MINNESOTA DEPARTMENT OF TRANSPORTATION

RESEARCH

2008-12

Measurement Sources for Freight Performance Measures and Indicators

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Technical Report Documentation Page

1. Report No. MN/RC 2008-12	2.	3. Recipients Accession No.
4. Title and Subtitle Measurement Sources for Freight Performance Measures and Indicators		5. Report Date July 2008
		6.
7. Author(s) Amiy Varma		8. Performing Organization Report No.
9. Performing Organization Name and Address Department of Civil Engineering North Dakota State University 1410 14th Avenue North Fargo, ND 58105		10. Project/Task/Work Unit No.
		11. Contract (C) or Grant (G) No. (c) 88173
12. Sponsoring Organization Name and Address Minnesota Department of Transportation 395 John Ireland Boulevard, Mail Stop 330 St. Paul, Minnesota 55155		13. Type of Report and Period Covered Final Report
		14. Sponsoring Agency Code
15. Supplementary Notes http://www.lrrb.org/PDF/200812.pdf		

16. Abstract (Limit: 200 words)

Development of freight performance measures and indicators is intended to assist the Office of Freight and Commercial Vehicle Operations (OFCVO) of Minnesota Department of Transportation (Mn/DOT) in responding to key stakeholders in the public and private sectors regarding the performance of Minnesota's freight transportation system and in assisting Mn/DOT's long-range planning efforts such as the update of Mn/DOT's Statewide Transportation Plan and its Statewide Freight Plan. Freight measurement sources (data and information sources) were compiled, analyzed, organized, and classified for all modes of transportation and different performance measure and indicator categories. The classification of measurement sources was done for performance measure and indicator categories pertaining to network and infrastructure, safety or damage, access, capacity, travel time, reliability, market share, mode share, modal costs, freight productivity, freight security, shipping rates, pricing, agency cost, carrier cost, shipper cost, externalities and community cost, transportation indices, and external factors related to or affecting freight movements within, through, out of, and into Minnesota. Assessment of key performance measures and indicators, and related measurement sources was carried out. Barriers, best available measurement sources, good existing practices, and recommended improvements pertaining to measurement sources for freight performance measures and indicators for Minnesota were identified.

17. Document Analysis/Descriptors Freight performance measure, Freight performance indicator, Measurement Sources, Minnesota freight	Classification of Freight, Measurement sources, Freight Data	18. Availability Statement No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161	
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 555	22. Price

Measurement Sources for Freight Performance Measures and Indicators

Final Report

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July 2008

Published by:

Minnesota Department of Transportation
Research Services Section
395 John Ireland Boulevard, Mail Stop 330
St. Paul, Minnesota 55155

Acknowledgements

The author would like to sincerely acknowledge the assistance, input, and direction provided by Project Technical Liaison, Bob Gale, and Administrative Liaisons, Jim Klessig and Nelson Cruz. The author also benefited from expertise and feedback provided by the project's Technical Advisory Panel members:

John Chell, ARDC, Duluth, MN
Ron Dvorak, Dvorak Group, Breezy Pt, MN
Deborah Johnson, BTS, Washington, DC
Jonette Kreideweis, Mn/DOT, St. Paul, MN
Richard Lambert, Mn/DOT, Mendota Heights, MN
Mark C. Larson, Mn/DOT, St. Paul, MN
Mike Louis, Mn/DOT, St. Paul, MN
Dan Murray, American Transportation Research Institute, St. Paul, MN
Matt Pahs, Mn/DOT, Mendota Heights, MN
Cecil Selness, Mn/DOT, Mendota Heights, MN
Jeffrey Short, American Transportation Research Institute, St. Paul, MN
Brian Sweeney, BNSF, St. Paul, MN
Bob Zelenka, Minnesota Grain & Feed, Minneapolis, MN

In addition, the author would like to express special thanks to John Tompkins and Bill Gardner of Mn/DOT and acknowledge assistance of research assistants: Scott Hagel, Gom Ale, and Jerilyn Swenson. Finally, the author would like to especially thank Jerry Baldwin, Director of Mn/DOT Library, and NDSU Interlibrary Loan staff for the assistance with loans of reports of interest for this study.

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Executive Summary

Background and motivation

The Office of Freight and Commercial Vehicle Operations (OFCVO) identified four performance indicators-- shipment rates, mode share, geographic market share, and travel time-- to be included in Mn/DOT's Statewide Freight Plan. Development of such and other performance measures and indicators was intended to assist the Freight Unit of OFCVO in responding to key stakeholders in the public and private sectors regarding the performance of Minnesota's freight transportation system and in Mn/DOT's long-range planning efforts such as the update of Mn/DOT's Statewide Transportation Plan.

Objectives

The research objectives were to:

(1) Compile, analyze, organize, and classify available freight data or information sources for all transportation modes, including intermodal;

(2) Assess the efficacy of relevant and important data or information sources as a measurement tool for developing performance measures and indicators for Minnesota; and

(3) Identify and recommend the best sources of information available and how Minnesota should proceed in terms of identifying and developing the most important performance measures or indicators related to freight movement within, inbound, outbound, and through Minnesota.

Scope of research

The scope of research was to address agency (Mn/DOT) as well as shipper and carrier needs and how all may assess their performance within the realm of freight movement inbound, outbound, through, and within Minnesota. Focus of this study was to identify and broadly assess measurement sources exist and in what form. The purpose of this assessment was to seek and identify answers, based on data, for performance measures and indicator categories related to or affecting freight movements within, inbound, outbound, and through Minnesota.

Research approach

The organization, classification, analysis, assessment, and recommendation for freight data or measurement sources were to be done at the backdrop of freight performance measures and indicators relevant to freight movement within, inbound, outbound and through Minnesota. The overall research effort and approach was divided into seven tasks--Task 1 – Scoping of Study; Task 2 – Literature/ Information Search; Task 3 – Classification of Measurement Sources; Task 4 – Assessment of Performance Measures/Indicators and Measurement Sources; Task 5 – Identification of Best Practices and Recommended Actions; and Tasks 6 and 7 – Development of Draft and Final Reports.

Best sources

Best Federal sources: Among federal data sources that are best available are CFS, Waybill, Waterway data from Army Corps, and Economic and Industry Surveys by Census. BTS and FHWA data (particularly FAF data) are useful summaries of major trends and freight flow data.

Best Minnesota sources: Past freight related studies and statewide and district plans in Minnesota has been good source of information for strategic directions, policies, strategies, and priorities. Thus, these sources also provide current use of transportation system performance measures and indicators and their relevance. Waterway data within Mn/DOT is very good. Economic, demographic, establishment, export and import, and other information available from economic development department and other Minnesota agencies are also very useful, especially for metro areas and regional trade areas. Here again sometimes data from commercial vendors are needed for forecast information. Travel Time, incident clearance, and snow removal time data are also good sources. However, it exists primarily for only metro area and some IRC. ATR, WIM, loop detector data that exists could provide good source of data to develop volume, time, classification, and speed data, which in turn can be instrumental in developing some good measures for freight significant corridors.

Best Private sources: Global Insight (formerly known as TRANSEARCH data) still seems to be the best to understand national and regional flows. Such data need to be complemented with state and local data sources when studying statewide or substate or local freight flows. AAR provides data on various aspects dealing with rail freight. IANA provides good data on intermodal freight. PIERS and AAPA data are important sources for waterway and port data. Logistic Management's monthly pricing trends information is a good source to understand the changing trends for air, water, trucking, and rail modes. The key question is whether Minnesota pricing trend follows national trends. Similarly, annual logistics survey provides good insight into the factors that are affecting performance of freight industry. Examination of such factors at Minnesota level can provide basis for improvements to be sought. There are various freight industry data sources and reporting that Mn/DOT should closely monitor and examine to understand what freight industry trends and general health is. These include: pricing trends by Reeds Business; Tonnage Index from BTS/FHWA; Wall Street Indices; performance data on net profits, loss/damage of freight, dwell times, and delays from AAR and IANA; economic Indicators—fuel prices, trade arrangements, economy, commodity marketing; logistical trends—in supply chain and use of technology; economic base of area of interest; annual logistic survey; and anecdotal data/information on access, capacity, and reliability problems from sources such as Transportation Journal, Journal of Commerce, Traffic World, and others.

Even though they are being cited as best sources, these sources are not complete or available to the level and detail whereby one can develop performance measures and indicators easily, clearly and convincingly.

Good practices and recommended actions

Network and physical asset databases pertaining to interregional corridor, connectors, intermodal facilities, bridges and pavements should be maintained and improved. Similarly, safety data collected by Department of Public Safety and compiled and analyzed by Mn/DOT has been a good source of safety data. Minnesota Waterway and Ports section has one of the best data on waterway and port flows in Minnesota. BTS data on border crossing is also important data source to understand truck and container movements from Canada into Minnesota and U.S and Mexico. All these sources provide bases for many of the performance measures that currently exist in the statewide transportation plan and statewide freight plan. It must be noted that not all data that are available has been compiled and analyzed. Intermodal facility database (separate one exists for Metro area and Greater Minnesota) is a good source but needs to be updated on regular basis using updated data on establishments. Duns and Bradstreet data have been used recently to update the information on freight clusters.

Three freight flow studies in 1990, 2000, and 2004 were very useful studies. Mn/DOT should conduct periodic freight flow studies at all levels. There are still data limitations related to national CFS data and Global Insight data, particularly in dealing with substate and local flows. One of the most important sources has been Mn/DOT's Freight Advisory Group, which has been instrumental in identifying issues and providing anecdotal evidences regarding freight problems and challenges. Regular meetings with the group have provided good insights and bases for important freight related studies in Minnesota. Operational data such as travel time data, loop detector data, classification data also are good source of data. However, they have not been tapped fully.

Freight specific studies dealing with agricultural freight movement, spring load restriction and its impact, connector studies, truck size and weight, rail-intermodal studies, modal shift studies, freight market segmentation studies for manufacturing sector, regional freight flow studies have been conducted in past. All these studies provide wealth of information which can be used to understand which freight measures and indicators to use and what data limitations exist. Effective use of past freight related studies and statewide and district plans in Minnesota is recommended to develop understanding of the strategic directions, policies, strategies, and priorities. This in turn could be instrumental in examination of performance measures and indicators and their continuing relevance. Similarly, transportation inventories need to be updated and expanded to provide better assessment of deficiencies and adequacy of freight significant corridors and nodes.

Innovative practices could be dealing with lack or absence of data, could be dealing with process of developing performance measures and indicators, or coming up with effective and innovative partnerships to deal with both data and performance measures. Good things to learn from others include imputing data, conflating data, developing new sources, public private partnerships, and in dealing with heterogeneous data.

Freight generation information can be obtained from secondary sources or through surveys of establishment. There are several examples of conducting surveys of freight stakeholders and facilities. Such surveys will be critical in developing freight trip generation information. Urban goods movement has been studied using various models. Such models can be effective in looking into strategies that could improve urban goods movement in metro areas. Similarly, some states have developed statewide freight flow models. Such models are especially useful in understanding the bottlenecks of future. Any improvement of expansion project required lead time. Having such information along freight siginificant corridors and nodes will be critical in proactively dealing with freight bottlenecks of future.

Travel time and reliability data exists but has not been compiled and studied in depth. Freight shipments take hours to several days, depending on destination of freight and nature of freight. CVISN and other ITS technologies have been used in enforcement of truck movements. This provides a good source of data but has not been studied well. Travel time data for metro area are good but needs to be updated and examined better. Travel time data along I-94 from St. Paul to Chicago using ATRI-FHWA effort could be useful and should be identified as one of the corridors for ATRI-FHWA travel time measurement effort.

It is also conceivable that needed trucking data elements that are not readily available but for which there is great demand, can be included with existing and ongoing data collection protocols, especially at national and state levels. For example, the data on empty trucks can be included with HPMS data collection effort. Similarly, information of distribution of freight volume and value by truck configuration can be collected as part of VIUS or other data collection efforts. It is important that VIUS be continued. It is important to consider the value of these data elements for the range of applications and the extra cost required to include them as part of existing data collection efforts.

Public-private approaches in gathering data, especially travel time along corridors is a good example. Such partnerships between public and private agencies and among different public agencies at different levels will become more critical in developing understanding of freight flows as freight flow is not confined to one jurisdiction. Good examples of public-private approaches include: ATRI Travel time efforts; efforts in conducting shipper panel surveys; and other surveys pertaining to inbound, outbound, transshipment, and intermodal movements. Similarly, grain elevator surveys in North Dakota, conducted periodically, are possible because of memorandum of agreement with ND Public Service commission. Needless to say because many of freight data is proprietory in nature, we cannot develop good understanding without public private partnerships which will ensure confidentiality and address competition issues. This process becomes more effective if there are ties developed through freight advisory groups or use of third party (like universities) or use of trade associations. Similarly, there needs to be better partnerships with districts, MPOs, other state agencies, and municipalities to address freight issues and related data. It can also serve as basis to develop or justify appropriate funding to develop plans and data.

Many freight measurement sources, which are available, need to be collated and compiled and analyzed. There is not much reporting of performance currently underway. Safety is the key performance that has been reported. Immediate focus should be on updating transportation invetories, intermodal facility database, safety database, and travel time and speeds along freight significant interregional corridors.

There needs to be a better understanding of multimodal nature of freight movement. Identifying bottlenecks and addressing inadequacies in performance, access, or capacity in a proactive way is very important. Connector studies have been important. But definitions for capacity and access need to be articulated better before we further develop performance measures and targets for those measures. Freight flow studies in 1995, 2000, and 2004 provided good information, but at best, they were snapshots of those years. A freight model—statewide and urban/metro level--could be useful in getting continuing and forecast information. Model development can be helped by private industry in providing modelers with data that can be used for calibration and validation. However, this will require resource commitment and effective public-private agreements.

Supply chains for different industries should be understood and the relevance and importance of transportation in the overall supply chain has to be identified clearly. Such studies would be of particular interest to freight industry, but Mn/DOT can gain from such studies and their findings.

Developing performance measures and indicators can be difficult due to variables in data measurement criteria, inconsistent data availability, unreliable and incomplete data resources, lack of geographic specificity and inaccessibility of some data required for adequate and verifiable measurement information. Self-generation of the desired or needed data by agency can be problematic from cost and accessibility (confidentiality) standpoints. Hence, performance measures and indicators should be assessed for the clarity in their descriptions, their technical appropriateness, data availability, and cost before they can be institutionalized and used as benchmarking of performance.

Chapter 1 Introduction

1.1 Background and motivation

Freight mobility is playing an increasingly important role in transportation planning, service and investments at local, state, regional, national, and international levels. Minnesota Department of Transportation (Mn/DOT) has conducted or has been involved with several freight studies. Freight data needs have been identified by many and there are numerous freight data as well as freight modeling challenges facing transportation and logistics professional community, public agencies, shippers, and carriers as the freight movement has become increasingly global and much more interdependent on various infrastructures, operational, and logistic systems.

The Freight unit of the Office of Freight and Commercial Vehicle Operations (OFCVO) identified four performance indicators to be included in Mn/DOT's Statewide Freight plan. The four performance indicators identified were shipment rates, mode share, geographic market share, and travel time. Development of such and other performance measures and indicators is intended to assist the Freight Unit of OFCVO in responding to key stakeholders in the public and private sectors regarding the performance of the Minnesota's freight transportation system. In addition, the results of the examination of various freight performance measures and indicators for Minnesota and the related measurement sources will assist in Mn/DOT's long range planning efforts such as the update of Mn/DOT's Statewide Transportation Plan.

Developing performance measures and indicators can be difficult due to variables in data measurement criteria, inconsistent data availability, unreliable and incomplete data resources, lack of geographic specificity and inaccessibility of some data required for adequate and verifiable measurement information. Self-generation of the desired or needed data by agency can be problematic from cost and accessibility (confidentiality) standpoints. Hence, performance measures and indicators should be assessed for the clarity in their descriptions, their technical appropriateness, data availability, and cost before they can be institutionalized as used as benchmarking of performance.

1.2 Objectives

The research objectives were to:

(1) Compile, analyze, organize, and classify available freight data or information sources for all transportation modes, including intermodal;

(2) Assess the efficacy of relevant and important data or information sources as a measurement tool for developing performance measures and indicators for Minnesota; and

(3) Identify and recommend the best sources of information available and how Minnesota should proceed in terms indentifying and developing most important performance

measures or indicators related to freight movement within, inbound, outbound, and through Minnesota.

1.3 Scope

The scope of research was to address agency (Mn/DOT) as well as shippers and carriers needs and how all may assess their performance within the realm of freight movement inbound, outbound, or through Minnesota. Focus of this study was to assess what measurement sources exist and in what form to seek and identify answers, based on data, to performance measures and indicator categories related to network and infrastructure, safety or damage, access, capacity, travel time, reliability, market share, mode share, modal costs, freight productivity, freight security, shipping rates, pricing, agency cost, carrier cost, shipper cost, externalities and community cost, transportation indices, and external factors related to or impacting freight movements within, inbound, outbound, and through Minnesota. It was also felt necessary to identify the most important performance measures and indicators that Minnesota presently does not have. Thus key example measures and indicators in each performance measure and indicator categories were assessed. The assessment of measurement sources was confined also to key measurement sources. The measurement sources were identified as primary, secondary, snapshots, anecdotal, or research findings of specialized studies.

1.4 Research approach

The organization, classification, analysis, assessment, and recommendation for freight data were to be done at the backdrop of freight performance measures and indicators relevant to freight movement within, inbound, outbound and through Minnesota. It was also emphasized to go beyond the measures relevant to only public agency as Mn/DOT and to examine the freight industry performance measures and indicators. Thus, a need to examine the trade association and private data sources more closely.

The overall research effort and approach is shown in Figure 1.1 and the study was divided into seven tasks. The details of each task are provided in following subsections.

1.4.1 Task 1—Scoping

Initially, at the start of the project, the interest was on focusing on the four new performance indicators -- market share, modal share, shipping rates, and travel time – identified in the 2005 Statewide Freight Plan. The interest was in finding data for developing these four performance indicators for selected commodities and markets. After July and December meeting with the Technical Advisory Panel this was revisited. This was discussed very extensively throughout the project and final consensus was to not focus or be tied to only those indicators that have been identified in the Statewide Freight Plan. Similarly, the interest was not in conducting another commodity flow study and all the work that led up to development of measures and indicators that went into into the final statewide freight plan. The idea was to go beyond. The focus had to be both “industry-centric” and “government-oriented.” Though pavement conditions, safety, and

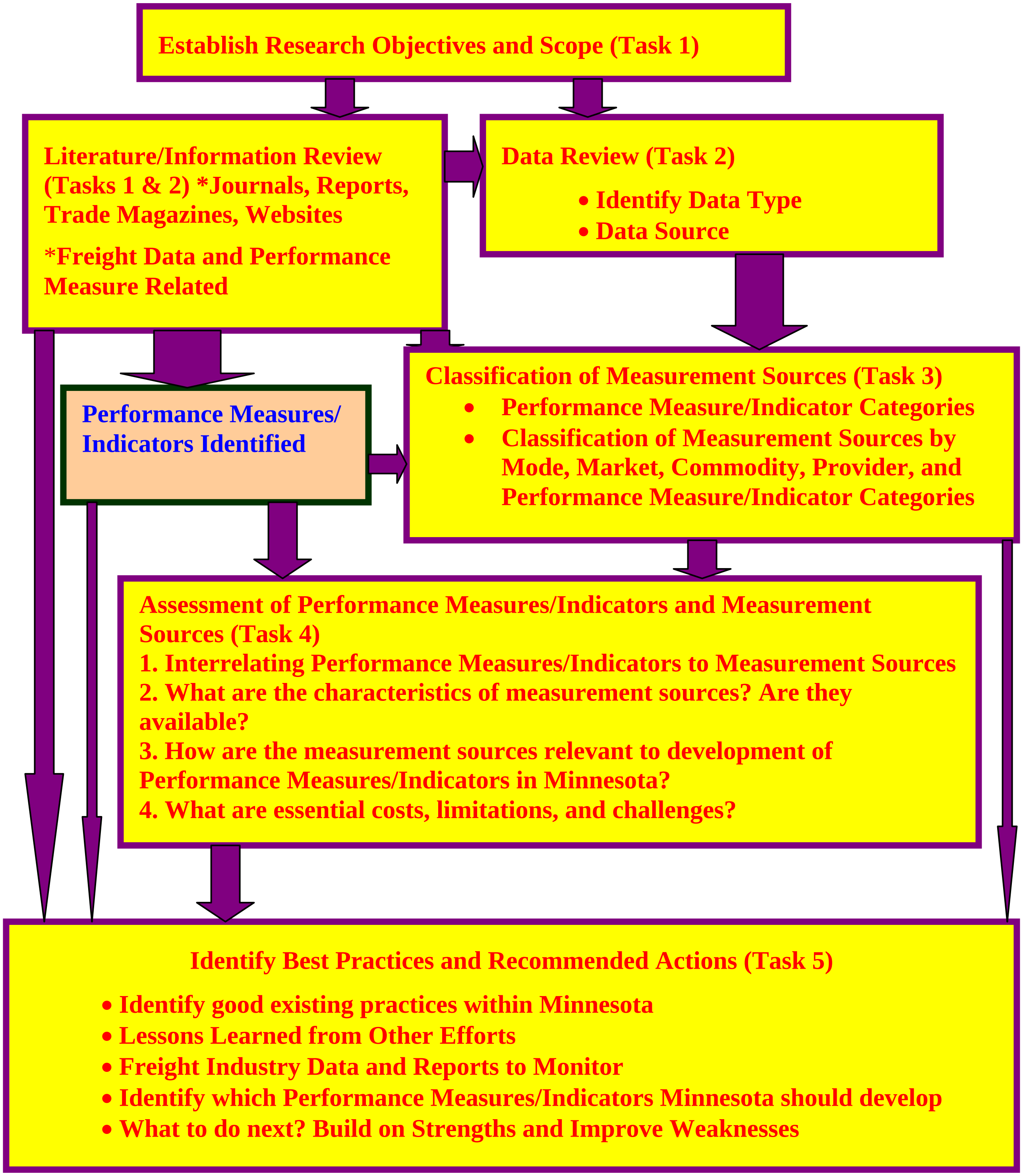


Figure 1.1. Overall research approach.

travel times were important, there was a need to better understand the costs, rates, and actual delivery times. In addition, it was surmised that this study should not worry about a formal government response with associated development of linkages, measures, or indicators. It was also concluded that there was a full set of measures from the Statewide Freight Plan to pursue that relate more to Mn/DOT's on-going programs and projects. It was felt that a general set of freight (industry) metrics will be useful in a variety of ways, mostly as a clue that something right or wrong is happening and may warrant further investigation. There was consensus that data availability will largely drive which particular measures and indicators can get implemented. In this research the intent was to cast a very wide net and then winnow down. In the end it was decided that we do not confine ourselves with the freight performance measures and indicators already identified in statewide freight plan but to explore all that is out there and especially what are the ones relevant to freight industry. Similarly, the interest was to look into all possible data and information sources, whether they provide snapshots or anecdotal evidence, whether obtained from census or routine observations, or whether they were developed and derived from models or multiple sources.

1.4.2 Task 2—Literature and data collection and review

Looking at the scope, we expanded the literature and data collection and one of the strengths of this research effort is in such wide identification and review. The review and data collection were very extensive and sources were varied in many respects. Some developed information sources are result of extensive study while others are viewpoints of industry experts. Some data are routinely collected while others have been collected, innovatively perhaps, for specific study or reason. The central theme was to examine if it shed a better light in our understanding regarding freight performance measure and indicators that are important and relevant to both transportation agencies and freight industry. The review and data collection were very involved work.

This effort was documented in Interim Report #1.

1.4.3 Task 3—Classification of measurement sources

In contrast to earlier data studies, where the data sources were compiled and their characteristics were outlined, this research effort first wanted to develop a rationale for classifying and organizing the disparate information and data sources that exist. The performance measure and indicator categories were defined first. Realizing that there are so many interpretations and connotations that exist, it was important to identify what is meant by each measure and indicator category, as far as this research is concerned. They are more like categories reflecting specific concerns related to freight movement. This classification was very tedious and important exercise as it allowed us to map the data/information source to specific mode, market, provider, and performance measure and indicator category. This mapping could be of interest to all interested in understanding what impacts freight movement inbound, outbound, and through their community. The classification was carried out for both public and private sources.

First, the definitions were developed, which are provided in Chapter 3. Second, the classification was carried out in the manner shown in schematic figures, Figures 1.2 and Figure1.3, and details of this mapping are provided in Appendices B and C. The details of references pertaining to reference numbers in Appendices B and C are provided in Appendix A. Third, the findings of the mapping are described. Finally, the implications of such findings are discussed.

First, the definitions were developed, which are provided in Chapter 3. Second, the classification was carried out in the manner shown in schematics, Figures 1.2 to 1.4, and details of this mapping are provided in Tables B.1, B.2, and B.3 of Appendix B.

MEASUREMENT SOURCE	MODE							MARKET(SCALE/LEVEL/DECISION CONTEXT)/ MOVEMENTS										
	AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULTISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL(G)	INBOUND (I)	OUTBOUND (O)	THROUGH(T)

Figure 1.2. Schematic of classification by mode and market.

MEASUREMENT SOURCE	SECTOR/ COMMODITY								PROVIDER/ DEVELOPERS				
	AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)

Figure 1.3. Schematic of classification by commodity and provider.

MEASUREMENT SOURCE	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
	NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)

Figure 1.4. Schematic of interrelating performance measures/indicators to measurement sources.

The effort of Task 3 was documented in Interim Report #2 and also incorporated in final draft report and final report.

1.4.4 Task 4—Assessment of example performance measures/indicators and measurement sources

First, for each of the performance measure and indicator category outlined and defined in Chapter 3, example measures and indicators were identified and assessed, which are discussed in Chapter 4. The example measures and indicators were assessed in the manner shown in Figure 1.5. The example measure and indicator were also tied to what has already been identified in Minnesota STP or SFP. For these example measures and indicators measurement source(s) were identified; if none existed then that was highlighted too.

Example Performance Measure/Indicator	
Strategic Direction (s)	Which Strategic Direction (s)?
Policy(Policies)	Which Policy (Policies)?
Sector(s)/Commodity(ies)	Agriculture, manufacturing, coal/iron/mining, pulp & paper, lumber & wood, retail, wholesale, food products?
Mode(s)	Air, intermodal, multimodal, rail, pipeline, truck, waterway/ports?
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Travel	Only freight or both passenger and freight?
Usage	Currently being used? Where? In Minnesota?
Stakeholder(s)	Public, Private, Both?
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Which measurement sources are useful?
Challenges	Descriptive Value— Technical Appropriateness – Data Availability— Cost--

Figure 1.5. Schematic of analysis of example performance measure/indicator.

Second, the criteria for determining efficacy of measurement sources were described. Third, the key federal, state, regional, local, and private measurement sources were identified and assessed. It was was not productive to assess all the measurement sources identified and classified in Task 3. Finally, the implications of the assessment were outlined and summarized.

The assessment included looking into data characteristics, how data were obtained, what were significant limitations, what are the costs and benefits, and how relevant and applicable are the sources for developing freight performance measures and indicators for Minnesota (see Figure 1.6). Included in the assessment, were performance indicators such as shipping rates, modal costs and travel time, the four new performance indicators in Statewide Freight Plan. Data characteristics or attributes included geographic coverage, issues of aggregation, when was data developed and how often is it updated. It was also assessed how data were obtained. For example, was it viewpoint of stakeholders, routine observation, census survey, special local surveys, or obtained through modeling or some other derivation. It was also important to identify, where clearly known, who were responsible for data that were collected and maintained. The limitations identified in the assessments were in terms of accessibility, adequacy, exclusions, efforts needed to verify or authenticate data, and costs. The applicability to freight performance measure/indicator categories --Network and Infrastructure, Safety or damage, Access, Capacity, travel time, reliability, market share, mode share, modal costs, freight productivity, freight security, shipping rates, pricing, agency cost, carrier cost, shipper cost, externalities and community cost, transportation indices, and external factors—was examined. In addition, if such sources can be applied for measures/indicators in Minnesota was determined. In some instances this examination or assessment were more detailed (for example CFS data, TRANSEARCH data, Waybill data, and others). In other instances this assessment did not include answers to all the aforementioned questions as data were developed and used for specific purpose rather than developed on regular basis.

This effort was documented in Interim Report #3 and also incorporated in final draft report and final report.

Measurement Source	
Characteristics & Availability	
Applicability & Benefits	**How is it applicable to development of PM/I and for MN?**
Costs, Limitations, and Challenges	

Figure 1.6. Schematic for assessing measurement sources.

1.4.5 Task 5—Best practices and recommended action

The assessment in Task 4 provided a very good insight into what exists and what Minnesota is already doing or having as a resource. This task was also to reflect on not only what Minnesota has or does not have it terms of data and information source but also to identify what it can learn from other efforts or what results of other efforts can be of value to Minnesota. In this effort it was emphasized to identify what freight industry sources and measures Minnesota should examine closely to understand the changes and impacts on freight transportation industry. Thus, this task involved the following actions:

1. What are the best sources available; best in terms of how it helps us identify freight performance measures/indicators and also in terms of availability, reliability and applicability of data/measurement source for freight movement within, inbound, outbound, and through Minnesota.

2. What should Mn/DOT continue to do data-wise that it is currently doing to develop understanding of measures related to freight movement inbound, outbound, and through Minnesota and in turn continue to develop an understanding of freight performance?

3. What data collection, modeling, or reporting approaches or efforts other agencies, associations or specific freight studies have adopted to deal with data limitations?

4. What freight industry data sources and reporting should Mn/DOT closely monitor and examine to understand what freight transportation industry trends are?

5. What institutional and public-private approaches should be adopted to improve freight transportation data in Minnesota?

6. What should Mn/DOT do that it is not currently doing to improve understanding of measures/indicators related to freight movement within, inbound, outbound, and through Minnesota and in turn have better understanding of freight performance?

7. What performance measures/indicators should Minnesota worry about?

Through this exercise the research provides recommendations on the best practices, optimum data sources and feasibility of Minnesota to self-generate data, where publicly generated data is not available or inadequate.

This effort was documented in Interim Report #4 and also incorporated in final draft report and final report.

1.4.6 Tasks 6 and 7—Development of reports

These tasks were related to documentation of research effort. Task 6 involved development of final draft report(s) and presentation materials for review by the Technical Advisory Panel (TAP) and Center for Transportation Studies (CTS). Task 7 involved preparations of presentation materials and the final report based on the review comments from the TAP and CTS for final approval by the TAP and CTS.

1.5 Report organization

This report is organized in six chapters and five appendices. Chapter 2 examines freight studies conducted at national, regional, state, and local levels; sectoral and specialized studies; freight studies in Minnesota; freight data related studies and work; and studies related to performance measures and indicators. The reference numbers for measurement sources are provided in Appendix A. The classification and mapping of measurement sources to mode, market, sector, provider, and performance measure/indicator categories are discussed in Chapter 3 and Appendix B. The assessments of example performance measures and indicators and the measurement sources are detailed in Chapter 4 and Appendices C and D. The best practices and recommended actions are identified and outlined in Chapter 5. Chapter 6 provides conclusions and recommendations.

Chapter 2 Search and Examination of Relevant Freight Literature and Data

The issues determine the types of data and analyses that are needed in order to develop strategies to address them. The significant issues are infrastructure capacity and deterioration, safety, global trade and competitiveness, financing, technology use, and environmental and energy impact. In addition, there are logistics issues; increasing demand for reliable, cost-effective, timely and visible door-to-door freight services coupled with lower inventory levels and less slack production capacity creates greater dependence on transportation services, particularly true for trucking. Furthermore, there are freight security issues to deal with; knowledge of the nature and characteristics of cars, vehicles and equipment (e.g., configuration, design) are required for cargo security (e.g., theft, pilferage, and smuggling).

In searching and reviewing freight related literature and data, the scope was wide open for this study. The freight related performance measures and indicators were regarded as the underlying basis for searching for and in turn organizing and classifying literature, data, and data sources. As was mentioned in Chapter 1, investigation was not primarily focused on or related to the existing freight performance measures or new freight performance indicators given in Minnesota's Statewide Freight Plan (Mn/DOT, 2005a). It was also an aim to see if there were any other relevant and useful freight performance measures or indicators being used by public and private agencies in other localities, states, regions, nations by public.

It is important to recognize that the nature of freight traffic is varied and is dependent on both transportation and logistics factors (see Table 2.1), some of which are influenced by public decision-making while others are motivated by private decisions and/or external socio-political-economic conditions. Understanding these interdependent interactions is essential to develop a responsive freight transportation and logistics infrastructure and systems.

Table 2.1. Nature of freight traffic.

<table>
<tr><th colspan="7">FREIGHT TRAFFIC</th></tr>
<tr><th colspan="6">Asset Based</th><th>Logistics</th></tr>
<tr><th>Truck</th><th colspan="2">Rail</th><th>Water</th><th>Air</th><th>Pipeline</th><th>Forwarder</th></tr>
<tr><td>LTL</td><td>Carload</td><td>Intermodal</td><td>Barge</td><td></td><td></td><td>3PL</td></tr>
<tr><td>TL</td><td></td><td>TOFC</td><td>Vessel</td><td></td><td></td><td>Regulatory</td></tr>
<tr><td></td><td></td><td>COFC</td><td></td><td></td><td></td><td>4PL</td></tr>
</table>

2.1 Freight studies

Several freight studies have been conducted since early 1970s. First major emphasis was at federal level and subsequently many states carried out detailed studies. The purpose of the examination of the studies is to primarily explore why those studies were conducted and what was the consequence of that effort in advancing understanding of freight movement and related performance measures and indicators.

2.1.1 National studies

The very first national level study was the dual effort of NCHRP 177 and 178 which was carried out by R.L. Banks and associates (Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc., 1977, 1978). The purpose was to find the data requirements for transportation system planning purposes. Soon thereafter a comprehensive study was carried out regarding application of statewide freight demand forecasting techniques (Memmott, 1983). Cambridge Systematics, Inc. has conducted several NCHRP and FHWA sponsored studies related to freight since 1980 and have been related to freight demand, freight modeling, and even on forecasting of freight performance measures at state level (Cambridge Systematics, Inc., 1999, 2001, 2003a, 2003b, 2004a, 2004b, 2004c; Cambridge Systematics, Inc. et al., 1995, 1996, 1997, 2005, 2006a). Urban goods movement has been studied (Czerniak and Gaiser, 1997a, 1997b). Since 2000 lot of logistics studies have also researched on transportation topics as it seems to be a big component of overall logistics costs and also it is one that no carriers have seen stabilizing or going down. A recent seminar (Levans et al., 2006) had various important findings about how carriers and shippers are responding to changing conditions.

2.1.2 Regional studies

The typical regional studies were generated from the need to understand the corridor movement of freight and particularly alone major interstate corridors. Regional movements were construed as both across multiple states or across multiple counties. Upper Great Plains transportation Institute and Upper Midwest Freight Corridor Coalition have conducted and generated information on regional basis (Wittwer et al., 2005). Niles (2003) looks into regional freight logistics profile.

2.1.3 Statewide studies

Several statewide freight studies have been conducted in last decade for Ohio (Cambridge Systematics, Inc. and Reebie Associates, Inc., 2002), Oregon (Cambridge Systematics, Inc. and HDR, 2005), and California (Barber and Grobar, 2001; California EPA, 2005). Czerniak and Gaiser (1996) have studied the use of intermodal performance measures by State Departments of Transportation.

2.1.4 Local studies

Metropolitan Planning Organizatios (MPOs) are the ones interested in local freight movements and how well to plan for it. It is harder to understand the local freight movement due to lack of good data. MPOs are now more visibly incorporating freight considerations into transportation planning by developing truck models. Goods movement within metropolitan areas has been studied (DMAMPO, 2002). There have been urban goods movement studies in different areas and ITE and FHWA is currently developing case studies on some of the successful implementations at local levels.

2.1.5 Sectoral studies

Sectoral studies for freight movement have been carried out. The sector that has been most extensively studied is Agriculture sector. Timber and Manfucturing sector has been studied too. UGPTI generates monthly report on grain elevator data. This was possible due to an agreement with Public Service Commission of North Dakota. USDA provides regular grain movement report nation wide through its publication "Grain Transportation."

2.1.6 Specialized studies

Among such studies are those that have been prompted by policy and investment objectives. Examples of such studies are those related to truck size and weight, spring load restriction studies, mobility measures, and impact on travel times, and others. TRB conferences and e-sessions have also provided information of freight trends, issues, data needs, and modeling needs as well as state of practice within DOTs.

2.2 Minnesota freight studies

Over $ 600 billion in goods are moved in Minnesota. It is projected to grow by 60% by 2020. Trucking Industry is growing fastest. Top five commodities by weight are farm products, mineral and ores, food products, coal, and lumber/wood products. Railroads are currently running at capacity. Rising fuel and labor prices and equipment shortage have resulted in increase in freight rates. Emerging trend is shipment of agricultural commodities in container, including export grain shipments. Future intermodal traffic, especially international shipments, will continue to use Pacific Ports to access global markets. There are physical limitations on the St. Lawrence Seaway and the Mississippi river, which constrain Minnesota Ports. Consolidation of farms has resulted into a new trend of farmers shipping their own products using their own or hired semitrailer equipment and possibly less reliance on railroads. However, expansion of livestock industry may make feeding industry more dependent on rail and the quality (timeliness and predictability) of service it provides.Minnesota is largely dependent on Chicago for efficient intermodal routing but face capacity constraints.

2.2.1 Statewide studies

Minnesota has conducted three statewide freight studies, one for flows based on data from 1990 in 1995 (Campbell et al., 1995), one in 2000 (Cambridge Systematics, Inc., 2000) and one in 2004 (Cambridge Systematics, Inc., 2004d). The principal data source for studies in 2000 and 2004 was Reebie data, TRANSEARCH. This database is now part of Global Insight and is called TRANSEARCH INSIGHT. C.J. Olson Market Research, Inc. (1995) conducted quantitative research regarding performance measures for intermodal freight transportation in Minnesota. Cambridge Systematics was involved in the recently developed Minnesota's Statewide Freight Plan (MNDOT, 2005a). Minnesota has also developed a Statewide Heavy Vehicle Safety Plan (CH2M Hill, 2005). Harper and Evers (1991) analyzed Intermodal Railroad-Truck freight transportation facilities and services in Minnesota.

2.2.2 Regional studies

Several regional studies have been carried out in Minnesota. For example, freight or rather commodity movement has been studied for northshore area (ARDC, 1983, ARDC, 1985), northeast area (ARDC, 1999), and northwest area (C.J. Petersen & Associates et al., 1997; Braslau and Fruin, 1998). These areas have been dominated by either coal movement or forest product movement and an essential aim was to see how these movements are stimulating economic development and to look into mode share and value. Recently, Twin Cities' regional freight planning model has been developed (SRF Consulting Group, Inc. and Cambridge Systematics, Inc., 2004).

2.2.3 Sectoral studies

Minnesota has conducted several studies in understanding agricultural freight movement. Buschena et al. (1985) looked into statewide grain movements in Minnesota. Some of the issues that have been studies are containerization etc. Edlridge and Fruin (1984) studied movement of forest products. Market segmentation study (SMS, 1998) analyzed the satisfaction of metro area manufacturing companies with respect to freight movements. Senf and Fruin (1986) assessed the competitive position of Great Lakes Ports in the International Steam Coal Market. Mn/DOT's Ports and Waterway section has looked into Minnesota's Lake Surperior Terminals, ports, and waterway (Lambert, 2004), and documented the Great Lakes Transportation system (Mn/DOT, 1989) as well as the Natural Gas & Liquid Petroleum System (Mn/DOT, 1995b). Shippers' requirements at Twin Ports intermodal freight terminal has been studied also (Stewart et al., 2003). Wilbur Smith Associates et al. (2006a, 2006b) developed the most recent Minnesota Aviation System Plan, and had a specific section on Air Cargo. The plan also outlines some performance measures related to air cargo. Specialized Studies

A good example is recently concluded Truck Size and Weight study (Cambridge Systematics, 2006b). Mussell and Fruin (1997) had earlier looked into the impact of truck size and weight laws on shippers. Spring load restriction impact on Minnesota's highways and streets is another example (Levinson et al., 2005). Adequacy of freight connectors to interregional corridors and major highways has been recently studied (SRF Consulting Group, Inc., 2003). Mn/PASS system has been documented in a recent study (Cambridge Systematics, Inc with URS Corporation, 2005). Barnes and Langworthy (2003) developed values for operating costs per mile for both automobiles and trucks using a spreadsheet model. Beier (2002) looked into the feasibility of shipper panel to measure transportation service. Kirtzy (2004) looked into speed performance measures of Minnesota's Interregional Corridor System. Several freight and logstics related annual symposiums have been conducted since 2000 (see CTS 2000, 2001, 2002, 2003, 2004, 2005, 2006, and 2007). These symposiums have talked about latest trends and issues in freight and logistics and also discussed the research findings from freight related research conducted in Minnesota. Donath et al. (2005) have conducted a study on how homeland security has impacted trucking industry or how has trucking industry responded to requirements for homeland security. Maze et al. (2005) looked into the impacts of trucks in traffic management in twin cities area.

Modal shifts have been a long standing concern and the need for understanding the shifts and their implications is felt more now. Mn/DOT's Ports and Waterway section has studied the environmental impact of modal shifts (MNDOT, 1991) and estimated the monetary cost for modal shifts (MnDOT, 1997). Fruin and Fortowsky (2004) studied modal shifts from the Mississippi River and Duluth/Superior to land transportation more recently. Ports and Waterway section has best waterway data that exists at state level and the section has also put out information regarding Minnesota's river terminals (MnDOT, 2005c) and also about twin cities barge fleeting (MnDOT, 2005b).Similarly, Minnesota's Lake Superior terminal information has been developed by the ports and waterway section (Mn/DOT, 2004). Agricultural and other commodity shipments have been analyzed in the past (UMVRDC, 1986, 1988).

The need for freight access has been an issue that has been a concern for sometime and was first studied in late 1980s (MNDOT, 1986; UMVRDC, 1987). The economic impact of metro freight movement has been studied (Mn/DOT, 1999b). Also, for metro area the need for intermodal terminal facilities have been studied (RL Banks and Associates, 1995; MnDOT, 1995a).

2.3 Freight data studies and sources

There have been freight data specific studies and they have been cross cutting in their approach. This means the data need were assessed from multiple perspectives and data gaps were identified looking into different levels where decisions are made. The type and characteristics of freight data are determined by the intended use. There are several public and private sources of freight data, each designed to serve a specific purpose. There are single or multiple issues that freight data are used to address. Not all freight data are available to the same degree in frequency, accuracy, or scale. This variability arises because of the type of uses they are put to and who their users are.

2.3.1 National level

Freight Data Requirements for Statewide Transportation Systems Planning was extensively studied in late 1970s (Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc., 1977, 1978). This was a very extensive study done at its time and many of the discussions and findings are still very relevant. The purposes of national studies have been different. For example, in one instance it was motivated by system planning requirements (Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc., 1977, 1978). In another instance, the need was to determine data for forecasting freight demand

(Cambridge Systematics, Inc., et al., 1997). In yet another case the need was to understand the changing transportation and logistics world and assess data needs for responding to that change (Meyburg and Mbwana, 2002). More recently, a review of freight data in the U.S. (Mani and Prozzi, 2004) was carried out where 30 databases were reviewed. Since 2003 "Talking Freight Seminars" have been developed and conducted on a monthly basis to promote freight awareness. BTS has put out several data, statistics, and indicies over years. Lambert (1997) identified critical issues facing freight data collection and analysis. Lambert (2005a) discussed the shipment characteristics in the Commodity Flow Surveys. Lawson (2004) put forward freight informatics framework for the 21st Century. Zmud (2005) provides useful discussion on how to improve methods to enhance data quality and usefulness of Commodity Flow Survey.

Freight data are needed for a wide range of applications by federal, state, and local transportation officials. These applications include development of short and long term transportation plans, congestion and asset management, energy, safety, and environmental impacts assessment, and transportation policy development.

Among most talked about national level freight data sets in public domain are the following:

- STB Carload Waybill Sample
- Army Corps of Engineers Waterborne Commerce Data
- USDA Transportation Services Branch (e.g. the weekly *Grain Transportation Report*)
- State and Federal Truck Size and Weight regulations publications.
- Vehicle Inventory and Use Survey (VIUS)
- Highway Performance Management System (HPMS)
- Vehicle Travel Information System (VTRIS)
- Traffic Volume Trends (TVT)
- Long Term Pavement Performance (LTPP)
- Commodity Flow Survey (CFS)
- Freight Analysis Framework (FAF)
- The Annual Survey of Manufactures (ASM)
- Large Truck Crash Facts
- Motor Carrier Management Information System (MCMIS) Crash File.
- Fatality Analysis Reporting System (FARS).
- General Estimates System (GES)
- Trucks Involved in Fatal Accidents (TIFA)
- North American Transportation Statistics
- Transborder Surface Freight Data
- Truck Transportation, Messenger Services and Warehousing Annual Survey
- For-Hire Trucking (Commodity Origin and Destination) Survey

2.3.2 Statewide

Many states have good inventory of physical network and accident data. Minnesota has good highway inventory databases for location, condition and rideability, and traffic volume. Minnesota has also developed intermodal facilities database for Metro area and Greater Minnesota. New York (Turnquist et al., 1993; Holguin Veras et al., 2001a, 2001b, 2001c, 2001d) and New Jersey (Fallat, 2003) have developed databases at statewide level to determine commodity flow. New Jersey did not use TRANSEARCH data in their development as it was very costly. Safety databases are improving as well. Mn/DOT has good accident records.

2.3.3 Regional

A regional freight model has been developed for the New York Metropolitan Council (NYMTC) Region (Holguin-Veras et al., 2001a, 2001b, 2001c, and 2001d). Similarly, for various mega or multi-state and national corridors freight flow has been measured and modeled, particularly to study the impact of NAFTA agreement. Travel time for freight is the most recent effort and that is done in partnership with ATRI and FHWA.

2.3.4 Local

Local data are those that are typically developed by MPOs and typically are hardest to find. Often times attempts are made to use national or statwide data for analyses at local level. Minnesota Metro Area and FHWA travel time Measurements and trends have been carried out. Victoria and Walton (2004) looked into freight data needs at the metropolitan level and the suitability of intelligent transportation systems in supplying MPOs with the needed freight data.

2.3.5 Specialized and Industry Sources

Industry Index DJTA

The Dow Jones Transportation Average (also called the "Dow Jones Transports;" DJTA) is the oldest U.S. stock market index. It was created on July 3, 1884 by Charles Dow, co-founder of Dow Jones & Company, as part of the "Customer's Afternoon Letter". At its inception DJTA consisted of eleven transportation-related companies: nine railroads and two non-rail companies.

Table 2.2 Transportation Industries in Computation of DJTA.

Initial Industries in DJTA	Transportation Industries Today in DJTA
Chicago, Milwaukee and St. Paul Railway	Alexander & Baldwin, Inc. (ALEX) (shipping) ;
Chicago and North Western Railway	AMR Corp. (AMR) (major airlines) ;
Delaware, Lackawanna and Western Railroad	Burlington Northern Santa Fe Corporation (BNI) (railroads) ;
Lake Shore and Michigan Southern Railway	C.H. Robinson Worldwide, Inc. (CHRW) (air delivery & freight services) ;
Louisville and Nashville Railroad	CNF, Inc. (CNF) (trucking) ;
Missouri Pacific Railway	AMR Corp. (AMR) (major airlines) ;
New York Central Railroad	Continental Airlines, Inc. (CAL) (major airlines) ;
Northern Pacific Railroad	CSX Corp. (CSX) (railroads) ;
Pacific Mail Steamship Company (not a railroad)	Expeditors International (EXPD) (air delivery & freight services) ;
Union Pacific Railway	FedEx Corp. (FDX) (air delivery & freight services) ;
Western Union (not a railroad)	GATX Corp. (GMT) (rental & leasing services) ;
	JB Hunt Transport Services, Inc. (JBHT) (trucking) ;
	JetBlue Airways Corp. (JBLU) (regional airlines) ;
	Landstar System, Inc. (LSTR) (trucking) ;
	Norfolk Southern Corp. (NSC) (railroads) ;
	Overseas Shipholding Group, Inc. (OSG) (shipping) ;
	Ryder System, Inc. (R) (rental & leasing services) ;
	Southwest Airlines, Inc. (LUV) (regional airlines) ;
	Union Pacific Corp. (UNP) (railroads) ;
	United Parcel Service, Inc. (UPS) (air delivery & freight services) ;
	Yellow Roadway Corp. (YELL) (trucking) ;
	JB Hunt Transport Services, Inc. (JBHT) (trucking) ;

Various trade associations and private industry have made critical contribution in development of freight data and background reports. For some statistics daily updates are available, for some other weekly dissemination takes places, for many monthly and annual averages or trends are available.

There are compilations such as those found in Trip Generation Handbook and manuals such as Quick Response Freight Manual.

Perhaps the most widely used private data source for commodity flow studies was Reebie's TRANSEARCH Data. This data set is now available as Global Insight's TRANSEARCH INSIGHT database.

Other notable industry sources are:

Association of American Railroads: http://www.aar.org/

Air Transport Association: http://www.airlines.org/home/default.aspx

American Short Line & Regional Railroad Association: http://www.aslrra.org/

American Trucking Associations: http://www.truckline.com/index

Eno Transporation Foundation: http://www.enotrans.com/

Intermodal Association of North America: http://www.intermodal.org/

Inland Rivers Ports & Terminals Assoc: http://www.irpt.net/

National Center for Intermodal Transportation: http://www.ie.msstate.edu/ncit/

International Air Transport Association: http://www.iata.org/index.htm

Journal of Commerce: http://www.joc.com/

Logistics Today: http://www.logisticstoday.com/

PIERS Global Solutions: http://www.piers.com/default.aspx

Railway Age Magazine: http://www.railwayage.com/

Traffic World: http://www.trafficworld.com/

Transport Topics (Publication of American Trucking Associations): http://www.ttnews.com/

2.4 Performance measures and indicators

Simply put performance measure is generic term used to describe a particular value or characteristic designated to measure input, output, outcome, efficiency, or effectiveness. Performance Measures are composed of a number and a unit of measure. The number provides the magnitude (how much) and the unit is what gives the number its meaning (what). Performance Indicator is particular value or characteristic used to measure output or outcome. Wye (2002) provides a good guide on how to develop performance measures.

2.4.1 General measures and indicators

Every successful organization, public or private, is bound to gain by developing and deploying effective performance measurement and performance management systems. President Clinton, by signing the Government Performance and Results Act of 1993 (GPRA) into law, institutionalized commitment to quality. Federal agencies were required to develop strategic plans for how they would deliver high-quality products and services to the American people. It was also in 1993 that President Clinton and Vice President Gore initiated the National Performance Review (NPR) to reinvent government. One of NPR's reinvention initiatives has been to foster collaborative, systematic benchmarking of best-in-class organizations, both public and private, to identify best practices in a wide range of subjects vital to the success of federal agencies in providing high-quality products and services to our principal customer the American people (Gore, 1997). Even in academia now we emphasize outcome assessment and development of measures (Rogers, 2005).

Performance measures should:

- Be closely related to the organization’s strategic goals.
- Reflect the range of things important to the organization.
- Reflect the significant aspects of an issue.
- Be chosen carefully.
- Be understood.
- Be used correctly.

According to NCHRP Synthesis 311 (Shaw, 2003) performance measure is “the use of statistical evidence to determine progress toward specific defined organizational objectives.” Thus, there is need to collect data and develop those statistics. Only after understanding the developed statistics and the associated trends, must one venture in to developing targets.

2.4.2 Transportation performance measures and indicators

Since inception of NPR within federal agencies, slowly the talk and use of performance measures started within DOTs. There have been several attempts made at use of transportation performance measures. In last decade, performance measures have been used by DOTs (Abbot et al., 1997; MnDOT, 2003; Baird, 2000a, 2000b; Bremmer et al., 2004; Yew, 2004; TRB, 2004; Larson, 2004), for ferries system performance (Gihring and Greene, 2000), to improve transportation planning (Barlosky, 2005; Mazur and Zabierek, 1997), use of ITS for freight applications (Belella,2005), for asset management (Cambridge Systematics, Inc. et al., 2006a; Halvorson et al., 2000), for airports and aviation system (Francis et al., 2002, Gosling, 2000, Humphreys and Francis, 2000), for multimodal transportation (Bertini et al., 2005; Cambridge Systematics, Inc., 1999; Pratt, 1996), for trade corridors (Blakely, 2005), for traffic operations and system performance (Bloomberg et al., 1997; Bremmer et al., 2006; NTOC, 2005), for state highway operation and protection (Booz Allen and Hamilton, Inc., 2000), for national transportation system (Codd and Walton, 1996; Kane, 2005), intermodal system (Czerniak et al., 1996; Zhang and Wu, 2003), regional transportation system (EPA, 2004), for auditing transportation system at metropolitan level (SRF Consulting Group, Inc., 2001), for capital investment strategy (Stout, 2002), for resource allocation (Straehl and Neumann, 2001), for statewide ITS system (TSI, 2004), in long-range state transportation plan (Mn/DOT 2003, TDOT, 2005), to assess connections to interregional corridors (Zemotel and Montebello, 2002), for sustainable transportation (Zietsman and

Rilet, 2002), and for measuring system performance (TRB, 2001a, 2001b, 2004; Meyer, 2001, 2002). There has been use of performance measures at international levels (Gannon and Shalizi, 1995) and in other countries (BIE, 1992; EEA, 2000; FTA, 2003). Internationally the emphasis on indicators and measures started after Agenda 21 meeting in 2002.

Developing and maintaining performance measures for transportation systems requires developing, maintaining, and updating databases. Data warehousing concepts have been promoted to develop effective databases, which can lend itself to performance analyses (Papiernik et al., 2000).

2.4.3 Freight transportation measures and indicators

It is often asked why we need measures and why do we measure. We need to rise above an anecdotal understanding of system performance. We need to improve communications and focus efforts. We also need to continually improve safety of traveling public and employees, stimulate economic development, reduce environmental degradation, alleviate congestion and improve reliability and time estimates, improve economic efficiencies, which are evidenced by larger economic trends or by costs of moving freight. For all this we need to have performance measures, which we continually measure. In addition, we need to see the trends, particularly the abnormality in trends, for performance indicators.

Freight performance measures and indicators have been developed and used (Hagler Bailly Services, Inc., 2000; Ivanov, 2004; Meyer, 2005; Jack Faucett Associates and ICF Kaiser, 1996; Mn/DOT, 2005a). Wittwer (2004) also describe the use of performance measures for freight systems and so does Meyer (2005). Public-private partnership has been used in developing travel time and reliability based measures in freight significant corridors (Johnson and Sedor, 2004; Jones, 2005; Jones et al., 2005; Lambert, 2005b; Murray, 2005).

Several freight performance measures were first discussed and identified in late 1990s in Minnesota (Mn/DOT, 1999a). Recently, Minnesota freight measures and indicators have been reported in its statewide freight plan (MnDOT, 2005). Minnesota has 10 policies and freight performance measures by mode. There are some new freight measures also. All this is outlined in Chapter 7 of the Statewide Freight Plan. New freight indicators included were: shipment rates, modal share, market share, and travel time. Selness (2005) made a presentation on Minnesota's freight performance measure during "Talking Freight" seminar series sponsored by FHWA.

Most recent work at national level has been NCHRP 8-43Forecasting Statewide Freight Toolkit (Cambridge Systematics, Inc. et al., 2005). Its essential purpose was to identify models and performance measures, particularly those that can be forecasted. It identifies 71 performance measures based on past work, interviews with Federal, MPO and state DOTs' sources. It also ties policy needs with performance measures.The focus was on public agency's perspective. However, the effort concentrated on only 15 of the 71 identified measures because of data limitations.

2.4.4 Public agency versus freight industry

There are differences in how public and private sector perceives performance.The public agency focus is on safety, security, durability, and capacity of infrastructure and any congestion, bottlenecks, or accidents on its infrastructure. The focus is on both passenger and goods movement; however, much investment decisions, particularly related to capacity and access, are based on passenger movement. The geographic scope is confined to jurisdiction limits. The private sector focus is on door to door travel time; reliability of service they provide to their customers; safety and security of product, vehicle, and operator; availability of right equipment and route with adequate capacity and strength; seamless and less burdensome administrative processing; and geographic scope has not jurisdictional boundaries. The workforce shortage is also impacting private sector. The shipments of many products to and from a region are getting increasingly global.

Morash (2000) discusses how the public and private performance measurement can be linked. Public sector can perceptibly affect private-sector performance through investment policy, financing arrangements, tax policy, infrastructure improvement, and similar policies and actions. Deregulation and global competitiveness warrants cooperation and collaboration among all public and private stakeholders. Nonetheless, public sector transportation policies should be market-driven. According to Morash (2000), the relative importance of performance measures in three global regions--North America, Europe, and the Pacific Basin--showed remarkable agreement as to which performance capabilities are most important to a firm’s success. Transportation dependability and customer service ranked at the top; low logistics cost and delivery flexibility came in the middle; and surprisingly, delivery speed was at the bottom. It appears that transportation public policy and plans should stress reliability over speed in terms of setting priorities.

2.5 Summary

Freight data are available but are also dirty, in disparate sources, and difficult to get hold of because of cost and confidentiality issues. Data challenges must be dealt with to understand and proactively deal with numerous challenges emerging from growth in freight movement. Identification of what is available in what form and what works and why is an important first step.

Inventory of network of physical infrastructure and accident information has enhanced over years. Congestion and travel time on metropolitan corridors and some regional corridors have been monitored and could provide a good performance measure.

Periodic data collection at federal level exists and are mostly carried out and maintained by BTS, FHWA, U.S. Army Corps, and STB. Data collection has been a periodic at state and local levels. Several internal commercial surveys have been used by States. Supplementary Shippers Surveys have been conducted for specific studies. In most instances it has been motivated by conducting specific analysis for understanding freight movement impacts on infrastructure, safety, and congestion. The most studied subject has been the truck size and weight issue. Commonly used trucking data are available from several public and private sources. Some of the needed trucking data elements are not readily available. Options to improve their availability include refinements and updates of existing models, coordination between public and private agencies, and inclusion in existing and ongoing data collection protocols. BTS, BLS, State-maintained data will continue to be the main data used for freight purposes. ATRs, CVISIN, traffic management systems may help. Needed freight data elements that are not readily available are derived from isolated studies or predictive models that are based on limited data and a number of assumptions.

TRANSEARCH (now part of Global Insight and named TRANSEARCH INSIGHT) data are used extensively by many interested in freight flows but are also very costly. Such analysis allows the agency to get a snapshot of the flows during the year study was done. This may not lend itself to continual assessment. The commodity flow data can help us understand commodity flow but are not adequate for freight movement and the related performance of time, reliability, and others. Much work remains to develop regional data sources and make them timely and accurate. We have most difficulty in understanding either local or global freight movements, based on the data that currently exists. The current data are not at all helpful for local movements; because of confidentiality issues much data are suppressed.

Performance Measures, though has been discussed a lot over last couple of decades, is being incorporated recently in last five years. Definitions of performance measures are not clear cut. Shippers have been hit hard by rising freight rates, fuel costs, a capacity crunch that won’t go away, and new global demands that are stretching the limits of logistics operations. To "hold the wheel steady" in this storm of logistics woe, shippers are turning to supply chain and logistics technology. Intermodal has many modes, multiple providers, and most volatile, which makes it harder to measure and control. We need to understand both the logistics-based factors and transportation-based factors. Freight industry wants to be part of decision-making and not be victim of circumstances.

Understanding the push and pull between demand and supply will be needed to truly identify performance factors of industry. One cannot manage what one can’t measure; just anecdotal evidence/statistics is not enough and we are dealing with numerous factors. There are issues of competition and mergers. Sometimes we have data but no information and there is always this fear of being blamed when providing data. Much relevant and important data resides in private sector and are proprietary in nature; need more innovative public-private partnerships. Interest in freight industry performance by public agencies is being slowly given importance and efforts to form freight advisory groups have helped generate understanding and data, which was not available before; this has been beneficial to both. Public private partnership, such as between FHWA and ATRI, has been successful in developing corridor buffer index, and in overcoming confidentiality concerns.

