SHRP 2
STRATEGIC HIGHWAY RESEARCH PROGRAM
Accelerating solutions for highway safety, renewal, reliability, and capacity

Freight Demand Modeling and Data Improvement Strategic Plan

S2-C20-RW-2

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

THE SECOND STRATEGIC HIGHWAY RESEARCH PROGRAM

Freight Demand Modeling and Data Improvement Strategic Plan

SHRP 2 Report S2-C20-RW-2

Keith M. Chase and Patrick Anater
Gannett Fleming, Inc.

Thomas Phelan
Eng-Wong, Taub and Associates

TRANSPORTATION RESEARCH BOARD

Washington, D.C.
2013
www.TRB.org

SUBSCRIBER CATEGORIES

Data and Information Technology
Freight Transportation
Highways
Planning and Forecasting

THE SECOND STRATEGIC HIGHWAY RESEARCH PROGRAM

America's highway system is critical to meeting the mobility and economic needs of local communities, regions, and the nation. Developments in research and technology—such as advanced materials, communications technology, new data collection technologies, and human factors science—offer a new opportunity to improve the safety and reliability of this important national resource. Breakthrough resolution of significant transportation problems, however, requires concentrated resources over a short time frame. Reflecting this need, the second Strategic Highway Research Program (SHRP 2) has an intense, large-scale focus, integrates multiple fields of research and technology, and is fundamentally different from the broad, mission-oriented, discipline-based research programs that have been the mainstay of the highway research industry for half a century.

The need for SHRP 2 was identified in *TRB Special Report 260: Strategic Highway Research: Saving Lives, Reducing Congestion, Improving Quality of Life,* published in 2001 and based on a study sponsored by Congress through the Transportation Equity Act for the 21st Century (TEA-21). SHRP 2, modeled after the first Strategic Highway Research Program, is a focused, time-constrained, management-driven program designed to complement existing highway research programs. SHRP 2 focuses on applied research in four areas: Safety, to prevent or reduce the severity of highway crashes by understanding driver behavior; Renewal, to address the aging infrastructure through rapid design and construction methods that cause minimal disruptions and produce lasting facilities; Reliability, to reduce congestion through incident reduction, management, response, and mitigation; and Capacity, to integrate mobility, economic, environmental, and community needs in the planning and designing of new transportation capacity.

SHRP 2 was authorized in August 2005 as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The program is managed by the Transportation Research Board (TRB) on behalf of the National Research Council (NRC). SHRP 2 is conducted under a memorandum of understanding among the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the National Academy of Sciences, parent organization of TRB and NRC. The program provides for competitive, merit-based selection of research contractors; independent research project oversight; and dissemination of research results.

SHRP 2 Report S2-C20-RW-2
ISBN: 978-0-309-12943-5

COPYRIGHT INFORMATION

Note: SHRP 2 report numbers convey the program, focus area, project number, and publication format. Report numbers ending in "w" are published as web documents only.

NOTICE

The project that is the subject of this report was a part of the second Strategic Highway 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 committee 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 committee 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 second Strategic Highway 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.

SHRP 2 REPORTS

Available by subscription and through the TRB online bookstore: www.TRB.org/bookstore

Contact the TRB Business Office: 202.334.3213

More information about SHRP 2: www.TRB.org/SHRP 2

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, upon 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

SHRP 2 STAFF

Ann M. Brach, *Director*
Stephen J. Andrle, *Deputy Director*
Neil J. Pedersen, *Deputy Director, Implementation and Communications*
James Bryant, *Senior Program Officer, Renewal*
Kenneth Campbell, *Chief Program Officer, Safety*
JoAnn Coleman, *Senior Program Assistant, Capacity and Reliability*
Eduardo Cusicanqui, *Financial Officer*
Walter Diewald, *Senior Program Officer, Safety*
Jerry DiMaggio, *Implementation Coordinator*
Shantia Douglas, *Senior Financial Assistant*
Charles Fay, *Senior Program Officer, Safety*
Carol Ford, *Senior Program Assistant, Renewal and Safety*
Elizabeth Forney, *Assistant Editor*
Jo Allen Gause, *Senior Program Officer, Capacity*
Rosalind Gomes, *Accounting/Financial Assistant*
Abdelmename Hedhli, *Visiting Professional*
James Hedlund, *Special Consultant, Safety Coordination*
Alyssa Hernandez, *Reports Coordinator*
Ralph Hessian, *Special Consultant, Capacity and Reliability*
Andy Horosko, *Special Consultant, Safety Field Data Collection*
William Hyman, *Senior Program Officer, Reliability*
Michael Marazzi, *Senior Editorial Assistant*
Linda Mason, *Communications Officer*
Reena Mathews, *Senior Program Officer, Capacity and Reliability*
Matthew Miller, *Program Officer, Capacity and Reliability*
Michael Miller, *Senior Program Assistant, Capacity and Reliability*
David Plazak, *Senior Program Officer, Capacity*
Monica Starnes, *Senior Program Officer, Renewal*
Onno Tool, *Visiting Professional*
Dean Trackman, *Managing Editor*
Connie Woldu, *Administrative Coordinator*
Patrick Zelinski, *Communications/Media Associate*

ACKNOWLEDGMENTS

This work was sponsored by the Federal Highway Administration in cooperation with the American Association of State Highway and Transportation Officials. It was conducted in the second Strategic Highway Research Program, which is administered by the Transportation Research Board of the National Academies. The project was managed by David Plazak, Senior Program Officer for SHRP 2 Capacity.

The research described in this report was performed by Gannett Fleming, Inc., supported by Arizona State University; Avant IMC; E-Squared Engineering; Eng-Wong, Taub and Associates; Global Quality and Engineering; Strategy Solutions; the University of Texas at Austin; Whitehouse Group; and Wordsworth Communications. Keith Chase of Gannett Fleming was the principal investigator. The other authors are Patrick Anater of Gannett Fleming and Thomas Phelan of Eng-Wong, Taub and Associates. The authors acknowledge the contributions to the research from Chandra Bhat of the University of Texas at Austin, Todd Brauer and Wade White of Whitehouse Group, James Brock of Avant IMC, Richard Easley of E-Squared Engineering, Julia Johnson of Wordsworth Communications, and Ram Pendyala of Arizona State University.

The research team acknowledges with appreciation the time and efforts of the TRB Visualization Committee, as well as the many stakeholders who were involved in outreach meetings and participated in surveys. Special appreciation is extended to those who submitted papers for consideration and presentation at the 2010 Innovations in Freight Modeling and Data Symposium.

FOREWORD

David J. Plazak
SHRP 2 Senior Program Officer, Capacity

Freight traffic has been growing faster than passenger traffic on the nation's highway network. As a result, freight bottlenecks have begun to develop at various points throughout the network. These bottlenecks have historically been near ports and other intermodal facilities. However, travel forecasts are beginning to show the effects of growing freight traffic on congestion on urban freeways, urban arterials, and some cross-country routes in rural areas. Being able to understand freight flows and forecast freight demand is taking on greater and greater importance.

The second Strategic Highway Research Program (SHRP 2) initiated two projects (Capacity Projects C15 and C20) designed to improve the nation's ability to plan for increased freight-related traffic and to begin to address the growing issue of freight bottlenecks. Capacity Project C20, which was the first one, assessed the state of the practice of freight demand modeling and freight data as they relate to highway capacity planning and programming. This assessment concludes that the state of freight demand modeling has been relatively stable during the past several decades, unlike demand modeling for passenger travel, which is advancing toward activity-based modeling. The state of the practice in freight data has also been relatively stable; however, promising developments based on new information technologies may greatly improve transportation planners' access to freight data. Examples include global positioning system data from trucks and (potentially) private supply chain data that could be aggregated for public sector planning purposes.

Accelerated innovation is needed so that freight demand modeling and freight data can better serve the needs of public sector decision making regarding highway capacity investments. The C20 Strategic Plan suggests strategic research initiatives that could begin to improve the practice of freight demand modeling and freight data. These are grouped into themes such as knowledge gaps, modeling, data, and data visualization. Knowledge gaps are a key issue because the perspectives and business planning time frames of the private and public sectors are so divergent with respect to freight. The

private sector focuses on optimizing short-term supply chains and operations, but the public sector focuses on making investments that may take a decade or more to put in place. Bridging this knowledge gap is essential to making progress in freight capacity planning. Visualization technologies are promising for helping freight decision makers and stakeholders understand each other's perspectives.

Since the responsibility for gathering freight data and conducting freight demand modeling is spread among a large number of agencies and organizations, the C20 Strategic Plan puts forward a potential model for organizing cooperation to encourage innovation and moving forward. One model for advancing the state of the practice in freight demand modeling and freight data is to hold innovation symposia. A pilot effort was initiated in September 2010 as part of the SHRP 2 C20 research project.

CONTENTS

1 CHAPTER 1 **Introduction**

3 CHAPTER 2 **Strategic Plan Summary**

5 CHAPTER 3 **Current State of the Practice**

5 Background
6 Summary Assessment of Current Freight Models, Data, and Techniques

8 CHAPTER 4 **Freight Decision-Making and Data Needs**

8 Background
9 Summary of Decision-Making and Data Needs

11 CHAPTER 5 **Sample Research Initiatives**

11 Strategic Vision for Moving Forward
13 Sample Research Initiative A
14 Sample Research Initiative B
15 Sample Research Initiative C
16 Sample Research Initiative D
17 Sample Research Initiative E
19 Sample Research Initiative F
20 Sample Research Initiative G

22 Sample Research Initiative H
23 Sample Research Initiative I
24 Sample Research Initiative J
25 Sample Research Initiative K
26 Sample Research Initiative L
28 Sample Research Initiative M

30 CHAPTER 6 **Future Directions**

30 Background and Purpose
31 Strategic Objectives
31 Organizing Concept: Global Freight Research Consortium
33 GFRC: A Win–Win Proposition
34 Innovations in Freight Modeling and Data Symposium: A Foundation for Moving Forward
35 GFRC Initiatives and Focus Areas for Achieving Strategic Objectives
37 Achieving Tangible Progress

38 CHAPTER 7 **Conclusion**

40 REFERENCES

1 INTRODUCTION

Freight transportation in the United States has been a topic of growing interest to policy makers, state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and varied stakeholders, particularly since the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. The overarching policy challenge for transportation agencies is to make informed investments in transportation infrastructure that support efficient freight mobility and access. Long-range transportation plans, transportation improvement programs, corridor studies, and project development should have a meaningful freight focus. This need to better integrate freight with transportation planning recognizes the importance of goods movement to economic performance and meeting consumer needs. Progress in freight planning also requires effective communication and coordination with the private sector (shippers and carriers) and local government with respect to development and land use considerations. Although more than 20 years have passed since ISTEA was enacted, accurate and timely freight planning and forecasting still remain formidable challenges with substantial opportunity for improvement.

