement evaluation been prepared for local elected officials?

Potential Solution

- Work with the local Chamber of Commerce or MPO to establish a freight advisory group made up of local business and industry leaders who ship or receive large volumes of freight to the area,
- Work with this group to identify projects under the jurisdiction of your local government that would most benefit urban goods movements in the area,
- Research how freight movements are considered in selecting projects by the local government and MPO,
- Educate the advisory group on who and how projects are selected and funded,
- Produce and provide a report on the findings from the goods movement analysis to elected officials,
- Use materials from the Resource CD to help educate local elected officials of the importance of efficient goods movement to local economic health and competitiveness, and
- Assist in providing advisory group members with data and facts on urban goods movements in the local jurisdiction.

Measuring Success

Measuring success will depend on the goals and objectives set by urban areas for integrating consideration of urban goods movement into the planning process and improving freight mobility and access within the urban area. Following is a list of potential activities and actions that may be an initial step to defining and measuring quantifiable improvements to the system.

- The terms or concepts "freight" or "goods movement" are included in city/agency goals or policies.
- Members of planning commission or city's advisory committee include shipper, motor carrier, or modal (rail, water, or airport) representative.
- Analysis of freight or urban goods movement is included in work conducted by planning and zoning staff, building codes department, and transportation department staff.
- City scan conducted to identify urban goods movement conflict locations—docking, parking, turning radii, height restrictions, weight restrictions (success can be measured by determining how many locations are corrected).
- Interviews or surveys are conducted with local businesses and industries to discuss goods movement problems and issues (success can be measured by determining how many problems are addressed).
- Truck routing study is conducted, truck routes identified, and adequate signage verified (success can be measured by development of a citywide truck routing plan that is compatible with surrounding regions).

- Working with MPO and neighboring jurisdictions is maintained to discuss shared urban goods movement problems, issues, and solutions.
- Working with owners and operators of warehouses and distribution centers, as well as intermodal facilities is performed to study "last mile" issues (success can be measured by determining how many locations are improved).
- Review and evaluation of design and zoning codes performed to assess if they are "freight friendly."
- Development of an urban goods movement action plan is performed.
- In evaluating projects for funding, freight or urban goods movements are a prioritization factor.
- Number of freight education sessions are conducted for the public, local decisionmakers, and officials
- Changes and improvements are made to improve freight mobility and access based on research.
- Changes to congestion, double parking, and freight-related complaints are visible.

CHAPTER 7

Case Studies

Atlanta: Effectively Managing Truck Traffic in the Urban Environment

Background

Principal Findings

When developing a strategic truck route master plan, it is important to change the mind-set from one of prohibiting commercial vehicles from certain neighborhoods to effectively and efficiently accommodating trucks in the urban environment. This is done through dialogue with stakeholders and identifying all possible routes exhibiting truck friendly characteristics that may be enhanced by investment, over

Originally named Terminus, Atlanta was the terminating point for several major railroads serving the South in the early and mid-1800s. As highway systems developed, Atlanta continued to be a hub of transportation activity. Today, Atlanta is the principal logistics hub for the southeastern United States. Current projections suggest that, without enhancement strategies, the region will be a victim of its own success. Traffic volumes will continue to outpace the ability to add capacity, with truck volumes leading the trend, resulting in ever-increasing delays and gridlock. Stakeholder interviews already indicate that congestion could be a significant hindrance to further economic expansion in the region. Other less congested cities such as Charlotte, North Carolina, and Memphis, Tennessee, stand ready to compete for future transportation and warehousing jobs.

Like most urban areas in the United States, many different jurisdictions have planning and management responsibility for elements of the Atlanta metropolitan area transportation network. These include the Georgia Department of Transportation (GDOT), Atlanta Regional Commission (ARC), and local jurisdictions including counties and municipalities. The ARC is the designated metropolitan planning organization (MPO) for the 18-county Atlanta region.

Many local jurisdictions in the Atlanta region have no designated truck routes on their secondary road networks. An inventory of truck management policies conducted as part of the Strategic Truck Route Plan found that some counties only maintain lists of "No Trucks Allowed" routes; others maintain signage on roadways that were designated as truck routes over 50 years ago, and others have not identified any form of truck routes at all.

With three major Interstate highways intersecting in the heart of Atlanta, as well as a perimeter ring-route Interstate, the radial design of Atlanta's Interstate highways has been relied upon to funnel most of the truck traffic crossing the region. Numerous capacity enhancements have added lanes, but traffic volumes continue to exceed capacity, and non-recurring events from weather or collisions can idle the network for hours.

With regional responsibility, the MPO embarked on a process to prepare a truck access plan for regionally oriented truck movement. This system had the following two goals:

- To alleviate the Interstate network of truck traffic that was regionally oriented, allowing the capacity to first be applied to truck movements through the region, and
- To offer multiple routes in each primary direction, using existing roadways, and to develop/implement a methodology acceptable to the public sector, private sector, and community for local implementation.

The Story

time, to satisfy both the needs of the freight community and the communities in which trucks operate.

On a hot July morning, John and Bob eased their vehicles into the stop-and-go procession of metal and humanity known as morning rush hour in Atlanta, Georgia. Bob, a commercial truck driver, had spent the previous night in the sleeper of his truck-tractor parked in the Flying J truck stop in Jackson, just south of Metro Atlanta. On his way from Orlando, Florida, to Lexington, Kentucky, with a load of produce scheduled for delivery at 6:00 A.M. the next morning, Bob hoped to reach Lexington before his hours of service (HOS) driving limit ran out. Bob pulled out of the truck stop at 7:30 A.M. and was back on the road again. John, also a commercial truck driver, had already commuted into work and was now beginning his day as a professional driver. This day would find him traveling a "milk run" delivering and picking up at various locations around the area, crisscrossing most of the 18 counties forming metropolitan Atlanta. John's customers have come to trust his dependability and cheery nature. At 7:45 A.M. John departed his base terminal located just south of the I-285 loop and proceeded down the entrance ramp to the freeway.

As is often the case in the South, hot, humid conditions can generate fast-moving storms that inundate an area for several minutes then move on or die out. This morning, one such storm popped up just as the rush hour in North Metro Atlanta peaked. Slippery conditions and poor visibility caused two cars to simultaneously slide into the median at the junction of I-75 and I-85. The incident immediately triggered four more vehicles to crash, including a tanker truck loaded with gasoline, effectively closing the northbound lanes of I-75 for the next 4 hours.

Thinking he had left late enough to miss the height of rush hour, Bob was now downstream from the pileup. A novice to driving the Atlanta region, Bob hoped I-75 would clear quickly, but 2 hours later he had progressed little and checked his road map for an alternate truck route. Uncertain of the local street restrictions, he felt forced to remain on I-75. As noon approached, traffic began moving, but having been "on-duty" behind the wheel for more than 4 hours, he would at best make Knoxville before HOS regulations required him to stop for a 10-hour rest period. After calling his customer, his delivery appointment was rescheduled to 6:00 A.M.—the day after next! Like dominoes, his remaining appointments for the week were rescheduled and ultimately he lost two loads reassigned to competing drivers. Under his breath, Bob murmured, "one lousy wreck that I'm not even involved in, and I lose a grand this week."

John, an old-hand at maneuvering around Atlanta's traffic jams, got caught in the snarled traffic, but soon advanced enough to take Exit 241, Cleveland Avenue. Using the alternative route and skirting a neighborhood where trucks were not allowed, he could still make his first appointment at Owens-Illinois. After reaching the exit, John turned first on Forrest Hills Drive, then Grand Avenue. Owens-Illinois soon came into view, the plant would still get the materials needed to maintain their just-in-time supply chain, and the manufacturing line would not be idled this morning.

Lessons and Outcomes

Modal selection for moving goods in urban areas is characterized by a strong dependence on trucks either as a sole-source service or as part of a multimodal solution. In 2002, the United States estimated that 60 percent of all goods by weight moved by truck (70 percent by value). Forecasts suggest the share of goods moving by truck will continue to grow, because trucking is the only modal business model that provides door-to-door service between the shipper and consumer. In Georgia, 86 percent of total freight volumes move by truck.

Truck traffic in Atlanta typically constitutes between 10 percent and 15 percent of Interstate traffic volumes. As freight volumes grow, having a well-defined strategy for providing future highway capacity for truck traffic becomes crucial to Atlanta's economic competitiveness, especially in the face of fiscal realities suggesting that infrastructure enhancements will be only marginal.

Designing and enhancing an alternative route network to the radial Interstate highway network was identified in the Regional Freight Mobility Plan as a potential strategy. Alternately, new construction of yet another bypass ring-route to alleviate truck volumes on existing Interstates in the metro region is another proposed solution. Each of these solutions provides resolution, but additional bypass capacity carries with it the possibility of unintended consequences for additional growth in the form of sprawl.

The development of a Strategic Truck Route Master Plan encompassed the identification of existing non-Interstate roadways that most suitably fulfill the need for access. Selected truck routes should exhibit truck friendly characteristics that may be enhanced by investment, over time, to satisfy both the needs of the freight community and the communities in which they operate. The adoption of such a system is one of

- Lesser investment needs that provide an efficiency-oriented solution instead of one of construction;
- Economy-of-scale expansion of the system in which the methodology exhibits a vision of future designation; and
- Complementary to integrated land-use designation practices that are planned to successfully adapt to land-use planning, existing and new development, and adaptation of previous land-use designations to new, more freight- or non-freight-centric uses.

In July 2010, the Atlanta Regional Commission (ARC Board), which is comprised of representatives of all local jurisdictions, adopted the Atlanta Strategic Truck Route Master Plan (ASTRoMaP). The successful adoption of ASTRoMaP has been attributed to the extensive interaction with all parties involved in creating the network. Throughout the process, local jurisdictions were well informed about the purpose and progress, and repeatedly throughout the process, allowed to question the designation of routes during the process as opposed to raising questions only at the point of adoption. Concerns were answered or adaptations made as the study was being conducted. ASTRoMaP represents a truly regional approach that avoided addressing access issues for individual jurisdictions. The network can be viewed as a benefit to all local communities in the Greater Atlanta region.

Many urban areas in the United States have designated truck routes primarily as prohibitions against commercial vehicles (i.e., truck routes more often than not are simply a means of keeping trucks out of residential neighborhoods). The approach adopted by Atlanta was undertaken as a means of effectively and efficiently accommodating trucks in the urban environment. This attitude contributed greatly to the success of the project and the overall strategy. The entities involved in the process expressed a significant desire to initiate a network that encompassed not only regional but local access issues. To prevent the distraction of an individual local road generating a specific need and counterpoint discussion, interviewees understood the MPO's approach to develop a "backbone" system. In subsequent discussions, post adoption, local county jurisdictions are reviewing funding mechanisms to pursue similar strategies to develop more localized networks to complement and support the regional network.

References and Sources

Arey, Norman, "Greater Atlanta Metropolitan Area Now Includes Alabama County," *Atlanta Journal-Constitution,* Knight Ridder/Tribune Business News, August 25, 2003.

Atlanta Regional Commission, *Cities and Towns 2009 Yearbook of Growth and Change,* 2010.

Atlanta Metropolitan Area, as defined by the U.S. Census.

U.S. Department of Transportation, Federal Highway Administration, *Freight Facts and Figures,* 2005.

Baltimore: The Maritime Industrial Zone Overlay District (MIZOD)

Background

Baltimore, Maryland, is the farthest inland deepwater port city on the U.S. East Coast. The city, founded in 1729, is now approximately 80 square miles and has grown to a population over 630,000 within an urban area population of approximately 2.7 million (U.S. Census 2010).

The waterfront has always been viewed as one of the city's most valuable assets. During the real estate boom of the late 1990s and early 2000s, the city converted numerous waterfront industrial properties to mixed-use development with significant high-end residential housing. These conversions occurred mainly through City Council and mayor-approved planned unit developments (PUDs) for sites in the existing industrial zone. In 2004, the city enacted a Maritime Industrial Zoning Overlay District (MIZOD) to protect its maritime industries by identifying waterfront areas with deepwater drafts of 18 feet or more and reserving them for industrial use. The Baltimore Department of Planning (DOP) annually evaluates the MIZOD's effectiveness in retaining the maritime industry. Based on its success in bringing jobs to the city, the MIZOD has been extended to 2024 and is being considered for permanent rezoning.

Principal Findings

Creating protected industrial zones in urban centers where there are restrictions placed by the planning authority on residential, retail, and leisure developments can safeguard commercial centers and attract new business. This policy is particularly applicable to port sites where waterfront land, which is vital for vessel management, could be lost to residential development, altering the land use of the area forever.

The Story

Baltimore Development Corporation (BDC) is the City of Baltimore's economic development agency. BDC conducts annual outreach meetings with businesses throughout Baltimore City. During the real estate boom in the early 2000s, many of the maritime and industrial businesses began raising concerns about real estate developers buying industrial waterfront parcels and having them rezoned as PUDs (see Exhibit 7-1). Developers began building high-end residential housing, "hop-scotching" over industrial parcels and quickly moving to take over the waterfront. As real estate developers urged "highest and best use" zoning, elected officials made decisions to rezone land as PUDs without vetting through the city's Planning Department. The limited and valuable waterfront land needed for port-based industrial development was disappearing.

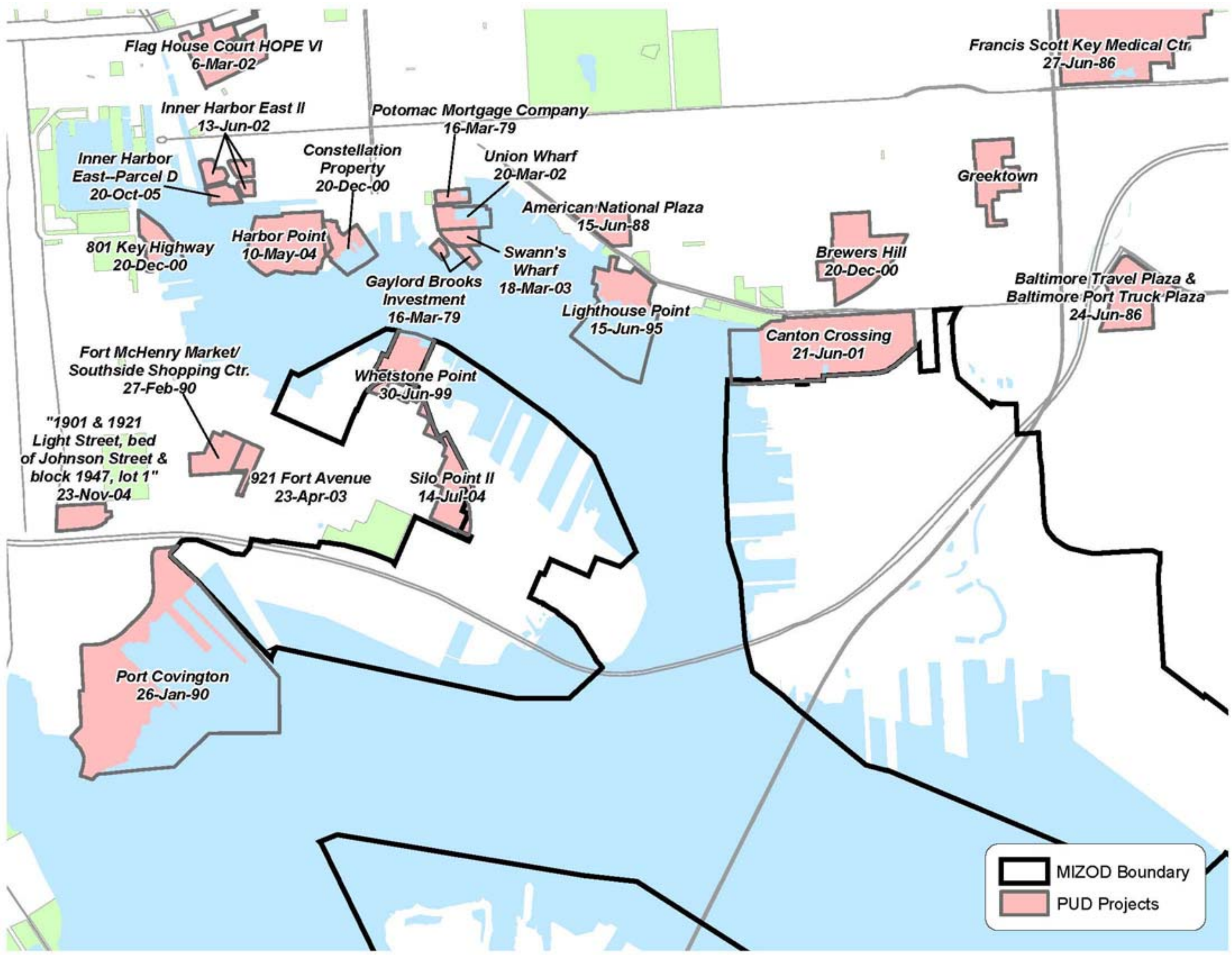
The port/maritime industries, once a powerful lobby, seemed to have lost their voice. Although the State of Maryland assumed administration of some Baltimore cargo terminals in 1972, the Maryland Port Administration and the City of Baltimore had communicated only infrequently about issues of land use and zoning since then.

When the city finally introduced legislation to address zoning practices, residents in new PUDs were also voicing concerns about the noise, truck traffic, and dirt generated by the industrial uses. Many new residents said developers led them to believe that industrial uses would be gone in 2 to 3 years.