Key research questions that emerge are:
a. What are the performance measures and indicators of most relevance to freight movement within, inbound, outbound and through Minnesota?
b. Should one concentrate on public agency perspective or industry perspective or both?
c. Do we have capability to develop and assess performance?

Chapter 3 Classification of Measurement Sources

3.1 Rationale for classification

Measurement sources are loosely defined in this study as any source from which certain insight is obtained about freight transportation system in general and freight movement in particular. Such insights could be trends of market behavior through qualitiative surveys undertaken periodically, observations and monitoring of use of transportation facility, growth in trade, growth in freight moved by value and weight, or specific problems faced by industry such as lack of capacity or inadequate access to equipment or facilities. Some source provide data on continuing basis, some articulate certain aspects of freight movement as snapshots to galvanize interest and action, and some maybe result of well thought out study of various data sets to foster improved understanding to deal with one or more freight related problems. However, each measurement source serves a purpose and its importance should be gauged within the backdrop of that purpose.

Freight movement uses variety of modes and carries numerous products to different markets or regions. Thus, freight movement is not confined to any jurisdictional boundaries and its multiple considerations make it complex phenomena to study. Similarly, various agencies provide different data which can be helpful in understanding the nature and extent of freight movement within, in, out or through a region. The purpose of the classification was to delineate which measurement sources pertain to which mode, market, sector, and performance measure/indicator category. Also of interest in this exercise of classification was to identify who is the provider of such measurement source—federal agency, state agency, regional agency, local agency, or private entities such as commercial data vendors, trade associations, and businesses themselves. There are various reasons for disseminating freight related data by various providers and that should be understood to find appropriate applicability of the source of information.

Sometimes one measurement source may provide data and information about several aspects of freight transportation system. However, more often to get an understanding of freight transportation system characteristics and performance we need to look into many different measurement sources. The intent of this classification was to illustrate both these points and identify what all exists through a series of matrix shown in Appendix B. It should also be mentioned that even though this mapping and classification described in this chapter and outlined in detail in Appendix B is an important exercise, it will not be sufficient. In other words, how good are all the sources that exist? In what context is one source more relevant and useful compared to other? It is natural we desire and need to understand and assess how important a source is and how well it provides information about a particular mode, market, sector, or performance measure/indicator category. Thus, classification is supported by assessment, keeping in mind not all sources can be assessed to same depth. The assessment of measurement sources is detailed in Chapter 4. The next several sections describe the classifications carried out in this study.

3.2 Classification by mode and market

Mode, as used in classification in this study, refers to modes used for freight movement--unimodal such as Trucks/Motor Carrier (T); Railroad (R); Waterway and Ports (W); Air Cargo (A); Pipelines (P); or Intermodal (I) such as TOFC/COFC; or Multi-modal (M). A freight trip often requires multiple modes, especially long distance freight movement. Urban or local freight movement is primarily based on trucks.

Market refers to where market for freight movement is -- Urban or Metro (U); Regional/Substate (R); Statewide (S); Multi-state (MS); National (N); Multi-national (MN); and Global (G). Such understanding of context is important to identify the stakeholders involved when movement takes place between or among different trading partners. Stakeholders could be from government or industry and may cross multiple jurisdictions and culture. It is also of interest to know if shipment or freight movement is within, inbound (IB); outbound (OB); or through (TH) local areas or regions in a state. This information is instrumental in identifying freight significant corridors. In these corridors there might be existence of multiple modes, which can be wisely used for multimodal freight service. On the other hand there might be corridors where movement is predominantly restricted to one mode. The origins and destinations of freight being moved is very much influenced by trade and economic considerations.

The mode and market of freight movement influences the importance of various freight performance measures and indicators such as cost, time, and reliability. For example, some freight movements are cost sensitive whereas others are time sensitive. Bulkier and heavier freight on waterways and rail are typically cost sensitive. On the other hand, perishable goods, high valued manufacturing product, or priority packages using trucks or air mode are very time sensitive.

Table B.1 in Appendix B provides a mapping of measurement sources by mode and market related to freight movement. It must be mentioned that this table by itself will not be useful. Other classifications mentioned in subsequent sections and other tables in Appendix C should also be looked into.

3.3 Classification by sector and provider

Sectors refer to industries that generate movement of commodity, product or freight. However, classification has only been carried out for significant sectors; significant in terms of tonnage or value of freight moved in the sector. In this study the sectors emphasized are Agriculture (A), Manufacturing (MG), Coal/ Iron Mining (MN), Pulp & Paper (P), Lumber & Wood (L), Retail (R), Wholesale (W), and Food Products (F).These comprise major sectors or commodity groups in Minnesota.

Provider or developer refers to who develops, maintains and provides data or information related to that measurement source. The providers could be local agency, state agency, regional agency, federal agency, or private/trade associations and vendors. It must be mentioned that some measurement sources are developed through public-private partnerships. Similary, some measurement sources may have been developed through partnerships of government at different levels—federal and state or state and local or all three levels of government. However for classification purposes which ever entity took the lead role in developing and disseminating the data and information, the measurement source was mapped to that entity.

Mapping of measurement sources to different sectors and providers is carried out in Table B.2 of Appendix B.

3.4 Performance measure or indicator categories

It is important we describe the performance measures or indicator categories that we used in this study so one can relate to the discussions in this study pertaining to how good are measurement sources for particular freight performance measure or indicator category. We were motivated by the following questions that guided our definitions and the classifications and assessments of the measurement sources.

1. What is meant by each measure/indicator category?

2. What all measurement sources are out there for each performance measure/indicator category? (this is addressed in Section 3.5)

3.4.1 Network and infrastructure (N)

Generically this category refers to physical condition and connectivity of network of infrastructure that supports freight movement. Thus it refers to facilities that support both line haul movements and interchanges at transfer facilities. The size and condition of facility may restrict some movements (for e.g. spring load restrictions do not allow all trucks to use all roads during spring). It is also important to note that this category and related measures/indicators apply to all transportation and not just to freight transportation in most of the cases (e.g. interstate routes being used heavily by both cars and trucks). Also, rail tracks are shared by both passenger and freight rail. Clear distinction is made at nodal points. For example, at intermodal freight centers, we primarily have freight movement. Specail generators such as airports and major mall can generate high passenger nd freight trips. The idea is to develop designs and operation policies for such network and infrastructure that are context sensitive and multimodal in such cases.

3.4.2 Safety or damage (S)

This category refers to safety of vehicles and operators carrying freight on physical network, which is of interest to carriers and shippers. Similarly, the public agencies are interested in safety of all travelers/users, their employees, as well as other construction workers. From freight industry standpoint this refers to prevention of loss of or damage to products/freight being delivered to the customers/ consumers. An accident could result into loss and damage of products being moved in the trucks that was involved in accident. There is some overlap between this category and the network and infrastructure category (for e.g. deficient route with hazard locations or poor geometries is a safety issue). Safety is an important issue for both freight and people movement.

3.4.3 Access (A)

This category refers to access to physical facilities or type of vehicle or equipment needed for freight movement. Freight connectors are good example of facilities related to access issues. Need for containers and equipment for loading and unloading at transfer centers can also be an access issue for freight industry—shippers and carriers; it may impair their abilities and limit their choices, which in turn can have cost, rate, and reliability implications. A rail line not supporting 143 ton cars could be yet another example of access issue. There is an overlap between this category and the category for network and infrastructure in this sense.

3.4.4 Capacity (C)

This category refers to network and facility as well as vehicle and equipment capacity issues related to freight movement. As mentioned before many of these categories overlap and may connote different things to different people. For example, having an adequate access to a major generator could be treated as an access issue, which in turn could translate into capacity issue for that mode as it restrains how much cargo can be moved within a certain time frame.

Highway capacity has been studied well and defined well over years. However, capacity of other modes has not been studied or defined well. Often times, inability to move freight at desired volume/weight level and in acceptable time frame is treated as capacity issue. Rail capacity at hubs such as Chicago, Kansas City, and Los Angeles/Long Beach has surfaced as national rail capacity issue and is being discussed in Congress. Airport capacity has been studied but more so from passenger standpoint. We do not have too many dedicated air cargo airports. Often time air cargo goes as belly freight.

For these reasons same measures may be seen in network, acces, as well as capacity categories as they may be directly or indirectly releated to that performance category. A particular measure that surface in multiple categories will naturally increase the importance of that measure and will warrant a closer look.

3.4.5 Travel time (T)

This category refers to all times--dwell time (D), processing time (P), and transit time (T). Dwell time includes loading/unloading times or waiting for connection or equipment. Transit time typically refers to time for line haul and “running” movement. Public agencies have devoted efforts in measure travel time along freight significant arterials, particularly in large metropiltan areas where congestion is very visible. For freight industry average travel time for line haul movement on facilities such as arterials is not that important. Freight industry, particularly shippers, are interested in “door to door” delivery times and could range from hours to several days, depending on where the market is—local, regional, statewide, national, or international. However, for time sensitive movements it is the last leg of the movement in ubran areas where concern is most as it can be influence shippers and carriers ability to meet customer's expectation or reliability of service. For internation movements processing at border crossings can influence travel time.

3.4.6 Reliability (R)

This category refers to both network (N) and service (S) reliability and ability of shippers and carriers to meet customers expectations using network of infrastructure and as well as dealing with all administrative, regulatory, and business processes impacting freight movement. The considerations increasingly complex for international and global movements as supply chains are long and involved. This category is very much intertwined with travel time, capacity, and access categories. Businesses are not much hung up on exact values of time or distances or capacity but would rather have an understanding of the ranges within which they have to develop their business plans to be successful and deal with contingencies. For example, package delivery industry has doubled their fleet size in cities like New York to deal with congestion and lack of parking facilities. Fines are part of business cost. Freight industry is commited to meet customer's expectation and provide reliable service. Thus, travel times during incidents—weather or accident related--and emergencies, is important to develop a sense of the range within which one has to operate.

3.4.7 Market share (MK)

Freight movements could be local, regional, statewide, national, or international depending on product. To develop a better understanding of outbound and inbound movements it could be critical to note the information on tonnage and value of shipments to different markets. Also, of interest could be through movements as they add to congestion of facilities. This measure could be instrumentl in defining which freight significant corridors are. The other measures and indicators such as network, capacity, access, and safety can then be focused for such corridors.

3.4.8 Modal share (MD)

Different modes are used for different markets and commodities. Understanding of the share of tonnage and value of shipments to different markets for different commodities could be of interest in determining adequacy of access and capacity of different modes, particularly along freight significant corridors. It is obvious if origin and destination are connected by highways, trucks will be the dominant mode. Thus this measure along with the market share measure is critical in defining the strategic freight corridors.

3.4.9 Modal costs (MC)

These are useful in modal shift studies. It is much harder to estimate these costs because of the complexity of factors involved and usually requires some assumptions and derivations. Often times the competition is between rail and waterway, or rail and truck or waterway and trucks.

3.4.10 Freight productivity (FP)

This refers to freight productivity of the industry. These measures/indicators are a measure of output per unit of input. For example, they provide information about the utilization of labor and equipment. Most of these measures, however, fail to directly address the relationship to the highway system and the quality of service. One of the measures that has greatest linkage to the highway system is annual miles per truck, since miles per truck is affected by road and traffic conditions.

3.4.11 Freight security (FS)

This refers to freight security of the industry. This includes cargo security as well as securing the freight significant nodes and corridors through which cargo is moved.

3.4.12 Shipment rates (SR)

This refers to rates for different modes for different commodities. It should be noted that there numerous factors that might affect shipment rates, transportation is one of them.

3.4.13 Pricing (PR)

This refers to pricing of different modes for different commodities and the variabilities associated with them. Pricing is perhaps the best measure to indicate the competitive advantages among the modes along different corridors.

3.4.14 Agency cost (AC)

This refers to infrastructure, administrative, enforcement cost. The agency cost by itself is not a predicter of efficient freight movement.

3.4.15 Carrier cost (CC)

Refers to economic, logistics, business, regulatory costs incurred by carriers. There are truck costing models out there. The driver cost varies in value.

3.4.16 Shipper cost (SC)

This category refers to economic, logistics, business, regulatory costs incurred by shippers. Besides the agricultural costs it is hard to find other costs related to shipper. On other hand there have been transportation and logisitic surveys that have provide trends and indications of factors which in turn affect cost of shippers.

3.4.17 Externalities and community cost (EX)

This category refers to environmental, energy, social, safety costs. Energy costs of different modes have been used in modal comparisons. Similarly, air and noise emissions have been compared.

3.4.18 Transportation indices (TI)

There are various transportation indices being currently used. The indices are usually composite values of multiple considerations and serve the purpose of denoting the trends. Travel time index and DJTA index are some examples. They do serve a purpose in providing an indication of the health of the industry through changes in mode and market share.

3.4.19 External factors (EF)

These refer to economic and demographic factors as well as logistics factors. Some examples are trade agreements, economy, inflation, fuel prices, and logistical factor changes. Such indicators do not tell about freight movement directly but serve as a precursor to freight movement or proxy for freight movement. Liberalizing trade agreements such as NAFTA considerably impacted not only the magnitude of freight movement but more importantly the pattern of movement. Such events lead to development of mega corridors involving multiple nations.

The mapping of measurement sources to different performance measure/indicator categories are shown in Table B.3 in Appendix B.

3.4.20 Mapping categories to strategic direction and policies

It was important to map the performance measure/indicator categories used in this study to the strategic direction and polcicies in Minnesota’s performance-based Statewide Transportation Plan (STP). At the time of this study, Minnesota’s STP is undergoing an update. This mapping is shown in Figure 3.1 on next page.

STRATEGIC DIRECTIONS	POLICIES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
1. SAFEGUARD WHAT EXISTS	Policy 1: Preserve Essential Elements of Existing Transportation Systems.	x																		
	Policy 2: Support Land Use Decisions that Preserve Mobility and Enhance the Safety of Transportation Systems.		x	x																
	Policy 3: Effectively Manage the Operation of Existing Transportation Systems to Provide Maximum Service to Customers.					x	x				x									
2. MAKE THE NETWORK PERATE BETTER	Policy 4: Provide Cost-Effective Transportation Options for People and Freight.			x	x															
	Policy 5: Enhance Mobility in Interregional Transportation Corridors Linking Regional Trade Centers.				x	x	x				x									
	Policy 6: Enhance Mobility Within Major Regional Trade Centers.				x	x	x				x									
	Policy 7: Increase the Safety and Security of the Transportation Systems and Their Users.		x									x								
3. MAKE Mn/DOT WORK BETTER	Policy 8: Continually Improve Mn/DOT's Internal Management and Program Delivery.														x					
	Policy 9: Inform, Involve and Educate all Potentially Affected Stakeholders in Transportation Plans and Investment Decision Processes.																			
	Policy 10: Protect the Environment and Respect Community Values.																	x		

Figure 3.1. Interrelating performance measures/indicator categories to strategic directions and policies in Minnesota STP.

3.5 Mapping of performance measures/indicator categories and measurement sources

The mapping of measurement source was done with mode, market, sector, provider, and performance measure/indicator categories (as shown in Appendix B). For the performance measure or indicator categories mapping the intent was to understand how many resources are related to each category. It was important to talk about categories at this stage.

3.5.1 Federal sources

National data has been typically collected through censuses. Such data is available and used by various other agencies, researchers, policy makers. Due to confidentiality and aggregation issues much data is suppressed and becomes not useful for analysis at regional, state, substate, and local levels without supplemental data collection efforts. Federal sources are good in providing trade data, establishment data, commodity flow data, border crossing data, and for developing an understanding of market share and mode share for different flows—state to state, state to other nation, and so on.

3.5.2 State sources

State agencies collect and maintain considerable amount of data. For example, state DOTs collect physical, safety, and operational data on transportation facilities (nodes and corridors). Similarly, state agencies are good source of socieconomic data, network data and safety data.

3.5.3 Regional sources

Regional agencies or consortium of entities collect and develop information on regional basis, which again can be helpful in understanding freght movement inbound, outbound, through, and within a region. Such sources are also responsible for developing qualititative information through surveys.

3.5.4 Local sources

Local agencies collect and maintain demographic, employment, and land use data which is rarely available from other sources. Such data has been very useful in understanding transportation demand and trends. Such data has also been instrumental in development of transportation models. Some examples of such kind of data include household data, data on freight generators, travel times, delays, and so on.

3.5.5 Private/industry sources

Private industry collects and monitors several data to assess its performance and learn lessons to be able to serve its customers better. However, not all such data is available to public agencies or everyone because of confidentiality issues and competition. Despite such obstacles there are some sources are available which can be helpful in getting a better understanding of freght movement inbound, outbound, through, and within Minnesota. Some of the important ones are Journal of Commerce, Transport Topics, eyefortransport, Traffic World, Transportation Journal, Logistics Management, and Logistics Today. Global Insight database (including its most recently acquired TRANSEARCH database) have been used extensively nationwide and also within Minnesota for various freight studies.

3.5.6 Public-private sources

These are result of effective public private partnerships. The most important one is the recent ATRI-FHWA effort in developing travel time and reliabilitiy information for selected freight significant corridors from national standpoint. Similarly, freight advisory group in Minnesota is a good example of such source.

3.5.7 Specialized sources

These are specialized freight related studies. Under this category are numerous freight related studies conducted for Minnesota. Some were carried out on statewide basis, some were carried out for particular region, and some were for Metro (Twin Cities) area. Each study provides a good delineation of freight issues affecting local, regional, or statewide areas and also how data was used to study those problems and issues.

3.6 Implications of the mapping and classification of measurement sources

This has been a fruitful exercise to see what all is out there in terms of measurement sources for different modes, markets, sectors, and performance measure/indicator categories. The mapping also indicates which providers do best in terms of which performance measure/indicator categories; some of this is in sense related to how transportation facilities are developed, operated, and managed. Highways are supported by public funds and hence much of network and safety data come from public sources at federal, state and local levels. On the other hand freight movement is very much dependent on economy and business decisions. Hence, data regarding weight and value of shipments naturally comes from businesses. However, there is a competition issue involved, which prevents us from getting a good understanding, Commodity flow information is provided by surveys of establishment carried out through census and developed by BTS. Similar data also come from private data vendors. Gobal Insight is key private source. Specialized studies often use multiple sources to generate information, which in turn becomes a source of information for a region or community. Anecdotal evidences are often provided by newsapers, and magazines and routine reports from trade associations. In freight transportation this is sometimes all we have and could provide a good insight into existing or emerging problems. The classification endorses the fact freight data is dirty, comes from different sources, and conveys different meanings.

Chapter 4 Assessment of Performance Measures/Indicators and Measurement Sources

4.1 Interrelating measurement sources and performance measures/indicators

Before assessing the measurement sources, first an interrelationship among various example freight performance measures and indicators under each category with the measurement sources is attempted. Appendix C provides details of the interrelationships and what challenges we face in establishing this interrelationship. The summary of analysis of interrelationship among measurements sources and specific performance measures/indicators within each category is carried out in next several sections. The analysis provides an insight as to which measures/indicators are most important within each category. The analysis also attempts to assess how good is the capability of developing those measures/indicators based on measurement sources. However, it must be mentioned that a much more detailed analysis of data that exists in each measurement source is needed before drawing definitive conclusions about the applicability and usefulness of the measurement source for developing performance measures or indicators for Minnesota. In this regard, the concluding section of this chapter reflects on the data needs and assesses the adequacy of data for example performance measures and indicators for Minnesota based on broad review.

4.2 Assessing example performance measures/indicators

The appropriateness of performance measures and indicators can be assessed based on descriptive value, technical appropriateness, data availability and cost involved.

For specific measures or indicators following questions can be asked:

(1) Is it measure, indicator, or both?

(2) What strategic direction and policy objectives it pertains to?

(3) What decision context it applies to?

(4) Is it relevant to only a specific mode or applies to all modes?

(5) Is it relevant for public agencies or private agencies or both?

(6) Is it being used in Minnesota currently? Is it in Minnesota Statewide Transportation Plan (MNSTP) or Minnesota Statewide Freight Plan (MNSFP) or Minnesota Aviation System Plan?

(7) Where else it is being used? Should any of these be used in Minnesota?

In addition, it was important to reflect on the following criteria in identifying how important a measure or indicator was in terms of truly reflecting freight performance.

Descriptive value –Is the measure/ indicator clear and understandable for a range of audiences? Does it communicate clearly or does it require a detailed explanation in order to be understood?

Technical appropriateness – How useful is the measure/indicator in describing the performance of freight movement into, out of, within, or through Minnesota? Is it conceptually appropriate as a freight performance measure or indicator in Minnesota?

Data Availability and Cost – Data issues include the following considerations:

> **Availability** – Are data available in existing databases? If data are available, is it easy to collect, or are there difficulties in obtaining the data? Are there new ways to develop or collect the data?
>
> **Cost** – How expensive would it be to collect the appropriate data?

It must be mentioned that the answers or analysis presented here is based on very broad review and not an in-depth investigation of each data or measurement source. Such an exercise would require more study of specific data and its applicability.

4.2.1 Network and infrastructure (N) related example measures/indicators

The measures and indicators in this category relate to either the degree of wear on facilities or design features that might restrict freight movement. The measures related to operating conditions of network such as those reflecting congestion are classified under travel time or reliability categories.

These measures and indicators do not measure performance directly. They provide Mn/DOT with information on the transportation system's ability to perform but not actually how it performs as a freight mover. Information for tracking most of these measures is available within DOT.

Measures of road quality or wear may include lane-miles of high-level highway requiring rehabilitation, percent of roads with surface condition classified as good, or percent of bridges in good condition. Such measures are generally available and even reported to FHWA as part of the Highway Performance Monitoring System (HPMS). A weakness of these measures is that they are not specific to freight: they represent the quality of road conditions experienced by all travelers. If road conditions improve, presumably freight movement benefits, but it is not clear how much freight is affected. A way to focus on freight would be to identify a set of facilities of particular importance to freight movement and track their condition. In this regard, Mn/DOT has focused on freeways and IRCs as freight significant facilities.

Measures related to design features could be number of at-grade railroad crossings, number of overpasses that have vertical clearance restrictions, number of weight restricted bridges, or ramps and intersections with inadequate turning radii for large trailers. These measures that focus on the number of impedances to freight movement are specific to freight but tend to be somewhat narrow. One problem is that the number of facilities with impedances is probably not a good measure of impact on freight movement. Many of these impedances may not be on segments of importance to freight. Hence, if such determinations are made for freeways and IRCs it could provide valuable information about deficiencies that possibly might be affecting freight performance.

The example performance measures and indicators in this category are listed in Table 4.1 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.1).

4.2.2 Safety or damage (S) related example measures/indicators

A number of past efforts have identified safety- or damage-related measures as indicators of highway performance. These include: accident rates, fatality rates, and insurance cost (for freight).

Loss and damage to cargoes provide a measure of the quality of freight service. A number of earlier efforts identified loss and damage of goods through accidents and pilferage as important aspects of relevance to the productivity and efficiency of freight service.

Accident and fatality rates are general safety measures that are tracked by the Minnesota's Department of Public Safety and at federal level by National Highway Transportation Safety Administration (NHTSA). Most data related to safety focus on the number of fatalities or injuries. The most important concern in regard to freight productivity is the value of goods damaged or lost due to accidents, and potentially greater insurance costs associated with accidents that cause loss of life or injury. Data on these costs are limited.

Cost of cargo insurance could provide a useful proxy for loss and damage. From the shipper's perspective, loss and damage is an important aspect of quality. As a result, insurance cost is a potentially useful performance measure. There are certain limitations: it reflects factors other than road conditions, e.g., level of driver experience and levels of theft. The proper metric (e.g., cost per ton of cargo) would need to be developed and data availability examined.

The example performance measures and indicators in this category are listed in Table 4.2 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.2).

Table 4.1. Network and infrastructure related performance measures/indicators.

No.	Example Performance Measure/Indicator
N.1	Percent of miles of highway that meet “good” and “poor” ride quality targets (1.1H MNSTP; 1.1T MNSFP)
N.2	Percent of airport runways that meet good and poor Pavement Condition Index (PCI) targets (1.2 A MNSTP; 1.2A MNSFP ;1.1 MASP)
N.3	Remaining service life of highway pavement (1.2H1 MNSTP)
N.4	Percent of bridges that meet good and poor structural condition targets.(1.2H2 MNSTP)
N.5	Benefit of truck weight enforcement on pavement service life. (1.2T MNSFP)
N.6	Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected (2.2H MNSTP)
N.7	Percent of miles of Principal Arterial corridors in RTCs 0 and 1 that are managed (3.2H MNSTP; 3.2T MNSFP)
N.8	Percent of major generators with appropriate roadway access to IRCs and major highways. (4.3T MNSFP)
N.9	Percent of major generators with appropriate rail access. (4.3R MNSFP)
N.10	Percent of rail track-miles with track speeds >25 mph. (MNSFP 1.2R1)
N.11	Percent of rail track-miles with 286,000-pound railcar capacity rating. (MNSFP 1.2R2)
N.12	Percent of airports for which land or airspace has been protected to meet requirements of Master Plans or Airport Layout Plans. (2.2A MNSTP; 2.1 MASP)
N.13	Percent of intermodal facilities whose infrastructure condition is adequate. (1.2I MNSFP)
N.14	Availability of container-handling capability and/or bulk transfer capability. (4.1I MNSFP)
N.15	Percent of Minnesota Population within 60 minutes of an airport with cargo activity (3.3 MASP)
N.16	Percent of airports that have Minnesota Rules Zoning (2.2 MASP)
N.17	Percent of airports with appropriate access to IRC (4.3A MNSTP)
N.18	Percent of airports with scheduled commercial air service having appropriate access to Interregional Corridors (3.4 MASP)
N.19	Number of at-grade railroad crossings along the freight significant corridors such as freeways and IRCs
N.20	Number of overpasses that have vertical clearance restrictions freight significant corridors such as freeways and IRCs
N.21	Number of weight restricted bridges freight significant corridors such as freeways and IRCs
N.22	Number of intersections and ramps with inadequate turning radii for large trailers freight significant corridors such as freeways and IRCs

Table 4.2. Safety or damage related performance measures/indicators.

No.	Example Performance Measure/Indicator
S.1	Crash Rate (7.1 MNSTP)
S.2	Heavy truck crash rate (three-year average) (7.1T MNSFP)
S.3	Number of heavy truck-related fatalities (three-year average) (7.2T MNSFP)
S.4	Total crashes at at-grade rail crossings (three-year average) (7.2 MNSTP; 7.2R1 MNSFP)
S.5	Percent of at-grade rail crossings meeting grade-separation guidelines. (7.2R2 MNSFP)
S.6	Number of truck-related fatalities at at-grade rail crossings (three-year average) (7.2R MNSFP)
S.7	Average total 3-year general aviation crashes as reported and defined by FAA (4.1 MASP)
S.8	Percent of study airports meeting TSA guidelines for general aviation security (4.3 MASP)
S.9	Rates and numbers of crashes and severity by major regional links
S.10	RR-Hwy crossing crashes in region
S.11	Class one derailments in region
S.12	Railroad Freight Loss
S.13	Regional truck crash and severity rates
S.14	Insurance Cost per ton of Cargo

4.2.3 Access related example measures/indicators

Access related measures measures and indicators are related to both links and nodes; nodes being special generators. There are definitional problems with these measures and indicators. Connector studies have shed better light on these issues.

The example performance measures and indicators in this category are listed in Table 4.3 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.3).

4.2.4 Capacity related example measures/indicators

Capacity related measures and indicators do not exist. There are definition problems. These measures have not been tried much in Minnesota. However, there is much talk about freight bottlenecks in past decade.

The example performance measures and indicators in this category are listed in Table 4.4 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.4).

Table 4.3. Access related performance measures/indicators.

No.	Example Performance Measure/Indicator
A.1	Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected (2.2H MNSTP; 2.2T MNSFP)
A.2	Percent of townships, counties, and municipalities along IRCs whose adopted local plans and ordinances support IRC Management Plans and Partnership Studies (2.1H MNSTP; 2.1T MNSFP)
A.3	Percent of major generators with appropriate roadway access to IRCs and major highways. (4.3T MNSFP)
A.4	Percent of at-grade rail crossings meeting grade-separation guidelines. (7.2R2 MNSFP)
A.5	Percent of major generators with appropriate rail access. (4.3R MNSFP)
A.6	Percent of rail track-miles with track speeds >25 mph. (MNSFP 1.2R1)
A.7	Percent of rail track-miles with 286,000-pound railcar capacity rating. (MNSFP 1.2R2)
A.8	Availability of direct international air cargo freighter service. (4.1A MNSFP)
A.9	Percent of air cargo facilities with appropriate roadway and rail access. (4.3A MNSFP)
A.10	Availability of container-handling capability and/or bulk transfer capability. (4.1I MNSFP)
A.11	Percent of major generators with appropriate roadway access to IRCs and major highways. (4.3T MNSFP)
A.12	Percent of intermodal facilities (ports/terminals) with appropriate roadway and rail access. (4.3I MNSFP)
A.13	Percent of Minnesota Population within 60 minutes of an airport with cargo activity (3.3 MASP)
A.14	Percent of major generators (ports/terminals/other major generators) with appropriate access to IRCs or water and/or rail corridors. (4.3F MNSTP)
A.15	Percent of airports with appropriate access to IRC (4.3A MNSTP)
A.16	Percent of airports with scheduled commercial air service having appropriate access to Interregional Corridors (3.4 MASP)
A.17	Percent of Level 1, 2, and 3 Regional Trade Centers that are within 20 miles of a Key Airport (3.5 MASP)
A.18	Percent of Level 4 and 5 Regional Trade Centers that are within 20 miles of a Key or an Intermediate Airport (3.6 MASP)
A.19	Percent of airports with a runway 5,000 feet long or longer that have a precision instrument approach (3.7 MASP)
A.20	Percent of airports with a paved and lighted runway that has a published non-precision or precision approach (3.8 MASP)
A.21	Percent of airports with schedules air service having appropriate access to Interregional Corridors (IRCs) (within 2 minutes)
A.22	Drive times to Commercial Airports from Freight Clusters
A.23	Availability of Containers/Rail Cars

Table 4.4. Capacity related performance measures/indicators.

No.	Example Performance Measure/Indicator
C.1	Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected (2.2H MNSTP)
C.2	Clearance time for incidents, crashes, or hazmats (metro) (3.1H1 MNSTP; 3.1T1 MNSFP)
C.3	Snow and ice removal clearance time (3.1H2 MNSTP; 3.1T2 MNSFP)
C.4	Percent of major generators with appropriate roadway access to IRCs and major highways.
C.5	Percent of IRC miles meeting speed targets (5.1H MNSTP; 5.1T MNSFP)
C.6	Miles of peak-period congestion per day (RTCs 0 and 1) (6.3H MNSTP; 6.3T MNSFP)
C.7	Percent of at-grade rail crossings meeting grade-separation guidelines. (7.2R2 MNSFP)
C.8	Percent of major generators with appropriate rail access. (4.3R MNSFP)
C.9	Percent of rail track-miles with track speeds >25 mph. (MNSFP 1.2R1)
C.10	Percent of rail track-miles with 286,000-pound railcar capacity rating. (MNSFP 1.2R2)
C.11	Percent of air cargo facilities with appropriate roadway and rail access.
C.12	Availability of container-handling capability and/or bulk transfer capability. (4.1I MNSFP)
C.13	Percent of intermodal facilities (ports/terminals) with appropriate roadway and rail access. (4.3I MNSFP)
C.14	Capacity of Roads in IRC
C.15	Port Capacity
C.15	Rail Capacity
C.16	Channel/Waterway Capacity
C.17	Intermodal Facility Capacity
C.18	Warehouse Capacity
C.19	Number of Truck Rest areas and their Capacities
C.20	Capacity of Weigh Stations – number of trucks processed per hour
C.21	Capacity of Border Crossings – number of trucks/containers processed per hour or day
C.22	Air Cargo Capacity

4.2.5 Travel time related example measures/indicators

Travel time-related performance measures include two general types of measures: measures of average travel time and measures of delay.

Some measures of average travel time include: average travel time in peak period in major metro areas or corridors; freight transfer time between modes (for intermodal); crossing time at border crossings; city-to-city travel time; and shipper point-to-point travel time.

Some measures of delay (or added travel time) include: hours of delay per 1000 vehicle-mile; percent of PM peak travel experiencing delay; average hours of delay per 1000 vehicles processed at border crossings; hours spent waiting at toll plazas per 1000 vehicle-mile; hours spent waiting at weigh stations per 1000 ton-mile.

A major strength of travel time measures as freight productivity indicators is that travel time and congestion are very important to shippers. Rapid service is a critical element of competition. Package carriers and long-haul truckers alike offer one-day and two-day service in many markets and customers expect rapid delivery of goods. Businesses typically expect package delivery early in the morning and pickups late in the afternoon, pressuring delivery services to be on the roads during congested peak hours and to move goods as quickly as possible. Transit time also affects the costs of shipping goods, which is important for shippers. As a result, efforts to reduce traffic congestion and bottlenecks are very important for freight movers. Travel time measures are also generally easy to understand. Currently available data streams, however, do not provide information on actual travel times. Travel time would have to be measured directly at selected sites.

A weakness occurs when it comes to developing indicators that are specific to freight but not too narrowly focused. Indicators such as “average travel time in peak period in major metro areas” and “percent of PM peak travel experiencing delay” are general mobility measures that address both freight and passenger traffic. On the other hand, measures that focus on specific freight bottlenecks, such as border crossings and toll plazas, are limited because they focus on a very small portion of total freight travel. In order for a travel time indicator to be most useful as a national indicator, specific routes of importance to freight or point-to-point combinations need to be identified.

Using a measure of average travel time requires identifying specific point-to-point (or city-to-city) combinations to examine. Point-to-point transit time directly addresses what is important to freight movers. It accounts for the full range of components of travel time, including time on the road, in intermodal transfers, and at toll plazas. Although many companies maintain such data and have their own targets, these data may not be readily available.

International border crossings are of particular importance to international freight; as such, they are important for freight movements in North American context, particularly related to bi-national movements (U.S.(Minnesota)-Canada). It could be also be relevant from a national and North American perspective. This indicator is limited, however, because it only addresses a portion of total freight traffic. Measures like hours spent waiting at weigh stations or toll plazas could be become significant depending on how it affects the delivery commitment of carriers.

An “hours of delay” measure focuses on “excess” travel time associated with incident-based or recurring congestion. The measure would be limited as a freight measure if data are only available for total traffic delays. Much of traffic delay is associated with commuter traffic during peak periods and freight traffic may be scheduled to avoid much of this delay. However, such information could be very relevant for urban freight deliveries in metro areas and could impact ability of carriers to meet their service expectations.

Travel time measures are most relevant. Measurements are to be made sector specific and mode specific or else it has little relevance.

The example performance measures and indicators in this category are listed in Table 4.5 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.5).

4.2.6 Reliability related example measures/indicators

Measures and indicators of reliability include: hours of incident-based delay; ratio of variance to average minutes per trip in peak periods in major metro areas; and percent of on-time arrivals

Reliability is an attribute of key importance to shippers. In fact, a number of reports noted that having predictable travel times may be even more important than average travel times. More than ever, logistics management emphasizes “just-in-time” delivery to reduce or eliminate storage and warehousing costs. Shippers schedule freight movements to account for travel delays and avoid peak period congestion to the extent possible. As a result, the rate of variation in travel time (unexpected delay) is of key concern.

Just like travel time measures, reliability measures are less useful if they focus on all travel. It would be important to focus on routes of particular importance to freight. Another weakness of these measures is that a high level of reliability does not necessarily reflect that conditions are good, only that they are consistent (e.g., it could reflect consistently slow or high-cost service). As a result, it would be useful to combine a reliability measure with a travel time or cost measure.

Incident-based delay reflects increases in travel time that are unexpected, and therefore would be of particular importance for freight delivery schedules. It may be difficult, however, to identify what portion of total delay results from recurrent versus incident-based congestion. A composite measure of delay in various metropolitan areas or key freight nodes would need to be developed to be used as a national measure.

Variation in travel time also is a potentially useful measure that would be useful to examine for specific corridors or routes of importance to freight. However, depending on how the measure is developed it might reflect not only unexpected incident-based delay but also more expected seasonal, day-of-week, or time-of-day fluctuations in travel time.

Percentage of on-time arrivals is a potentially useful measure since it focuses directly on freight movements and reflects highway conditions. The advantage of the other reliability measures is that they directly represent highway conditions; the percent of on-time arrivals may reflect other factors as well. In terms of tracking progress over time, the measure is also limited because it could be a “moving target” in that schedules may be adjusted to account for worsening congestion or other factors that reflect lower quality service. Data availability also is an issue. On-time arrivals are tracked by private firms, but such information may not be publicly available.

This is closely tied to the travel time measures. Similar measurement sources can provide information regarding the measures and indicators related to reliability.

Reliability measures can be related to network performance on freight significant facilities and corridors or service performance at processing facilities like weigh stations, toll plazas, or border crossings.

The example performance measures and indicators in this category are listed in Table 4.6 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.6).

Table 4.5. Travel time related performance measures/indicators.

No.	Example Performance Measure/Indicator
TT.1	Clearance time for incidents, crashes, or hazmats (metro) (3.1H1 MNSTP; 3.1T1 MNSFP)
TT.2	Snow and ice removal clearance time (3.1H2 MNSTP; 3.1T2 MNSFP)
TT.3	Percent of IRC miles meeting speed targets (5.1H MNSTP; 5.1T MNSFP)
TT.4	Peak-period travel time reliability on IRCs and other high-use truck roadways.
TT.5	Ratio of peak to off-peak travel time – Travel Rate Index (metro) (6.1H MNSTP; 6.1T MNSFP)
TT.6	Peak period travel time reliability. (5.2H and 6.2 H MNSTP)
TT.7	Peak-period travel time reliability on metro area highways. (6.2 T MNSFP)
TT.8	Miles of peak-period congestion per day (RTCs 0 and 1) (6.3H MNSTP; 6.3T MNSFP)
TT.9	Travel time for selected commodities, modes, and regional and national markets (Policy 5, PI4 MNSFP)
TT.10	Travel time for selected commodities, modes, and local markets (Policy 5, PI4 MNSFP)
TT.11	Travel time for selected commodities, modes, and regional markets (Policy 5, PI4 MNSFP)
TT.12	Travel time for selected commodities, modes, and national markets (Policy 5, PI4 MNSFP)
TT.13	Travel time for selected commodities, modes, and international markets (Policy 5, PI4 MNSFP)
TT.14	Average delay time at river locks. (3.2W MNSFP)
TT.15	Loading/Unloading Times at Intermodal Centers
TT.16	Processing time at border crossings
TT.17	Processing time at Weigh Stations
TT.18	Processing times for Customs Clearance

Table 4.6. Reliability related performance measures/indicators.

No.	Example Performance Measure/Indicator
R.1	Clearance time for incidents, crashes, or hazmats (metro) (3.1H1 MNSTP; 3.1T1 MNSFP)
R.2	Snow and ice removal clearance time (3.1H2 MNSTP; 3.1T2 MNSFP)
R.3	Percent of IRC miles meeting speed targets
R.4	Peak period travel time reliability. (5.2H and 6.2 H MNSTP)
R.5	Peak-period travel time reliability on IRCs and other high-use truck roadways. (5.2T MNSFP)
R.6	Ratio of peak to off-peak travel time – Travel Rate Index (metro) (6.1H MNSTP)
R.7	Peak-period travel time reliability on metro area highways. (6.2 MNSFP)
R.8	Miles of peak-period congestion per day (RTCs 0 and 1) (6.3H MNSTP; 6.3T MNSFP)
R.9	Range of delay time at river locks.
R.10	Travel time ranges
R.11	Processing time at border crossings
R.12	Processing time at Weigh Stations
R.13	Processing times for Customs Clearance
R.14	Delivery window time
R.15	Shipment time ranges

4.2.7 Market share related example measures/indicators

Where goods are going and coming from is critical in developing strategies for competitiveness. This measure is important in defining the freight significant routes, nodes and related facilities. This measure is also important in defnining the connectedness and importance or a region nationally and globally. This sort of measures will be of importance for legislature and decision-makers in understanding what businesses are connected globally and nationally and what are related freight movement supporting that trade and businesses.

The example performance measures and indicators in this category are listed in Table 4.7 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.7).

4.2.8 Modal share related example measures/indicators

Modal share and its changes are cirtical in understanding modal shifts and the related implications. Mode shifts takes place for various reasons including demand for goods, destination of goods, trade, rates, and competitive factors affecting the design and operation of the entire supply chain for a particular industry. Trucking has been dominant mode and has substantial share of most freight movement. Nonetheless, freight movement has been much more multimodal compared to national trends.

The example performance measures and indicators in this category are listed in Table 4.8 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.8).

Table 4.7. Market share related performance measures/indicators.

No.	Example Performance Measure/Indicator
MK.1	Tonnage of shipments to Minnesota by major commodity groups
MK.2	Value of shipments to Minnesota by major commodity groups
MK.3	Tonnage of shipments from Minnesota by major commodity groups
MK.4	Value of shipments from Minnesota by major commodity groups
MK.5	Tonnage of shipments through Minnesota by major commodity groups
MK.6	Value of shipments through Minnesota by major commodity groups
MK.7	Tonnage of freight movement in Metro Areas in Minnesota by major commodity groups
MK.8	Value of freight movement in Metro Areas in Minnesota by major commodity groups
MK.9	Tonnage of freight movement regionally within Minnesota by major commodity groups
MK.10	Value of freight movement regionally within Minnesota by major commodity groups

Table 4.8. Modal share related performance measures/indicators.

No.	Example Performance Measure/Indicator
MD.1	Tonnage of shipments to Minnesota by major commodity groups by different Modes
MD.2	Value of shipments to Minnesota by major commodity groups by different Modes
MD.3	Tonnage of shipments from Minnesota by major commodity groups by different Modes
MD.4	Value of shipments from Minnesota by major commodity groups by different Modes
MD.5	Tonnage of shipments through Minnesota by major commodity groups by different Modes
MD.6	Value of shipments through Minnesota by major commodity groups by different Modes
MD.7	Tonnage of freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
MD.8	Value of freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
MD.9	Tonnage of freight movement regionally within Minnesota by major commodity groups by different Modes
MD.10	Value of freight movement regionally within Minnesota by major commodity groups by different Modes

4.2.9 Modal costs related example measures/indicators

Transportation costs are important to freight shippers. Lower transportation costs per unit shipped are beneficial to shippers; lower transportation costs contribute to more efficient use of resources in production and distribution. Greater efficiency ultimately benefits consumers in better quality and/or lower prices for goods. Declining costs, however, are not necessarily all positive for freight performance. Lower costs could be the result of lower quality of service (e.g., reduced reliability).

Total cost of freight per ton-mile, is certainly a useful measure. It is specific to freight, and is affected by transportation conditions. It is also affected by factors unrelated to the transportation system, however, such as transportation technology, drivers' wages, fuel costs, and trandsportation companies' skill in managing their fleets of vehicles and containers, emissions and pollution and its impact on communities, damaging impact on transportation facilities. As a result, it may be skewed by factors that have nothing to do with transportation infrastructure.

One weakness with cost measures is that they do not account for the quality of service. A measure of total costs attempts to account for this problem by focusing not only on the costs of shipping goods but also costs associated with damage to goods, logistics costs, constructing roads, expanding and maintaining highways, etc. As a result, a measure of total public and private costs of travel takes into account all the resource costs associated with travel.

Unfortunately, tracking total costs instead of unit costs can be highly misleading. Total costs would be expected to increase due to increased population and economic growth (benefits would also increase: mobility, economic activity, etc.). As a result, rising total costs would be normal effects of an expanding economy. A composite measure of total travel costs is also analytically complex and difficult to develop.

Modal costs are all inclusive and needed for modal shift analysis. However, as stated above, it is analytically complex and difficult to develop and usually involves several assumptions, which are sometimes controversial. Nonetheless, such attempts have been made to make modal comparisons and in studying modal diversions of freight.

The example performance measures and indicators in this category are listed in Table 4.9 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.9).

4.2.10 Freight productivity related example measures/indicators

Freight industry productivity measures include the following metrics: average load factors / percent of vehicle miles empty; average length of haul; annual miles per truck; ton-miles per unit of labor; and multi-factor productivity measures.

These measures all are a measure of output per unit of input. They provide information about the utilization of labor and equipment. They are good measures of the productivity of the freight industry, but fail to directly address the relationship to the highway system. They also fail to address the quality of service. Of these measures, the one that has the greatest linkage to the highway system is annual miles per truck, since miles per truck is affected by road and traffic conditions.

Technical appropriateness of such measures depend on the degree to which the measure truly reflects a significant aspect of cost, quality, or productivity of the highway-freight system and its intermodal connections. A major thrust of this effort is to measure the contribution of highway-freight movement to overall U.S. productivity, not just the productivity of highway freight. Therefore, it is appropriate to measure quality and cost of the highway system as it related to freight.

Productivity measures indicate the health and efficiency of freight industry.

The example performance measures and indicators in this category are listed in Table 4.10 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.10).

Table 4.9. Modal costs related performance measures/indicators.

No.	Example Performance Measure/Indicator
MC.1	Transportation Cost related to shipments by major commodity groups by different Modes
MC.2	Transportation Cost related to shipments to Minnesota by major commodity groups by different Modes
MC.3	Transportation Cost related to shipments from Minnesota by major commodity groups by different Modes
MC.4	Transportation Cost related to shipments through Minnesota by major commodity groups by different Modes
MC.5	Transportation Cost related to freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
MC.6	Transportation Cost related to freight movement regionally within Minnesota by major commodity groups by different Modes

Table 4.10. Freight productivty related performance measures/indicators.

No.	Example Performance Measure/Indicator
FP.1	Ton-miles per employee
FP.2	Percent truckloads empty
FP.3	Average load factor
FP.4	Percent of vehicle miles empty
FP.5	Average length of haul
FP.6	Annual miles per truck
FP.7	Ton-miles per unit of labor
FP.8	Multi-factor productivity measures

4.2.11 Freight security related example measures/indicators

Freight Security measures indicate how prepared or vulnerable is the region under extreme conditions of disasters—mad-made or natural. Often times the ocurrances of such events are beyond control of Mn/DOT can do but preparing for such events is getting more critical. The measures emphasize screening, building redundancy in network and processes and in making infrastructure resilient.

This also involves identifying and inventorying critical infrastructure—routes and nodes and identifying alternative and emergency (evacuation routes) in events of emergency. Such events can also disrupt freight movements and impair abilities to deal with emergency operations. Recent flood in south Minnesota, I-35 bridge collapse were few instances where such preparedness was tested. There are cost implications for lack of such preparation.

These measures have not been fully developed.

The example performance measures and indicators in this category are listed in Table 4.11 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.11).

4.2.12 Shipment rates related example measures/indicators

Rates are typically not highly dependent on transportation system changes. For some sectors it might be more relevant than others. Agriculture sector has experienced some volatility in shipment rates in last decade. This has impacted where shippers have chosen to ship their products.

Shipment rates are impacted by various factors and a recent survey by Logistics management has cited fuel surcharges, equipment availability, on-time delivery commitments, and port and rail congestion to be some of the factors that have impacted shipment rates.

The example performance measures and indicators in this category are listed in Table 4.12 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.12).

Table 4.11. Freight security related performance measures/indicators.

No.	Example Performance Measure/Indicator
FS.1	Percent of study airports meeting TSA guidelines for general aviation security (4.3 MASP)
FS.2	Security/Vulnerability at Ports
FS.3	Secure/Vulnerable Access
FS.4	Secure/Vulnerable Hazardous Materials Route
FS.5	Secure/vulnerable Airports
FS.6	Secure/Vulnerable Bridges
FS.7	Secure/Vulnerable Cargo Containers
FS.8	Secure/Vulnerable Railroad
FS.9	Percent of Containers Screened
FS.10	Availability of emergency (evacuation) alternate routes for freight significant routes and nodes

Table 4.12. Shipment rates related performance measures/indicators.

No.	Example Performance Measure/Indicator
SR.1	Shipment rates for selected commodities, modes, and regional and national markets (Policy 4 PI1 MNSFP)
SR.2	Shipment Rates related to shipments to Minnesota by major commodity groups by different Modes
SR.3	Shipment Rates related to shipments from Minnesota by major commodity groups by different Modes
SR.4	Shipment Rates related to shipments through Minnesota by major commodity groups by different Modes
SR.5	Shipment Rates related to freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
SR.6	Shipment Rates related to freight movement regionally within Minnesota by major commodity groups by different Modes
SR.7	Fuel surcharges
SR.8	Equipment Availability
SR.9	Hours of Service
SR.10	Driver Turnovers
SR.11	Safety and Security Requirements
SR.12	Increase in Demand of Services
SR.13	Port Congestion
SR.14	Rail Congestion

4.2.13 Pricing related example measures/indicators

Pricing is the best measure for competitiveness of different modes and could be influence by external factors and profitability. On national level pricing trends have been disseminated by Logistics Management. Whether it applies to case of Minnesota or not is not that clear. Agriculture pricing has been documented by USDA in its weekly Grain Transportation report and other related reports.

The example performance measures and indicators in this category are listed in Table 4.13 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.13).

4.2.14 Agency cost related example measures/indicators

Transportation agencies, such as Mn/DOT, are responsible for providing adequate, safe, efficient, and accessible multimodal transportation system. Hence, cost measures are considered as potential use as transportation system indicators. Transportation cost measures include: cost of highway freight per ton-mile, fuel consumption per ton-mile, total public and private costs of travel, and maintenance cost of connector links.

Lower transportation costs per unit shipped are beneficial to shippers; lower transportation costs contribute to more efficient use of resources in production and distribution. Greater efficiency ultimately benefits consumers in better quality and/or lower prices for goods. Declining costs, however, are not necessarily all positive for freight performance. Lower costs could be the result of lower quality of service (e.g., reduced reliability). Cost measures that focus on transportation infrastructure costs and expenditures, may or may not reflect improved freight performance.

Cost per Ton-mile is certainly a useful measure. It is specific to freight, and is affected by transportation conditions. It is also affected by factors unrelated to the highway system, however, such as truck technology, drivers’ wages, fuel costs, and trucking companies’ skill in managing their fleets. As a result, it may be skewed by factors that have nothing to do with transportation infrastructure.

Fuel consumption per ton-mile, is not really a “cost” measure but it does reflect one of the costs associated with transport that is related to highway condition. It reflects the same things as costs per ton-mile, but would not be affected by the prices of labor and fuel. As a result, it may be a better measure of the performance of highway-system performance in freight carriage because it reflects fewer costs unrelated to highway conditions. It may be more difficult to grasp intuitively as an indicator of freight performance, however.

As noted above, one weakness with cost measures is that they do not account for the quality of service. A measure of total costs attempts to account for this problem by focusing not only on the costs of shipping goods but also costs associated with damage to goods, constructing roads, expanding and maintaining highways, etc. As a result, a measure of total public and private costs of travel takes into account all the resource costs associated with travel.

Unfortunately, tracking total costs instead of unit costs can be highly misleading. Total costs would be expected to increase due to increased population and economic growth (benefits would also increase: mobility, economic activity, etc.). As a result, rising total costs would be normal effects of an expanding economy. A composite measure of total travel costs is also analytically complex and difficult to develop.

Maintenance costs on roads of importance to freight or intermodal traffic has been used as an indicator of freight performance. Although investment clearly signifies that priority is being placed on these routes, it is not a measure of freight productivity. It is not clear whether higher or lower maintenance costs are good or bad. More spending on highway maintenance does not necessarily indicate an improvement in road condition; it could indicate wasteful spending.

Agency cost is an indicator of how much transportation improvement is being made to achieve certain policies and performance. In this regard, expenditures on enforcement and monitoring programs could reflect efficiencies within Mn/DOT, if similar performance is achieved (say, in reduction of congestion or clearance times during incidents) with less expenditure. Some of these productivity gains may result due to implementation of technologies such as ITS for advanced traveler information, advanced traffic management and commercial vehicle enforcements.

The example performance measures and indicators in this category are listed in Table 4.14 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.14).

Table 4.13. Pricing related performance measures/indicators.

No.	Example Performance Measure/Indicator
PR.1	Truck Pricing Trends
PR.2	Air Pricing Trends
PR.3	Rail Pricing Trends
PR.4	Water Pricing Trends
PR.5	Agricultural Pricing

Table 4.14. Agency cost related performance measures/indicators.

No.	Example Performance Measure/Indicator
AC.1	Cost/benefit of clearing incidents, crashes, or hazmats (metro)
AC.2	Cost/benefit of snow and ice removal and traffic clearance
AC.3	Cost of managing Principal Arterial corridors in RTCs 0 and 1
AC.4	Cost of maintaining highways above “good” ride quality targets
AC.5	Cost of adopting local plans and ordinances to support IRC Management Plans and Partnership Studies with townships, counties, and municipalities along IRCs
AC.6	Cost of enforcing truck weight for preserving or enhancing pavement service life.
AC.7	Cost of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected
AC.8	Percent of Mn/DOT projects in the first year of the STIP that are let for construction in their planned year. (8.1 MNSTP)
AC.9	Preconstruction. Percent variation in major projects' cost from estimates when they enter the STIP to actual cost when let for construction. (8.2 MNSTP)
AC.10	General administrative expenditures as a percent of total expenditures. (8.3 MNSTP)

4.2.15 Carrier cost related example measures/indicators

Cost measures are often considered for potential use as transportation system indicators. Carrier cost measures and indicators include: cost of highway freight per ton-mile and fuel consumption per ton-mile.

Declining costs are good for carriers' profitability. Declining costs, however, are not necessarily all positive for freight performance. Lower costs could be the result of lower quality of service (e.g., reduced reliability).

Cost of highway freight per ton-mile, is certainly a useful measure. It is specific to freight, and is affected by highway conditions. It is also affected by factors unrelated to the highway system, however, such as truck technology, drivers' wages, fuel costs, and trucking companies' skill in managing their fleets.

Fuel consumption per ton-mile, is not really a "cost" measure but it does reflect one of the costs associated with transport that is related to highway condition. It reflects the same things as costs per ton-mile, but would not be affected by the prices of labor and fuel. As a result, it may be a better measure of the performance of highway-system performance in freight carriage because it reflects fewer costs unrelated to highway conditions. It may be more difficult to grasp intuitively as an indicator of freight performance, however.

One weakness with many cost measures is that they do not account for the quality of service. A measure of total costs attempts to account for this problem by focusing not only on the costs of shipping goods but also costs associated with damage to goods, constructing roads, expanding and maintaining highways, etc.

Has carrier cost gone down or up is of interest to shippers as well as transportation agencies. Carrier cost measures include many costs.

The example performance measures and indicators in this category are listed in Table 4.15 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.15).

4.2.16 Shipper cost related example measures/indicators

Cost measures of interest to shippers include: cost of freight per ton-mile, transportation cost as part of overall logistics costs.

Transportation costs are important to freight shippers. Lower transportation costs per unit shipped are beneficial to shippers; lower transportation costs contribute to more efficient use of resources in production and distribution. Greater efficiency ultimately benefits consumers in better quality and/or lower prices for goods. Declining costs, however, are not necessarily all positive for freight performance. Lower costs could be the result of lower quality of service (e.g., reduced reliability).

Cost of freight per ton-mile, is certainly a useful measure. It is specific to freight, and is affected by transportation conditions. It is also affected by factors unrelated to the transportation system, however, such as transportation technology, drivers' wages, fuel costs, and transportation companies' skill in managing their fleets of vehicles, containers, and other resources.

One weakness with many cost measures is that they do not account for the quality of service. A measure of total logistics costs attempts to account for this problem by focusing not only on the costs of shipping goods but also costs associated with damage to goods, inefficiences in freight forwarding, inefficiencies in supply chains, constructing, expanding and maintaining transportation facilities, etc. As a result, a measure of total logistic costs takes into account all the resource and transactions costs associated with supply chain. Tracking transportation cost as percent of overall logistics costs is particularly useful to reflect on the business and global connectivity that exists in the region.

Shipper costs are different from carrier cost.

The example performance measures and indicators in this category are listed in Table 4.16 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.16).

Table 4.15. Carrier cost related performance measures/indicators.

No.	Example Performance Measure/Indicator
CC.1	Carrier Cost related to shipments to Minnesota by major commodity groups by different Modes
CC.2	Carrier Cost related to shipments from Minnesota by major commodity groups by different Modes
CC.3	Carrier Cost related to shipments through Minnesota by major commodity groups by different Modes
CC.4	Carrier Cost related to freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
CC.5	Carrier Cost related to freight movement regionally within Minnesota by major commodity groups by different Modes
CC.6	Fuel Surcharges

Table 4.16. Shipper cost related performance measures/indicators.

No.	Example Performance Measure/Indicator
SC.1	Shipper Cost related to shipments to Minnesota by major commodity groups by different Modes
SC.2	Shipper Cost related to shipments from Minnesota by major commodity groups by different Modes
SC.3	Shipper Cost related to shipments through Minnesota by major commodity groups by different Modes
SC.4	Shipper Cost related to freight movement in Metro Areas in Minnesota by major commodity groups by different Modes
SC.5	Shipper Cost related to freight movement regionally within Minnesota by major commodity groups by different Modes
SC.6	Fuel Surchages
SC.7	Cost of Freight per ton-mile
SC.8	Total Logistics cost
SC.9	Transportation cost as percent of total logistics costs

4.2.17 Externalities/community cost related example measures/indicators

Cost to community is indicative by the increase of emissions and resulting pollution.

The example performance measures and indicators in this category are listed in Table 4.17 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.17).

4.2.18 Transportation indices related example measures/indicators

Various indices used provide an aggregate or composite measure for freight industry health or transportation system.

The example performance measures and indicators in this category are listed in Table 4.18 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.18).

Table 4.17. Externalities/community costs related performance measures/indicators.

No.	Example Performance Measure/Indicator
EX.1	Increase in Air Pollution Impacts/Costs
EX.2	Increase in injuries or cost related to injuries
EX.3	Increase in energy consumed or costs related to Energy Consumption
EX.4	Increase in congestion levels or costs related to Congestion
EX.5	Federal Compliance Standards: Outdoor levels of ozone, nitrogen dioxide, carbon monoxide and particulate matter. (10.1AQ1 MNSTP)
EX.6	Estimated carbon dioxide emissions from motor vehicles in Minnesota. (10.1AQ2 MNSTP)
EX.7	Percent of Mn/DOT fuel consumption defined as cleaner fuels. (10.1AQ3 MNSTP)
EX.8	Number of undeveloped acres converted to another land use.. (10.3L2 MNSTP)
EX.9	Time to complete EIS, Environmental Assessment, and EAW per project. (10.4ES MNSTP)

Table 4.18. Transportation indices related performance indicators.

No.	Example Performance Measure/Indicator
TI.1	Ratio of peak to off-peak travel time – Travel Rate Index (metro)
TI.2	DJTA Index
TI.3	BTS Transportation Index
TI.4	ATRI Buffer Index for Transportation Corridors
TI.5	Transportation as a percent of National or State GDP
TI.6	Regional Freight Index

4.2.19 External factors related example measures/indicators

One of the key performance measures and indicators related to external factors is the economic impact measures and indicators. Measures and indicators of economic impact include: contribution of investment to GDP growth; direct and indirect jobs created; net present value of improvements; benefit-cost ratio of highway improvements; and value of transportation-related goods and services delivered to the final customer

These measures focus on the economic benefits associated with investment in transportation facilities. Although transportation investments certainly can support efficient freight movement, the economic impacts of infrastructure investment are greater than those associated solely with freight movement. Transportation investment results in savings in travel time, reduction in vehicle operating costs, and a reduction in accident costs that accrue to all users, freight and non-freight.

Some works have have examined the contributions of highways, railroads, and airports to the output growth and productivity of various industry sectors comprising the U.S. economy. It provides empirical evidence of the positive impacts of highway, rail, and airports on private sector costs of production and calculates the net social rate of return on transportation infrastructure spending.