Transportation investments are capital intensive and represent long-term commitments. It is important that transportation planners possess both the tools and the skills to forecast freight demand and to analyze scenarios and investment alternatives as part of the overall transportation analysis. Travel demand forecasting, however, has historically been oriented toward passenger transportation. Passenger-oriented forecasting models draw on economic and demographic variables that are insufficient and sometimes irrelevant for estimating future freight demand, which is shaped by a much wider range of factors as a result of a complex logistics chain.

Long-range transportation plans, transportation improvement programs, corridor studies, and project development should have a meaningful freight focus.

The SHRP 2 C20 research initiative has been developed to provide the strategic framework for making further inroads in freight forecasting, planning, and data and to accelerate innovative breakthroughs with the aim of integrating freight considerations into the planning process with confidence.

2 STRATEGIC PLAN SUMMARY

The SHRP 2 C20 Freight Demand Modeling and Data Improvement Strategic Plan advances a broad new direction for improving freight planning, promoting continuous innovation for breakthrough solutions to freight analytic and data needs, and fostering a collaborative approach for private, public, and academic stakeholders. The project's full technical report provides in-depth information for each section of this document.

The Strategic Plan provides summaries of the current state of the practice and a review of the decision-making needs related to freight transportation. It provides important context for presenting the strategic objectives, the sample research initiatives, and future directions for moving forward.

Seven strategic objectives have been identified as the basis for future innovation in freight travel demand forecasting and data and to guide both near-term and long-term implementation. The objectives reflect the desired direction for enhanced freight planning, forecasting, and data analysis as expressed by the many stakeholders who participated in this project. The objectives aim to stimulate innovation through the avenues laid out in the Strategic Plan and will provide the basis for evaluating progress over time.

The strategic objectives are

1. Improve and expand the knowledge base for planners and decision makers;
2. Develop and refine forecasting and modeling practices that accurately reflect supply chain management;
3. Develop and refine forecasting and modeling practices based on sound economic and demographic principles;
4. Develop standard freight data (e.g., Commodity Flow Survey [CFS], Freight Analysis Framework [FAF], and possible future variations of these tools) to smaller geographic scales;

5. Establish methods for maximizing the beneficial use of new freight analytic tools by state DOTs and MPOs in their planning and programming activities;
6. Improve the availability and visibility of data among agencies and between the public and private sectors; and
7. Develop new and enhanced visualization tools and techniques for freight planning and forecasting.

The sample research initiatives represent a near-term opportunity to advance research that addresses freight-related decision-making needs. These ideas for short-term research have been vetted by a range of stakeholders.

The future directions lay out an organizational approach to continue to identify freight modeling and data priority needs, spur innovative ideas, and foster breakthrough solutions for wide application. The Global Freight Research Consortium (GFRC) identified as part of this research effort is seen as an effective means for making continued analytic breakthroughs and targeting future supporting research toward that end.

Seven strategic objectives have been identified as the basis for future innovation in freight travel demand forecasting and data and to guide both near-term and long-term implementation.

The ultimate long-term goal for the research documented is to build on Strategic Objectives 2 and 3. Ultimately, this research will lead to the development of a full network-based freight forecasting model that incorporates all modes of freight transport and accurately reflects the various factors related to the supply of freight infrastructure and services (Strategic Objective 2) and the underlying demand for these services (Strategic Objective 3). This model will effect a dramatic change in current freight planning and forecasting. It is a highly ambitious endeavor because of the complexity of freight transportation and the numerous elements that are necessary to achieve this long-term goal.

The other five strategic objectives are tied to this goal through the development of the applicable knowledge base needed to further the goal (Strategic Objective 1), the development and dissemination of data necessary to support it (Strategic Objectives 4 and 6), and the development of enhanced methods for disseminating information from these analytic tools for public stakeholders (Strategic Objective 5) and decision makers (Strategic Objective 7).

Although development of a full multimodal network-based freight forecasting model is the ultimate long-term goal, it is important to note that freight transportation has traditionally not lent itself to innovative planning and forecasting practices. This is because freight transport has historically been a relatively uncomplicated, low-tech process. In addition, past experience in freight transportation does not necessarily correlate well with future freight activity due to short-term changes in the forces of supply and demand. Therefore, accurately planning for freight transportation will require a radical paradigm shift in the way the practice is conducted.

3 CURRENT STATE OF THE PRACTICE

BACKGROUND

Major changes in domestic and global freight transportation have occurred over the past several decades. These changes have been driven by population growth, changes in consumer behavior, dynamic market and economic forces, and advances in transportation and information technology.

Public and private decision makers responsible for understanding the implications of these trends in relation to transportation investment and system operation must contend with the influence of increasingly complex supply chains and logistics processes. However, public sector transportation decision making remains relatively uninformed with respect to freight transportation due to the limits of the current models. These models are unable to accurately forecast the impacts of freight on transportation systems, thus limiting the possibilities for policies and improvements to solve expected problems.

The practice of freight demand forecasting has received greater attention with the recognition that efficient freight and commercial truck travel is essential to national, state, and local transportation infrastructure planning and economic well-being. Incorporating freight movement considerations in the transportation planning process is difficult, but these considerations are increasingly critical to the ability to forecast long-term transportation trends and plan for future needs.

SUMMARY ASSESSMENT OF CURRENT FREIGHT MODELS, DATA, AND TECHNIQUES

Freight planning and forecasting employ a variety of tools and techniques, including economic flow models, land use and economic input–output analyses, commodity-based models, vehicle- or trip-based models, and other analytic tools. The common underlying objective is to document baseline conditions related to freight movement and estimate future activity based on metrics involving economic activity, demographic changes, employment by economic sector, supply and demand of raw materials and finished products by consumers and industries, commodity flows, and other factors. Different tools are used by planners for different geographic scales, depending on the issues and scale of needs.

The data used in these freight planning and forecasting processes are drawn from predominantly public resources. Freight models developed and maintained by public agencies typically use the following data sources:

- Local data sources (including traffic counts, traffic forecasts, demographic data and forecasts, and land use information);
- National Transportation Atlas Database;
- CFS;
- FAF;
- Transearch data;
- Other federal resources (e.g., U.S. Census Bureau, Bureau of Transportation Statistics, Surface Transportation Board Carload Waybill Sample); and
- Private sector data sets (e.g., private shipper data, purchase orders, bills of lading, ship manifests).

The underlying methodology for most tools used in freight planning and forecasting includes using these data resources to (1) document existing demographic and employment conditions and characteristics of freight transportation (including tonnage, geographic origins and destinations, and mode of transport) and (2) estimate future measures of freight transportation for these same parameters (tonnage, origins, destinations, mode of transport) based on changes in population and employment, productivity improvements by industry, and other economic forecasts. Depending on the geographic scale of the forecasting effort in question, the ultimate objective of freight planning and forecasting is to forecast freight activity and its effects on local or regional conditions related to economic activity, traffic congestion, air quality, and other impacts.

However, current freight planning and forecasting tools, data, and techniques have various limitations. Key shortcomings in the current state of the practice in freight forecasting include the following:

- Existing data resources are best suited to large geographic scales and do not translate well to local planning efforts;

- Current planning tools and data do not accurately reflect the nature of supply chains and increasingly complex logistics practices in freight-dependent industries;
- Documenting the various factors that influence freight transportation needs is challenging because establishing links between disparate data resources (e.g., land use, demographics, employment by industry) and the freight activity that relates to these measures (e.g., truck counts, vessel activity, rail activity) is extremely difficult;
- Transportation forecasting and modeling practices tend to focus on average trip generation rates, but freight activity is heterogeneous and does not lend itself to average rates of production and consumption; and
- The growing role of third-party transportation providers makes freight less visible to many shippers and receivers; thus it is more difficult for the public sector to document detailed freight activity through information gained from traditional shipper surveys.

4 FREIGHT DECISION-MAKING AND DATA NEEDS

BACKGROUND

Establishing a strategic direction for innovative freight research requires an understanding of the decision-making and data needs of state DOTs and MPOs, as well as their perspectives on promising areas of research. It is also important to consider private sector freight decision-making needs, particularly to the extent that they overlap the needs of public agencies.

This section summarizes freight decision-making needs in the public and private sectors derived through extensive outreach in the forms of background research, special meetings, and workshops, including

- State DOT workshops in Ohio and Washington;
- A regional freight stakeholders workshop for the Northeast held in Newark, New Jersey;
- The Innovations in Freight Modeling and Data Symposium in Washington, D.C.;
- Engagement of a range of stakeholders at various conferences, including the American Planning Association and TRB freight and visualization conferences; and
- Validation of draft decision-making needs through a special stakeholders meeting in Washington, D.C.