When businesses and residents became more vocal, the BDC and DOP teamed up to preserve maritime industries in Baltimore. A 2002 BDC report stated that private-sector investments in port facilities were in danger of being deferred over uncertainty about city zoning policies. In addition, the study suggested that when a deepwater site was rezoned for mixed-use development, it was very unlikely to revert to maritime use. The report recommended zoning as one method available for protecting deepwater access for maritime shipping and related activities.

In 2004, in response to study findings, the City of Baltimore adopted a Maritime Industrial Zoning Overlay District (MIZOD) land parcel designation. The new zoning designation overlaid the heavy industrial (M-3) zone and protects waterfront land with a draft greater than 18 feet that is already industrial and has good highway or rail access. The city limited the MIZOD to a 10-year life; however, shortly after MIZOD establishment, the industrial community successfully lobbied to have its life extended to 2024.

Exhibit 7-1. Boundaries and dates of adoption of PUDs around the MIZOD.



Source: City of Baltimore Department of Planning, MIZOD Summary and Evaluation 2009-2010.

The MIZOD preserves the areas within the district for maritime industrial use by

- Disallowing PUDs, which are currently the principal method of converting industrial zoning to mixed-use;
- Prohibiting hotels, motels, taverns, and all other uses not permitted in an M-3 district;
- Allowing offices and restaurants as accessory uses only; and
- Maintaining the underlying heavy industrial (M-3) zoning.

The 2004 MIZOD legislation required the DOP to produce an annual report to track its effectiveness in retaining maritime industries. The annual report has shown that about 16,700 direct jobs can be connected to the port. Since 2007, approximately 100 new firms have located to the MIZOD area that now boasts over 160 businesses. Because of the global recession in 2009, there were 1,713 vessel calls, down from a 2005 high of 2,119.

Lessons and Conclusion

Although annual totals vary from year to year, the annual average investment in the MIZOD since 2000 is $26.3 million. Currently, the city is rewriting its 30-year-old zoning code and considering permanently codifying the MIZOD to a maritime industrial zone. This process has also elevated truck routing issues to more prominence. For example, while Baltimore has had a "non-truck" route map, it had no truck route map. In response to the raising of this issue during the MIZOD discussions, the Baltimore Department of Transportation is developing an official truck route map.

According to the BDC and the Maryland Port Administration, recognizing the problem and the development of the MIZOD required an education process. The state, the Maryland Port Administration, and the area's maritime industry needed to take the lead and explain to local elected officials and the public the port's importance in terms of jobs and the economy and the significance of their waterfront location. Their message explained that a "critical mass" of port-related industries is necessary to maintain ongoing port operations.

The city's creation of the MIZOD was a first step in protecting the port operation. While Baltimore's origins and history are directly tied to the waterfront, it is important to understand that once a working port is gone, it is likely gone forever. Luxury condos provide taxes, but they are not a job engine like a working port. Planning officials do not believe the Baltimore story is yet over; the MIZOD is working now, but the city is constantly evolving. As the economy and tastes in housing change, populations and housing patterns will shift and new problems and issues will arise. Protecting the land around the port and the health of port industries is critical to the region's economy. How MIZOD use may evolve also will need continual monitoring to ensure that the zoning designation continues to achieve its objectives.

References and Sources

Maritime Industrial Zoning Overlay District Annual Report, Summary and Evaluation 2009–2010, City of Baltimore, Department of Planning.

Interviews with

- Deputy Director for Planning, Maryland Port Administration, State of Maryland,
- Managing Director of Industrial Development, Baltimore Development Corp.,
- Division Chief for Research and Strategic Planning, Department of Planning, and
- Economic Development Planner, Department of Planning.

Toronto: Harmonizing of Loading Area Regulation across a Mega-City

Background

With a population of over 2.5 million, Toronto is Canada's largest city and the heart of one of North America's largest metropolitan areas. The city's official plans, bylaws, and zoning regulations seek to focus growth in geographic areas where it is best accommodated. As a result, Toronto's designated activity centers contain a significant amount of high-density, mixed-use development, including both business and residential uses. As Toronto's downtown and centers have become more densely occupied, goods movement activities become mired in traffic congestion, parking shortages, and inadequate loading/unloading facilities. Consequently, the efficiency and cost-effectiveness of goods movement in the city may be compromised, with direct effects on both shippers and receivers. Partially to address these incompatibilities, the City of Toronto has undertaken efforts in recent years to manage and accommodate goods movement and delivery needs in the most densely developed parts of the city.

In 1998, the Province of Ontario passed legislation "amalgamating" seven municipalities—the regional government of metropolitan Toronto and six local area municipalities.

Principal Findings

Unifying loading, unloading, and waiting restrictions within contiguous jurisdictions in a metropolitan area can make urban delivery more efficient, harmonize enforcement strategies, and improve understanding between logistics providers, their clients, and local authorities. In addition, freight and service vehicles can be catered for in simple ways such as minimum waiting periods for freight vehicles displaying a windshield "service provider" ID card, standardizing loading spaces, and allowing hand delivery of parcels using metro and underground services.

In 2006, amalgamated Toronto had a population of 2,503,281. The Greater Toronto area has a total population of 5,555,912 with an average density of over 3,900 persons per square kilometer. In 2009, the city employed 1.3 million people. The office sector is the city's largest employer with 607,800 jobs. The institutional sector, with 216,000 employees, is the second largest sector.

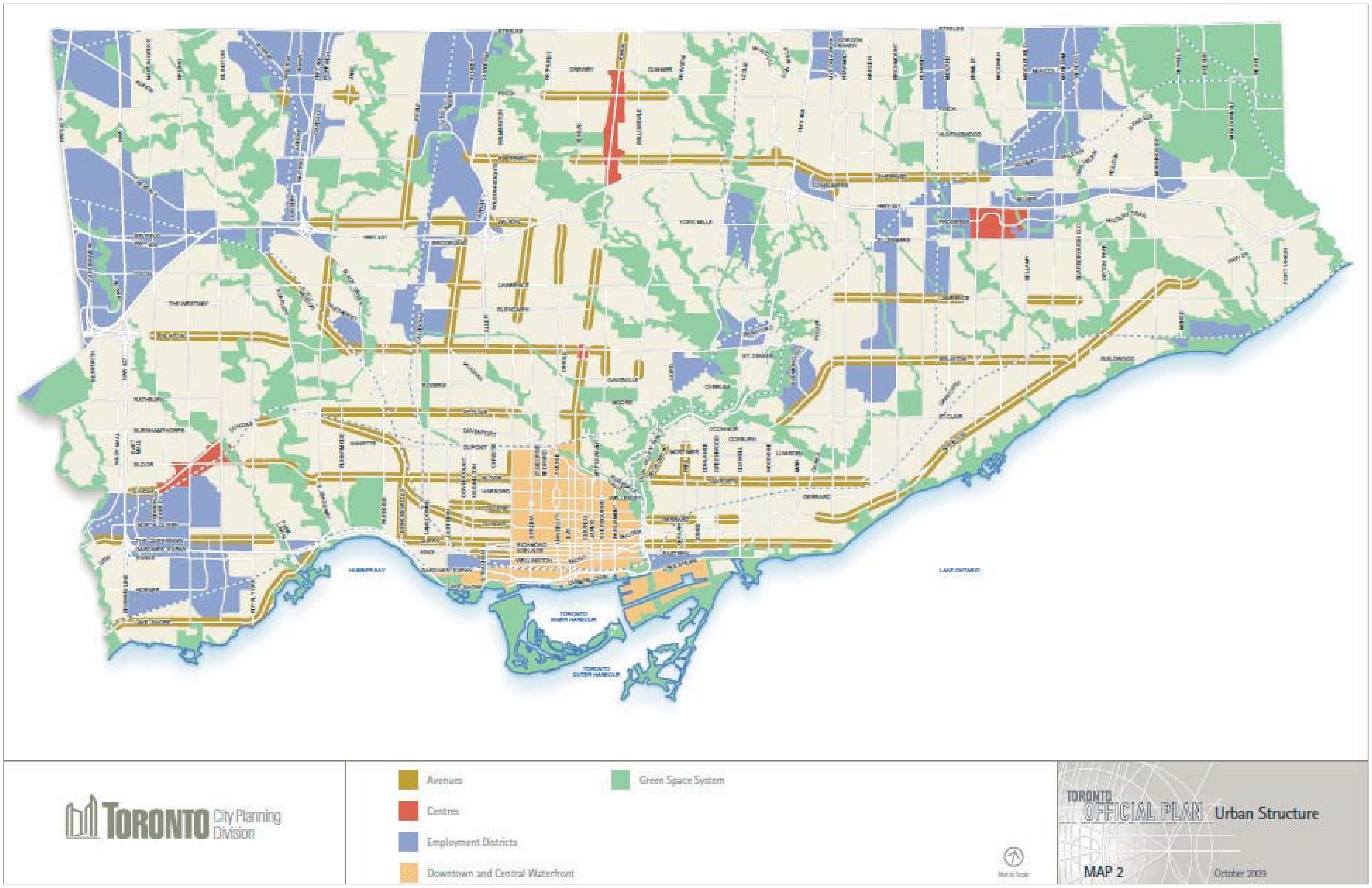
Toronto has a well-established history of encouraging and pursuing high-density, mixed-use development in the central city and appropriate growth zones across the city. The city's Official Plan directs growth to a number of key areas of the city that can accommodate the magnitude of growth expected while also protecting and preserving the fabric of existing residential neighborhoods and the valuable green space system. As shown in Exhibits 7-2 and 7-3, these areas are the downtown and central waterfront, the centres, the avenues, the employment districts, and certain Secondary Plan areas.

Toronto's downtown core has long been the focal point of issues related to goods movement and local delivery operations. As building development and the associated traffic levels grow, competition for curbside access becomes more intense. Until recently, cab stands have been the only legal curbside activity in downtown's central core—anchored by office towers of the financial district. Delivery needs associated with new storefronts often occupying ground level (e.g., Starbucks) increase the pressure to formally allow use of curbside parking delivery vehicles in no-parking zones. Data from Toronto found that the average courier stop time in the downtown zone was about 7 minutes.

Exhibit 7-2. Amalgamated municipal components—city of Toronto.

Source: City of Toronto Official Plan, October 2009.

Exhibit 7-3. City of Toronto Official Plan urban structure, 2009.



Source: City of Toronto Official Plan, October 2009.

The Story

To achieve the vision of Toronto's Official Plan, the city must accommodate and facilitate efficient goods movement, including curbside access to loading/unloading areas in the central city. In the dense, mixed-use urban environment envisioned by the Official Plan, inadequate planning for loading zones undermines cost-effective logistics, safety, passenger and freight mobility, and general quality of life.

Toronto is pursuing initiatives to both facilitate more efficient delivery and support alternative logistics methods for delivery operations in the central city area. These initiatives include citywide harmonization of loading zone requirements and policies, new and expanded loading zone signage, a courier windshield permit system, and use of an underground walkway network by couriers and delivery services.

Shortly after amalgamation of Toronto was complete, the city recognized the need to thoroughly review and consider major revisions to rezoning, parking and loading policies, and regulations. In 2002, Toronto City Planning staff began laying out a course for a comprehensive effort to unify zoning, parking, and loading bylaws. The goal was to make city codes more uniform, understandable, and enforceable across the entire city and more in line with current and future plans for development projects and patterns.

The harmonization process took nearly 8 years and included an extensive effort that encompassed multiple studies and reviews, as well as ongoing outreach to citizens and stakeholders across the city. The process culminated in August 2010 with Toronto City Council approval of a new citywide zoning bylaw. With the adoption of standard loading/unloading space standards across the amalgamated City of Toronto, all concerned parties have a common set of rules by which to play. City officials believe that while the bylaw may not significantly affect existing development and buildings, it will facilitate much more efficient and safe delivery and goods movement in new structures in the downtown area. For example, new construction in the Maple Leaf Square area has been required to have all loading areas built underground and to be interconnected.

During 2011, Toronto plans to install signs in some no-parking zones of the downtown (see Exhibit 7-4) to delineate specific curbside package delivery space to accommodate two or three vehicles at a time at each location. The city is beginning this effort by signing the zones that records compiled by the courier industry show as being the 10 most frequently ticketed locations in the downtown. The City Traffic Operations Division will monitor the use of these signed spaces, evaluate their impact/effectiveness, and possibly expand the delivery space concept across the entire downtown in 2012.

Windshield Permits for Downtown Messenger Vehicles

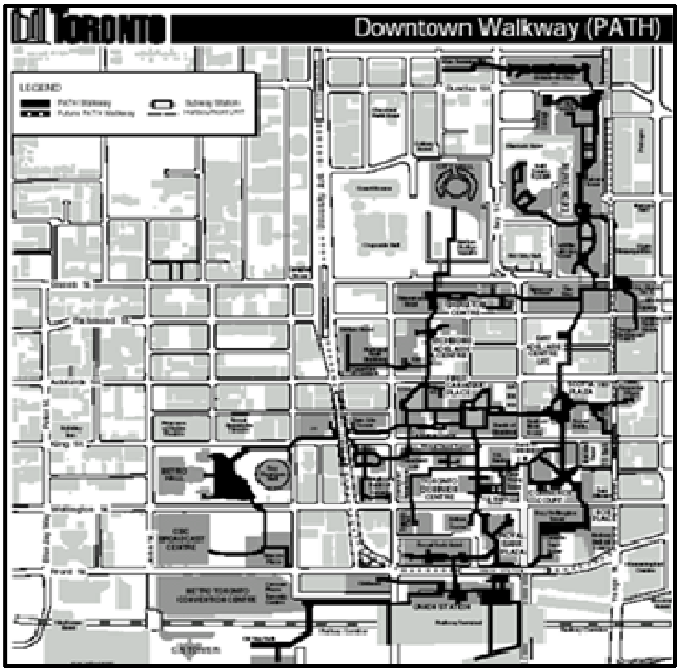
Many messenger services in Toronto employ vehicles (typically automobiles) that park briefly in curbside no-parking areas adjacent to office towers because of the time-sensitivity of their business. Often, these vehicles have no identifying information to indicate their commercial purposes to a parking enforcement officer. To accommodate the messenger service demand and manage the number of vehicles vying for curbside parking in dense downtown areas, the City of Toronto is facilitating creation of a messenger identification card system. The courier industry is designing and issuing numbered windshield identification cards that will be recognized by Toronto Police Parking Enforcement. The Traffic Operations Unit will request parking enforcement officers to provide reasonable consideration to the parked vehicle (10 to 15 minutes) to allow the driver to complete his/her delivery before issuing a parking ticket.

Courier Use of Toronto PATH (Downtown Walkway) System

PATH is downtown Toronto's underground walkway system, linking 28 kilometers of shopping, services, and entertainment. The system facilitates pedestrian linkages to public transit, accommo-

Exhibit 7-4. Delivery vehicle in downtown no-parking zone.

Exhibit 7-5. Map of Toronto's downtown walkway system (PATH).



Source: "City of Toronto PATH—Toronto's Downtown Walkway," http://www.toronto.ca/path/

dating more than 100,000 daily commuters and thousands of additional tourists and residents on route to sports and cultural events. As shown in Exhibit 7-5, more than 50 buildings/office towers are connected through PATH. Twenty parking garages, five subway stations, two major department stores, six major hotels, and a railway terminal also are accessible through PATH.

The first underground path in Toronto originated in 1900 and by 1917 there were five tunnels in the downtown core. With the opening of Union Station in 1927, an underground tunnel was built to connect it to the Royal York Hotel (now the Fairmont Royal York). The PATH began to grow in earnest in the 1970s and in 1987 Toronto's City Council adopted the recommendation that the city become the co-coordinating agency of PATH and pay for the systemwide costs of designing a signage program. Each segment of the walkway system is owned and controlled by the owner of the property through which it runs, with about 35 corporations involved.

The City of Toronto is developing a PATH Master Plan to guide the future development of the underground pedestrian network and improve its current operational design. Currently, the PATH system is a network of approximately 28 kilometers of combined underground and above-ground walkways that provides direct access to close to 4 million gross square feet of retail space. There are plans to connect the PATH to seven proposed residential buildings over the next 5 years, and the city is constructing a new link that will extend 300 meters northward from Union Station under Wellington Street at a cost of $60 million.

PATH also provides an important means for timely and cost-effective deliveries in a major part of downtown Toronto. For example, Purolator Courier, Canada's largest courier service provider, maintains five package distribution rooms within the PATH system, from which about 35 foot couriers operate to and from buildings across downtown. One of the most important benefits for Purolator of using the PATH system is that it can maintain its courier services even when mobility on the surface streets is disrupted.

By moving to use of foot couriers in the underground walkway, Purolator both avoids having to deal with surface street congestion and helps to mitigate overall traffic congestion in the downtown. Purolator officials estimate that the firm's use of the PATH system has allowed it to remove 36 delivery vehicles (on average) from surface streets each day. Purolator anticipates that its courier operations in the PATH system would expand along with expansion of the system itself.

At this time, at least one other courier, UPS, is also using the PATH system, but with only one package distribution room and in a much more limited manner than Purolator.