A useful measure is contribution of investment in transportation to GDP growth. There have been studies that have statistically analyzed the relationship of businesses' costs to investment in transportation. In large measure, response of business costs to highway investment reflects improvement in the highways as freight carriers. However, reduction in firms' costs could also reflect an improvement in passenger travel on highways (by expanding the pool of potential employees). There is no way to separate the effects of passenger travel from the effects of freight carriage in these analyses. Some questions arise as to the statistical validity of year-to-year changes in these results.

Number of jobs created is another economic impact measure and indicator. While this measure or indicator can be important to a local community, it is not a measure of freight productivity. The number of direct jobs created by a highway project tells nothing of how the project will affect freight movement or whether the project is worthwhile. These figures relate to the impacts of project spending, not to the value of the project for freight. However, such an investment for freight significant highway or rail corridors could result in creation of jobs as well as improvement in freight productivity.

Net present value and benefit/cost ratios are a measure of the value of transportation investments. Both measures involve a comparison of the benefits and costs associated with infrastructure investment, but with slightly different implications. Since the benefits of transportation projects include travel time savings, vehicle operating cost savings, safety improvements, etc., these measures capture a range of economic effects beyond the impact on freight movement. These measures do not isolate impacts associated with freight movement, and in fact, most of the economic benefits measured probably are associated with personal travel.

The value of transportation-related goods and services delivered to customers provides a measure of the how much of the economy is associated with transportation. This is not really a measure of freight productivity or the implications of highway investment on freight.

In addition to economic impacts there are other external factors that affect freight movement. External factors that affect business practices could be sometime more influential in defining the changes in the freight movement than the transportation system themselves. These measures or indicators can sometimes be useful in explaining drastic changes in trends reflected by mode and market shares.

Such factors include: demographic and employment trends; number of businesses in region and their freight generation; inflationary pressures; competitive business edge of surrounding regions; trade agreements; technology changes; product substitution effects; fuel availability (or lack of availability) and its impact on fuel prices; land use changes or land use policy changes; mergers and acquistions within transportation industry; changing nature of businesses within U.S. and its impact of physical distribution and logistics; and environmental regulations and mandates.

The example performance measures and indicators in this category are listed in Table 4.19 and for some of these measures and indicators detailed analysis is carried out in Appendix C (see Table C.19).

Table 4.19. External factors related performance indicators.

No.	Example Performance Measure/Indicator
EF.1	Population growth in metro areas, in regions, and statewide
EF.2	Growth in number of businesses or establishments in metro area, in region, and statewide
EF.3	Fuel Prices and Surcharges
EF.4	Trade Agreements
EF.5	Mergers/Acquistions
EF.6	Labor Prices
EF.7	Environmental Regulations/Mandates
EF.8	Land Use Changes or Land Use Policy Changes
EF.9	Business Practices – Consolidation of Shipments
EF.10	Business Practices -- Outsourcing
EF.11	Technology Trends
EF.12	GDP Levels
EF.13	Inflation Rates
EF.14	Percent of customers satisfied with the reliability of Mn/DOT communications. (9.1 MNSTP)

4.3 Critieria for assessing measurement sources

When developing new data source, continuing with existing data source, expanding the existing data, or using data obtained from any sources there are several questions that arise. Figure 1.5 outlines the key criteria that were used to assess measurement sources in this study.

Some basic questions are:

1. What are the characteristics of measurement sources? Are they available?

2. How are they relevant to development of Performance Measures/ Indicators in Minnesota?

3. What are essential costs, limitations, and challenges involved in developing the measurement source or using it?

4.3.1 Characteristics and availability

Included in this discussion are geographic coverage, type of aggregation used, when was it first developed? How was it developed (observation, survey, derived, advisory groups, anecdotal)? When it was last developed? What is its updating frequency?

Availability pertains to data format, who maintains it, who is it made accessible to?

4.3.2 Applicability

The most important assessment critieria was usefulness of measurement sources in developing freight related measures and indicators and whether they are useful or applicable to Minnesota.

4.3.3 Costs, limitations, and challenges

This refers to accessibility, adequacy, exclusions, costs, and validation.

In some instances this assessment could be detailed. In some other instances this assessment may not include answers to all the aforementioned questions as data may have been anecdotal or used for specific purpose rather than developed on regular basis and have wide applicability. Appendix D provides details of the assessment.

4.4 Assessment of measurement sources

Based on the criteria mentioned and discussed in previous section and subsections, approximately 55 of the 440 measurement sources were assessed. Appendix D provides assessment for specific measurement source. Some common findings of the assessment are discussed in this section.

4.4.1 Federal data sources

Examples of such sources are identified in Table D.1 in Appendix D. Practically all socio-economic, industry surveys and transportation surveys are based on national level survey. They are available in different frequencies, from monthly dissemination to being available once in 5 years. Examples are commodity flow survey, STB Waybill Data, TIUS/VIUS Data, Economic Data from BEA. USDA’s Grain report is useful data source for understanding agricultural freight movement trends, issues, problems, and performance. For example, mode shares have changed for agricultural movements over time. In another instance, it might provide explanation for why performance changed; for example, the reduction of barge traffic for agricultural movements might be due to the containerized movements of use of value added products as opposed to simply grain movement.

Commonly available trucking data elements are truck dimensions (length, width, height), truck traffic volume (AADTT), percent of trucks in AADT, truck classification, weight distribution (axle load and gross vehicle weight), volume of freight, value of freight, vehicle miles of travel (VMT), time of day variation of truck traffic, crash statistics, and crash costs.

There are several critical data that are not readily available. Some of these data are collected for specific projects but there are no easily identifiable data sources or systematic data collection efforts. The number of empty trucks by configuration and their spatial distribution on the highway network is required in capacity analysis, development of strategies, freight analysis, and infrastructure and safety impact assessment. This data is not readily available. This information is derived from expert knowledge of the trucking industry and models based on a number of simplifying assumptions.

Distribution of freight volume by type of commodity and by truck type is important for strategic planning, highway improvement assessment, regulatory and policy development, impact assessment. This information is not readily available. It is a derived data element based on expert knowledge of the trucking industry as well as physical and operating characteristics of trucks.

Vehicle Operating Cost data are required for highway investment analysis and critical component of such analytical models as Highway Economic Requirements System (HERS). The existing data was developed more than 30 years ago. Since then, truck technologies, sizes, and operating weights have changed significantly. More current data on the operating characteristics, maintenance costs, and other variables required for estimating vehicle operating costs are not readily available.

The number of trucks equipped with safety oriented technologies, infrastructure friendly equipment (e.g., suspension systems), fuel efficient engines, idling technologies, use of alternative fuels are needed in evaluating regulatory and policy initiatives directed at improving highway safety, as well as their potential impacts (e.g., impacts on energy use, highway revenue, and air pollution). These data are not readily available. These data elements are derived from models or from simulation or collected for specific projects.

For example, in conducting highway capacity analysis as part of the Freight Analysis Framework project, the number of empty trucks was estimated based on assumptions and knowledge of the trucking industry operations. Furthermore, with the current trends in crude prices, it became necessary to examine the possible impacts of recent and even more drastic future increases in oil prices on highway revenue from motor fuel and other highway use taxes. This analysis requires various data elements including data on vehicle sales, extent and use of alternative fuels and truck engine idling practices. Also, in evaluating policies relating the size and weight limits of existing and potential future truck configurations, it is critical to examine their safety related performance measures.

There are some potential options for collecting needed trucking data that are not readily available. One option is to appraise existing isolated public domain data sources and predictive models with the primary objective of refining them to forecast into the near future. The refined models can then be updated periodically with new data from private and other public sources. This is considered a short term option because in the long term, reliability of extrapolations would become questionable.

Trucking data that are not readily available especially in the public domain can be solicited from the private sector including freight industry and truck manufacturing industry. It is believed that the trucking industry better understands services and equipment and should be in a better position to gather and project trucking data. While this option may satisfy both short and long term needs, issues of data quality, data ownership, and standardization need to be properly considered. As such, coordination of trucking data collection efforts among public and private agencies is essential.

One of the most important sources has been the most updated Freight Analysis Framework data and information. It provides extensive update on freight network, freight O-D pattern, and the data is at finer detail than before (now it is at county level compared to BEA regions before). This has been helpful. However, the level of detail for agricultural movements is not at that detail.

4.4.2 State data sources

Examples of such sources are identified in Table D.2 in Appendix D. Examples of data are those obtained within Minnesota state agencies, particularly Mn/DOT. Such data include network or physical asset data, safety data, operations data, economic and trade data, intermodal facility data, port and waterway data.

Similarly, information about demographics, employment, growth of establishment, competitiveness of state and specific region (particularly Metro area) can be obtained from Department of Economic Development, which regularly puts out reports on such statistics. In such reports are comparisons with other similar areas. For example, Twin Cities is regard as among one of the competitive cities for business location.

Office of Investment Management puts out various statistics about IRC system and statewide information from planning and programming standpoint. Office of Freight and Commercial Vehicle also is good resource; most significant is the waterway data.

4.4.3 Regional data sources

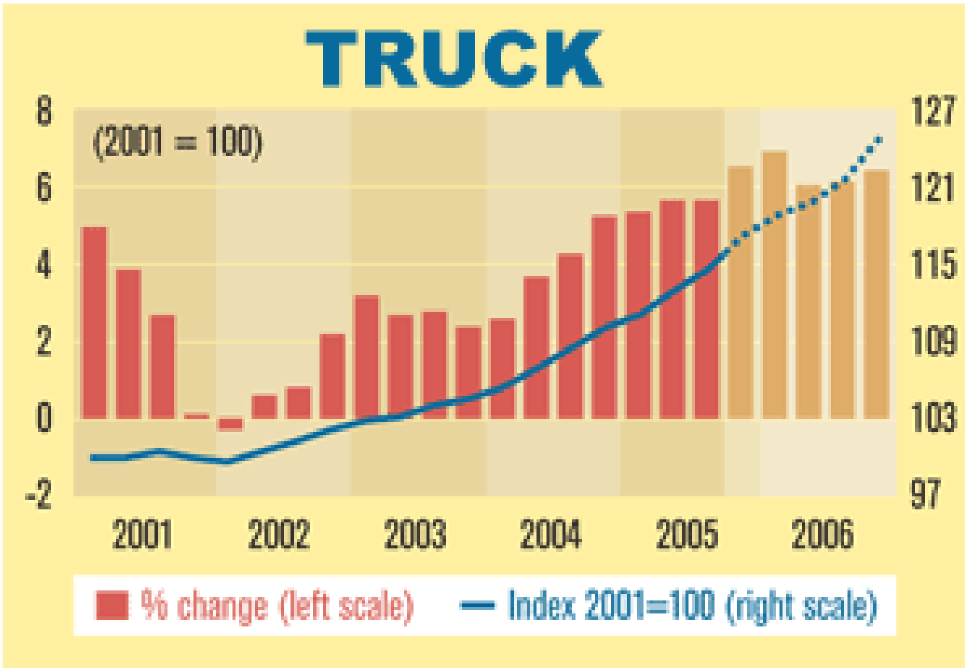
Examples of such sources are identified in Table D.3 in Appendix D. Upper Midwest corridor study and Upper Great Plains Transportation Insitutte have compiled regional data sources which could be useful for particularly understanding freight flows in, out, and through Minnesota. Agricultural freight movements from elevator to elevator can be found from UGPTI. Regional intermodal center activities and movements can be found from repository in Upper Midwest Corridor. Some examples of good regional data sources are freight flow information, intermodal activity, elevator flows, MPOs, and RDCs.

4.4.4 Local data sources

Examples of such sources are identified in Table D.4 in Appendix D. Examples of such data are intermodal facility data, freight cluster data, elevator data, urban goods movement data—parking, and transfers. Similarly, travel time and clearance time (for incidents and snow removal) are monitored in Metro area.

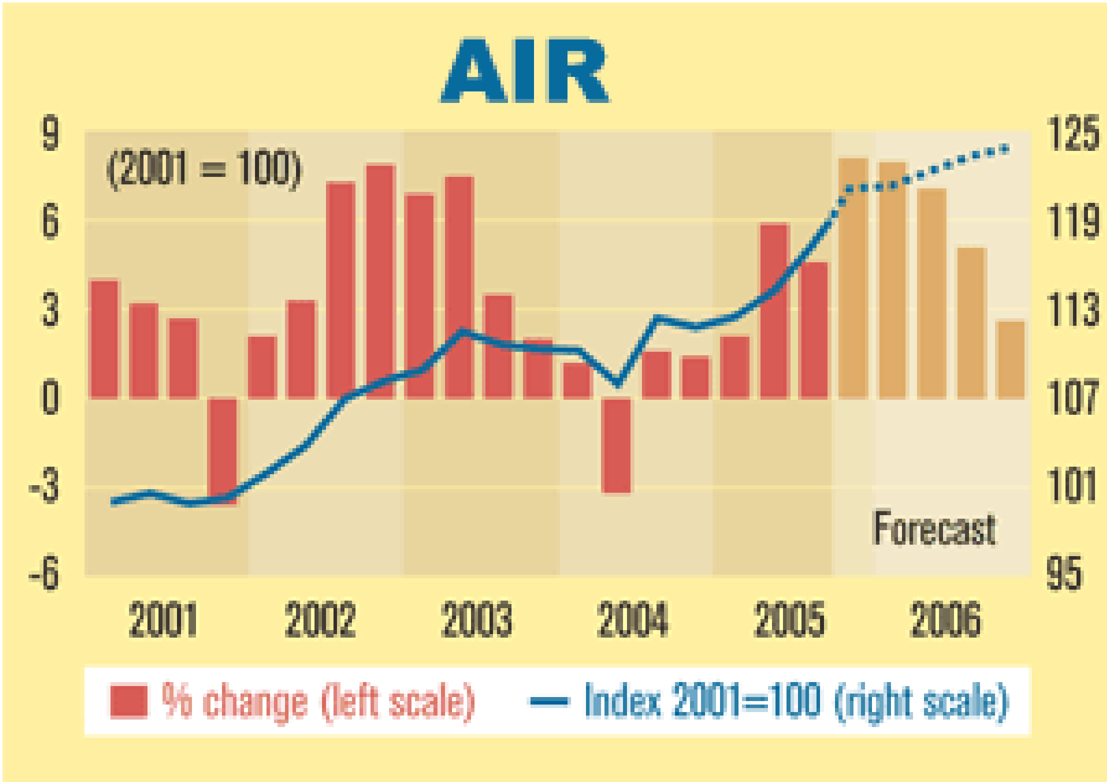
4.4.5 Industry/private data sources

Examples of such sources are identified in Table D.5 in Appendix D. For sometime Reebie data was used for developing the baseline data for developing commodity flows and Global Insight data was used for developing the forecasts. Performance Measures put out by freight industry or association, e.g. AAR or IANA can provide useful insights about rail tonnage and value information. The pricing trends information from Reed Business Logisitic Management could provide good industry performance insight. Similar the annual logistics and transportation trend study can help one understand how customers, carriers, and shippers find different performance measures as important. Some insight include the following: port congestion is not as important on time delivery. Hence, measure of reliability is to be paid more attention to. Industry cost, revenue, and profit data could also be useful to monitor the health of industry. The anecdotal information from industry groups can be useful in highlight performance issues such as capacity problems, cargo velocity problems, and travel or transit time problems, or inability to meet customer expectations using same fleet size and composition that worked in past. Air cargo movements and data can provide how the performance is. Since Minnesota did not have dedicated air cargo service from any airports in Minnesota, developing such performance measures were difficult as it was all translated as truck movements. Some general performance measures are published by AAR such as Class one published delivery times between major points and on-time statistics. There also exist parcel carrier published land delivery times between major points and on-time statistics.



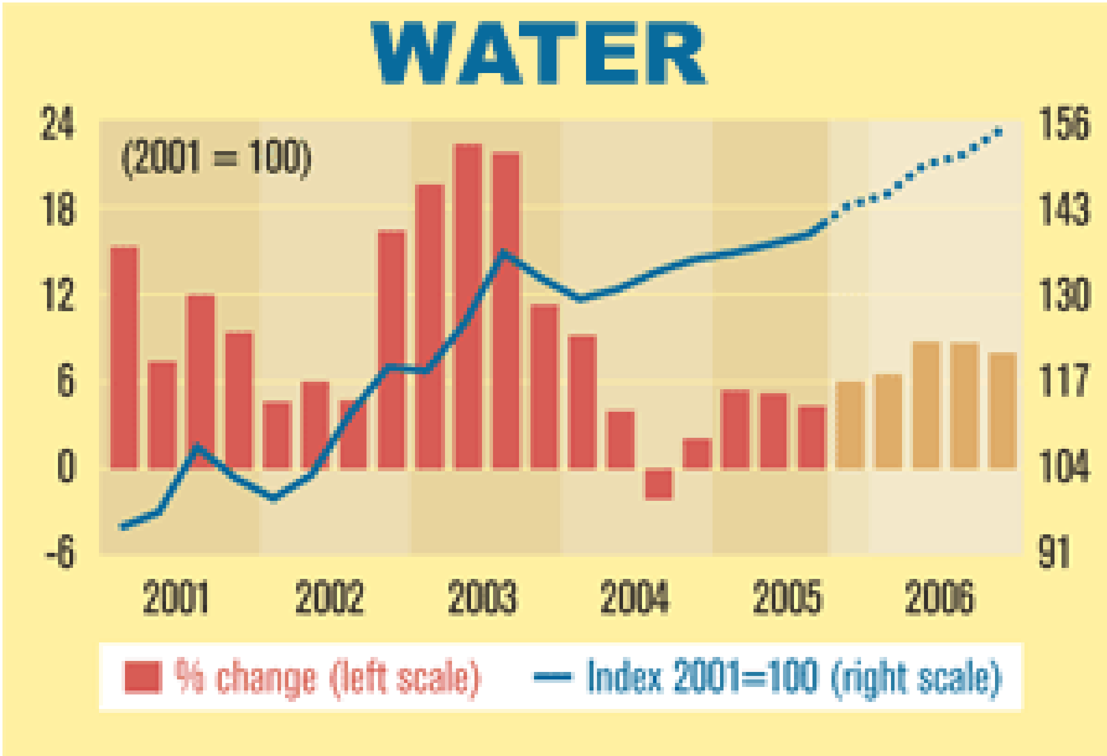
% CHANGE VS.:	1 month ago	6 mos. ago	1 yr. ago
General freight - local	-1.5	0.6	3.7
Truckload	0.5	3.8	6.7
Less-than-truckload	-0.6	3.3	6.8
Tanker & other specialized freight	-0.2	3.0	5.9

Figure 4.1. Truck pricing trends.
Source (Baatz, 2006)



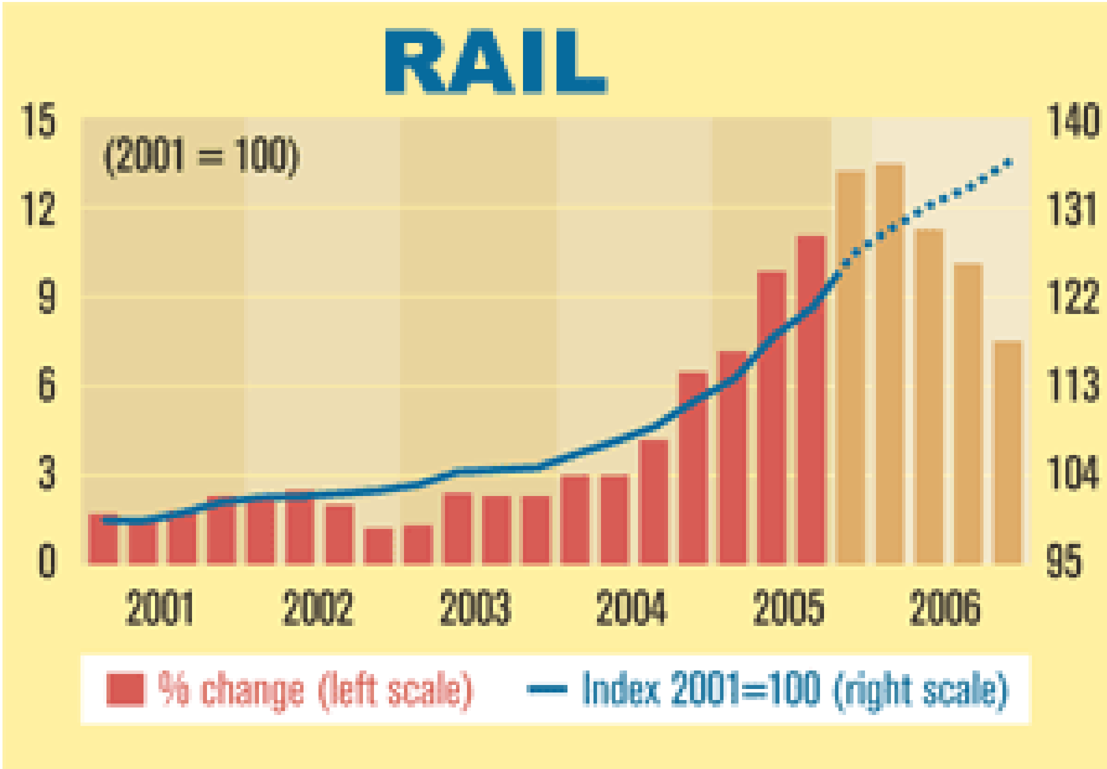
% CHANGE VS.:	1 month ago	6 mos. ago	1 yr. ago
Scheduled air freight	1.6	6.1	9.7
Chartered air freight & passenger	-0.1	1.6	5.4
Domestic air courier	3.1	4.7	9.4
International air courier	5.0	6.5	11.8

Figure 4.2. Air pricing trends.
Source (Baatz, 2006)



% CHANGE VS.:	1 month ago	6 mos. ago	1 yr. ago
Deep-sea freight	0.0	0.8	1.1
Coastal & intercoastal freight	0.0	4.3	14.5
Grt. Lks.-St. Lawrence Seaway	1.3	3.3	6.7
Inland water freight	0.0	23.2	27.1

Figure 4.3. Water pricing trends.
Source (Baatz, 2006)



% CHANGE VS.:	1 month ago	6 mos. ago	1 yr. ago
Rail freight	1.5	6.1	13.7
Intermodal (trailer or flatcar)	0.4	9.2	14.8
Carload	1.7	5.6	13.8

Figure 4.4. Rail pricing trends.
Source (Baatz, 2006)

4.4.6 Public-private partnerships

Examples of such sources are identified in Table D.6 in Appendix D. One of the most talked about public-private partnerships to develop freight significant corridor specific travel time and buffer index as well as reliability measures has been the FHWA-ATRI effort. In this effort, trucks were used as probes to measure the performance of the Interstate System. The system used to collect information monitors the velocity and reliability of truck movements on the Interstate System. All identifying information is cleansed from the data stream so FHWA has no knowledge of which trucks are providing the data points. The FAF was used to select five freight significant corridors (I-5, I-10, I-45, I-65 & I-70). Data was collected from 250,000 trucks. From this data, FHWA has developed speed and travel time reliability measures for those corridors. In April 2006, this effort was expanded to a total of 25 corridors.

FHWA is also establishing performance measures for border crossings using the same methodology and is in the process of developing those metrics.

4.4.7 Specialized sources

Examples of such sources are identified in Table D.7 in Appendix D. Examples of such data sources are agricultural freight data and studies, market segmentation studies of manufacturing sector, interregional corridor data/studies, spring load restriction data/studies, truck size and weight data/studies, and modal diversion/share data/studies (from water to highway), connector studies, regional freight flow studies, agricultural movement studies, statewide freight flow studies, and system studies as part of development of statewide freight plan. Similarly, comprehensive commercial heavy vehicle safety plan have been developed. Statewide transportation plan, STIP, long range plans of Districts, and 10-year highway work plan provide very relevant information regarding freight significant IRC system and special generators and related needs. Highway cost allocation studies have also provided important information about modal costs, factors affecting modal diversions, and others.

4.5 Assessment of performance measures/indicators and data for Minnesota

Minnesota is a leading state in terms of performance based transportation planning. Its strategic plan, 2003 statewide transportation plan, and 2005 statewide freight plan have provided significant guidance in development of performance measures and indicators. The data which are available on regular bases are physical facilities, operational data, safety data, intermodal connectors, and intermodal facility data. In addition, with studies in 1995, 2000, and 2004 Minnesota has developed information of total freight flows by tonnage and value within, inbound, outbound, and through Minnesota.

However, measurement sources for most desired performance measures and indicators are lacking. From economic standpoint and determining infrastructure capacities the interest in knowing total freight flows within, inbound, outbound, and through Minnesota is important. This will also be of interest to legislature. There is interest in travel time and reliability information for sectors like manufacturing and wholesale. There is interest in transportation cost, particularly transportation cost as percent of overall cost, for agriculture and timber/wood product industry. Minnesota also wants to keep close watch on national issues like rail and port capacity and congestion, which affects nation as a whole in efficiently moving international freight shipments. Minnesota should also monitor industry trends as put out by Annual Transportation and Logisitics Surveys, DJTA, AAR, IANA, ATA, and others. It is also in Minnesota's interest to monitor economic and pricing trends. In addition, there are numerous anecdotal evidence and statistics from articles, trends, and freight story put out by newspapers and magazines of trade associations. Among principal sources for anecdotal statistics are Traffic World, Transportation Journal, Journal of Commerce, etc.

Data by themselves will not do the job but will be useful if used in conjunction with in house data. Known policy issues are modal share, modal costs, time; performance at a point, along a corridor, or over a network. In addition, Minnesota freight flows in and out may be impacted by performance at regional freight intermodal centers or gateway airports and ports. All these may affect reliability, rates, costs, and in turn policies. How they affect it is not part of this study. It is a complicated issue.

Many of the issues are intertwined. For example, the capacity and access issues may reflect same concerns. The idea of developing indicators is to follow trend and not actual value. The care and caution should be taken to not even give perception of making one "more competitive" but to find why one is fairing better than others; are conditions unduly bad for some. It is important to look at both private and public perspectives to get a better understanding.

4.5.1 Network and infrastructure (N)

Minnesota has several measures and indicators in this category and has good data for the same. However, not all data has been compiled and analyzed. As a result many of the measures are developmental or emerging in nature.

4.5.2 Safety or damage (S)

Minnesota's Department of Public Safety collects crash data and has a good history of that. Mn/DOT has used that data and analyzed it well over years. Minnesota's zero death policy relies heavily on this data. Various measures can be easily developed using the data that is available. However, not all data has been compiled. Data on crashes at railroad crossings has been of interest.

4.5.3 Access (A)

Highway connector studies for Greater Minnesota and Metro areas have been carried out recently. These efforts have provided good information and understanding about appropriate access to traffic generators and access of IRC by generators. There still needs more work to develop measures further and cmpile and analyze data for developing such measures.

4.5.4 Capacity (C)

There is one measure in Minnesota SFP that refers to capacity directly. It has been studied and identified that there have been capacity problems for waterway and constraint Minnesota faces in sending freight by rail to east, south, or west. All such movements and containers have to go through Chicago. Hence, Minnesota's future is tied to resolving this national problem. Currently there is a national effort in tune of billion dollars with public-private partnership to improve Chicago rail capacity. There needs to be more work in developing capacity related measures/indicators and in compiling and analyzing data related to that.

4.5.5 Travel time (T)

There are some measures in this category. However, data has not been collected and analyzed for such a measure. The best example it the travel time and clearance time in Metro Areas which Traffic Management Center puts out as part of their performance measure effort. There are speed targets for IRC corridors from which travel time can be estimated. There is also plan to have a segment of I-94 from St. Paul to Chicago be part of the expanded freight significant corridor that ATRI-FHWA will monitor and measure for travel time. This is the most congested segment. Nortwest freight flow study had obtained and compiled some information about point to point travel time for selected commodities in early 1990s. Border crossing times can be obtained from BTS effort.

4.5.6 Reliability (R)

There are some measures in this category. However, data has not been collected and analyzed for such a measure. This measure is very much related to travel time. For freight industry this is a better measure as it allows them to plan better in meeting service commitments and customer expectations. There still needs lot of work in compiling and analyzing data for development of this measure.

4.5.7 Market share (MK)

Freight movements could be local, regional, statewide, national, or international. The freight flow studies for various regions as well as statewide has provided good set of information about market share. The consultants used Reebie (now TRANSEARCH) data develop freight profiles for the state, districts, region, and metro areas. However, such studies will have to be conducted in future to develop such information.

4.5.8 Modal share (MD)

The freight flow studies for various regions as well as statewide has provided good set of information about mode share. The consultants used Reebie (now TRANSEARCH) data develop freight profiles for the state, districts, region, and metro areas. The most important finding was that freight movement is much more multimodal in Minnesota compared to national trend.

4.5.9 Modal costs (MC)

These are useful in modal shift studies. It is much harder to estimate these costs because of complexity of factors involved and usually requires some assumptions and derivations. Some empirical analyses have been done to make modal comparions. However, these involved several assumptions. There are some reports out that provide operating cost in dollar per mile for trucks. There is not one clear source for this and much of such numbers are derived.

4.5.10 Freight productivity (FP)

This refers to freight productivity of the industry. These have not been used in Minnesota. It would be important to develop some of these measures. Data for development of such measures/indicators are available but needs to be compiled and analyzed.

4.5.11 Freight security (FS)

This refers to freight security. There are no measures in this category. It is important for Minnesota to have some of these measures to benchmark their preparedness to deal with emergencies. Data for such measures need to be developed.

4.5.12 Shipment rates (SR)

USDA provides good source of rate information, which is applicable to Minnesota. This was cited by freight advisory group as an important performance indicator. Such information can be obtained from shipper panel surveys. There is no such information available readily for other sectors. This will require good public-private partnerships and agreement.

4.5.13 Pricing (PR)

This refers to pricing of different modes for different commodities and the variabilities associated with them. The best data identifying trends on national basis is the one put out by Logistics Management. Minnesota does not have any measures/indicators in this category.

4.5.14 Agency cost (AC)

This category refers to infrastructure, administrative, enforcement cost. Minnesota does not have any measures/indicators in this category. Such information is available but has not been compiled or analyzed. It would be useful to have such measures and look into tradeoffs of being more efficient versus additional costs. Many of the CVO enforcement use ITS technologies and having such a measure may indicate how useful that investment has been.

4.5.15 Carrier cost (CC)

This category refers to economic, logistics, business, regulatory costs incurred by carriers. Minnesota does not have any measures/indicators in this category. Much of this is proprietary information and cannot be obtained without good public private agreements. Freight Advisory Group can be used to at least get information about what factors are affecting carrier's costs and if any transportation improvements can minimize that.

4.5.16 Shipper cost (SC)

This category refers to economic, logistics, business, regulatory costs incurred by shippers. Minnesota does not have any measures/indicators in this category. Of most importance is the knowledge of transportation cost as part of overall logistics costs. Over time with efficiencies in supply chains designs and operation, transportation cost has increased in share. Freight cost per ton mile is a good measure. Much of this is proprietary information and cannot be obtained without good public private agreements.

4.5.17 Externalities and community Cost (EX)

This category refers to environmental, energy, social, safety costs. Minnesota Statewide Transportation Plan has few measures in this category but Minnesota Statewide Freight Plan did not have any measure in this category. Fuel consumption, emissions from vehicles and fuel substitutes are of importance to promote sustainable freight mobility. Freight specific measures in this category can be developed for Minnesota. Data needs to be compiled from industry, DOE, EEA, and other sources and then analyzed.

4.5.18 Transportation indices (TI)

There are various transportation indices being currently used. The indices are usually composite values of multiple considerations and serve the purpose of denoting the trends. Travel time index, Transportation Services Index and DJTA index are some examples. Montoring such indices can help Minnesota understand the national trends. Often times national trends also affect state trends.

4.5.19 External factors (EF)

These refer to economic and demographic factors as well as logistics factors. Some examples are trade agreements, economy, inflation, fuel prices, and logistical factor changes. There are no such measures/indicators currently. It is very important to compile such information as for decision makers the performance measurements are only good if one can connect it to policies and goals. Such measures can also look into economic impacts and factors that may help explain trends which do not follow trendline projection.

Chapter 5 Best Practices

5.1 Barriers to use of performance measures/indicators

There are several barriers to use of performance measures or indicators. The clear definition and use of the performance measure may not be known. The cost of acquiring data and developing a particular performance measure or indicator may be high. Cost of developing data for a particular performance measure or indicator in-house may be higher. Cost of maintaining and updating the performance measure and the related measurement source may not be known.

Difficulties in developing performance measures are:

1. Each mode as part of multimodal freight system continues to change to remain competitive in response to the evolving business logistics needs;

2. Much relevant and important data resides in private sector and are proprietary in nature;

3. Since Sept 11, 2001 routine industry reports are now withheld for security reasons;

4. One of the challenges of developing performance measures for freight is defining performance measures;

5. One of the challenges of developing performance measures for freight is defining performance measures that reflect the concerns of the business community and freight forwarders who rely on the transportation system;

6. Suppliers must provide their products to their customers consistently on time, on budget and on demand;

7. Availability and accuracy of data usually drives what is measured rather than what freight system attributes should be measured and benchmarked to track performance;

8. Challenge is developing and accessing critical data sources on regional, state, national, and international freight movement by time, freight modes, location (routing, origins and destination), value and tonnage;

9. "Freight does not vote. Potholes vote. Because of that you have to become people who are engaged in recognizing the value of freight," said John Ficker (CTS, 2006); and

10. At the same time freight logistics have no political boundaries.

5.2 Best measurement sources available

The best sources available at local, state, regional and federal level and in private sector domain may be different but complement each other in developing more complete understanding for freight performance. Best sources are those that help in identifying freight performance measures/indicators and at the same time are also best in terms of availability, reliability and relevant for freight movement inbound, outbound, and through Minnesota.

Among federal data sources that are best available are CFS, Waybill, Waterway data from Army Corps, and Economic and Industry Surveys. HPMS database is also a good source. Global Insight (TRANSEARCH data) still seems to best to understand national and regional flows. Such data need to be complemented with state and local data sources when studying statewide or substate or local freight flows.

Logistic Management’s monthly pricing trends information is a good source of changing trends for air, water, trucking, and rail modes. The key question is whether Minnesota pricing trend can be to such trends. Similarly, annual logistics survey provides good insight into the factors that are affecting performance of freight industry. Examination of such factors at Minnesota level can then provide basis for improvements to be sought. AAR provides data on various aspects dealing with rail freight. IANA provides good data on intermodal freight. PIERS and AAPA data are important sources for waterway and port data.

Past freight related studies and statewide and district plans in Minnesota has been good source of information for strategic directions, policies, strategies, and priorities. Thus, these sources also provide current use of transportation system performance measures and indicators and their relevance.

Economic, demographic, establishment, export and import, and other information available from economic development department are also very useful, especially from metro areas or regional trade centers of level 0 and 1. Here again sometimes data from commercial vendors may be needed for forecast information.

Travel Time and incident clearance and snow removal time data is also a good source. However, it exists for only metro area. ATR, WIM, loop detector data that exists could provide good source to develop volume, time, classification, and speed data, which in turn can be instrumental in developing some good measures for freight significant corridors.

Even though they are being cited as best sources, these sources are not complete or available to level and detail, whereby one can develop performance measures and indicators clearly.

5.3 Good existing practices in Minnesota

Thus, the question is what Mn/DOT should continue to do in general and data-wise in particular that it is currently doing to develop understanding of measures and indicators related to freight movement inbound, outbound, and through Minnesota. In other words, what should be continued to develop an improved understanding of freight performance.

Network and physical asset databases pertaining to interregional corridor, connectors, intermodal facilities, bridges and pavements should be maintained and improved. Similarly, safety data collected by Department of Public Safety and compiled and analyzed by Mn/DOT has been a good source of data. Minnesota Waterway and Ports section has one of the best data on waterway and port flows in Minnesota. BTS data on border crossing is also important data source to understand truck and container movements from Canda into Minnesota and U.S and Mexico. All these sources provide bases for many of the performance measures that currently exist in the statewide transportation plan and statewide freight plan. It must be noted that not all data that are available has not been compiled and analyzed. Intermodal facility database (separate one exists for Metro area and Greater Minnesota) is a good source but needs to be updated on regular basis. Duns and Bradstreet data have been used recently to update the information on freight clusters.

Three freight flow studies in 1990, 2000, and 2004 were very useful studies. Mn/DOT should conduct periodic freight flow studies at all levels. There are still data limitations related to national CFS data and Global Insight data in dealing with substate and local flows.

One of the most important sources has been Mn/DOT's Freight Advisory Group, which has been instrumental in identifying issues and anecdotal evidences regarding freight problems. Regular meetings with the group have provided good insights and bases for important freight related studies in Minnesota.

Operational data such as travel time data, loop detector data, classification data also are good source of data. However, they have not been tapped fully.

Freight specific studies dealing with agricultural freight movement, spring load restriction and its impact, connector studies, truck size and weight, rail-intermodal studies, modal shift studies, freight market segmentation studies for manufacturing sector, regional freight flow studies have been conducted in past. All these studies provide wealth of information which can be used to understand which freight measures and indicators to use and what data limitations exist.

Effective use of past freight related studies and statewide and district plans in Minnesota is recommended to develop understanding of the strategic directions, policies, strategies, and priorities. This in turn could be instrumental in examination of performance measures and indicators and their continuing relevance. Similarly, transportation inventories need to be updated and expanded to provide better assessment of deficiencies and adequacy of freight significant corridors and nodes.

5.4 Innovative practices

Innovative practices could be dealing with lack or absence of data, could be dealing with process of developing performance measures and indicators, or coming up with effective and innovative partnerships to deal with both data and performance measures.

Freight generation information can be obtained from secondary sources or through surveys of establishment. There are several examples of conducting surveys of freight stakeholders and facilities. Such surveys will be critical in developing freight trip generation information.

Urban goods movement has been studied using various models. Such models can be effective in looking into strategies that could improve urban goods movement in metro areas. Similarly, some states have developed statewide freight flow models. Such models are especially useful in understanding the bottlenecks of future. Any improvement of expansion project required lead time. Having such information along freight siginificant corridors and nodes will be critical in proactively dealing with freight bottlenecks of future.

Public-private approaches in gathering data, especially travel time along corridors is a good example. Such partnerships between public and private agencies and among different public agencies at different levels will become more critical in developing understanding of freight flows as freight flow is not confined to one jurisdiction.

Travel time and reliability data exists but has not been compiled and studied in depth. Freight shipments take hours to several days, depending on destination of freight and nature of freight.

CVISN and other ITS technologies have been used in enforcement of truck movements. This provides a good data but has not been studied well.

5.5 Industry data sources to monitor

There are various freight industry data sources and reporting that Mn/DOT should closely monitor and examine to understand what freight industry trends and general health is. These include:

a. Pricing Trends

b. Tonnage Index from BTS/FHWA

c. Wall Street Indices

d. Performance Data on Net Profits

e. Performance Data on Dwell Times and Delays

f. Economic Indicators—Fuel Prices, Trade Arrangements, Economy, Commodity Marketing

g. Logistical Trends—in supply chain and use of technology

h. Economic Base of Area of Interest

i. Performance Data of Loss/Damage of Freight from AAR, Annual logistic survey

j. Anecdotal data on Access, Capacity, Reliability Problems from sources such as Transportation Journal, Journal of Commerce, Traffic World, and others.

5.6 Public-private approaches

Good examples of public-private approaches include: ATRI Travel time efforts; efforts in conducting shipper panel surveys; and other surveys pertaining to inbound, outbound, transshipment, and intermodal movements. Similarly, grain elevator surveys in North Dakota, conducted periodically, are possible because of memorandum of agreement with ND Public Service commission. Needless to say because many of freight data is proprietory in nature, we cannot develop good understanding without public private partnerships which will ensure confidentiality and address competition issues. This process becomes more effective if there are ties developed through freight advisory groups or use of third party (like universities) or use of trade associations.

5.7 Institutional inter- and intra- agency arrangements

Similarly, there needs to be better partnerships with districts, MPOs, other state agencies, and municipalities to address freight issues and related data. It can also serves as basis to develop appropriate funding to develop plans and data.

5.8 Minnesota's future expanded and improved efforts

Many freight measurement sources, which are available, need to be collated and compiled and analyzed. There is not much reporting of performance is currently underway. Safety is the key performance which has been reported. This should be the immediate focus—updating transportation invetories, intermodal facility database, safety database, and travel time and speeds along freight significant interregional corridors.

It is also conceivable that needed trucking data elements that are not readily available but for which there is great demand, can be included with existing and ongoing data collection protocols. For example, the data on empty trucks can be included with HPMS data collection effort. Similarly, information of distribution of freight volume and value by truck configuration can be collected as part of VIUS or other data collection efforts. It is important to consider the value of these data elements for the range of applications and the extra cost required to include them as part of existing data collection efforts.

Good things to learn from others are in terms of imputing data, conflating data, developing new sources, public private partnerships, and in dealing with heterogeneous data.

Travel time data for metro area is good but needs to be updated and examined better. Travel time data along I-94 from St. Paul to Chicago using ATRI-FHWA effort could be useful.

There needs to be a better understanding of multimodal nature of freight movement. Identifying bottlenecks and addressing inadequacies in performance, access, or capacity in a proactive way is very important. Connector studies have been important. But definitions for capacity and access need to be articulated better before we develop performance measures more and develop targets for it.

Freight flow studies in 1995, 2000, and 2004 provided good information but at best they were snapshots of those years. A freight model—statewide and urban/metro level could be useful in getting continuing and forecast information. Model development can be helped by private industry in providing modelers with data that can be used for calibration and validation. However, this will require resource commitment and effective public-private agreements.

Supply chains for different industry should be understood and relevance and importance of transportation in the overall supply chain has to be identified.

Some useful performance measure/indicators which could be developed or developed in more detail are:

1. Modal cost of agricultural shipments by markets.
2. Shipment rates for agricultural shipments.
3. Transportation cost as percent of total cost for timber/lumber industry.
4. Door-to-door time (range of times) for manufacturing shipments; especially in last leg of supply chain.
5. Transportation cost for wholesale by market.
6. Truck parking shortages along corridors or near major shipment, distribution or intermodal centers.

Chapter 6 Conclusions and Recommendations

6.1 Significant findings

There are numerous data sources and they can be classified as primary data, compilations, reference studies, industry sources, indices, and others. However, these sources are not complete or available to level and detail, whereby one can develop performance measures and indicators clearly, convincingly, and readily. Safety performance measures and indicators have been developed in more mature way.

Very valuable data sources are available within Minnesota, such as ATR data, WIM data, loop detector data, speed and travel time data, infrastructure inventory and condition data, and safety data. In addition, Office of Freight has started developing freight planning support system, had intermodal facilities database, and in conjunction with waterway and ports section and rail section puts out maps and tables of trends and snapshots of market and mode shares. But the data as it presently exist or is stored cannot be readily used to develop performance measures and indicators. There is a distinct need for these data to be mined, collated, and analyzed to develop better information, which could then be used as measurement source for developing freight performance measures and indicators. Similarly, the commodity flow surveys and related data that exist should be carefully examined for its usefulness for Minnesota. Global Insight data has problems with developing statewide, substate, and metro area freight flows. More importantly, there has been little effort to translate commodity based freight flows to freight vehicle flows on infrastructure that support the movement.

The performance measures and indicators related to network and infrastructure, safety, and travel time (particularly travel time on infrastructure) can be developed using available data. Similarly, there is a lot more information available for agricultural freight movement from USDA and grain elevator surveys, which can be used very effectively to understand the nature of agricultural freight flows and what are the factors affecting such movements. Statewide and regional freight flows have been studied in the past but the conditions keep changing so much and the data based on which one estimates such flows are lagging much in time. Thus, credibility of such estimates becomes questionable.

There needs to be a determination regarding what performance measures or indicators are relevant and most important. For legislators the information regarding market share, mode share, shipment rate, pricing, externalities, and external factors is very important. For Mn/DOT understanding the impact of freight on various facilities, especially on freight significant corridor and nodes, is important. Freight industry needs information regarding bottlenecks. Hence, freight industry is more interested in access and capacity related performance measures and indicators. In fact, freight industry (for example AAR and IANA) does put out such measures and indicators periodically. However, they are more like national and regional averages and whether it can be applied to Minnesota is always a question.

There is a need to develop better modeling capabilities within Minnesota to be able to develop freight flow information on a continuing basis, which in turn could provide market share and mode share information. There is also a need for forecast values for such information.

6.2 Recommendations

There should be a concerted effort to define the performance measure and indicators more clearly. The interaction between industry and different levels of government is important in developing such definitions. Freight advisory group can play a key role here. Many of the example measures and indicators identified in this study can be discussed and used. In developing definitions or descriptions of the performance measures and indicators there should be conscious effort to tie them to strategic directions, policies, and objectives that are identified in both the statewide transportation plan and the statewide freight plan.

It is also important to identify who will develop, keep and maintain the freight performance measures and indicators. There should also be agreement on reporting times and audiences. It is advisable to start small and expand as deemed appropriate.

Many important and relevant performance measures and indicators are related to freight significant corridors and nodes. Hence, there should be efforts to strengthen identification of freight significant strategic corridors and nodes. This would involve interaction with districts, counties, freight industry, and various state agencies, including economic development agencies.

The performance measures and indicators related to network and infrastructure, safety, travel time, external factors should be developed in short term. It is very important to start defining performance measures and indicators related to capacity and access and then develop measurement sources for development of such measures and indicators. Reliability information is vital to freight industry and should be presented in many ways. In medium term Freight Advisory Group can play an important role in defining access, capacity, and reliability related performance measures and indicators. A lot of insight can be gained from the anecdotal evidences routinely provided by trade association magazines and journals. However, it is important to develop measurement sources to address these and take it beyond mere anecdotal evidences.

On a longer-term basis survey programs can be developed. Ongoing survey programs could be initiated and maintained. Such programs can be handled by third party and must make use of freight advisory groups. Survey of inbound and outbound movements can be ascertained through shippers. It is also important to survey what industry considers important as time goes by. There might be need to do Origin-destination surveys for external-external movements. Statewide travel demand model as well as urban freight models might be necessary to develop freight flow information on continuing basis as well as for future.

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Appendix A. Measurement Sources – Data and/or Information

This appendix provides the reference number or identifier and description of the measurement sources (data and information) used in this study. These sources were collected through various searches—literature databases, online searches, attendance at various professional meetings such as annual meetings of professional societies such as TRB, ITE, APA, and ASCE.

The sources include journal articles, research resports, data sites, data publications, magazine articles, newsletter articles, webcasts, e-sessions, and others. Often times information regarding data or use of data, and challenges in using data may not be only available from data sources but maybe discussed in various study efforts or discussion during meetings, based on work done in dealing with data to achieve some other purpose. Hence, the term “measurement sources” is meant to be inclusive of all these data and information sources in this study.

Table A.1. Measurement source identifiers and description.

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
1	AAR. (2006a). Freight Commodity Statistics, American Association of Railroads, Washington, DC, http://www.aar.org/
2	AAR (2006b.) Railroad Equipment Report, http://www.aar.org/
3	AAR (2006c). Weekly Carload (as reported to the AAR) , http://www.aar.org/
4	AAR (2006d).Terminal Dwell Time, http://www.aar.org/
5	AAR (2006e). Weekly Cars online, http://www.aar.org/
6	AAR (2006f). Train Speeds, http://www.aar.org/
7	AAR (2006g). Freight Loss and Damage, http://www.aar.org/
8	AAR (2006h). Railroad Facts, http://www.aar.org/
9	AAR (2006i). Railroad Revenues, Expenses & Income, http://www.aar.org/
10	AAR (2006j). Railroad Ten-Year Trends, http://www.aar.org/
11	AAR (2006k). Railroads and States, http://www.aar.org/
12	AAR. (2006l). North American Trucking Survey (NATS), Washington, DC
13	AAR (2006m). Weekly Railroad Traffic, http://www.aar.org/
14	AAR (2006n) Railroad Cost Indexes, http://www.aar.org/
15	AAR (2006o). Railroad Cost Recovery Index (RCR), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCRDescription.pdf
16	AAR (2006p). Rail Cost Adjustment Factor (RCAF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCAFHistory.pdf
17	AAR (2006q). All-Inclusive Index Less Fuel (All-LF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/AllLF.pdf
18	AAR (2006r). Index of Monthly Railroad Fuel Prices, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_MonthlyFuelPrices.pdf
19	AAR (2006s). Analysis of Class I Railroads 2005 Data for 2005, http://www.aar.org/
20	AAR (2006t). Railway Performance Measures, http://www.railroadpm.org/
21	AAR (2006u). Railroad Class I Statistics, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Statistics.pdf
22	AAR (2006v). Profiles of U.S. Railroads, http://www.aar.org/
23	AAR (2006w). Rail Transportation of Chemicals, http://www.aar.org/
24	AAR (2006x). Rail Transportation of Coal, http://www.aar.org/
25	AAR (2006y). Rail Transportation of Grain, http://www.aar.org/
26	Abbott,J. K.B. Manrodt., and P. Moore (2004). From Visibility to Action, Report on Trends and Issues in Logistics and Transportation, Oracle, Georgia Southern University and Capgemini,USA., 2004.

Table A.1. Measurement source identifiers and description, continued

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
27	Abkowitz, M. and E. Meyer. (1996).Technological Advancements in Hazardous Materials Evacuation Planning. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 116–121.
28	Abkowitz, M.D., J.P. DeLorenzo, R. Duych, A. Greenberg, and T. McSweeney (2001). Assessing the Economic Effect of Incidents Involving Truck Transport of Hazardous Materials.In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 125–129.
29	ACI-NA. (2006) Worldwide Airport Traffic Report, Airports Council International (ACI)- North America (NA), Washington, DC.
30	Ammah-Tagoe, F. and Johnson, D. (2004). Understanding Potential Freight Bottlenecks in the United States: A Look at the GeoFreight Visual Display Tool, Paper presented at the 7th MTS Research and Technology Coordination Conference, Washington, D.C., November 16-18, 2004; http://trb.org/Conferences/MTS/4C%20Ammah-Tagoe%20Johnson%20paper.pdf; Accessed July 15, 2005.
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32	ARDC (1983).North Shore Commodity Movement Study : final report / prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.
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34	ARDC. (1999). Northeast Minnesota Freight Study, prepared by Arrowhead Regional Development Commission (ARDC), Duluth, MN.Paul, MN.
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36	ATA (2006). Truckline Express, American Trucking Associations E-Newsletter, www.truckline.com
37	ATRI (2005). Travel Time in Freight Significant Corridors. American Transportation Research Institute. www.atri-online.org; Accessed July 26, 2005.
38	Jones, C., Murray, D. and Short, J. (2005) Methods of Travel Time Measurement in Freight-Significant Corridors. Prepared by American Transportation Research Institute. For Transportation Research Board Annual Meeting, January, 2005.
39	Baatz, E. (2006). Pricing Trends – Pricing Across the Modes, Logistics Management, http://www.logisticsmgmt.com/October, 2006.

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REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
40	Baird, ME and Stammer, RE, Jr. (2000a). Conceptual Model To Support Systematic Use Of Performance Measures In State Transportation Agencies. In Transportation Research Record 1706, TRB, Washington, DC, 2000, pp. 64-72.
41	Baird, ME and Stammer, RE, Jr. (2000b). Measuring The Performance Of State Transportation Agencies: Three Perspectives. In Transportation Research Record 1729, TRB, Washington, DC, 2000, pp. 26-34.
42	Ballis, A. (2004a). Introducing Level-of-Service Standards for Intermodal Freight Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 79-88.
43	Barber, D. and L. Grobar. (2001). Implementing A Statewide Goods Movement Strategy and Performance Measurement of Goods Movement in California, METRANS Transportation Center, California State University, Long Beach, June, 2001.
44	Barkan, C.P.L., T. T. Treichel, and G.W. Widell (2000). Reducing Hazardous Materials Releases from Railroad Tank Car Safety Vents. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 27–34.
45	Barnes, G. and P. Langworthy (2003). The Per-Mile Costs of Operating Automobiles And Trucks, Report No. MN/RC 2003-19, Minnesota Department of Transportation, St. Paul, MN, June, 2003.
46	Barolsky, R. (2005). Performance Measures to Improve Transportation Planning Practice--A Peer Exchange, Transportation Research Circular E-C073, Transportation Research Board, Washington, D.C., May, 2005.
47	Barton, R.A. And John Morrall (1998)., Study of Long Combination Vehicles on Two-Lane Highways, in Transportation Research Record 1613, Journal of Transportation Research Board, TRB, Washington, DC, pp. 43 to 49, 1998.
48	BEA. (1987). 1982 Benchmark Input-Output Accounts of the United States, Department of Commerce, Bureau of Census, Washington, DC.
49	BEA. (2005). Regional Economic Accounts, www.bea.gov/bea/regional/data.htm
50	Beier, F.J. (2002). The Feasibility of a Shipper Panel to Measure Transportation Services. Final Report. Minnesota Department of Transportation, December, 2002.
51	Beilock, R. (2005).Transportation Factors Influencing the Competitiveness of Agricultural and Food Products, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.
52	Bertini, R.L., J. Strathman, S. Tantiyanugulchai, S. Malik, and A. El-Geneidy (2005). Multimodal ITS Data Integration and Performance Measurement in Portland, Oregon. TRB Annual Meeting CDROM, 2005.
53	Berwick, M. and Farooq, M. (2003). Truck Costing Model for Transportation Managers, Report MPC-03-152, Upper Great Plains Transportation Institute, North Dakota State University, August 2003

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54	Bester, N. L. (1996). Incorporating Energy Criteria in Intermodal Transportation Policy Decisions. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 83–86.
55	Bureau of Industry Economics (BIE). (1992). International Performance Indicators -- Road Freight, Research Report 46, Canberra, Australia, 1992.
56	Bingham, P. (2006). Freight Transportation "Megatrends" , Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm
57	Black, W. (2000). Social Change and Sustainable Transport (S C A S T), A Summary of Workshop and Conference Activities, Research Needs and Future Directions, National Science Foundation, 2000.
58	BLS. (2005a). Wages, Earnings, and Benefits, Bureau of Labor Statistics (BLS), www.bls.gov/wages.htm
59	BLS (2005b). Productivity, Bureau of Labor Statistics (BLS), www.bls.gov/bls/productivity.htm
60	Boardman, J. (2001). The Emerging Importance of Freight Data. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/boardman.pdf Accessed July 15, 2005.
61	Booz Allen & Hamilton, Inc. (2000a). North American International Trade Corridor, Comprehensive and Coordinated ITS/CVO Plan, Interim Report of the Corridor Baseline, Prepared for Missouri Department of Transportation, December, 2000.
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63	Booz Allen Hamilton, Inc. with ATA Foundation, TransCore, In Association With CTRE, Iowa State University, C.J. Petersen & Associates, Kentucky Transportation Center, University of Kentucky. (2001). North American International Trade Corridor, Development Plan, Comprehensive and Coordinated ITS/CVO Plan for the North American International Trade Corridor, Phase 3 Report, December, 2001.
64	Boske,L., A. Kantak and S. Spruiell. (2004). Identifying Gaps and Limitations in Data Sources by Mapping the Transportation Chain of International Trade Shipments at U.S. Ports, Report No. SWUTC/04/167241-1, Center for Transportation Research, University of Texas at Austin, TX, September, 2004.
65	Brander, J.R.G. and F. R. Wilson (2001). Regional Intermodal Freight Transport Flows and Projections. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 20–26.
66	Braslau, D. and Fruin, J. (1998). Northwest Minnesota Freight Flow Study : Freight Flow Estimation and Identification of Significant Corridors, Minnesota Department of Transportation, St. Paul, MN.

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67	Braver, E.R., Michael X. Cammisa, Adrian K. Lund, Nancy Early, Eric L. Mitter, And Michael R. Powell (1997). Incidence of Large Truck–Passenger Vehicle Underride Crashes in Fatal Accident Reporting System and National Accident Sampling System, in Transportation Research Record 1595, Journal of Transportation Research Board, TRB, Washington, DC, 1997, pp. 27 to 33.
68	Bremmer, D., K. C. Cotton, D. Cotey, C. E. Prestrud, G. Westby (2006). Measuring Congestion: Learning From Operational Data, paper to appear in Journal of Transportation Research Board, Washington, DC., 2006.
69	Brewster, R. (2005). Identifying Vulnerabilities and Security Management Practices in Agricultural & Food Commodity Transportation, Paper for Transportation Research Board Annual Meeting, January, 2005.
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71	Bronzini, M.S. (2006). New Data Sources, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm
72	BTS (1998). Transportation Statistics Beyond ISTEA: Critical Gaps and Strategic Responses. BTS98-A-01. U.S. Department of Transportation, Washington, D.C., 1998.
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78	BTS (2005d) National Transportation Atlas Database (NTAD), www.bts.gov/programs/geographic_information_services, 2005.
79	BTS. (2005e). National Transportation Statistics, www.bts.gov/publications/national_transportation_statistics, BTS, Washington, DC.
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82	C.J. Petersen & Associates, C.L. Bann & Associates, and Management Directions, Inc. (1997). Northwest Minnesota Freight Flow Study : Primary Data Collection Activities, Minnesota Department of Transportation, St. Paul, MN.

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REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
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86	Cambridge Systems, Inc. (2000). Statewide Multimodal Freight Flows Study, Executive Summary, Minnesota Department of Transportation, St. Paul, MN. April, 2000.
87	Cambridge Systematics, Inc. (2001). *Vermont Statewide Freight Study,* Final Report, prepared for the Vermont Department of Transportation, March 2001.
88	Cambridge Systematics, Inc.(2003a). *Best Practices in Statewide Freight Planning.* NCHRP 8-36(33), Final Report. TRB, National Research Council, Washington, D.C. October, 2003.
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92	Cambridge Systems, Inc. (2004c). Traffic Congestion and Reliability:Linking Solutions to Problems, Final Report, Federal Highway Administration, Washington, DC. July, 2004.
93	Cambridge Systematics, Inc. (2004d). Minnesota Statewide Feight Plan,Technical Memorandum 2, Systems Analysis, Final Technical Memorandum, Mn/DOT, July, 2004.
94	Cambridge Systematics, Inc with HDR, Inc. (2005b). *Oregon Transportation Plan Policy Analysis.* Oregon Department of Transportation, June, 2005.
95	Cambridge Systematics, Inc. et al. *(1995a). Intermodal Freight Transportation Volume 1--Overview of Impediments, Data Sources for Intermodal Transportation Planning, and Annotated Bibliography*. Report No. DOT-T-96-04, U.S. Department of Transportation, Washington, D.C., December 1995.

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387	TRB. (2004a). The Marine Transportation System and the Federal Role--Measuring Performance, Targeting Improvement. TRB Special Report 279, TRB, National Research Council, Washington, D.C.
388	Turnquist, M., A. Meyburg, and G. List (1993). Goods Movement: Regional Analysis and Database, Draft Final Report, University Transportation Research Centers Program, Region II, Cornell University, March 26, 1993.
389	Turnquist, M.A. (2006). Characteristics of Effective Freight Models, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm

Table A.1. Measurement source identifiers and description, continued

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
390	UMTRI (2005). Trucks Involved in Fatal Accidents (TIFA) – http://www.umtri.umich.edu/cnts/tifa.htm
391	UMVRDC (1986). Locational and Feasibility Study Containerized Shipment of Agricultural Products, Upper Minnesota Valley Regional Development Commission (UMVRDC), June, 1986.
392	UMVRC (1987). Freight Access Improvement Program, Upper Minnesota Valley Regional Development Commission (UMVRDC), September, 1987.
393	UMVRC (1988). Impacts of Commodities Shipments on Highway and Rail Systems, Upper Minnesota Valley Development Commission (UMVRDC), November, 1988.
394	U.S. Army Corps Engineers (2005a). Waterborne Commerce: Domestic, www.iwr.usace.army.mil/ndc, 2005
395	U.S. Army Corps Engineers (2005b). Waterborne Commerce: Foreign, www.iwr.usace.army.mil/ndc/usforeign
396	U.S. Army Corps Engineers (2005c). U.S. Ports and Waterway Facilities Database, www.iwr.usace.army.mil/ndc
397	U.S. Army Corps Engineers (2005d). Vessel Characteristics -- Waterborne Transportation Lines of the United States, www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm
398	U.S. Army Corps Engineers (2005e). Lock Performance Monitoring System (LPMS), www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm
399	USBOC (2005a). 2002 Vehicle Inventory and Use Survey (VIUS), www.census.gov/econ/www/viusmain.html, 2005
400	USBOC (2005b). U.S. Economic Census, U.S.Bureau of Census, www.census.gov/econ/census02
401	USBOC (2005c). U.S. Census County Business Patterns, www.census.gov/epcd/cbp
402	USBOC (2005d). U.S. Bureau of Census. Exports from Manufacturing Establishments.
403	USBOC (2005e). U.S. Bureau of Census. Motor Freight Transportation and Warehousing Survey.
404	USBOC (2005f). U.S. Bureau of Census. Annual Survey of Manufactures Publication.
405	USBOC (2005g) 2002 U.S. Imports/Exports of Merchandise on CD-ROM
406	USBOC (2005h). 2002 Commodity Flow Survey, U.S.Census Bureau,http://www.census.gov/econ/www/cfsmain.html 2002 data being processed
407	USDA (1998). Transportation of U.S. Grains—A Modal Share Analysis, 1978-95, United States Department of Agriculture, Washington, D.C., March, 1998.
408	USDA. (2000). A Framework Report for the National Agricultural Transportation Summit. www.ams.usda.gov/tmd/summit/intro.pdf; Accessed July 31, 2005.
409	USDA. (2005a). Shipping Costs for Agricultural Products. Presentation. U.S. Department of Agriculture, Transportation Services Branch, Agricultural Marketing Service.
410	USDA. (2005b). Fresh Fruit and Vegetable Arrival Totals for 23 Cities, U.S. Department of Agriculture, Washington, DC.