SUMMARY OF DECISION-MAKING AND DATA NEEDS

The following list highlights those items that stakeholders have most commonly raised as top priorities for freight modeling and data research:

- Freight forecasting and analysis can be enhanced through a recognized and valid inventory of standardized data sources with common definitions;
- A range of analytic tools and applications to address diverse decision-making needs is needed;
- A process is needed to routinely generate new data sources and problem-solving methods;
- Behavior-based facets of freight decision making need to be incorporated into modeling, or at least better understood as important context;
- Industry-level freight data are needed at a subregional level, and there is also a need to better understand local deliveries in urban areas;
- Cost–benefit analysis tools are needed that go beyond traditional financial measures by including direct and indirect benefits and costs (public and private);
- Consideration should be given to developing a statistical sampling of truck shipment data similar to the Carload Waybill Sample available for railroads;
- Better information is needed to understand the nature, volume, and trends of intermodal transfers;
- Attention should be given to using technologies such as global positioning systems (GPS), IntelliDrive, intelligent transportation systems (ITS), and the associated data generated to aid freight planning and modeling;
- Local land use policies and controls should be factored into models to increase the accuracy of freight forecasting at the local level;
- A better understanding is needed of the correlation between freight activity and various economic influences such as fuel price, currency valuation, and macroeconomic trends;
- Methodologies are needed to apply freight forecasts to revenue projections for toll authorities and other funding and finance analyses;
- The ultimate long-term goal is the development of a multimodal, network-based freight demand model that incorporates all modes of transport (e.g., vehicle, railcar, vessel) to a similar level of detail for various geographies;
- A concentrated effort to develop the requisite knowledge and skills that support freight analysis should be emphasized. Stakeholders generally acknowledged that this will need to be accomplished through more training, greater public–private collaboration, and expanded professional development approaches;
- Enhanced tools and processes would be beneficial to measure the accuracy of freight analyses and data forecasts; and

Greater communication and structured information exchanges between the public and private sectors are needed to expand data sharing and to advance required analytic approaches.

- There is a strong interest among highway agencies to develop tools that use freight forecasts to support the agencies' infrastructure design processes.

Greater communication and structured information exchanges between the public and private sectors are needed to expand data sharing and to advance required analytic approaches. The need for greater capacity building can be partially achieved through more routine outreach by planners to shippers and carriers to identify trends, changing decision-making needs, and areas of improvement. Expanded exchange will serve to improve model development and calibration, in addition to improving freight analysis overall through greater understanding of carrier and shipper operations and business practices.

5 SAMPLE RESEARCH INITIATIVES

STRATEGIC VISION FOR MOVING FORWARD

The SHRP 2 C20 research effort culminated in the development of 13 research areas, described in this strategic plan as *sample research initiatives*. Collectively, these sample research initiatives constitute a programmatic approach for systematically improving freight modeling and data availability and forecasting and planning tools. These initiatives are tied to the seven strategic objectives listed in Chapter 2, with the ultimate goal of promoting and cultivating innovation through Strategic Objectives 2 and 3, supported by the innovations in data development in Strategic Objective 4 and visualization in Strategic Objective 7.

Each of the sample research initiatives relates to one or more of the three main research dimensions identified at the 2010 Innovations in Freight Modeling and Data Symposium:

- *Knowledge* relates to a general understanding of freight transportation issues and the extensive array of elements involved in planning and forecasting freight demand;
- *Models* are the tools used to plan and forecast freight transport–related activities at various geographic levels; and
- *Data* are the underlying information resources for modeling and planning efforts; these data often represent an important limitation of modeling.

The sample research initiatives are summarized in Table 5.1. For full descriptions and implementation considerations, see the SHRP 2 C20 technical report. These sample research initiatives are based on the SHRP 2 C20 research conducted, but they should be viewed in their proper context as steps in support of the seven strategic objectives. The specific research projects detailed in the technical report are initial

TABLE 5.1. SAMPLE RESEARCH INITIATIVE

Sample Research Initiatives[a]	Research Dimensions			Strategic Objectives						
	Knowledge	Models	Data	1. Improve and expand knowledge base.	2. Develop modeling methods to reflect actual supply chain management practices.	3. Develop modeling methods based on sound economic and demographic principles.	4. Develop standard freight data to smaller geographic scales.	5. Maximize use of freight tools by public sector for planning and programming.	6. Improve availability and visibility of data between public and private sectors.	7. Develop new and enhanced visualization tools and techniques.
A: Determine the freight and logistics knowledge and skill requirements for transportation decision makers and professional and technical personnel. Develop the associated learning systems to address knowledge and skill deficits.	●			■						
B: Establish techniques and standard practices to review and evaluate freight forecasts.		●		■	□	□				
C: Establish modeling approaches for behavior-based freight movement.	●	●			■					
D: Develop methods that predict mode shift and highway capacity implications of various what-if scenarios.	●	●			■	■				
E: Develop a range of freight forecasting methods and tools that address decision-making needs and that can be applied at all levels (national, regional, state, metropolitan planning organization, municipal).		●	●		■	■	□			
F: Develop robust tools for freight cost–benefit analysis that go beyond financial considerations to the full range of benefits, costs, and externalities.	●	●				□		■		
G: Establish analytic approaches that describe how elements of the freight transportation system operate and perform and how they affect the larger overall transportation system.	●	●				■		□		
H: Determine how economic, demographic, and other factors and conditions drive freight patterns and characteristics. Document economic and demographic changes related to freight choices.	●					■				
I: Develop freight data resources for application at subregional levels.			●		□	□	■			
J: Establish, pool, and standardize a portfolio of core freight data sources and data sets that supports planning, programming, and project prioritization.			●				■	■	□	
K: Develop procedures for applying freight forecasting to the design of transportation infrastructure, particularly pavement and bridges.		●						■		
L: Advance research to effectively integrate logistics practices (private sector) with transportation policy, planning, and programming (public sector).	●				□			■	■	
M: Develop visualization tools for freight planning and modeling through a two-pronged approach of discovery and addressing known decision-making needs.	●	●	●							■

Note: Directly Addresses Objective ■ Indirectly Addresses Objective □

[a] The sample research initiatives outlined as part of the SHRP 2 C20 research project demonstrate how the strategic objectives could be advanced. Each initiative also applies to one or more of the three research dimensions (indicated by ●).

recommendations for potential research to help move this process forward, but many of these are likely to change based on funding sources, industry needs, and developments that spring from some of the other elements of the Strategic Plan (e.g., the GFRC and future data and modeling symposia).

Given that freight transportation is highly dynamic, the research required for planning and decision-making support will evolve over time. An important function for those involved in implementing the Strategic Plan is to periodically assess changing research needs relative to decision-making requirements.

SAMPLE RESEARCH INITIATIVE A

Determine the freight and logistics knowledge and skill requirements for transportation decision makers and professional and technical personnel.
Develop the associated learning systems to address knowledge and skill deficits.

Description

The complex factors that drive freight transportation demand require an understanding of economics, land use, public policy, demographics, finance, and information technology. The education and development of professionals involved in freight planning and forecasting will be an effective strategy for improving freight planning, analysis, and decision making. Successful planning and forecasting in freight transportation can be enhanced through the dissemination of knowledge among professionals whose current training is likely to be oriented toward passenger travel or general transportation issues.

The intermodal revolution of freight transportation in the past several decades, for example, was primarily aimed at enhancing efficiency for private sector interests. The dramatic transformation of freight transportation during recent decades, however, was not reflected in advances in planning practices by state DOTs or MPOs. These advances in freight transportation practices were largely driven by advances in information technology and information management. Consequently, this research is aimed at sparking a revolution in freight planning and forecasting through a broad-based initiative to enhance knowledge of public and private sector interests.

The lack of uniformity in knowledge levels about freight issues in the transportation planning community is compounded by a significant disconnect between the goals and objectives of shippers and carriers in the private sector and planners in the public sector. This research identifies skill sets and techniques to help bridge these gaps and facilitate more effective planning and problem solving. An ideal skill set includes an integrated curriculum with subject areas such as computer science, planning, economics, political science, and organizational skills. Communication skills are also critical for professional development in this area.

This initiative will be implemented in three major research phases:

1. Conducting an extensive knowledge and skills requirements analysis for all levels of transportation professionals and decision makers.

2. Over time, developing, piloting, and evaluating comprehensive knowledge transfer subject matter and media. This phase will include a wide range of approaches, even including brief employment swaps.
3. Developing the supporting organizational and structural approaches, such as national and regional freight innovation academies, to effectively deliver an ongoing knowledge and skills delivery system.

Benefits and Expected Outcomes

- Enhanced performance of individuals and organizations through a greater knowledge of freight and logistics;
- Greater understanding of the need for public planning and analysis to incorporate freight and logistics; and
- Greater collaboration between public and private sectors to provide a much-needed understanding of the discrete segments of the freight transport community, including shippers, carriers, customers, and other elements of the supply chain.

SAMPLE RESEARCH INITIATIVE B

Establish techniques and standard practices to review and evaluate freight forecasts.

Description

Freight modeling, like passenger travel demand modeling, has forecasting capabilities that are used to estimate the movement of freight on highways, railroads, and other elements of the freight transportation system. The effectiveness of these modeling tools is rarely analyzed, mainly because validation processes completed years after forecasts are done are perceived to be of dubious value in light of how rapidly circumstances may change during the planning period.

This research aims at developing practices to review previous freight forecasts over short- and intermediate-term horizons, with a review of factors used in forecasts and a backcasting comparison of actual freight values, mode shares, and other characteristics of freight transportation. In light of the ongoing developments in freight forecasting and the fact that the most robust forecasting tools used by public agencies have been developed within the last two decades, the validation of long-term projections is not considered a near-term research priority.

This research effort will be oriented toward the freight forecasting methods documented in *NCHRP Report 388: A Guidebook for Forecasting Freight Transportation Demand* (Cambridge Systematics 1997) and in National Highway Institute Course 139002: Uses of Multimodal Freight Forecasting in Transportation Planning (Federal Highway Administration 2010). This research involves a historical survey of 15 to 20 public agencies that (1) have used one or more of the various tools described in these publications and (2) have documented or published results from their freight forecasting processes that can be assessed at the present time. The validation research is based on a mix of short-term (up to 3 years from original forecast) and intermediate-term

(3 to 10 years from original forecast) results. The survey will document projected versus actual conditions for these 15 to 20 models as measured by the facility (highway, rail, and terminal) operating characteristics (volumes), mode choice, routing, and commodity flows. The use of these measures will depend on their applicability to individual models.

Benefits and Expected Outcomes

- Improved freight forecasting through a structured learning process related to actual versus projected conditions;
- Development of model calibration tools to improve models over time;
- Guidance on additional data and other factors to be incorporated into the planning and forecasting processes; and
- Insight into how various factors used in previous freight forecasts can change over time and influence each other in ways not previously considered.