Lessons and Conclusion

As Toronto continues to grow and attract mixed-use, high-density development to the city's downtown, it has recognized the importance of making appropriate provisions for efficient and safe movement of goods and deliveries that support the city's economy. Although problems with traffic congestion, competition for curbside delivery spaces, and illegal parking remain, the City of Toronto has begun to take significant, measured steps toward workable solutions to these problems. In addition, the city is contemplating at least two longer-term strategies for making delivery activities in the downtown area more efficient: (1) an annual permitting fee that would allow exemptions to certain no-parking restrictions for those willing to purchase such permits; and/or (2) an in-vehicle metering system that would allow entry to, and delivery stops within, certain downtown zones for limited periods each day. Through this coordinated set of strategies, Toronto is helping optimize mobility for downtown activities and facilitating a sustainable, vital city for the long term.

Principal Findings

Overweight trucks can be significant contributors to pavement and bridge repair costs. In the District of Columbia, these costs were estimated to be as much as $16 million per year. The implementation of innovative enforcement technologies (e.g., weigh-in-motion scales) can have significant impacts in reducing these costs.

References and Sources

"City of Toronto Official Plan," available online at http://www.toronto.ca/planning/official_plan/introduction.htm
"City of Toronto PATH—Toronto's Downtown Walkway," available online at http://www.toronto.ca/path/
"City of Toronto Zoning Bylaw Project—About the Project," available online at http://www.toronto.ca/zoning/about.htm
Haider, M. et al., *Challenges Facing Express Delivery Services in Canada's Urban Centres,* Ryerson University: Institute of Housing and Mobility, 2009.
Interviews with officials of City of Toronto Planning and Traffic Departments, November/December 2010.
Interviews with officials of Purolator Courier (Canada), December 2010.
MMM Group, Ltd., *City of Toronto Loading Standards Review,* prepared for the City of Toronto, May 2009.
Metrolinx, *Greater Toronto-Hamilton Area (GTHA) Urban Freight Study Stakeholder Workshop—Workshop Summary Report,* March 2010.

Washington, D.C.: Commercial Vehicle Regulation

Background

The U.S. Constitution established the District of Columbia (D.C. or "the District") in 1789 when this land area was set aside for the nation's capitol. D.C.'s population peaked in 1950 with just over 800,000 residents. As of 2010, estimates place the D.C. population at 601,723. In 2007, the Washington-Arlington-Alexandria, D.C.-VA-MD-WV Metropolitan Statistical Area (MSA) ranked second nationally in congestion, with an average of 62 hours of traffic delays per traveler per year. Trucks make up approximately 5 percent of total average daily traffic in the District, but on some routes, trucks constitute 12 percent to 15 percent of total traffic.

In 2004, the Planning and Policy Analysis Division of the John A. Volpe National Transportation Systems Center completed a study for D.C. officials entitled *District of Columbia Motor Carrier Management and Threat Assessment Study* (Volpe National Transportation Research Center

2003). The District sponsored the study to address concerns about truck traffic, commercial vehicle parking, and security concerns in the wake of 2001 terrorist attacks against the United States. In response to the study's recommendations, the District DOT (DDOT) created a Motor Carrier Planning Division.

The Story

Following one of the recommendations in the Threat Assessment Study, DDOT formed the Motor Carrier Division to address mobility, safety, security, and environmental concerns related to freight and bus transportation. In 2008, Eulois Cleckley joined the DDOT staff as manager of the newly formed Motor Carrier Division. Since most commerce in the District originates from freight generators in surrounding Maryland and Virginia, mobility and efficiency were paramount concerns that could be addressed by developing a truck route network. There are no officially designated truck routes in D.C., but a number of de facto truck routes had been identified that drivers preferred because of roadway geometry, traffic conditions, and location relative to trip origins and destinations. The formal designation of truck routes in the District would address many longstanding concerns such as noise and vibration complaints from residents, security concerns around high-risk facilities, congestion, and the need for better information and services for truck operators and their customers. The *District of Columbia Motor Carrier Management and Threat Assessment Study* recommended several truck routes and restricted truck zones.

Cleckley understood that to move forward with designating a District truck route network, he had to improve communications with the trucking industry and D.C. neighborhoods. At the same time, there was a need to develop better baseline information about the level of illegal trucking operations, such as overweight vehicles. DDOT began the truck route effort by conducting a best practice review of other major urban areas that had implemented truck routes.

Ultimately, the design and planning of the District's truck and bus route system employed a primarily original approach that included engineering and planning considerations, neighborhood contextual analysis, commercial considerations, public feedback, and practicality. The District designed the process to be as holistic as possible, with significant attention paid to balancing various engineering and planning elements with stakeholder interests.

The first step to balance various interests was to receive feedback about the proposed truck routes from the ward, city, and regional planners in the District. Meetings were held with each planner to explain the background, purpose, and goals of the project. Next, meetings were held with private truck and bus firms to explore opportunities for improving operational efficiency for industry and improving the clarity of truck and bus regulations for industry groups. Initially proposed bus and truck routes also were distributed to all advisory neighborhood commissions (ANCs) for their review. Meetings were arranged with responding ANC commissioners to discuss the proposed routes, answer questions, and receive advice on specific neighborhood elements to consider.

Despite the extensive outreach program, DDOT still faced many challenges to implementing the truck and bus route system. Beyond the obvious challenge of getting both public and private sectors to agree with a particular route, there was also the issue of whether selected routes were in a condition to handle the wear and tear of being designated a commercial route. Following the design process, the Motor Carrier Division developed maps detailing the truck and bus route system. Several internal use maps detailed all truck and bus restrictions and categorized routes by type (i.e., National Network versus Charter Bus Only). An additional map was developed for public distribution showing primary routes, charter bus only routes, restricted areas, and loading zones. In addition to the maps, the project developed official rules to be incorporated into the D.C. government Code of Municipal Regulations.

Lessons and Conclusion

Cleckley believed that once a truck route network was in place, enforcing truck size and weight laws would be a key factor in preserving the infrastructure and improving truck safety. Each year, DDOT spent roughly $20 million on pavement rehabilitation and preservation, and it was suspected that a significant amount of pavement and bridge wear resulted from damage caused by overweight trucks. DDOT officials understood that increasing maintenance costs while facing diminishing highway funds would require effective steps for preserving some roadways rapidly approaching critical condition.

To address the enforcement issues, DDOT developed a project scope to analyze and quantify the effects of overweight trucks and their associated costs on the District roadway network, and developed an enforcement strategy to mitigate future damage resulting from illegal truck operations. The District hired a consultant to assist in carrying out the analysis with the ultimate goal of developing a citywide truck safety enforcement plan.

The analysis undertaken for the study estimated total infrastructure costs, both pavement and bridges, attributable to overweight trucks at approximately $16 million per year. The study also laid out a comprehensive plan for upgrading enforcement technologies, such as the addition of several weigh-in-motion (WIM) scales to detect overweight trucks, and an increased amount of enforcement personnel.

After making great progress in less than 2 years, the election cycle and a new administration granted D.C transportation officials time to reflect on next steps for implementing and maintaining a quality truck route system, steps that would require resources and increased interagency cooperation. At a peer-to-peer exchange with NYDOT in 2010, D.C. officials witnessed how cooperation across offices and departments could, to an extent, overcome resource hurdles. So the next challenge was to improve communication and cooperation among offices and jurisdictions responsible for truck licensing, data collection, and traffic enforcement in the District.

References and Sources

D.C. DOT Freight and Commercial Vehicle Operations website: http://www.godcgo.com/home/get-me-there/getting-around/freight-management.aspx

District-wide Truck Safety Enforcement Study, online fact sheet available online at http://www.godcgo.com/Portals/0/Freight_PDF/District-wide%20Truck%20Safety%20Enforcement%20Study.pdf

Presentation to DVRPC Freight Committee: *Innovative Approaches to Enhancing Goods Movement* available online at http://www.dvrpc.org/Freight/pdf/2010-07_Cleckley.pdf

U.S. Census Bureau, 2010 Census Bureau: Population Density, available online at http://2010.census.gov/2010census/data/

Texas Transportation Institute, 2009 Annual Urban Mobility Report, Summary Table 1, available online at http://mobility.tamu.edu/ums/congestion_data/tables/national/table_1.pdf

Nashville: Vanderbilt Medical Center—Freight Consolidation

Background

Nashville, Tennessee, is a medium-sized U.S. urban area of 2.1 million residents. The metropolitan population has more than doubled in the past 2 decades; its growth has accelerated from almost a 3 percent compound annual rate in the first 10 years, to more than 5 percent in the next 10 years. Situated on the Cumberland River, Nashville is the state capital and stands at the intersection of three Interstate highways: I-40, I-65, and I-24. This crossroads location, coupled with the pressures of growth, has brought important transportation challenges to the area.

Vanderbilt University is Nashville's largest private employer, generating economic activity of $6.5 billion annually. The university's renowned medical center, which includes medical and nursing schools as well as an extensive network of hospitals, clinics, and research facilities, produces the greatest part of Vanderbilt-related employment and economic impact. Since healthcare is the metropolitan area's leading industry, Vanderbilt Medical Center (VMC) is at the apex of the urban economy.

Like the region it serves, VMC has experienced tremendous growth. Spending more than $100 million each year on major construction and renovation projects, its physical footprint expanded over 80 percent during the past decade. This investment supports a system that handles 50,000 admissions, 100,000 emergency room visits, and more than 1 million ambulatory visits each year.

Principal Findings

Freight consolidation centers (FCC) can have major benefits in terms of reducing the numbers of vehicles entering urban areas. Of key importance to their establishment is a detailed understanding of the current methods of supply by businesses in the district and the mechanisms by which the FCC could operate (100 percent privately funded, a mixture of private/public partnership, compulsory buy-in for access to specific areas, and/or voluntary buy-in).

The Story

VMC's supply requirements are tremendous, ranging from large quantities of everyday materials like bed linens and food, to sophisticated medical instruments and sensitive products like blood plasma, stents, and pharmaceuticals. The breadth of individual items and the number of individual suppliers—distributing from a range of points that are local to global—could easily give rise to a barrage of separate shipments arriving daily. Add to this the urgency with which many goods are required, and the diversity of care and caregivers they supply, and two consequences can follow:

1. Hospital space and hospital budgets stuffed with inventory, or
2. Hospital delivery docks constantly under siege from an endless line of delivery trucks.

The VMC in this sense is a microcosm of the city; it has a large, insistent population wanting many things as soon as possible, all uncoordinated as to needs and timing. Freight carriers serving VMC will, as a matter of efficiency, combine shipments into single deliveries when possible, but since each carrier has only limited control over their link of the supply chain, several carriers often serve any given receiver of goods.

In the early 1990s, VMC recognized the situation for the well-intentioned chaos it promised, and anticipating coming growth, inaugurated a consolidated supply system with the aid of third-party logistics providers (3PLs). Prior to consolidation, VMC was devoting an ever-expanding portion of facility space to a centralized stock room and keeping inventory on care wards as well. Inventory stocking practices piled building and inventory carrying expenses on top of healthcare costs, and this situation was made worse by the high costs of transporting small, expedited shipments.

After seeking input from 3PLs, two basic changes followed. First, wards would be resupplied daily and directly with whatever they needed, but inventory would be kept off-site in distribution centers (DCs) that received goods from many suppliers and served many hospitals. Supplies would be guaranteed and emergency requirements accommodated, but mainly this would be done from a warehouse about an hour away. Second, the 3PLs would consolidate and deliver all of the supplies from all of the vendors. This meant that a single delivery truck would handle a full set of shipments, and although several might arrive in the course of a day, the number of trucks arriving (and the miles they traveled) would be drastically reduced. By serving multiple hospitals, the 3PLs were able to consolidate truck arrivals inbound to the distribution centers as well.

Today, the VMC logistics system has evolved into five supply chains, treating five distinct sets of needs, as follows:

- Medical-pharmaceutical is for the supply of drugs. Drugs have a host of regulatory and security requirements preventing them from being mixed with other products. Hence, pharmaceutical products are handled as an independent logistics chain.

- Medical-surgical provides most other patient supplies, excluding drugs. Management of this supply chain has been contracted to a 3PL that operates from a local warehouse served by a hub DC in the region. Multiple scheduled deliveries occur daily, emergencies are added, and stocks are managed at the ward level by the 3PL interacting with caregivers.
- Laboratory supplies for research and diagnostics come directly from manufacturers to a central DC in the city and arrive twice daily at VMC.
- Office supplies supporting administrative needs are handled through a single catalogue vendor offering daily service. Office supplies are managed cooperatively with Vanderbilt University, so that both parties are supplied at once.
- Miscellaneous supplies, principally linens and food service, are handled directly by local vendors and managed cooperatively with the university. In addition, small package carriers bring vendor-direct materials for patient-specific needs, oxygen and blood come from nearby sources, and waste haulers carry away refuse.

The evolving consolidated supply system allows the full range of medical center needs to be accommodated with just three loading docks. The docks have bays and handling areas (see Exhibit 7-6), but the stock room is now gone and has been converted to medical space. Inventory investment is kept low, yet the wards have better command of their materials and better access to more supplies than previously. VMC staff estimate that in the first dozen years of implementation, volumes climbed by a factor of 10 or more, while truck activity remained constant. The net effects of this system are more productive utilization of capital by VMC, improved service to patients, lower healthcare costs to the public, and a more competitive healthcare industry in a region that depends on it—plus effective management of truck VMT.

Lessons and Conclusion

Cities commonly suffer through circumstances like those that VMC faced: disparate users situated in constrained facilities cause excessive delivery activity for goods. One solution tried in Europe and elsewhere under various management approaches has been the urban consolidation center. Its central concept is the requirement that all deliveries and pickups in an urban district be funneled through a staging center that consolidates shipments to reduce truck traffic (and often to ensure the use of low-emission vehicles and off-peak hours). These typically have been government-initiated programs, although the more successful ones have deferred heavily to private stakeholders in operational management.

Exhibit 7-6. Inside VMC's main dock.

Source: Halcrow.

The VMC logistics system is a purely private solution. Its motivations are higher service levels, lower costs, and the more productive use of private capital and assets. Truck VMT reductions and smaller public health burdens are byproducts the system does not strive for, yet they are real benefits nevertheless and valuable to public planners. VMC is not unique in its logistics model—3PLs have introduced the same core features across the healthcare industry and around the country, and numerous hospital groups have adopted them. On the one hand, medical supply management is a specialty business where the large size of customers has been helpful in taking control of distribution methods from producers. On the other hand, 3PLs make a business out of specialties and one role public agencies potentially can play is to organize small customers into large negotiating bodies.

The key lessons from VMC are that private motivations can align with public purposes in very desirable ways, and that private markets at a minimum can further these purposes—and perhaps be allied with, and encouraged, as well. The first step for a private planner seeking such benefits is to understand the methods of supply management employed by the businesses in its district.

References and Sources

United States Department of Census, population statistics and projections available online at www.census.gov

Facts 2010 and Facts 2007, Vanderbilt Medical Center: http://www.vanderbilt.edu/about/history

"Growth of Medical Center's Campus Outlined at Meeting," *Vanderbilt Medical Center Reporter,* February 29, 2008, available online at http://www.civitas-initiative.org

Private interviews with Vanderbilt Medical Center staff in 2004 and 2009.

London: Reducing Freight Impacts via Out-of-Hours Deliveries

Background

The city of London is the largest metropolitan area in the United Kingdom and the largest urban zone in the European Union. There are approximately 7.5 million residents in Greater London (2007) with a population density of 4,542 inhabitants per square kilometer, more than 10 times that of any other region in the United Kingdom. The population of London is projected to grow by 900,000 people to a total population of 8.3 million by 2025.

As a commerce center, London generates approximately 20 percent of the United Kingdom's GDP, and is one of the world's major international finance hubs. More than half of the United Kingdom's top 100 listed companies (the FTSE 100) and over 100 of Europe's 500 largest companies are headquartered in central London. Over 325,000 people are employed in London's financial services sector alone. London is also a major tourist attraction that hosts some 15 million international visitors every year. Road congestion is the biggest cost to the movement of freight in London with around 82 percent of freight being moved by trucks. Congestion costs the freight industry around £800 million per year. Population growth projections suggest that freight activity could increase by up to 15 percent over present levels by 2025.

Central London attracts 180,000 light trucks and 60,000 heavy trucks each day. Commercial trucks travelled 5.6 billion vehicle kilometers on London roads in 2007. Approximately 60 percent of all commercial vehicle kilometers were attributed to company-owned light trucks in London between 2003 and 2005, reflecting the importance of the service sector as a freight vehicle trip generator. The impact of freight activity in terms of on-street waiting time in the capital is highlighted by the fact that 33 percent of warden-issued penalty charge notices (PCNs) and 59 percent of camera PCNs (fines for vehicle parking/loading) were issued to commercial vehicles in 2008.

Principal Findings

Out-of-hours deliveries (OHDs) are best suited to large businesses operating centralized distribution systems fed from a regional distribution center because they can justify the additional staff costs in manning the facility out of hours, and also have the potential for handling vehicles off the public *highway. OHDs have been shown to (1) improve driver and fleet productivity, (2) reduce the environmental footprint of the logistics operation by operating vehicles more efficiently during less congested periods, and (3) reduce the wider impacts (crashes, noise, parking, etc.) of logistics operations on the local area. Existing legislation (related to noise levels and access hours) is often the major hurdle to more widespread adoption.*

Safety and emissions are significant issues associated with truck traffic in London. In 2007, 419 people were killed or seriously injured in collisions involving commercial vehicles in the capital. The situation has been steadily improving (this was 46 percent lower compared to the annual average between 1994 and 1998). It also is estimated that commercial trucks account for approximately 25 percent of CO_2 emissions resulting from transportation in London.