Table A.1. Measurement source identifiers and description, continued

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
411	USDA. (2005c). Grain Transportation, Agricultural Marketing Service, U.S. Department of Agriculture. http://www.ams.usda.gov/tmd/TSB/publications.htm#General%20Transportation%20Information
412	USDOC. (1997). 1993 Commodity Flow Survey Minnesota, 1992 Census of Transportation, Communications, and Utilities, TC92-CF-24, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.
413	USDOC.(2005) 2002Commodity Flow Survey (CFS), U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.
414	USDOE (2005a). Quarterly Coal Report, U.S. Department of Energy.
415	USDOE (2005b). Natural Gas Monthly, U.S. Department of Energy.
416	USDOE (2005c). Natural Gas Annual, U.S. Department of Energy.
417	USDOE (2005d). Petroleum Supply Monthly, U.S. Department of Energy.
418	USDOT (2000). NHS Intermodal Freight Connectors: A Report to Congress. U. S. Department of Transportation. 2000 http://www.ops.fhwa.dot.gov/freight/infrastr/nhs/index.htm Accessed July 10, 2005
419	USDOT. Freight and the Environment Charrette Proceedings Report, February, 2005. http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed September, 2005.
420	Vachal, K. and B. Baldwin (2001). Factors Affecting Rail Car Supply, Report MPC-01-121, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, North Dakota, 2001.
421	Vachal, K and J. Bitzan (2002). Long-Term Availability of Railroad Services for U.S. Agriculture. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 62-72.
422	Vachal, K.. H. Reichert, and T. Van Wechel (2004). U.S. Containerized Grain and Oilseed Exports Industry Survey. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp120-125
423	Vandersteel, W., Y. Zhao, and T.S. Lundgren (1997). Automating Movement of Freight. In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 71–76.
424	Victoria, I.C. and C. M. Walton (2004). Freight Data Needs at the Metropolitan Level and the Suitability of Intelligent Transportation Systems in Supplying MPOs with the Needed Freight Data, Report No. SWUTC/04/167247-1, Center for Transportation Research, University of Texas at Austin, TX, December, 2004.
425	Vilain, P., L. N. Liu, and D. Aimen (1999). Estimation of Commodity Inflows to a Substate Region. An Input-Output Based Approach. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 17–26.
426	Wallbaum, M. and C. Pils (2001). Security Considerations for the Parcel Call Real-Time Tracking and Tracing System. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp 138–144.

Table A.1. Measurement source identifiers and description, continued

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
427	Wargo, B. (2006). PierPASS & Operations as a Solution to Freight Congestion, FHWA Talking Freight Seminar, June 21, 2006.
428	Weinblatt, H. (1996). Using Seasonal and Day-of-Week Factoring to Improve Estimates of Truck Vehicle Miles Traveled. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 1–8.
429	Wilbur Smith Associates (2002). Virginia Statewide Traffic Model --Review of Available Data, Virginia Department of Transportation, May 22, 2002. http://www.wilbursmith.com/vdotmodel/attachments/082902/Review%20of%20Avail%20Data%20%28Draft%2005-22-02%29.pdf; Accessed July 18, 2005.
430	Wilbur Smith Associates (2003a). The National I-10 Freight Corridor Study-Summary of Findings, Strategies, and Solutions, Final Report, Texas Department of Transportation, 2003.
431	Wilbur Smith Associates (2003b). Louisiana Statewide Transportation Plan—Statewide Intermodal Freight Planning, Presentation at TRB Annual Meeting, January, 2005.
432	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006a). Minnesota Aviation System Plan -- Air Cargo, prepared for Minnesota Department of Transportation, 2006.
433	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006b). Minnesota Aviation System Plan, Executive Summary, prepared for Minnesota Department of Transportation, 2006.
434	Wittwer, E., T. Adams, T. Gordon, J. Gupta, K. Kawamura, P. Lindquist, M. Vonderembse, and S. McNeil (2005). Upper Midwest Freight Corridor Study, Midwest Regional University Transportation Center, University of Wisconsin-Madison, Madison, WI, March 31, 2005.
435	Wolfe, M (2002). Technology to Enhance Freight Transportation Security and Productivity, Appendix to: "Freight Transportation Security and Productivity", Report Prepared for: Office of Freight Management and Operations, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. 2002.
436	Zavattero, D.A., F.G. Rawling, and D.F. Rice (1998). Mainstreaming Intermodal Freight into the Metropolitan Transportation Planning Process. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 1–11.
437	Zemotel, LM and Montebello, DK.(2002). Interregional Corridors: Prioritizing And Managing Critical Connections Between Minnesota's Economic Centers. In Transportation Research Record 1817, TRB, Washington, DC, 2002, pp. 79-87.
438	Zhang, Y. and D. Wu (2003). Development of Trustworthy Intermodal Traffic Measurement. National Center for Intermodal Transportation. http://www.ie.msstate.edu/ncit/Research/ncitdec04/TrustworthyData.htm accessed August 29, 2005
439	Zhang, Y., R. O. Bowden, Jr., A. J. Allen (2003). *Intermodal Freight Transportation Planning Using Commodity Flow Data*. National Center for Intermodal Transportation. 2003.

Table A.1. Measurement source identifiers and description, continued

REF NO.	DESCRIPTION OF MEASUREMENT SOURCE
440	Zmud, S. (2005). Commodity Flow Survey: Improving Methods to Enhance Data Quality and Usefulness. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.
441	Zografos, K.G. and I.M. Giannouli (2002). Emerging Trends in Logistics and Their Impact on Freight Transportation Systems: A European Perspective. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 36-44.
442	Zografos, K.G. and Giannouli, I.G. (2003). Emerging Supply Chain Management Trends and Their Impact on Spatial Organization of Logistical Networks. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 30-39.
443	Zografos, K.G. and A.C. Regan. Current Challenges for Intermodal Freight Transport and Logistics in Europe and the United States. In Transportation Research Record 1873, TRB, National Research Council, Washington, D.C., 2003, pp. 70-78.

Appendix B. Classification of Measurement Sources

CLASSIFICATION OF MEASUREMENT SOURCES BY MODE AND MARKET

CODES:	
MODE	DESCRIPTOR
A	AIR
I	INTERMODAL (TOFC/COFC)
M	MULTIMODAL
P	PIPELINE
R	RAIL
T	TRUCK (MOTOR CARRIER)
W	WATERWAY AND PORTS

CODES:	
MARKET (LEVEL/SCALE/DECISION CONTEXT)/ MOVEMENTS	
MARKET	DESCRIPTOR
U	URBAN/METRO/LOCAL
R	REGIONAL/SUBSTATE
S	STATEWIDE
MS	MULTI-STATE
N	NATIONAL
MN	MULTI-NATIONAL
G	GLOBAL
I	INBOUND
O	OUTBOUND
T	THROUGH

Note: The numbers for measurement sources in Appendix B correspond to the Ref No. shown in Appendix A.

Table B.1. Classification of measurement sources by mode and market.

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
1	AAR. (2006a). Freight Commodity Statistics, American Association of Railroads, Washington, DC, http://www.aar.org/				x							x	x			x	x	x
2	AAR (2006b.) Railroad Equipment Report, http://www.aar.org/				x													
3	AAR (2006c). Weekly Carload (as reported to the AAR) , http://www.aar.org/				x								x	x		x	x	x
4	AAR (2006d).Terminal Dwell Time, http://www.aar.org/				x								x					
5	AAR (2006e). Weekly Cars online, http://www.aar.org/				x								x					
6	AAR (2006f). Train Speeds, http://www.aar.org/				x								x					
7	AAR (2006g). Freight Loss and Damage, http://www.aar.org/				x								x					
8	AAR (2006h). Railroad Facts, http://www.aar.org/				x						x		x					
9	AAR (2006i). Railroad Revenues, Expenses & Income, http://www.aar.org/				x								x					
10	AAR (2006j). Railroad Ten-Year Trends, http://www.aar.org/				x								x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
11	AAR (2006k). Railroads and States, http://www.aar.org/				x						x							
12	AAR. (2006l). North American Trucking Survey (NATS), Washington, DC	x			x	x	x	x					x	x		x	x	
13	AAR (2006m). Weekly Railroad Traffic, http://www.aar.org/				x								x					
14	AAR (2006n) Railroad Cost Indexes, http://www.aar.org/				x								x					
15	AAR (2006o). Railroad Cost Recovery Index (RCR), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCRDescription.pdf				x								x					
16	AAR (2006p). Rail Cost Adjustment Factor (RCAF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCAFHistory.pdf				x								x					
17	AAR (2006q). All-Inclusive Index Less Fuel (All-LF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/AllLF.pdf				x								x					
18	AAR (2006r). Index of Monthly Railroad Fuel Prices, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_MonthlyFuelPrices.pdf				x								x					
19	AAR (2006s). Analysis of Class I Railroads 2005 Data for 2005, http://www.aar.org/		x		x							x	x					
20	AAR (2006t). Railway Performance Measures, http://www.railroadpm.org/				x							x	x	x				

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
21	AAR (2006u). Railroad Class I Statistics, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Statistics.pdf		x		x								x					
22	AAR (2006v). Profiles of U.S. Railroads, http://www.aar.org/				x								x	x				
23	AAR (2006w). Rail Transportation of Chemicals, http://www.aar.org/				x								x					
24	AAR (2006x). Rail Transportation of Coal, http://www.aar.org/				x								x					
25	AAR (2006y). Rail Transportation of Grain, http://www.aar.org/				x													
26	Abbott,J. K.B. Manrodt., and P. Moore (2004). From Visibility to Action, Report on Trends and Issues in Logistics and Transportation, Oracle, Georgia Southern University and Capgemini,USA., 2004.	x	x		x		x						x			x	x	
27	Abkowitz, M. and E. Meyer. (1996).Technological Advancements in Hazardous Materials Evacuation Planning. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 116–121.						x											
28	Abkowitz, M.D., J.P. DeLorenzo, R. Duych, A. Greenberg, and T. McSweeney (2001). Assessing the Economic Effect of Incidents Involving Truck Transport of Hazardous Materials.In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 125–129.						x						x					
29	ACI-NA. (2006) Worldwide Airport Traffic Report, Airports Council International (ACI)- North America (NA), Washington, DC.	x											x	x	x	x	x	
30	Ammah-Tagoe, F. and Johnson, D. (2004). Understanding Potential Freight Bottlenecks in the United States: A Look at the GeoFreight Visual Display Tool, Paper presented at the 7th MTS Research and Technology Coordination Conference, Washington, D.C., November 16-18, 2004; http://trb.org/Conferences/MTS/4C%20Ammah-Tagoe%20Johnson%20paper.pdf; Accessed July 15, 2005.				x		x	x				x	x	x		x	x	x

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
31	Apffel, C., J. Jayawardana, A. Ashar, K. Horn, R. McLaughlin, and A. Hochstein (1996). Freight Components in Louisiana's Statewide Intermodal Transportation Plan. In *Transportation Research Record 1552, TRB, National Research Council, Washington, D.C., 1996, pp. 32-41*	x	x	x	x		x	x			x	x	x		x	x	x	x
32	ARDC (1983).North Shore Commodity Movement Study: final report / prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.		x	x	x		x	x		x						x	x	
33	ARDC (1985). Regional Goods Movement Study, Prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.	x	x	x	x	x	x	x		x						x	x	x
34	ARDC. (1999). Northeast Minnesota Freight Study, prepared by Arrowhead Regional Development Commission (ARDC), Duluth, MN.Paul, MN.	x	x	x	x	x	x	x		x						x	x	
35	ATA (2005). LTL Commodity and Market Flow Database, American Trucking Associations, Virginia.						x				x	x	x					
36	ATA (2006). Truckline Express, American Trucking Associations E-Newsletter, www.truckline.com	x	x		x		x	x					x					
37	ATRI (2005). Travel Time in Freight Significant Corridors. American Transportation Research Institute. www.atri-online.org; Accessed July 26, 2005.						x				x	x	x					
38	Jones, C., Murray, D. and Short, J. (2005) Methods of Travel Time Measurement in Freight-Significant Corridors. Prepared by American Transportation Research Institute. For Transportation Research Board Annual Meeting, January, 2005.						x				x	x	x					
39	Baatz, E. (2006). Pricing Trends – Pricing Across the Modes, Logistics Management, http://www.logisticsmgmt.com/October, 2006.	x	x		x		x	x					x					

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
42	Ballis, A. (2004a). Introducing Level-of-Service Standards for Intermodal Freight Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 79-88.		x										x					
43	Barber, D. and L. Grobar. (2001). Implementing A Statewide Goods Movement Strategy and Performance Measurement of Goods Movement in California, METRANS Transportation Center, California State University, Long Beach, June, 2001.		x				x	x	x	x		x	x		x			
44	Barkan, C.P.L., T. T. Treichel, and G.W. Widell (2000). Reducing Hazardous Materials Releases from Railroad Tank Car Safety Vents. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 27–34.				x								x					
45	Barnes, G. and P. Langworthy (2003). The Per-Mile Costs of Operating Automobiles And Trucks, Report No. MN/RC 2003-19, Minnesota Department of Transportation, St. Paul, MN, June, 2003.						x		x	x	x							
47	Barton, R.A. And John Morrall (1998)., Study of Long Combination Vehicles on Two-Lane Highways, in Transportation Research Record 1613, Journal of Transportation Research Board, TRB, Washington, DC, pp. 43 to 49, 1998.						x						x					
48	BEA. (1987). 1982 Benchmark Input-Output Accounts of the United States, Department of Commerce, Bureau of Census, Washington, DC.												x					
49	BEA. (2005). Regional Economic Accounts, www.bea.gov/bea/regional/data.htm												x					
50	Beier, F.J. (2002). The Feasibility of a Shipper Panel to Measure Transportation Services. Final Report. Minnesota Department of Transportation, December, 2002.	x	x	x	x		x	x	x	x	x					x	x	

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
51	Beilock, R. (2005).Transportation Factors Influencing the Competitiveness of Agricultural and Food Products, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.				x		x	x			x	x	x		x			
53	Berwick, M. and Farooq, M. (2003). Truck Costing Model for Transportation Managers, Report MPC-03-152, Upper Great Plains Transportation Institute, North Dakota State University, August 2003						x			x	x							
54	Bester, N. L. (1996). Incorporating Energy Criteria in Intermodal Transportation Policy Decisions. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 83–86.		x										x					
55	Bureau of Industry Economics (BIE). (1992). International Performance Indicators -- Road Freight, Research Report 46, Canberra, Australia, 1992.						x						x	x	x			
56	Bingham, P. (2006). Freight Transportation "Megatrends" , Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm	x			x		x	x					x	x	x			
60	Boardman, J. (2001). The Emerging Importance of Freight Data. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/boardman.pdf Accessed July 15, 2005.						x				x			x		x	x	

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
61	Booz Allen & Hamilton, Inc. (2000a). North American International Trade Corridor, Comprehensive and Coordinated ITS/CVO Plan, Interim Report of the Corridor Baseline, Prepared for Missouri Department of Transportation, December, 2000.						x					x	x	x				
63	Booz Allen Hamilton, Inc. with ATA Foundation, TransCore, In Association With CTRE, Iowa State University, C.J. Petersen & Associates, Kentucky Transportation Center, University of Kentucky. (2001). North American International Trade Corridor, Development Plan, Comprehensive and Coordinated ITS/CVO Plan for the North American International Trade Corridor, Phase 3 Report, December, 2001.						x					x	x	x				
64	Boske,L., A. Kantak and S. Spruiell. (2004). Identifying Gaps and Limitations in Data Sources by Mapping the Transportation Chain of International Trade Shipments at U.S. Ports, Report No. SWUTC/04/167241-1, Center for Transportation Research, University of Texas at Austin, TX, September, 2004.							x			x	x	x	x	x			
65	Brander, J.R.G. and F. R. Wilson (2001). Regional Intermodal Freight Transport Flows and Projections. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 20–26.		x		x		x						x	x				
66	Braslau, D. and Fruin, J. (1998). Northwest Minnesota Freight Flow Study : Freight Flow Estimation and Identification of Significant Corridors, Minnesota Department of Transportation, St. Paul, MN.	x	x		x		x	x		x						x	x	x
67	Braver, E.R., Michael X. Cammisa, Adrian K. Lund, Nancy Early, Eric L. Mitter, And Michael R. Powell (1997). Incidence of Large Truck–Passenger Vehicle Underride Crashes in Fatal Accident Reporting System and National Accident Sampling System, in Transportation Research Record 1595, Journal of Transportation Research Board, TRB, Washington, DC, 1997, pp. 27 to 33.						x						x					
68	Bremmer, D., K. C. Cotton, D. Cotey, C. E. Prestrud, G. Westby (2006). Measuring Congestion: Learning From Operational Data, paper to appear in Journal of Transportation Research Board, Washington, DC.						x		x									
69	Brewster, R. (2005). Identifying Vulnerabilities and Security Management Practices in Agricultural & Food Commodity Transportation, Paper for Transportation Research Board Annual Meeting, January, 2005.				x		x	x			x		x	x	x			
70	Brogan, J.J., S.C. Brich, and M.J. Demetsky (2002). Identification and Forecasting of Key Commodities for Virginia. In *Transportation Research Record 1790*, TRB, Washington, D.C., pp. 73-79				x		x				x					x	x	

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
71	Bronzini, M.S. (2006). New Data Sources, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm	x	x		x		x	x			x	x	x	x	x			
73	BTS (1999). 1997 Commodity Flow Survey Minnesota, 1997 Economic Census Transportation. U.S. Department of Transportation, Bureau of Transportation Statistics, December, 1999.	x			x		x	x			x		x					
74	BTS (2002). Maritime Trade and Transportation, Bureau of Transportation Statistics, Washington, D.C. 2002.							x					x					
75	BTS (2005a). Expenses per Mile for the Motor Carrier Industry: 1990 through 2000 and Forecasts through 2005. ops.fhwa.dot.gov/freight/documents/bts.pdf; Accessed October 26, 2005.						x						x					
76	BTS (2005b). Transborder Surface Freight Data, www.bts.gov/transborder, 2005		x		x		x						x	x				
77	BTS (2005c). Air Traffic Statistics, www.bts.gov/programs/airline_information, 2005	x							x		x		x	x	x	x	x	
78	BTS (2005d) National Transportation Atlas Database (NTAD), www.bts.gov/programs/geographic_information_services, 2005.	x	x		x	x	x	x			x		x					
79	BTS. (2005e). National Transportation Statistics, www.bts.gov/publications/national_transportation_statistics, BTS, Washington, DC.	x	x		x	x	x	x					x					
80	Buschena, D.E., J. Fruin, and D.W. Halbach (1988). Minnesota Grain Movements 1985, Staff Paper P88-25. Department of Agriculture and Applied Economics, University of Minnesota, August, 1988.		x		x		x	x	x	x	x	x	x	x	x			

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
81	C.J. Olson Market Research, Inc. (1995). Quantitative Research Regarding Performance Measures for Intermodal Freight Transportation, Executive Summary, The Minnesota Department of Transportation, St. Paul, MN, October, 1995.	x	x		x		x	x	x	x	x					x	x	
82	C.J. Petersen & Associates, C.L. Bann & Associates, and Management Directions, Inc. (1997). Northwest Minnesota Freight Flow Study : Primary Data Collection Activities, Minnesota Department of Transportation, St. Paul, MN.	x	x	x	x	x	x	x		x						x	x	
84	Cambridge Systematics, Inc. (1993). *Characteristics and Changes in Freight Transportation Demand.* National Cooperative Highway Research Program (NCHRP) Report 388, 1993.	x	x	x	x	x	x	x					x					
86	Cambridge Systems, Inc. (2000). Statewide Multimodal Freight Flows Study, Executive Summary, Minnesota Department of Transportation, St. Paul, MN. April, 2000.	x			x		x	x			x					x	x	x
87	Cambridge Systematics, Inc. (2001). *Vermont Statewide Freight Study,* Final Report, prepared for the Vermont Department of Transportation, March 2001.										x					x	x	x
88	Cambridge Systematics, Inc.(2003a). *Best Practices in Statewide Freight Planning.* NCHRP 8-36(33), Final Report. TRB, National Research Council, Washington, D.C. October, 2003.	x	x	x	x	x	x	x			x							
89	Cambridge Systematics, Inc. (2003b). *Intermodal Freight Connectors: Strategies for Improvement*, NCHRP Project 8-36, Task 30, Final Report, August, 2003.		x										x					
90	Cambridge Systematics, Inc. (2004a). *Development of a Multimodal Tradeoffs Methodology for Use in Statewide Transportation Planning.* NCHRP 8-36(7), Final Report. TRB, National Research Council, Washington, D.C. October, 2004.										x		x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
91	Cambridge Systematics, Inc. (2004b). Accounting for Commercial Vehicles in Urban Transportation Models. 2004. http://tmip.fhwa.dot.gov/clearinghouse/docs/accounting/ Accessed July 12, 2005						x		x				x					
92	Cambridge Systems, Inc. (2004c). Traffic Congestion and Reliability: Linking Solutions to Problems, Final Report, Federal Highway Administration, Washington, DC. July, 2004.						x						x					
93	Cambridge Systematics, Inc. (2004d). Minnesota Statewide Feight Plan,Technical Memorandum 2, Systems Analysis, Final Technical Memorandum, Mn/DOT, July, 2004.	x	x		x	x	x	x			x							
95	Cambridge Systematics, Inc. et al. *(1995a). Intermodal Freight Transportation Volume 1--Overview of Impediments, Data Sources for Intermodal Transportation Planning, and Annotated Bibliography*. Report No. DOT-T-96-04, U.S. Department of Transportation, Washington, D.C., December 1995.	x	x		x		x	x					x					
96	Cambridge Systematics, Inc. et al. (1996). *Quick Response Freight Manual*. Report No. DOT-T-97-10, U.S. Department of Transportation, Washington, D.C., September 1996.						x		x				x					
97	Cambridge Systematics, Inc. with Reebie Associates, Inc. (2002). Freight Impacts on Ohio's Roadways, The Ohio Department of Transportation, Final Report, June, 2002.				x		x				x							
98	Cambridge Systematics, Inc. with Reebie Associates, H. Cohen, A. Horowitz, R. Pendyala (2005a). *Forecasting Statewide Freight Toolkit*. NCHRP 8-43 Final Report. TRB, National Research Council, Washington, D.C., 2005	x	x		x		x	x					x					
99	Cambridge Systematics, Inc with URS Corporation (2005c). MnPASS System Study, Final Report, prepared for Minnesota Department of Transportation, April 7, 2005.						x				x	x						

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
101	Cambridge Systematics, Inc. , SRF Consulting Group and H. Cohen (2006b). Minnesota Truck Size and Weight Project, prepared for Minnesota Department of Transportation, June, 2006.				x		x			x	x							
102	Campbell, C., D. Braslau, C. Petersen, J. Levine (1995). Minnesota Freight Flows – 1990, Report MN/RC – 95/14, Minnesota Department of Transportation, St. Paul, MN, February, 1995.	x			x		x	x			x					x	x	x
103	Carey, J. and J. Semmens (2005). Measurement Tools for Assessing Motor Vehicle Division Port-of-Entry Performance. Forthcoming In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005						x						x	x				
104	Casgar, T. (2001). The National Perspective. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/casgar.pdf Accessed July 15, 2005.												x					
105	CBM (2005a). The Journal of Commerce Online, Commonwealth Business Media, (www.joc.com)	x	x		x		x	x	x	x	x		x	x	x			
106	CBM (2005b). Port Import/Export Reporting Service (PIERS), Commonwealth Business Media, www.piers.com.							x	x				x	x	x	x	x	
107	CBM (2005c). Traffic World (www.trafficworld.com)	x	x		x		x	x	x	x	x		x	x	x			
108	CBO (2006). Freight Rail Transportation: Long Term Issues, A Congressional Budget Office Paper, January, 2006.				x								x					
109	CH2M Hill (2005). Minnesota Statewide Heavy Vehicle Safety Plan, prepared for the Minnesota Departments of Transportation and Public Safety, June, 2005.						x			x	x							
110	Cheng, Y., W. Lin. (2005). Comparison of Methods for Allocating Costs of Empty Railcar Movements in a Railcar Pooling System. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005				x								x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
111	Clark, M.L., E. L. Jessup, and K. Casavant.(2003). Dynamics of Wheat and Barley Shipments on Haul Roads to and from Grain Warehouses in Washington State, Strategic Freight Transportation Analysis Report #5, Washington State University, Pullman, WA, September, 2003.						x			x	x							
112	CTS (2000). Fourth Annual Symposium on the Impacts of Logistics on the Upper Midwest Economy, September 11, 2000, Bloomington, Minnesota, Summary Report, Center for Transportation Studies, 2000.	x	x		x		x	x	x	x	x							
113	CTS (2001). Fifth Annual Freight and Logistics Symposium,December 7, 2001, Minneapolis, Minnesota, Summary Report, Center for Transportation Studies, 2001.	x	x		x		x	x	x	x	x							
114	CTS (2002). Sixth Annual Freight and Logistics Symposium,December 6, 2002, St. Paul, Minnesota, Summary Report, Center for Transportation Studies, 2002.	x	x		x		x	x	x	x	x							
115	CTS. Seventh Annual Freight and Logistics Symposium,December 5, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2003.	x	x		x		x	x	x	x	x							
116	CTS (2004). Eighth Annual Freight and Logistics Symposium,December 3, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2004.	x	x		x		x	x	x	x	x							
117	CTS (2005). Ninth Annual Freight and Logistics Symposium--Freight Mobility:Economic Impacts on the Upper Midwest,December 2, 2005, Minnesota, Summary Report, Center for Transportation Studies, 2005.	x	x		x		x	x	x	x	x							
118	Curlee, R. (2006). Freight Demand Modeling: State of the Practice within Federal Agencies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm	x			x		x	x					x					
119	Czerniak, R. and S. Gaiser (1997a). Proceedings of Conference One National Freight Planning Applications Conference held in San Antonio, Texas, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.	x	x		x		x	x					x					
120	Czerniak, R. and S. Gaiser (1997b). Proceedings of Conference Two Urban Goods And Freight Forecasting Conference held in San Antonio, Texas, Part 2, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.						x		x				x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
121	Czerniak, R., S. Gaiser, D. Gerard. (1996). The Use of Intermodal Performance Measures by State Departments of Transportation, Final Report, Federal Highway Administration, Washington DC, June 1996.	x	x		x		x	x			x		x					
122	Dennis, S. M. (2001). Freight Transportation Rates -- A Multimodal Approach, Bureau of Transportation Statistics, 2001.	x	x		x		x	x					x					
123	Dow Jones Transportation Average (DJTA) (2006), http://www.marketwatch.com/tools/marketsummary/indices/	x			x		x	x					x					
125	Donath, M., D. Murray, and J. Short, J. (2005). Homeland Security and the Trucking Industry, Final Report., Report prepared for International Truck & Engine Corporation and published by Intelligent Transportation Systems Institute Center for Transportation Studies, University of Minnesota, Minneapolis, MN, July, 2005.						x						x					
126	Drucker, K. (2005). China - U.S. Transportation Data & Information Exchange, Presentation at Transportation Research Board 84th Annual Meeting, Washington, D.C., January, 2005.	x						x					x		x			
127	Duluth Port Authority (2006). Marine Tonnage Reports, http://www.duluthport.com/seawaytonnagestats.html				x		x	x	x									
128	Duych, R.J. (2005). Scope and Industry Coverage of the 2007 Commodity Flow Survey. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.	x			x		x	x					x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
131	EIA (2006a). Oil Pipeline Data, www.eia.doe.gov/neic/a-z/petroleuma-z.htm#p					x			x	x	x		x					
132	EIA (2006b). Capacity and Service on the Interstate Natural Gas Pipeline System Publication					x							x					
133	Eisele, W.L. and L.R. Rilett (2002). Examining Information Needs for Efficient Motor Carrier Transportation by Investigating Travel Time Characteristics and Logistics, Report No. SWUTC/01/473700-00005-1, Center for Transportation Research, University of Texas at Austin, TX, August, 2002.						x						x					
134	E.J.B. Associates (2005). Transportation Perspective 2005, June, 2005 http://www.remassoc.com/Portals/0/Transportation%20Perspective%202005.pdf; Accessed July 26, 2005.						x						x					
135	Eldridge, C. and J. Fruin (1984). The Transportation of Minnesota Forest Products, Staff Paper P85-17. Department of Agriculture and Applied Economics, University of Minnesota, December 1984.				x		x			x	x							
136	Elias, B. (2003). *Air Cargo Security*, CRS Report for Congress, September 11, 2003.	x											x					
137	Elliott, H.R. and R.T. Mitchell. (2002). Development of a Nonaccident-Release. Risk Index. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 52-65.				x		x						x					
139	Erlbaum, N. and Holguín-Veras, J. (2005). *Some Suggestions For Improving CFS Data Products. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.*	x			x		x	x					x					
140	eyefortransport (2006). eyefortransport Daily Newsletter, www.eyefortransport.com	x	x		x		x	x	x	x			x	x	x	x	x	

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
141	FAA. (2005a). U.S. Air Carrier Traffic and Capacity Data by Nonstop Segment and On-Flight Market (Form 41 Schedule T-100), Washington,DC.	x							x	x	x		x					
142	FAA. (2005b). Airport Activity Statistics of Certificated Route Air Carriers, Washington, DC.	x							x	x	x		x					
143	Fallat, G., K. Opie, J. Curley, J. Rowinski, R. Liu. (2003). Freight Planning Support System – Final Summary Report. National Center for Transportation and Industrial Productivity, New Jersey Institute of Technology, Newark, NJ. July, 2003. http://transportation.njit.edu/nctip/final_report/FreightPlanning.pdf Accessed July 12, 2005.	x	x		x		x	x			x							
144	Fekpe, E.S.K. (1996) Computerized Heavy-Vehicle Size and Weight Regulations Data Base. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 77–82.						x						x					
147	FHWA (1997). Highway Cost Allocation Study, Final Report, August, 1997.				x		x						x					
148	FHWA. (1998). U.S. Freight Economy in Motion, Federal Highway Administration, Washington, DC. 1998.	x			x		x						x					
149	FHWA (2000). National Freight Transportation Workshop Proceedings. September, 2000. http://ops.fhwa.dot.gov/freight/documents/workshop_all.pdf; Accessed, August 5, 2005.	x	x		x		x	x					x					
150	FHWA (2001a). Review of Environmental Factors Affecting Intermodal Freight Transportation Facility Development and Expansion. Office of Freight Management and Operations, Federal Highway Administration, Washington, D.C. January 2001; http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed, August 5, 2005.		x		x		x	x					x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
151	FHWA (2001b). Vehicle Travel Information System (VTRIS), http://www.fhwa.dot.gov/ohim/ohimvtis.htm						x				x		x					
152	FHWA. (2005a). Freight Facts and Figures. Www.ops.fhwa.dot.gov/freight	x	x		x		x	x			x		x					
153	FHWA (2005b). Monthly Traffic Volume Trends (TVT), FHWA, Washington, DC; http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm						x						x					
154	FHWA (2005c). Vehicle Classification and Vehicle Miles Travelled (VCVMT) Database						x						x					
155	FHWA (2005d). Freight Analysis Framework (FAF) Commodity Flow Database, 2002, http://ops.fhwa.dot.gov/freight/freight_analysis/faf	x	x		x		x	x			x	x	x	x	x	x	x	x
156	FHWA (2005e). Highway Performance Monitoring System (HPMS), www.fhwa.dot.gov/policy/ohpi/hpms						x				x		x					
157	FHWA (2005f). National Planning Highway Network (NHPN), http://www.fhwa.dot.gov/planning/nhpn						x						x					
158	FHWA (2005g). FAF Highway Capacity Database, www.ops.fhwa.dot.gov/freight/freight_analysis/faf						x						x					
159	FHWA (2005h). Long Term Pavement Performance (LTPP) – http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=260						x						x					
160	FHWA (2005i). Highway Statistics,www.fhwa.dot.gov/policy/ohim/hs02/mv.htm						x						x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
161	Figliozzi, M. A., R. Harrison, and J.P. McCray (2001). Estimating Texas-Mexico North American Free Trade Agreement Truck Volumes. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 42–47.						x						x	x				
162	FMCSA (2005c). Commerical Vehicle Safety Data, www.fmcsa.dot.gov/factsfigs/dashome.htm						x						x					
163	FMSCA (2005a). Large Truck Crash Facts - http://ai.fmcsa.dot.gov/CrashProfile/National_Profiles/Introduction.htm						x				x		x					
164	FMCSA (2005b). Motor Carrier Management Information System (MCMIS) Crash File. http://mcmiscatalog.fmcsa.dot.gov/beta/Catalogs&Documentation/						x						x					
165	FRA (1978). Rail Planning Manual, Volume II—Guide for Planners, Federal Railroad Administration, Washington, D.C., July, 1978.				x								x					
166	FRA (2005a). Railroad-Highway Crossings, http://gis.fra.dot.gov				x						x		x					
167	FRA (2005b). FRA National Planning Network, FRA, Washington, DC.				x						x		x					
168	FRA (2005c). Grade Crossing Inventory System (GCIS)				x						x		x					
169	Francis, G, Fry, J, and Humphreys, I. (2002). International Survey Of Performance Measurement In Airports. In Transportation Research Record 1788, TRB, Washington, DC, 2002, pp. 101-106.	x													x			
170	Fruin, J. and R. Crnkovich. (1978). Western Coal Transportation Rates for Minnesota Users, Staff Paper P78-3. Department of Agriculture and Applied Economics, University of Minnesota, 1978.				x					x	x							

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
171	Fruin, J., (1989). U.S. Corn Movements, 1985 - A Preliminary Report of Data, Staff Paper P89-24. Department of Agriculture Economics, University of Minnesota, Juy, 1989.				x		x	x		x	x		x		x			
172	Fruin, J. and D.E. Halbach (1994). An Analysis of Canadian Rail Movements to the United States Using the 1992 Public Use Waybill Sample,Staff Paper P94-5. Department of Agriculture Economics, University of Minnesota, March, 1994.				x								x	x		x		
173	Fruin, J. and D.G. Tiffany (2002). Where Does Minnesota's Grain Crop Go? An Analysis of Minnesota's Elevator Grain Shipments for the Period, 7/99 - 6/00, Report No. MN/RC 2002-12, Minnesota Department of Transportation, St. Paul, MN, 2002.				x		x	x		x	x				x			
174	Fruin, J. (1995). The Importance of Barge Transportation to America's Agriculture, Staff Paper P95-4. Department of Agriculture Economics, University of Minnesota, 1995.							x			x		x		x			
175	Fruin, J. and K. Fortowsky (2004). Modal Shifts from the Mississippi River & Duluth/Superior to Land Transportation, Report No. MN/RC-2004-28, Minnesota Department of Transportation, St. Paul, MN, 2004.				x		x	x		x	x							
176	FTR Associates (2003). The Rails Ahead, U.S. Freight Outlook for the Rail Industry Published Monthly, Freight Transportation Research (FTR) Associates Inc., Nashville, IN 47448, www.ftrassociates.net, June 2003.				x								x					
177	Gannon, C. and Z. Shalizi. The Use of Sectoral and Project Performance Indicators In Bank-Financed Transport Operations. Report TWU 21, Environmentally Sustainable Development, Transportation, Water & Urban Development Department, The World Bank, Washington, D.C. April 1995.	x			x		x	x							x			
180	Gihring, CK and Greene, W. (2000). Washington State Ferries: Performance Measures And Information Support. In Transportation Research Record 1704, TRB, Washington, DC, 2000, pp. 93-99.							x			x							

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
181	Global Insight, Inc. (2005a). Perspectives, weekly e-Newsletter, http://www.globalinsight.com/	x	x		x	x	x	x			x	x	x	x	x			
182	Global Insight, Inc. Port Tracker A Monthly Logistics and Intermodal Outlook, http://www.globalinsight.com/		x										x	x	x			
183	Global Insight, Inc. (2005b). Intermodal Freight Flow Database, http://www.globalinsight.com/		x										x	x	x			
184	Global Insight, Inc. (2005c). FREIGHT LOCATOR™ , http://www.globalinsight.com/	x	x		x	x	x	x					x	x	x			
185	Global Insight, Inc. (2005e). TRANSEARCH® INSIGHT, http://www.globalinsight.com/	x	x		x	x	x	x					x	x	x			
186	Global Insight, Inc. (2005f) Global Trade and Transportation GLOBALINSIGHT, http://www.globalinsight.com/												x		x			
187	Gordon, P. and Q. Pan (2001). Assembling and Processing Freight Shipment Data: Developing a GIS-Based Origin-Destination Matrix for Southern California Freight Flows, METRANS Transportation Center, University of Southern California, Los Angeles, California, June 30, 2001.				x		x			x								

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
191	Halbach, D. and J. Fruin (1985). Upper Mississippi River Barge and Towing Industry Fuel Use Analysis, Staff Paper P85-14. Department of Agriculture and Applied Economics, University of Minnesota.							x		x	x							
192	Halbach, D., J. Fruin, and S. Wulf. 1984 Barge Rates for Upper Mississippi River Commodities, Staff Paper P85-13. Department of Agriculture and Applied Economics, University of Minnesota, April, 1985.							x		x	x							
193	Halbach, D. and J. Fruin, Use of the 1992 ICC Public Use Waybill Sample to analyze Corn Movements by Rail, Staff Paper P94-6. Department of Agriculture and Applied Economics, University of Minnesota, March, 1994.				x					x	x							
196	Han, L.D., S. Chin, O. Franzese, and H. Hwang (2005). Estimation of Traffic Impacts Due to Pickup and Delivery Related Illegal Parking Activities. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005						x		x									
197	Harper, D.V. ad P.T. Evers (1991). An Analysis of Intermodal Railroad-Truck Freight Transportation Facilities and Services in Minnesota, Department of Marketing and Logistics Management, University of Minnesota, December, 1991.		x						x	x	x							
198	Holguín-Veras, J. and E. Thorson (2000). Trip Length Distributions in Commodity-Based and Trip-Based Freight Demand Modeling Investigation of Relationships. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 37–48.						x		x									
199	Holguín-Veras, J. and E. Thorson (2003). Practical Implications of Modeling Commercial Vehicle Empty Trips. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 87-94.						x						x	x				
200	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001a). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.	x			x		x	x	x	x								

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
201	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001b). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix I: Literature Review, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.		x		x		x			x								
202	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001c). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix II: Compendium of Freight Data Sources, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.		x		x		x			x								
203	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001d). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.		x		x		x			x								
204	Holguín-Veras, J., Y. López-Genao, and A. Salam (2002). Truck-Trip Generation at Container Terminals Results from a Nationwide Survey. In *Transportation Research Record 1790*, TRB, pp. 89-96.						x						x					
205	Holguín-Veras, J., E. Thorson, and K. Ozbay (2004). Preliminary Results of Experimental Economics Application to Urban Goods Modeling Research. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 9-16.						x		x									
206	Holguin-Veras, J., J. Polimeni, B. Cruz, N. Xu, G. List, J. Nordstrom, and J. Haddock (2005). Off-Peak Freight Deliveries: Challenges and Stakeholders Perceptions. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005						x		x									
207	Horowitz, J.L. and Plewes, T. (2005). Measuring International Trade on U.S. Highways. Committee on National Statistics, Division of Behavioral and Social Sciences and Education, National Research Council, Washington, D.C. 2005.	x			x			x					x	x	x			
209	Hunt, J.D. (2006a). Calgary Tour-Based Microsimulation of Urban Commercial Vehicle Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm						x		x									
210	Hunt, J.D. (2006b). Oregon Generation 1 Land Use Transport Economic Model Treatment of Commercial Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006.						x		x									

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
211	Huynh, N.N. and C.M. Walton (2005). Methodologies for Reducing Truck Turn Time at Marine Container Terminals, Report No. SWUTC/05/167830-1, Center for Transportation Research, The University of Texas at Austin, TX, May, 2005.		x				x	x	x	x								
212	Huynh, N., C.M. Walton, and J. Davis (2004). Finding the Number of Yard Cranes Needed to Achieve Desired Truck Turn Time at Marine Container Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 99-108.		x				x	x	x	x								
213	Hwang, H. and T. R. Curlee (2005). FAF Commodity Classification: STCC or SCTG?, Oak Ridge National Laboratory, February, 2005.	x	x		x		x	x			x	x	x	x	x			
214	IANA (2006a). Intermodal Market Trends & Statistics, a Quarterly Analysis of Industry Activities, Intermodal Association of North America (IANA), http://www.intermodal.org/		x		x		x						x					
215	IANA (2006b). Intermodal Market Trends & Statistics—Equipment Type, Size and Ownership Monthly Data File, Intermodal Association of North America (IANA), http://www.intermodal.org/		x		x		x						x					
216	IANA (2006c). Intermodal Market Trends & Statistics, A Five-Year Data File of Industry Activity, Intermodal Association of North America (IANA)http://www.intermodal.org/		x		x		x						x					
217	ICF Consulting (2001). North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies, prepared for the North American Commission for Environmental Cooperation, February 21, 2001.													x				

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
222	ITE (2003). Trip Generation Handbook, 7th Edition, Institute of Transportation Engineers (ITE), Virginia, D3142003.						x		x									
225	Jessup, E., K.L. Casavant, C.T. Lawson (2004). *Truck Trip Data Collection Methods: Final Report.* SPR 343. Oregon Department of Transportation, Salem OR, 2004. http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/TruckTripData.pdf Accessed July 15, 2005.						x		x									
226	Jessup, E. and R. Herrington (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products:Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005						x			x	x		x					
227	Johnson, S. and J. Sedor (2004). Reliability: Critical to Freight Transportation. Public Roads, November/December 2004 · Vol. 68 · No. 3.						x						x					
228	Jones, C. (2005). Measuring Travel Time in Freight-Significant Corridors, FHWA, April, 2005.						x						x					
229	Kale, S.R. (2002). *Intermodal and Multimodal Freight Policy, Planning, and Programmingat State Departments of Transportation in the Decade Since ISTEA*, TRB Annual Meeting CDROM, November, 2002		x	x							x		x					
230	Kapros, S., K. Panou, D. A. Tsamboulas, K. Seraphim (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products:Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005						x						x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
231	KRAMER aerotek, Inc., Ricondo & Associates, Inc., and SHE,Inc. Tier 2 Air Service Study --Minnesota in Partnership with Wisconsin, Technical Report, Office of Aeronautics, Minnesota Department of Transportation, June, 2003.	x							x	x		x						
232	Kritzky, B. (2004). Updating Speed Performance Measures of Minnesota's Interregional Corridor System, Presentation at GIS-T 2004 Symposium, 2004.						x		x	x								
234	LaFrance-Linden, D., S. Watson, and M. J. Haines (2001).Threat Assessment of Hazardous Materials Transportation in Aircraft Cargo Compartments. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 130–137.	x											x					
236	Lambert, B. (1997). Critical Issues Facing Freight Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/lambert.pdf Accessed July 15, 2005.				x		x	x					x					
237	Lambert, D. (2004). 2004 Minnesota's Lake Superior Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. 2004.				x			x	x	x	x							
238	Lambert, B. (2005a). *Shipment Characteristics in the Commodity Flow Survey - Can One Describe An Elephant?* Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.	x			x		x	x					x					
239	Lambert, B. (2005b). Developing Freight Performance Measures Using Travel Time Estimates, Presentation, FHWA Office of Freight Management and Operations, USDOThttp://www.ops.fhwa.dot.gov/freight; Accessed July 15, 2005.						x						x					
240	Lambert, D. (2005c). Minnesota's River Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. March, 2005.							x	x	x	x							

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
244	Lawson, C.T., Strathman, J.G. and Anne-Elizabeth Riis, A. (2002). Survey Methods For Assessing Freight Industry Opinions, Final Report, Prepared for Oregon Department of Transportation, Salem OR, March 2002.												x					
245	Leachman, R. (2006). Port and Modal Elasticity Studies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm				x		x	x					x					
246	Levans, M., K.B. Manrodt, and M. Holcomb (2006). Masters of Logistics: 15th Annual Study of Trends and Issues, Presentation/Webcast by Reed Business Information, Supply Chain Group, Logistics Management, October 25, 2006.	x	x		x		x						x					
247	Levinson, D., M. Marasteanu, V. Voller, I. Margineau, B. Smalkoski, M. Hashami, N. Li, M. Corbett, and E. Lukanen (2005). Cost/Benefit Study: Spring Load Restrictions, Final Report, Report No. MN/RC 2005-15, Minnesota Department of Transportation, St. Paul, MN, March, 2005.						x			x								
248	Lin, C. (2004). Load Planning with Uncertain Demands for Time-Definite Freight Common Carriers. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 17-24.						x		x									
249	Lin, I.I., H. S. Mahmassani, P. Jaillet, and C. M. Walton (2002). Electronic Marketplaces for Transportation Services Shipper Considerations. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 1-9.												x					
250	Lipinski, M. E. and D. B. Clarke (1996). Resolution of Land Use and Port Access Conflicts at Inland Waterway Ports. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 102–107.							x	x									

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
251	Lofgren, M. An Overview of State & Provincial Truck Regulations and Permitting - Commonalities and Differences, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.						x				x	x						
252	Lofgren, M. and M. Berwick. Evaluation of Strategic Logistics of Rural Firms, Report # MPC-05-177, Upper Great Plains Transportation Institute: North Dakota State University, Fargo, October 2005.						x			x								
253	Loughlin, M.J. and J.S. Adams (1998). Overseas Air Cargo Service, Airborne Export-Producing Industries, and U.S. Cities, 1980-1995, Report No. MN/RC-1998/13, Center for Transportation Studies, University of Minnesota, 1998.	x							x				x					
254	Luskin, D.M., R. Harrison, C. M. Walton, Z. Zhang, and J. L. Jamieson, Jr. (2002). Divisible-Load Permits for Overweight Trucks on Texas Highways: An Evaluation. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 104-109.						x				x							
256	Akshay Mani, A. and J. Prozzi (2004). *State-Of-The-Practice In Freight Data: A Review Of Available Freight Data In The U.S.* Report No. 0-4713-P2, Center for Transportation Research, The University of Texas at Austin, Austin, Texas. February 2004.	x	x		x		x	x					x					
257	Maritime Administration (2006). Port Facilities Inventory, Maritime Administration, Washington, DC.							x					x					
258	Matheny-Katz, M. Barge and Towboat Operating Costs. Presentation. Institute of Water Resources. U.S. Army Corps of Engineers, September, 2002.							x		x	x							
259	Maze, T.H. Dennis Kroeger, and Mark Berndt (WSA) (2005). Trucks and Twin Cities Traffic Management, Report No. MN/RC-2005-21, Minnesota Department of Transportation, 2005.						x		x									
260	McCray, J.P. (1998). North American Free Trade Agreement Truck Highway Corridors U.S.-Mexican Truck Rivers of Trade. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 71–78.						x					x	x	x				

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
261	McCray, J.P. and R. Harrison (1999). North American Free Trade Agreement Trucks on U.S. Highway Corridors. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 79–85.						x					x	x	x				
262	McCullough, G.J.(2003). Trucking Efficiency Versus Transportation Efficiency: An Economic Evaluation of TRB Special Report 267. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 24-29.						x						x					
263	McVey, M.J. and Baumel, C.P. and Hurburgh, C.R (1996). Efficient Distribution of Grain to Meet the Quality Needs of End-Users. Iowa State University, September, 1996.						x				x							
264	Memmott, F.W. (1983). Application of Statewide Freight Demand Forecasting Techniques, NCHRP Report 260, TRB, Washington, D.C., 1983.	x	x		x		x	x					x					
265	Meyburg, A. and J.R. and Mbwana (2002). *Data Needs in the Changing World of Logistics and Freight Transportation.* Conference Synthesis. 2002 http://www.dot.state.ny.us/ttss/conference/synthesis.pdf Accessed July 15, 2005.	x	x		x		x	x			x		x					
268	Mn/DOT (1986). Minnesota Freight Access Improvement Program: A Discussion Paper, Minnesota Department of Transportation, St. Paul, MN.		x		x		x		x	x								
269	Mn/DOT (1989). Great Lakes Transportation in Minnesota, Prepared by Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN.																	
270	MNDOT (1991). Environmental Impacts of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, January 1991.				x		x	x	x	x	x							

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
271	MNDOT (1995a). Need for Intermodal Railroad Terminal Facilities in the Twin Cities Metropolitan Area, Minnesota Department of Transportation, St. Paul, MN. February 1995.		x		x		x		x									
272	Mn/DOT (1995b). Natural Gas & Liquid Petroleum System, Ports and Waterways Section, Minnesota Department of Transportation, 1995.							x			x							
274	Mn/DOT (1999b). The Economic Component of the Metro Freight Study, Minnesota Department of Transportation, January, 1999.	x	x		x		x	x	x									
275	MnDOT (2000). Minnesota Statewide Transportation Plan, Moving Minnesota from 2000 to 2020, Minnesota Department of Transportation, St. Paul, MN. August, 2000.	x	x	x	x	x	x	x		x	x							
276	MnDOT (2003). Minnesota Statewide Transportation Plan, Moving People and Freight from 2003 to 2023, Minnesota Department of Transportation, St. Paul, MN. August, 2003.	x	x	x	x	x	x	x		x	x							
277	Mn/DOT (2004). 2004 Minnesota's Lake Superior Terminals, Ports And Waterways Section, Minnesota Department of Transportation, Spring, 2004.							x			x							
278	MNDOT (2005a). *Minnesota Statewide Freight Plan*. Minnesota Department of Transportation (MNDOT). Office of Freight and Commercial Vehicle Operations. May, 2005. http://www.dot.state.mn.us/ofrw/statewide_plan.htm	x			x	x	x	x			x							
279	MNDOT (2005b). Twin Cities Area Barge Fleeting, http://www.dot.state.mn.us/ofrw/reports.html; Accessed July 15, 2005.							x	x									
280	Mn/DOT (2005c). Minnesota's River Terminals, Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN., March, 2005.							x			x							

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
281	MNDOT (1997). Monetary Cost of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, March, 1997.				x		x	x		x								
285	Morlok, E.K. and S. P. Riddle (1999). Estimating the Capacity of Freight Transportation Systems A Model and Its Application in Transport Planning and Logistics. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 1–8.		x		x		x						x					
286	Morris,A.G. A.L. Kornhauser, and M.J. Kay (1998). Urban Freight Mobility Collection of Data on Time, Costs, and Barriers Related to Moving Product into the Central Business District. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 27–32.						x		x									
287	Morris, A.G., A.L. Kornhauser, and M. J. Kay (1999). Getting the Goods Delivered in Dense Urban Areas. A Snapshot of the Last Link of the Supply Chain. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 34–41.						x		x									
288	Morris, A.G. and A. L. Kornhauser (2000). Relationship of Freight Facilities in Central Business District Office Buildings to Truck Traffic. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 56–63.						x		x									
289	Murray, D. (2005). Tracking the Trucking Industry … 2004 and Beyond, Presentation, American Transportation Research Institute (ATRI), March, 2005.						x						x					
290	Mussell, A. and J. Fruin (1997). Minnesota Shippers and State Truck Size/Weight Regul;ations, A Report Submitted to Minnesota Department of Transportation, Staff Paper P97-3, Department of Agriculture and Applied Economics, University of Minnesota, April, 1997.						x				x							

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
291	NATS (2006). National American Transportation Statistics (NATS), http://nats.inegi.gob.mx/nats	x	x		x	x	x	x					x					
293	NGP (2001). Trade Patterns and the Economy of the Northern Great Plains: A Baseline Report, Northern Great Plains, Inc., March 2001.									x	x	x						
294	NHTSA (2005a). Fatality Analysis Reporting System (FARS). http://wwwfars.nhtsa.dot.gov/						x						x					
295	NHTSA (2005b). General Estimates System (GES). http://wwwnrd.nhtsa.dot.gov/departments/nrd-30/ncsa/ges.html						x						x					
296	Niles, J. (2003). *Trucks, Traffic, and Timely Transport:A Regional Freight Logistics Profile.* MTI REPORT 02-04, Mineta Transportation Institute, San Jose, CA, June, 2003.						x		x	x								
298	NPWI (1995).Lousiana Statewide Intermodal Plan. Louisiana State University. National Ports and Waterways Institute(NPWI), Louisiana Department of Transportation and Development, LA. July, 1995.	x	x		x		x	x			x							
300	OECD. OECD Trilog Plenary Symposium: Public Policy Issues in Global Freight Logistics. Conference Proceedings. Washington, D.C., December 17-18, 1998. http://ntl.bts.gov/lib/8000/8300/8351/trilog1.pdf Accessed July 15, 2005	x	x												x			

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)										
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
301	ORNL (1990). Nationwide Truck Activity and Commodity Survey (NTACS), Oak Ridge National Laboratory, Tennessee.						x						x					
302	ORNL (2006), Transportation Energy Data Book, 25th Edition, Oak Ridge National Laboratory, Tennessee.												x					
305	Minyoung Park, M. and A. Regan (2005).Capacity Modeling in Transportation: A Multimodal Perspective.*Forthcoming* In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005			x									x					
307	R.L. Banks and Associates (1995). Twin Cities Region Intermodal Terminal Needs Study, A Report to The Metropolitan Council, January, 1995.		x		x		x		x									
308	R.L. Banks and Associates (2004). Rail Freight Competition Study, Report prepared for State of Montana, Governor's Office of Economic Development, MT, October, 2004.				x								x					
309	Rabah, M. and H. S. Mahmassani (2002). Impact of Information and Communication Technologies on Logistics and Freight Transportation -- Example of Vendor-Managed Inventories. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 10-19.												x					
310	Raj, P.K. and E.W. Pritchard (2000). Hazardous Materials Transportation on U.S. Railroads Application of Risk Analysis Methods to Decision Making in Development of Regulations. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 22–26.				x								x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
311	Reed Business Information (2006). Logistics Management, www.logisticsmgmt.com, Waltham, MA.	x	x		x		x	x		x			x		x			
312	Resor, R.R. and G. L. Thompson (1999). Do North American Railroads Understand Their Costs? Implications for Strategic Decision Making. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 9–16.				x								x	x				
313	Resor, R.R. and Blaze, J.R. (2004). Short-Haul Rail Intermodal--Can It Compete with Trucks? In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 45-52.				x		x			x								
315	Rodríguez, D.A., M. Rocha, A. J. Khattak, and M. H. Belzer (2003). Effects of Truck Driver Wages and Working Conditions on Highway Safety Case Study. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 95-102.						x						x					
316	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1977) *Freight Data Requirements for Statewide Transportation Systems Planning.* Research Report, NCHRP Report 177, TRB, Washington, D.C.	x	x		x	x	x						x					
317	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1978). *Freight Data Requirements for Statewide Transportation Systems Planning. User's Manual*, NCHRP Report 178, TRB, Washington, D.C.	x	x		x	x	x						x					
318	Ross, T., Manrodt, K.B. and Holcomb, M.C. (2003). Operations Excellence --The Transition from Tactical to Adaptive Supply Chains--Report on Trends and Issues in Logistics and Transportation, A Report by Cap Gemini Ernst & Young and The University Of Tennessee, 2003.	x			x		x						x					
320	RTI International (2004). Economic Impact of Inadequate Infrastructure for Supply Chain Integration, Planning Report 04-2, Prepared for National Institute of Standards & Technology, Washington, D.C., June, 2004.												x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
321	Schmitt, R.R. (2002). Freight Analysis Framework-North American Interchange on Transportation Statistics, Presentation, Federal Highway Administration, April 2002.	x	x		x		x	x				x	x	x	x			
322	Schofer, J.L. (2003). *Shrinking Sample Size Undermines Usefulness of Commodity Flow Survey Data*. Third Letter Report, Committee to Review the Bureau of Transportation Statistics' (BTS) Survey Programs. March, 2003. http://trb.org/publications/reports/bts_cfs.pdf	x	x		x		x	x					x					
323	Selness, C. (2005). Minnesota's Freight Performance Measure, Presentation at FHWA Talking Freight Seminar August 17, 2005						x				x							
324	Senf, D.R. and J. Fruin (1986). An Assessment of the Competitive Position of Great Lakes Ports in the International Steam Coal Market, Staff Paper P86-1. Department of Agriculture and Applied Economics, University of Minnesota, January, 1986.							x					x	x				
326	SITA Logistics Solutions (2001). *Minneapolis-Saint Paul Air Cargo Study, SITA Logistics Solutions,* Geneva, Switzerland, December 2001.	x							x				x	x				
327	SLSA (2005). St. Lawrence Seaway Annual Traffic Report. St. Lawrence Seaway Development Corporation (SLSDC).http://www.greatlakes-seaway.com/en/news/tonnage_info.html							x		x		x	x					
328	Smalkoski, B. And Levinson, D. (2003). Value Of Time For Commercial Vehicle Operators In Minnesota, University Of Minnesota, Twin Cities, December, 2003.																	
329	Smith, N., G. Chow, and L. Ferreira (2002). E-Business Challenges for Intermodal Freight. Some International Comparisons. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 20-28.		x												x			
330	Satisfaction Management Systems, Inc. (1998). Mn/DOT 1998 Freight Market Segmentation Study for the Manufacturing Industries.	x					x		x									

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
331	Solano, P., R. Wright and V. Wanca (2003). BTS Intermodal Facility Freight Transfer Database. Bureau of Transportation Statistics, Washington, D.C., 2003.		x										x					
332	Sorensen, P.C., E. Irelan, B. Winningham, and T. A. Noyes (1997). Skagit Countywide Air, Rail, Water, and Port Transportation System Study .In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 4–13.	x			x			x		x								
333	Southworth, F. (2001). The Future for Freight Transportation Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/southworth.pdf Accessed July 15, 2005.												x					
334	Southworth, F. (2003). Simulating U.S. Freight Movements in the 2002 Commodity Flow Survey (Putting the Miles in Ton-Miles), a Presentation to Bureau of Transportation Statistics' International Trade Traffic Study Workshop, Washington, DC., November, 2003.	x	x		x		x	x					x					
335	Southworth, F. (2005). Filling Gaps in the U.S. Commodity Flow Picture: Using the CFS with Other Data Sources, Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.	x	x		x		x		x				x					
337	Spear, B. (2006). Freight Modeling in Urban Areas: State of the Practice, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm						x		x									
338	SRF Consulting (2001). Metropolitan Council 2001 Twin Cities Transportation System Audit Metropolitan Council, St. Paul, Minnesota, 2001.	x	x		x		x	x	x									
339	SRF Consulting Group, Inc. (2003) Adequacy of Freight Connectors to Interregional Corridors and Major Highways, Prepared for Minnesota Department of Transportation, June, 2003.		x							x								
340	SRF Consulting Group, Inc. and Cambridge Systematics, Inc. (2004). Twin Cities Regional Freight Planning Model, Technical Memorandum, prepared for Metropolitan Council and Minnesota Department Of Transportation, November 30, 2004.						x		x									