SAMPLE RESEARCH INITIATIVE C

Establish modeling approaches for behavior-based freight movement.

Description

Analytic tools are required to model or forecast freight flows and modal volumes in ways that generally reflect the decision making of shippers, carriers, and receivers of goods. These tools will assist state DOTs and MPOs in better planning and prioritizing system investments and assessing and measuring system performance. Private sector freight stakeholders must work with public sector stakeholders to establish model parameters, processing methods, and product elements. The end goal of this initiative is to establish tools that better model the freight movement patterns of various segments of the industry. Behaviors are not monolithic; that is, long-haul operations behave differently from hub-and-spoke operations, which behave differently from local dray operations. Each has different behaviors and operating characteristics, such as time of day, preferred routes, parking needs, and congestion contribution levels.

Analytic tools are required to model or forecast freight flows and modal volumes in ways that generally reflect the decision making of shippers, carriers, and receivers of goods.

The research will cover the equipment choices, motivations, and economic choices germane to individual segments and stakeholders of the freight transport community. Specifically, each research task will provide an in-depth and complete look at a single segment of the industry. Examples include detailed exploration of deliveries to various-sized grocery stores, restaurant delivery of food and beverages, fuel delivery, and parcel package delivery.

The tasks in this project will serve as building blocks in the development of a more comprehensive overall freight transport model. Much like subroutines embedded in a highly complex program, this research will provide a modeling approach that includes decision tree creation methodology.

Benefits and Expected Outcomes

- Provide a much-needed understanding of the discrete segments of the freight transport community, including shippers, carriers, customers, and other elements of the supply chain;
- Help public sector agencies gain a better understanding of the impacts policy decisions have on individual freight transport segments;
- Develop a well-rounded and representative understanding of freight movement that does not generalize or assume that freight movement activity is similar across different industry sectors;
- Provide insight on service availability, pricing, and reliability as performance measures for different industry sectors; and
- Develop improved understanding of intermodal freight movement.

SAMPLE RESEARCH INITIATIVE D

Develop methods that predict mode shift and highway capacity implications of various what-if scenarios.

Description

Freight is substantially more varied than passenger transport in the complexity of its transportation processes and its global multimodal and intermodal nature. Some trucking companies are now transportation brokers, making customer service, cost, and the freight's delivery schedule the focus—not the mode. State DOTs and MPOs need to better understand how freight shifts across modes and how highway capacity is affected by such shifts. What-if scenarios are valuable for planning and testing alternative investment scenarios. Considerations in such scenarios include fuel costs, congestion pricing, toll increases, new or closed rail spurs, and improved waterway infrastructure.

This area of research identifies the key decision points and factors that dictate mode shifts, route selections, equipment selection (e.g., size and type of truck, container or noncontainer), trip frequency, and so forth. These decision points and factors vary greatly in any given situation. In addition to the example considerations identified above, variables include policy changes, customer demand, weather, infrastructure capacity, transportation company mergers, and strategic partnership development. Completed research will provide a decision tree model to illustrate what-if scenarios.

The research effort described in this initiative will build on the underlying economic and demographic foundations of traditional econometric models used in freight forecasting. There will also be enhancements related to considering intermodal transfers, the growing role of third-party and fourth-party logistics providers in the freight transportation industry, and ongoing refinements in supply chain management.

Benefits and Expected Outcomes

- A tool provided for public agencies and private entities that can help determine unforeseen effects caused by a variety of factors facing the freight community on a regular basis;
- An opportunity for public agencies to consider the impacts associated with infrastructure investments (or lack of investments) and also to create realistic contingency plans;
- A better understanding gained by public sector agencies of the impacts that policy and infrastructure investment decisions may have on individual elements of the freight transportation system or geographic regions;
- Similar to Sample Research Initiative C, improved insight on service availability, pricing, and reliability as performance measures for different industry sectors; and
- An improved understanding of freight movement and the role of intermodal transfers and service providers (including less-than-truckload carriers and third-party and fourth-party logistics providers) in freight transportation.

SAMPLE RESEARCH INITIATIVE E

Develop a range of freight forecasting methods and tools that address decision-making needs and that can be applied at national, regional, state, MPO, and municipal levels.

Description

Many of the techniques used in forecasting freight movement are oriented toward specific geographic scales reflecting varied planning needs. Some of these methods require tools and data that are specific to one geographic scale and may not translate well from one geographic scale to another. Data sources that are most applicable to more coarse geographies (e.g., FAF, Transearch) do not translate to local levels, and local freight planning techniques are usually vehicle-based, are inextricably linked to land uses, and do not take into account the broad economic factors that drive freight movement. In addition, wide differences exist between the warehousing and distribution practices for different commodity types (e.g., the delivery process for a local food distributor versus a multistate distribution process for major retailers).

This research will bridge the gap between the varied geographic scales used in freight planning by establishing a set of tools as a foundation that can be applied to different geographies depending on need. This foundation can be laid by completing research into

- Freight and truck generation rates for different types of land uses and commodity types by trip type (local, long-haul, drayage) and direction (inbound–outbound);
- Different practices for warehousing and distribution for various commodity types, geographic areas, and population densities; and

- Approaches to combine this information with data that are readily available on a broader geographic scale through existing industry sources in order to create planning and forecasting processes for up to four geographic scales.

Sample Research Initiative E is similar to Sample Research Initiative C and will build on that research effort. Sample Research Initiative C relates to freight data, while Sample Research Initiative E involves enhancing analytic processes that build on previous and ongoing research in this area. Previous work related to this research effort includes *NCFRP Report 8: Freight-Demand Modeling to Support Public-Sector Decision Making* (Cambridge Systematics and GeoStats 2010); *NCHRP Synthesis of Highway Practice 384: Forecasting Metropolitan Commercial and Freight Travel* (Kuzmyak 2008); *NCHRP Report 606: Forecasting Statewide Freight Toolkit* (Cambridge Systematics et al. 2008); *NCHRP Report 388: A Guidebook for Forecasting Freight Transportation Demand* (Cambridge Systematics 1997); and others. The multitiered planning and forecasting processes documented in National Highway Institute Course 139002: Uses of Multimodal Freight Forecasting in Transportation Planning (Federal Highway Administration 2010) can also provide direction for this effort.

The approach for this initiative involves research at four geographic levels:

1. Regional (e.g., mid-Atlantic region);
2. State (e.g., Pennsylvania);
3. Major metropolitan area (e.g., Philadelphia); and
4. Minor metropolitan area (e.g., Harrisburg).

The research involves documentation of current freight planning practices for the types of areas listed above and research on freight activity (by all modes) within each geographic level, including special generators such as rail terminals and port facilities. Internal links between generators and intermediate destinations (e.g., intermodal terminals and regional distribution centers) will be documented, along with links between these intermediate destinations and final freight delivery locations (e.g., retail establishments). Freight activity will be documented by mode, commodity, origin and destination (internal–internal, internal–external, external–internal, and through movements), and other pertinent characteristics for each geographic level. This effort will be carried out in close collaboration with the Sample Research Initiative C effort, as the final recommended research element of Sample Research Initiative C specifically ties to the four geographic areas described here.

An innovative element of this effort is the use of data resources that may not be used in traditional freight forecasting practices, such as state labor departments, economic development authorities, and similar public agencies. The development of data fusion tools, collective industry knowledge, and advanced technology (e.g., GPS data, radio frequency identification technology for inventory control) to support these efforts is a potential outcome of this research. Further efforts to link these data to existing data resources used in traditional planning practices (e.g., FAF Version 3, Transearch) are also envisioned as an outcome of this initiative.

Benefits and Expected Outcomes

- Document current freight planning and forecasting practices for different geographic levels, along with ongoing research related to potential enhancements of these practices;
- Provide a detailed view of freight planning and forecasting considerations for different geographic levels;
- Link enhanced data resources from Sample Research Initiative B to new or enhanced forecasting methods for different geographic levels;
- Develop new tools for linking disparate data resources not traditionally used for freight planning and forecasting;
- Establish a correlation between or supplement to local data (including nontraditional data) and commodity flow data available for broad geographic scales, including national data sources such as FAF and Transearch; and
- Develop methods for nesting local freight planning data and tools into those that are used for larger scales (i.e., developing local tools that function as subsets of national tools and data resources).

SAMPLE RESEARCH INITIATIVE F

Develop robust tools for freight cost–benefit analysis that go beyond financial considerations to the full range of benefits, costs, and externalities.

Description

Freight movement and logistics are significant components of the nation's economy and gross domestic product. Transportation agencies are looking for ways to better link transportation planning decisions with economic development and other factors, both costs and benefits. This research is aimed at helping to better understand and estimate the full range of monetary and nonmonetary freight costs and benefits in support of more informed decision making and analyses of policies, programs, projects, and investments.

The research objectives include the development of measures that can standardize the disparate costs and benefits for use in an overall cost–benefit analysis. This effort includes metrics such as congestion, air quality, employment, social equity, property value impacts, community livability, diversification of economic activity, system redundancy, and safety and security.

Several research efforts provide guidance on nonmonetary metrics related to freight transport. These include Shipper Willingness to Pay to Increase Environmental Performance in Freight Transportation (Fries et al. 2010) and Building Resilience into Freight Transportation Systems (Ta et al. 2010).

Benefits and Expected Outcomes

- Identify nontraditional components necessary for a comprehensive, holistic cost–benefit analysis;
- Document and include external benefits and costs in infrastructure investment decisions; and
- Garner support from a range of stakeholders, including those not directly involved in transportation, in the planning and decision-making processes for major transportation investments.

SAMPLE RESEARCH INITIATIVE G

Establish analytic approaches that describe how elements of the freight transportation system operate and perform and how they affect the larger overall transportation system.

Description

One of the challenges in freight transportation planning is identifying how local and regional freight operations are affected by passenger travel and land uses that potentially conflict with freight activity, and vice versa. Issues to be examined include impacts of trucking activity related to congestion on the highway system during commuter peak periods, passenger and freight rail conflicts on shared rail alignments, and the effect of local ordinances limiting freight activity near certain types of land uses (e.g., residential, institutional).