Across London, planning and environmental health restrictions limit when retailers and businesses can take delivery of goods and services. Individual boroughs (32 across London) decide on their own delivery restrictions, primarily to protect residents from noise disturbances. It is typical for commercial truck activity to be restricted between 10 P.M. and 7 A.M. Parking and unloading restrictions are indicated by yellow lines on the roadside, as well as "red routes" designed to keep specific key arterial routes clear of parked vehicles in the capital. Red routes prohibit vehicles from stopping adjacent to the pavement from 7 A.M. to 7 P.M., Monday through Friday. Loading bays are provided at selected locations along the routes where loading/unloading activities can take place from 10 A.M. to 4 P.M. with a maximum dwell time of 20 minutes per operation.

The Story

London's transportation strategy, Transport 2025: Transport Vision for a Growing World City, focuses on measures to address congestion and reduce CO_2 emissions while at the same time supporting London's sustainable economic growth. In particular, freight strategies look at balancing demand between modes, with an eye toward changes driven by technology and new operating practices. Out-of-hours deliveries (OHD) offer one suite of measures to enable more sustainable movement of goods in the capital. The *London Freight Plan* published in December 2007, encouraged communities to examine OHD strategies within the Greater London area.

Within central London, the following four types of delivery restrictions can exist:

- Planning restrictions are imposed at the time of planning consent for developing the premises. In the United Kingdom, restrictions specifically related to delivery activity may be contained within terms-of-use stipulations in the planning consent, typically drawn from suggested restrictions contained within planning policy guidance, issued by central government.
- Environmental health restrictions are most often in the form of Noise Abatement Notices; they may be imposed at any time and are designed to preserve the quality of life of local residents.
- Local voluntary agreements are decided at the local level and often are exercised as a voluntary good code of practice outlining when deliveries should not be made. Voluntary restrictions can be imposed by law if members of the public complain about noise disturbances.
- Highway-related traffic management restrictions are national-level decisions that can include local loading/unloading restrictions or larger schemes such as the London Lorry Control Scheme (LLCS). The LLCS restricts the movements of goods vehicles greater than 18 tons during the night and weekends. The LLCS is a permit-type scheme, requiring the use of specified routes to access premises, the reality of which means that the most direct access route can often not be used leading to inefficient, circuitous routes being taken to avoid key residential areas.

OHD is a strategy addressing deliveries made during periods when local nighttime restrictions may apply or during other periods when delivery restrictions apply. OHDs can

- Improve driver and fleet productivity;
- Improve the environmental footprint of the logistics operation by operating vehicles more efficiently during times when there is less congestion; and
- Reduce the wider impacts (e.g., crashes, noise, and parking) of logistics operations on the local area.

To help local authorities facilitate nighttime deliveries, the Department for Transport (DfT) published *Delivering the Goods: Guidance on Delivery Restrictions* (Department for Transport 2005), which set out to inform local authorities on how to implement and enforce delivery restrictions within their areas. This accompanied guidance on nighttime deliveries by the Freight Transport Association. Delivering the Goods, a toolkit for improving nighttime deliveries, was designed to help logistics providers set up pilot trials for OHD, while highlighting the important role local authorities have to play in protecting the interests of local residents.

In London, there also are incentives for commercial vehicle operators to implement OHD strategies. The London Congestion Charge adopted in 2003 levies a £10 daily access charge (as of January 2011) to all vehicles entering the center of London between 7 A.M. and 6 P.M., Monday to Friday. Vehicles entering the zone are tracked using close-circuit TV and are given a set time to pay the charge after entering the zone. OHDs made outside the charging period, in addition to greatly improving fleet efficiency, also can save money on access charges.

In a study of the potential for OHDs in London undertaken by Transport and Travel Research Ltd. (2008), retailers who operate their own fleets were more likely to be interested in the OHD concept than those relying on contracted transportation services. This was due to private fleets being more likely to give their own drivers direct access to their stores without security concerns. The results suggested local authorities were interested in aiding businesses in developing OHD strategies provided that local noise regulations were not compromised and industry-led solutions (e.g., noise curtains, rubber floor mats, and driver training) applied whenever possible.

Sainsbury's is the third largest supermarket chain in the United Kingdom with approximately 537 supermarkets and 335 convenience stores in their network. The Sainsbury's store in the borough of Wandsworth was originally served with a Noise Abatement Notice in 2001, meaning that deliveries could not be received between midnight and 6 A.M.

In 2007, Sainsbury's undertook a trial delivery program to evaluate impacts associated with moving to nighttime deliveries in the borough of Wandsworth. The Noise Abatement Society (NAS)—a working group of Sainsbury's and the Wandsworth Borough Council—developed a framework to have nighttime restrictions lifted at the Sainsbury's supermarket in Wandsworth for a 3-month period to conduct the trial. The purpose of the trial was to quantify whether nighttime deliveries had any detrimental impact on local residents or the wider community.

For the OHD trial, the delivery profile that had been imposed on the market in Wandsworth was amended to incorporate specific deliveries during the previously restricted period between 1:30 A.M. and 3:00 A.M. Sainsbury's developed a series of operating rules for these deliveries that stipulated

- All vehicle engines must be switched off when stationary.
- No empty roll cages are to be loaded during nighttime deliveries.
- Rubber matting must be installed at appropriate locations to reduce the noise of the roll cages.
- Doors must not be slammed and cab radios must be switched off when doors are open.
- The distribution center must contact the Wandsworth store when the vehicle leaves to give an estimated time of arrival at the store.
- A designated telephone line was to be established by the NAS and advertised at the store for complaints to be evaluated and acted upon immediately. If approached by a member of the public, staff should immediately direct complainants to the store manager or the NAS complaint line.

A noise monitoring survey also was undertaken to quantify before-and-after trial noise levels from deliveries made to the store.

Between October and December 2007, the Sainsbury's-Wandsworth ODH delivery trial

- Reduced the maximum recorded noise level during roll cage unloading by 8 to 10 decibels. (This was primarily attributed to the use of "dock curtains" on the loading bays to contain the noise from inside the trailer.)
- Reduced average delivery vehicle journey times by 60 minutes over a round trip from the distribution center.
- Produced a saving in drivers' time of 2 hours per day, equal to 700 hours or £16,000 per year.
- Removed 700 vehicle journeys from the road annually (2 per day during the congested period), which is equivalent to a 68-ton reduction in CO_2, and a 700-liter per year savings in fuel.
- Improved mean vehicle turnaround times at the store by 37 minutes.
- Increased overall staff productivity by 15 percent and improved product availability.
- Increased average sales by between 5 percent and 6 percent because of product availability at store opening time.

Lessons and Conclusion

Although ODH strategies appear to be a fairly simple, straightforward solution to urban delivery problems, existing laws and regulations are often major hurdles to widespread adoption. Large retailers are usually very aware of the different restrictions placed on their store operations, and one of the most common grievances among freight operators in London is the inconsistency in regulations and enforcement between authorities, as well as the level of PCNs issued to delivery vehicles.

Other challenges potentially limiting the implementation of OHD strategies include

- Noise generated by loading and unloading operations (e.g., tail lifts, roll cages);
- Time-specific deliveries requiring arrival within specified time windows;
- Lack of staff to receive deliveries during out-of-hours periods;
- Security concerns related to the vehicle, load, and driver; and
- The LLCS, which restricts the routes that can be used by lorries (trucks) over 18 tons at night and over the weekend. While helping to protect residential nighttime amenities, the scheme can sometimes lead to an increase in fuel use and emissions and deter journeys at less congested times of the day.

London's experiences to date with OHDs occurring outside the charging period suggest that, in addition to greatly improving fleet efficiency, truck operators also save money on access charges. In addition, research on London's system suggests that OHD strategies are most effective where local authorities assist businesses with developing such strategies to ensure that local noise regulations are not compromised and that industry-led solutions (e.g., noise curtains, rubber floor mats, and driver training) apply whenever possible.

References and Sources

Transport for London (2010) London Freight Data Report, prepared by the University of Westminster for TfL Freight and Fleet, available online at http://www.tfl.gov.uk/microsites/freight/documents/London_Freight_Data_Report_2009_final_10-06-2010_UoW.pdf

Freight Transport Association (2007) "Night-Time Deliveries—Wandsworth Trial," available online at http://www.fta.co.uk/export/sites/fta/_galleries/downloads/night_time_deliveries/nighttime_deliver_wandsworth.pdf

Department for Transport (2005) *Delivering the Goods: Guidance on Delivery Restrictions*, available online at http://www.dft.gov.uk

Transport and Travel Research Ltd., (2008) *Out-of-Hours Deliveries in Central London*, prepared for the Central London Freight Quality Partnership, available online at http://www.londonsfqps.co.uk/LinkClick.aspx?fileticket=b%2BPtq06WfK8%3D&tabid=178&mid=538

NICHES, (2007) *Innovative Approaches in City Logistics: Inner-City Night Delivery*, available online at http://www.niches-transport.org/fileadmin/archive/Deliverables/D4.3b_5.8_b_PolicyNotes/14683_pn7_night_delivery_ok_low.pdf

London Freight Quality Partnerships Network (2010), available online at http://www.londonsfqps.co.uk/Home.aspx

Bristol (United Kingdom): Reducing Freight Impacts through Consolidation Centers

Background

Bristol, England, is the largest urban area in the southwest region of the United Kingdom (see Exhibit 7-7), covering approximately 110 square kilometers. In 2009, the city of Bristol had an estimated population of 433,100. Bristol has an estimated drive-to-work population of over 1 million, and is considered one of the most congested cities in the United Kingdom with average peak-hour traffic speeds of approximately 16 mph. In the city center, the main retail area of Broadmead receives 100,000 deliveries per year, contributing to congestion and harmful emissions.

Bristol is a regional center for industry, commerce, education, and culture, and serves as a major transportation hub providing a gateway to the southwest region of the United Kingdom via the M4 and M5 motorways. In addition, the Bristol Temple Meads Train Station is on a strategic national rail network. Bristol has 48 distinct shopping areas collectively offering over 940,000 square meters of floor space (retail, leisure, and other services). The city is unusual in

Exhibit 7-7. Location of Bristol in the southwest United Kingdom.

Source: http://www.progress-project.org/Progress/pdf/Chapter%20A%20Bristol.pdf

Principal Findings

Freight Consolidation Centers (FCCs) can reduce truck traffic levels in urban areas, alter the type of truck used (e.g., fewer light or very heavy trucks), reduce the environmental impacts associated with truck activity, improve the efficiency of urban freight transport, and reduce the need for goods storage and logistics activities near the urban core.

that independent retailers occupy 70 percent of all retail units (49 percent of floor space) and form unique shopping attractions, drawing people into the area. Unlike the traditional single city center shopping experience offered in many United Kingdom cities, Bristol has several specialty retail areas (e.g., Queens Road/White Ladies Road, Christmas Steps/Michaels Hill, and Clifton Village), each with its own unique retail experience. Noteworthy items are

- Average peak-hour traffic speeds down to 16 mph in some parts of the city (23 percent of traveling time within the city can be spent stationary in traffic queues);
- Road freight that accounts for approximately 81 percent of total freight ton-km moved in the area;
- The city center retailing area, Broadmead, which receives 100,000 deliveries per year contributing to congestion, traffic-related air pollution, and vehicle conflict; and
- The Council's Local Transport Plan and Air Quality Action Plan, which recognizes the need to minimize the impact of freight vehicles while ensuring the economic vitality of the city center.

The Story

Truck movements contribute to the congestion and pollution problems found in Bristol, as well as other issues relating to road safety, negatively affecting the condition of the roads and causing conflicts with other road users. The City Council's transportation strategy, set out to support the economy of the city and the effective delivery of goods, is seen as essential to achieving this aim. At the same time, however, it is widely recognized that the impacts of trucks entering the city center needed to be minimized based on research suggesting that the average retail business may be receiving up to 10 "core goods" and 7 service vehicle visits per week (Cherrett et al. 2009).

Bristol City Council's Local Transport Plan and Air Quality Action Plan both state the need to reduce the impacts of trucks without adversely affecting the economic vitality of the city center. In response, the Bristol City Council set out to

1. Establish a local freight network in the form of a Freight Quality Partnership (FQP) to promote and facilitate the efficient, economic, safe, and sustainable distribution of freight in Bristol and the surrounding area;
2. Introduce access control and priority measures to improve efficiency while minimizing the impact of freight movements in conjunction with the redevelopment of the core shopping area; and
3. Through the use of the Freight Consolidation Center (FCC), achieve a 50 percent reduction in associated delivery trips and a doubling of load factors related to consolidated reverse flows.

A key issue from the outset was the lack of dialogue and understanding between the local authorities and the freight sector in terms of individual user needs. To address this, Bristol established a local freight network in 2003, which took the form of an FQP. The aim of this partnership was to promote and facilitate the efficient, economic, safe, and sustainable distribution of freight in Bristol and the surrounding area. It consisted of 17 organizations including 4 neighboring communities, logistics providers, and retailers.

The Bristol FCC opened in 2004, consisting of a 5,000-square-foot warehouse operated by Exel Logistics, on an established industrial estate (Emerald Park), 11 km northwest of Bristol close to both the M4 and M5 motorways. There are benefits resulting from a multi-user FCC as a means of reducing truck impacts in an urban center. The definition of a FCC in this context (DfT 2010) is

> A consolidation center allows the grouping of individual shipments or partial loads from different suppliers/logistics providers, destined for the same locality, so that a smaller number of full loads can be transported to their final destination.

An FCC is usually implemented for one or more of the following reasons (Browne et al. 2005):

- To reduce truck traffic levels (reducing truck movements in the urban area through improved consolidation or modal shift);
- To alter the type of truck used (e.g., fewer light or very heavy trucks);
- To reduce the environmental impacts associated with truck activity (i.e., through a reduction in total trips and/or greater use of environmentally friendly vehicles);
- To improve the efficiency of urban freight transport operations (through improved load factors or fewer deliveries); and
- To reduce the need for goods storage and logistics activities near the urban core (offering storage facilities at the FCC, as well as other value-added services).

The Bristol FCC serves the Broadmead area of Bristol's urban core where over 300 retailers are located. The Bristol Consolidation Centre (BCC) is serviced by two delivery vehicles (a 7.5-ton and 17.5-ton rigid) and is testing the use of a 9-ton Newton electric truck built by Smith Electric Vehicles that can travel at 50 mph and has a range of 100 miles on a single 6- to 8-hour charge.

To act as a "stick" and enhance the appeal of the Bristol FCC to retailers, Bristol City Council restricted freight vehicle access times to the main pedestrian portion of the retail area from 5 A.M. to 8 A.M., and 6 P.M. to 8 P.M., and accompanied this restriction with a strict requirement for trucks to use a one-way route system.

Lessons and Conclusion

Logistics providers/suppliers' vehicles with goods destined for city center retailers deliver into the Bristol FCC where items are stored. Once a vehicle load has been consolidated, the goods are loaded out in roll cages via one of the three dedicated Bristol FCC service vehicles into the city center for a round-robin style delivery.

When launched, the consolidation center was 100 percent publicly funded, with time-limited financial assistance (2002–2006) coming through the VIVALDI (Visionary and Vibrant Actions through Local Transport Demonstration Initiatives) Project. Since 2006, efforts have been made to move to a business model based on maximum cost recovery from the participating retailers.

In 2007, the BCC was serving 64 retailers whose combined delivery vehicle movements had fallen by 75 percent (6,945 vehicle movements) over the pre-BCC case. This direct reduction in vehicle movements equated to an annual savings of 178,000 vehicle kilometers, 20.3 tons of CO_2, 660 kg of NO_x, and 19.7 kg of PM_{10}. In addition, reverse logistics resulted in 12.9 tons of consolidated cardboard and plastic being collected from the 64 retailers and recycled.

The logistics of the delivery system proved to be very reliable with 100 percent on-time deliveries, no recorded loss or damage to stock, and the majority of retailers reporting savings on the previous mean delivery times, some in the order of 20 minutes. Consequently, 38 percent of the participating retailers indicated that this enabled their staff to spend more time with customers, with 45 percent stating that staff morale had been improved. Ninety-four percent of the participants stated that they would recommend the BCC to other retailers.

References and Sources

Cherrett T. J., McLeod F. N., Maynard, S., Hickford, A., Allen, J., Browne, M. (2009), "Understanding Retail Supply Chains to Enable 'Greener' Logistics," 14th Annual Logistics Research Network Conference, 9–11 September 2009. Cardiff University.