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
341	STB (2005). Carload Rail Waybill Sample, Surface Transportation Board (STB), Washington, DC, www.stb.dot.gov				x					x	x	x	x	x				
342	Stewart, R.D., R. J. Eger III, L. Ogard and F. Harder, Tioga Group and Associates (2003). Twin Ports Intermodal Freight Terminal Study: Evaluation of Shipper Requirements and Potential Cargo Required to Establish a Rail-Truck-Marine Intermodal Terminal in the Twin Ports of Superior, Wisconsin and Duluth, Minnesota, Midwest Regional University Transportation Center, University of Wisconsin, Madison, 2003.							x	x									
343	Stiehl, M. and F.G. Rawling (2001). Intermodal Volumes: Tracking Trends & Anticipating Impacts in Northeast Illinois, Working Paper 01-04, Chicago Area Transportation Study (CATS), Chicago, Illinois, May, 2001.		x							x								
345	Strauss-Wieder, A. (2003). Integrating Freight Facilities and Operations with Community Goals. National Cooperative Highway Research Program (NCHRP) Synthesis of Highway Practice 320, TRB, National Research Council, Washington, D.C.		x						x				x					
346	Street Smarts, Rizzo Associates, and Georgia Institute of Technology (2003). Study of Hourly Truck Movements around Atlanta, Georgia Department of Transportation, Atlanta, Georgia, 2003.						x		x									
347	Sylvester, J.T., S.S. Wallwork, P.E. Polzin, M. Nesary (1995). Montana Airport Multimodal Study—Part 1—Methods and Results, Bureau of Business and Economic Research, The University of Montana, November, 1995.	x									x							
348	Tan, A.C. and Royce O. Bowden (2004). The Virtual Intermodal Transportation System (VITS), Final Report, Department of Industrial Engineering, Mississippi State University, May 2004.		x								x		x					
349	Taniguchi, E. and Thompson, R.G. (2004). Modeling City Logistics. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 45-51.						x		x									
350	Tarkenton, L. (2005). Trends in Marine Terminal Operations Management, Port of Virginia, 2005.							x			x							

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
351	The Colography Group (2006a). U.S. Domestic And Export Air Traffic And Yield Analyses By Competitor And Market Segment (Colography), Marietta Georgia. http://www.colography.com/exportairtandy.html	x											x	x	x			
352	The Colography Group (2006b). Global Cargo Market Projections (Colography), Marietta Georgia. http://www.colography.com/gcmp.html	x													x			
353	The Colography Group (2006c). U.S. International Cargo By Commodity And Country (Colography), Marietta Georgia. http://www.colography.com/iacc.html	x													x			
354	The Colography Group (2006d). Domestic Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/dact.html	x											x					
355	The Colography Group (2006e). International Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/iact.html	x												x	x			
356	The Logistics Institute - Asia Pacific. *The Asia Pacific Air Cargo System*, Research Paper No: TLI-AP/00/01, Georgia Institute of Technology, 2001.	x													x			
360	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2002). Logistics and Transportation, 11 th Annual Survey of Issues and Trends, A Report by Ernst & Young and The University Of Tennessee, 2002.	x			x		x						x					

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
361	TRANSCORE (2001). Washington-British Columbia Cross-Border Commercial Vehicle Operations, Updated Final, Concept of Operations, Northwest International Trade Corridor Program Phase-2, June 15, 2001.						x						x	x				
362	Transport Topics Publishing Group (2006). Transport Topics, Daily Update of Trucking News, www.ttnews.com/						x		x	x	x		x	x	x			
364	TRB. (1986). Twin Trailer Trucks. TRB Special Report 211, TRB, National Research Council, Washington, D.C.						x						x					
365	TRB. (1987). Measuring Airport Landside Capacity. TRB Special Report 215, TRB, National Research Council, Washington, D.C.	x							x				x					
366	TRB. (1990a). Truck Weight Limits: Issues and Options. TRB Special Report 225, TRB, National Research Council, Washington, D.C.						x						x					
367	TRB. (1990c). Data Requirements for Monitoring Truck Safety. TRB Special Report 228, TRB, National Research Council, Washington, D.C.						x						x					
368	TRB. (1992). Intermodal Marine Container Transportation -- Impediments and Opportunities. TRB Special Report 236, TRB, National Research Council, Washington, D.C.		x					x					x					
370	TRB. (1993b). Landside Access to U.S. Ports. TRB Special Report 238, TRB, National Research Council, Washington, D.C.						x	x					x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE: AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	MARKET (LEVEL/SCALE/ DECISION CONTEXT): URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
371	TRB. (1994). International Symposium on Motor Carrier Transportation. Conference Proceedings 3. TRB, National Research Council, Washington, D.C.						x						x	x				
373	TRB. (1997). National Conference on Setting an Intermodal Transportation Research Framework. Conference Proceedings 12. TRB, National Research Council, Washington, D.C.		x										x					
374	TRB. (1998a). Policy Options for Intermodal Freight Transportation. TRB Special Report 252, TRB, National Research Council, Washington, D.C.		x										x					
375	TRB. (1998b). Intermodal Transportation Education and Training. Conference Proceedings 17. TRB, National Research Council, Washington, D.C.		x										x					
376	TRB. (2001a). Global Intermodal Freight State of Readiness for the 21st Century, Report of a Conference, Conference Proceedings 25, TRB, National Research Council, Washington, D.C., 2001		x										x	x	x			
377	TRB. (2002a). The NHTSA's Rating System for Rollover Resistance-An Assessment. TRB Special Report 265, TRB, National Research Council, Washington, D.C.						x						x					
378	TRB. (2002b). Regulation of Weights, Lengths, and Widths of Commercial Motor Vehicles. TRB Special Report 267, TRB, National Research Council, Washington, D.C.						x						x					
379	TRB. (2003a). A Concept for a National Freight Data Program. TRB Special Report 276, TRB, National Research Council, Washington, D.C.	x	x		x	x	x	x					x					
380	TRB. (2003c). Shipboard Automatic Identification System Displays--Meeting the Needs of Mariners. TRB Special Report 273, TRB, National Research Council, Washington, D.C.							x					x					

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
381	TRB. (2003d). Cybersecurity of Freight Information Systems -- A Scoping Study. TRB Special Report 274, TRB, National Research Council, Washington, D.C.	x	x		x	x		x					x					
382	TRB. (2003e). TRB. Measuring Personal Travel and Goods Movement, A Review of the Bureau of Transportation Statistics' Surveys, TRB Special Report 277, Transportation Research Board, Washington, DC.	x			x		x						x					
383	TRB (2005). Intermodal Shipments, Warehousing, and Third Parties: A Special Measurement Issue. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.		x										x					
384	TRB. (1990b). New Trucks for Greater Productivity and Less Road Wear-An Evaluation of the Turner Proposal. TRB Special Report yyy, TRB, National Research Council, Washington, D.C.						x						x					
385	TRB. (1998c). Transportation Issues in Large U.S. Cities. Conference Proceedings 18. TRB, National Research Council, Washington, D.C.						x		x									
386	TRB. (2003b). Freight Capacity for the 21st Century. TRB Special Report 271, TRB, National Research Council, Washington, D.C.	x	x		x		x	x					x					
387	TRB. (2004a). The Marine Transportation System and the Federal Role--Measuring Performance, Targeting Improvement. TRB Special Report 279, TRB, National Research Council, Washington, D.C.							x										
388	Turnquist, M., A. Meyburg, and G. List (1993). Goods Movement: Regional Analysis and Database, Draft Final Report, University Transportation Research Centers Program, Region II, Cornell University, March 26, 1993.				x		x		x	x								
389	Turnquist, M.A. (2006). Characteristics of Effective Freight Models, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm												x					
390	UMTRI (2005). Trucks Involved in Fatal Accidents (TIFA) – http://www.umtri.umich.edu/cnts/tifa.htm						x						x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
391	UMVRDC (1986). Locational and Feasibility Study Containerized Shipment of Agricultural Products, Upper Minnesota Valley Regional Development Commission (UMVRDC), June, 1986.		x				x	x		x	x				x			
392	UMVRC (1987). Freight Access Improvement Program, Upper Minnesota Valley Regional Development Commission (UMVRDC), September, 1987.		x				x			x								
393	UMVRC (1988). Impacts of Commodities Shipments on Highway and Rail Systems, Upper Minnesota Valley Development Commission (UMVRDC), November, 1988.				x		x			x								
394	U.S. Army Corps Engineers (2005a). Waterborne Commerce: Domestic, www.iwr.usace.army.mil/ndc, 2005							x					x					
395	U.S. Army Corps Engineers (2005b). Waterborne Commerce: Foreign, www.iwr.usace.army.mil/ndc/usforeign							x					x	x	x			
396	U.S. Army Corps Engineers (2005c). U.S. Ports and Waterway Facilities Database, www.iwr.usace.army.mil/ndc							x					x					
397	U.S. Army Corps Engineers (2005d). Vessel Characteristics -- Waterborne Transportation Lines of the United States, www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm							x					x	x	x			
398	U.S. Army Corps Engineers (2005e). Lock Performance Monitoring System (LPMS), www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm							x					x					
399	USBOC (2005a). 2002 Vehicle Inventory and Use Survey (VIUS), www.census.gov/econ/www/viusmain.html, 2005						x						x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
401	USBOC (2005c). U.S. Census County Business Patterns, www.census.gov/epcd/cbp									x	x		x					
402	USBOC (2005d). U.S. Bureau of Census. Exports from Manufacturing Establishments.									x	x		x					
403	USBOC (2005e). U.S. Bureau of Census. Motor Freight Transportation and Warehousing Survey.					x							x					
404	USBOC (2005f). U.S. Bureau of Census. Annual Survey of Manufactures Publication.												x					
405	USBOC (2005g) 2002 U.S. Imports/Exports of Merchandise on CD-ROM												x	x	x			
406	USBOC (2005h). 2002 Commodity Flow Survey, U.S.Census Bureau,http://www.census.gov/econ/www/cfsmain.html 2002 data being processed	x	x		x	x	x	x					x		x			
407	USDA (1998). Transportation of U.S. Grains—A Modal Share Analysis, 1978-95, United States Department of Agriculture, Washington, D.C., March, 1998.				x		x	x					x					
409	USDA. (2005a). Shipping Costs for Agricultural Products. Presentation. U.S. Department of Agriculture, Transportation Services Branch, Agricultural Marketing Service.												x					
410	USDA. (2005b). Fresh Fruit and Vegetable Arrival Totals for 23 Cities, U.S. Department of Agriculture, Washington, DC.												x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
411	USDA. (2005c). Grain Transportation, Agricultural Marketing Service, U.S. Department of Agriculture. http://www.ams.usda.gov/tmd/TSB/publications.htm#General%20Transportation%20Information				x		x	x					x					
412	USDOC. (1997). 1993 Commodity Flow Survey Minnesota, 1992 Census of Transportation, Communications, and Utilities, TC92-CF-24, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.	x			x		x	x			x							
413	USDOC.(2005) 2002Commodity Flow Survey (CFS), U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.	x			x		x	x					x					
414	USDOE (2005a). Quarterly Coal Report, U.S. Department of Energy.				x								x					
415	USDOE (2005b). Natural Gas Monthly, U.S. Department of Energy.					x							x					
416	USDOE (2005c). Natural Gas Annual, U.S. Department of Energy.					x							x					
417	USDOE (2005d). Petroleum Supply Monthly, U.S. Department of Energy.					x							x					
418	USDOT (2000). NHS Intermodal Freight Connectors: A Report to Congress. U. S. Department of Transportation. 2000 http://www.ops.fhwa.dot.gov/freight/infrastr/nhs/index.htm Accessed July 10, 2005		x										x					
419	USDOT. Freight and the Environment Charrette Proceedings Report, February, 2005. http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed September, 2005.								x				x					
420	Vachal, K. and B. Baldwin (2001). Factors Affecting Rail Car Supply, Report MPC-01-121, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, North Dakota, 2001.				x					x			x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
421	Vachal, K and J. Bitzan (2002). Long-Term Availability of Railroad Services for U.S. Agriculture. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 62-72.				x								x					
422	Vachal, K.. H. Reichert, and T. Van Wechel (2004). U.S. Containerized Grain and Oilseed Exports Industry Survey. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp120-125				x		x	x					x					
424	Victoria, I.C. and C. M. Walton (2004). Freight Data Needs at the Metropolitan Level and the Suitability of Intelligent Transportation Systems in Supplying MPOs with the Needed Freight Data, Report No. SWUTC/04/167247-1, Center for Transportation Research, University of Texas at Austin, TX, December, 2004.								x									
425	Vilain, P., L. N. Liu, and D. Aimen (1999). Estimation of Commodity Inflows to a Substate Region. An Input-Output Based Approach. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 17–26.									x								
427	Wargo, B. (2006). PierPASS & Operations as a Solution to Freight Congestion, FHWA Talking Freight Seminar, June 21, 2006.												x					
428	Weinblatt, H. (1996). Using Seasonal and Day-of-Week Factoring to Improve Estimates of Truck Vehicle Miles Traveled. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 1–8.						x						x					
429	Wilbur Smith Associates (2002). Virginia Statewide Traffic Model --Review of Available Data, Virginia Department of Transportation, May 22, 2002. http://www.wilbursmith.com/vdotmodel/attachments/082902/Review%20of%20Avail%20Data%20%28Draft%2005-22-02%29.pdf; Accessed July 18, 2005.										x							
430	Wilbur Smith Associates (2003a). The National I-10 Freight Corridor Study-Summary of Findings, Strategies, and Solutions, Final Report, Texas Department of Transportation, 2003.						x					x	x					

Table B.1. Classification of measurement sources by mode and market, continued

	MEASUREMENT SOURCE	MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
431	Wilbur Smith Associates (2003b). Louisiana Statewide Transportation Plan—Statewide Intermodal Freight Planning, Presentation at TRB Annual Meeting, January, 2005.	x	x		x		x	x			x							
432	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006a). Minnesota Aviation System Plan -- Air Cargo, prepared for Minnesota Department of Transportation, 2006.	x							x	x	x							
433	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006b). Minnesota Aviation System Plan, Executive Summary, prepared for Minnesota Department of Transportation, 2006.	x							x	x	x							
434	Wittwer, E., T. Adams, T. Gordon, J. Gupta, K. Kawamura, P. Lindquist, M. Vonderembse, and S. McNeil (2005). Upper Midwest Freight Corridor Study, Midwest Regional University Transportation Center, University of Wisconsin-Madison, Madison, WI, March 31, 2005.	x			x		x	x				x						
435	Wolfe, M (2002). Technology to Enhance Freight Transportation Security and Productivity, Appendix to: "Freight Transportation Security and Productivity", Report Prepared for: Office of Freight Management and Operations, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. 2002.												x x					
436	Zavattero, D.A., F.G. Rawling, and D.F. Rice (1998). Mainstreaming Intermodal Freight into the Metropolitan Transportation Planning Process. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 1–11.		x						x									
437	Zemotel, LM and Montebello, DK.(2002). Interregional Corridors: Prioritizing And Managing Critical Connections Between Minnesota's Economic Centers. In Transportation Research Record 1817, TRB, Washington, DC, 2002, pp. 79-87.									x								
439	Zhang, Y., R. O. Bowden, Jr., A. J. Allen (2003). *Intermodal Freight Transportation Planning Using Commodity Flow Data*. National Center for Intermodal Transportation. 2003.		x										x					
440	Zmud, S. (2005). Commodity Flow Survey: Improving Methods to Enhance Data Quality and Usefulness. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.												x					

Table B.1. Classification of measurement sources by mode and market, continued

MEASUREMENT SOURCE		MODE							MARKET (LEVEL/SCALE/ DECISION CONTEXT)									
		AIR (A)	INTERMODAL (I)	MULTIMODAL (M)	RAIL (R)	PIPELINE (P)	TRUCK (T)	WATERWAY & PORTS (W)	URBAN/MTERO/LOCAL (U)	REGIONAL/SUBSTATE (R)	STATEWIDE (S)	MULT-ISTATE (MS)	NATIONAL (N)	MULTINATIONAL (MN)	GLOBAL (G)	INBOUND (1)	OUTBOUND (O)	THROUGH (T)
441	Zografos, K.G. and I.M. Giannouli (2002). Emerging Trends in Logistics and Their Impact on Freight Transportation Systems: A European Perspective. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 36-44.	x			x		x	x					x		x			
443	Zografos, K.G. and A.C. Regan. Current Challenges for Intermodal Freight Transport and Logistics in Europe and the United States. In Transportation Research Record 1873, TRB, National Research Council, Washington, D.C., 2003, pp. 70-78.		x										x		x			

CLASSIFICATION OF MEASUREMENT SOURCES BY SECTOR AND PROVIDER

CODES:	
SECTOR	DESCRIPTOR
A	AGRICULTURE
MG	MANUFACTURING
MN	COAL/IRON/MINING
P	PULP & PAPER
L	LUMBER & WOOD
R	RETAIL
W	WHOLESALE
F	FOOD PRODUCTS

CODES:	
PROVIDER	DESCRIPTOR
F	FEDERAL AGENCY
R	REGIONAL AGENCY
S	STATE AGENCY
L	LOCAL AGENCY
P	PRIVATE

Note: The numbers for measurement sources in Appendix B correspond to the Ref No. shown in Appendix A

Table B.2. Classification of measurement sources by sector and provider.

MEASUREMENT SOURCES		SECTOR/ COMMODITY/ INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
1	AAR. (2006a). Freight Commodity Statistics, American Association of Railroads, Washington, DC, http://www.aar.org/	x	x	x	x	x			x					x
2	AAR (2006b.) Railroad Equipment Report, http://www.aar.org/													x
3	AAR (2006c). Weekly Carload (as reported to the AAR) , http://www.aar.org/													x
4	AAR (2006d).Terminal Dwell Time, http://www.aar.org/													x
5	AAR (2006e). Weekly Cars online, http://www.aar.org/													x
6	AAR (2006f). Train Speeds, http://www.aar.org/													x
7	AAR (2006g). Freight Loss and Damage, http://www.aar.org/													x
8	AAR (2006h). Railroad Facts, http://www.aar.org/													x
9	AAR (2006i). Railroad Revenues, Expenses & Income, http://www.aar.org/													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
10	AAR (2006j). Railroad Ten-Year Trends, http://www.aar.org/													x
11	AAR (2006k). Railroads and States, http://www.aar.org/													x
12	AAR. (2006l). North American Trucking Survey (NATS), Washington, DC													x
13	AAR (2006m). Weekly Railroad Traffic, http://www.aar.org/													x
14	AAR (2006n) Railroad Cost Indexes, http://www.aar.org/													x
15	AAR (2006o). Railroad Cost Recovery Index (RCR), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCRDescription.pdf													x
16	AAR (2006p). Rail Cost Adjustment Factor (RCAF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCAFHistory.pdf													x
17	AAR (2006q). All-Inclusive Index Less Fuel (All-LF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/AIILF.pdf													x
18	AAR (2006r). Index of Monthly Railroad Fuel Prices, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_MonthlyFuelPrices.pdf													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
19	AAR (2006s). Analysis of Class I Railroads 2005 Data for 2005, http://www.aar.org/	x	x	x	x	x			x					x
20	AAR (2006t). Railway Performance Measures, http://www.railroadpm.org/													x
21	AAR (2006u). Railroad Class I Statistics, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Statistics.pdf	x	x	x	x	x			x					x
22	AAR (2006v). Profiles of U.S. Railroads, http://www.aar.org/													x
23	AAR (2006w). Rail Transportation of Chemicals, http://www.aar.org/													x
24	AAR (2006x). Rail Transportation of Coal, http://www.aar.org/			x										x
25	AAR (2006y). Rail Transportation of Grain, http://www.aar.org/	x												x
26	Abbott,J. K.B. Manrodt., and P. Moore (2004). From Visibility to Action, Report on Trends and Issues in Logistics and Transportation, Oracle, Georgia Southern University and Capgemini,USA., 2004.		x											x
27	Abkowitz, M. and E. Meyer. (1996).Technological Advancements in Hazardous Materials Evacuation Planning. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 116–121.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
28	Abkowitz, M.D., J.P. DeLorenzo, R. Duych, A. Greenberg, and T. McSweeney (2001). Assessing the Economic Effect of Incidents Involving Truck Transport of Hazardous Materials.In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 125–129.													x
29	ACI-NA. (2006) Worldwide Airport Traffic Report, Airports Council International (ACI)- North America (NA), Washington, DC.													x
30	Ammah-Tagoe, F. and Johnson, D. (2004). Understanding Potential Freight Bottlenecks in the United States: A Look at the GeoFreight Visual Display Tool, Paper presented at the 7th MTS Research and Technology Coordination Conference, Washington, D.C., November 16-18, 2004; http://trb.org/Conferences/MTS/4C%20Ammah-Tagoe%20Johnson%20paper.pdf; Accessed July 15, 2005.									x				
31	Apffel, C., J. Jayawardana, A. Ashar, K. Horn, R. McLaughlin, and A. Hochstein (1996). Freight Components in Louisiana's Statewide Intermodal Transportation Plan. In *Transportation Research Record 1552, TRB, National Research Council, Washington, D.C., 1996, pp. 32-41*											x		
32	ARDC (1983).North Shore Commodity Movement Study : final report / prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.				x	x	x				x			
33	ARDC (1985). Regional Goods Movement Study, Prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.	x	x			x					x			
34	ARDC. (1999). Northeast Minnesota Freight Study, prepared by Arrowhead Regional Development Commission (ARDC), Duluth, MN.Paul, MN.	x	x	x		x	x	x			x			
35	ATA (2005). LTL Commodity and Market Flow Database, American Trucking Associations, Virginia.	x	x				x	x	x					x
36	ATA (2006). Truckline Express, American Trucking Associations E-Newsletter, www.truckline.com	x	x		x		x	x	x					x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
37	ATRI (2005). Travel Time in Freight Significant Corridors. American Transportation Research Institute. www.atri-online.org; Accessed July 26, 2005.													x
38	Jones, C., Murray, D. and Short, J. (2005) Methods of Travel Time Measurement in Freight-Significant Corridors. Prepared by American Transportation Research Institute. For Transportation Research Board Annual Meeting, January, 2005.													x
39	Baatz, E. (2006). Pricing Trends – Pricing Across the Modes, Logistics Management, http://www.logisticsmgmt.com/October, 2006.													x
44	Barkan, C.P.L., T. T. Treichel, and G.W. Widell (2000). Reducing Hazardous Materials Releases from Railroad Tank Car Safety Vents. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 27–34.													x
45	Barnes, G. and P. Langworthy (2003). The Per-Mile Costs of Operating Automobiles And Trucks, Report No. MN/RC 2003-19, Minnesota Department of Transportation, St. Paul, MN, June, 2003.											x		

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
46	Barolsky, R. (2005). Performance Measures to Improve Transportation Planning Practice--A Peer Exchange, Transportation Research Circular E-C073, Transportation Research Board, Washington, D.C., May, 2005.	x	x	x	x	x	x	x	x	x	x	x	x	x
48	BEA. (1987). 1982 Benchmark Input-Output Accounts of the United States, Department of Commerce, Bureau of Census, Washington, DC.	x	x	x	x	x	x	x	x	x				
49	BEA. (2005). Regional Economic Accounts, www.bea.gov/bea/regional/data.htm	x	x	x	x	x	x	x	x	x				
50	Beier, F.J. (2002). The Feasibility of a Shipper Panel to Measure Transportation Services. Final Report. Minnesota Department of Transportation, December, 2002.	x	x	x	x	x	x	x	x			x		
51	Beilock, R. (2005).Transportation Factors Influencing the Competitiveness of Agricultural and Food Products, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.	x							x		x			
53	Berwick, M. and Farooq, M. (2003). Truck Costing Model for Transportation Managers, Report MPC-03-152, Upper Great Plains Transportation Institute, North Dakota State University, August 2003	x	x				x	x	x		x			
54	Bester, N. L. (1996). Incorporating Energy Criteria in Intermodal Transportation Policy Decisions. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 83–86.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
55	Bureau of Industry Economics (BIE). (1992). International Performance Indicators -- Road Freight, Research Report 46, Canberra, Australia, 1992.													x
56	Bingham, P. (2006). Freight Transportation "Megatrends" , Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
58	BLS. (2005a). Wages, Earnings, and Benefits, Bureau of Labor Statistics (BLS), www.bls.gov/wages.htm									x				
59	BLS (2005b). Productivity, Bureau of Labor Statistics (BLS), www.bls.gov/bls/productivity.htm									x				
60	Boardman, J. (2001). The Emerging Importance of Freight Data. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/boardman.pdf Accessed July 15, 2005.													x
61	Booz Allen & Hamilton, Inc. (2000a). North American International Trade Corridor, Comprehensive and Coordinated ITS/CVO Plan, Interim Report of the Corridor Baseline, Prepared for Missouri Department of Transportation, December, 2000.	x	x				x	x	x			x		
63	Booz Allen Hamilton, Inc. with ATA Foundation, TransCore, In Association With CTRE, Iowa State University, C.J. Petersen & Associates, Kentucky Transportation Center, University of Kentucky. (2001). North American International Trade Corridor, Development Plan, Comprehensive and Coordinated ITS/CVO Plan for the North American International Trade Corridor, Phase 3 Report, December, 2001.	x	x				x	x	x		x	x		x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
64	Boske, L., A. Kantak and S. Spruiell. (2004). Identifying Gaps and Limitations in Data Sources by Mapping the Transportation Chain of International Trade Shipments at U.S. Ports, Report No. SWUTC/04/167241-1, Center for Transportation Research, University of Texas at Austin, TX, September, 2004.	x	x				x	x	x					x
65	Brander, J.R.G. and F. R. Wilson (2001). Regional Intermodal Freight Transport Flows and Projections. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 20–26.													x
66	Braslau, D. and Fruin, J. (1998). Northwest Minnesota Freight Flow Study : Freight Flow Estimation and Identification of Significant Corridors, Minnesota Department of Transportation, St. Paul, MN.	x	x			x					x			
67	Braver, E.R., Michael X. Cammisa, Adrian K. Lund, Nancy Early, Eric L. Mitter, And Michael R. Powell (1997). Incidence of Large Truck–Passenger Vehicle Underride Crashes in Fatal Accident Reporting System and National Accident Sampling System, in Transportation Research Record 1595, Journal of Transportation Research Board, TRB, Washington, DC, 1997, pp. 27 to 33.													x
68	Bremmer, D., K. C. Cotton, D. Cotey, C. E. Prestrud, G. Westby (2006). Measuring Congestion: Learning From Operational Data, paper to appear in Journal of Transportation Research Board, Washington, DC., 2006.													x
69	Brewster, R. (2005). Identifying Vulnerabilities and Security Management Practices in Agricultural & Food Commodity Transportation, Paper for Transportation Research Board Annual Meeting, January, 2005.	x							x					x
70	Brogan, J.J., S.C. Brich, and M.J. Demetsky (2002). Identification and Forecasting of Key Commodities for Virginia. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 73-79		x	x	x	x			x					x
71	Bronzini, M.S. (2006). New Data Sources, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
72	BTS (1998). Transportation Statistics Beyond ISTEA: Critical Gaps and Strategic Responses. BTS98-A-01. U.S. Department of Transportation, Washington, D.C., 1998.									x				

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
73	BTS (1999). 1997 Commodity Flow Survey Minnesota, 1997 Economic Census Transportation. U.S. Department of Transportation, Bureau of Transportation Statistics, December, 1999.	x	x	x	x	x	x	x	x	x				
74	BTS (2002). Maritime Trade and Transportation, Bureau of Transportation Statistics, Washington, D.C. 2002.									x				
75	BTS (2005a). Expenses per Mile for the Motor Carrier Industry: 1990 through 2000 and Forecasts through 2005. ops.fhwa.dot.gov/freight/documents/bts.pdf; Accessed October 26, 2005.									x				
76	BTS (2005b). Transborder Surface Freight Data, www.bts.gov/transborder, 2005	x	x		x				x	x				
77	BTS (2005c). Air Traffic Statistics, www.bts.gov/programs/airline_information, 2005									x				
78	BTS (2005d) National Transportation Atlas Database (NTAD), www.bts.gov/programs/geographic_information_services, 2005.									x				
79	BTS. (2005e). National Transportation Statistics, www.bts.gov/publications/national_transportation_statistics, BTS, Washington, DC.	x	x	x	x	x	x	x	X	x				
80	Buschena, D.E., J. Fruin, and D.W. Halbach (1988). Minnesota Grain Movements 1985, Staff Paper P88-25. Department of Agriculture and Applied Economics, University of Minnesota, August, 1988.	x												x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
82	C.J. Petersen & Associates, C.L. Bann & Associates, and Management Directions, Inc. (1997). Northwest Minnesota Freight Flow Study : Primary Data Collection Activities, Minnesota Department of Transportation, St. Paul, MN.	x	x	x	x	x	x	x	x		x			
83	California EPA and Business, Transportation and Housing Agency (2005). Goods Movement Action Plan, Phase I: Foundations. http://www.arb.ca.gov/gmp/docs/finalgmpplan090205.pdf; Accessed September 29, 2005.											x		
84	Cambridge Systematics, Inc. (1993). *Characteristics and Changes in Freight Transportation Demand.* National Cooperative Highway Research Program (NCHRP) Report 388, 1993.	x	x	x	x	x	x	x	x					x
86	Cambridge Systems, Inc. (2000). Statewide Multimodal Freight Flows Study, Executive Summary, Minnesota Department of Transportation, St. Paul, MN. April, 2000.	x	x	x	x	x	x	x	x			x		
87	Cambridge Systematics, Inc. (2001). *Vermont Statewide Freight Study,* Final Report, prepared for the Vermont Department of Transportation, March 2001.		x	x	x	x		x	x			x		
88	Cambridge Systematics, Inc.(2003a). *Best Practices in Statewide Freight Planning.* NCHRP 8-36(33), Final Report. TRB, National Research Council, Washington, D.C. October, 2003.	x	x	x	x	x	x	x	x					x
89	Cambridge Systematics, Inc. (2003b). *Intermodal Freight Connectors: Strategies for Improvement*, NCHRP Project 8-36, Task 30, Final Report, August, 2003.													x
90	Cambridge Systematics, Inc. (2004a). *Development of a Multimodal Tradeoffs Methodology for Use in Statewide Transportation Planning.* NCHRP 8-36(7), Final Report. TRB, National Research Council, Washington, D.C. October, 2004.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
91	Cambridge Systematics, Inc. (2004b). Accounting for Commercial Vehicles in Urban Transportation Models. 2004. http://tmip.fhwa.dot.gov/clearinghouse/docs/accounting/ Accessed July 12, 2005									x				
92	Cambridge Systems, Inc. (2004c). Traffic Congestion and Reliability:Linking Solutions to Problems, Final Report, Federal Highway Administration, Washington, DC. July, 2004.									x				
93	Cambridge Systematics, Inc. (2004d). Minnesota Statewide Freight Plan, Technical Memorandum 2, Systems Analysis, Final Technical Memorandum, Mn/DOT, July, 2004.	x	x	x	x	x	x	x	x			x		
94	Cambridge Systematics, Inc with HDR, Inc. (2005b). *Oregon Transportation Plan Policy Analysis.* Oregon Department of Transportation, June, 2005.											x		
95	Cambridge Systematics, Inc. et al. *(1995a). Intermodal Freight Transportation Volume 1--Overview of Impediments, Data Sources for Intermodal Transportation Planning, and Annotated Bibliography*. Report No. DOT-T-96-04, U.S. Department of Transportation, Washington, D.C., December 1995.									x				
96	Cambridge Systematics, Inc. et al. (1996). *Quick Response Freight Manual*. Report No. DOT-T-97-10, U.S. Department of Transportation, Washington, D.C., September 1996.									x				
97	Cambridge Systematics, Inc. with Reebie Associates, Inc. (2002). Freight Impacts on Ohio's Roadways, The Ohio Department of Transportation, Final Report, June, 2002.											x		
98	Cambridge Systematics, Inc. with Reebie Associates, H. Cohen, A. Horowitz, R. Pendyala (2005a). *Forecasting Statewide Freight Toolkit*. NCHRP 8-43 Final Report. TRB, National Research Council, Washington, D.C., 2005									x				
99	Cambridge Systematics, Inc with URS Corporation (2005c). MnPASS System Study, Final Report, prepared for Minnesota Department of Transportation, April 7, 2005.											x		

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
100	Cambridge Systematics, Inc., PB Consult, Inc., and TTI (2006a). Performance Measures and Targets for Transportation Asset Management, NCHRP Report 551, Transportation Research Board, Washington, DC, 2006.													x
101	Cambridge Systematics, Inc. , SRF Consulting Group and H. Cohen (2006b). Minnesota Truck Size and Weight Project, prepared for Minnesota Department of Transportation, June, 2006.	x	x			x	x	x	x			x		
102	Campbell, C., D. Braslau, C. Petersen, J. Levine (1995). Minnesota Freight Flows – 1990, Report MN/RC – 95/14, Minnesota Department of Transportation, St. Paul, MN, February, 1995.	x	x	x	x	x	x	x	x			x		
103	Carey, J. and J. Semmens (2005). Measurement Tools for Assessing Motor Vehicle Division Port-of-Entry Performance. Forthcoming In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005													x
104	Casgar, T. (2001). The National Perspective. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/casgar.pdf Accessed July 15, 2005.													x
105	CBM (2005a). The Journal of Commerce Online, Commonwealth Business Media, (www.joc.com)	x	x	x	x	x	x	x	x					x
106	CBM (2005b). Port Import/Export Reporting Service (PIERS), Commonwealth Business Media, www.piers.com.	x	x	x	x	x	x	x	x					x
107	CBM (2005c). Traffic World (www.trafficworld.com)	x	x	x	x	x	x	x	x					x
108	CBO (2006). Freight Rail Transportation: Long Term Issues, A Congressional Budget Office Paper, January, 2006.									x				

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
109	CH2M Hill (2005). Minnesota Statewide Heavy Vehicle Safety Plan, prepared for the Minnesota Departments of Transportation and Public Safety, June, 2005.											x		
110	Cheng, Y., W. Lin. (2005). Comparison of Methods for Allocating Costs of Empty Railcar Movements in a Railcar Pooling System. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005													x
111	Clark, M.L., E. L. Jessup, and K. Casavant.(2003). Dynamics of Wheat and Barley Shipments on Haul Roads to and from Grain Warehouses in Washington State, Strategic Freight Transportation Analysis Report #5, Washington State University, Pullman, WA, September, 2003.	x												x
112	CTS (2000). Fourth Annual Symposium on the Impacts of Logistics on the Upper Midwest Economy, September 11, 2000, Bloomington, Minnesota, Summary Report, Center for Transportation Studies, 2000.													x
113	CTS (2001). Fifth Annual Freight and Logistics Symposium,December 7, 2001, Minneapolis, Minnesota, Summary Report, Center for Transportation Studies, 2001.													x
114	CTS (2002). Sixth Annual Freight and Logistics Symposium,December 6, 2002, St. Paul, Minnesota, Summary Report, Center for Transportation Studies, 2002.													x
115	CTS. Seventh Annual Freight and Logistics Symposium,December 5, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2003.													x
116	CTS (2004). Eighth Annual Freight and Logistics Symposium,December 3, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2004.													x
117	CTS (2005). Ninth Annual Freight and Logistics Symposium--Freight Mobility:Economic Impacts on the Upper Midwest,December 2, 2005, Minnesota, Summary Report, Center for Transportation Studies, 2005.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHIOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
118	Curlee, R. (2006). Freight Demand Modeling: State of the Practice within Federal Agencies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
119	Czerniak, R. and S. Gaiser (1997a). Proceedings of Conference One National Freight Planning Applications Conference held in San Antonio, Texas, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.									x				
120	Czerniak, R. and S. Gaiser (1997b). Proceedings of Conference Two Urban Goods And Freight Forecasting Conference held in San Antonio, Texas, Part 2, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.									x				
121	Czerniak, R., S. Gaiser, D. Gerard. (1996). The Use of Intermodal Performance Measures by State Departments of Transportation, Final Report, Federal Highway Administration, Washington DC, June 1996.									x				
122	Dennis, S. M. (2001). Freight Transportation Rates -- A Multimodal Approach, Bureau of Transportation Statistics, 2001.									x				
123	Dow Jones Transportation Average (DJTA) (2006), http://www.marketwatch.com/tools/marketsummary/indices/													x
124	Des Moines Area Metropolitan Planning Organization (DMAMPO). (2002). Goods Movement In The Des Moines Metropolitan Area, June, 2002; http://www.dmampo.org/Publications/goods%20movement.pdf; Accessed July 18, 2005.												x	
125	Donath, M., D. Murray, and J. Short, J. (2005). Homeland Security and the Trucking Industry, Final Report., Report prepared for International Truck & Engine Corporation and published by Intelligent Transportation Systems Institute Center for Transportation Studies, University of Minnesota, Minneapolis, MN, July, 2005.													x
126	Drucker, K. (2005). China - U.S. Transportation Data & Information Exchange, Presentation at Transportation Research Board 84th Annual Meeting, Washington, D.C., January, 2005.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
127	Duluth Port Authority (2006). Marine Tonnage Reports, http://www.duluthport.com/seawaytonnagestats.html			x		x							x	
128	Duych, R.J. (2005). Scope and Industry Coverage of the 2007 Commodity Flow Survey. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.													x
131	EIA (2006a). Oil Pipeline Data, www.eia.doe.gov/neic/a-z/petroleuma-z.htm#p									x				
132	EIA (2006b). Capacity and Service on the Interstate Natural Gas Pipeline System Publication									x				
133	Eisele, W.L. and L.R. Rilett (2002). Examining Information Needs for Efficient Motor Carrier Transportation by Investigating Travel Time Characteristics and Logistics, Report No. SWUTC/01/473700-00005-1, Center for Transportation Research, University of Texas at Austin, TX, August, 2002.													x
134	E.J.B. Associates (2005). Transportation Perspective 2005, June, 2005 http://www.remassoc.com/Portals/0/Transportation%20Perspective%202005.pdf; Accessed July 26, 2005.													x
135	Eldridge, C. and J. Fruin (1984). The Transportation of Minnesota Forest Products, Staff Paper P85-17. Department of Agriculture and Applied Economics, University of Minnesota, December 1984.					x								x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHIOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
136	Elias, B. (2003). *Air Cargo Security*, CRS Report for Congress, September 11, 2003.									x				
137	Elliott, H.R. and R.T. Mitchell. (2002). Development of a Nonaccident-Release. Risk Index. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 52-65.													x
138	EPA (2004). Characteristics and Performance of Regional Transportation System. Report EPA-231-R-04-001, Development, Community, and Environment Division, Washington, D.C., January 2004									x				
139	Erlbaum, N. and Holguín-Veras, J. (2005). *Some Suggestions For Improving CFS Data Products. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.*													x
140	eyefortransport (2006). eyefortransport Daily Newsletter, www.eyefortransport.com	x	x	x	x	x	x	x	x					x
141	FAA. (2005a). U.S. Air Carrier Traffic and Capacity Data by Nonstop Segment and On-Flight Market (Form 41 Schedule T-100), Washington,DC.									x				
142	FAA. (2005b). Airport Activity Statistics of Certificated Route Air Carriers, Washington, DC.									x				
143	Fallat, G., K. Opie, J. Curley, J. Rowinski, R. Liu. (2003). Freight Planning Support System – Final Summary Report. National Center for Transportation and Industrial Productivity, New Jersey Institute of Technology, Newark, NJ. July, 2003. http://transportation.njit.edu/nctip/final_report/FreightPlanning.pdf Accessed July 12, 2005.													x
144	Fekpe, E.S.K. (1996) Computerized Heavy-Vehicle Size and Weight Regulations Data Base. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 77–82.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
145	Fekpe, E. and D. Gopalakrishna (2003). Traffic Data Quality Workshop Proceedings and Action Plan, Final Report, Federal Highway Administration, Washington, D.C., September 25, 2003.									x				
146	Fekpe, E.S.K., T. Windholz, K. Beard and K. Novak (2003). *Quality and Accuracy of Positional Data in Transportation.* National Cooperative Highway Research Program Report 506, TRB, National Research Council, Washington, D.C., 2003.									x				
147	FHWA (1997). Highway Cost Allocation Study, Final Report, August, 1997.									x				
148	FHWA. (1998). U.S. Freight Economy in Motion, Federal Highway Administration, Washington, DC. 1998.									x				
149	FHWA (2000). National Freight Transportation Workshop Proceedings. September, 2000. http://ops.fhwa.dot.gov/freight/documents/workshop_all.pdf; Accessed, August 5, 2005.									x				
150	FHWA (2001a). Review of Environmental Factors Affecting Intermodal Freight Transportation Facility Development and Expansion. Office of Freight Management and Operations, Federal Highway Administration, Washington, D.C. January 2001; http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed, August 5, 2005.									x				
151	FHWA (2001b). Vehicle Travel Information System (VTRIS), http://www.fhwa.dot.gov/ohim/ohimvtis.htm	x	x		x	x	x	x	x	x				
152	FHWA. (2005a). Freight Facts and Figures. Www.ops.fhwa.dot.gov/freight									x				
153	FHWA (2005b). Monthly Traffic Volume Trends (TVT), FHWA, Washington, DC; http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm									x				

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
154	FHWA (2005c). Vehicle Classification and Vehicle Miles Travelled (VCVMT) Database									x				
155	FHWA (2005d). Freight Analysis Framework (FAF) Commodity Flow Database, 2002, http://ops.fhwa.dot.gov/freight/freight_analysis/faf	x	x	x	x	x	x	x	x	x				
156	FHWA (2005e). Highway Performance Monitoring System (HPMS), www.fhwa.dot.gov/policy/ohpi/hpms									x				
157	FHWA (2005f). National Planning Highway Network (NHPN), http://www.fhwa.dot.gov/planning/nhpn									x				
158	FHWA (2005g). FAF Highway Capacity Database, www.ops.fhwa.dot.gov/freight/freight_analysis/faf									x				
159	FHWA (2005h). Long Term Pavement Performance (LTPP) – http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=260									x				
160	FHWA (2005i). Highway Statistics,www.fhwa.dot.gov/policy/ohim/hs02/mv.htm									x				
161	Figliozzi, M. A., R. Harrison, and J.P. McCray (2001). Estimating Texas-Mexico North American Free Trade Agreement Truck Volumes. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 42–47.													x
162	FMCSA (2005c). Commerical Vehicle Safety Data, www.fmcsa.dot.gov/factsfigs/dashome.htm									x				

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
163	FMSCA (2005a). Large Truck Crash Facts - http://ai.fmcsa.dot.gov/CrashProfile/National_Profiles/Introduction.htm									x				
164	FMCSA (2005b). Motor Carrier Management Information System (MCMIS) Crash File. http://mcmiscatalog.fmcsa.dot.gov/beta/Catalogs&Documentation/									x				
165	FRA (1978). Rail Planning Manual, Volume II—Guide for Planners, Federal Railroad Administration, Washington, D.C., July, 1978.									x				
166	FRA (2005a). Railroad-Highway Crossings, http://gis.fra.dot.gov									x				
167	FRA (2005b). FRA National Planning Network, FRA, Washington, DC.									x				
168	FRA (2005c). Grade Crossing Inventory System (GCIS)									x				
169	Francis, G, Fry, J, and Humphreys, I. (2002). International Survey Of Performance Measurement In Airports. In Transportation Research Record 1788, TRB, Washington, DC, 2002, pp. 101-106.													x
170	Fruin, J. and R. Crnkovich. (1978). Western Coal Transportation Rates for Minnesota Users, Staff Paper P78-3. Department of Agriculture and Applied Economics, University of Minnesota, 1978.			x										x
171	Fruin, J., (1989). U.S. Corn Movements, 1985 - A Preliminary Report of Data, Staff Paper P89-24. Department of Agriculture Economics, University of Minnesota, Juy, 1989.	x												x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
172	Fruin, J. and D.E. Halbach (1994). An Analysis of Canadian Rail Movements to the United States Using the 1992 Public Use Waybill Sample,Staff Paper P94-5. Department of Agriculture Economics, University of Minnesota, March, 1994.	x		x	x	x	x							x
173	Fruin, J. and D.G. Tiffany (2002). Where Does Minnesota's Grain Crop Go? An Analysis of Minnesota's Elevator Grain Shipments for the Period, 7/99 - 6/00, Report No. MN/RC 2002-12, Minnesota Department of Transportation, St. Paul, MN, 2002.	x												x
174	Fruin, J. (1995). The Importance of Barge Transportation to America's Agriculture, Staff Paper P95-4. Department of Agriculture Economics, University of Minnesota, 1995.	x												x
175	Fruin, J. and K. Fortowsky (2004). Modal Shifts from the Mississippi River & Duluth/Superior to Land Transportation, Report No. MN/RC-2004-28, Minnesota Department of Transportation, St. Paul, MN, 2004.	x	x	x	x				x			x		
176	FTR Associates (2003). The Rails Ahead, U.S. Freight Outlook for the Rail Industry Published Monthly, Freight Transportation Research (FTR) Associates Inc., Nashville, IN 47448, www.ftrassociates.net, June 2003.	x												x
177	Gannon, C. and Z. Shalizi. The Use of Sectoral and Project Performance Indicators In Bank-Financed Transport Operations. Report TWU 21, Environmentally Sustainable Development, Transportation, Water & Urban Development Department, The World Bank, Washington, D.C. April 1995.													x
178	Giaimo, G. (1996). State of the Practice in Freight Modeling at State DOT's, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
179	Giannopoulos, G. A. (2002). Integrating Freight Transportation with Intelligent Transportation Systems - Some European Issues and Priorities. *In Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 29-35.													x
180	Gihring, CK and Greene, W. (2000). Washington State Ferries: Performance Measures And Information Support. In Transportation Research Record 1704, TRB, Washington, DC, 2000, pp. 93-99.											x		

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
181	Global Insight, Inc. (2005a). Perspectives, weekly e-Newsletter, http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
182	Global Insight, Inc. Port Tracker A Monthly Logistics and Intermodal Outlook, http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
183	Global Insight, Inc. (2005b). Intermodal Freight Flow Database, http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
184	Global Insight, Inc. (2005c). FREIGHT LOCATOR™ , http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
185	Global Insight, Inc. (2005e). TRANSEARCH® INSIGHT, http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
186	Global Insight, Inc. (2005f) Global Trade and Transportation GLOBALINSIGHT, http://www.globalinsight.com/	x	x	x	x	x	x	x	x					x
187	Gordon, P. and Q. Pan (2001). Assembling and Processing Freight Shipment Data: Developing a GIS-Based Origin-Destination Matrix for Southern California Freight Flows, METRANS Transportation Center, University of Southern California, Los Angeles, California, June 30, 2001.													x
188	Gore, A. (1997). Serving the American Public: Best Practices in Performance Measurement. A Benchmarking Study Report, June, 1997. http://govinfo.library.unt.edu/npr/library/papers/benchmrk/nprbook.html; Accessed July 15, 2005.									x				
189	Gosling, GD (2000). Aviation System Performance Measures For State Transportation Planning. In Transportation Research Record 1703, TRB, Washington, DC, 2000, pp. 7-15													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY: AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHIOLESALE (W)	FOOD PRODUCTS (F)	PROVIDER/ DEVELOPER: FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
191	Halbach, D. and J. Fruin (1985). Upper Mississippi River Barge and Towing Industry Fuel Use Analysis, Staff Paper P85-14. Department of Agriculture and Applied Economics, University of Minnesota, March, 1985.													x
192	Halbach, D., J. Fruin, and S. Wulf. 1984 Barge Rates for Upper Mississippi River Commodities, Staff Paper P85-13. Department of Agriculture and Applied Economics, University of Minnesota, April, 1985.	x		x										x
193	Halbach, D. and J. Fruin, Use of the 1992 ICC Public Use Waybill Sample to analyze Corn Movements by Rail, Staff Paper P94-6. Department of Agriculture and Applied Economics, University of Minnesota, March, 1994.	x		x	x	x								x
194	Mark E. Hallenbeck, M.E., E. McCormack, J. Nee, and D. Wright (2003). *Freight Data from Intelligent Transportation System Devices.* Washington State Transportation Center (TRAC), University of Washington, Seattle, WA. July 2003.													x
195	Hamouda, G., F. Saccomanno, and L. Fu (2004). Quantitative Risk Assessment Decision-Support Model for Locating Hazardous Materials Teams. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004 pp. 1-8.													x
197	Harper, D.V. ad P.T. Evers (1991). An Analysis of Intermodal Railroad-Truck Freight Transportation Facilities and Services in Minnesota, Department of Marketing and Logistics Management, University of Minnesota, December, 1991.													x
198	Holguín-Veras, J. and E. Thorson (2000). Trip Length Distributions in Commodity-Based and Trip-Based Freight Demand Modeling Investigation of Relationships. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 37–48.						x							x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
199	Holguín-Veras, J. and E. Thorson (2003). Practical Implications of Modeling Commercial Vehicle Empty Trips. In *Transportation Research Record 1833*, TRB, Washington, D.C., 2003, pp. 87-94.						x	x						x
200	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001a). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.													x
201	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001b). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix I: Literature Review, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.													x
202	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001c). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix II: Compendium of Freight Data Sources, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.													x
203	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001d). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.													x
204	Holguín-Veras, J., Y. López-Genao, and A. Salam (2002). Truck-Trip Generation at Container Terminals Results from a Nationwide Survey. In *Transportation Research Record 1790*, TRB, pp. 89-96.													x
205	Holguín-Veras, J., E. Thorson, and K. Ozbay (2004). Preliminary Results of Experimental Economics Application to Urban Goods Modeling Research. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 9-16.													x
206	Holguin-Veras, J., J. Polimeni, B. Cruz, N. Xu, G. List, J. Nordstrom, and J. Haddock (2005). Off-Peak Freight Deliveries: Challenges and Stakeholders Perceptions. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005													x
207	Horowitz, J.L. and Plewes, T. (2005). Measuring International Trade on U.S. Highways. Committee on National Statistics, Division of Behavioral and Social Sciences and Education, National Research Council, Washington, D.C. 2005.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
208	Humphreys, I and Francis, G (2000). Traditional Airport Performance Indicators: A Critical Perspective. In Transportation Research Record 1703, TRB, Washington, DC, 2000, pp. 24-30.													x
209	Hunt, J.D. (2006a). Calgary Tour-Based Microsimulation of Urban Commercial Vehicle Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
210	Hunt, J.D. (2006b). Oregon Generation 1 Land Use Transport Economic Model Treatment of Commercial Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
211	Huynh, N.N. and C.M. Walton (2005). Methodologies for Reducing Truck Turn Time at Marine Container Terminals, Report No. SWUTC/05/167830-1, Center for Transportation Research, The University of Texas at Austin, TX, May, 2005.													x
212	Huynh, N., C.M. Walton, and J. Davis (2004). Finding the Number of Yard Cranes Needed to Achieve Desired Truck Turn Time at Marine Container Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 99-108.													x
213	Hwang, H. and T. R. Curlee (2005). FAF Commodity Classification: STCC or SCTG?, Oak Ridge National Laboratory, February, 2005.									x				
214	IANA (2006a). Intermodal Market Trends & Statistics, a Quarterly Analysis of Industry Activities, Intermodal Association of North America (IANA), http://www.intermodal.org/	x	x	x	x	x	x	x	x					x
215	IANA (2006b). Intermodal Market Trends & Statistics—Equipment Type, Size and Ownership Monthly Data File, Intermodal Association of North America (IANA), http://www.intermodal.org/													x
216	IANA (2006c). Intermodal Market Trends & Statistics, A Five-Year Data File of Industry Activity, Intermodal Association of North America (IANA)http://www.intermodal.org/	x	x	x	x	x	x	x	x					x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
217	ICF Consulting (2001). North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies, prepared for the North American Commission for Environmental Cooperation, February 21, 2001.													x
218	ICF Consulting and HLB Decision Economics (2002). Economic Effects of Transportation: The Freight Story, Final Report , Federal Highway Administration, Washington, DC., January, 2002.									x				
219	ICF Consulting with Delcan, Inc. (2004). 2010 and Beyond: A Vision of America's Transportation Future – 21st Century Freight Mobility, NCHRP Project 20-24(33) A, Final Report, Prepared for: The National Cooperative Highway Research Program (NCHRP), TRB, National Research Council, August 2004.													x
220	ICF Consulting, HLB Decision Economics, and Louis Berger Group (2001). Freight Benefit/Cost Study-Compilation of the Literature, Final Report , Federal Highway Administration, Washington, DC., February 9, 2001													x
221	Ioannou, P. et al. (2001). Modeling and Route Guidance of Trucks in Metropolitan Areas, METRANS Transportation Center at USC and CSLUB, February, 2001.													x
222	ITE (2003). Trip Generation Handbook, 7th Edition, Institute of Transportation Engineers (ITE), Virginia, D3142003.													x
223	Ivanov, B. (2004). Measuring Performance in Difficult-to-Measure Areas: Freight Systems Second National Conference on Performance Measures To Improve Transportation Systems, Sponsored by Transportation Research Board, August 24, 2004.													x
225	Jessup, E., K.L. Casavant, C.T. Lawson (2004). *Truck Trip Data Collection Methods: Final Report.* SPR 343. Oregon Department of Transportation, Salem OR, 2004. http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/TruckTripData.pdf Accessed July 15, 2005.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
226	Jessup, E. and R. Herrington (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products: Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005	x												x
227	Johnson, S. and J. Sedor (2004). Reliability: Critical to Freight Transportation. Public Roads, November/December 2004 · Vol. 68 · No. 3.									x				x
228	Jones, C. (2005). Measuring Travel Time in Freight-Significant Corridors, FHWA, April, 2005.									x				x
229	Kale, S.R. (2002). *Intermodal and Multimodal Freight Policy, Planning, and Programmingat State Departments of Transportation in the Decade Since ISTEA*, TRB Annual Meeting CDROM, November, 2002													x
230	Kapros, S., K. Panou, D. A. Tsamboulas, K. Seraphim (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products: Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005													x
231	KRAMER Aerotek, Inc., Ricondo & Associates, Inc., and SHE,Inc. Tier 2 Air Service Study --Minnesota in Partnership with Wisconsin, Technical Report, Office of Aeronautics, Minnesota Department of Transportation, June, 2003.											x		
232	Kritzky, B. (2004). Updating Speed Performance Measures of Minnesota's Interregional Corridor System, Presentation at GIS-T 2004 Symposium, 2004.											x		
233	Krueger, H. (1999). Parametric Modeling In Rail Capacity Planning. In *Proceedings of the 1999 Winter Simulation Conference* (P. A. Farrington, H. B. Nembhard, D. T. Sturrock, and G. W. Evans, eds.) pp. 1194-1200.									x				
234	LaFrance-Linden, D., S. Watson, and M. J. Haines (2001).Threat Assessment of Hazardous Materials Transportation in Aircraft Cargo Compartments. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 130–137.													x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
235	Lahsene, J.S. (2006). Emerging Techniques in Development and in Practice, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, TRB, Washington, D.C., September 25-27, 2006.													x
236	Lambert, B. (1997). Critical Issues Facing Freight Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/lambert.pdf													x
237	Lambert, D. (2004). 2004 Minnesota's Lake Superior Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. 2004.	x		x	x	x			x			x		
238	Lambert, B. (2005a). *Shipment Characteristics in the Commodity Flow Survey - Can One Describe An Elephant?* Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.	x	x	x	x	x	x	x	x	x				
239	Lambert, B. (2005b). Developing Freight Performance Measures Using Travel Time Estimates, Presentation, FHWA Office of Freight Management and Operations, USDOThttp://www.ops.fhwa.dot.gov/freight; Accessed July 15, 2005.									x				
240	Lambert, D. (2005c). Minnesota's River Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. March, 2005.	x		x	x	x			x			x		
241	Lambert, B. (2006). Defining Future Needs, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
242	Larson, M.C. (2004). Organizing for Performance-Based Management, Presented at 2nd National Conference on Performance Measures to Improve Transportation Systems, Transportation Research Board, Irvine, California, August 22-24, 2004.													x
243	Lawson, C.T. (2004). Freight Informatics: 21st-Century Data Just in Time *ITE Journal*; Vol. 74 No.12. Institute of Transportation Engineers, Washington, D.C., December, 2004. pp. 38-41.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
244	Lawson, C.T., Strathman, J.G. and Anne-Elizabeth Riis, A. (2002). Survey Methods For Assessing Freight Industry Opinions, Final Report, Prepared for Oregon Department of Transportation, Salem OR, March 2002.											x		
245	Leachman, R. (2006). Port and Modal Elasticity Studies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
246	Levans, M., K.B. Manrodt, and M. Holcomb (2006). Masters of Logistics: 15th Annual Study of Trends and Issues, Presentation/Webcast by Reed Business Information, Supply Chain Group, Logistics Management, October 25, 2006.													x
247	Levinson, D., M. Marasteanu, V. Voller, I. Margineau, B. Smalkoski, M. Hashami, N. Li, M. Corbett, and E. Lukanen (2005). Cost/Benefit Study: Spring Load Restrictions, Final Report, Report No. MN/RC 2005-15, Minnesota Department of Transportation, St. Paul, MN, March, 2005.	x	x				x	x				x		
248	Lin, C. (2004). Load Planning with Uncertain Demands for Time-Definite Freight Common Carriers. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 17-24.													x
249	Lin, I.I., H. S. Mahmassani, P. Jaillet, and C. M. Walton (2002). Electronic Marketplaces for Transportation Services Shipper Considerations. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 1-9.													x
250	Lipinski, M. E. and D. B. Clarke (1996). Resolution of Land Use and Port Access Conflicts at Inland Waterway Ports. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 102–107.													x
251	Lofgren, M. An Overview of State & Provincial Truck Regulations and Permitting - Commonalities and Differences, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.										x			
252	Lofgren, M. and M. Berwick. Evaluation of Strategic Logistics of Rural Firms, Report # MPC-05-177, Upper Great Plains Transportation Institute: North Dakota State University, Fargo, October 2005.										x			

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
253	Loughlin, M.J. and J.S. Adams (1998). Overseas Air Cargo Service, Airborne Export-Producing Industries, and U.S. Cities, 1980-1995, Report No. MN/RC-1998/13, Center for Transportation Studies, University of Minnesota, 1998.													x
254	Luskin, D.M., R. Harrison, C. M. Walton, Z. Zhang, and J. L. Jamieson, Jr. (2002). Divisible-Load Permits for Overweight Trucks on Texas Highways: An Evaluation. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 104-109.													x
255	MacDonald, D.B. (2006). Measures, Markers and Mileposts, The Gray Notebook for the quarter ending March 31, 2006, 5 Year Anniversary Edition, WSDOT's quarterly report to the Governor and the Washington State Transportation Commission on transportation programs and department management, WSDOT, 2006.											x		
256	Akshay Mani, A. and J. Prozzi (2004). *State-Of-The-Practice In Freight Data: A Review Of Available Freight Data In The U.S.* Report No. 0-4713-P2, Center for Transportation Research, The University of Texas at Austin, Austin, Texas. February 2004.													x
257	Maritime Administration (2006). Port Facilities Inventory, Maritime Administration, Washington, DC.									x				
258	Matheny-Katz, M. Barge and Towboat Operating Costs. Presentation. Institute of Water Resources. U.S. Army Corps of Engineers, September, 2002.									x				
259	Maze, T.H. Dennis Kroeger, and Mark Berndt (WSA) (2005). Trucks and Twin Cities Traffic Management, Report No. MN/RC-2005-21, Minnesota Department of Transportation, 2005.											x		
260	McCray, J.P. (1998). North American Free Trade Agreement Truck Highway Corridors U.S.-Mexican Truck Rivers of Trade. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 71–78.													x
261	McCray, J.P. and R. Harrison (1999). North American Free Trade Agreement Trucks on U.S. Highway Corridors. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 79–85.													x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
262	McCullough, G.J.(2003). Trucking Efficiency Versus Transportation Efficiency: An Economic Evaluation of TRB Special Report 267. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 24-29.													x
263	McVey, M.J. and Baumel, C.P. and Hurburgh, C.R (1996). Efficient Distribution of Grain to Meet the Quality Needs of End-Users. Iowa State University, September, 1996.	x												x
264	Memmott, F.W. (1983). Application of Statewide Freight Demand Forecasting Techniques, NCHRP Report 260, TRB, Washington, D.C., 1983.	x	x	x	x	x	x	x	x					x
265	Meyburg, A. and J.R. and Mbwana (2002). *Data Needs in the Changing World of Logistics and Freight Transportation.* Conference Synthesis. 2002 http://www.dot.state.ny.us/ttss/conference/synthesis.pdf Accessed July 15, 2005.													x
266	Meyburg, A.H., J. M. Saphores, and R. E.. Schuler (1996). Collecting Usage Data for Analyzing a Heavy-vehicle, Divisible-Load Permit System. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 9–17.													x
267	Meyer, M.D. (2006). Future Freight Modeling, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
268	Mn/DOT (1986). Minnesota Freight Access Improvement Program: A Discussion Paper, Minnesota Department of Transportation, St. Paul, MN.											x		
269	Mn/DOT (1989). Great Lakes Transportation in Minnesota, Prepared by Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN.	x		x	x							x		
270	MNDOT (1991). Environmental Impacts of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, January 1991.	x		x								x		