The purpose of this research is to develop, pilot, and validate new analytic techniques to effectively integrate freight movement behavior with passenger movements.

The purpose of this research is to develop, pilot, and validate new analytic techniques to effectively integrate freight movement behavior with passenger movements. The intent of this research is to demonstrate the interaction and impacts of freight on the overall transportation system. The research needs to be sensitive to variations in long-haul shipping and local deliveries as each relates to land use patterns, population density, and underlying (non-freight-related) congestion on the transportation system. This sample research initiative attempts to identify the relationship between freight activity and infrastructure and land use constraints related to competing transportation needs and land uses that do not complement intensive freight activity. These efforts will be accomplished through research into

- Decisions related to transport mode and route choice due to congestion on a freight transportation network;
- Relationships between population density and freight activity on local and regional levels;
- Changes in delivery schedules by time of day based on constraints during periods of peak passenger travel; and
- Variations in freight activity by time of day under local regulatory constraints (e.g., zoning ordinances restricting freight activity during overnight periods).

The research as it relates to the second and fourth items above will build on some of the temporal freight data documented extensively in Chapter 3 of *NCFRP Report 8: Freight-Demand Modeling to Support Public-Sector Decision Making* (Cambridge Systematics and GeoStats 2010).

The approach for this initiative involves research in three metropolitan regions of North America, with existing travel demand modeling tools in place that have been subject to peer review and have been used extensively for general transportation planning. The three regions include (1) a metropolitan area with freight movement activity associated with freight generators such as manufacturing and warehousing centers and port and rail terminals (e.g., Columbus, Ohio); (2) a metropolitan area where most of the freight activity is associated with local consumer demand (e.g., New York City); and (3) a metropolitan area that serves as a major freight hub even as it supports a sizable local consumer market (e.g., Chicago or Los Angeles). The cities used as the basis for the research documented in *NCFRP Report 8* will be examined to determine their applicability to this effort. Targeting these metropolitan areas will provide this research effort with an extensive array of GPS data.

Although the research documented in Chapter 3 of *NCFRP Report 8* was done using the Federal Highway Administration's (FHWA's) Highway Performance Monitoring System and Vehicle Travel Information System data, the present research is aimed at taking this type of base data and documenting the relationship between local trucking activity and local roadway congestion. A second element of this research involves a survey of business establishments in each of the three metropolitan areas to document how local congestion on the freight transportation system (primarily highway, but rail congestion will also be addressed) affects the business and operating decisions of shippers and carriers with respect to mode choice, operating hours, delivery processes, and routing. This research is qualitative by nature, but these business practices need to be quantified to the extent possible (e.g., "we start our driver shifts at 5:00 a.m. to avoid highway congestion" or "we have to use 30% more drivers today than we did 10 years ago due to increased congestion and fewer turns at the port terminals").

Work related to congestion pricing as it pertains to trucking may be applicable for this research as well, such as Tolling Heavy Goods Vehicles: Overview of European Practice and Lessons from German Experience (Broaddus and Gertz 2008).

Benefits and Expected Outcomes

- Improved understanding of how freight movement affects the overall transportation system at a corridor, regional, or possibly larger geographic scale;
- Improved analytic tools to enhance the ability to develop long-range transportation plans that meaningfully consider goods movement, especially in the evaluation of long-term needs and investment alternatives;
- Establishment of better coordination between transportation and land use planning;
- Improved means to evaluate alternative system capacity investment scenarios;
- Improved means to evaluate transportation operations, including ITS applications;

- Provision of a means to enhance public–private mutual understanding and collaboration for freight planning and analysis;
- Support to develop meaningful transportation system performance measures;
- Development of common metrics to use for freight planning and modeling for similar geographic scales (when applicable);
- Improved means to understand the intermodal freight movement; and
- Enhanced means to understand reliability as a performance measure for freight movement.

SAMPLE RESEARCH INITIATIVE H

Determine how economic, demographic, and other factors and conditions drive freight patterns and characteristics.
Document economic and demographic changes related to freight choices.

Description

Freight movement is part of a complex supply chain involving the movement of raw materials and products from a source to a point of consumption or to an intermediate point for manufacturing or distribution. The characteristics of this supply chain are heavily influenced by economic factors such as access to labor, markets, transportation infrastructure (various modes), and capital.

This research topic involves the development of correlating factors between market conditions for consumption and production and their impact on freight movement for different commodities. In addition, the economic benefits of freight activity and the relationship between freight movement and land use needs and decisions will be explored. This research is built on current principles and practices in econometric modeling, with additional research into factors beyond population and labor (i.e., age and income-based modeling and other demographic factors). This research also includes a variation of econometric modeling to assess economic and demographic changes that may result from decisions by shippers and carriers related to site selection, operations, and other considerations.

This effort can be informed by recent and ongoing research related to local trip generation, land use, and zoning, such as *NCHRP Synthesis of Highway Practice 298: Truck Trip Generation Data* (Cambridge Systematics and Jack Faucett Associates 2001) and *NCFRP Project 25 [Active]: Freight Trip Generation and Land Use* (Holguín-Veras 2011). However, the aim of this research is to go beyond traditional factors related to freight movement in terms of land use, industry types, and other issues. One key outcome of this effort is to document the economic benefits of freight activity related to various industries rather than the impacts of freight activity on infrastructure. The industrial real estate development and brokerage communities will likely serve as good sources of information for this research.

Benefits and Expected Outcomes

- Establish correlating coefficients and analytic tools that can be applied to regional and state transportation plan development;
- Enhance existing econometric models to reflect additional factors that drive freight transportation demand;
- Provide supporting data to enhance cost–benefit analysis tools for infrastructure investment decision making; and
- Support more robust analyses of alternative investment scenarios by including economic development and land use considerations.

SAMPLE RESEARCH INITIATIVE I

Develop freight data resources for application at subregional levels.

Description

A major breakthrough for freight data analysis and modeling will be the ability to conduct meaningful analyses at small geographic levels that are not currently supported by national-level or large metropolitan area data sets. This research includes the refinement of these current data sources or development of new data sources on smaller geographic scales (e.g., by county, municipality, or zip code). In addition, this research incorporates existing and emerging freight-related data to include permitting data, weigh-in-motion data, license plate reader data, toll agency data, Highway Performance Monitoring System traffic count data, and others. All of these resources are to be measurable at the local and corridor-specific levels.

This research identifies the data currently collected by state and local jurisdictions and recommends standard formats for consolidating these unlinked data sources so that collectively they can provide reliable assessments of freight movement at a more refined granular geographic level.

This research will build on applicable efforts recently documented in *NCFRP Report 8: Freight-Demand Modeling to Support Public-Sector Decision Making* (Cambridge Systematics and GeoStats 2010), specifically as they pertain to local decision-making needs. In addition, the tour-based commercial vehicle model used in Calgary, Alberta, documented by Kuzmyak (2008) in *NCHRP Synthesis of Highway Practice 384: Forecasting Metropolitan Commercial and Freight Travel,* is a useful reference for the types of local data that support freight forecasting efforts on a small geographic scale.

Benefits and Expected Outcomes

- Identify disparate sources of data that currently exist but are not used for modeling freight movements;
- Develop recommendations for refinement or augmentation of existing public data resources (e.g., FAF, CFS, U.S. Census Bureau) and private data sets (e.g.,

Transearch) to address gaps in data and enhance or supplement these data sources to support analytic tools on smaller geographic scales;

- In conjunction with the efforts described for Sample Research Initiative J, provide guidance to all states and local jurisdictions on acceptable data formats that will facilitate incorporation into local freight models and allow for transferability of data across institutional and jurisdictional boundaries;
- Establish methods for local agencies to fill gaps in data and create placeholders for freight data that they may not collect currently but plan to incorporate in future freight forecasting methods; and
- Improve the understanding of local freight activity that is not captured accurately in national and regional data sets (including local distribution, touring, and intermodal transfers).

SAMPLE RESEARCH INITIATIVE J

Establish, pool, and standardize a portfolio of core freight data sources and data sets that supports planning, programming, and project prioritization.

Description

This sample research initiative recognizes that varied sources of freight data are used by planners and state DOTs. It also recognizes that the use of freight data for analytic, planning, and decision-making purposes is far more of a hodgepodge than a uniform approach. The research for this initiative is built on the following assumptions:

- Flexibility in data sources and analytic methods remains important to individual jurisdictional needs and requirements;
- The general myth that private sector freight data are unattainable can be substantially debunked through the development of some common or core data sets;
- The benefits of this research will be substantially greater than its cost because fewer MPOs and state DOTs will duplicate efforts; and
- The development of web-based data resources will be an ideal mechanism for sharing and disseminating data.

This research is most timely because government agencies are operating under unprecedented fiscal austerity that will likely become even greater. Data collection is typically viewed as expensive and discretionary. This research in effect becomes an intelligent way of pooling resources nationally rather than continuing a fragmented approach to data collection. The organization of this research must include a wide cross section of private and public sector users and data suppliers in the process.

A solid foundation for this effort has already been established through the recently published *NCFRP Report 9: Guidance for Developing a Freight Transportation Data Architecture* (Quiroga et al. 2011). The recommendations and specifications of that report will serve as the basis of this research effort, specifically with regard to its

three-tiered approach (single application, intermediate, and holistic) for developing a national freight data architecture. This effort will also include research into existing electronic data interchange protocols and processes used in freight transportation (e.g., ANSI 856 Ship Notice/Manifest).

Benefits and Expected Outcomes

- Improved and more reliable analytic results;
- Greater efficiency and cost-effectiveness of planning and analysis;
- Opportunity to overcome some of the perceived barriers related to data availability;
- Improved understanding of processes in individual industries and their impact on freight demand at different geographic levels;
- Improved understanding of the relationships between businesses and industries;
- More comprehensive understanding of issues related to full supply chains (as opposed to discrete freight movements); and
- Elimination of costly freight data redundancies.