DfT (2010), Freight Consolidation Study (prepared by TTR and TRL), available online at http://www.dft.gov.uk/pgr/freight/research/freightreport/

Browne, M., Sweet, M., Woodburn, A., Allen, J. (2005), *Urban Freight Consolidation Centres Final Report,* Transport Studies Group, University of Westminster, available online at http://freightbestpractices.org.uk/urban-freight-consolidation-centre-report
Anonymous (2006) Broadmead Freight Consolidation Scheme, Niches project, available online at http://www.osmose-os.org/documents/118/Os_Aw_Appl_Bristol.pdf
Anonymous (2008) D2.4 Report on Partnerships, START (Short Term Actions to Reorganize Transport of Goods) Project Report, available online at www.startproject.org/. . ./D2.4%20Reporton%20Partnerships%20FINAL.pdf
Anonymous (2008) D2.1 Integrated Demonstration Report, START (Short Term Actions to Reorganize Transport of Goods) Project Report, available online at http://www.start-project.org/downloads.html
DfT (2010) Freight Consolidation Study (prepared by TTR and TRL), available online at http://www.dft.gov.uk/pgr/freight/research/freightreport/
Anonymous (2010) West of England Joint Local Transport Plan 3, Freight Supplementary Document, draft for consideration at 20th September 2010 meeting of the Bristol & Neighbouring FQP, available online at http://www.travelplus.org.uk/media/186924/network%20management%20and%20freight.pdf
Anonymous (2010) West of England Partnership, *Joint Local Transport Plan Progress Report 2009/10,* available online at http://www.westofengland.org/media/187971/item%2010%20jiltp2%20progress%20report.pdf
Anonymous (2010) *Freight Consolidation Study* (South East Scotland Transport Partnership), report produced by Scott Wilson Ltd., available online at http://www.sestran.gov.uk/uploads/Freight%20Consolidation%20Centre%20Study%20-%20Final%20Report.pdf
Anonymous (2006) Vivaldi project, D12 Final Publishable Report, available online at http://www.transport-research.info/Upload/Documents/200909/20090917_164909_1792_VIVALDI%20-%20Final%20Report.pdf
Joint Local Transport Plan 3, 2011–2026: Network Management and Freight Supplementary Document, Engagement Draft, July 2010, available online at http://www.travelplus.org.uk/media/186924/network%20management%20and%20freight.pdf

Principal Findings

For effective enforcement, it is essential that all traffic and law enforcement officers have details of truck route and waiting rules for their district. In addition, simple guidance signage should be considered for aiding truck drivers through urban areas (e.g., "green" and "red" route signage to denote acceptable and unacceptable routes, respectively). Also, out-of-hours delivery is an effective way of maximizing efficiency in delivery and collection schedules.

New York City: Commercial Vehicle Regulation and Off-Peak Delivery

Background

New York City has been regulating commercial vehicle operations for nearly 100 years. Commercial vehicles are essential to the commerce and services of America's largest city; New York City hosts a population of more than 8 million in an area of just 300 square miles. Stacey Hodge, Director of the Office of Freight Mobility for the New York City Department of Transportation (NYCDOT), understood that trucks were both a blessing and a curse. Without trucks, New York City's retail and entertainment businesses would come to a halt, but adding trucks to an already overburdened street and highway network often brought traffic to a standstill. It took nearly 100 years for one of the most complex truck route and truck regulation schemes in the nation to evolve—now NYCDOT sought to simplify the truck regulation scheme, while improving effectiveness.

In 2007, NYCDOT completed a 4-year study effort: *The Truck Route Management and Community Impact Reduction Study,* completed by a consulting firm. The study sought to "coordinate engineering, education, information, and enforcement efforts to mitigate the negative impacts relating to truck traffic, as well as to improve the overall truck management framework that exists in the city of New York."

After completing the truck route study in 2006, one of the first actions taken by NYCDOT was to create a new Office of Freight Mobility. Stacey Hodge, who had spent 10 years in the private sector consulting as a transportation engineer and planner, joined NYCDOT in spring 2007 to lead the Office of Freight Mobility. As Hodge came on board, she was confronted with the following list of issues identified by the truck route study just completed:

- New York City had experienced a 35 percent increase in truck volumes over the past 20 years with no comprehensive changes to the regulations or policies governing truck access and no changes in the number of truck route miles (street capacity) to meet this demand.

- Current truck regulations in the city were based on standards put in place over 20 years ago. During the last truck route study, completed in the early 1980s, a 55-foot vehicle design standard was in place. National fleet trends had increased the design limit to 65 feet. Most streets in New York City were not designated to safely accommodate these larger vehicles.
- Enforcement efforts were lacking because of the overly complicated regulatory scheme imposed on trucks in the city. The comprehension of truck regulations was limited in both the New York Police Department (NYPD) and among judges who adjudicated summonses.
- Only 5 percent of the city's streets were designated as truck route streets. Most designated truck routes operated at or near capacity.
- Signs were one of the most critical tools for managing the city's Truck Route Network; however, there were several problems with the current signage program:
  - The city had multiple designs for truck route signs. Although the differences are subtle, the lack of consistency fosters confusion among truck drivers.
  - The placement of truck route signs at intersections was inconsistent, affecting driver recognition and reaction time, as well as driver actions at decision points.
  - Truck route sign panels were not always visible. The message on some panels was not clear because of weather, sun exposure, or graffiti. In other cases, truck route signs were blocked from view by another sign.
- A survey of freight stakeholders revealed that most stakeholders had limited knowledge or did not understand New York City's truck route regulations.
- NYPD recruits trained at the Police Academy are inundated with a great deal of information on rules and regulations. Traffic rules are just one small component of their training. As a result, most officers on the street have a very limited working knowledge of the Truck Route Network.

The Story

Eager to develop an action plan for addressing as many of the issues identified by the truck route study as possible, Hodge realized that truck issues would have to compete for limited resources against a wide array of other transportation issues. Without much political clout, freight issues often took a back seat to other constituent transportation concerns.

A necessary step in making the new Freight Mobility Office successful was to communicate the office mission and identify its champion to those public partners from which the office would need support. In November 2007, Commissioner Janette Sadik-Khan sent a letter to all elected officials in New York State introducing them to the new office and describing initiatives the office would pursue to address truck management and goods movement in New York City.

One of the first initiatives undertaken by the Freight Mobility Office built upon existing regulations to make them more effective. New York City did have designated truck routes. Dated and less than optimal, New York City regulations required commercial trucks to operate only on designated truck routes unless a delivery required the use of a non-designated route (Section 4-13(e) of New York City Traffic Rules). Designated truck routes, however, were rarely enforced unless citizens complained, and directional signs were often difficult for truck drivers to follow. Off-route trucks were not only an aggravation for city residents; they were also costing New York City millions of dollars in bridge rehabilitation and maintenance. In 2007, there had been 64 reported incidents of trucks striking low bridges or overpasses; in 2008, there were 98 reported truck-bridge incidents. Many of these incidents were the result of trucks traveling on the parkway system, which is off-limits to trucks.

NYCDOT recognized the immediate benefits that could be derived from improving compliance with the existing route network while also communicating better with truck drivers about low clearance bridges and truck routes. To accomplish these goals, the following initiatives were advanced.

- *The NYPD Truck Enforcement Program.* In 2007, NYCDOT released an electronic online version of the city's first comprehensive citywide truck route map. The online map provided detailed routing information for all five boroughs, regulatory information, and contact information for useful truck and commercial vehicle resources. During 2008, the city distributed 74,000 truck route maps. However, NYPD realized that better public information about truck routes would not solve the route compliance issues alone. Without more proactive enforcement of network violations, the information campaign would be less effective. As a result, the Police Placard Pilot Program was launched to provide officers with the resources to enforce truck network violations at the precinct level. Only 4 of the city's 76 precincts were included in the initial pilot.
- *Truck Route Signage Pilot.* Another recommendation from the truck route study was to undertake efforts to improve the city's truck route signs. Nationwide, the design of traffic signs on public roadways is prescribed by the *Manual on Uniform Traffic Control Devices* (MUTCD). MUTCD is published by FHWA under 23 Code of Federal Regulations (CFR), Part 655, Subpart F. In 2008, NYCDOT petitioned FHWA to conduct a truck route signage pilot program that would allow the city to experiment with new truck route sign designs to make the signs more identifiable to truck drivers.
- *The Delivery Windows Program.* The objective of the delivery windows program was to make curb space available for delivery trucks. By reducing the number of trucks double parking, traffic congestion can be reduced and air quality improved. In addition, reasonable curbside access supports the New York City economy by improving the efficiency of truck deliveries. In New York City, most retailers and grocery stores do not have off-street loading docks, and on-street parking is typically occupied by passenger vehicles, which forces delivery vehicles to double-park and cause traffic congestion. To address curbside access, NYCDOT implemented a multi-pronged approach. By working with merchants and through curb utilization surveys, information was gathered in specific neighborhoods regarding peak demands for curbside access. Using the data gathered, delivery windows were installed alongside a protected bike lane with offset parking on Columbus Avenue in Manhattan, First and Second Avenues in Manhattan, along the Fordham Road Bronx Bus Rapid Transit (BRT) route, and were planned for Church Avenue in Brooklyn in January 2011.

In addition to improving existing programs, the Freight Mobility Office also sought innovative win-win solutions for addressing other urban freight issues like curbside access for delivery trucks. Many companies operating in New York City had grown accustomed to paying millions of dollars in parking fines on an annual basis, because double-parking delivery vehicles had become a way of doing business on New York City's busy streets.

- *Off-Hours Delivery Program.* In 2009, the Office of Freight Mobility formed a partnership with Rensselaer Polytechnic Institute, Rutgers University, the Rudin Center at NYU Wagner, and ALK Technologies on a USDOT-funded program to encourage off-peak deliveries between 7 P.M. and 6 A.M. The pilot ran from late 2009 through early 2010, with encouraging results for the 33 participants. The participants included a diverse group of 8 delivery companies (carriers) and 25 business locations (receivers) that participated in the pilot for at least 1 month, and included restaurants and retail stores.

Lessons and Conclusion

The Police Placard Pilot Program was well received by NYPD. Now, NYPD officers in all 76 police precincts receive inserts for their memo books that detail truck route rules in their precinct. Fully implemented in 2008, the NYPD memo insert program heightened officer understanding of the truck route system. NYPD also added truck route summonsing to their Traffic-Stat data monitoring program, and these efforts together have contributed to an increase in truck route enforcement.

The first generation of new experimental truck route signs incorporated a green circle, the universally accepted symbol for positive guidance, into the existing conventional sign. A prohibitive route sign incorporated the red circle and diagonal. The pilot signage program was implemented in the Hunt's Point area of the Bronx, and NYCDOT continues to evaluate the results of this program.

Feedback from the off-hours delivery program suggested that fewer deliveries during normal business hours allowed shops and restaurants to focus more on their customers. In addition, receivers said their staffs were more productive because they waited around less for deliveries that were tied up in traffic. Carriers found that their trucks could make more deliveries in the same amount of time because their service time at a receiver's location was reduced from 1.8 hours to 0.5 hours. They also saved money on fuel costs and could use a smaller fleet by balancing daytime and nighttime deliveries. Legal parking was more readily available during these hours, and drivers reported feeling safer and less stressed. The study also found that travel speeds from a truck depot in New Jersey to a delivery driver's first stop in Manhattan improved by 75 percent.

Reviewing the accomplishments of the Office of Freight Mobility in its first 3 years, Hodge was most proud of the advances made in opening lines of communication between the various units within NYCDOT responsible for regulating commercial vehicles. Before the Office of Freight Mobility, there was no single point of contact in city government for commercial vehicle operators. Today, the office is the face of freight for NYCDOT.

Extensive stakeholder and community outreach aided the progress of the Office of Freight Mobility, but each outreach effort had been specific to each program, requiring extensive time and resource commitments. Moving forward, Hodge and her team will explore opportunities to institutionalize stakeholder outreach through some form of public-private freight committee that would foster trust and get the private sector solidly behind NYCDOT efforts to increase efficiency.

References and Sources

Truck Route Management and Community Impact Reduction Study, "Executive Summary," New York City Department of Transportation, Edwards and Kelcey, Inc. March 2007, p. 1.

The NYCDOT Citywide Truck Enforcement Fact Sheet, available online at http://www.nyc.gov/html/dot/motorist/trucks.shtml

Commissioner's Corner Monthly Letter, "When Trucks Strike Back," August 2008, available online at http://www.nyc.gov/html/dot/html/about/corner_august.shtml

Commissioner's Corner Monthly Letter, "Off-Hour Delivery," July 2010, available online at http://www.nyc.gov/html/dot/html/about/corner_july2010.shtml

Buffalo: Brownfield Redevelopment for a Logistics Hub

Background

In 1900, Buffalo, New York, was the eighth largest city in the United States, and the nation's second largest railroad hub. During World War II, Buffalo's Bethlehem-Lackawanna Steel Plant was the largest steelmaking operation in the world, employing 20,000 workers on a 1,300-acre site. In the late 1970s, however, global competition brought great quantities of imported steel to

Principal Findings

In urban areas focused on redevelopment of underused or brownfield lands, consideration of access and logistics needs should be a high priority for planning and economic development officials. Protecting and strengthening multimodal transportation links, access, and facilities that support industrial and/or commercial uses in a redevelopment zone can be an important part of attracting investment and tenants to that zone. It is also important to consider the need for adequate buffer zones between such redevelopment and incompatible land uses such as residential neighborhoods.

the United States and Bethlehem Steel began reducing its workforce at the Lackawanna plant. In the early 1980s, Bethlehem Steel closed most of its steel making operations in Buffalo. By 2010, with 267,703 residents, Buffalo had slipped to 70th place in population among U.S. cities.

In 2006, to address the impacts of the changing economy and declining population of Western New York State, the two counties comprising the Buffalo metropolitan region—Erie and Niagara—embarked on developing a framework for regional growth, as follows:

> In addition to the effects of national and international-level influences—global competition and free trade, unfunded mandates from state and federal governments, and the rise of the sunbelt—decisions about the pace, pattern, and form of development have affected the region's ability to attract investment and retain talent.

Although the framework acknowledged the limitations counties have in affecting the planning authority of municipal governments in New York State, it was developed as a resource for regional leaders to leverage limited resources and provide consistent direction and useful support to municipalities in both counties.

One of the issues raised in the *Erie-Niagara Framework for Regional Growth* study concerned the inventory of investment-ready commercial and industrial land-use sites. As of 2006, when the framework was published, "the counties have identified only 2,220 acres of land available for industrial and commercial development, and only 9 of the 38 individual sites identified are more than 100 acres." To address this deficiency, the report recommended the following strategies for supporting economic development and freight transportation:

- Expand on previous "shovel-ready site" assessments and develop a regional inventory and marketing strategy for vacant, underutilized, and brownfield properties, and support the preparation of conceptual development plans and marketing strategies for sites best positioned to support regional economic development objectives.
- Encourage localities to preserve and properly zone larger-scale vacant and underutilized sites with potential to accommodate research and development, technology, manufacturing, and distribution enterprises.
- Support efforts to: (1) plan and zone for employment-intensive commercial and industrial development on sites with ready access to the region's highway and rail networks; (2) recognize areas well served by public transportation as catalysts for higher density development and reinvestment in regional centers and growth corridors; and (3) improve access to, between, and within regional centers and growth corridors.

The Story

In 2008, building on the regional growth initiative, the executive leadership of Erie County adopted its own strategy for economic development within the framework established for the region. Erie County's *Road to a Bright Future* established a strategy to capitalize on the county's position as an international gateway rather than focus on job and population loss.

> To succeed as a community, the definition of economic development can no longer be to just give away tax incentives or low-cost loans. Instead, we must develop our area's economy through articulation and the support of a community vision that guides public investment, drives private investment, and provides decisive execution with a foundation of good planning.

By virtue of its location and existing freight transportation assets, Erie County and the surrounding region is well positioned to expand its role in international and domestic logistics. The availability of industrial land such as the former Bethlehem Steel plant site and other real estate assets with access to rail, highway, and water transportation provides significant logistics development opportunities.

Kenneth Swanekamp, director of business assistance for Erie County, and Christopher Pawenski, Coordinator for the Industrial Assistance Program, are invested in the success of their community. Swanekamp has 30 years of experience in business development, and Pawenski returned to Erie County after a successful career as a project manager for a private construction firm. In Pawenski's words, "Having grown up in the Buffalo area, and watching the economic decline, I wanted to return and give back to the community. I wanted to do my part in helping turn around our economic situation." Swanekamp and Pawenski work as a team, with Swanekamp taking responsibilities for working with other agencies in the region and Pawenski meeting and interacting with the business community. Both men have a keen sense of the transportation and supply chain needs of businesses already located in the region, as well as those businesses looking to move into the area. In addition, with the rapid growth of the transportation and warehousing industrial sector, they view developments such as the Bethlehem Steel Lackawanna site, with its ready highway, rail, port, and airport access, as an excellent employment opportunity for the region.

Today, most of the former Bethlehem Steel Lackawanna site is owned by Tecumseh Redevelopment, a subsidiary of the international steel company giant ArcelorMittal. The primary development site comprises 11,000 acres (see Exhibit 7-8).

The site offers effective rail and highway access as well as access to the Port of Buffalo. Another benefit of this location is that portions of the site fall within an "Empire Zone," a New York State

Exhibit 7-8. Bethlehem Steel Lackawanna industrial site development map.

Source: Erie County Office of Economic Development.

designation for a geographic area of a county or municipality that has been deemed eligible for special state tax incentives and other state and local support meant to encourage new and expanded economic development and investment.

As of early 2010, Tecumseh Redevelopment was preparing a concept redevelopment plan for potential transportation- and industrial-related businesses. It is also working with state and federal agencies to explore the possibility of rerouting portions of Smokes Creek, which currently bisects the southern portion of the site. Such a project would require between $15 million and $20 million in infrastructure improvements. The site also is served by the short-line South Buffalo Railroad. Even with its limited network, the railroad would provide a connection to the facility for each of the major railroads of the region. It served a similar role in the past when the steel mill was operational.