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
271	MNDOT (1995a). Need for Intermodal Railroad Terminal Facilities in the Twin Cities Metropolitan Area, Minnesota Department of Transportation, St. Paul, MN. February 1995.											x	x	
272	Mn/DOT (1995b). Natural Gas & Liquid Petroleum System, Ports and Waterways Section, Minnesota Department of Transportation, 1995.											x		
273	Mn/DOT (1999a). Freight Performance Measures: A Yardstick for Minnesota's Transportation System. Recommendations of the Minnesota Freight Advisory Committee, November 1999.											x		
274	Mn/DOT (1999b). The Economic Component of the Metro Freight Study, Minnesota Department of Transportation, January, 1999.											x	x	
275	MnDOT (2000). Minnesota Statewide Transportation Plan, Moving Minnesota from 2000 to 2020, Minnesota Department of Transportation, St. Paul, MN. August, 2000.											x		
276	MnDOT (2003). Minnesota Statewide Transportation Plan, Moving People and Freight from 2003 to 2023, Minnesota Department of Transportation, St. Paul, MN. August, 2003.											x		
277	Mn/DOT (2004). 2004 Minnesota's Lake Superior Terminals, Ports And Waterways Section, Minnesota Department of Transportation, Spring, 2004.											x		
278	MNDOT (2005a). *Minnesota Statewide Freight Plan*. Minnesota Department of Transportation (MNDOT). Office of Freight and Commercial Vehicle Operations. May, 2005. http://www.dot.state.mn.us/ofrw/statewide_plan.htm											x		
279	MNDOT (2005b). Twin Cities Area Barge Fleeting, http://www.dot.state.mn.us/ofrw/reports.html; Accessed July 15, 2005.												x	

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
280	Mn/DOT (2005c). Minnesota's River Terminals, Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN., March, 2005.	x		x	x							x		
281	MNDOT (1997). Monetary Cost of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, March, 1997.	x		x								x		
282	Moore, P.D., K.B. Manrodt, M.C. Holcomb (2005). Collaboration: Enabling Synchronized Supply Chain, Collaboration: Enabling Synchronized Supply Chains, Report on Trends and Issues in Logistics and Transportation.													x
283	Moore, P.D., K.B. Manrodt, M.C. Holcomb, M. Riegler (2006). The Power of O3: Optimized Strategy, Planning and Execution, Report on Trends and Issues in Logistics and Transportation, Capgemini, Georgia Southern University, and the University of Tennessee, 2006.													x
284	Morash, EA. (2000). Linking Public And Private Performance Measurement. In Transportation Research Record 1729, TRB, Washington, DC, 2000, pp. 42-50.													x
285	Morlok, E.K. and S. P. Riddle (1999). Estimating the Capacity of Freight Transportation Systems A Model and Its Application in Transport Planning and Logistics. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 1–8.		x											x
286	Morris,A.G. A.L. Kornhauser, and M.J. Kay (1998). Urban Freight Mobility Collection of Data on Time, Costs, and Barriers Related to Moving Product into the Central Business District. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 27–32.						x							x
287	Morris, A.G., A.L. Kornhauser, and M. J. Kay (1999). Getting the Goods Delivered in Dense Urban Areas. A Snapshot of the Last Link of the Supply Chain. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 34–41.													x
288	Morris, A.G. and A. L. Kornhauser (2000). Relationship of Freight Facilities in Central Business District Office Buildings to Truck Traffic. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 56–63.													x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
289	Murray, D. (2005). Tracking the Trucking Industry … 2004 and Beyond, Presentation, American Transportation Research Institute (ATRI), March, 2005.													x
290	Mussell, A. and J. Fruin (1997). Minnesota Shippers and State Truck Size/Weight Regul;ations, A Report Submitted to Minnesota Department of Transportation, Staff Paper P97-3, Department of Agriculture and Applied Economics, University of Minnesota, April, 1997.	x	x				x	x				x		
291	NATS (2006). National American Transportation Statistics (NATS), http://nats.inegi.gob.mx/nats	x	x	x	x	x	x	x	x					x
292	Neels, K. (2006). Freight Demand Modeling: Perspectives from the Private Sector, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
293	NGP (2001). Trade Patterns and the Economy of the Northern Great Plains: A Baseline Report, Northern Great Plains, Inc., March 2001.													x
294	NHTSA (2005a). Fatality Analysis Reporting System (FARS). http://wwwfars.nhtsa.dot.gov/									x				
295	NHTSA (2005b). General Estimates System (GES). http://wwwnrd.nhtsa.dot.gov/departments/nrd-30/ncsa/ges.html									x				
296	Niles, J. (2003). *Trucks, Traffic, and Timely Transport:A Regional Freight Logistics Profile.* MTI REPORT 02-04, Mineta Transportation Institute, San Jose, CA, June, 2003.													x
297	Norwood, J. and J. Casey (2002). Key Transportation Indicators. Summary of a Workshop. National Research Council, National Academy Press, Washington, DC. 2002.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
298	NPWI (1995).Lousiana Statewide Intermodal Plan. Louisiana State University. National Ports and Waterways Institute(NPWI), Louisiana Department of Transportation and Development, LA. July, 1995.											x		
299	NTOC (2005). Performance Measurement Initiative, Final Report, National Transportation Operations Coalition (NTOC), July, 2005.													x
300	OECD. OECD Trilog Plenary Symposium: Public Policy Issues in Global Freight Logistics. Conference Proceedings. Washington, D.C., December 17-18, 1998. http://ntl.bts.gov/lib/8000/8300/8351/trilog1.pdf Accessed July 15, 2005													x
301	ORNL (1990). Nationwide Truck Activity and Commodity Survey (NTACS), Oak Ridge National Laboratory, Tennessee.									x				
302	ORNL (2006), Transportation Energy Data Book, 25th Edition, Oak Ridge National Laboratory, Tennessee.									x				
304	Papiernik, DK, Nanda, D, Cassada, RO, and Morris, WH (2000). Data Warehouse Strategy To Enable Performance Analysis In Transportation Research Record 1719, TRB, Washington, DC, 2000, pp. 175-183.													x
305	Minyoung Park, M. and A. Regan (2005).Capacity Modeling in Transportation: A Multimodal Perspective.*Forthcoming* In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005													x
306	Pratt, RH and Lomax, TJ (1996). Performance Measures For Multimodal Transportation Systems, In Transportation Research Record 1518, TRB, Washington, DC, pp. 85-93, 1996.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHIOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
307	R.L. Banks and Associates (1995). Twin Cities Region Intermodal Terminal Needs Study, A Report to The Metropolitan Council, January, 1995.											x	x	
308	R.L. Banks and Associates (2004). Rail Freight Competition Study, Report prepared for State of Montana, Governor's Office of Economic Development, MT, October, 2004.											x		
309	Rabah, M. and H. S. Mahmassani (2002). Impact of Information and Communication Technologies on Logistics and Freight Transportation -- Example of Vendor-Managed Inventories. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 10-19.													x
310	Raj, P.K. and E.W. Pritchard (2000). Hazardous Materials Transportation on U.S. Railroads Application of Risk Analysis Methods to Decision Making in Development of Regulations. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 22–26.													x
311	Reed Business Information (2006). Logistics Management, www.logisticsmgmt.com, Waltham, MA.													x
312	Resor, R.R. and G. L. Thompson (1999). Do North American Railroads Understand Their Costs? Implications for Strategic Decision Making. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 9–16.													x
313	Resor, R.R. and Blaze, J.R. (2004). Short-Haul Rail Intermodal--Can It Compete with Trucks? In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 45-52.													x
314	Roden, D.B. Forecasting Travel Time, In Transportation Research Record 1518, TRB, Washington, DC, pp. 7-12, 1996.													x
315	Rodríguez, D.A., M. Rocha, A. J. Khattak, and M. H. Belzer (2003). Effects of Truck Driver Wages and Working Conditions on Highway Safety Case Study. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 95-102.													x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
316	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1977) *Freight Data Requirements for Statewide Transportation Systems Planning.* Research Report, NCHRP Report 177, TRB, Washington, D.C., 1977	x	x	x	x	x	x	x	x					x
317	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1978). *Freight Data Requirements for Statewide Transportation Systems Planning. User's Manual*, NCHRP Report 178, TRB, Washington, D.C., 1978	x	x	x	x	x	x	x	x					x
318	Ross, T., Manrodt, K.B. and Holcomb, M.C. (2003). Operations Excellence --The Transition from Tactical to Adaptive Supply Chains--Report on Trends and Issues in Logistics and Transportation, A Report by Cap Gemini Ernst & Young and The University Of Tennessee, 2003.													x
319	Rowinski, J., Y. Wang, M. P. Boilé, and L.N. Spasovic (2000). *A Multi-Commodity, Multi-Class Generalized Cost User Equilibrium Assignment Model.*National Center for Transportation and Industrial Productivity, New Jersey Institute of Technology, Newark, NJ. July 30, 2000. http://transportation.njit.edu/nctip/publications/multi_commodity.pdf Accessed July 12, 2005.													x
320	RTI International (2004). Economic Impact of Inadequate Infrastructure for Supply Chain Integration, Planning Report 04-2, Prepared for National Institute of Standards & Technology, Washington, D.C., June, 2004.													x
321	Schmitt, R.R. (2002). Freight Analysis Framework-North American Interchange on Transportation Statistics, Presentation, Federal Highway Administration, April 2002.									x				
322	Schofer, J.L. (2003). *Shrinking Sample Size Undermines Usefulness of Commodity Flow Survey Data.* Third Letter Report, Committee to Review the Bureau of Transportation Statistics' (BTS) Survey Programs. March, 2003. http://trb.org/publications/reports/bts_cfs.pdf									x				x
323	Selness, C. (2005). Minnesota's Freight Performance Measure, Presentation at FHWA Talking Freight Seminar August 17, 2005											x		
324	Senf, D.R. and J. Fruin (1986). An Assessment of the Competitive Position of Great Lakes Ports in the International Steam Coal Market, Staff Paper P86-1. Department of Agriculture and Applied Economics, University of Minnesota, January, 1986.			x										x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
325	Shaw, T. (2003). Performance Measures of Operational Effectiveness for Highway Segments and Systems, A Synthesis of Highway Practice, NCHRP Synthesis 311, Transportation Research Board, Washington, D.C., 2003.													x
326	SITA Logistics Solutions (2001). *Minneapolis-Saint Paul Air Cargo Study, SITA Logistics Solutions,* Geneva, Switzerland, December 2001.												x	
327	SLSA (2005). St. Lawrence Seaway Annual Traffic Report. St. Lawrence Seaway Development Corporation (SLSDC).http://www.greatlakes-seaway.com/en/news/tonnage_info.html										x			
328	Smalkoski, B. And Levinson, D. (2003). Value Of Time For Commercial Vehicle Operators In Minnesota, University Of Minnesota, Twin Cities, December, 2003.											x		
329	Smith, N., G. Chow, and L. Ferreira (2002). E-Business Challenges for Intermodal Freight. Some International Comparisons. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 20-28.													x
330	Satisfaction Management Systems, Inc. (1998). Mn/DOT 1998 Freight Market Segmentation Study for the Manufacturing Industries.		x										x	
331	Solano, P., R. Wright and V. Wanca (2003). BTS Intermodal Facility Freight Transfer Database. Bureau of Transportation Statistics, Washington, D.C., 2003.									x				
332	Sorensen, P.C., E. Irelan, B. Winningham, and T. A. Noyes (1997). Skagit Countywide Air, Rail, Water, and Port Transportation System Study .In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 4–13.													x
333	Southworth, F. (2001). The Future for Freight Transportation Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/southworth.pdf Accessed July 15, 2005.													x

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
334	Southworth, F. (2003). Simulating U.S. Freight Movements in the 2002 Commodity Flow Survey (Putting the Miles in Ton-Miles), a Presentation to Bureau of Transportation Statistics' International Trade Traffic Study Workshop, Washington, DC., November, 2003.									x				
335	Southworth, F. (2005). Filling Gaps in the U.S. Commodity Flow Picture: Using the CFS with Other Data Sources, Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.									x				
336	Southworth, F. (2006). Ongoing Research: Some Emerging Methodologies in Freight Demand Modeling, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
337	Spear, B. (2006). Freight Modeling in Urban Areas: State of the Practice, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
338	SRF Consulting (2001). Metropolitan Council 2001 Twin Cities Transportation System Audit Metropolitan Council, St. Paul, Minnesota, 2001.												x	
339	SRF Consulting Group, Inc. (2003) Adequacy of Freight Connectors to Interregional Corridors and Major Highways, Prepared for Minnesota Department of Transportation, June, 2003.										x			
340	SRF Consulting Group, Inc. and Cambridge Systematics, Inc. (2004). Twin Cities Regional Freight Planning Model, Technical Memorandum, prepared for Metropolitan Council and Minnesota Department Of Transportation, November 30, 2004.										x		x	
341	STB (2005). Carload Rail Waybill Sample, Surface Transportation Board (STB), Washington, DC, www.stb.dot.gov	x	x	x	x	x	x	x	x	x				
342	Stewart, R.D., R. J. Eger III, L. Ogard and F. Harder, Tioga Group and Associates (2003). Twin Ports Intermodal Freight Terminal Study: Evaluation of Shipper Requirements and Potential Cargo Required to Establish a Rail-Truck-Marine Intermodal Terminal in the Twin Ports of Superior, Wisconsin and Duluth, Minnesota, Midwest Regional University Transportation Center, University of Wisconsin, Madison, 2003.												x	x

Table B.2. Classification of measurement sources by sector and provider, continued

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		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
343	Stiehl, M. and F.G. Rawling (2001). Intermodal Volumes: Tracking Trends & Anticipating Impacts in Northeast Illinois, Working Paper 01-04, Chicago Area Transportation Study (CATS), Chicago, Illinois, May, 2001.													x
344	Stone, JR, Baugh, JW, Chakravarty, S, and Surasky, MN (2001). Winston-Salem Mobility Manager: Data Collection, Validation, and Performance Evaluation. In Transportation Research Record 1760, TRB, Washington, DC, 2001, pp. 114-120.													x
345	Strauss-Wieder, A. (2003). Integrating Freight Facilities and Operations with Community Goals. National Cooperative Highway Research Program (NCHRP) Synthesis of Highway Practice 320, TRB, National Research Council, Washington, D.C.													x
346	Street Smarts, Rizzo Associates, and Georgia Institute of Technology (2003). Study of Hourly Truck Movements around Atlanta, Georgia Department of Transportation, Atlanta, Georgia, 2003.												x	
347	Sylvester, J.T., S.S. Wallwork, P.E. Polzin, M. Nesary (1995). Montana Airport Multimodal Study—Part 1—Methods and Results, Bureau of Business and Economic Research, The University of Montana, November, 1995.											x		
348	Tan, A.C. and Royce O. Bowden (2004). The Virtual Intermodal Transportation System (VITS), Final Report, Department of Industrial Engineering, Mississippi State University, May 2004.													x
349	Taniguchi, E. and Thompson, R.G. (2004). Modeling City Logistics. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 45-51.												x	x
350	Tarkenton, L. (2005). Trends in Marine Terminal Operations Management, Port of Virginia, 2005.												x	
351	The Colography Group (2006a). U.S. Domestic And Export Air Traffic And Yield Analyses By Competitor And Market Segment (Colography), Marietta Georgia. http://www.colography.com/exportairtandy.html													x

Table B.2. Classification of measurement sources by sector and provider, continued

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		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
352	The Colography Group (2006b). Global Cargo Market Projections (Colography), Marietta Georgia. http://www.colography.com/gcmp.html													x
353	The Colography Group (2006c). U.S. International Cargo By Commodity And Country (Colography), Marietta Georgia. http://www.colography.com/iacc.html													x
354	The Colography Group (2006d). Domestic Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/dact.html													x
355	The Colography Group (2006e). International Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/iact.html													x
356	The Logistics Institute - Asia Pacific. *The Asia Pacific Air Cargo System*, Research Paper No: TLI-AP/00/01, Georgia Institute of Technology, 2001.													x
357	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (1999). Striving for Excellence: New Measures for Logistics—Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 1999.													x
358	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2000). Transforming Logistics--A Roadmap to Fulfillment Excellence, Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 2000.													x
359	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2001). Logistics@ Internet Speed:—The Impact of e-Commerce on Logistics, Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 2001.													x
360	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2002). Logistics and Transportation, 11 th Annual Survey of Issues and Trends, A Report by Ernst & Young and The University Of Tennessee, 2002.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
361	TRANSCORE (2001). Washington-British Columbia Cross-Border Commercial Vehicle Operations, Updated Final, Concept of Operations, Northwest International Trade Corridor Program Phase-2, June 15, 2001.											x		
362	Transport Topics Publishing Group (2006). Transport Topics, Daily Update of Trucking News, www.ttnews.com/													x
363	TransTech Management, Inc. (2003). Strategic Performance Measures for State Departments of Transportation: A Handbook for CEOs and Executives, FINAL REPORT, National Cooperative Highway Research Program, Project No. 20-24(20), TRB, National Research Council, Washington DC, June 2003.													x
364	TRB. (1986). Twin Trailer Trucks. TRB Special Report 211, TRB, National Research Council, Washington, D.C.													x
365	TRB. (1987). Measuring Airport Landside Capacity. TRB Special Report 215, TRB, National Research Council, Washington, D.C.													x
366	TRB. (1990a). Truck Weight Limits: Issues and Options. TRB Special Report 225, TRB, National Research Council, Washington, D.C.													x
367	TRB. (1990c). Data Requirements for Monitoring Truck Safety. TRB Special Report 228, TRB, National Research Council, Washington, D.C.													x
368	TRB. (1992). Intermodal Marine Container Transportation -- Impediments and Opportunities. TRB Special Report 236, TRB, National Research Council, Washington, D.C.													x
369	TRB. (1993a). ISTEA and Intermodal Planning-Concept Practice Vision. TRB Special Report 240, TRB, National Research Council, Washington, D.C.													x

Table B.2. Classification of measurement sources by sector and provider, continued

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		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
370	TRB. (1993b). Landside Access to U.S. Ports. TRB Special Report 238, TRB, National Research Council, Washington, D.C.													x
371	TRB. (1994). International Symposium on Motor Carrier Transportation. Conference Proceedings 3. TRB, National Research Council, Washington, D.C.													x
372	TRB (1997)."Findings," In Information Needs to Support State and Local Transportation Decision Making into the 21st Century, Conference Proceedings 14, Transportation Research Board, Washington, DC, pp. 23-59, 1007.													x
373	TRB. (1997). National Conference on Setting an Intermodal Transportation Research Framework. Conference Proceedings 12. TRB, National Research Council, Washington, D.C.													x
374	TRB. (1998a). Policy Options for Intermodal Freight Transportation. TRB Special Report 252, TRB, National Research Council, Washington, D.C.													x
375	TRB. (1998b). Intermodal Transportation Education and Training. Conference Proceedings 17. TRB, National Research Council, Washington, D.C.													x
376	TRB. (2001a). Global Intermodal Freight State of Readiness for the 21st Century, Report of a Conference, Conference Proceedings 25, TRB, National Research Council, Washington, D.C., 2001													x
377	TRB. (2002a). The NHTSA's Rating System for Rollover Resistance-An Assessment. TRB Special Report 265, TRB, National Research Council, Washington, D.C.													x
378	TRB. (2002b). Regulation of Weights, Lengths, and Widths of Commercial Motor Vehicles. TRB Special Report 267, TRB, National Research Council, Washington, D.C.													x

Table B.2. Classification of measurement sources by sector and provider, continued

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		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
379	TRB. (2003a). A Concept for a National Freight Data Program. TRB Special Report 276, TRB, National Research Council, Washington, D.C.													x
380	TRB. (2003c). Shipboard Automatic Identification System Displays--Meeting the Needs of Mariners. TRB Special Report 273, TRB, National Research Council, Washington, D.C.													x
381	TRB. (2003d). Cybersecurity of Freight Information Systems -- A Scoping Study. TRB Special Report 274, TRB, National Research Council, Washington, D.C.													x
382	TRB. (2003e). TRB. Measuring Personal Travel and Goods Movement, A Review of the Bureau of Transportation Statistics' Surveys, TRB Special Report 277, Transportation Research Board, Washington, DC.													x
383	TRB (2005). Intermodal Shipments, Warehousing, and Third Parties: A Special Measurement Issue. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.													x
384	TRB. (1990b). New Trucks for Greater Productivity and Less Road Wear-An Evaluation of the Turner Proposal. TRB Special Report yyy, TRB, National Research Council, Washington, D.C.													x
385	TRB. (1998c). Transportation Issues in Large U.S. Cities. Conference Proceedings 18. TRB, National Research Council, Washington, D.C.													x
386	TRB. (2003b). Freight Capacity for the 21st Century. TRB Special Report 271, TRB, National Research Council, Washington, D.C.													x
387	TRB. (2004a). The Marine Transportation System and the Federal Role--Measuring Performance, Targeting Improvement. TRB Special Report 279, TRB, National Research Council, Washington, D.C.													x

Table B.2. Classification of measurement sources by sector and provider, continued

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388	Turnquist, M., A. Meyburg, and G. List (1993). Goods Movement: Regional Analysis and Database, Draft Final Report, University Transportation Research Centers Program, Region II, Cornell University, March 26, 1993.													x
389	Turnquist, M.A. (2006). Characteristics of Effective Freight Models, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm													x
390	UMTRI (2005). Trucks Involved in Fatal Accidents (TIFA) – http://www.umtri.umich.edu/cnts/tifa.htm													x
391	UMVRDC (1986). Locational and Feasibility Study Containerized Shipment of Agricultural Products, Upper Minnesota Valley Regional Development Commission (UMVRDC), June, 1986.	x									x			
392	UMVRC (1987). Freight Access Improvement Program, Upper Minnesota Valley Regional Development Commission (UMVRDC), September, 1987.	x									x			
393	UMVRC (1988). Impacts of Commodities Shipments on Highway and Rail Systems, Upper Minnesota Valley Development Commission (UMVRDC), November, 1988.										x			
394	U.S. Army Corps Engineers (2005a). Waterborne Commerce: Domestic, www.iwr.usace.army.mil/ndc, 2005									x				
395	U.S. Army Corps Engineers (2005b). Waterborne Commerce: Foreign, www.iwr.usace.army.mil/ndc/usforeign									x				
396	U.S. Army Corps Engineers (2005c). U.S. Ports and Waterway Facilities Database, www.iwr.usace.army.mil/ndc									x				

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
397	U.S. Army Corps Engineers (2005d). Vessel Characteristics -- Waterborne Transportation Lines of the United States, www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm									x				
398	U.S. Army Corps Engineers (2005e). Lock Performance Monitoring System (LPMS), www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm									x				
399	USBOC (2005a). 2002 Vehicle Inventory and Use Survey (VIUS), www.census.gov/econ/www/viusmain.html, 2005									x				
400	USBOC (2005b). U.S. Economic Census, U.S.Bureau of Census, www.census.gov/econ/census02									x				
401	USBOC (2005c). U.S. Census County Business Patterns, www.census.gov/epcd/cbp									x				
402	USBOC (2005d). U.S. Bureau of Census. Exports from Manufacturing Establishments.									x				
403	USBOC (2005e). U.S. Bureau of Census. Motor Freight Transportation and Warehousing Survey.									x				
404	USBOC (2005f). U.S. Bureau of Census. Annual Survey of Manufactures Publication.									x				
405	USBOC (2005g) 2002 U.S. Imports/Exports of Merchandise on CD-ROM									x				

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
406	USBOC (2005h). 2002 Commodity Flow Survey, U.S.Census Bureau,http://www.census.gov/econ/www/cfsmain.html 2002 data being processed									x				
407	USDA (1998). Transportation of U.S. Grains—A Modal Share Analysis, 1978-95, United States Department of Agriculture, Washington, D.C., March, 1998.									x				
408	USDA. (2000). A Framework Report for the National Agricultural Transportation Summit. www.ams.usda.gov/tmd/summit/intro.pdf; Accessed July 31, 2005.									x				
409	USDA. (2005a). Shipping Costs for Agricultural Products. Presentation. U.S. Department of Agriculture, Transportation Services Branch, Agricultural Marketing Service.									x				
410	USDA. (2005b). Fresh Fruit and Vegetable Arrival Totals for 23 Cities, U.S. Department of Agriculture, Washington, DC.									x				
411	USDA. (2005c). Grain Transportation, Agricultural Marketing Service, U.S. Department of Agriculture. http://www.ams.usda.gov/tmd/TSB/publications.htm#General%20Transportation%20Information									x				
412	USDOC. (1997). 1993 Commodity Flow Survey Minnesota, 1992 Census of Transportation, Communications, and Utilities, TC92-CF-24, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.		x	x	x	x	x	x	x	x				
413	USDOC.(2005) 2002Commodity Flow Survey (CFS), U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.		x	x	x	x	x	x	x	x				
414	USDOE (2005a). Quarterly Coal Report, U.S. Department of Energy.			x						x				

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
415	USDOE (2005b). Natural Gas Monthly, U.S. Department of Energy.									x				
416	USDOE (2005c). Natural Gas Annual, U.S. Department of Energy.									x				
417	USDOE (2005d). Petroleum Supply Monthly, U.S. Department of Energy.									x				
418	USDOT (2000). NHS Intermodal Freight Connectors: A Report to Congress. U. S. Department of Transportation. 2000 http://www.ops.fhwa.dot.gov/freight/infrastr/nhs/index.htm Accessed July 10, 2005									x				
419	USDOT. Freight and the Environment Charrette Proceedings Report, February, 2005. http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed September, 2005.									x				
420	Vachal, K. and B. Baldwin (2001). Factors Affecting Rail Car Supply, Report MPC-01-121, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, North Dakota, 2001.									x				
421	Vachal, K and J. Bitzan (2002). Long-Term Availability of Railroad Services for U.S. Agriculture. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 62-72.	x									x			
422	Vachal, K.. H. Reichert, and T. Van Wechel (2004). U.S. Containerized Grain and Oilseed Exports Industry Survey. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp120-125	x									x			
423	Vandersteel, W., Y. Zhao, and T.S. Lundgren (1997). Automating Movement of Freight. In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 71–76.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
424	Victoria, I.C. and C. M. Walton (2004). Freight Data Needs at the Metropolitan Level and the Suitability of Intelligent Transportation Systems in Supplying MPOs with the Needed Freight Data, Report No. SWUTC/04/167247-1, Center for Transportation Research, University of Texas at Austin, TX, December, 2004.													x
425	Vilain, P., L. N. Liu, and D. Aimen (1999). Estimation of Commodity Inflows to a Substate Region. An Input-Output Based Approach. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 17–26.													x
426	Wallbaum, M. and C. Pils (2001). Security Considerations for the Parcel Call Real-Time Tracking and Tracing System. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp 138–144.													x
427	Wargo, B. (2006). PierPASS & Operations as a Solution to Freight Congestion, FHWA Talking Freight Seminar, June 21, 2006.									x				
428	Weinblatt, H. (1996). Using Seasonal and Day-of-Week Factoring to Improve Estimates of Truck Vehicle Miles Traveled. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 1–8.													x
429	Wilbur Smith Associates (2002). Virginia Statewide Traffic Model --Review of Available Data, Virginia Department of Transportation, May 22, 2002. http://www.wilbursmith.com/vdotmodel/attachments/082902/Review%20of%20Avail%20Data%20%28Draft%2005-22-02%29.pdf; Accessed July 18, 2005.											x		
430	Wilbur Smith Associates (2003a). The National I-10 Freight Corridor Study-Summary of Findings, Strategies, and Solutions, Final Report, Texas Department of Transportation, 2003.											x		
431	Wilbur Smith Associates (2003b). Louisiana Statewide Transportation Plan—Statewide Intermodal Freight Planning, Presentation at TRB Annual Meeting, January, 2005.											x		
432	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006a). Minnesota Aviation System Plan -- Air Cargo, prepared for Minnesota Department of Transportation, 2006.											x		

Table B.2. Classification of measurement sources by sector and provider, continued

	MEASUREMENT SOURCES	SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
433	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006b). Minnesota Aviation System Plan, Executive Summary, prepared for Minnesota Department of Transportation, 2006.											x		
434	Wittwer, E., T. Adams, T. Gordon, J. Gupta, K. Kawamura, P. Lindquist, M. Vonderembse, and S. McNeil (2005). Upper Midwest Freight Corridor Study, Midwest Regional University Transportation Center, University of Wisconsin-Madison, Madison, WI, March 31, 2005.										x			
435	Wolfe, M (2002). Technology to Enhance Freight Transportation Security and Productivity, Appendix to: "Freight Transportation Security and Productivity", Report Prepared for: Office of Freight Management and Operations, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. 2002.									x				
436	Zavattero, D.A., F.G. Rawling, and D.F. Rice (1998). Mainstreaming Intermodal Freight into the Metropolitan Transportation Planning Process. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 1–11.													x
437	Zemotel, LM and Montebello, DK.(2002). Interregional Corridors: Prioritizing And Managing Critical Connections Between Minnesota's Economic Centers. In Transportation Research Record 1817, TRB, Washington, DC, 2002, pp. 79-87.											x		
438	Zhang, Y. and D. Wu (2003). Development of Trustworthy Intermodal Traffic Measurement. National Center for Intermodal Transportation. http://www.ie.msstate.edu/ncit/Research/ncitdec04/TrustworthyData.htm													x
439	Zhang, Y., R. O. Bowden, Jr., A. J. Allen (2003). *Intermodal Freight Transportation Planning Using Commodity Flow Data*. National Center for Intermodal Transportation. 2003.													x
440	Zmud, S. (2005). Commodity Flow Survey: Improving Methods to Enhance Data Quality and Usefulness. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005.													x
441	Zografos, K.G. and I.M. Giannouli (2002). Emerging Trends in Logistics and Their Impact on Freight Transportation Systems: A European Perspective. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 36-44.													x

Table B.2. Classification of measurement sources by sector and provider, continued

MEASUREMENT SOURCES		SECTOR/ COMMODITY/INDUSTRY								PROVIDER/ DEVELOPER				
		AGRICULTURE (A)	MANUFACTURING (MG)	COAL/IRON/MINING (MN)	PULP & PAPER (P)	LUMBER & WOOD (L)	RETAIL (R)	WHOLESALE (W)	FOOD PRODUCTS (F)	FEDERAL AGENCY (F)	REGIONAL AGENCY (R)	STATE AGENCY (S)	LOCAL AGENCY (L)	PRIVATE (P)
442	Zografos, K.G. and Giannouli, I.G. (2003). Emerging Supply Chain Management Trends and Their Impact on Spatial Organization of Logistical Networks. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 30-39.													x
443	Zografos, K.G. and A.C. Regan. Current Challenges for Intermodal Freight Transport and Logistics in Europe and the United States. In Transportation Research Record 1873, TRB, National Research Council, Washington, D.C., 2003, pp. 70-78.													x

MEASUREMENT SOURCES CLASSIFIED BY PERFORMANCE MEASURE/INDICATOR CATEGORIES

PERFORMANCE MEASURE/INDICATOR CATEGORIES		
NO	PMI	DESCRIPTOR
1	N	NETWORK AND INFRASTRUCTURE
2	S	SAFETY AND DAMAGE
3	A	ACCESS
4	C	CAPACITY
5	T	TRAVEL TIME
6	R	RELIABILITY
7	MK	MARKET SHARE
8	MD	MODE SHARE
9	MC	MODAL COSTS
10	FP	FREIGHT PRODUCTIVTY
11	FS	FREIGHT SECURITY
12	SR	SHIPMENT RATES
13	PR	PRICING
14	AC	AGENCY COST
15	CC	CARRIER COST
16	SC	SHIPPER COST
17	EX	EXTERNALITIES
18	TI	TRANSPORTATION INDICES
19	EF	EXTERNAL FACTORS

Note: The numbers for measurement sources in Appendix B correspond to the Ref No. shown in Appendix A.

Table B.3. Classification of measurement sources by performance measure/indicator categories.

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
1	AAR. (2006a). Freight Commodity Statistics, American Association of Railroads, Washington, DC, http://www.aar.org/							X	x											
2	AAR (2006b.) Railroad Equipment Report, http://www.aar.org/			X																
3	AAR (2006c). Weekly Carload (as reported to the AAR) , http://www.aar.org/							x	X											
4	AAR (2006d).Terminal Dwell Time, http://www.aar.org/					X														
5	AAR (2006e). Weekly Cars online, http://www.aar.org/							x	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
6	AAR (2006f). Train Speeds, http://www.aar.org/					x														
7	AAR (2006g). Freight Loss and Damage, http://www.aar.org/		x																	
8	AAR (2006h). Railroad Facts, http://www.aar.org/							x	x		x					x		x		
9	AAR (2006i). Railroad Revenues, Expenses & Income, http://www.aar.org/															x				
10	AAR (2006j). Railroad Ten-Year Trends, http://www.aar.org/							x	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
11	AAR (2006k). Railroads and States, http://www.aar.org/							x	x											
12	AAR. (2006l). North American Trucking Survey (NATS), Washington, DC							x	x											
13	AAR (2006m). Weekly Railroad Traffic, http://www.aar.org/							x	x											
14	AAR (2006n) Railroad Cost Indexes, http://www.aar.org/															x			x	
15	AAR (2006o). Railroad Cost Recovery Index (RCR), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCRDescription.pdf															x			x	

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
16	AAR (2006p). Rail Cost Adjustment Factor (RCAF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_RCAFHistory.pdf															x				
17	AAR (2006q). All-Inclusive Index Less Fuel (All-LF), http://www.aar.org/PubCommon/Documents/AboutTheIndustry/AllLF.pdf															x				
18	AAR (2006r). Index of Monthly Railroad Fuel Prices, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Index_MonthlyFuelPrices.pdf															x				
19	AAR (2006s). Analysis of Class I Railroads 2005 Data for 2005, http://www.aar.org/							x	x		x					x		x	x	x
20	AAR (2006t). Railway Performance Measures, http://www.railroadpm.org/			x		x	x													

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
21	AAR (2006u). Railroad Class I Statistics, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Statistics.pdf							x	x		x					x		x	x	x
22	AAR (2006v). Profiles of U.S. Railroads, http://www.aar.org/							x	x		x									
23	AAR (2006w). Rail Transportation of Chemicals, http://www.aar.org/							x	x											
24	AAR (2006x). Rail Transportation of Coal, http://www.aar.org/							x	x											
25	AAR (2006y). Rail Transportation of Grain, http://www.aar.org/							X	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
26	Abbott,J. K.B. Manrodt., and P. Moore (2004). From Visibility to Action, Report on Trends and Issues in Logistics and Transportation, Oracle, Georgia Southern University and Capgemini,USA., 2004.		x	x			x									x				
27	Abkowitz, M. and E. Meyer. (1996).Technological Advancements in Hazardous Materials Evacuation Planning. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 116–121.					x	x			x										
28	Abkowitz, M.D., J.P. DeLorenzo, R. Duych, A. Greenberg, and T. McSweeney (2001). Assessing the Economic Effect of Incidents Involving Truck Transport of Hazardous Materials.In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 125–129.					x	x			x										
29	ACI-NA. (2006) Worldwide Airport Traffic Report, Airports Council International (ACI)- North America (NA), Washington, DC.							x												x
30	Ammah-Tagoe, F. and Johnson, D. (2004). Understanding Potential Freight Bottlenecks in the United States: A Look at the GeoFreight Visual Display Tool, Paper presented at the 7th MTS Research and Technology Coordination Conference, Washington, D.C., November 16-18, 2004.				x															

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
31	Apffel, C., J. Jayawardana, A. Ashar, K. Horn, R. McLaughlin, and A. Hochstein (1996). Freight Components in Louisiana's Statewide Intermodal Transportation Plan. In *Transportation Research Record 1552, TRB, National Research Council, Washington, D.C., 1996, pp. 32-41*	x	x	x																
32	ARDC (1983).North Shore Commodity Movement Study : final report / prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.	x	x	x		x		x	x				x					x		x
33	ARDC (1985). Regional Goods Movement Study, Prepared by the Arrowhead Regional Development Commission (ARDC), Duluth, MN.	x	x	x		x		x	x				x					x		x
34	ARDC. (1999). Northeast Minnesota Freight Study, prepared by Arrowhead Regional Development Commission (ARDC), Duluth, MN.Paul, MN.	x	x	x		x		x	x				x					x		x
35	ATA (2005). LTL Commodity and Market Flow Database, American Trucking Associations, Virginia.							x	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
36	ATA (2006). Truckline Express, American Trucking Associations E-Newsletter, www.truckline.com		x	x	x			x	x		x		x	x		x	x		x	x
37	ATRI (2005). Travel Time in Freight Significant Corridors. American Transportation Research Institute. www.atri-online.org; Accessed July 26, 2005.					x	x													
38	Jones, C., Murray, D. and Short, J. (2005) Methods of Travel Time Measurement in Freight-Significant Corridors. Prepared by American Transportation Research Institute. For Transportation Research Board Annual Meeting, January, 2005.					x	x													
39	Baatz, E. (2006). Pricing Trends – Pricing Across the Modes, Logistics Management, http://www.logisticsmgmt.com/October, 2006.													x						

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
42	Ballis, A. (2004a). Introducing Level-of-Service Standards for Intermodal Freight Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 79-88.			x		x														
43	Barber, D. and L. Grobar. (2001). Implementing A Statewide Goods Movement Strategy and Performance Measurement of Goods Movement in California, METRANS Transportation Center, California State University, Long Beach, June, 2001.	x	x	x	x															
44	Barkan, C.P.L., T. T. Treichel, and G.W. Widell (2000). Reducing Hazardous Materials Releases from Railroad Tank Car Safety Vents. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 27–34.																	x		
45	Barnes, G. and P. Langworthy (2003). The Per-Mile Costs of Operating Automobiles And Trucks, Report No. MN/RC 2003-19, Minnesota Department of Transportation, St. Paul, MN, June, 2003.									x										

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
46	Barolsky, R. (2005). Performance Measures to Improve Transportation Planning Practice--A Peer Exchange, Transportation Research Circular E-C073, Transportation Research Board, Washington, D.C., May, 2005.	x	x	x		x												x		
47	Barton, R.A. And John Morrall (1998)., Study of Long Combination Vehicles on Two-Lane Highways, in Transportation Research Record 1613, Journal of Transportation Research Board, TRB, Washington, DC, pp. 43 to 49, 1998.		x																	
48	BEA. (1987). 1982 Benchmark Input-Output Accounts of the United States, Department of Commerce, Bureau of Census, Washington, DC.							x												
49	BEA. (2005). Regional Economic Accounts, www.bea.gov/bea/regional/data.htm							x												
50	Beier, F.J. (2002). The Feasibility of a Shipper Panel to Measure Transportation Services. Final Report. Minnesota Department of Transportation, December, 2002.	x	x	x	x						x									

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
51	Beilock, R. (2005).Transportation Factors Influencing the Competitiveness of Agricultural and Food Products, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.			x									x							x
52	Bertini, R.L., J. Strathman, S. Tantiyanugulchai, S. Malik, and A. El-Geneidy (2005). Multimodal ITS Data Integration and Performance Measurement in Portland, Oregon. TRB Annual Meeting CDROM, 2005.																			x
53	Berwick, M. and Farooq, M. (2003). Truck Costing Model for Transportation Managers, Report MPC-03-152, Upper Great Plains Transportation Institute, North Dakota State University, August 2003									x										
54	Bester, N. L. (1996). Incorporating Energy Criteria in Intermodal Transportation Policy Decisions. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 83–86.																	x		
55	Bureau of Industry Economics (BIE). (1992). International Performance Indicators -- Road Freight, Research Report 46, Canberra, Australia, 1992.		x	x	x															x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
56	Bingham, P. (2006). Freight Transportation "Megatrends" , Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			X
57	Black, W. (2000). Social Change and Sustainable Transport (S C A S T), A Summary of Workshop and Conference Activities, Research Needs and Future Directions, National Science Foundation, 2000.																	X		
58	BLS. (2005a). Wages, Earnings, and Benefits, Bureau of Labor Statistics (BLS), www.bls.gov/wages.htm																			X
59	BLS (2005b). Productivity, Bureau of Labor Statistics (BLS), www.bls.gov/bls/productivity.htm																			X
60	Boardman, J. (2001). The Emerging Importance of Freight Data. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/boardman.pdf Accessed July 15, 2005.							X	X											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
61	**Booz Allen & Hamilton, Inc. (2000a). North American International Trade Corridor, Comprehensive and Coordinated ITS/CVO Plan, Interim Report of the Corridor Baseline, Prepared for Missouri Department of Transportation, December, 2000.**		x	x		x	x			x										x
62	**Booz·Allen & Hamilton Inc.(200b). Transportation System Performance Measures Applicability of Indicators to Projects in the State Highway Operation and Protection Program (SHOPP), Prepared for California Department of Transportation, July 2000.**		x	x		x	x													x
63	**Booz Allen Hamilton, Inc. with ATA Foundation, TransCore, In Association With CTRE, Iowa State University, C.J. Petersen & Associates, Kentucky Transportation Center, University of Kentucky. (2001). North American International Trade Corridor, Development Plan, Comprehensive and Coordinated ITS/CVO Plan for the North American International Trade Corridor, Phase 3 Report, December, 2001.**		x	x		x	x													x
64	**Boske,L., A. Kantak and S. Spruiell. (2004). Identifying Gaps and Limitations in Data Sources by Mapping the Transportation Chain of International Trade Shipments at U.S. Ports, Report No. SWUTC/04/167241-1, Center for Transportation Research, University of Texas at Austin, TX, September, 2004.**							x												
65	**Brander, J.R.G. and F. R. Wilson (2001). Regional Intermodal Freight Transport Flows and Projections. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 20–26.**							x	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
66	Braslau, D. and Fruin, J. (1998). Northwest Minnesota Freight Flow Study : Freight Flow Estimation and Identification of Significant Corridors, Minnesota Department of Transportation, St. Paul, MN.	x	x	x	x	x				x										
67	Braver, E.R., Michael X. Cammisa, Adrian K. Lund, Nancy Early, Eric L. Mitter, And Michael R. Powell (1997). Incidence of Large Truck–Passenger Vehicle Underride Crashes in Fatal Accident Reporting System and National Accident Sampling System, in Transportation Research Record 1595, Journal of Transportation Research Board, TRB, Washington, DC, 1997, pp. 27 to 33.		x																	
68	Bremmer, D., K. C. Cotton, D. Cotey, C. E. Prestrud, G. Westby (2006). Measuring Congestion: Learning From Operational Data, paper to appear in Journal of Transportation Research Board, Washington, DC., 2006.					x	x													
69	Brewster, R. (2005). Identifying Vulnerabilities and Security Management Practices in Agricultural & Food Commodity Transportation, Paper for Transportation Research Board Annual Meeting, January, 2005.	x										x								
70	Brogan, J.J., S.C. Brich, and M.J. Demetsky (2002). Identification and Forecasting of Key Commodities for Virginia. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 73-79							x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
71	Bronzini, M.S. (2006). New Data Sources, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm							x	x			x							x	x
72	BTS (1998). Transportation Statistics Beyond ISTEA: Critical Gaps and Strategic Responses. BTS98-A-01. U.S. Department of Transportation, Washington, D.C., 1998.							x	x		x								x	x
73	BTS (1999). 1997 Commodity Flow Survey Minnesota, 1997 Economic Census Transportation. U.S. Department of Transportation, Bureau of Transportation Statistics, December, 1999.							x	x											
74	BTS (2002). Maritime Trade and Transportation, Bureau of Transportation Statistics, Washington, D.C. 2002.							x	x											x
75	BTS (2005a). Expenses per Mile for the Motor Carrier Industry: 1990 through 2000 and Forecasts through 2005. ops.fhwa.dot.gov/freight/documents/bts.pdf; Accessed October 26, 2005.									x						x				

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
76	BTS (2005b). Transborder Surface Freight Data, www.bts.gov/transborder, 2005					x		x	x											
77	BTS (2005c). Air Traffic Statistics, www.bts.gov/programs/airline_information, 2005							x	x											
78	BTS (2005d) National Transportation Atlas Database (NTAD), www.bts.gov/programs/geographic_information_services, 2005.	x																		x
79	BTS. (2005e). National Transportation Statistics, www.bts.gov/publications/national_transportation_statistics, BTS, Washington, DC.															x		x	x	x
80	Buschena, D.E., J. Fruin, and D.W. Halbach (1988). Minnesota Grain Movements 1985, Staff Paper P88-25. Department of Agriculture and Applied Economics, University of Minnesota, August, 1988.					x		x	x				x							

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
81	C.J. Olson Market Research, Inc. (1995). Quantitative Research Regarding Performance Measures for Intermodal Freight Transportation, Executive Summary, The Minnesota Department of Transportation, St. Paul, MN, October, 1995.		x	x		x	x	x	x		x		x				x			
82	C.J. Petersen & Associates, C.L. Bann & Associates, and Management Directions, Inc. (1997). Northwest Minnesota Freight Flow Study : Primary Data Collection Activities, Minnesota Department of Transportation, St. Paul, MN.					x	x	x	x				x							
83	California EPA and Business, Transportation and Housing Agency (2005). Goods Movement Action Plan, Phase I: Foundations. http://www.arb.ca.gov/gmp/docs/finalgmpplan090205.pdf; Accessed September 29, 2005.		x	x		x												x		
84	Cambridge Systematics, Inc. (1993). *Characteristics and Changes in Freight Transportation Demand.* National Cooperative Highway Research Program (NCHRP) Report 388, 1993.							x	x	x										
85	Cambridge Systematics, Inc. (1999). Multimodal Transportation: Development of a Performance-Based Planning Process, NCHRP Web Document 26 (Project B8-32(2)A): Contractor.s Final Report, TRB, Washington, DC., 1999.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
86	Cambridge Systems, Inc. (2000). Statewide Multimodal Freight Flows Study, Executive Summary, Minnesota Department of Transportation, St. Paul, MN. April, 2000.	x	x	x	x	x	x	x	x											x
87	Cambridge Systematics, Inc. (2001). *Vermont Statewide Freight Study,* Final Report, prepared for the Vermont Department of Transportation, March 2001.			x		x		x	x											x
88	Cambridge Systematics, Inc.(2003a). *Best Practices in Statewide Freight Planning.* NCHRP 8-36(33), Final Report. TRB, National Research Council, Washington, D.C. October, 2003.																			x
89	Cambridge Systematics, Inc. (2003b). *Intermodal Freight Connectors: Strategies for Improvement*, NCHRP Project 8-36, Task 30, Final Report, August, 2003.	x	x	x	x															x
90	Cambridge Systematics, Inc. (2004a). *Development of a Multimodal Tradeoffs Methodology for Use in Statewide Transportation Planning.* NCHRP 8-36(7), Final Report. TRB, National Research Council, Washington, D.C. October, 2004.									x										x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
91	Cambridge Systematics, Inc. (2004b). Accounting for Commercial Vehicles in Urban Transportation Models. 2004. http://tmip.fhwa.dot.gov/clearinghouse/docs/accounting/ Accessed July 12, 2005								x											x
92	Cambridge Systems, Inc. (2004c). Traffic Congestion and Reliability:Linking Solutions to Problems, Final Report, Federal Highway Administration, Washington, DC. July, 2004.					x	x													
93	Cambridge Systematics, Inc. (2004d). Minnesota Statewide Feight Plan,Technical Memorandum 2, Systems Analysis, Final Technical Memorandum, Mn/DOT, July, 2004.	x	x	x	x	x	x	x	x				x							x
94	Cambridge Systematics, Inc with HDR, Inc. (2005b). *Oregon Transportation Plan Policy Analysis.* Oregon Department of Transportation, June, 2005.					x			x											x
95	Cambridge Systematics, Inc. et al. *(1995a). Intermodal Freight Transportation Volume 1--Overview of Impediments, Data Sources for Intermodal Transportation Planning, and Annotated Bibliography*. Report No. DOT-T-96-04, U.S. Department of Transportation, Washington, D.C., December 1995.			x				x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
96	Cambridge Systematics, Inc. et al. (1996). *Quick Response Freight Manual*. Report No. DOT-T-97-10, U.S. Department of Transportation, Washington, D.C., September 1996.							x	x											x
97	Cambridge Systematics, Inc. with Reebie Associates, Inc. (2002). Freight Impacts on Ohio's Roadways, The Ohio Department of Transportation, Final Report, June, 2002.							x	x											x
98	Cambridge Systematics, Inc. with Reebie Associates, H. Cohen, A. Horowitz, R. Pendyala (2005a). *Forecasting Statewide Freight Toolkit*. NCHRP 8-43 Final Report. TRB, National Research Council, Washington, D.C., 2005	x	x	x	x	x	x	x	x	x										x
99	Cambridge Systematics, Inc with URS Corporation (2005c). MnPASS System Study, Final Report, prepared for Minnesota Department of Transportation, April 7, 2005.					x														
100	Cambridge Systematics, Inc., PB Consult, Inc., and TTI (2006a). Performance Measures and Targets for Transportation Asset Management, NCHRP Report 551, Transportation Research Board, Washington, DC, 2006.	x																		x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
101	Cambridge Systematics, Inc. , SRF Consulting Group and H. Cohen (2006b). Minnesota Truck Size and Weight Project, prepared for Minnesota Department of Transportation, June, 2006.	x							x	x										x
102	Campbell, C., D. Braslau, C. Petersen, J. Levine (1995). Minnesota Freight Flows – 1990, Report MN/RC – 95/14, Minnesota Department of Transportation, St. Paul, MN, February, 1995.							x	x											x
103	Carey, J. and J. Semmens (2005). Measurement Tools for Assessing Motor Vehicle Division Port-of-Entry Performance. Forthcoming In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005					x														
104	Casgar, T. (2001). The National Perspective. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/casgar.pdf Accessed July 15, 2005.																			x
105	CBM (2005a). The Journal of Commerce Online, Commonwealth Business Media, (www.joc.com)			x	x		x	x	x	x	x	x	x	x		x	x			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
106	CBM (2005b). Port Import/Export Reporting Service (PIERS), Commonwealth Business Media, www.piers.com.								x											
107	CBM (2005c). Traffic World (www.trafficworld.com)			x	x		x	x	x	x	x	x	x	x		x	x			x
108	CBO (2006). Freight Rail Transportation: Long Term Issues, A Congressional Budget Office Paper, January, 2006.			x	x					x										x
109	CH2M Hill (2005). Minnesota Statewide Heavy Vehicle Safety Plan, prepared for the Minnesota Departments of Transportation and Public Safety, June, 2005.		x																	x
110	Cheng, Y., W. Lin. (2005). Comparison of Methods for Allocating Costs of Empty Railcar Movements in a Railcar Pooling System. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005			x						x										

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
111	Clark, M.L., E. L. Jessup, and K. Casavant.(2003). Dynamics of Wheat and Barley Shipments on Haul Roads to and from Grain Warehouses in Washington State, Strategic Freight Transportation Analysis Report #5, Washington State University, Pullman, WA, September, 2003.	x		x																
112	CTS (2000). Fourth Annual Symposium on the Impacts of Logistics on the Upper Midwest Economy, September 11, 2000, Bloomington, Minnesota, Summary Report, Center for Transportation Studies, 2000.																			x
113	CTS (2001). Fifth Annual Freight and Logistics Symposium,December 7, 2001, Minneapolis, Minnesota, Summary Report, Center for Transportation Studies, 2001.																			x
114	CTS (2002). Sixth Annual Freight and Logistics Symposium,December 6, 2002, St. Paul, Minnesota, Summary Report, Center for Transportation Studies, 2002.																			x
115	CTS. Seventh Annual Freight and Logistics Symposium,December 5, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2003.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
116	CTS (2004). Eighth Annual Freight and Logistics Symposium,December 3, 2003, Minnesota, Summary Report, Center for Transportation Studies, 2004.																			x
117	CTS (2005). Ninth Annual Freight and Logistics Symposium--Freight Mobility:Economic Impacts on the Upper Midwest,December 2, 2005, Minnesota, Summary Report, Center for Transportation Studies, 2005.																			x
118	Curlee, R. (2006). Freight Demand Modeling: State of the Practice within Federal Agencies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm							x	x	x										x
119	Czerniak, R. and S. Gaiser (1997a). Proceedings of Conference One National Freight Planning Applications Conference held in San Antonio, Texas, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.			x	x															x
120	Czerniak, R. and S. Gaiser (1997b). Proceedings of Conference Two Urban Goods And Freight Forecasting Conference held in San Antonio, Texas, Part 2, October, 1996. Federal Highway Administration, Washington, D.C., March, 1997.			x	x															x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
121	Czerniak, R., S. Gaiser, D. Gerard. (1996). The Use of Intermodal Performance Measures by State Departments of Transportation, Final Report, Federal Highway Administration, Washington DC, June 1996.	x	x	x	x	x	x			x	x		x	x		x		x		x
122	Dennis, S. M. (2001). Freight Transportation Rates -- A Multimodal Approach, Bureau of Transportation Statistics, 2001.												x							
123	Dow Jones Transportation Average (DJTA) (2006), http://www.marketwatch.com/tools/marketsummary/indices/																		x	
124	Des Moines Area Metropolitan Planning Organization (DMAMPO). (2002). Goods Movement In The Des Moines Metropolitan Area, June, 2002; http://www.dmampo.org/Publications/goods%20movement.pdf; Accessed July 18, 2005.								x											x
125	Donath, M., D. Murray, and J. Short, J. (2005). Homeland Security and the Trucking Industry, Final Report., Report prepared for International Truck & Engine Corporation and published by Intelligent Transportation Systems Institute Center for Transportation Studies, University of Minnesota, Minneapolis, MN, July, 2005.											x								

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
126	Drucker, K. (2005). China - U.S. Transportation Data & Information Exchange, Presentation at Transportation Research Board 84th Annual Meeting, Washington, D.C., January, 2005.							x												x
127	Duluth Port Authority (2006). Marine Tonnage Reports, http://www.duluthport.com/seawaytonnagestats.html								x											
128	Duych, R.J. (2005). Scope and Industry Coverage of the 2007 Commodity Flow Survey. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.							x	x											
129	EEA (2000). Are we moving in the right direction? Indicators on transport and environment integration in the EU, Environmental issues series No 12, European Environment Agency, Copenhagen, February 2000																	x		x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
131	EIA (2006a). Oil Pipeline Data, www.eia.doe.gov/neic/a-z/petroleuma-z.htm#p								x											
132	EIA (2006b). Capacity and Service on the Interstate Natural Gas Pipeline System Publication				x															
133	Eisele, W.L. and L.R. Rilett (2002). Examining Information Needs for Efficient Motor Carrier Transportation by Investigating Travel Time Characteristics and Logistics, Report No. SWUTC/01/473700-00005-1, Center for Transportation Research, University of Texas at Austin, TX, August, 2002.					x														x
134	E.J.B. Associates (2005). Transportation Perspective 2005, June, 2005 http://www.remassoc.com/Portals/0/Transportation%20Perspective%202005.pdf; Accessed July 26, 2005.																			x
135	Eldridge, C. and J. Fruin (1984). The Transportation of Minnesota Forest Products, Staff Paper P85-17. Department of Agriculture and Applied Economics, University of Minnesota, December 1984.							x												

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
136	Elias, B. (2003). *Air Cargo Security*, CRS Report for Congress, September 11, 2003.											x								x
137	Elliott, H.R. and R.T. Mitchell. (2002). Development of a Nonaccident-Release. Risk Index. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 52-65.		x									x								
138	EPA (2004). Characteristics and Performance of Regional Transportation System. Report EPA-231-R-04-001, Development, Community, and Environment Division, Washington, D.C., January 2004																			x
139	Erlbaum, N. and Holguín-Veras, J. (2005). *Some Suggestions For Improving CFS Data Products. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.*							x	x											
140	eyefortransport (2006). eyefortransport Daily Newsletter, www.eyefortransport.com			x	x	x	x	x	x		x	x	x	x		x	x		x	x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
141	FAA. (2005a). U.S. Air Carrier Traffic and Capacity Data by Nonstop Segment and On-Flight Market (Form 41 Schedule T-100), Washington,DC.				x				x											x
142	FAA. (2005b). Airport Activity Statistics of Certificated Route Air Carriers, Washington, DC.								x											x
143	Fallat, G., K. Opie, J. Curley, J. Rowinski, R. Liu. (2003). Freight Planning Support System – Final Summary Report. National Center for Transportation and Industrial Productivity, New Jersey Institute of Technology, Newark, NJ. July, 2003. http://transportation.njit.edu/nctip/final_report/FreightPlanning.pdf Accessed July 12, 2005.		x	x	x	x	x				x									x
144	Fekpe, E.S.K. (1996) Computerized Heavy-Vehicle Size and Weight Regulations Data Base. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 77–82.	x	x							x								x		x
145	Fekpe, E. and D. Gopalakrishna (2003). Traffic Data Quality Workshop Proceedings and Action Plan, Final Report, Federal Highway Administration, Washington, D.C., September 25, 2003.	x			x	x									x					x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
146	Fekpe, E.S.K., T. Windholz, K. Beard and K. Novak (2003). *Quality and Accuracy of Positional Data in Transportation.* National Cooperative Highway Research Program Report 506, TRB, National Research Council, Washington, D.C., 2003.	x					x													x
147	FHWA (1997). Highway Cost Allocation Study, Final Report, August, 1997.	x	x							x					x					x
148	FHWA. (1998). U.S. Freight Economy in Motion, Federal Highway Administration, Washington, DC. 1998.							x	x											x
149	FHWA (2000). National Freight Transportation Workshop Proceedings. September, 2000. http://ops.fhwa.dot.gov/freight/documents/workshop_all.pdf; Accessed, August 5, 2005.	x	x	x	x	x														x
150	FHWA (2001a). Review of Environmental Factors Affecting Intermodal Freight Transportation Facility Development and Expansion. Office of Freight Management and Operations, Federal Highway Administration, Washington, D.C. January 2001; http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed, August 5, 2005.	x																x		x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
151	FHWA (2001b). Vehicle Travel Information System (VTRIS), http://www.fhwa.dot.gov/ohim/ohimvtis.htm	x							x											
152	FHWA. (2005a). Freight Facts and Figures. Www.ops.fhwa.dot.gov/freight	x	x					x	x					x				x		x
153	FHWA (2005b). Monthly Traffic Volume Trends (TVT), FHWA, Washington, DC; http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm	x							x											
154	FHWA (2005c). Vehicle Classification and Vehicle Miles Travelled (VCVMT) Database	x							x											
155	FHWA (2005d). Freight Analysis Framework (FAF) Commodity Flow Database, 2002, http://ops.fhwa.dot.gov/freight/freight_analysis/faf	x						x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
156	FHWA (2005e). Highway Performance Monitoring System (HPMS), www.fhwa.dot.gov/policy/ohpi/hpms	x	x	x	x															x
157	FHWA (2005f). National Planning Highway Network (NHPN), http://www.fhwa.dot.gov/planning/nhpn	x																		x
158	FHWA (2005g). FAF Highway Capacity Database, www.ops.fhwa.dot.gov/freight/freight_analysis/faf	x			x															x
159	FHWA (2005h). Long Term Pavement Performance (LTPP) – http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=260	x																		x
160	FHWA (2005i). Highway Statistics,www.fhwa.dot.gov/policy/ohim/hs02/mv.htm	x																		