SAMPLE RESEARCH INITIATIVE K

Develop procedures for applying freight forecasting to the design of transportation infrastructure, particularly pavement and bridges.

Description

Freight movements have unique characteristics and infrastructure needs. Often these needs are not fully considered in infrastructure design, particularly with regard to pavement and bridge design. Procedures and processes to integrate true freight forecasting into this design will ensure that current and near-term projects will not become future freight constraints. Research includes collecting best practices for considering freight needs in the design, construction, operations, and maintenance of roadway infrastructure.

Procedures and processes to integrate true freight forecasting into this design will ensure that current and near-term projects will not become future freight constraints.

The research efforts in this initiative involve documenting the role of truck weight and volumes in pavement and bridge design among public agencies in the United States and abroad, along with the role that forecasting tools play in the design process. Design vehicles, current and projected volumes, and oversized load considerations will be examined. The focus of this effort is to bring freight planning tools and data into the design process for pavement and bridges.

The recommended approach for this research includes an initial survey of highway departments and toll authorities, with detailed documentation of how these agencies incorporate truck activity into the design and maintenance of their infrastructure. The primary design parameters to be included in this effort include truck volumes and vehicle weight, length, height, and axle configuration.

This research will build on ongoing developments in GPS tracking and asset management for truck fleets, along with existing weigh-in-motion, permit, and routing data. Collaboration with private industry for vehicle configuration and weight data (when possible) is crucial to the success of this effort.

Benefits and Expected Outcomes

- Documentation of the role of truck size and weight characteristics in the planning, design, and maintenance of highway infrastructure across an array of different agencies;
- Identification of design parameters for which changes in future truck activity, measured in terms of increased truck volumes, changes in truck sizes, or changes in load characteristics (i.e., full versus empty trucks), can influence life cycles and design standards; and
- Identification of ways to incorporate freight planning tools and data into the planning, design, and maintenance of highway infrastructure.

SAMPLE RESEARCH INITIATIVE L

Advance research to effectively integrate logistics practices (private sector) with transportation policy, planning, and programming (public sector).

Description

There is a substantial disconnect between private and public sector decision making related to the movement of goods and the infrastructure that supports those activities. This research builds on the behavior-based freight research documented in Sample Research Initiative C and attempts to integrate the real-world supply chain management practices of the private sector with the policy and planning decision making of the public sector. Although it is unrealistic to expect that the timelines and planning horizons of the public and private sectors will be fully harmonized in an effective manner (public sector planning horizons are typically years or decades in length, but the decision-making needs of private industry can change almost on an hourly basis), a thorough understanding of the decision-making needs of both private and public sectors enhances the interests of both.

This research is an initiative to determine areas of mutual benefit for improving data and planning tools across public and private sectors and to develop ideas for planning processes to incorporate actual supply chain management processes and logistics decisions to the extent possible. The research includes answers to why, how, when, where, what, who, and how much in order to bridge the gap between how shippers and carriers operate on a short-term basis and what the public sector needs to make decisions, taking into account that decision making often requires years of planning. Recommendations for streamlining public sector decision-making processes are beyond the scope of this effort, but the research will yield interesting ideas about approaches to public sector planning and programming efforts that include phased implementation,

interim short-term improvements in place of costly long-term investments, and conditional approvals.

NCHRP Report 594: Guidebook for Integrating Freight into Transportation Planning and Project Selection Processes (Cambridge Systematics et al. 2007) will serve as a foundation and an instructional guide for this sample research initiative.

This research includes the following areas:

- Real estate—What are the standard timelines for private sector investments in real estate that is related to freight activity, including port and rail terminals, distribution centers, and truck terminals and hubs? What are some of the variations among different types of ownership and operating arrangements, including site selection, modifications of existing facilities versus construction of new facilities, and build-to-suit versus "spec" buildings?
- Facility operations—What are some of the ongoing changes in facility operations that extend the useful life of existing facilities or result in dramatic changes in off-site impacts? What are some of the factors that drive functional obsolescence of facilities far in advance of physical depreciation of these assets, and what are the life-cycle implications of these factors? Examples of these include port and rail terminal hours of operation, the gradual transformation of warehouses (focused on product storage) to distribution centers (focused on load consolidation and distribution, with accompanying reductions in on-site product inventory), and other improvements in the efficiency of facility operations.
- Vehicles and vessels—This research area includes freight rolling stock, such as trucks and railcars, in addition to freight vessels (including barges). How have the dimensions of these various elements of the freight system changed over time, and what are the implications of these changes with regard to roadway design, bridge height and weight limits, channel depth, and other infrastructure considerations? How frequently do these elements of the system change relative to the life cycles of the accompanying infrastructure? What are the life cycles of these vehicles and vessels, and how quickly do different types of carriers change their fleet management decisions to reflect changing business conditions?
- Infrastructure—What are the timelines for various types of infrastructure improvements, including roadway and rail rehabilitation, new construction of these types of facilities, channel deepening, and other major infrastructure development? What potential changes should be made in the permitting and approval processes for these elements to provide short-term or conditional capacity enhancements to reflect the needs of private industry as documented in the above items?

Benefits and Expected Outcomes

- Provide an understanding of the investment cycles for different elements of the freight transportation industry, including shippers, carriers, and public agencies, encompassing decision-making cycles for land use, facilities, and infrastructure;

- Provide a detailed view of operational, rolling stock, and supply chain decisions that may change on a short-term basis to reflect private sector needs;
- Document potential inefficiencies in the freight transportation system related to the disparate decision-making cycles of the public and private sectors; and
- Develop potential approaches through which public agencies can implement short-term or interim measures to reflect the changing, dynamic needs of the private sector.

SAMPLE RESEARCH INITIATIVE M

Develop visualization tools for freight planning and modeling through a two-pronged approach of discovery and addressing known decision-making needs.

Description

Visualization tools provide a powerful means of communicating complex concepts and data. This research is aimed at providing analysts with tools for managing data (discovery) in an organized and intuitive way to make freight information more accessible, understandable, and usable. In addition, this effort seeks to apply visualization techniques to provide a sensible platform for developing more robust forecasting models while communicating concepts and analyses to decision makers. A general need for the freight planning and forecasting industry is the enhancement of computer science skills related to graphic presentation.

Visualization tools provide a powerful means of communicating complex concepts and data.

The nature of the freight transportation process across different geographic scales lends itself well to a geographic information system platform for visualization. An innovative element of this research involves developing standard visualization techniques and tying them to improved web access to data for different geographic levels. Private companies such as Esri that already develop products for a multitude of clients will be good partners and research champions, along with other private sector firms that develop tools to meet their own internal needs.

This initiative includes the use of gaming technologies and methods as part of learning systems to address knowledge and skill deficits in freight planning and modeling. Existing tools and methods currently being applied in all levels of education (e.g., Epistemic Games at the University of Wisconsin–Madison and the Virtual Construction Simulator at Penn State University) are examples of ongoing developments that may be applicable to this field.

Benefits and Expected Outcomes

- Foster a strong interest among data visualization and user interface experts currently applying their skills in other industries to bring their talents to bear on freight demand modeling and data, to assist this industry with seeing, understanding, and communicating;

- Apply visualization tools and techniques systematically across other appropriate research initiatives in this effort to enhance their effectiveness and promote unconventional thinking;
- Use visualization as a common language to promote a greater understanding and more productive dialogue among modelers, planners, researchers, the private sector, and other stakeholders; and
- Incorporate visualization techniques to evaluate innovative freight demand models.

6 FUTURE DIRECTIONS

BACKGROUND AND PURPOSE

This chapter highlights future directions for building momentum beyond the completion of the SHRP 2 C20 technical research report. This road map provides a broad direction and an organizing process for sustaining innovation in freight planning and modeling. The approach is designed to address the wide range of opportunities and needs that have been identified to date and expressed broadly by the seven strategic objectives.

The future directions build on a strong foundation of the SHRP 2 C20 project accomplishments, including

- Fostering interest among the freight community based on extensive outreach and engagement of public and private freight stakeholders;
- Documenting freight decision-making needs, particularly those of state DOTs and MPOs;
- Piloting a successful Innovations in Freight Modeling and Data Symposium with national and international participation to spur breakthrough thinking and innovative ideas; and
- Developing an initial set of sample research initiatives validated by freight stakeholders.

STRATEGIC OBJECTIVES

This road map provides a broad direction and an organizing process for sustaining innovation in freight planning and modeling.

The seven strategic objectives are

1. Improve and expand the knowledge base for planners and decision makers;
2. Develop and refine forecasting and modeling practices that accurately reflect supply chain management;
3. Develop and refine forecasting and modeling practices based on sound economic and demographic principles;
4. Develop standard freight data (e.g., CFS, FAF, and possible future variations of these tools) to smaller geographic scales;
5. Establish methods for maximizing the beneficial use of new freight analytic tools by state DOTs and MPOs in their planning and programming activities;
6. Improve the availability and visibility of data among agencies and between the public and private sectors; and
7. Develop new and enhanced visualization tools and techniques for freight planning and forecasting.

ORGANIZING CONCEPT: GLOBAL FREIGHT RESEARCH CONSORTIUM

SHRP 2 C20's project leadership stressed that future directions should not be burdened with an inflexible bureaucratic organization or cumbersome administration. Rather than establishing a program as part of a government organization, the organizing concept lays out a flexible mechanism—an agile, collaborative framework—for achieving the strategic objectives.

To meet this expectation, a Global Freight Research Consortium is recommended. This consortium would promote research through funding agencies and other organizations having a stake in improved freight system performance and decision making, supported by enhanced analytic approaches. Participation would be voluntary, attracting those sectors that have a stake in the achievement of the strategic objectives.

This peer-based consortium would enable, fund, and promote research, supported through national and international public organizations and private organizations whose efforts serve the freight transportation sector.

The member organizations will include public domestic agencies, modal and other associations, universities, and the transportation research entities of other countries. It is also envisioned that the private sector will participate in the GFRC. Firms such as Con-way, Wal-Mart, EXCEL Logistics, FedEx, and UPS also have a stake in the research innovation that the consortium will promote. Table 6.1 summarizes the organizational mix that will potentially represent the core of the consortium.