The site has significant potential to help the region establish itself as a logistics hub. The site has plenty of room and good rail, water, and roadway connections. Logistics areas require large amounts of land, and this is one of the few brownfield sites in the area that has sufficient land. A number of trading opportunities have been identified that could help the Buffalo-Niagara region to establish itself as a logistics center. The region could serve as an inland hub for the Port of New York/New Jersey. Rail intermodal service between Buffalo and the Port of New York/New Jersey has dramatically improved in recent years. The site also could serve as a distribution hub to serve Canada. A recent study by the World Trade Center of Buffalo found that numerous Canadian shippers use U.S. ports and then deliver products by truck through Buffalo into southern Ontario. With improved intermodal rail service, Buffalo could serve as an intermodal hub for the southern Lake Ontario region of Canada, which is known as the "Golden Horseshoe."

County officials also are urging that development be founded on an effective planning and zoning process that would create a buffer between the heavy industrial activities on the west side of the site and the residential development adjacent to the site on the east side of Route 5. The county plan calls for light industrial (commercial) tenants to be located on the portion of the site along Route 5, while heavy industrial tenants will be located farther into the location.

Lessons and Conclusion

As with other properties the Erie County Office of Economic Development prepares for market, the Bethlehem Steel site needs to be made usable before attracting potential tenants. Rail lines on the site must be upgraded; currently, the lines are built to 1900 standards. Recently, the New York State Department of Transportation Multimodal Program awarded Erie County a $2 million grant to realign and modernize rail track on the property.

Current plans also call for the site to be served by two to three roadway access points. Erie County has already entered into discussions with nearby residents living across Route 5 to find acceptable solutions to traffic issues. The county has stated to nearby residents that traffic will be entering and exiting only at the north and south ends of the site, away from residential areas. Using a generic environmental review process, the county is developing traffic parameters with which potential tenants would need to comply in order to avoid requirements for additional traffic studies.

References and Sources

"Buffalo Slips to 70th in City Population," *Buffalo Business First,* available online at http://www.bizjournals.com/buffalo/news/2010/11/21/buffalo-slips-to-70th-in-city-population.html

Erie-Niagara Framework for Regional Growth: Final Report, 2006, available online at http://www.erie.gov/regionalframework/docs/Framework%20for%20Regional%20Growth%20-%20Final%20Plan.pdf

Ibid, 2006, Chapter 2, p 23.

Erie County's Road to a Bright Future, Hon. Chris Collins, Erie County Executive, available online at http://www.erie.gov/exec/?rebuild-the-economy/road-to-a-bright-future.html
Erie County, *Industrial Parks Report,* July 2010.

Case Studies—Key Findings

Key findings from the nine case studies follow.

1. Long-term planning for freight in urban development is essential.

Creating protected industrial zones in urban centers where there are restrictions placed by the planning authority on residential, retail, and leisure developments can safeguard commercial centers and attract new business. This policy is particularly applicable to port sites where waterfront land, which is vital for vessel management, could be lost to residential development, altering the land use of the area forever. Wherever possible, areas of brownfield land with good multimodal transportation links should be safeguarded for industrial/commercial use.

2. Harmonizing truck access and loading regulations along with enforcement strategies within and across regions can bring about significant efficiency savings to both the local community and logistics providers.

Unifying loading/unloading/waiting restrictions within city areas and across different cities can make urban delivery more efficient, harmonize enforcement strategies, and improve understanding among logistics providers, their clients, and local authorities.

Freight and service vehicles can be catered for in simple ways such as minimum waiting periods for freight vehicles displaying a windshield "service provider" ID card, standardizing loading spaces, and allowing hand delivery of parcels using metro and underground services. Simple guidance signage should be considered for aiding truck drivers through urban areas (e.g., green and red route signage to denote acceptable and unacceptable routes respectively).

Overweight trucks can be responsible for annual pavement and bridge repair costs of around $16 million in some cities. The implementation of innovative enforcement technologies (e.g., weigh-in-motion scales) can have a significant impact on reducing these costs.

When developing a strategic truck route master plan it is important to change the mindset from one of prohibiting commercial vehicles from certain neighborhoods to effectively and efficiently accommodating trucks in the urban environment. This is done through dialogue with stakeholders and identifying all possible routes exhibiting truck-friendly characteristics that may be enhanced by investment, over time, to satisfy both the needs of the freight community and the communities in which they operate.

For effective enforcement, it is essential that all traffic and law enforcement officers have details of truck route and waiting rules for their district.

3. Freight Consolidation Centers (FCCs) are a proven system for reducing freight vehicle impacts in urban centers and should be seriously considered as part of city planning.

Key benefits to be gained from implementing FCCs are

- Reducing truck traffic levels (reducing truck movements in the urban area through improved consolidation or modal shift);
- Altering the type of truck used (e.g., fewer light or very heavy trucks);
- Reducing the environmental impacts associated with truck activity (i.e., through a reduction in total trips and/or greater use of environmentally friendly vehicles);
- Improving the efficiency of urban freight transportation operations (through improved load factors or fewer deliveries);
- Reducing the need for goods storage and logistics activities near the urban core (offering storage facilities at the FCC, as well as other value-added services); and

- Understanding, in detail, the current methods of supply by businesses in the district and the mechanisms by which the FCC could operate (100 percent privately funded, a mixture of private/public partnership, compulsory buy-in for access to specific areas, voluntary buy-in) is of key importance to the establishment of an FCC.

4. ***Altering access regulations to allow out-of-hours supply can help reduce the impacts of freight vehicles on urban centers.***

Out-of-hours deliveries (OHDs) are best suited to large businesses operating centralized distribution systems fed from a regional distribution center because such businesses can better justify the additional costs in staffing the facility out of hours and can handle vehicles off the public highway. OHDs have been shown to (1) improve driver and fleet productivity, (2) reduce the environmental footprint of the logistics operation by operating vehicles more efficiently during less congested periods, and (3) reduce the wider impacts (crashes, noise, parking, etc.) of logistics operations on the local area.

Existing legislation (related to noise levels and access hours) is often the major hurdle to widespread adoption.

APPENDIX A

Additional Supply Chain Case Illustrations

Four of the 12 urban supply chains examined for this guidebook were discussed in Chapter 3. The remaining eight are presented in this appendix. They are

- In the **Industrial Production** channel: pharmaceuticals and biotechnology;
- In the **Retail Distribution** channel: food service, urban wholesale food, supermarkets, big box retail, and retail drug stores; and
- In the **Service Provision** channel: hospitals, and waste and recyclables.

Comparisons of all 12 supply chains can be found in Exhibit 3-5 and accompanying discussion that concludes Chapter 3.

Case Illustration 5: Pharmaceutical and Biotechnology Supply Chain

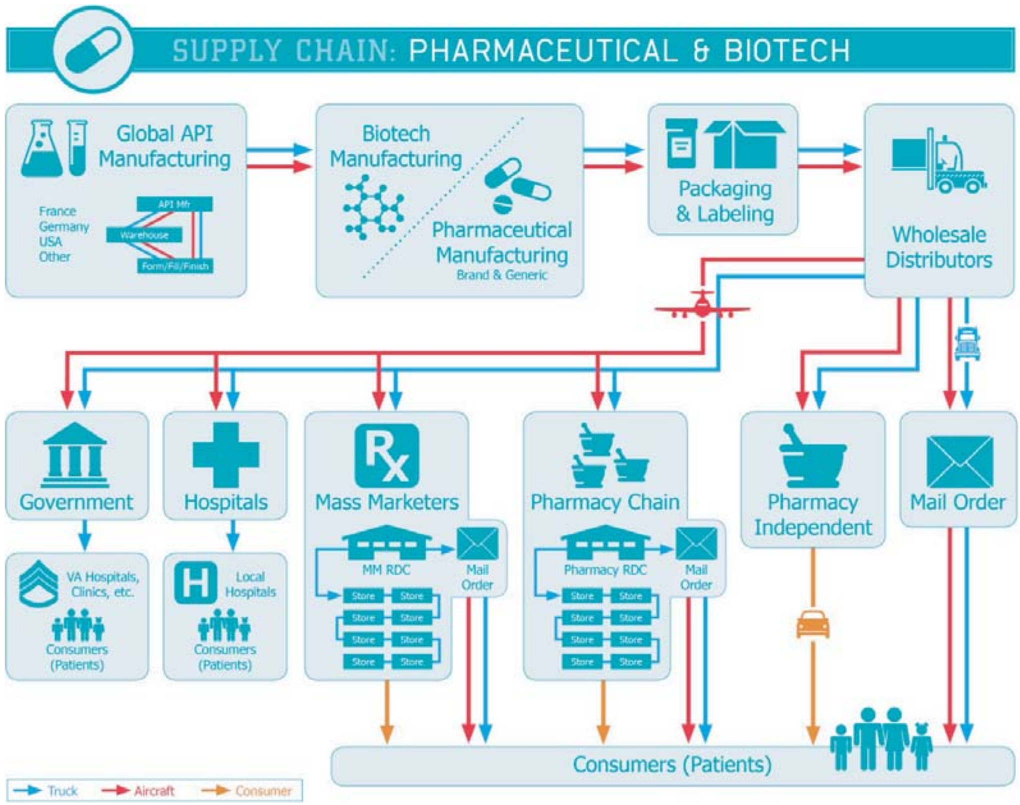
Overview

Pharmaceutical and biotechnology drugs travel a complex, multi-step supply chain path, from the ingredient manufacturing process through delivery to the consumer (patient). The supply chain starts with the manufacturing of active pharmaceutical ingredients (APIs). APIs are warehoused until transported to another manufacturing facility where they are used in the production of specific pharmaceuticals. There, the formulation and finish manufacturing of pharmaceuticals occurs, resulting in a semi-finished product. After storage and perhaps transport between facilities, this is packaged into a finished product, and then held at a DC until shipment to customers. For example, an API may originate in China, be shipped frozen to the United States where it is thawed, further processed, and filled into larger aliquots (portions), then flown on cargo aircraft to Europe for filtration and the addition of excipients (inactive substance used as a carrier for the active ingredients of a drug), then airlifted back to the United States for filling into pre-filled syringes and final package assembly. Only at this point is the drug ready for in-country distribution. This process can take weeks or months and at each step of the process it involves manufacturing, processing, warehousing, packaging, and transport. In many instances throughout the process, temperatures and humidity must be tightly controlled. At the beginning of the process, the shipment size may only be a few liter-sized bottles, but by the time it reaches the DC in the United States, it may have grown into several pallet-sized containers containing 30,000 syringes in their final packaging and having a value of $20 million. Delivery for retail dispensing and institutional use is handled chiefly by wholesalers operating from DCs over multi-stop truck routes. See Exhibit A-1.

Performance

Pharmaceutical and biotechnology companies depend on the expediency of air transport to minimize risk and view it as relatively low-cost insurance against potential product loss from

Exhibit A-1. Pharmaceutical/biotechnology flowchart.



mishandling, delay, or extended exposure. It is a means of protecting brand equity and the manufacturing pipeline for their high-value goods. Trucks often supplement air transport to deliver active product ingredients and pharmaceutical products from plant to plant or plant to distribution center. Pharmaceutical plants and DCs are typically located in exurban regions of metropolitan areas where parking facilities, areas for maneuvering, and docking facilities are almost always adequate.

Trucks also are used to transport finished products to facilities, such as hospitals or drug stores, located in dense urban areas. Getting goods from an airport or DC to metropolitan destinations is slow; this portion of the trip is measured in stem time or stem miles because of the prolonged transit times. Per mile costs are much greater in this "last mile" segment of the product journey because of traffic congestion, the chief inhibitor of the transport operation. In general, congestion is greatest at such choke points such as tunnels, bridges, and points where lanes are reduced. Another common issue in urban environments is the need to change truck equipment for city operations. Smaller truck cabs (day cabs) and shorter semitrailers (i.e., transloading from one 53-foot trailer to twin 28-foot or two single-unit trucks) are often required to negotiate narrow urban streets, alley ways, and parking areas. Transloading requires an extra step in labor and time as workers manually transfer trailer contents from one type of equipment to another.

Case Illustration 6: Food Services Supply Chain

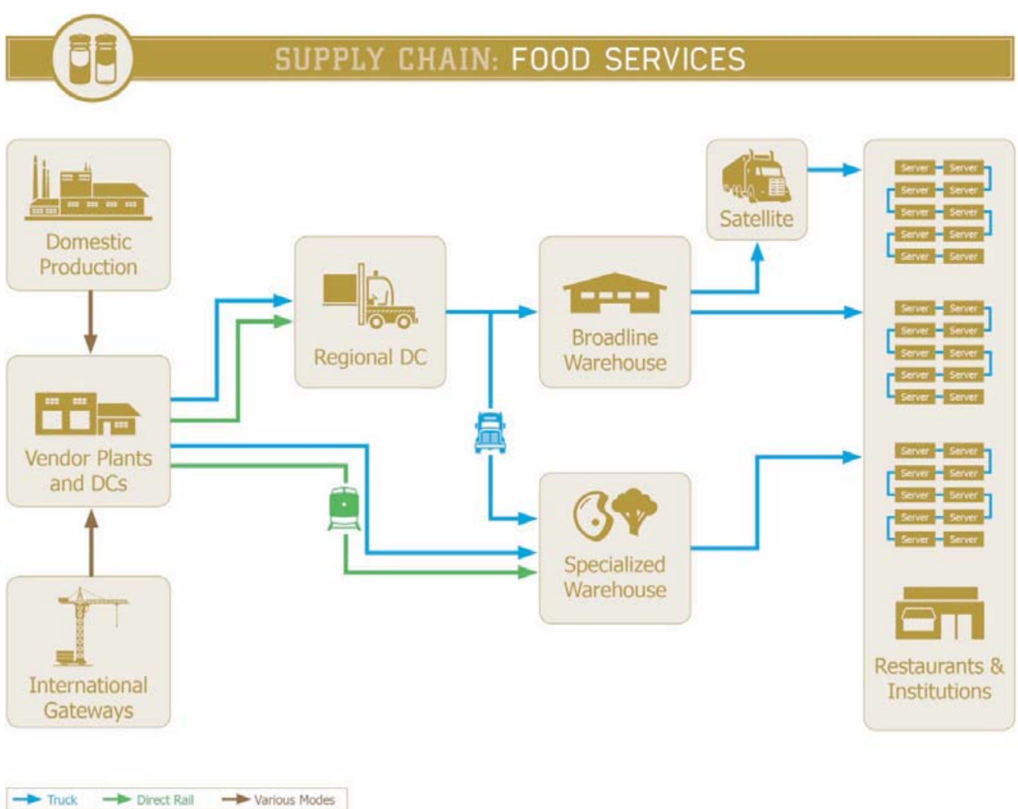
Overview

The company portrayed in this supply chain illustration distributes essentially anything needed in a restaurant, whether it is independently owned, a restaurant chain, or an institution providing food service. This company manufactures nothing, but offers many goods under its private label, alongside commercial brands. Its warehouse facilities are identified as either broadline, which supply a comprehensive line of products, or specialized distribution, which supply meat and produce or give dedicated service to certain restaurant chains. The majority of products inbound to distribution facilities moves from suppliers directly to the warehouse, under the company's control and mostly via refrigerated truck. A minority of products travel first to a regional distribution center where they are staged for truck movement onward to the warehouse; this will become the prevalent pattern in the future because it promises greater efficiencies. Warehouses handle both dry and temperature-controlled product; company trucks operating from the warehouses deliver both, using compartmentalized trailers. Customer orders are placed through a sales force and delivery routing plans developed using logistics software. Delivery truck route patterns are loaded stems out to one or more pockets via intermediate stems, then empty return to the warehouse. The average truck delivers 10 to 12 stops over a round trip of 130 to 140 miles, and the vast majority of product is unloaded by the driver by hand. See Exhibit A-2.

Performance

Routing and scheduling of trucks is a daily challenge, and achievement of a 1 to 2 percent cost savings is significant. The company uses order history to rationalize delivery frequency, and then negotiates a schedule with its customers. Most facilities deliver weekdays, and Tuesday and Friday volumes are the heaviest for restaurant clients. Two key measures of routing consistency are off-date deliveries, which are deliveries not on scheduled days, and unused delivery days, which are scheduled days without deliveries. There are seasonal volume variations as well that vary by region. The company schedules arrival times with a 3- to 4-hour window to allow for delay. In everyday management, company drivers work with clients to have delayed deliveries accepted the same day, and to bring nothing back to the warehouse. Drivers are not sales people per se but

Exhibit A-2. Food services flowchart.



their pay is based on activity—by the mile, case, and stop. Therefore, drivers have an incentive to move product, nurture customer relationships, and monitor competitor activity.

Traffic conditions can have a major effect on performance, and warehouses in heavily congested regions seek ways to mitigate it. Early-morning departures are one method, because the influence of congestion is less once the stem is complete and the driver is in the delivery pocket, with short distances between stops. After-hours deliveries are a second way, and satellite yards are a third. The company maintains nearly a dozen satellites within 50 miles of the warehouse in one prominently congested city. Parking is a further performance hurdle; to maintain schedules, drivers may opt to park illegally but close to the customer and risk getting a parking ticket, rather than walking the load over from a legal spot at a greater distance. (The company regards parking fines as a necessary cost of doing business.) Utility, or city, trucks parked in commercial loading zones are a further obstacle cited by drivers. Although these units are nominally commercial vehicles, they are not managing the heavy pickup and delivery volumes of freight delivery trucks.