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
161	Figliozzi, M. A., R. Harrison, and J.P. McCray (2001). Estimating Texas-Mexico North American Free Trade Agreement Truck Volumes. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 42–47.							x	x											x
162	FMCSA (2005c). Commerical Vehicle Safety Data, www.fmcsa.dot.gov/factsfigs/dashome.htm		x																	
163	FMSCA (2005a). Large Truck Crash Facts - http://ai.fmcsa.dot.gov/CrashProfile/National_Profiles/Introduction.htm		x																	
164	FMCSA (2005b). Motor Carrier Management Information System (MCMIS) Crash File. http://mcmiscatalog.fmcsa.dot.gov/beta/Catalogs&Documentation/		x																	x
165	FRA (1978). Rail Planning Manual, Volume II—Guide for Planners, Federal Railroad Administration, Washington, D.C., July, 1978.	x		x	x															x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
166	FRA (2005a). Railroad-Highway Crossings, http://gis.fra.dot.gov		x																	
167	FRA (2005b). FRA National Planning Network, FRA, Washington, DC.	x			x															
168	FRA (2005c). Grade Crossing Inventory System (GCIS)	x	x																	
169	Francis, G, Fry, J, and Humphreys, I. (2002). International Survey Of Performance Measurement In Airports. In Transportation Research Record 1788, TRB, Washington, DC, 2002, pp. 101-106.																			x
170	Fruin, J. and R. Crnkovich. (1978). Western Coal Transportation Rates for Minnesota Users, Staff Paper P78-3. Department of Agriculture and Applied Economics, University of Minnesota, 1978.								x				x							

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
171	Fruin, J., (1989). U.S. Corn Movements, 1985 - A Preliminary Report of Data, Staff Paper P89-24. Department of Agriculture Economics, University of Minnesota, Juy, 1989.			x				x	x				x							x
172	Fruin, J. and D.E. Halbach (1994). An Analysis of Canadian Rail Movements to the United States Using the 1992 Public Use Waybill Sample,Staff Paper P94-5. Department of Agriculture Economics, University of Minnesota, March, 1994.							x												
173	Fruin, J. and D.G. Tiffany (2002). Where Does Minnesota's Grain Crop Go? An Analysis of Minnesota's Elevator Grain Shipments for the Period, 7/99 - 6/00, Report No. MN/RC 2002-12, Minnesota Department of Transportation, St. Paul, MN, 2002.			x				x	x											
174	Fruin, J. (1995). The Importance of Barge Transportation to America's Agriculture, Staff Paper P95-4. Department of Agriculture Economics, University of Minnesota, 1995.								x											x
175	Fruin, J. and K. Fortowsky (2004). Modal Shifts from the Mississippi River & Duluth/Superior to Land Transportation, Report No. MN/RC-2004-28, Minnesota Department of Transportation, St. Paul, MN, 2004.			x		x				x										x

The header row above "NETWORK AND INFRASTRUCTURE (N)" through "EXTERNAL FACTORS (EF)" is headed: PERFORMANCE MEASURE/INDICATOR CATEGORIES

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
176	**FTR Associates (2003). The Rails Ahead, U.S. Freight Outlook for the Rail Industry Published Monthly, Freight Transportation Research (FTR) Associates Inc., Nashville, IN 47448, www.ftrassociates.net, June 2003.**							x	x											x
177	**Gannon, C. and Z. Shalizi. The Use of Sectoral and Project Performance Indicators In Bank-Financed Transport Operations. Report TWU 21, Environmentally Sustainable Development, Transportation, Water & Urban Development Department, The World Bank, Washington, D.C. April 1995.**																			x
178	**Giaimo, G. (1996). State of the Practice in Freight Modeling at State DOT's, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm**							x	x											x
179	**Giannopoulos, G. A. (2002). Integrating Freight Transportation with Intelligent Transportation Systems - Some European Issues and Priorities. *In Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 29-35.**																			x
180	**Gihring, CK and Greene, W. (2000). Washington State Ferries: Performance Measures And Information Support. In Transportation Research Record 1704, TRB, Washington, DC, 2000, pp. 93-99.**	x	x		x	x	x			x						x				x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
181	Global Insight, Inc. (2005a). Perspectives, weekly e-Newsletter, http://www.globalinsight.com/							x	x										x	x
182	Global Insight, Inc. Port Tracker A Monthly Logistics and Intermodal Outlook, http://www.globalinsight.com/							x	x											x
183	Global Insight, Inc. (2005b). Intermodal Freight Flow Database, http://www.globalinsight.com/							x	x											x
184	Global Insight, Inc. (2005c). FREIGHT LOCATOR™ , http://www.globalinsight.com/							x	x											x
185	Global Insight, Inc. (2005e). TRANSEARCH® INSIGHT, http://www.globalinsight.com/							x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
186	Global Insight, Inc. (2005f) Global Trade and Transportation GLOBALINSIGHT, http://www.globalinsight.com/							x	x											x
187	Gordon, P. and Q. Pan (2001). Assembling and Processing Freight Shipment Data: Developing a GIS-Based Origin-Destination Matrix for Southern California Freight Flows, METRANS Transportation Center, University of Southern California, Los Angeles, California, June 30, 2001.	x						x	x											x
188	Gore, A. (1997). Serving the American Public: Best Practices in Performance Measurement. A Benchmarking Study Report, June, 1997. http://govinfo.library.unt.edu/npr/library/papers/benchmrk/nprbook.html; Accessed July 15, 2005.																			x
189	Gosling, GD (2000). Aviation System Performance Measures For State Transportation Planning. In Transportation Research Record 1703, TRB, Washington, DC, 2000, pp. 7-15																			x
190	Hagler Bailly Services, Inc. (2000). Measuring Improvements In The Movement of Highway and Intermodal Freight, Final Report, Prepared for Federal Highway Administration, Washington, D, March 20, 2000.	x	x	x	x	x	x						x			x	x	x	x	x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
191	Halbach, D. and J. Fruin (1985). Upper Mississippi River Barge and Towing Industry Fuel Use Analysis, Staff Paper P85-14. Department of Agriculture and Applied Economics, University of Minnesota, March, 1985.															x		x		x
192	Halbach, D., J. Fruin, and S. Wulf. 1984 Barge Rates for Upper Mississippi River Commodities, Staff Paper P85-13. Department of Agriculture and Applied Economics, University of Minnesota, April, 1985.	x		x				x	x				x							x
193	Halbach, D. and J. Fruin, Use of the 1992 ICC Public Use Waybill Sample to analyze Corn Movements by Rail, Staff Paper P94-6. Department of Agriculture and Applied Economics, University of Minnesota, March, 1994.	x		x		x			x				x							x
194	Mark E. Hallenbeck, M.E., E. McCormack, J. Nee, and D. Wright (2003). *Freight Data from Intelligent Transportation System Devices.* Washington State Transportation Center (TRAC), University of Washington, Seattle, WA. July 2003.	x	x			x														x
195	Hamouda, G., F. Saccomanno, and L. Fu (2004). Quantitative Risk Assessment Decision-Support Model for Locating Hazardous Materials Teams. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004 pp. 1-8.		x									x								x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
196	Han, L.D., S. Chin, O. Franzese, and H. Hwang (2005). Estimation of Traffic Impacts Due to Pickup and Delivery Related Illegal Parking Activities. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005														x	x				x
197	Harper, D.V. ad P.T. Evers (1991). An Analysis of Intermodal Railroad-Truck Freight Transportation Facilities and Services in Minnesota, Department of Marketing and Logistics Management, University of Minnesota, December, 1991.	x		x	x	x		x	x				x							x
198	Holguín-Veras, J. and E. Thorson (2000). Trip Length Distributions in Commodity-Based and Trip-Based Freight Demand Modeling Investigation of Relationships. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 37–48.					x		x												x
199	Holguín-Veras, J. and E. Thorson (2003). Practical Implications of Modeling Commercial Vehicle Empty Trips. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 87-94.									x						x				x
200	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001a). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region,* Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
201	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001b). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix I: Literature Review, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.																			x
202	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001c). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Appendix II: Compendium of Freight Data Sources, Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.																			x
203	Holguín-Veras, J., G.F. List, A.H. Meyburg, K. Ozbay, R. E. Passwell, S. Yahalom (2001d). *An Assessment of Methodological Alternatives for a Regional Freight Model in the NYMTC Region*, Report Prepared For New York Metropolitan Transportation Council (NYMTC), New York, May 30, 2001.																			x
204	Holguín-Veras, J., Y. López-Genao, and A. Salam (2002). Truck-Trip Generation at Container Terminals Results from a Nationwide Survey. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 89-96.								x											x
205	Holguín-Veras, J., E. Thorson, and K. Ozbay (2004). Preliminary Results of Experimental Economics Application to Urban Goods Modeling Research. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 9-16.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
206	Holguin-Veras, J., J. Polimeni, B. Cruz, N. Xu, G. List, J. Nordstrom, and J. Haddock (2005). Off-Peak Freight Deliveries: Challenges and Stakeholders Perceptions. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005			x	x										x	x				x
207	Horowitz, J.L. and Plewes, T. (2005). Measuring International Trade on U.S. Highways. Committee on National Statistics, Division of Behavioral and Social Sciences and Education, National Research Council, Washington, D.C. 2005.							x	x											x
208	Humphreys, I and Francis, G (2000). Traditional Airport Performance Indicators: A Critical Perspective. In Transportation Research Record 1703, TRB, Washington, DC, 2000, pp. 24-30.																			x
209	Hunt, J.D. (2006a). Calgary Tour-Based Microsimulation of Urban Commercial Vehicle Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm	x			x															x
210	Hunt, J.D. (2006b). Oregon Generation 1 Land Use Transport Economic Model Treatment of Commercial Movements, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
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211	Huynh, N.N. and C.M. Walton (2005). Methodologies for Reducing Truck Turn Time at Marine Container Terminals, Report No. SWUTC/05/167830-1, Center for Transportation Research, The University of Texas at Austin, TX, May, 2005.				X	X	X			X						X				X
212	Huynh, N., C.M. Walton, and J. Davis (2004). Finding the Number of Yard Cranes Needed to Achieve Desired Truck Turn Time at Marine Container Terminals. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 99-108.			X	X	X	X													X
213	Hwang, H. and T. R. Curlee (2005). FAF Commodity Classification: STCC or SCTG?, Oak Ridge National Laboratory, February, 2005.							X	X											X
214	IANA (2006a). Intermodal Market Trends & Statistics, a Quarterly Analysis of Industry Activities, Intermodal Association of North America (IANA), http://www.intermodal.org/							X												X
215	IANA (2006b). Intermodal Market Trends & Statistics—Equipment Type, Size and Ownership Monthly Data File, Intermodal Association of North America (IANA), http://www.intermodal.org/			X				X											X	X

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
216	IANA (2006c). Intermodal Market Trends & Statistics, A Five-Year Data File of Industry Activity, Intermodal Association of North America (IANA)http://www.intermodal.org/							x	x											x
217	ICF Consulting (2001). North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies, prepared for the North American Commission for Environmental Cooperation, February 21, 2001.																	x		x
218	ICF Consulting and HLB Decision Economics (2002). Economic Effects of Transportation: The Freight Story, Final Report , Federal Highway Administration, Washington, DC., January, 2002.																			x
219	ICF Consulting with Delcan, Inc. (2004). 2010 and Beyond: A Vision of America's Transportation Future –21st Century Freight Mobility, NCHRP Project 20-24(33) A, Final Report, Prepared for: The National Cooperative Highway Research Program (NCHRP), TRB, National Research Council, August 2004.																			x
220	ICF Consulting, HLB Decision Economics, and Louis Berger Group (2001). Freight Benefit/Cost Study-Compilation of the Literature, Final Report , Federal Highway Administration, Washington, DC., February 9, 2001									x	x									x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
221	Ioannou, P. et al. (2001). Modeling and Route Guidance of Trucks in Metropolitan Areas, METRANS Transportation Center at USC and CSLUB, February, 2001.	x				x	x													x
222	ITE (2003). Trip Generation Handbook, 7th Edition, Institute of Transportation Engineers (ITE), Virginia, D3142003.								x											
223	Ivanov, B. (2004). Measuring Performance in Difficult-to-Measure Areas: Freight Systems Second National Conference on Performance Measures To Improve Transportation Systems, Sponsored by Transportation Research Board, August 24, 2004.			x				x	x	x						x	x	x		x
225	Jessup, E., K.L. Casavant, C.T. Lawson (2004). *Truck Trip Data Collection Methods: Final Report.* SPR 343. Oregon Department of Transportation, Salem OR, 2004. http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/TruckTripData.pdf Accessed July 15, 2005.								x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
226	Jessup, E. and R. Herrington (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products:Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005			x	x	x		x	x											x
227	Johnson, S. and J. Sedor (2004). Reliability: Critical to Freight Transportation. Public Roads, November/December 2004 · Vol. 68 · No. 3.					x	x													
228	Jones, C. (2005). Measuring Travel Time in Freight-Significant Corridors, FHWA, April, 2005.					x	x													
229	Kale, S.R. (2002). *Intermodal and Multimodal Freight Policy, Planning, and Programmingat State Departments of Transportation in the Decade Since ISTEA*, TRB Annual Meeting CDROM, November, 2002	x		x				x	x		x									x
230	Kapros, S., K. Panou, D. A. Tsamboulas, K. Seraphim (2005). Estimating the Impact of Seasonal Truck Shortages On Movement of Time-Sensitive, Perishable Products:Transportation Cost Minimization Approach. *Forthcoming In Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005			x	x	x		x	x											

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231	KRAMER aerotek, Inc., Ricondo & Associates, Inc., and SHE,Inc. Tier 2 Air Service Study --Minnesota in Partnership with Wisconsin, Technical Report, Office of Aeronautics, Minnesota Department of Transportation, June, 2003.			x		x		x	x											x
232	Kritzky, B. (2004). Updating Speed Performance Measures of Minnesota's Interregional Corridor System, Presentation at GIS-T 2004 Symposium, 2004.					x														x
233	Krueger, H. (1999). Parametric Modeling In Rail Capacity Planning. In *Proceedings of the 1999 Winter Simulation Conference* (P. A. Farrington, H. B. Nembhard, D. T. Sturrock, and G. W. Evans, eds.) pp. 1194-1200.				x															
234	LaFrance-Linden, D., S. Watson, and M. J. Haines (2001).Threat Assessment of Hazardous Materials Transportation in Aircraft Cargo Compartments. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp. 130–137.		x									x								
235	Lahsene, J.S. (2006). Emerging Techniques in Development and in Practice, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x

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MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
236	Lambert, B. (1997). Critical Issues Facing Freight Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/lambert.pdf Accessed July 15, 2005.																			x
237	Lambert, D. (2004). 2004 Minnesota's Lake Superior Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. 2004.	x		x	x			x	x											x
238	Lambert, B. (2005a). *Shipment Characteristics in the Commodity Flow Survey - Can One Describe An Elephant?* Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.							x	x											x
239	Lambert, B. (2005b). Developing Freight Performance Measures Using Travel Time Estimates, Presentation, FHWA Office of Freight Management and Operations, USDOThttp://www.ops.fhwa.dot.gov/freight; Accessed July 15, 2005.					x	x													
240	Lambert, D. (2005c). Minnesota's River Terminals, Ports and Waterway Section, Minnesota Department of Transportation, St. Paul, MN. March, 2005.	x		x	x			x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
241	Lambert, B. (2006). Defining Future Needs, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
242	Larson, M.C. (2004). Organizing for Performance-Based Management, Presented at 2nd National Conference on Performance Measures to Improve Transportation Systems, Transportation Research Board, Irvine, California, August 22-24, 2004.																			x
243	Lawson, C.T. (2004). Freight Informatics: 21st-Century Data Just in Time *ITE Journal*; Vol. 74 No.12. Institute of Transportation Engineers, Washington, D.C., December, 2004. pp. 38-41.																			x
244	Lawson, C.T., Strathman, J.G. and Anne-Elizabeth Riis, A. (2002). Survey Methods For Assessing Freight Industry Opinions, Final Report, Prepared for Oregon Department of Transportation, Salem OR, March 2002.						x									x	x			x
245	Leachman, R. (2006). Port and Modal Elasticity Studies, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm								x	x										x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
246	Levans, M., K.B. Manrodt, and M. Holcomb (2006). Masters of Logistics: 15th Annual Study of Trends and Issues, Presentation/Webcast by Reed Business Information, Supply Chain Group, Logistics Management, October 25, 2006.		x	x	x	x						x		x		x	x		x	x
247	Levinson, D., M. Marasteanu, V. Voller, I. Margineau, B. Smalkoski, M. Hashami, N. Li, M. Corbett, and E. Lukanen (2005). Cost/Benefit Study: Spring Load Restrictions, Final Report, Report No. MN/RC 2005-15, Minnesota Department of Transportation, St. Paul, MN, March, 2005.	x		x						x					x	x	x			x
248	Lin, C. (2004). Load Planning with Uncertain Demands for Time-Definite Freight Common Carriers. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 17-24.					x										x				x
249	Lin, I.I., H. S. Mahmassani, P. Jaillet, and C. M. Walton (2002). Electronic Marketplaces for Transportation Services Shipper Considerations. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 1-9.																x			x
250	Lipinski, M. E. and D. B. Clarke (1996). Resolution of Land Use and Port Access Conflicts at Inland Waterway Ports. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 102–107.			x																x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

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251	Lofgren, M. An Overview of State & Provincial Truck Regulations and Permitting - Commonalities and Differences, Presented at Cross Border Regional Truck Transportation Conference, June 15-16, 2005.	x	x							x					x					x
252	Lofgren, M. and M. Berwick. Evaluation of Strategic Logistics of Rural Firms, Report # MPC-05-177, Upper Great Plains Transportation Institute: North Dakota State University, Fargo, October 2005.			x																x
253	Loughlin, M.J. and J.S. Adams (1998). Overseas Air Cargo Service, Airborne Export-Producing Industries, and U.S. Cities, 1980-1995, Report No. MN/RC-1998/13, Center for Transportation Studies, University of Minnesota, 1998.							x												x
254	Luskin, D.M., R. Harrison, C. M. Walton, Z. Zhang, and J. L. Jamieson, Jr. (2002). Divisible-Load Permits for Overweight Trucks on Texas Highways: An Evaluation. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 104-109.	x								x										x
255	MacDonald, D.B. (2006). Measures, Markers and Mileposts, The Gray Notebook for the quarter ending March 31, 2006, 5 Year Anniversary Edition, WSDOT's quarterly report to the Governor and the Washington State Transportation Commission on transportation programs and department management, WSDOT, 2006.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

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		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
256	Akshay Mani, A. and J. Prozzi (2004). *State-Of-The-Practice In Freight Data: A Review Of Available Freight Data In The U.S.* Report No. 0-4713-P2, Center for Transportation Research, The University of Texas at Austin, Austin, Texas. February 2004.																			x
257	Maritime Administration (2006). Port Facilities Inventory, Maritime Administration, Washington, DC.	x																		
258	Matheny-Katz, M. Barge and Towboat Operating Costs. Presentation. Institute of Water Resources. U.S. Army Corps of Engineers, September, 2002.									x						x				
259	Maze, T.H. Dennis Kroeger, and Mark Berndt (WSA) (2005). Trucks and Twin Cities Traffic Management, Report No. MN/RC-2005-21, Minnesota Department of Transportation, 2005.	x	x	x	x	x									x					x
260	McCray, J.P. (1998). North American Free Trade Agreement Truck Highway Corridors U.S.-Mexican Truck Rivers of Trade. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 71–78.							x												x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
261	McCray, J.P. and R. Harrison (1999). North American Free Trade Agreement Trucks on U.S. Highway Corridors. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 79–85.																			x
262	McCullough, G.J.(2003). Trucking Efficiency Versus Transportation Efficiency: An Economic Evaluation of TRB Special Report 267. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 24-29.																			x
263	McVey, M.J. and Baumel, C.P. and Hurburgh, C.R (1996). Efficient Distribution of Grain to Meet the Quality Needs of End-Users. Iowa State University, September, 1996.																			x
264	Memmott, F.W. (1983). Application of Statewide Freight Demand Forecasting Techniques, NCHRP Report 260, TRB, Washington, D.C., 1983.							x	x											x
265	Meyburg, A. and J.R. and Mbwana (2002). *Data Needs in the Changing World of Logistics and Freight Transportation.* Conference Synthesis. 2002 http://www.dot.state.ny.us/ttss/conference/synthesis.pdf Accessed July 15, 2005.																			x

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266	Meyburg, A.H., J. M. Saphores, and R. E.. Schuler (1996). Collecting Usage Data for Analyzing a Heavy-vehicle, Divisible-Load Permit System. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 9–17.																			x
267	Meyer, M.D. (2006). Future Freight Modeling, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
268	Mn/DOT (1986). Minnesota Freight Access Improvement Program: A Discussion Paper, Minnesota Department of Transportation, St. Paul, MN.	x		x	x	x		x	x											
269	Mn/DOT (1989). Great Lakes Transportation in Minnesota, Prepared by Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN.	x		x		x		x	x											
270	MNDOT (1991). Environmental Impacts of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, January 1991.									x								x		

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
271	MNDOT (1995a). Need for Intermodal Railroad Terminal Facilities in the Twin Cities Metropolitan Area, Minnesota Department of Transportation, St. Paul, MN. February 1995.	x		x	x															x
272	Mn/DOT (1995b). Natural Gas & Liquid Petroleum System, Ports and Waterways Section, Minnesota Department of Transportation, 1995.	x																		
273	Mn/DOT (1999a). Freight Performance Measures: A Yardstick for Minnesota's Transportation System. Recommendations of the Minnesota Freight Advisory Committee, November 1999.	x	x	x	x	x		x	x											x
274	Mn/DOT (1999b). The Economic Component of the Metro Freight Study, Minnesota Department of Transportation, January, 1999.	x		x				x	x											x
275	MnDOT (2000). Minnesota Statewide Transportation Plan, Moving Minnesota from 2000 to 2020, Minnesota Department of Transportation, St. Paul, MN. August, 2000.	x	x	x	x	x														x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
276	MnDOT (2003). Minnesota Statewide Transportation Plan, Moving People and Freight from 2003 to 2023, Minnesota Department of Transportation, St. Paul, MN. August, 2003.	x	x	x	x	x														x
277	Mn/DOT (2004). 2004 Minnesota's Lake Superior Terminals, Ports And Waterways Section, Minnesota Department of Transportation, Spring, 2004.	x						x	x											x
278	MNDOT (2005a). *Minnesota Statewide Freight Plan*. Minnesota Department of Transportation (MNDOT). Office of Freight and Commercial Vehicle Operations. May, 2005. http://www.dot.state.mn.us/ofrw/statewide_plan.htm	x	x	x		x	x	x	x				x							x
279	MNDOT (2005b). Twin Cities Area Barge Fleeting, http://www.dot.state.mn.us/ofrw/reports.html; Accessed July 15, 2005.	x						x		x										
280	Mn/DOT (2005c). Minnesota's River Terminals, Ports and Waterways Section, Minnesota Department of Transportation, St. Paul, MN., March, 2005.	x		x					x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
281	MNDOT (1997). Monetary Cost of a Modal Shift, Ports And Waterways Section, Minnesota Department of Transportation, March, 1997.			x		x				x								x		x
282	Moore, P.D., K.B. Manrodt, M.C. Holcomb (2005). Collaboration: Enabling Synchronized Supply Chain, Collaboration: Enabling Synchronized Supply Chains, Report on Trends and Issues in Logistics and Transportation, 2005.																			x
283	Moore, P.D., K.B. Manrodt, M.C. Holcomb, M. Riegler (2006). The Power of O3: Optimized Strategy, Planning and Execution, Report on Trends and Issues in Logistics and Transportation, Capgemini, Georgia Southern University, and the University of Tennessee, 2006.																			x
284	Morash, EA. (2000). Linking Public And Private Performance Measurement. In Transportation Research Record 1729, TRB, Washington, DC, 2000, pp. 42-50.																			x
285	Morlok, E.K. and S. P. Riddle (1999). Estimating the Capacity of Freight Transportation Systems A Model and Its Application in Transport Planning and Logistics. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 1–8.				x		x													x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
286	Morris,A.G. A.L. Kornhauser, and M.J. Kay (1998). Urban Freight Mobility Collection of Data on Time, Costs, and Barriers Related to Moving Product into the Central Business District. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 27–32.			x		x				x						x				x
287	Morris, A.G., A.L. Kornhauser, and M. J. Kay (1999). Getting the Goods Delivered in Dense Urban Areas. A Snapshot of the Last Link of the Supply Chain. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 34–41.			x		x				x						x				x
288	Morris, A.G. and A. L. Kornhauser (2000). Relationship of Freight Facilities in Central Business District Office Buildings to Truck Traffic. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 56–63.			x		x				x						x				x
289	Murray, D. (2005). Tracking the Trucking Industry … 2004 and Beyond, Presentation, American Transportation Research Institute (ATRI), March, 2005.																			x
290	Mussell, A. and J. Fruin (1997). Minnesota Shippers and State Truck Size/Weight Regul;ations, A Report Submitted to Minnesota Department of Transportation, Staff Paper P97-3, Department of Agriculture and Applied Economics, University of Minnesota, April, 1997.	x		x					x								x			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
291	NATS (2006). National American Transportation Statistics (NATS), http://nats.inegi.gob.mx/nats		x					x	x											x
292	Neels, K. (2006). Freight Demand Modeling: Perspectives from the Private Sector, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
293	NGP (2001). Trade Patterns and the Economy of the Northern Great Plains: A Baseline Report, Northern Great Plains, Inc., March 2001.																			x
294	NHTSA (2005a). Fatality Analysis Reporting System (FARS). http://wwwfars.nhtsa.dot.gov/		x																	
295	NHTSA (2005b). General Estimates System (GES). http://wwwnrd.nhtsa.dot.gov/departments/nrd-30/ncsa/ges.html		x																	

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
296	Niles, J. (2003). *Trucks, Traffic, and Timely Transport:A Regional Freight Logistics Profile.* MTI REPORT 02-04, Mineta Transportation Institute, San Jose, CA, June, 2003.			x		x	x													
297	Norwood, J. and J. Casey (2002). Key Transportation Indicators. Summary of a Workshop. National Research Council, National Academy Press, Washington, DC. 2002.																	x		x
298	NPWI (1995).Lousiana Statewide Intermodal Plan. Louisiana State University. National Ports and Waterways Institute(NPWI), Louisiana Department of Transportation and Development, LA. July, 1995.	x	x	x	x															x
299	NTOC (2005). Performance Measurement Initiative, Final Report, National Transportation Operations Coalition (NTOC), July, 2005.					x	x													x
300	OECD. OECD Trilog Plenary Symposium: Public Policy Issues in Global Freight Logistics. Conference Proceedings. Washington, D.C., December 17-18, 1998. http://ntl.bts.gov/lib/8000/8300/8351/trilog1.pdf Accessed July 15, 2005																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
301	ORNL (1990). Nationwide Truck Activity and Commodity Survey (NTACS), Oak Ridge National Laboratory, Tennessee.							x	x											
302	ORNL (2006), Transportation Energy Data Book, 25th Edition, Oak Ridge National Laboratory, Tennessee.																	x		x
304	Papiernik, DK, Nanda, D, Cassada, RO, and Morris, WH (2000). Data Warehouse Strategy To Enable Performance Analysis In Transportation Research Record 1719, TRB, Washington, DC, 2000, pp. 175-183.																			x
305	Minyoung Park, M. and A. Regan (2005).Capacity Modeling in Transportation: A Multimodal Perspective.*Forthcoming* In *Transportation Research Record*, TRB, National Research Council, Washington, D.C., 2005				x															

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
306	Pratt, RH and Lomax, TJ (1996). Performance Measures For Multimodal Transportation Systems, In Transportation Research Record 1518, TRB, Washington, DC, pp. 85-93, 1996.																			x
307	R.L. Banks and Associates (1995). Twin Cities Region Intermodal Terminal Needs Study, A Report to The Metropolitan Council, January, 1995.	x		x	x			x	x											x
308	R.L. Banks and Associates (2004). Rail Freight Competition Study, Report prepared for State of Montana, Governor's Office of Economic Development, MT, October, 2004.																			x
309	Rabah, M. and H. S. Mahmassani (2002). Impact of Information and Communication Technologies on Logistics and Freight Transportation -- Example of Vendor-Managed Inventories. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 10-19.							x	x											x
310	Raj, P.K. and E.W. Pritchard (2000). Hazardous Materials Transportation on U.S. Railroads Application of Risk Analysis Methods to Decision Making in Development of Regulations. In *Transportation Research Record 1707*, TRB, National Research Council, Washington, D.C., 2000, pp 22–26.		x									x								

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
311	Reed Business Information (2006). Logistics Management, www.logisticsmgmt.com, Waltham, MA.				x	x	x	x	x					x					x	x
312	Resor, R.R. and G. L. Thompson (1999). Do North American Railroads Understand Their Costs? Implications for Strategic Decision Making. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 9–16.									x						x				
313	Resor, R.R. and Blaze, J.R. (2004). Short-Haul Rail Intermodal--Can It Compete with Trucks? In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp. 45-52.									x										x
314	Roden, D.B. Forecasting Travel Time, In Transportation Research Record 1518, TRB, Washington, DC, pp. 7-12, 1996.					x														
315	Rodríguez, D.A., M. Rocha, A. J. Khattak, and M. H. Belzer (2003). Effects of Truck Driver Wages and Working Conditions on Highway Safety Case Study. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 95-102.		x													x				x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
316	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1977) *Freight Data Requirements for Statewide Transportation Systems Planning.* Research Report, NCHRP Report 177, TRB, Washington, D.C., 1977	x	x	x	x	x	x	x	x											x
317	Roger Creighton Associates, Inc. and R.L. Banks & Associates, Inc. (1978). *Freight Data Requirements for Statewide Transportation Systems Planning. User's Manual*, NCHRP Report 178, TRB, Washington, D.C., 1978	x	x	x	x	x	x	x	x											x
318	Ross, T., Manrodt, K.B. and Holcomb, M.C. (2003). Operations Excellence --The Transition from Tactical to Adaptive Supply Chains--Report on Trends and Issues in Logistics and Transportation, A Report by Cap Gemini Ernst & Young and The University Of Tennessee, 2003.																			x
319	Rowinski, J., Y. Wang, M. P. Boilé, and L.N. Spasovic (2000). *A Multi-Commodity, Multi-Class Generalized Cost User Equilibrium Assignment Model.*National Center for Transportation and Industrial Productivity, New Jersey Institute of Technology, Newark, NJ. July 30, 2000. http://transportation.njit.edu/nctip/publications/multi_commodity.pdf Accessed July 12, 2005.																			x
320	RTI International (2004). Economic Impact of Inadequate Infrastructure for Supply Chain Integration, Planning Report 04-2, Prepared for National Institute of Standards & Technology, Washington, D.C., June, 2004.			x	x															x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES: NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
321	Schmitt, R.R. (2002). Freight Analysis Framework-North American Interchange on Transportation Statistics, Presentation, Federal Highway Administration, April 2002.	x		x				x	x											x
322	Schofer, J.L. (2003). *Shrinking Sample Size Undermines Usefulness of Commodity Flow Survey Data*. Third Letter Report, Committee to Review the Bureau of Transportation Statistics' (BTS) Survey Programs. March, 2003. http://trb.org/publications/reports/bts_cfs.pdf							x	x											
323	Selness, C. (2005). Minnesota's Freight Performance Measure, Presentation at FHWA Talking Freight Seminar August 17, 2005	x	x	x																
324	Senf, D.R. and J. Fruin (1986). An Assessment of the Competitive Position of Great Lakes Ports in the International Steam Coal Market, Staff Paper P86-1. Department of Agriculture and Applied Economics, University of Minnesota, January, 1986.								x	x										x
325	Shaw, T. (2003). Performance Measures of Operational Effectiveness for Highway Segments and Systems, A Synthesis of Highway Practice, NCHRP Synthesis 311, Transportation Research Board, Washington, D.C., 2003.			x	x	x	x													x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
326	SITA Logistics Solutions (2001). *Minneapolis-Saint Paul Air Cargo Study, SITA Logistics Solutions,* Geneva, Switzerland, December 2001.							x	x											x
327	SLSA (2005). St. Lawrence Seaway Annual Traffic Report. St. Lawrence Seaway Development Corporation (SLSDC).http://www.greatlakes-seaway.com/en/news/tonnage_info.html	x						x	x											
328	Smalkoski, B. And Levinson, D. (2003). Value Of Time For Commercial Vehicle Operators In Minnesota, University Of Minnesota, Twin Cities, December, 2003.					x				x										
329	Smith, N., G. Chow, and L. Ferreira (2002). E-Business Challenges for Intermodal Freight. Some International Comparisons. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 20-28.																			x
330	Satisfaction Management Systems, Inc. (1998). Mn/DOT 1998 Freight Market Segmentation Study for the Manufacturing Industries.							x	x								x			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
331	Solano, P., R. Wright and V. Wanca (2003). BTS Intermodal Facility Freight Transfer Database. Bureau of Transportation Statistics, Washington, D.C., 2003.	x		x				x	x											x
332	Sorensen, P.C., E. Irelan, B. Winningham, and T. A. Noyes (1997). Skagit Countywide Air, Rail, Water, and Port Transportation System Study .In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 4–13.							x	x											x
333	Southworth, F. (2001). The Future for Freight Transportation Data Collection and Analysis. Presented at Conference on Data Needs in the Changing World of Logistics and Freight Transportation, Saratoga Springs, New York, November 14 - 15, 2001; http://www.dot.state.ny.us/ttss/conference/southworth.pdf Accessed July 15, 2005.																			x
334	Southworth, F. (2003). Simulating U.S. Freight Movements in the 2002 Commodity Flow Survey (Putting the Miles in Ton-Miles), a Presentation to Bureau of Transportation Statistics' International Trade Traffic Study Workshop, Washington, DC., November, 2003.							x	x											x
335	Southworth, F. (2005). Filling Gaps in the U.S. Commodity Flow Picture: Using the CFS with Other Data Sources, Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.							x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
336	Southworth, F. (2006). Ongoing Research: Some Emerging Methodologies in Freight Demand Modeling, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
337	Spear, B. (2006). Freight Modeling in Urban Areas: State of the Practice, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
338	SRF Consulting (2001). Metropolitan Council 2001 Twin Cities Transportation System Audit Metropolitan Council, St. Paul, Minnesota, 2001.																			
339	SRF Consulting Group, Inc. (2003) Adequacy of Freight Connectors to Interregional Corridors and Major Highways, Prepared for Minnesota Department of Transportation, June, 2003.	x	x	x	x	x	x													
340	SRF Consulting Group, Inc. and Cambridge Systematics, Inc. (2004). Twin Cities Regional Freight Planning Model, Technical Memorandum, prepared for Metropolitan Council and Minnesota Department Of Transportation, November 30, 2004.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
341	STB (2005). Carload Rail Waybill Sample, Surface Transportation Board (STB), Washington, DC, www.stb.dot.gov							x	x											
342	Stewart, R.D., R. J. Eger III, L. Ogard and F. Harder, Tioga Group and Associates (2003). Twin Ports Intermodal Freight Terminal Study: Evaluation of Shipper Requirements and Potential Cargo Required to Establish a Rail-Truck-Marine Intermodal Terminal in the Twin Ports of Superior, Wisconsin and Duluth, Minnesota, Midwest Regional University Transportation Center, University of Wisconsin, Madison, 2003.	x		x		x											x			x
343	Stiehl, M. and F.G. Rawling (2001). Intermodal Volumes: Tracking Trends & Anticipating Impacts in Northeast Illinois, Working Paper 01-04, Chicago Area Transportation Study (CATS), Chicago, Illinois, May, 2001.							x	x											
344	Stone, JR, Baugh, JW, Chakravarty, S, and Surasky, MN (2001). Winston-Salem Mobility Manager: Data Collection, Validation, and Performance Evaluation. In Transportation Research Record 1760, TRB, Washington, DC, 2001, pp. 114-120.					x	x													
345	Strauss-Wieder, A. (2003). Integrating Freight Facilities and Operations with Community Goals. National Cooperative Highway Research Program (NCHRP) Synthesis of Highway Practice 320, TRB, National Research Council, Washington, D.C.																	x		x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
346	Street Smarts, Rizzo Associates, and Georgia Institute of Technology (2003). Study of Hourly Truck Movements around Atlanta, Georgia Department of Transportation, Atlanta, Georgia, 2003.	x		x	x	x														x
347	Sylvester, J.T., S.S. Wallwork, P.E. Polzin, M. Nesary (1995). Montana Airport Multimodal Study—Part 1—Methods and Results, Bureau of Business and Economic Research, The University of Montana, November, 1995.																			x
349	Taniguchi, E. and Thompson, R.G. (2004). Modeling City Logistics. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 45-51.																			x
350	Tarkenton, L. (2005). Trends in Marine Terminal Operations Management, Port of Virginia, 2005.							x	x										x	

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
351	The Colography Group (2006a). U.S. Domestic And Export Air Traffic And Yield Analyses By Competitor And Market Segment (Colography), Marietta Georgia. http://www.colography.com/exportairtandy.html							x	x											x
352	The Colography Group (2006b). Global Cargo Market Projections (Colography), Marietta Georgia. http://www.colography.com/gcmp.html							x	x											x
353	The Colography Group (2006c). U.S. International Cargo By Commodity And Country (Colography), Marietta Georgia. http://www.colography.com/iacc.html							x	x											x
354	The Colography Group (2006d). Domestic Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/dact.html							x	x											x
355	The Colography Group (2006e). International Air Cargo Trends (Colography), Marietta Georgia. http://www.colography.com/iact.html							x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
356	The Logistics Institute - Asia Pacific. *The Asia Pacific Air Cargo System*, Research Paper No: TLI-AP/00/01, Georgia Institute of Technology, 2001.							x	x											x
357	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (1999). Striving for Excellence: New Measures for Logistics—Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 1999.																			x
358	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2000). Transforming Logistics--A Roadmap to Fulfillment Excellence, Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 2000.																			x
359	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2001). Logistics@ Internet Speed:—The Impact of e-Commerce on Logistics, Trends & Issues in Logistics and Transportation, A Report by Ernst & Young and The University Of Tennessee, 2001.																			x
360	Thompson, R. H., Manrodt, K.B. and Holcomb, M.C. (2002). Logistics and Transportation, 11 th Annual Survey of Issues and Trends, A Report by Ernst & Young and The University Of Tennessee, 2002.	x	x	x	x	x	x	x	x		x	x				x	x			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES
361	TRANSCORE (2001). Washington-British Columbia Cross-Border Commercial Vehicle Operations, Updated Final, Concept of Operations, Northwest International Trade Corridor Program Phase-2, June 15, 2001.	T, MK, EF
362	Transport Topics Publishing Group (2006). Transport Topics, Daily Update of Trucking News, www.ttnews.com/	A, C, MK, MD, CC, SC, EF
363	TransTech Management, Inc. (2003). Strategic Performance Measures for State Departments of Transportation: A Handbook for CEOs and Executives, FINAL REPORT, National Cooperative Highway Research Program, Project No. 20-24(20), TRB, National Research Council, Washington DC, June 2003.	EF
364	TRB. (1986). Twin Trailer Trucks. TRB Special Report 211, TRB, National Research Council, Washington, D.C.	N, MC, EF
365	TRB. (1987). Measuring Airport Landside Capacity. TRB Special Report 215, TRB, National Research Council, Washington, D.C.	C, EF

No.	NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
361					X		X												X
362			X	X			X	X							X	X			X
363																			X
364	X								X										X
365				X															X

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
366	TRB. (1990a). Truck Weight Limits: Issues and Options. TRB Special Report 225, TRB, National Research Council, Washington, D.C.	x								x										
367	TRB. (1990c). Data Requirements for Monitoring Truck Safety. TRB Special Report 228, TRB, National Research Council, Washington, D.C.		x																	
368	TRB. (1992). Intermodal Marine Container Transportation -- Impediments and Opportunities. TRB Special Report 236, TRB, National Research Council, Washington, D.C.	x		x	x															
369	TRB. (1993a). ISTEA and Intermodal Planning-Concept Practice Vision. TRB Special Report 240, TRB, National Research Council, Washington, D.C.																			x
370	TRB. (1993b). Landside Access to U.S. Ports. TRB Special Report 238, TRB, National Research Council, Washington, D.C.			x																x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
371	TRB. (1994). International Symposium on Motor Carrier Transportation. Conference Proceedings 3. TRB, National Research Council, Washington, D.C.																			x
372	TRB (1997)."Findings," In Information Needs to Support State and Local Transportation Decision Making into the 21st Century, Conference Proceedings 14, Transportation Research Board, Washington, DC, pp. 23-59, 1007.																			x
373	TRB. (1997). National Conference on Setting an Intermodal Transportation Research Framework. Conference Proceedings 12. TRB, National Research Council, Washington, D.C.																			x
374	TRB. (1998a). Policy Options for Intermodal Freight Transportation. TRB Special Report 252, TRB, National Research Council, Washington, D.C.			x	x															x
375	TRB. (1998b). Intermodal Transportation Education and Training. Conference Proceedings 17. TRB, National Research Council, Washington, D.C.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
376	TRB. (2001a). Global Intermodal Freight State of Readiness for the 21st Century, Report of a Conference, Conference Proceedings 25, TRB, National Research Council, Washington, D.C., 2001			x	x			x	x											x
377	TRB. (2002a). The NHTSA's Rating System for Rollover Resistance-An Assessment. TRB Special Report 265, TRB, National Research Council, Washington, D.C.		x																	
378	TRB. (2002b). Regulation of Weights, Lengths, and Widths of Commercial Motor Vehicles. TRB Special Report 267, TRB, National Research Council, Washington, D.C.	x	x							x										
379	TRB. (2003a). A Concept for a National Freight Data Program. TRB Special Report 276, TRB, National Research Council, Washington, D.C.																			x
380	TRB. (2003c). Shipboard Automatic Identification System Displays--Meeting the Needs of Mariners. TRB Special Report 273, TRB, National Research Council, Washington, D.C.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
381	TRB. (2003d). Cybersecurity of Freight Information Systems -- A Scoping Study. TRB Special Report 274, TRB, National Research Council, Washington, D.C.											x								
382	TRB. (2003e). TRB. Measuring Personal Travel and Goods Movement, A Review of the Bureau of Transportation Statistics' Surveys, TRB Special Report 277, Transportation Research Board, Washington, DC.							x	x											x
383	TRB (2005). Intermodal Shipments, Warehousing, and Third Parties: A Special Measurement Issue. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.							x	x											x
384	TRB. (1990b). New Trucks for Greater Productivity and Less Road Wear- An Evaluation of the Turner Proposal. TRB Special Report yyy, TRB, National Research Council, Washington, D.C.	x									x				x					x
385	TRB. (1998c). Transportation Issues in Large U.S. Cities. Conference Proceedings 18. TRB, National Research Council, Washington, D.C.		x	x	x	x														x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
386	TRB. (2003b). Freight Capacity for the 21st Century. TRB Special Report 271, TRB, National Research Council, Washington, D.C.			x	x															x
387	TRB. (2004a). The Marine Transportation System and the Federal Role--Measuring Performance, Targeting Improvement. TRB Special Report 279, TRB, National Research Council, Washington, D.C.																			
388	Turnquist, M., A. Meyburg, and G. List (1993). Goods Movement: Regional Analysis and Database, Draft Final Report, University Transportation Research Centers Program, Region II, Cornell University, March 26, 1993.	x	x					x	x											x
389	Turnquist, M.A. (2006). Characteristics of Effective Freight Models, Freight Demand Modeling: Tools for Public-Sector Decision Making, e-Sessions, Transportation Research Board, Washington, D.C., September 25-27, 2006. http://www.trb.org/conferences/e-session/2006fdm.htm																			x
390	UMTRI (2005). Trucks Involved in Fatal Accidents (TIFA) – http://www.umtri.umich.edu/cnts/tifa.htm		x																	

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
391	UMVRDC (1986). Locational and Feasibility Study Containerized Shipment of Agricultural Products, Upper Minnesota Valley Regional Development Commission (UMVRDC), June, 1986.							x	x											x
392	UMVRC (1987). Freight Access Improvement Program, Upper Minnesota Valley Regional Development Commission (UMVRDC), September, 1987.			x																
393	UMVRC (1988). Impacts of Commodities Shipments on Highway and Rail Systems, Upper Minnesota Valley Development Commission (UMVRDC), November, 1988.	x						x	x	x					x					x
394	U.S. Army Corps Engineers (2005a). Waterborne Commerce: Domestic, www.iwr.usace.army.mil/ndc, 2005							x	x											x
395	U.S. Army Corps Engineers (2005b). Waterborne Commerce: Foreign, www.iwr.usace.army.mil/ndc/usforeign							x	x											x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
396	U.S. Army Corps Engineers (2005c). U.S. Ports and Waterway Facilities Database, www.iwr.usace.army.mil/ndc	x		x	x			x	x											x
397	U.S. Army Corps Engineers (2005d). Vessel Characteristics -- Waterborne Transportation Lines of the United States, www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm	x		x	x			x	x											x
398	U.S. Army Corps Engineers (2005e). Lock Performance Monitoring System (LPMS), www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm	x				x	x													x
399	USBOC (2005a). 2002 Vehicle Inventory and Use Survey (VIUS), www.census.gov/econ/www/viusmain.html, 2005	x																		x
400	USBOC (2005b). U.S. Economic Census, U.S.Bureau of Census, www.census.gov/econ/census02																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
401	USBOC (2005c). U.S. Census County Business Patterns, www.census.gov/epcd/cbp																			x
402	USBOC (2005d). U.S. Bureau of Census. Exports from Manufacturing Establishments.							x												x
403	USBOC (2005e). U.S. Bureau of Census. Motor Freight Transportation and Warehousing Survey.							x	x											x
404	USBOC (2005f). U.S. Bureau of Census. Annual Survey of Manufactures Publication.							x												x
405	USBOC (2005g) 2002 U.S. Imports/Exports of Merchandise on CD-ROM							x												x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
406	USBOC (2005h). 2002 Commodity Flow Survey, U.S.Census Bureau,http://www.census.gov/econ/www/cfsmain.html 2002 data being processed							x	x											
407	USDA (1998). Transportation of U.S. Grains—A Modal Share Analysis, 1978-95, United States Department of Agriculture, Washington, D.C., March, 1998.								x											
408	USDA. (2000). A Framework Report for the National Agricultural Transportation Summit. www.ams.usda.gov/tmd/summit/intro.pdf; Accessed July 31, 2005.	x		x	x			x	x				x	x			x	x	x	x
409	USDA. (2005a). Shipping Costs for Agricultural Products. Presentation. U.S. Department of Agriculture, Transportation Services Branch, Agricultural Marketing Service.																x			
410	USDA. (2005b). Fresh Fruit and Vegetable Arrival Totals for 23 Cities, U.S. Department of Agriculture, Washington, DC.							x	x				x							

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
411	USDA. (2005c). Grain Transportation, Agricultural Marketing Service, U.S. Department of Agriculture. http://www.ams.usda.gov/tmd/TSB/publications.htm#General%20Transportation%20Information							x	x	x			x					x		x
412	USDOC. (1997). 1993 Commodity Flow Survey Minnesota, 1992 Census of Transportation, Communications, and Utilities, TC92-CF-24, U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.							x	x											
413	USDOC.(2005) 2002Commodity Flow Survey (CFS), U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Washington, D.C.							x	x											
414	USDOE (2005a). Quarterly Coal Report, U.S. Department of Energy.							x												x
415	USDOE (2005b). Natural Gas Monthly, U.S. Department of Energy.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

	MEASUREMENT SOURCES	PERFORMANCE MEASURE/INDICATOR CATEGORIES																			
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
416	USDOE (2005c). Natural Gas Annual, U.S. Department of Energy.																			x
417	USDOE (2005d). Petroleum Supply Monthly, U.S. Department of Energy.																			x
418	USDOT (2000). NHS Intermodal Freight Connectors: A Report to Congress. U. S. Department of Transportation. 2000 http://www.ops.fhwa.dot.gov/freight/infrastr/nhs/index.htm Accessed July 10, 2005	x	x	x	x															x
419	USDOT. Freight and the Environment Charrette Proceedings Report, February, 2005. http://ops.fhwa.dot.gov/freight/publications/index.htm#enviro; Accessed September, 2005.																	x		
420	Vachal, K. and B. Baldwin (2001). Factors Affecting Rail Car Supply, Report MPC-01-121, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, North Dakota, 2001.			x	x															

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
421	Vachal, K and J. Bitzan (2002). Long-Term Availability of Railroad Services for U.S. Agriculture. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 62-72.			x				x												
422	Vachal, K.. H. Reichert, and T. Van Wechel (2004). U.S. Containerized Grain and Oilseed Exports Industry Survey. In *Transportation Research Record 1873*, TRB, National Research Council, Washington, D.C., 2004, pp120-125							x	x											
423	Vandersteel, W., Y. Zhao, and T.S. Lundgren (1997). Automating Movement of Freight. In *Transportation Research Record 1602*, TRB, National Research Council, Washington, D.C., 1997, pp 71–76.																			x
424	Victoria, I.C. and C. M. Walton (2004). Freight Data Needs at the Metropolitan Level and the Suitability of Intelligent Transportation Systems in Supplying MPOs with the Needed Freight Data, Report No. SWUTC/04/167247-1, Center for Transportation Research, University of Texas at Austin, TX, December, 2004.																			x
425	Vilain, P., L. N. Liu, and D. Aimen (1999). Estimation of Commodity Inflows to a Substate Region. An Input-Output Based Approach. In *Transportation Research Record 1653*, TRB, National Research Council, Washington, D.C., 1999, pp 17–26.							x	x											

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
426	Wallbaum, M. and C. Pils (2001). Security Considerations for the Parcel Call Real-Time Tracking and Tracing System. In *Transportation Research Record 1763*, TRB, National Research Council, Washington, D.C., 2001, pp 138–144.											x								
427	Wargo, B. (2006). PierPASS & Operations as a Solution to Freight Congestion, FHWA Talking Freight Seminar, June 21, 2006.					x														
428	Weinblatt, H. (1996). Using Seasonal and Day-of-Week Factoring to Improve Estimates of Truck Vehicle Miles Traveled. In *Transportation Research Record 1522*, TRB, National Research Council, Washington, D.C., 1996, pp 1–8.	x																		x
429	Wilbur Smith Associates (2002). Virginia Statewide Traffic Model --Review of Available Data, Virginia Department of Transportation, May 22, 2002. http://www.wilbursmith.com/vdotmodel/attachments/082902/Review%20of%20Avail%20Data%20%28Draft%2005-22-02%29.pdf; Accessed July 18, 2005.							x	x											x
430	Wilbur Smith Associates (2003a). The National I-10 Freight Corridor Study-Summary of Findings, Strategies, and Solutions, Final Report, Texas Department of Transportation, 2003.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
431	Wilbur Smith Associates (2003b). Louisiana Statewide Transportation Plan—Statewide Intermodal Freight Planning, Presentation at TRB Annual Meeting, January, 2005.																			x
432	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006a). Minnesota Aviation System Plan -- Air Cargo, prepared for Minnesota Department of Transportation, 2006.			x				x	x											x
433	Wilbur Smith Associates, Short Elliot Hendrickson Inc., & Kramer Aerotek (2006b). Minnesota Aviation System Plan, Executive Summary, prepared for Minnesota Department of Transportation, 2006.			x				x	x											
434	Wittwer, E., T. Adams, T. Gordon, J. Gupta, K. Kawamura, P. Lindquist, M. Vonderembse, and S. McNeil (2005). Upper Midwest Freight Corridor Study, Midwest Regional University Transportation Center, University of Wisconsin-Madison, Madison, WI, March 31, 2005.	x	x	x	x			x	x											x
435	Wolfe, M (2002). Technology to Enhance Freight Transportation Security and Productivity, Appendix to: "Freight Transportation Security and Productivity", Report Prepared for: Office of Freight Management and Operations, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. 2002.											x								

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
436	Zavattero, D.A., F.G. Rawling, and D.F. Rice (1998). Mainstreaming Intermodal Freight into the Metropolitan Transportation Planning Process. In *Transportation Research Record 1613*, TRB, National Research Council, Washington, D.C., 1998, pp 1–11.																			x
437	Zemotel, LM and Montebello, DK.(2002). Interregional Corridors: Prioritizing And Managing Critical Connections Between Minnesota's Economic Centers. In Transportation Research Record 1817, TRB, Washington, DC, 2002, pp. 79-87.	x	x	x	x	x														
438	Zhang, Y. and D. Wu (2003). Development of Trustworthy Intermodal Traffic Measurement. National Center for Intermodal Transportation. http://www.ie.msstate.edu/ncit/Research/ncitdec04/TrustworthyData.htm accessed August 29, 2005			x				x	x											x
439	Zhang, Y., R. O. Bowden, Jr., A. J. Allen (2003). *Intermodal Freight Transportation Planning Using Commodity Flow Data*. National Center for Intermodal Transportation. 2003.							x	x											x
440	Zmud, S. (2005). Commodity Flow Survey: Improving Methods to Enhance Data Quality and Usefulness. Paper Prepared for The 2005 Commodity Flow Survey Users' Conference, Boston, MA, July 8-9, 2005. http://trb.org/conferences/cfs/Workshop-Comparability-Research.pdf Accessed July 26, 2005.																			x

Table B.3. Classification of measurement sources by performance measure/indicator categories, continued

MEASUREMENT SOURCES		PERFORMANCE MEASURE/INDICATOR CATEGORIES																		
		NETWORK AND INFRASTRUCTURE (N)	SAFETY AND DAMAGE (S)	ACCESS (A)	CAPACITY (C)	TRAVEL TIME (T)	RELIABILITY (R)	MARKET SHARE (MK)	MODE SHARE (MD)	MODAL COSTS (MC)	FREIGHT PRODUCTIVITY (FP)	FREIGHT SECURITY (FS)	SHIPMENT RATES (SR)	PRICING (PR)	AGENCY COST (AC)	CARRIER COST (CC)	SHIPPER COST (SC)	EXTERNALITIES/ COMMUNITY COST (EX)	TRANSPORTATION INDICES (TI)	EXTERNAL FACTORS (EF)
441	Zografos, K.G. and I.M. Giannouli (2002). Emerging Trends in Logistics and Their Impact on Freight Transportation Systems: A European Perspective. In *Transportation Research Record 1790*, TRB, National Research Council, Washington, D.C., 2002, pp. 36-44.																			x
442	Zografos, K.G. and Giannouli, I.G. (2003). Emerging Supply Chain Management Trends and Their Impact on Spatial Organization of Logistical Networks. In *Transportation Research Record 1833*, TRB, National Research Council, Washington, D.C., 2003, pp. 30-39.																			x
443	Zografos, K.G. and A.C. Regan. Current Challenges for Intermodal Freight Transport and Logistics in Europe and the United States. In Transportation Research Record 1873, TRB, National Research Council, Washington, D.C., 2003, pp. 70-78.																			x

Appendix C. Assessment of Example Performance Measures/Indicators

PERFORMANCE MEASURE/INDICATOR CATEGORIES		
NO	PMI	DESCRIPTOR
1	N	NETWORK AND INFRASTRUCTURE
2	S	SAFETY AND DAMAGE
3	A	ACCESS
4	C	CAPACITY
5	T	TRAVEL TIME
6	R	RELIABILITY
7	MK	MARKET SHARE
8	MD	MODE SHARE
9	MC	MODAL COSTS
10	FP	FREIGHT PRODUCTIVTY
11	FS	FREIGHT SECURITY
12	SR	SHIPMENT RATES
13	PR	PRICING
14	AC	AGENCY COST
15	CC	CARRIER COST
16	SC	SHIPPER COST
17	EX	EXTERNALITIES
18	TI	TRANSPORTATION INDICES
19	EF	EXTERNAL FACTORS

Note: Some abbreviations that have been used in the tables that follow in Appendix C are:

MNSTP = Minnesota Statewide Transportation Plan

MNSFP = Minnesota Statewide Freight Plan

MNASP = Minnesota Aviation System Plan

1. NETWORK AND INFRASTRUCTURE RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.1. Assessment of network and infrastructure related performance measures/indicators.