This partnership will support independent research and reward innovative and compelling investigations and experiments by sponsoring an annual research competition spanning various research tracks and providing a seed-grant award. Establishing and maintaining the GFRC will require careful planning, including

- Investigate the appropriate governance model (e.g., foundation, institute, charity) for the GFRC and complete its charter;
- Perform outreach to possible member organizations to promote participation;
- Obtain public and private start-up funding as appropriate;
- Secure the services of a qualified consultant to assist in the early organizing and start-up activities of the GFRC, which could include developing a draft GFRC work program, organizing additional research idea competitions, holding annual competitions for grants, and facilitating the first few GFRC meetings; and
- Regularly restructure and renew the governance model to ensure an entrepreneurial approach and genuine innovation.

TABLE 6.1. ILLUSTRATIVE ORGANIZATIONS FOR GFRC PARTICIPATION

Agency	Role and Focus Area
TRB cooperative research programs (e.g., NCFRP, NCHRP)	Funding applied research on freight modeling and data; integrating existing separate research tracks with freight
TRB, Second Strategic Highway Research Program (until March 2015)	Sponsoring innovation symposia; funding development of training and outreach materials suggested by the future directions
U.S. DOT modal administrations (e.g., Federal Highway Administration [FHWA], Federal Railroad Administration)	Supporting pilots of advanced freight demand models
U.S. DOT intermodal organizations (e.g., FHWA, Research and Innovative Technology Administration, Bureau of Transportation Statistics)	Improving and expanding freight data resources
Academic institutions and university transportation centers	Funding and conducting basic research on freight models and data collection and fusion; pooled fund consortia
Associations such as the American Trucking Association	Networking work and priorities of GFRC to industry and modal operators and carriers
State DOTs and MPOs	Piloting and application of research
Private sector	Improving and expanding freight data resources; identifying advances in freight transportation technology and business practices for future research

The SHRP 2 C20 Technical Expert Task Group participated in a facilitated discussion to frame the future directions. That consensus-building exercise helped establish basic definitions and parameters for the GFRC, including what the consortium should be and should not be, as seen in Table 6.2. These important attributes are documented for reference as this initiative goes forward.

TABLE 6.2. DEFINING THE GLOBAL FREIGHT RESEARCH CONSORTIUM

What the GFRC is	What the GFRC is not
• More innovation • Nonlinear progress • Mechanism similar to National Academies • All relevant research funders at the table • Mechanism to broadly diffuse the research agenda • Way to seek resources • Vehicle to attract participants and one or more champions • Methods to stimulate innovative ideas and research and assessment of who is capable of pursuing less conventional methods • An approach for infusing freight modeling efforts with knowledge, innovation, and capacity building • Bridge to greater public and private understanding of system development needs • Framework to broadcast information and ideas • Living, dynamic, experimental, and evolutionary • Window on other fields that might be able to provide input • Explicit—not implied—international outlook and focus • Momentum builder, viral • Bridge between private sector and public sector freight planning	• A research program • A single university transportation center–run research program • Centralized • A formal organization with a governing body • A governance program • Concentration on one or a few projects that narrow the scope • A predefined end product • A Procrustean bed (an arbitrary standard to which exact conformity is forced) for ideas or processes • Hosted by an academic organization (although academic institutions will participate in the GFRC)

GFRC: A WIN–WIN PROPOSITION

The Global Freight Research Consortium provides an effective means for public–private–academic collaboration on freight modeling and planning with abundant benefits for all participants. Further, these benefits can be accomplished without creating another formal organization bureaucracy. The consortium's power is one of influence: it brings together those with a shared stake in greater innovation and successful implementation of new forecasting and analytic tools. The wins may differ by organization or sector, but they include the following:

- Improved infrastructure investment from a freight transportation perspective;
- Achievement of a global perspective that reflects freight's global dimensions;
- Improved performance of the transportation system over time as a result of better investment decisions;

- An opportunity to validate research from the standpoint of its utility to the freight industry;
- An opportunity to gain a better mutual understanding of the analytic needs of the public and private sectors and how they intersect;
- An opportunity to validate any research or tools from a practitioner standpoint;
- Greater understanding of freight movement requirements and performance criteria and how new analytic tools reflect such key factors; and
- An opportunity to shape the knowledge and skill requirements for employees in public and private organizations and to influence the instructional focus for universities.

INNOVATIONS IN FREIGHT MODELING AND DATA SYMPOSIUM: A FOUNDATION FOR MOVING FORWARD

The successful Innovations in Freight Modeling and Data Symposium held in September 2010 provided a solid foundation for future efforts. The symposium's success factors include the following:

- The symposium provided a low-cost approach to generating a variety of research concepts.
- The competitive nature of the symposium generated numerous excellent ideas and promising research concepts.
- The symposium brought together academic, private sector, and public sector perspectives.
- The symposium fostered a greater shared understanding of the issues and requirements for improved freight modeling and planning.

Future symposia may have a different focus or emphasis area, but the principles of collaboration, competition, and communication represent significant building blocks for successful symposia.

The Innovations in Freight Modeling and Data Symposium was held in Herndon, Virginia, with about 50 attendees. The symposium featured 18 presentations selected to address the challenge of developing the next generation of freight demand models (symposium material is available at www.trb.org/Main/Blurbs/167628.aspx).

The symposium model was characterized by a combination of modeling data and ideas presented by U.S. and international practitioners and academics, followed by open and direct dialogue and debate. Major needs identified during the symposium include

- A priority need to include international research addressing the macro view of global freight and its impact on multimodal freight traffic;
- A need to share unfettered domestic and international research; and
- A need to weave data, modeling, and knowledge (and terminology) within the public infrastructure modeling and policy view, as well as private sector logistics and distribution forecasting efforts.

In short, the successful Innovations in Freight Modeling and Data Symposium provided a strong foundation for moving forward in that it

- Generated ideas;
- Attracted international attention and participation;
- Resulted in the identification of several promising areas of research; and
- Provided a forum for public and private sector stakeholders, as well as university researchers.

GFRC INITIATIVES AND FOCUS AREAS FOR ACHIEVING STRATEGIC OBJECTIVES

This section briefly describes six major activities or initiatives that the GFRC would address as part of its overall approach to achieving the strategic objectives. The list is by no means exhaustive, recognizing that the ultimate activities of the consortium will be determined on the basis of the combined interests and priorities of the participants.

Each of the six major initiatives is briefly defined below and is followed by a list of actions to advance that initiative.

Defining research focus areas that reflect the decision-making needs of state DOTs and MPOs in relation to freight planning, policy making, and project development will be of particular importance.

Define Priority Research Issues

The GFRC will periodically issue a list of research priority areas based on submissions to GFRC-sponsored calls for ideas, similar to the process followed for the 2010 Innovations in Freight Modeling and Data Symposium. Defining research focus areas that reflect the decision-making needs of state DOTs and MPOs in relation to freight planning, policy making, and project development will be of particular importance. Ideally, these research focus areas will reflect a dynamic communication and consensus building between the private and public sectors, both on the GFRC and between state DOTs and MPOs with the freight industry, and with international practitioners.

Actions

- Establish the initial set of problems or research issues demanding attention;
- Publish and widely distribute a call for ideas; and
- Communicate the submission format approach standards and the incentives or awards being made available.

Provide Recognition and Incentives to Spur Breakthroughs

The 2010 Innovations in Freight Modeling and Data Symposium confirmed that recognition and a nominal financial award are powerful inducements for generating ideas. The future directions recognize the value in continuing to offer awards and recognition, particularly for meritorious research ideas with potentially breakthrough solutions. Nonfinancial recognition is also important. Efforts will be made to promote this process to the greatest extent possible as a way of doing business for the GFRC.

Actions

- Establish initial sources for the first call for innovative ideas;
- Consider establishing the GFRC following a foundation model to provide a basis for contributions for funding awards, prizes, and related activities; and
- Over time, as funding for awards increases, establish multiple categories and multiple award winners.

Conduct Regular Innovation Forums

Ideally, an annual forum, similar to the 2010 Innovations in Freight Modeling and Data Symposium, will be conducted for presenting innovative research and selecting the most promising ideas in freight modeling and data for further development. Each forum will publish a report that will frame the freight modeling and data research agenda.

Actions

- Determine the content, themes, or focus areas for periodic innovation forums;
- Review and incorporate the results of the forums in relation to other GFRC activities; and
- Provide guidance for maximizing the dissemination of forum results and promoting forum participation among colleagues and peers.

Promote Technology Transfer from Other Disciplines

The SHRP 2 C20 Technical Expert Task Group has expressed the need to consider solutions to modeling needs from other fields that can be transferable or adaptable to freight transportation. Transferable solutions will be promoted regularly and serve as a focus for a broader outreach to various utilities and other sectors, and will also be a consideration in screening ideas.

Actions

- Organize a forum that would bring together presenters from other sectors to consider how their modeling and planning techniques might be adaptable to freight forecasting; and
- Organize a competition devoted to adopting and adapting analytic techniques from other sectors.

Promote an International Focus

Research innovation for freight demand and analysis must necessarily reflect the global nature of freight movement. Implementation must draw on global research and promote participation from all relevant freight sectors and academic institutions worldwide.

Actions

- Secure public, private, and academic participants from other nations through the contacts and networks of those who have already been involved in SHRP 2 C20;
- Conduct an early GFRC meeting in a strategically selected country; and
- Regularly showcase freight planning and modeling approaches employed in other nations.

Recognize the Application of Completed Research

Another important component of recognition and information dissemination for the consortium will be to periodically draw attention to the impacts and benefits of applied freight modeling and data research. This activity will be particularly important from the standpoint of promoting broader implementation of successful freight analytic approaches.

Actions

- Advance a general tracking activity to capture the benefits and experiences of those using new research approaches; and
- Publish this information on a periodic basis to reflect the long-term benefit of GFRC efforts.

ACHIEVING TANGIBLE PROGRESS

The formation of a GFRC represents a significant institutional breakthrough with a strong potential for success. It is important to move to a start-up or implementation phase sometime within the first 6 to 12 months of the publication of the Strategic Plan to build on the momentum achieved to date through the Innovations in Freight Modeling and Data Symposium and other stakeholder forums.