Case Illustration 7: Urban Wholesale Food Supply Chain (Produce)

Overview

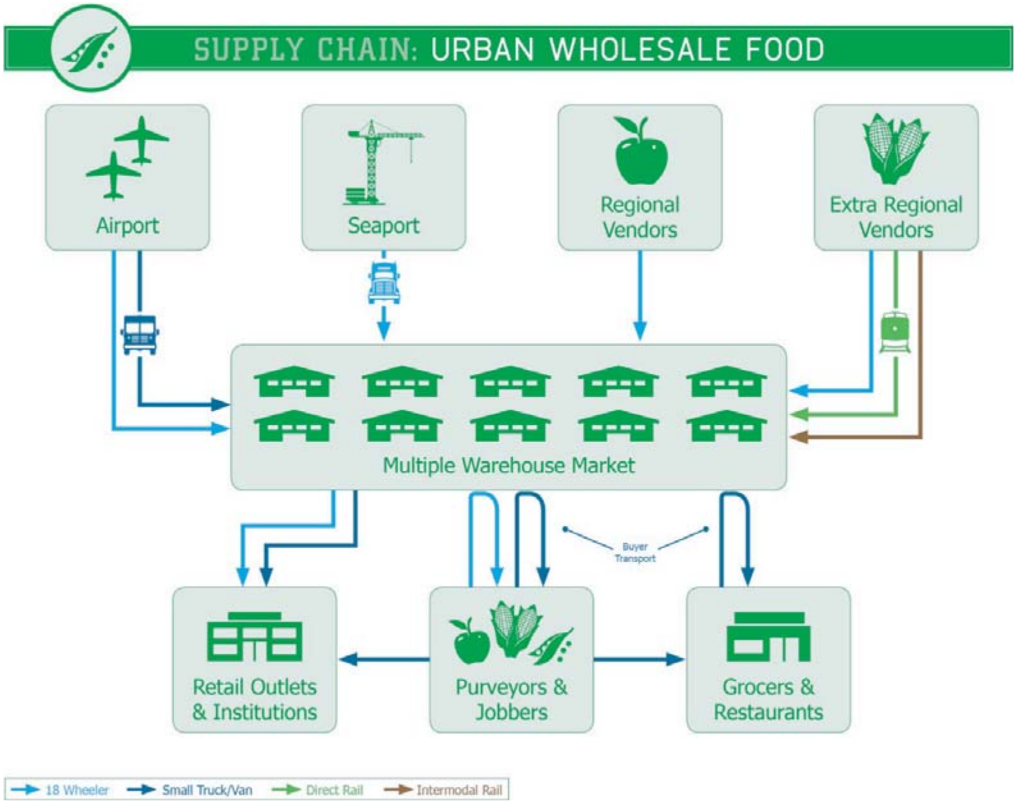
The nodal points for the staging of food products to populations are distribution centers, of which there are two main types: (1) public wholesale or terminal markets and (2) private-sector DCs. This supply chain illustration portrays a public urban wholesale produce market in the United States. Public wholesale food markets serve the function of receiving food from regional, national, and global sources, and staging and recombining the incoming food for delivery to metropolitan areas. Produce from international or distant domestic origins arrives in the region by air or rail and is then transferred to the terminal market facility by full truckload. Regionally grown produce is delivered directly from suppliers to the facility, also typically by the truckload. There is some rail access to the terminal market and some product is transported in this manner. Very little on-site processing occurs and storage is difficult because of the perishability of the product. Buyers will come directly to the facility each evening to select produce for purchase and will either arrange transport directly for immediate delivery or have this managed by the wholesaler. Wholesaler delivery trips start in the early morning and trucks can make two to three trips a day, each with several customer drops and sometimes as many as four deliveries on one city block. See Exhibit A-3.

Performance

Performance expectations are linked to the perishability of the product—in the words of one market participant, "perishability runs our lives." It necessitates on-time delivery of inbound produce, careful monitoring and storage of product, and prompt delivery of outbound produce to customers. Sustainability is an increasing concern: many trucks used to collect purchased produce are old and have poor emission profiles. Unfortunately, these tend to belong to market customers, over whom the wholesalers have no direct influence.

Given that the product is so time-sensitive, traffic- and weather-related delays can severely affect on-time performance. Poor signage and pavement conditions can create additional delays for inbound deliveries. Inbound delays can cause vendors to miss opportunities to sell product; unsold products stress limited storage capacity and inventory management capabilities. Outbound delivery delays result in two potential consequences: (1) customers may shift business away from the terminal market and (2) delivery drivers complete fewer trips. For older facilities,

Exhibit A-3. Wholesale produce market flowchart.



outdated terminal designs may constrain access and pose a further risk to performance. Turning radii for trucks may be inadequate, rail deliveries may face a lack of physical capacity, and trains themselves may block traffic from the loading docks.

Case Illustration 8: Supermarket Grocery Supply Chain

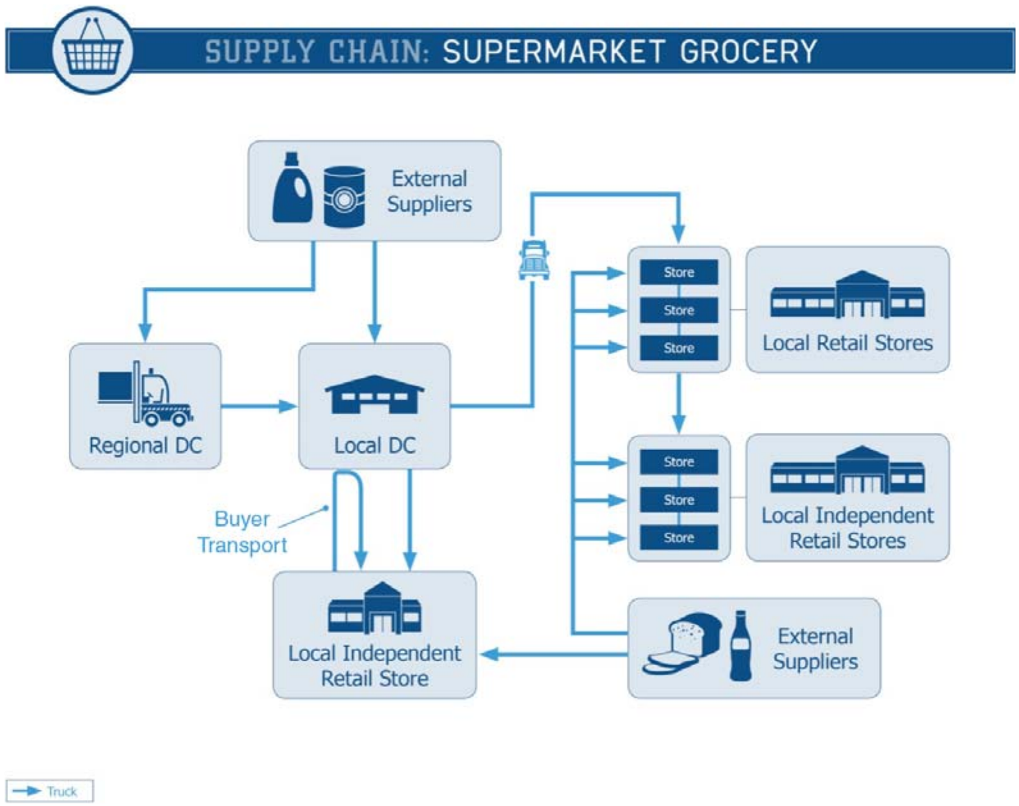
Overview

This illustration portrays the supply chain of a national grocery chain operating both as a retailer and a wholesaler. It is a large-scale distribution business serving independent retailers in addition to supplying its own stores. The company specializes in distributing both dry grocery products and frozen foods. Products are received from suppliers at one of the company's regional facilities and then transported by truck to company DCs. The DCs provide products to both the company's retail stores and the wholesale customers. Most movements throughout the supply chain are handled by truck, although a small fraction of inbound deliveries from suppliers are carried by rail. Trucks handling store deliveries may make a single stop for large recipients, or make several stops in sequence for smaller outlets. Stores also receive a certain amount of product directly from local and regional vendors. See Exhibit A-4.

Performance

The company continuously seeks new technologies to boost fleet performance. All fleet trucks are equipped with satellite devices to record arrival and departure times, travel speed, idle time, and other critical information. So far, the technology has lead to a 30 percent reduction in idle run time

Exhibit A-4. Supermarket flowchart.



across the fleet. Another example of the company's adoption of technology is the recent installation of newly designed truck mud flaps, which simultaneously channel rain water more efficiently and reduce air drag. This simple change is expected to diminish fuel consumption by 2 percent.

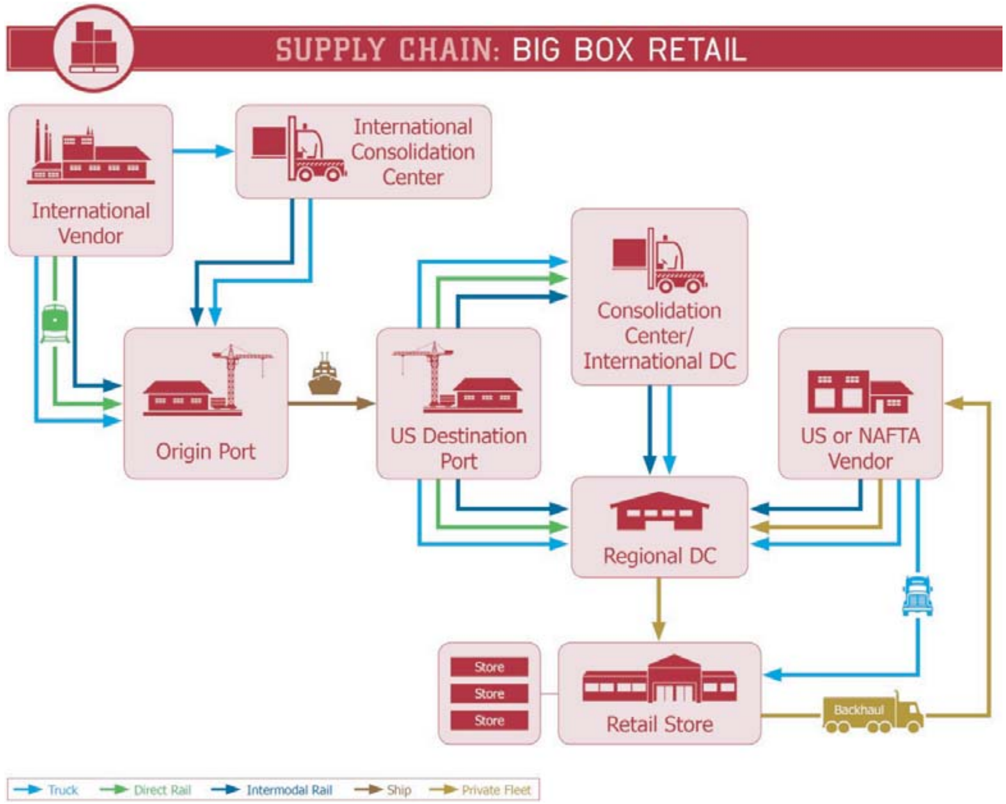
There are many external barriers to optimal fleet performance over which the company has less control. General traffic congestion in many metropolitan areas causes delays for delivery drivers. Lane closures, ramp closures, and merging lanes on major corridors cause numerous delays and additional truck miles. Also, since access to delivery destinations can be restricted by ordinance during certain time periods, drivers may be forced to make deliveries under less efficient traffic conditions. Additional performance hindrances are associated with physical access to the delivery locations, which may be impeded because of utility poles, medians, or other physical structures. Finally, the commonplace lack of truck stops makes it hard for drivers to find convenient places to take needed rest breaks.

Case Illustration 9: Big Box Retail Supply Chain

Overview

Although it handles a diverse selection of goods, the supply chain for a large chain of big box retail stores is based on a relatively simple model. Most goods are delivered directly from product vendors to one of the company's regional DCs or to a consolidation/deconsolidation center and then to the regional DC. This inbound transport stage is often arranged and controlled by the retailer, but some suppliers prefer to handle shipments themselves. Products can move from the vendor to the DC or between DCs by truck, rail direct—siding to siding—or via intermodal

Exhibit A-5. Big box retail flowchart.



containers. After products are sorted at the regional DCs, trucks, either for-hire or the company's private fleet, transport goods to specific stores in an extensive retail network. Generally, a truck trip entails a single delivery to a single store (but each store can receive multiple deliveries). The duration of most store delivery trips is limited to allow the roundtrip to be completed within a single work day. Whenever possible, the company will arrange for an empty delivery truck to pick up a vendor shipment on its return trip to the regional DC. See Exhibit A-5.

Performance

Minimizing vehicle miles traveled is a critical performance target for this company's fleet. In recent years, routing improvements, fully loading trailers, and packaging initiatives have allowed the company to eliminate hundreds of millions of miles while still increasing store deliveries by hundreds of millions of cases. Reducing product packaging cuts transportation costs for the vendor shipping to DCs, and for the retailer delivering to stores; the combination produces a double-digit percent reduction in truck volume. The company uses satellite tracking to improve truck routing and manage congestion, and voice-controlled onboard navigation for safety. The company is experimenting with truck engines operating on natural gas, waste oil, and electricity to improve energy efficiency. All trucks in the fleet have been supplied with energy saving technologies like auxiliary power units (APUs) to reduce the need to idle diesel engines for cooling or other power needs.

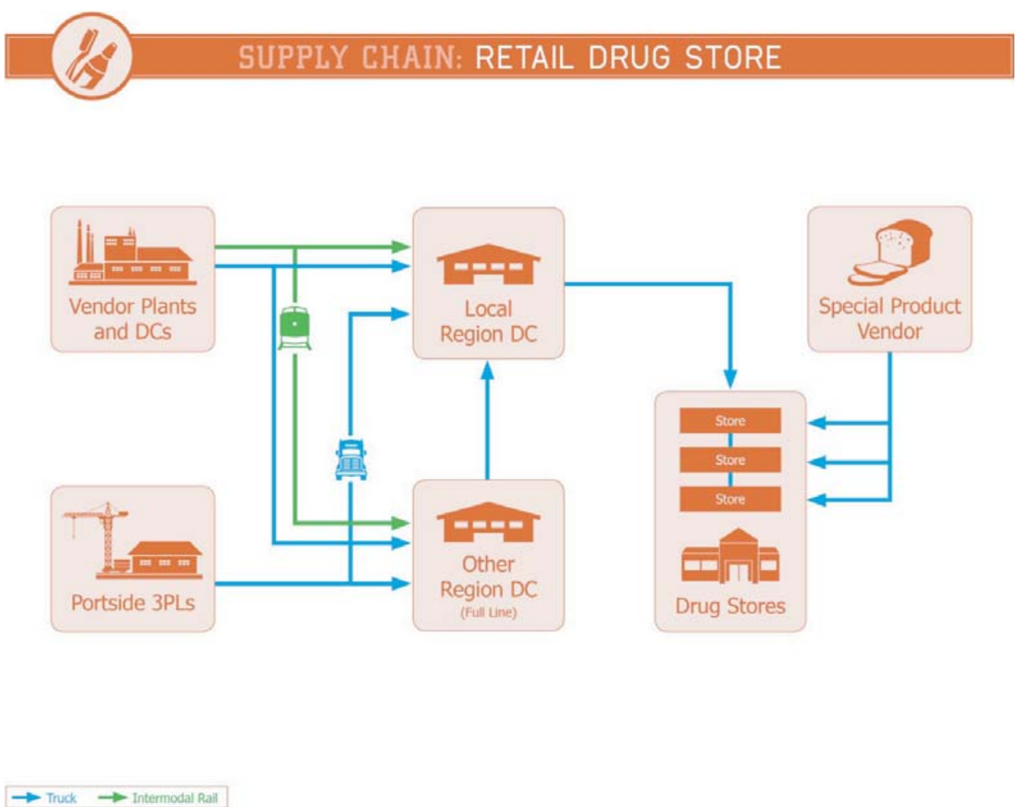
Traffic congestion is a significant barrier to efficient operations and afflicts most of the largest cities. The company pays an extra stipend to drivers who work in highly congested conditions; in some areas, the company splits city distribution into two smaller DC service areas. This enables store deliveries to be approached from two separate directions and eliminates the need for stem travel to traverse the entire metropolitan district. The greatest external performance barriers, both within the urban context and outside it, are inconsistent laws and regulations including bridge limits, size and weight restrictions, and noise ordinances. Many stores are in areas where there are noise abatement ordinances in effect during specific time periods. Although nighttime deliveries are generally preferable from a traffic and store requirement point of view, these ordinances can force trucks to avoid store deliveries during otherwise optimal hours.

Case Illustration 10: Retail Drug Store Supply Chain

Overview

The retail drug store supply chain is a relatively simple system that moves product from various vendors to the company's regional DCs and from there to specific retail stores. Given the diversity of goods available for purchase at contemporary drug stores, products can originate essentially anywhere domestically or may be imported from overseas. Regardless of origin and type, the vast majority of goods pass through a regional DC that uniquely serves a specific set of retail stores in a surrounding territory. Most inbound goods are trucked to DCs from locations 1 or 2 days away; a minority is shipped by rail intermodal. Products not stocked by the serving DC are supplied by truck from another but are cross-docked (sorted and transloaded, but not stored) through the serving facility. Store deliveries are handled either by the company's private truck fleet, or by a third party providing dedicated truck service. With the exception of a handful of vendor-direct products like bread and milk, everything in the store (including pharmaceuticals) arrives in a single, usually weekly shipment from one DC. The DC serves a radius of several hundred miles, and delivery trucks working within it make three to four stops per trip. See Exhibit A-6.