Early activities should include bringing together the prospective members of the GFRC for a facilitated organizational meeting or strategy workshop. The initial focus would include presenting the business case for the GFRC and seeking participant buy-in and input on how to strengthen the consortium approach and implementation. A draft work program for the first year or two of activities should also be presented for review of those initially involved. Of particular importance is that all current research funding agencies be at the table with the other prospective partners, as consideration should be given to how freight modeling and data research will be prioritized, which promising areas of research from SHRP 2 C20 should be advanced, and what other areas of research should be identified. This early work plan development and GFRC formation should be consultant-supported, as there is no one agency or organization positioned to carry out the process on its own.

7 CONCLUSION

This second decade of the twenty-first century will place even greater emphasis on global trade, technology, innovation, and competitiveness. These megaissues will strongly influence transportation strategies and decisions about system investments. These strategies and decisions, in turn, will require capacity building for state DOTs and MPOs and greater collaboration with the freight industry at every level. This includes collaboration on the types of freight planning research described in this strategic plan and the accompanying SHRP 2 C20 technical research report.

The long-term ability to effectively and efficiently move goods will depend on the performance of public and private infrastructure, which is a key strategic asset to enterprises that ship and receive freight of all types in a fiercely competitive business environment.

Ironically, in this information age when the linkage between goods movement and information technology continues to expand, state DOTs and MPOs lack the kinds of data and analytic tools needed to effectively plan for freight transportation. The result is that public decision makers lack the information they need to effectively support freight-related transportation decision making. This research has established a road map to move freight tools and data innovation forward through

- Implementing sample research initiatives that support the seven key strategic objectives; and
- Expanding the dialogue on freight analysis and data innovation through the GFRC, an ongoing international forum of key stakeholders comprising a public–private–academic collaboration to encourage innovative research to support decision-making needs.

By the end of this decade, a vision for improved freight modeling and data will be characterized as follows:

- A robust freight forecasting toolkit has been developed and is the standard for public sector freight transportation planning;
- Forecasting tools and data link dynamically with other key variables, such as development and land use, and their application to local scale, corridors, or regions is also dynamic;
- The challenges associated with the data necessary to support new planning tools have been addressed through a broad-based effort bringing together the varied resources of the public and private sectors;
- The knowledge and skills of state DOT and MPO staff have been methodically enhanced to complement the development of better tools and data; and
- Decision makers recognize that transportation investments are to a greater degree being informed by an understanding of the implications, benefits, and trade-offs relative to freight.

These megaissues will strongly influence transportation strategies and decisions about system investments. These strategies and decisions, in turn, will require capacity building for state DOTs and MPOs and greater collaboration with the freight industry at every level.

REFERENCES

Broaddus, A., and C. Gertz. 2008. Tolling Heavy Goods Vehicles: Overview of European Practice and Lessons from German Experience. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2066,* Transportation Research Board of the National Academies, Washington, D.C., pp. 106–113.

Cambridge Systematics, Inc. 1997. *NCHRP Report 388: A Guidebook for Forecasting Freight Transportation Demand*. TRB, National Research Council, 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 of the National Academies, Washington, D.C.

Cambridge Systematics, Inc., Global Insight, H. Cohen, A. Horowitz, and R. Pendyala. 2008. *NCHRP Report 606: Forecasting Statewide Freight Toolkit*. Transportation Research Board of the National Academies, Washington, D.C.

Cambridge Systematics, Inc., and Jack Faucett Associates. 2001. *NCHRP Synthesis of Highway Practice 298: Truck Trip Generation Data*. TRB, National Research Council, Washington, D.C.

Cambridge Systematics, Inc., Prime Focus, LLC, and K. Heanue. 2007. *NCHRP Report 594: Guidebook for Integrating Freight into Transportation Planning and Project Selection Processes*. Transportation Research Board of the National Academies, Washington, D.C.

Federal Highway Administration. 2010. Freight Management and Operations. Announcing a New Freight Course: Uses of Multimodal Freight Forecasting in Transportation Planning. U.S. Department of Transportation.

Fries, N., G. C. de Jong, Z. Patterson, and U. Weidmann. 2010. Shipper Willingness to Pay to Increase Environmental Performance in Freight Transportation. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2168,* Transportation Research Board of the National Academies, Washington, D.C., pp. 33–42.

Holguín-Veras, J. 2011. *NCFRP 25 [Active]: Freight Trip Generation and Land Use*. Transportation Research Board of the National Academies, Washington, D.C.

Kuzmyak, J. R. 2008. *NCHRP Synthesis of Highway Practice 384: Forecasting Metropolitan Commercial and Freight Travel*. Transportation Research Board of the National Academies, Washington, D.C.

Proc., Second Strategic Highway Research Program: Innovations in Freight Modeling and Data Symposium, Washington, D.C., Transportation Research Board of the National Academies, 2010.

Quiroga, C., N. Koncz, E. Kraus, J. Villa, J. Warner, Y. Li, D. Winterich, T. Trego, and J. Short. 2011. *NCFRP Report 9: Guidance for Developing a Freight Transportation Data Architecture*. Transportation Research Board of the National Academies, Washington, D.C.

Ta, C., A. V. Goodchild, and B. Ivanov. 2010. Building Resilience into Freight Transportation Systems. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2168,* Transportation Research Board of the National Academies, Washington, D.C., pp. 129–135.

RELATED SHRP 2 RESEARCH

Partnership to Develop an Integrated, Advanced Travel Demand Model and a Fine-Grained, Time-Sensitive Network (C10A)
Partnership to Develop an Integrated, Advanced Travel Demand Model with Mode Choice Capability and Fine-Grained, Time-Sensitive Networks (C10B)
Integrating Freight Considerations into Collaborative Decision Making for Additions to Highway Capacity (C15)

TRB OVERSIGHT COMMITTEE FOR THE STRATEGIC HIGHWAY RESEARCH PROGRAM 2*

Chair: **Kirk T. Steudle,** *Director, Michigan Department of Transportation*

MEMBERS

H. Norman Abramson, *Executive Vice President (retired), Southwest Research Institute*
Alan C. Clark, *MPO Director, Houston–Galveston Area Council*
Frank L. Danchetz, *Vice President, ARCADIS-US, Inc.*
Stanley Gee, *Executive Deputy Commissioner, New York State Department of Transportation*
Michael P. Lewis, *Director, Rhode Island Department of Transportation*
Susan Martinovich, *Director, Nevada Department of Transportation*
John R. Njord, *Executive Director, Utah Department of Transportation*
Charles F. Potts, *Chief Executive Officer, Heritage Construction and Materials*
Ananth K. Prasad, *Secretary, Florida Department of Transportation*
Gerald M. Ross, *Chief Engineer, Georgia Department of Transportation*
George E. Schoener, *Executive Director, I-95 Corridor Coalition*
Kumares C. Sinha, *Olson Distinguished Professor of Civil Engineering, Purdue University*
Paul Trombino III, *Director, Iowa Department of Transportation*

EX OFFICIO MEMBERS

John C. Horsley, *Executive Director, American Association of State Highway and Transportation Officials*
Victor M. Mendez, *Administrator, Federal Highway Administration*
David L. Strickland, *Administrator, National Highway Transportation Safety Administration*

LIAISONS

Ken Jacoby, *Communications and Outreach Team Director, Office of Corporate Research, Technology, and Innovation Management, Federal Highway Administration*
Tony Kane, *Director, Engineering and Technical Services, American Association of State Highway and Transportation Officials*
Jeffrey F. Paniati, *Executive Director, Federal Highway Administration*
John Pearson, *Program Director, Council of Deputy Ministers Responsible for Transportation and Highway Safety, Canada*
Michael F. Trentacoste, *Associate Administrator, Research, Development, and Technology, Federal Highway Administration*

CAPACITY TECHNICAL COORDINATING COMMITTEE*

Chair: **Mark Van Port Fleet,** *Director, Bureau of Highway Development, Michigan Department of Transportation*

MEMBERS

Kome Ajise, *Program Manager, Public-Private Partnership Program, California Department of Transportation (Caltrans)*
Michael Bruff, *Manager, Transportation Planning Branch, North Carolina Department of Transportation*
Jacquelyn D. Grimshaw, *Vice President for Policy, Center for Neighborhood Technology*
Kris Hoellen, *Director, Conservation Leadership Network, The Conservation Fund*
Carolyn H. Ismart, *Florida Department of Transportation (retired)*
Randy Iwasaki, *Executive Director, Contra Costa Transportation Authority*
Thomas J. Kane, *Thomas J. Kane Consulting*
Keith L. Killough, *Assistant Director, Travel Demand Modeling and Analysis, Multimodal Planning Division, Arizona Department of Transportation*
T. Keith Lawton, *Principal, Keith Lawton Consulting, Inc.*
Edward A. Mierzejewski, *Director of Transportation Research, Gannett Fleming, Inc.*
Bob Romig, *State Transportation Development Administrator, Florida Department of Transportation*
Joseph L. Schofer, *Professor of Civil Engineering and Environmental Engineering and Associate Dean, McCormick School of Engineering and Applied Science, Northwestern University*
Barry Seymour, *Executive Director, Delaware Valley Regional Planning Commission*
Brian Smith, *Washington State Department of Transportation*
John V. Thomas, *Office of Policy, Economics, and Innovation, Environmental Protection Agency*
Gary Toth, *Director, Project for Public Spaces*
Jeff Welch, *Director, Knoxville Regional Transportation Planning Organization*
Doug Woodall, *State Director, Turnpike Planning and Development, Texas Turnpike Authority Division, Texas Department of Transportation*

AASHTO LIAISON

Janet P. Oakley, *Director, Policy and Government Relations, American Association of State Highway and Transportation Officials*

FHWA LIAISONS

Patricia Cazenas, *SHRP 2 Implementation Director, Research and Financial Services, Federal Highway Administration*
Spencer Stevens, *Community Planner, Office of Planning Oversight and Stewardship, Federal Highway Administration*

**Membership as of August 2012*