Exhibit A-6. Retail drug store flowchart.



Performance

Delivery performance is carefully monitored, both for goods inbound to DCs and outbound deliveries to retail outlets. Ship-to-arrive dates are indicated on purchase orders for vendor supplies, set plus or minus 2 days, and inbound trailers are permitted a 30-minute delivery window once shipped. DC inbound service is 97.5 percent on time to appointments. On the outbound trips, delivery service to stores must occur within 15-minute delivery windows, and is tracked in trucks with onboard computers. Store delivery performance is 99 percent on time to the first delivery, which is the end of the initial stem and the beginning of a multi-stop sequence. DCs typically are 30 minutes from cities and trucks depart in the early morning, allowing stem travel to begin before rush hour.

The biggest liabilities to the company are significant oversupply or undersupply of products at a retail location. The company closely tracks trends and forecasts, and buyers know every day what sales have been. Most stores have very little space for excess inventory, but stores also should not run out of specific items. Although DCs are servicing store demand, they don't replenish based on point-of-sale volume, but rather on stock draw from the DC. Vendors are allowed 7 to 10 days lead time on orders to supply products to the regional DC, and the company keeps 1 week of safety stock; thus, DCs need to keep 3 weeks' total inventory. Pharmaceutical inventories are less because they turn quickly, and the company keeps close watch on stocks; pharmaceutical deliveries generally are not performed against urgent deadlines, because the company keeps abreast of demand.

Case Illustration 11: Hospital Supply Chain

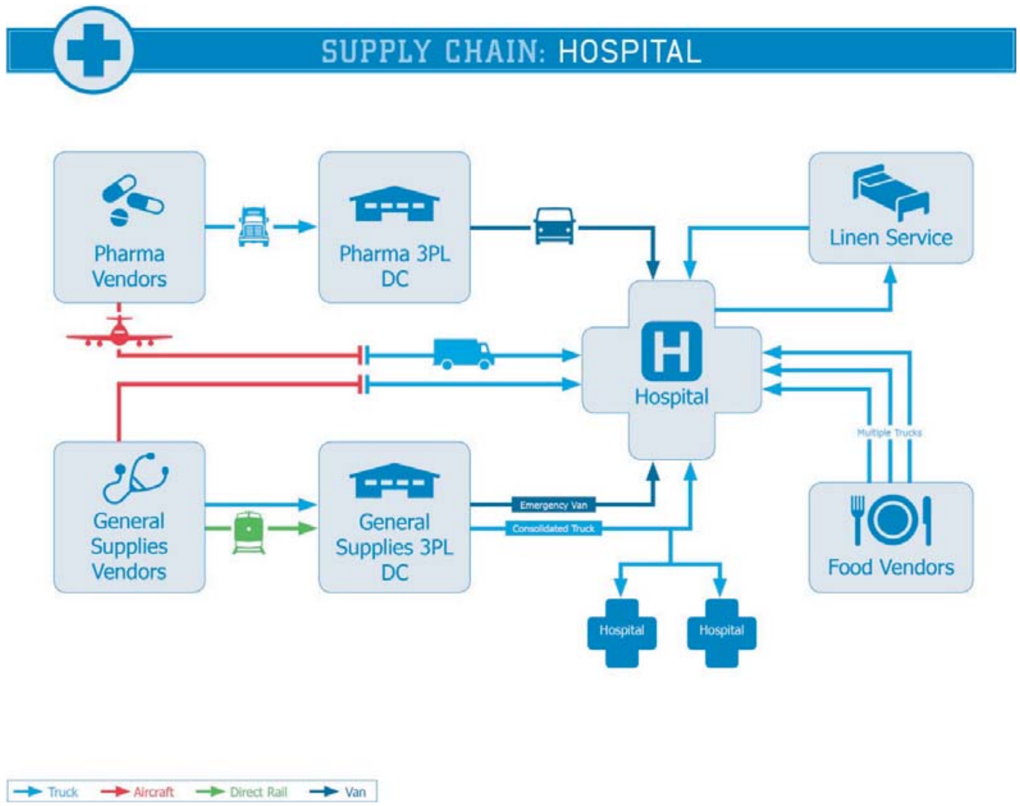
Overview

Supplies to this full-service hospital come through four principal channels: general medical care supplies, pharmaceuticals, food, and a miscellaneous group of which laundry is a major component. All supplies are delivered to the hospital by truck, and most from facilities within 30 to 50 miles. General supplies and pharmaceuticals are staged to the facility from regional DCs operated by 3PL providers, contracted by a multi-hospital organization of which the one illustrated is a member. These DCs receive and consolidate products purchased by this hospital and others, or by the 3PL for sale to these entities. Goods come from vendor plants and distribution points all over the country, arriving to the DCs by truck and occasionally by rail for certain high-volume general supplies. Consolidated hospital deliveries take place daily—for this facility with a single truck, and for larger facilities with multiple trucks—emergency deliveries are accommodated by vans from the DC as needed. Goods are unloaded at the receiving dock, presorted and marked for distribution to care wards by hospital personnel, or for stock in the onsite warehouse. Incidental volume, unique or emergency supplies not stocked by the DC may be procured by the hospital directly from vendors and delivered by parcel carriers. Food products are supplied by multiple vendors, food service providers, and distributors, and are staged by truck from regional plants and DCs. Laundry is handled by a national service with a local facility that delivers fresh linens and collects soiled materials by truck daily. See Exhibit A-7.

Performance

The hospital sets a main performance target of a 97.5 percent fill rate for medical supplies, implying that it should almost never be out of stock. Its 3PLs periodically examine the hospital's handling process and inventory procedures, resulting in recommendations that help both the hospital and its suppliers to improve and hit the target fill rate. The criticality of requirements

Exhibit A-7. Hospital flowchart.



for some materials, and the risks associated with failure of even simple things like clean linens, mean that supplies must be highly reliable and disruptions rapidly remediable. Nevertheless, the volume and routine use of many items allows dependable systems to be established without regular resort to urgent and expedited replenishment. The supply chains of the hospital and its 3PL partners are designed around these factors.

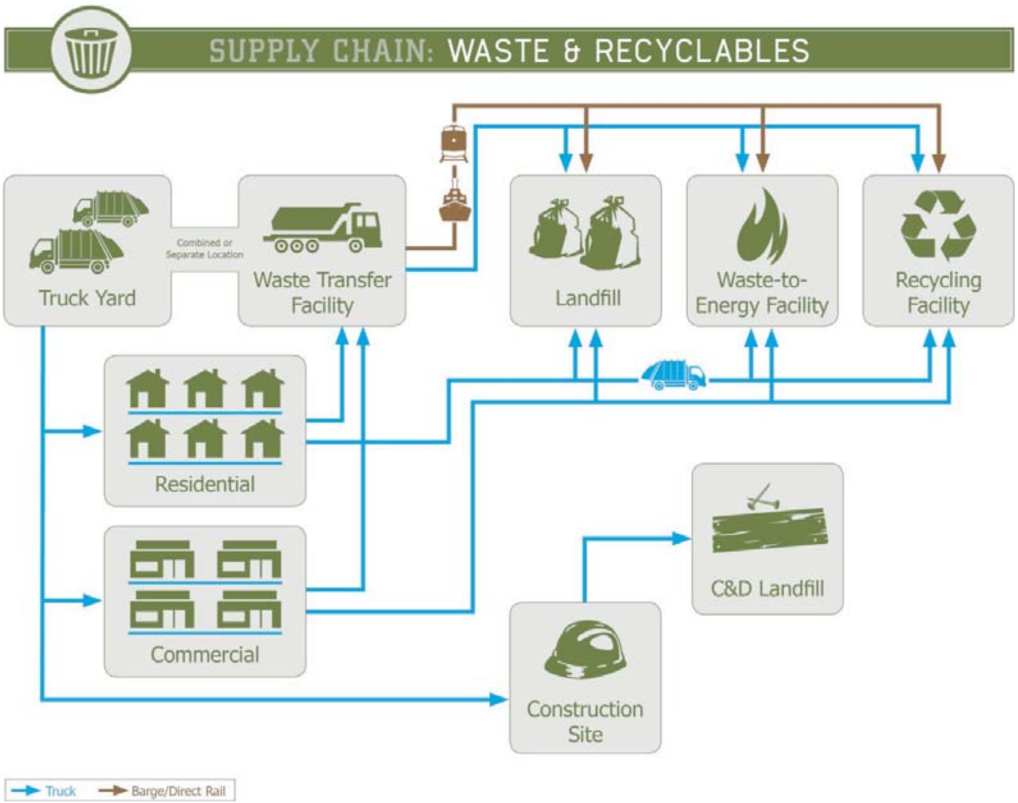
Deliveries of essential supplies are made daily on fixed schedules. To avoid traffic congestion and because of the narrow streets surrounding many city hospitals, these are generally set early in the morning. Urban neighborhood lobbies often oppose the presence of trucks during the day, and do not want their noise at night, so that balancing the needs of hospitals with physical and political factors is a common challenge to supply chain logistics.

Case Illustration 12: Waste & Recyclables Supply Chain

Overview

The waste and recyclables supply chain can be viewed as the reverse of a typical goods delivery supply chain. Rather than distributing products from a central location, waste vehicles transport materials from dispersed locations to central disposal facilities. The collection and disposal of solid waste and recycling materials is managed by both public- and private-sector service providers. Private-sector waste companies and municipal waste departments operate in much the same way. Both solid waste and recycling waste is collected by special vehicles directly from residential and commercial generator locations. Frequently, these vehicles bring the waste directly to disposal locations such as municipal solid waste landfills, construction and demoli-

Exhibit A-8. Waste and recyclables flowchart.



tion debris landfills, recycling facilities or mixed-waste recycling facilities, and waste-to-energy facilities. However, if such destination facilities are far away, the waste may first be brought to a waste transfer facility for consolidation and loading onto lighter weight container trucks, trains, or barges. See Exhibit A-8.

Performance

Weight restrictions are often the largest barriers to the efficient movement of waste. For instance, packer trucks are designed to carry up to 65,000 pounds, but weight restrictions on bridges and elsewhere generally prevent this. If it happens to rain, waste can actually absorb so much water that weight violations occur inadvertently.

It is important for trucks to keep moving along routes and onward through the disposal process, especially for the private-sector collection companies. However, there are many barriers to this in the urban environment. Blocked access to collection bins or alleyways, traffic congestion, and long waits at disposal facilities can cause schedule delays. It is unsafe for collection and transfer staff to rush their own work to compensate for such delays. For most waste haulers, a preferred solution to some of these delay problems would be nighttime waste collection, ideally between 10 P.M. and 6 A.M. Some cities, such as Jersey City and San Francisco, have permitted this. However, nighttime waste collection is a politicized issue. Even when operating during the day, there are complaints about waste collection truck noise, particularly in denser urban areas.

APPENDIX B

References and Resources

References

Beagan, Daniel, Fischer, Michael, and Kuppam, Arun. September 2007. *Quick Response Freight Manual II.* USDOT/FHWA FHWA-HOP-08-010.

Cambridge Systematics, Inc., Transmanagement, Inc., Transtech Management, Inc., and Heanue, K. 2007. *NCHRP Report 570: Guidebook for Freight Policy, Planning, and Programming in Small- and Medium-Size Metropolitan Areas,* Transportation Research Board, Washington, D.C.

Cambridge Systematics, Inc. and GeoStats, LLP. 2010. *NCFRP Report 8:* Freight-Demand Modeling to Support Public-Sector Decision Making, Transportation Research Board, Washington, D.C., p 3.

Rodrigue, Jean-Paul, Comtois, Claude, and Slack, Brian. 2009. *The Geography of Transport Systems,* 2nd ed, New York: Routledge.

Deitz, Richard. February/March 2006. *Current Issues in Economics and Finance.*

Laeser, Edward, Kolko, Jed, and Saiz, Albert. 2000. "Consumer City," National Bureau of Economic Research, http://www.nber.org/papers/w7790

Lakshmanan, T. R., Anderson, William P. January 2002. *Transportation Infrastructure, Freight Services Sector and Economic Growth: A Synopsis.* FHWA.

Lomax, T. J., Schrank, D. L., and Turner, S. M. December 2010. *TTI's 2010 Urban Mobility Report,* Texas Transportation Institute, Texas A&M University System, p 1.

Porter, Michael E., Harvard University et al. 2002. "Atlanta-Columbus: Clusters of Innovation Initiative."

Reebie Associates et al. 2003. "The Economic Impact of Rail to the City of Chicago." Chicago Department of Transportation.

Strauss-Wieder, Anne. 2003. *NCHRP Synthesis 320: Integrating Freight Facilities and Operations with Community Goals.* Transportation Research Board, Washington, D.C.

U.S. Census Bureau. (2009). Population and Percent Distribution by Core-Based Statistical Area (data file), retrieved from http://www.census.gov/popest/estimates/html

U.S. Census Bureau. Online Glossary. http://factfinder.census.gov/home/en/epss/glossary_a.html

U.S. Census Bureau. "2008 National Population Projections" (released August 2008). http://www.census.gov/population/www/projections/2008projections.html

USDOT, RITA, Bureau of Transportation Statistics and U.S. Department of Commerce, U.S. Census Bureau. December 2009. 2007 Economic Census: Transportation Commodity Flow Survey.

Wilson, Rosalyn. June 2009. *20th Annual State of Logistics Report,* Council of Supply Chain Management Professionals. Presented at the National Press Club, July 17, 2009.

Wilson, Rosalyn. 2010. *Annual State of Logistics Report.* Council of Supply Chain Management Professionals.

Resources

BESTUFS Good Practice Guide on Urban Freight Transport. 2007. www.bestufs.net

Bok, Susan. *Improving Truck Movement in Urban Industrial Districts: Application of GIS, Accident and Field Data.* Paper presented at the 2006 METRANS conference. Abstract available on http://www.usc.edu/schools/price/research/publications/recent_publications.html

Chatterjee, Arun. 2006. "Curbside Truck Loading in Downtown Areas." *Talking Freight.*

Chatterjee, Arun. "Freight Transportation Planning for Urban Areas." *ITE Journal,* 74(12), 20–25.

Edwards and Kelcey, Inc., *2007 Chicago Downtown Freight Study.* Chicago Department of Transportation.

Forbes, Gerald, December 2010. "Urban Roadway Classification before the Design Begins," *Transportation Research Board Circular E-C019: Urban Street Symposium.* Transportation Research Board, Washington, D.C.

HDR Engineering, Inc. 2006. *Downtown Orlando Transportation Plan: Final Report.* City of Orlando.

Lethco, Trent, et al., 2008. *A Street Management Framework for Lower Manhattan: The Downtown of the 21st Century.* Article submitted for presentation and publication for TRB 88th Annual Meeting.

Lu, Xiao-Yun, et al. 2007. *Investigating the Possibility of Using BART for Air Freight Movement.* 2nd National Urban Freight Conference, Dec. 5–7, 2007, Long Beach, California.

Morris, Anne. 2009. *The Last Mile—Developing Efficient Freight Operations for Manhattan's Buildings.* Steven L Newman Real Estate Institute. Available at http://aux.zicklin.baruch.cuny.edu/newman/pdf/thelastmile.pdf

New York Department of Transportation. 2002. *Off-Loading Dock Study.*

OECD Publishing. 2003. *Delivering the Goods: 21st Century Challenges to Urban Goods Transport.* Organisation for Economic Co-operation and Development.

Pivo, Gary, et al. 2002. "Learning from Truckers: Truck Drivers' Views of the Planning and Design of Urban and Suburban Centers." *Journal of Planning and Research,* 19:1.

Scott, Marina, et al. 2009. *Improving Freight Movement in Delaware Central Business Districts.* Delaware Department of Transportation.

Seattle Department of Transportation, 2008. *10 Best Practices in Freight Movement,* "10A: Freight Mobility" In *Seattle Urban Mobility Plan.* Available at http://www.seattle.gov/transportation/docs/ump/10%20SEATTLE%20Best%20Practices%20in%20Freight%20Movement.pdf

Transportation Research Board. 2003. *NCHRP Synthesis 320: Integrating Freight Facilities and Operations with Community Goals.* Washington, D.C.

FHWA. 2005. *Assessing the Effects of Freight Movement on Air Quality on a National and Regional Level.*

USDOT, FHWA, Office of Freight Management & Operations. 2009. *Urban Freight Case Studies: Los Angeles.*

USDOT, FHWA, Office of Freight Management & Operations. 2009. *Urban Freight Case Studies: New York.*

USDOT, FHWA, Office of Freight Management & Operations. 2009. *Urban Freight Case Studies: Orlando.*

USDOT, FHWA, Office of Freight Management & Operations. 2009. *Urban Freight Case Studies: Washington D.C.*

Volpe National Transportation Center. 2003. *District of Columbia Motor Carrier Management and Threat Assessment.* District of Columbia Department of Transportation.

Wilbur Smith Associates and S. R. Kale Consulting, LLC. January 2009. *A Guidebook for Engaging the Private Sector in Freight Transportation Planning,* USDOT/FHWA. FHWA-HEP-09-015.

Abbreviations and acronyms used without definitions in TRB publications:

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	Air Transport Association
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
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