Example Performance Measure/Indicator	**N.1 Percent of miles of highway that meet "good" and "poor" ride quality targets**
Goal/Strategic Direction (s)	Strategic Direction 1 -- Safeguard what exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various; mostly TL and LTL shipments
Mode(s)	Trucks; Indirectly affects Rail, Air, and Waterways (Access Routes)
Market(s)/Decision Context(s)	Multinational (North American), National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight. This is particularly relevant for freight movements within Minnesota. It also is related to inbound, outbound, and through freight movements.
Usage	Currently being used in Minnesota -- (1.1H MNSTP; 1.1T MNSFP)
Domain(s)	Both Public and Private; however, mostly public
Maturity	Well Developed and mature
Measurement Source(s)	**Mn/DOT Roadway Inventory and Pavement Databases; HPMS Database; LTPP Database**
Challenges	Overtime this measure has been used and understood well by transportation agencies; public is not totally clear on it but understands it. It reflects and measures performance of highways more than it does freight performance. Data is available within Minnesota. Data along national, regional corridors is being explored and collated through regional and corridor studies. Within Minnesota this type of data are already being collected so cost is related to maintaining such information and identifying it for freight significant corridors (freeways and IRC corridors) and nodes (freight generators and transfer stations)

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.2 Percent of airport runways that meet good and poor Pavement Condition Index (PCI) targets**
Goal/Strategic Direction (s)	Strategic Direction 1 -- Safeguard what exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Air Cargo; Express Packages; Air Mail
Mode(s)	Air; Intermodal; Multimodal
Market(s)/Decision Context(s)	Regional, National; International
Type of Movement(s)	Both passenger and freight; mostly inbound and outbound movments
Usage	Currently being used In Minnesota -- (1.2 A MNSTP; 1.2A MNSFP ;1.1 MASP)
Stakeholder(s)	Public and Private; mostly public
Maturity	Well Developed; most recent Minnesota Aviation System Plan documents targets for this measure
Measurement Source(s)	Mn/DOT Aeronautics Pavement Database; 2007 Minnesota Aviation System Plan ; Airport Master Planning and Capital Improvement Plans.
Challenges	This has been recently used as part of the development of update of Minnesota Aviation System Plan; public and freight stakeholders are not totally clear on how it affects freight performance. It reflects and measures performance of airport infrastructure more than it does freight performance. A good infrastructure helps freight performance. Data is available but needs to be updated and maintained. As part of Master Planning and capital improvement plan development, airports do acquire and have such information and Mn/DOT Aeronautics Office has access to it; so additional cost incurred may not be significant.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.3 Remaining service life of highway pavement**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various, mostly TL and LTL shipments
Mode(s)	Trucking directly; Air, Rail, and Water indirectly by affecting the access routes
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used In Minnesota -- **1.2H1 MNSTP**
Stakeholder(s)	Both Public and Private; mostly public
Maturity	Not Well Developed
Measurement Source(s)	Mn/DOT Road Inventory and Pavement Condition Databases; HPMS Database
Challenges	This is difficult to understand by generalist, particularly the idea of service life. Reflects highway performance more than freight performance. However, deficient pavements can be impediment for freight movement and may affect its costs. The data have been analyzed to make such determination, particularly in truck size and weight studies as well as highway cost allocation studies. There is additional costs needed to do develop this measure and maintain it.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.4 Percent of bridges that meet good and poor structural condition targets.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various, mostly TL and LTL shipments
Mode(s)	Trucking directly; Air, Rail, and Water indirectly by affecting the access routes
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota -- **1.2H2 MNSTP**
Stakeholder(s)	Public and Private; mostly public
Maturity	Well Developed and mature
Measurement Source(s)	Mn/DOT Bridge Monitoring Program and related Database; HPMS Database
Challenges	Public has good understanding of value of bridges to be safe and durable; however, they may not be sure how it is assessed. Reflects bridge performance and critical bridges on freight significant routes could be of great interest to private freight industry, especially if alternate routes are not available. Besides emergency situations, significance of this measure for freight performance may not be clear. Bridge condition databases are available from which such determinations can be made. Periodic montoring of bridges do provide such data already so cost would be minimal. However, effectively and appropriately analyzing these data may involve cost.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.5. Benefit of truck weight enforcement on pavement service life.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 2 – Support land use decisions that preserve mobility and enhance safety of transportation systems
Sector(s)/Commodity(ies)	Various, mostly TL and LTL shipments
Mode(s)	Trucking directly; Air, Rail, and Water indirectly by affecting the access routes
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local; all truck movements to, from, within, and through Minnesota has to undergo weight enforcement.
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota -- 1.2T MNSFP
Stakeholder(s)	Public and Private
Maturity	Not Well Developed; Developmental
Measurement Source(s)	WIM Database; CVO Database; CVISN
Challenges	This measure is hard for generalist to understand. It affects agency cost (enforcement and pavement repair) and freight productivity (for example, spring load restrict may limit the amount of payload that can be carried on certain truck routes). While data is available on the effect of truck weight and overweight trucks on pavement life, sufficient data is not available at present that links level of enforcement to incidence of overweight violations and, therefore, to its effect on pavement service life. Definitely additional cost will be needed to develop this.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.6 Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucking directly; Air, Rail, and Water indirectly by affecting the access routes
Market(s)/Decision Context(s)	Multi-state, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota -- 2.2H MNSTP
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	STIP; LRP of Districts; 10-Yr Highway Work Plan
Challenges	This could be understood by generalist or public, especially when plans are presented. It Indirectly reflects adequacy of infrastructure and access and capacity for freight movement. However, such projects cater to both passengers and freight needs. It will be difficult to tie to freight performance based on this measure. Data Availability—Available Minimal cost is involved. However, time needs to be devoted for appropriate collaboration and interaction with stakeholders at state and district level, and also with freight industry. Input from freight industry in such decisions have been minimal to date but is increasing.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.7 Percent of miles of Principal Arterial corridors in RTCs 0 and 1 that are managed**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 -- Effectively manage the operation of existing transportation systems to provide maximum service to customers.
Sector(s)/Commodity(ies)	TL and LTL shipments
Mode(s)	Trucking; other modes indrectly
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota -- 3.2H MNSTP; 3.2T MNSFP
Stakeholder(s)	Both Public and Private; mostly public
Maturity	Not well Developed, developmental
Measurement Source(s)	Mn/DOT Office of Investment Management; Metro Area
Challenges	This is hard for generalist to understand. The development of this measure shows effort and intent to improve freight significant corridor; however, if it really affects freight performance is not clear. Data can be obtained but is not readily available. This is especially done when STP and District and Long Range Plans are updated. It will require some cost.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.8 Percent of major generators with appropriate roadway access to IRCs and major highways.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the Network Operate Better
Policy(Policies)	Policy 4 -- Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	All modes
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Mostly freight
Usage	Currently being used in Minnesota -- 4.3T MNSFP
Stakeholder(s)	Public and Private
Maturity	Not Developed to Not Mature
Measurement Source(s)	Mn/DOT Intermodal Facility Database for Greater Minnesota and Metro Areas; Spring Load Restriction Study; Highway Connector Studies and related reports
Challenges	This is easy to understand and demonstrate with intermodal connector inventories. It reflects the need for appropriate access to major freight generators and in that regard is reflection of freight performance. Location of freight generators have been developed—separate database for greater Minnesots and Metro areas; also highway and intermodal connector specialized studies have provide better understanding and information. Cost is moderate since this information needs to be updated on periodic basis as freight generators develop.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.9 Percent of major generators with appropriate rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the Network Operate Better
Policy(Policies)	Policy 4 -- Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Heavier bulkier freight; Agriculture; Coal; Mining; Aggregates
Mode(s)	Rail, Intermodal and Waterway
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Mostly freight
Usage	Currently being used in Minnesota -- 4.3R MNSFP
Stakeholder(s)	Both Public and Private
Maturity	Not well Developed, Developmental
Measurement Source(s)	Mn/DOT Intermodal Facility Database for Greater Minnesota and Metro Areas; Railroad Companies; FRA; Highway Connector Studies and related reports
Challenges	It is easy to understand Impediments to freight movements can be understood through this measures; however this measure alone will not be enough to indicate freight performance Data is available but needs to be compiled and analyzed. Cost is moderate

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.10 Percent of rail track-miles with track speeds >25 mph.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail; Intermodal
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local; Rail access to Chicago is of particular concern.
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota - (MNSFP 1.2R1)
Stakeholder(s)	Private
Maturity	Not well developed
Measurement Source(s)	Mn/DOT Rail Office; FRA database; Railroad Companies
Challenges	This is easy to understand It is hard to connect this directly to freight performance by itself. Indirectly it might also affect capacity and access. Data is generally available for this measure from the rail companies (and perhaps the Federal Railroad Administration). However, it needs to be compiled and analyzed. Cost to obtain data and compile it and analyze it will be incurred. It may also require development of public-private partnerships as operational information on tracks is within private domain.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.11 Percent of rail track-miles with 286,000-pound railcar capacity rating.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 – Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail; Intermodal
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local; Rail access to Chicago hub is of particular concern.
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota - (MNSFP 1.2R2)
Stakeholder(s)	Private
Maturity	Not well developed; emerging
Measurement Source(s)	Mn/DOT Rail Office; FRA database; Railroad Companies
Challenges	This is easy to understand Appropriate measure to reflect the capacity constraint on freight performance. Data is generally available for this measure from the rail companies (and perhaps the Federal Railroad Administration); however, it needs to be compiled and analyzed. There is cost involved to obtain data, to compile it and to analyze it. It may also require development of public-private partnerships.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.12 Percent of airports for which land or airspace has been protected to meet requirements of Master Plans or Airport Layout Plans.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Express Package and Belly Freight
Mode(s)	Air Cargo
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate
Type of Movement(s)	Both passenger and freight
Usage	Currently being used In Minnesota -- (2.2A MNSTP; 2.1 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	Master Plans; Mn/DOT Aeronautics Office; Minnesota Aviation System Plan
Challenges	This is easy to understand. This is, however, a weak measure to reflect freight performance. Data is available from Aeronautics Office. It does not require separate cost as it is a fundamental requirement and routinely collected and updated.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.13 Percent of intermodal facilities whose infrastructure condition is adequate.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 -- Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail; Intermodal
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local; Rail access to Chicago is of particular concern.
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota - (MNSFP 1.2I)
Stakeholder(s)	Both Public and Private
Maturity	Not well Developed, emerging
Measurement Source(s)	Mn/DOT Intermodal Facility Database; Freight Advisory Group
Challenges	This is not as easy to understand. For example, what does condition mean? What is considered adequate? Not easy to connect directly condition to freight performance. Data are generally available; but has to compiled and analyzed. There is cost to compile and analyze dara

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.14 Availability of container-handling capability and/or bulk transfer capability.**
Goal/Strategic Direction (s)	Strategic Direction 2 – make the Network Operate Better
Policy(Policies)	Policy 4 -- Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Heavier and bulkier goods; Agriculture; Mining; Aggregate
Mode(s)	Ports; Intermodal
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota -- (4.1I MNSFP)
Stakeholder(s)	Private
Maturity	Not well Developed, developmental
Measurement Source(s)	Mn/DOT Waterway Section usually has this information
Challenges	This is easy to understand It reflects on constraints (when appropriate contained handling equipment is not available) that may affect freight performance Data has not been compiled or analyzed. There is a need to survey intermodal facilities and ports and even warehouses to obtain this information, which will involve cost.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.15 Percent of Minnesota Population within 60 minutes of an airport with cargo activity**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 3 -- Effectively manage the operation of existing transportation systems to provide maximum service to customers.
Sector(s)/Commodity(ies)	Express mail and belly freight
Mode(s)	Air Cargo
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, statewide, regional, local
Type of Movement(s)	Both freight and people
Usage	Currently being used in Minnesota-- (3.3 MASP)
Stakeholder(s)	Public and Private
Maturity	Well Developed
Measurement Source(s)	Minnesota Aviation System Plan
Challenges	It is easy to understand It is a weak measure and does not clearly and directly reflect freight performance This measure was developed as part of the most recent Minnesota Aviation System Plan development Cost to update the data seems minimal

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.16 Percent of airports that have Minnesota Rules Zoning**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Express package and belly freight
Mode(s)	Air
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota -- (2.2 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	Minnesota Aviation System Plan
Challenges	Not as well understood by generalist Weak measure for freight performance It was developed as part of updated Minnesota Aviation System Plan Cost is minimal

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.17 Percent of airports with appropriate access to IRC**
Goal/Strategic Direction (s)	Strategic Direction 2 – make the Network Operate Better
Policy(Policies)	Policy 4 -- Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Air Cargo – Express package and belly freight
Mode(s)	Air
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate
Type of Movement(s)	both passenger and freight
Usage	Currently being used in Minnesota -- (4.3A MNSTP)
Stakeholder(s)	Both Public and Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	IRC Studies; Connector Studies; Airport Master Plans
Challenges	Appropriate access is not always clear to everyone. A fair measure of freight performance, particularly how it might affect performance of express mail companies like FEDEX, UPS and DHL The data are available to some extent through recent Minnesota Aviation System Plan update and also connector studies. Cost is needed to acquire updated information.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.18 Percent of airports with scheduled commercial air service having appropriate access to Interregional Corridors**
Goal/Strategic Direction (s)	Strategic Direction 2 – make the Network Operate Better
Policy(Policies)	Policy 3 -- Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Air Cargo – Express package and belly freight
Mode(s)	Air
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate
Type of Movement(s)	both passenger and freight
Usage	Currently being used in Minnesota -- (3.4 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	IRC Studies; Connector Studies; Airport Master Plans
Challenges	Appropriate access is not clear to everyone. A fair measure of freight performance, particularly how it might affect performance of express mail companies like FEDEX and UPS and DHL especially in rural areas. Data available to some extent through recent Minnesota Aviation System Plan update Cost needed to acquire updated information

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.19 Number of at-grade railroad crossings along the freight significant corridors such as freeways and IRCs**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 -- Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	TL and LTL shipments
Mode(s)	Trucking
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	both passenger and freight
Usage	Not being used
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	Road Inventory Databases or FRA Database; Mn/DOT Office of Freight
Challenges	It is easy to understand. It reflects on the impediments to freight movement but by itself may not indicate freight performance Data are available but needs to be compiled and analyzed Cost is moderate

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.20 Number of overpasses that have vertical clearance restrictions freight significant corridors such as freeways and IRCs**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 -- Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	TL and LTL shipments
Mode(s)	Trucking
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	freight
Usage	Not being used
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	Road Inventory Databases
Challenges	It is easy to understand. It reflects on the impediments to freight movement but by itself may not indicate freight performance. Data are available but needs to be compiled and analyzed. Cost is moderate.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.21 Number of weight restricted bridges freight significant corridors such as freeways and IRCs**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 -- Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	TL and LTL shipments
Mode(s)	Trucking
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Not being used
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	Road Inventory and Bridge Databases; HPMS Databases
Challenges	It is easy to understand It reflects on the impediments to freight movement but by itself may not indicate freight performance; such impediment may increase circuity of freight movement and thus increase time and costs. Data seems to be available but needs to be compiled and analyzed. Cost is moderate but determination of impacts could be complex.

Table C.1 Assessment of network and infrastructure related performance measures/indicators, continued

Example Performance Measure/Indicator	**N.22 Number of intersections and ramps with inadequate turning radii for large trailers freight significant corridors such as freeways and IRCs**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what Exists
Policy(Policies)	Policy 1 -- Preserve essential elements of existing transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucking primarily.
Market(s)/Decision Context(s)	Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used? Where? In Minnesota?
Stakeholder(s)	Public, Private, Both?
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Mn/DOT Road Inventory
Challenges	This is easy to understand. Weak measure but it reflects on constraints imposed on trucks and thus may affect capacity and access. Data is not available but can be compiled. Cost is moderate.

2. SAFETY OR DAMAGE RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.2. Assessment of safety or damage related performance measures/indicators.

Example Performance Measure/Indicator	**S.1 Crash Rate**
Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 – Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, other modes indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Travel	Both passenger and freight
Usage	Currently being used in Minnesota **(7.1 MNSTP)**
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety Database**
Challenges	Easy to understand. Crash rate by itself may not serve as freight performance indicator because it also includes passenger cars related crashes. But lossess due to crashes to freight carrier is important freight performance indicator. Data is readily available but could be improved further. Cost commitment is already there for developing this indicator.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.2 Heavy truck crash rate (three-year average)**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 – Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, other modes indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota **(7.1T MNSFP)**
Stakeholder(s)	Both Public and Private
Maturity	Well developed
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety Database**
Challenges	Easy to understand. Heavy truck crash rate can serve as a good freight performance indicator but lossess due to crashes to freight carrier is important freight performance indicator. Data is readily available to develop crash rates, but focus on heavy truck crash rate is recent. Cost commitment is already there for developing this indicator.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.3 Number of heavy truck-related fatalities (three-year average)**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 – Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, other modes indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota **(7.2T MNSFP)**
Stakeholder(s)	Both Public and Private
Maturity	Well developed
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety Database**
Challenges	Easy to understand. Heavy truck related fatalities can serve as a good as freight performance indicator. Data is available to do this. Cost commitment is already there for developing this indicator.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.4 Total crashes at at-grade rail crossings (three-year average)**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 – Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, Rail
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota **(7.2T MNSTP; 7.2R1 MNSFP)**
Stakeholder(s)	Both Public and Private
Maturity	Well developed
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety Database**
Challenges	Easy to understand. Total crashes may not be as well related to freight performance Data is available to do this. Cost commitment is already there for developing this indicator.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.5 Percent of at-grade rail crossings meeting grade-separation guidelines.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, Rail
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used In Minnesota **(7.2R2 MNSFP)**
Stakeholder(s)	Both public and private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	**Roadway Inventory System**
Challenges	Easy to understand. Weak measure/indicator as it is difficult to easily relate to freight performance measure Data are Available Cost of establishing and maintaining this inventory, part of existing inventory

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.6 Number of truck-related fatalities at at-grade rail crossings (three-year average)**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used in Minnesota **(7.2R MNSFP)**
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety Database**
Challenges	Easy to understand. Appropriate measure/indicator which indirectly relates to freight performance measure related to safety Data are Available Cost of establishing and interrelating it with crash database

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.7 Average total 3-year general aviation crashes as reported and defined by FAA**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems. (It is Policy 4 in MASP)
Sector(s)/Commodity(ies)	Air cargo, belly freight
Mode(s)	Air
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota -- **(4.1 MASP)**
Stakeholder(s)	Public, Private, Both?
Maturity	Not Mature, with development of new MASP this information is being collected more frequently
Measurement Source(s)	Master Plans; Mn/DOT Aeronautics Office; Minnesota Aviation System Plan
Challenges	Easy to understand. Weak measure/indicator as it does not provide direct linkage to freight performance Data is available but not analyzed Cost is medium

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.8 Percent of study airports meeting TSA guidelines for general aviation security**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems. (It is Policy 4 in MASP)
Sector(s)/Commodity(ies)	Air cargo
Mode(s)	Air
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota **(4.3 MASP)**
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	TSA and Airport Authorities
Challenges	Not easily understood by generalist. Weak measure as it is not clearly related to freight performance measure/indicator related to security Data not available readily High Cost of complying

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	S.9 Rates and numbers of crashes and severity by major regional links
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems. (It is Policy 4 in MASP)
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used In Minnesota
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**Roadway Inventory System, Department of Public Safety at Mn/DOT**
Challenges	Easy to understand. Appropriate as it is related to freight performance measure; more the crash on major link, the impore impact on freight movement. Data on IRC corridors are being developed as part of plan development but have not been fully analyzed and compiled. There is a cost of analyzing data and establishing a program o monitoring Safety Management System.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.10 RR-Hwy crossing crashes in region**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks, Rail
Market(s)/Decision Context(s)	Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	**Roadway Inventory System, RR-Highway Crossing Databases, Department of Public Safety**
Challenges	Easy to understand Does not directly relate to freight performance measure by itself Data is availability but has not been compiled and analyzed consistently Cost of compilation, analysis

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.11 Class one derailments in region**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Both passenger and freight, mostly freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**AAR or FRA Databases**
Challenges	Easy to understand Appropriate measure but not directly related to freight performance Data is available with FRA or AAR Cost should be minimal

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	S.12 Railroad Freight Loss
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better; Minimize loss to Freight Industry
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota; Railroad Industry puts out statistics on this
Stakeholder(s)	Private
Maturity	Well Developed at Industry level; not specific to Minnesota
Measurement Source(s)	**AAR and FRA databases**
Challenges	Very easy to understand Freight industry values this measure highly AAR reports such information as part of their performance data Cost should be low as it is already gathered by the industry but whether it can be Minnesota specific is not clear.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.13 Regional truck crash and severity rates**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better; Minimize loss to Freight Industry
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota; Upper Midwest Freight Corridor Study has attempted to develop such information on regional basis; For IRC corridors Minnesota has attempted some of this
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**Safety Databases from Multiple States and Counties could provide such information**
Challenges	Hard to get all to see the value for such a measure. It would be important for those regions and corridors that are freight significant.

Table C.2. Assessment of safety or damage related performance measures/indicators, continued

Example Performance Measure/Indicator	**S.14 Cargo Insurance Cost**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better; Minimize loss to Freight Industry
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	All Modes
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used In Minnesota
Stakeholder(s)	Private
Maturity	Not developed to Not Mature, Freight Industry do use such information to assess their performance
Measurement Source(s)	**Survey of Insurance Companies or State Insurance Companies**
Challenges	This indicator would require some explanation for a generalist. Changes over time in cargo insurance rates will track very closely with the value of loss-and-damage claims. From the point of view of shippers and receivers, loss-and-damage is a significant aspect of the quality of freight service. As a result, cargo insurance rates are appropriate as a measure of one aspect of quality of service. Cargo insurance rates, however, do not solely reflect the quality of the highway system; they also reflect driver experience and loss and damage resulting from pilferage and handling. Changing rates could also reflect changing cargo values. Nonetheless, loss and damage is an important aspect of the quality of freight service, and this measure merits further examination. Data should not be a significant problem. Two potential sources exist. One is the insurance companies themselves. They routinely supply quotes for cargo insurance, and it is not proprietary information. One viable approach would be to select a panel of a small number of insurance companies and survey them once a year to get quotes. Another source would be State insurance commissions. Insurance companies regularly file their rates with the offices of the State commissions. Cost will depend on the appropriate partnerships with insurance companies.

3. ACCESS RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.3. Assessment of access related performance measures/indicators.

Example Performance Measure/Indicator	**A.1 Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, and indirectly Air, Water, and Rail
Market(s)/Decision Context(s)	Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (**2.2H MNSTP; 2.2T MNSFP**)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature,
Measurement Source(s)	**STP, District Plans, LRTP Efforts, Office of Investment Management at Mn/DOT**
Challenges	Hard for generalist to understand. Measure is appropriate but connection to freight performance measure/indicator is not intuitive. Data is subjective as issue of bottleneck could have different perceptions. If the bottleneck is routine the freight industry can plan around it. But if the bottleneck is non-recurrent then it might affect the freight industry adversely. Cost estimate is difficult to make.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.2 Percent of townships, counties, and municipalities along IRCs whose adopted local plans and ordinances support IRC Management Plans and Partnership Studies**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	All Modes potentially
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota ((2.1H MNSTP; 2.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**STP, District Plans, LRTP Efforts, Office of Investment Management at Mn/DOT**
Challenges	Freight considerations such as access, capacity, and others can be considered. The direct connection of this measure to freight performance is elusive and anecdotal at best. The notion of access and capacity needs to be defined in clearer terms.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.3 Percent of major generators with appropriate roadway access to IRCs and major highways.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the Network Operate Better
Policy(Policies)	Policy 4 – Provide cost-effective transportation option for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	All Modes
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used In Minnesota (4.3T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Freight; Freight Generator Facilities Inventory; Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.4 Percent of at-grade rail crossings meeting grade-separation guidelines.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks, Railroads
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (7.2R2 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**Roadway Inventory System; Rail Office at Mn/DOT; FRA Databases**
Challenges	Easy to understand. Weak measure/indicator as it is difficult to easily relate to freight performance measure Data are Available Cost of establishing and maintaining this inventory, part of existing inventory

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.5 Percent of major generators with appropriate rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail, Truck, and also Water
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (4.3R MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Freight; Office of Investment Management; Freight Generator Facilities Inventory; Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.6 Percent of rail track-miles with track speeds >25 mph.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve Essential Elements of Existing Transportation System
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (MNSFP 1.2R1)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**FRA and AAR databases ; Rail Office and Office of Freight at Mn/DOT**
Challenges	Easy to understand. It is hard to make an accurate interrelationship between speed and freight performance so not a good measure Data is available to develop this measure. Maps are put out now for this. Cost to develop this is low.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.7 Percent of rail track-miles with 286,000-pound railcar capacity rating.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve Essential Elements of Existing Transportation System
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (MNSFP 1.2R2)
Stakeholder(s)	Private
Maturity	Well Developed
Measurement Source(s)	**FRA and AAR databases ; Rail Office at Mn/DOT; Office of Freight at Mn/DOT**
Challenges	This is not as easy to understand. Along major corridor this could be a major issue and hence such measure could be good to identify the freight access issue for freight movement by rail. Cost is low to develop this measure.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.8 Availability of direct international air cargo freighter service.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.1A MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	**Aeronautic Office and Office of Freight of Mn/DOT; Freight Advisory Group**
Challenges	This is easy to understand and is an appropriate measure to identify access and even competitive issues. Data is difficult to gather. Does it mean such availability is within Minnesota or within reach from Minnesota? Recently Minnesota decided to develop such a service within Minnesota.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.9 Percent of air cargo facilities with appropriate roadway and rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Air, Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.3A MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Freight and Aeronautics Office at Mn/DOT; Freight Advisory Group**
Challenges	Easy to understand, except for the fact the word “appropriate” may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies and in development of recent Aviation System Plan has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.10 Availability of container-handling capability and/or bulk transfer capability.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Water, Intermodal, Rail, Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.1I MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature—mostly anecdotal evidences
Measurement Source(s)	**Waterway and Port Section and Office of Freight at Mn/DOT; Freight Advisory Group; Rail and Barge Companies**
Challenges	Not as clear to understand—is it availability all the time, most of the time? It is an appropriate measure to reflect on access and capacity issues. Data availability is anecdotal but the two Offices have good information. Cooperation with private entities—railroads, barge companies can provide good information. Cost should be minimal.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.11 Percent of major generators with appropriate roadway access to IRCs and major highways.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, indirectly Rail, Water, and Air
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used in Minnesota (4.3T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Freight, Connector Studies**
Challenges	Easy to understand, except for the fact the word “appropriate” may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.12 Percent of intermodal facilities (ports/terminals) with appropriate roadway and rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Water, Port, Intermodal, Truck, Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.3I MNSFP)
Stakeholder(s)	Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Freight, Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.13 Percent of Minnesota Population within 60 minutes of an airport with cargo activity**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Air Cargo
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (3.3 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study**
Challenges	Easy to understand Measure is too specific and clearly related to freight performance. Data is available to some extent, with the development of Minnesota Aviation System Plan and Air Cargo studies. Cost is low.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.14 Percent of major generators (ports/terminals/other major generators) with appropriate access to IRCs or water and/or rail corridors.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Water, Rail, Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.3F MNSTP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Connector studies, Office of Freight, Waterway and Port Section/Office, Rail Office**
Challenges	Easy to understand, except for the fact the word “appropriate” may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.15 Percent of airports with appropriate access to IRC**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Air, Truck
Market(s)/Decision Context(s)	Global, National, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (4.3A MNSTP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Connector Studies**
Challenges	The word appropriate makes it difficult to clearly understand this measure. Not the best measure for freight performance. Some data is available through the recent Connector Studies and also Minnesota Aviation System Plan development.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.16 Percent of airports with scheduled commercial air service having appropriate access to Interregional Corridors**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.4 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Connector Studies**
Challenges	The word appropriate makes it difficult to clearly understand this measure. Not the best measure for freight performance. Some data is available through the recent Connector Studies and also Minnesota Aviation System Plan development.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.17 Percent of Level 1, 2, and 3 Regional Trade Centers that are within 20 miles of a Key Airport**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Air, Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.5 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Connector Studies, IRC studies**
Challenges	Easy to understand Somewhat appropriate measure for freight performance. Some data is available through the recent Connector Studies, IRC studies, and also Minnesota Aviation System Plan development. Cost involved is medium.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.18 Percent of Level 4 and 5 Regional Trade Centers that are within 20 miles of a Key or an Intermediate Airport**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Air, Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.6 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Connector Studies, IRC studies**
Challenges	Easy to understand Somewhat appropriate measure for freight performance. Some data is available through the recent Connector Studies, IRC studies, and also Minnesota Aviation System Plan development. Cost involved is medium.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.19 Percent of airports with a runway 5,000 feet long or longer that have a precision instrument approach**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.7 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Well develped
Measurement Source(s)	**Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Airport Master Plans, Airport Airfield Inventory**
Challenges	Easy to understand Weak measure for freight performance. Some data is available through Master Plans, and also Minnesota Aviation System Plan development. Cost involved is medium.

Table C.3. Assessment of access related performance measures/indicators, continued

Example Performance Measure/Indicator	**A.20** Percent of airports with a paved and lighted runway that has a published non-precision or precision approach (3.8 MASP)
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.7 MASP)
Stakeholder(s)	Both Public and Private
Maturity	Well developed
Measurement Source(s)	**Office of Aeronautics, Minnesota Aviation System Plan, Minnesota Air Cargo Study, Airport Master Plans, Airport Airfield Inventory**
Challenges	Easy to understand Weak measure for freight performance. Some data is available through Master Plans, and also Minnesota Aviation System Plan development. Cost involved is medium.

4. CAPACITY RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.4. Assessment of capacity related performance measures/indicators.

Example Performance Measure/Indicator	**C.1 Percent of IRC and bottleneck removal projects identified in the 10-Year Program for which right-of-way needs have been protected**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 2 -- Support land use decisions that preserve mobility and enhance the safety of transportation systems
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, and indirectly Air, Water, and Rail
Market(s)/Decision Context(s)	Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (**2.2H MNSTP; 2.2T MNSFP**)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature,
Measurement Source(s)	**STP, District Plans, LRTP Efforts, Office of Investment Management at Mn/DOT**
Challenges	Hard for generalist to understand. Measure is appropriate but connection to freight performance measure/indicator is not intuitive. Data is subjective as issue of bottleneck could have different perceptions. If the bottleneck is routine the freight industry can plan around it. But if the bottleneck is non-recurrent then it might affect the freight industry adversely. Accidents and incidents can decrease capacity. Cost estimate is difficult to make.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.2 Clearance time for incidents, crashes, or hazmats (metro)**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks and indirectly rail and air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H1 MNSTP; 3.1T1 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature, information is improving
Measurement Source(s)	Traffic Management Center at Mn/DOT
Challenges	Easy to understand Has potential to affect freight movement, particularly truck movement. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Traffic Management Center activities.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.3 Snow and ice removal clearance time**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H2 MNSTP; 3.1T2 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Recent research on snow and ice control; Maintenance Office at Mn/DOT.
Challenges	Easy to understand. Has potential to affect freight movement, particularly truck movement. But not directly related to freight performance. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Maintenance Division and Traffic Management Center activities.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.4 Percent of major generators with appropriate roadway access to IRCs and major highways.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the Network Operate Better
Policy(Policies)	Policy 4 – Provide cost-effective transportation option for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	All Modes
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used In Minnesota (4.3T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Freight; Freight Generator Facilities Inventory; Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.5** Percent of IRC miles meeting speed targets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 5 – Enhance Mobility in Interregional Transportation Corridors (IRC) linking regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks directly, air, rail, and water indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (5.1H MNSTP; 5.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Metro office and Office of Investment Management at Mn/DOT; IRC plans and maps.
Challenges	Easy to understand. Weak measure; not clear how these speed targets actually affect freight performance. Data is available but not analyzed completely. Cost is moderate.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.6 Miles of peak-period congestion per day (RTCs 0 and 1)**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (6.3H MNSTP; 6.3T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Office of Investment Management at Mn/DOT; no clear source; IRC plans and updates
Challenges	Not as easy to understand Weak measure—cannot directly associate with freight performance Data is not available adequately; periodically available Cost is moderate

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.7 Percent of at-grade rail crossings meeting grade-separation guidelines.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make Network Operate Better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems.
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks, Railroads
Market(s)/Decision Context(s)	Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (7.2R2 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**Roadway Inventory System; Rail Office at Mn/DOT; FRA Databases**
Challenges	Easy to understand. Weak measure/indicator as it is difficult to easily relate to freight performance measure Data are Available Cost of establishing and maintaining this inventory, part of existing inventory

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.8 Percent of major generators with appropriate rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail, Truck, and also Water
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (4.3R MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**Office of Freight; Office of Investment Management; Freight Generator Facilities Inventory; Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.9 Percent of rail track-miles with track speeds >25 mph.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve Essential Elements of Existing Transportation System
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (MNSFP 1.2R1)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	**FRA and AAR databases ; Rail Office and Office of Freight at Mn/DOT**
Challenges	Easy to understand. It is hard to make an accurate interrelationship between speed and freight performance so not a good measure; It is construed mostly as a mobility measure rather than capacity measure. But inability to move at that speed may turn out to be a constraint and capacity issue. Capacity and mobility issues are intertwined. Data is available to develop this measure. Maps are put out now for this. Cost to develop this is low.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.10 Percent of rail track-miles with 286,000-pound railcar capacity rating.**
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard What Exists
Policy(Policies)	Policy 1 – Preserve Essential Elements of Existing Transportation System
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (MNSFP 1.2R2)
Stakeholder(s)	Private
Maturity	Well Developed
Measurement Source(s)	**FRA and AAR databases ; Rail Office at Mn/DOT; Office of Freight at Mn/DOT**
Challenges	This is not as easy to understand. Along major corridor this could be a major issue and hence such measure could be good to identify the freight access issue for freight movement by rail. Cost is low to develop this measure.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.11 Availability of container-handling capability and/or bulk transfer capability.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Water, Intermodal, Rail, Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.1I MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature—mostly anecdotal evidences
Measurement Source(s)	**Waterway and Port Section and Office of Freight at Mn/DOT; Freight Advisory Group; Rail and Barge Companies**
Challenges	Not as clear to understand—is it availability all the time, most of the time? It is an appropriate measure to reflect on access and capacity issues. Data availability is anecdotal but the two Offices have good information. Cooperation with private entities—railroads, barge companies can provide good information. Cost should be minimal.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.12 Percent of intermodal facilities (ports/terminals) with appropriate roadway and rail access.**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Water, Port, Intermodal, Truck, Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (4.3I MNSFP)
Stakeholder(s)	Public and Private
Maturity	Not Mature
Measurement Source(s)	**Roadway Inventory System, Office of Freight, Connector Studies**
Challenges	Easy to understand, except for the fact the word "appropriate" may mean different things to different people. This needs to be defined. It is a very appropriate measure and has been highlighted at national level and by many states Data is available through the freight generator facility database, recent connector studies, and roadway inventory. Investment in connector studies has provided valuable initial data, which can be updated and expanded in future.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.13 Capacity of Roads in IRC**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used? Where? In Minnesota?
Stakeholder(s)	Public, Private, Both?
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Road Inventory Databases; IRC plans and updates; Office of Investment Management at Mn/DOT
Challenges	Not clear to generalist. Weak measure as direct connection to freight performance cannot be made. Data is available. Cost is moderate.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.14 Port Capacity**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Bulkier goods--various
Mode(s)	Water, Rail, Barge
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Public, Private, Both?
Maturity	Not Mature to Well Developed
Measurement Source(s)	Waterway Section at Mn/DOT; Good data exists.
Challenges	Not clear to generalist. Good measure as connection to freight performance can be made—could be related to modal share, modal cost also. Data is available. Cost is moderate.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	C.15 Rail Capacity
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Mature—data is mostly anecdotal
Measurement Source(s)	AAR. Railroad Companies, Office of Rail and Freight at Mn/DOT; Freight Advisory Group; Transportation Journal; FRA
Challenges	Not understood easily by generalist. Good measure as there has been lot of taolk about how rail capacity crunch is affecting freight movement. Data is anecdotal and not clearly known. Cost is moderate but determination is complex.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.16 Channel/Waterway Capacity**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Bulkier goods--various
Mode(s)	Water
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Mature to Well Developed
Measurement Source(s)	Waterway section at Mn/DOT; Waterway data from Army Corps; Transportation Journal; Freight Advisory Group
Challenges	1. Understood well 2. Connection to freight performance can be made; there are anecdotal evidences 3. Mn/DOT Waterway section has good data on this.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.17 Intermodal Facility Capacity**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, Rail, Water, Intermodal
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private, Both
Maturity	Not Developed
Measurement Source(s)	Office of Freight at Mn/DOT; IANA; AAR; FRA; Intermodal Companies; Freight Advisory Group
Challenges	Could be understood Has impact on freight performance Data not readily available; notion of capacity could be many. Cost is moderate.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.18 Warehouse Capacity**
Goal/Strategic Direction (s)	Timeliness
Policy(Policies)	Meet Customer Demand Effectively
Sector(s)/Commodity(ies)	Retail goods mostly
Mode(s)	Truck, Intermodal
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Developed
Measurement Source(s)	Transportation Journal; Trade Magazines; Freight Advisory Group
Challenges	Not clearly understood. Weak measure and direct connection to freight performance is hard to make. Data available is anecdotal; data available in private domain. Cost of obtaining this data from private companies may be high

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.19 Number of Truck Rest areas and their Capacities**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Recent Truck Rest Area Study and another one is continuing
Challenges	Not easy to understand. This is one of the most important concerns facing trucking industry that is trying to meet the constraint of lack of parking space in town and delivery window being only 9 to 5. Data is being gathered and analysis is being made. Cost is moderate and worth the money.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.20 Capacity of Weigh Stations – number of trucks processed per hour**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Developed
Measurement Source(s)	Weigh Station database; Office of Freight at Mn/DOT
Challenges	Not easily understood. Weak measure as direct connection to freight performance cannot be made. This could become a big issue at border crossing areas. Data can be easily obtained but is not being gathered. Cost is minimal.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.21 Capacity of Border Crossings – number of trucks/containers processed per hour**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used? Where? In Minnesota?
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	BTS Border Crossing Data
Challenges	Not easy to understand. Not easily developed from border crossing data; knowing how many are being processed in a hour is not an indication of how many can be processed. It could be related to freight performance. Data is available but amenable to determination of capacity readily. Cost is moderate and determination is complex.

Table C.4. Assessment of capacity related performance measures/indicators, continued

Example Performance Measure/Indicator	**C.22 Air Cargo Capacity**
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Time sensitive goods
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Not Developed
Measurement Source(s)	Aeronautics and Freight Office at Mn/DOT; Air Cargo Studies; FAA; Airlines; Freight Shippers and Carriers
Challenges	Not easy to understand. Is related to freight performance so a good measure. Data hard to find, especially as only belly freight goes from Minnesota; rest goes to Chicago. Cost could be high; gathering information and determining it could be difficult.

5. TRAVEL TIME RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.5. Assessment of travel time related performance measures/indicators.

Example Performance Measure/Indicator	**TT.1** Clearance time for incidents, crashes, or hazmats (metro)
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks and indirectly rail and air
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H1 MNSTP; 3.1T1 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature, information is improving
Measurement Source(s)	Traffic Management Center at Mn/DOT
Challenges	Easy to understand Has potential to affect freight movement, particularly truck movement. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Traffic Management Center activities.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.2** Snow and ice removal clearance time
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H2 MNSTP; 3.1T2 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Recent research on snow and ice control; Maintenance Office at Mn/DOT.
Challenges	Easy to understand. Has potential to affect freight movement, particularly truck movement. But not directly related to freight performance. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Maintenance Division and Traffic Management Center activities.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.3** Percent of IRC miles meeting speed targets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 5 – Enhance Mobility in Interregional Transportation Corridors (IRC) linking regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks directly, air, rail, and water indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (5.1H MNSTP; 5.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Metro office and Office of Investment Management at Mn/DOT; IRC plans and maps.
Challenges	Easy to understand. Weak measure; not clear how these speed targets actually affect freight performance. Data is available but not analyzed completely. Cost is moderate.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.4** Peak-period travel time reliability on IRCs and other high-use truck roadways.
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (5.2 T MSFP; 6.2H MNSTP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Office of Operations
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as IRCs are freight significant corridors and may affect freight performance in terms of travel time and reliability associated with it. Data is not readily available but could be derived. Cost is moderate.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.5** Ratio of peak to off-peak travel time – Travel Rate Index (metro)
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (6.1H MNSTP; 6.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Traffic Management Center.
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as metro area is a freight significant node and corridors within it are freight significant corridors for last mile freight movement and may affect freight performance in terms of travel time and reliability associated with it. Data is available for metro are but needs to be analyzed more. Cost is moderate.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.7** Peak-period travel time reliability on metro area highways.
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (6.1H MNSTP; 6.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Traffic Management Center.
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as metro area is a freight significant node and corridors within it are freight significant corridors for last mile freight movement and may affect freight performance in terms of travel time and reliability associated with it. Data is available for metro are but needs to be analyzed more. Cost is moderate.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.9** Travel time for selected commodities, modes, and regional and national markets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 5 – Enhance Mobility in Interregional Transportation Corridors (IRC) linking regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	All modes
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (Policy 5, PI4 MNSFP)—PI refers to Performance Indicator
Stakeholder(s)	Private
Maturity	Not Developed
Measurement Source(s)	No Source exist; some isolated freight flow studies had done a survey of shippers in Minnesota to see how much time they take to deliver to various destinations nationawide and internationally.
Challenges	This is very important piece of information and exists in private sector. Useful public-private partnerships and effective use of freight advisory group could provide such data. Hard to get this data because of proprietary nature of data. Cost could be high to buy commercial data.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.10** Travel time for selected commodities, modes, and local markets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 5 – Enhance Mobility in Interregional Transportation Corridors (IRC) linking regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	All modes
Market(s)/Decision Context(s)	Metro/Local
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used in Minnesota (Policy 5, PI4 MNSFP)—PI refers to Performance Indicator
Stakeholder(s)	Private
Maturity	Not Developed
Measurement Source(s)	No Source exist; some isolated freight flow studies had done a survey of shippers in Minnesota to see how much time they take to deliver to various destinations within metro area.
Challenges	This is very important piece of information and exists in private sector. Useful public-private partnerships and effective use of freight advisory group could provide such data. Hard to get this data because of proprietary nature of data. Cost could be high to buy commercial data.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.14** Average delay time at river locks.
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Waterway, Intermodal
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight or both passenger and freight?
Usage	Currently being used in Minnesota (3.2W MNSFP)
Stakeholder(s)	Public, Private, Both?
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Waterway and Port Section at Mn/DOT
Challenges	Easy to understand. Through effective partnsership with freight industry such data has been developed. Data is available and cost is minimal.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.15** Loading/Unloading Times at Intermodal Centers
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Intermodal, Truck, Rail
Market(s)/Decision Context(s)	Global, Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Private
Maturity	Well Developed in Private domain; Not developed in public domain
Measurement Source(s)	Intermodal Companies, AAR and IANA databases
Challenges	Easy to understand. Directly related to freight performance. Data available on national and regional average basis from AAR and IANA as dwell times. Cost of subscribing to IANA data. AAR data is publicly available. The question is if it applies to Minnesota.

Table C.5. Assessment of travel time related performance measures/indicators, continued

Example Performance Measure/Indicator	**TT.16** Processing time at border crossings
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Global,Multinational, National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Stakeholder(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	BTS Border crossing data
Challenges	1. Easy to understand. 2. Cannot be directly be related to freight performance but it does have impact. 3. Data available 4. Cost is minimal

6. RELIABILITY RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.6. Assessment of reliability related performance measures/indicators.

Example Performance Measure/Indicator	**R.1** Clearance time for incidents, crashes, or hazmats (metro)
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks and indirectly rail and air
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H1 MNSTP; 3.1T1 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature, information is improving
Measurement Source(s)	Traffic Management Center at Mn/DOT
Challenges	Easy to understand Has potential to affect freight movement, particularly truck movement. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Traffic Management Center activities.

Table C.6. Assessment of reliability related performance measures/indicators, continued

Example Performance Measure/Indicator	**R.2** Snow and ice removal clearance time
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (3.1H2 MNSTP; 3.1T2 MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Recent research on snow and ice control; Maintenance Office at Mn/DOT.
Challenges	Easy to understand. Has potential to affect freight movement, particularly truck movement. But not directly related to freight performance. Data is available but not complete and mechanism for updating it needs to mature. Cost is inbuilt with Maintenance Division and Traffic Management Center activities.

Table C.6. Assessment of reliability related performance measures/indicators, continued

Example Performance Measure/Indicator	**R.3** Percent of IRC miles meeting speed targets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 5 – Enhance Mobility in Interregional Transportation Corridors (IRC) linking regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks directly, air, rail, and water indirectly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (5.1H MNSTP; 5.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Metro office and Office of Investment Management at Mn/DOT; IRC plans and maps.
Challenges	Easy to understand. Weak measure; not clear how these speed targets actually affect freight performance. Data is available but not analyzed completely. Cost is moderate.

Table C.6. Assessment of reliability related performance measures/indicators, continued

Example Performance Measure/Indicator	**R.5** Peak-period travel time reliability on IRCs and other high-use truck roadways.
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (5.2 T MSFP; 6.2H MNSTP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Office of Operations
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as IRCs are freight significant corridors and may affect freight performance in terms of travel time and reliability associated with it. Data is not readily available but could be derived. Cost is moderate.

Table C.6. Assessment of reliability related performance measures/indicators, continued

Example Performance Measure/Indicator	**R.6** Ratio of peak to off-peak travel time – Travel Rate Index (metro)
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (6.1H MNSTP; 6.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Traffic Management Center.
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as metro area is a freight significant node and corridors within it are freight significant corridors for last mile freight movement and may affect freight performance in terms of travel time and reliability associated with it. Data is available for metro are but needs to be analyzed more. Cost is moderate.

Table C.6. Assessment of reliability related performance measures/indicators, continued

Example Performance Measure/Indicator	**R.7** Peak-period travel time reliability on Twin Cities Metro Area (TCMA)/metro area highways.
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 6 – Enhance Mobility within major regional trade centers
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (6.1H MNSTP; 6.1T MNSFP)
Stakeholder(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Mn/DOT Traffic Management Center.
Challenges	This is intended to measure the relative severity of peak-period congestion. It serves a purpose as metro area is a freight significant node and corridors within it are freight significant corridors for last mile freight movement and may affect freight performance in terms of travel time and reliability associated with it. Data is available for metro are but needs to be analyzed more. Cost is moderate.

7. MARKET SHARE RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.7. Assessment of market share related performance measures/indicators.

Example Performance Measure/Indicator	**MK.1** Geographic market share – Tonnage and value of shipments to/from the state, by major commodity groups, to major trading partners.
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Stakeholder(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

Table C.7. Assessment of market share related performance measures/indicators, continued

Example Performance Measure/Indicator	**MK.2** Tonnage of shipments to Minnesota by major commodity groups
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

Table C.7. Assessment of market share related performance measures/indicators, continued

Example Performance Measure/Indicator	**MK.3** Value of shipments to Minnesota by major commodity groups
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

8. MODE SHARE RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.8. Assessment of mode share related performance measures/indicators.

Example Performance Measure/Indicator	**MD.1** Mode share (tonnage and value)– Amount of freight carried by each freight mode, by major commodity groups (Policy 4, PI2 MNSFP)
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

Table C.8. Assessment of mode share related performance measures/indicators, continued

Example Performance Measure/Indicator	**MD.2** Tonnage of shipments to Minnesota by major commodity groups by different Modes
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

Table C.8. Assessment of mode share related performance measures/indicators, continued

Example Performance Measure/Indicator	**MD.3** Value of shipments to Minnesota by major commodity groups by different Modes
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional
Type of Movement(s)	Only freight
Usage	Currently being used In Minnesota (Policy 4, PI3 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Past Freight Flow studies provided snapshots; CFS, Global Insight's TRANSEARCH-INSIGHT data, local surveys; FAF data
Challenges	So far snapshots have been developed almost at 5 year interval. Data is available; Mn/DOT Office of Freight with its Freight Planning Support System will be able to provide updates. Data is not good for substate and local freight flows Cost is moderate to high (for Global Insight data); commitment of staff by Mn/DOT will be helpful.

9. MODAL COSTS RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.9. Assessment of modal costs related performance measures/indicators.

Example Performance Measure/Indicator	**MC.1** Transportation Cost related to shipments by major commodity groups by different Modes
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes.
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota?
Domain(s)	Private
Maturity	Not Mature
Measurement Source(s)	Highway Cost Allocation Studies; Spring load restriction studies; Waterway and Port Section at Mn/DOT; USDA Transportation Services Administration; Truck Cost Models
Challenges	Easy to understand. Could be related to freight performance of different modes. Data difficult to determine and involves lot of assumptions in derivation. Mostly has been determined as part of specialized studies.

10. FREIGHT PRODUCTIVITY RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.10. Assessment of freight productivity related performance measures/indicators.

Example Performance Measure/Indicator	**FP.1** Ton-miles per employee
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better Improve Freight Industry's Productivity
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes. Make freight transportation more efficient
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck, Rail, Water
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota?
Domain(s)	Private and Public
Maturity	Not Mature
Measurement Source(s)	Private companies
Challenges	Easy to understand. Does reflect freight performance. Data available but in private domain. Cost of acquiring it is moderate.

Table C.10. Assessment of freight productivity related performance measures/indicators, continued

Example Performance Measure/Indicator	**FP.2** Percent truckloads empty
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better Improve Freight Industry's Productivity
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes. Make freight transportation more efficient
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	VIUS (but this is being discontinued)
Challenges	Easy to understand. This is very important measure for freight performance. Data is not available. Cost is high to obtain such data. The number of empty trucks by configuration and their spatial distribution on the highway network is required in capacity analysis, development of strategies, freight analysis, and infrastructure and safety impact assessment. This data is not readily available. This information is derived from expert knowledge of the trucking industry and models based on a number of simplifying assumptions.

Table C.10. Assessment of freight productivity related performance measures/indicators, continued

Example Performance Measure/Indicator	**FP.4** Percent of vehicle miles empty
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better Improve Freight Industry's Productivity
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and Investment Decision Processes. Make freight transportation more efficient
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	VIUS (but this is being discontinued)
Challenges	Easy to understand. This is very important measure for freight performance. Data is not available. Cost is high to obtain such data. The number of empty trucks by configuration and their spatial distribution on the highway network is required in capacity analysis, development of strategies, freight analysis, and infrastructure and safety impact assessment. This data is not readily available. This information is derived from expert knowledge of the trucking industry and models based on a number of simplifying assumptions.

11. FREIGHT SECURITY RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.11. Assessment of freight security related performance measures/indicators.

Example Performance Measure/Indicator	**FS.1** Percent of study airports meeting TSA guidelines for general aviation security
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems and their users
Sector(s)/Commodity(ies)	Air cargo
Mode(s)	Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (4.3 MASP)
Domain(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Aeronautics Office at Mn/DOT; TSA; Airport Authorities
Challenges	Hard to find such data.

Table C.11. Assessment of freight security related performance measures/indicators, continued

Example Performance Measure/Indicator	**FS.2** Security/Vulnerability at Ports
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems and their users
Sector(s)/Commodity(ies)	Various, containers
Mode(s)	Waterway, Intermodal
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	Waterway and Port section at Mn/DOT; TSA; not developed yet.
Challenges	Definition of vulnerability needs to be developed.

Table C.11. Assessment of freight security related performance measures/indicators, continued

Example Performance Measure/Indicator	**FS.3** Secure/Vulnerable Access
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 7 -- Increase the safety and security of the transportation systems and their users
Sector(s)/Commodity(ies)	Various
Mode(s)	Waterway, Intermodal, Truck, Rail
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	Waterway and Port section at Mn/DOT; TSA; not developed yet; Connector Studies
Challenges	Definition of vulnerability needs to be developed.

12. SHIPMENT RATES RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.12. Assessment of shipment rates related performance measures/indicators.

Example Performance Measure/Indicator	SR.1 Shipment rates for selected commodities, modes, and regional and national markets
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Policy 4 – Provide cost-effective transportation options for people and freight
Sector(s)/Commodity(ies)	Various—for Agriculture there is good information
Mode(s)	Truck, Rail, Barge
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently being used in Minnesota (Policy 4 PI1 MNSFP) – Performance Indicator
Domain(s)	Private
Maturity	Not Mature for most; Well Developed for Agriculture freight movement
Measurement Source(s)	USAD Agricultural Transportation Services; USDA Grain Report
Challenges	For Agriculture data is good. It is not as readily available for other commodities.

13. PRICING RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.13. Assessment of pricing related performance measures/indicators.

Example Performance Measure/Indicator	**PR.1** Truck Pricing Trends
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	Reed Business' Pricing Trends
Challenges	It is to be determined if these national pricing trends apply to Minnesota.

Table C.13 Assessment of pricing related performance measures/indicators, continued

Example Performance Measure/Indicator	**PR.2** Air Pricing Trends
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	Air
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	Reed Business' Pricing Trends
Challenges	It is to be determined if these national pricing trends apply to Minnesota.

Table C.13 Assessment of pricing related performance measures/indicators, continued

Example Performance Measure/Indicator	**PR.3** Rail Pricing Trends
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	Rail
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	Reed Business' Pricing Trends
Challenges	It is to be determined if these national pricing trends apply to Minnesota.

Table C.13 Assessment of pricing related performance measures/indicators, continued

Example Performance Measure/Indicator	**PR.4** Water Pricing Trends
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	Water
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	Reed Business' Pricing Trends
Challenges	It is to be determined if these national pricing trends apply to Minnesota.

Table C.13 Assessment of pricing related performance measures/indicators, continued

Example Performance Measure/Indicator	**PR.5** Agricultural Pricing
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Agricultural commodities
Mode(s)	Truck, Rail, Barge, Ocean, Intermodal
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	USDA Transportation Services; USDA Grain Transportation Report
Challenges	This is fairly good source.

14. AGENCY COST RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.14. Assessment of agency cost related performance measures/indicators.

Example Performance Measure/Indicator	**AC.1** Cost/benefit of clearing incidents, crashes, or hazmats (metro)
Goal/Strategic Direction (s)	Strategic Direction 1 – Safeguard what exists Strategic Direction 3 – Make Mn/DOT Work Better
Policy(Policies)	Policy 3 – Effectively Manage the Operation of Existing Transportation System to Provide Maximum Service to Customer Policy 8 – Continually improve Mn/DOT's internal management and program delivery
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide
Type of Movement(s)	Both passenger and freight?
Usage	Currently not being used In Minnesota?
Domain(s)	Public
Maturity	Not Developed
Measurement Source(s)	Which measurement sources are useful? **Roadway Inventory System**
Challenges	This is more for performance of DOT; could indirectly relate to freight performance if these clearances do not take place in timely manner.

15. CARRIER COST RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.15. Assessment of carrier cost related performance measures/indicators.

Example Performance Measure/Indicator	**CC.1** Carrier Cost related to shipments to Minnesota by major commodity groups by different Modes
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT Work Better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	ATA, Trucking Companies, ATRI
Challenges	Data is available in private domain but accessible in public domain.

16. SHIPPER COST RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.16. Assessment of shipper cost related performance measures/indicators.

Example Performance Measure/Indicator	**SC.1** Shipper Cost related to shipments to Minnesota by major commodity groups by different Modes
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT Work Better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	Possible with Shippers Companies
Challenges	Interest is more on shipment rates rather than shipper cost for public sector.

17. EXTERNALITIES/COMMUNITY COST RELATED PERFORMANCE MEASURES/INDICATORS

Table C.17. Assessment of externalities/community cost related performance measures/indicators.

Example Performance Measure/Indicator	**EX.1** Increase in Air Pollution Impacts/Costs
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 10 – Protect the environment and respect community values
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	Emission Inventories; Field Data Collection
Challenges	There is a move toward sustainable freight movement, starting from using better engines, alternative fuels, freight villages, and others.

Table C.17. Assessment of externalities/community cost related performance measures/indicators, continued

Example Performance Measure/Indicator	**EX.2** Increase in injuries or cost related to injuries
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 10 – Protect the environment and respect community values
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	**Roadway Inventory System, Safety Database of Mn/DOT; Office of Investment Management at Mn/DOT**
Challenges	Truck-auto conflict and increase in severity of accidents is always a concern.

Table C.17. Assessment of externalities/community cost related performance measures/indicators, continued

Example Performance Measure/Indicator	**EX.3** Increase in energy consumed or costs related to Energy Consumption
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 10 – Protect the environment and respect community values
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	Fuel Consumption Data--EIA
Challenges	With rising diesel prices there is tremendous pressure to seek alternative fuels and higher efficiencies to reduce need for fuel.

Table C.17. Assessment of externalities/community cost related performance measures/indicators, continued

Example Performance Measure/Indicator	**EX.4** Increase in congestion levels or costs related to Congestion
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes Policy 10 – Protect the environment and respect community values
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Not Developed
Measurement Source(s)	**Roadway Inventory System, Roadway Capacity, Traffic Volume and Composition**
Challenges	Impact of congestion on freight performance and congestion due to trucks both are important concerns.

Table C.17. Assessment of externalities/community cost related performance measures/indicators, continued

Example Performance Measure/Indicator	**EX.9** Time to complete EIS, Environmental Assessment, and EAW per project.
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT work better
Policy(Policies)	Policy 8 – Continually improve Mn/DOT's internal management and program delivery Policy 10 – Protect the environment and respect community values
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (10.4ES MNSTP)
Domain(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Office of Investment Management (OIM) at Mn/DOT; Examination of contract and project documents to see how long it took each time.
Challenges	Delays in freight significant corridors, links, nodes can adversely impact freight movement and performance. A good example of impact is evident from collapse of I-35W bridge and its impact on truck movement.

18. TRANSPORTATION INDICIES AS PERFORMANCE INDICATORS

Table C.18. Assessment of transportation indices as performance indicators.

Example Performance Measure/Indicator	**TI.2** DJTA Index
Goal/Strategic Direction (s)	Freight Industry Health
Policy(Policies)	Stock Value of Freight Industry should grow
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Well Developed
Measurement Source(s)	Wall Street
Challenges	Hard to understand. One of the earliest indicators used for transportation industry. Data is reported peridocially. Cost is minimal

Table C.18. Assessment of transportation indices as performance indicators, continued

Example Performance Measure/Indicator	**TI.3** BTS Transportation Services Index
Goal/Strategic Direction (s)	Freight Industry Health
Policy(Policies)	Maintaining and keeping up with freight demand
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	National
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	BTS
Challenges	Hard to understand by generalist. Very good indicator for how freight industry as a whole is doing—increasing trend or decreasing business. Could signal concerns. Data is developed by BTS and reported periodically. Cost -- is part of BTS activities.

Table C.18. Assessment of transportation indices as performance indicators, continued

Example Performance Measure/Indicator	**TI.4** ATRI Buffer Index for Transportation Corridors
Goal/Strategic Direction (s)	Strategic Direction 2 – Make the network operate better
Policy(Policies)	Enhance Freight Mobility on Freight Siginificant Corridors
Sector(s)/Commodity(ies)	Various
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota? Could be useful for St. Paul to Chicago Corridor
Domain(s)	Both Public and Private
Maturity	Not Mature to Well Developed
Measurement Source(s)	Which measurement sources are useful? **Roadway Inventory System**
Challenges	Not easily understood by generalist. Very good indicator of travel time and reliability on freight significant corridor. TTI has developed similar indicator for personal urban mobility Data being developed by FHWA/ATRI public-private partnership Cost is high; great way to get around privacy and competition issues

Table C.18. Assessment of transportation indices as performance indicators, continued

Example Performance Measure/Indicator	**TI.5** Transportation as a percent of National or State GDP
Goal/Strategic Direction (s)	Economic Health of Nation or State
Policy(Policies)	What is the constribution of transportation in overall economic growth?
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local?
Type of Movement(s)	Only freight
Usage	Currently not being used in Minnesota
Domain(s)	Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	BTS and FHWA; not developed at state level. Selected studies.
Challenges	Easy to understand. A very good indicator to see the importance of freight to economy but not necessarily indicative of freight performance. Data not readily available. Cost is moderate.

19. EXTERNAL FACTORS RELATED PERFORMANCE MEASURES AND INDICATORS

Table C.19. Assessment of external factors related performance measures/indicators.

Example Performance Measure/Indicator	**EF.1** Population growth in metro areas, in regions, and statewide
Goal/Strategic Direction (s)	Attract people and activities to the region
Policy(Policies)	Economic and transportation advantages bring people in and that generates need for freight
Sector(s)/Commodity(ies)	Various, mostly retail and warehousing
Mode(s)	Truck
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	State Demographers, also Census Data
Challenges	Good indicator of growth in need for retail goods and possibly warehousing needs.

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.2** Growth in number of businesses or establishments in metro area, in region, and statewide
Goal/Strategic Direction (s)	Economic development of metro, region, statewide
Policy(Policies)	How to improve business climate
Sector(s)/Commodity(ies)	Various
Mode(s)	Trucks mostly
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	As an indicator of freight demand and growth
Domain(s)	Bth Public and Private
Maturity	Not Developed, Not Mature, Well Developed
Measurement Source(s)	Survey of County Businesses; Department of Economic Development in Minnesota; Office of Freight at Mn/DOT; Duns and Bradstreet Business Data
Challenges	Easy to understand. Direct indicator of freight generation and also outbound and inbound movements. Data is available. Cost is moderate.

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.3** Fuel Prices and Surcharges
Goal/Strategic Direction (s)	Energy conservation and independence
Policy(Policies)	Keep the energy prices to a sustainable level
Sector(s)/Commodity(ies)	Various
Mode(s)	All, particularly Truck and Air
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	As an indicator for many things—costs and rates
Domain(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	EIA; Oil and Gas Journal; Oil Companies report
Challenges	Easily understood. Direct impact of costs, prices, and rates—so a good indicator for freight performance Data is available Cost is minimal

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.9** Business Practices – Consolidation of Shipments
Goal/Strategic Direction (s)	Improve logistics
Policy(Policies)	Maintain a better balance between inventory and transportation
Sector(s)/Commodity(ies)	Various; mostly retail
Mode(s)	Truck
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Only freight
Usage	Indicator of changes in nature of freight demand and movements
Domain(s)	Private
Maturity	Not Developed
Measurement Source(s)	Transport Topics; Journal of Commerce; Transportation Journal; Annual Survey of Logistics; Freight Advisory Group
Challenges	Hard to understand. Good measure of freight performance Data is not available or only available in anecdotal form Cost is moderate

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.12** GDP or GSP Levels
Goal/Strategic Direction (s)	Quality of life
Policy(Policies)	Maintain steady economic growth
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Public, Private, Both?
Maturity	Well Developed
Measurement Source(s)	Department of Employment and Economic Development, Commercial Vendors
Challenges	Easy to understand. Not easy to connect to freight performance; intuitively more GDP more freight movement; It might be an indicator for freight increase but not necessarily freight performance. Data is available. Cost is minimal.

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.13** Inflation Rates
Goal/Strategic Direction (s)	Keep economy moving
Policy(Policies)	Keep inflation rates low
Sector(s)/Commodity(ies)	Various
Mode(s)	All modes
Market(s)/Decision Context(s)	Global,Multinational, National, Multistate, Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently not being used in Minnesota
Domain(s)	Both Public and Private
Maturity	Well Developed
Measurement Source(s)	Department of Economic Development in Minnesota; Economic Consultants
Challenges	Easy to understand Affects goods prices and transportation prices; indicator of health of freight industry. Data is available. Cost is minimal

Table C.19. Assessment of external factors related performance measures/indicators, continued

Example Performance Measure/Indicator	**EF.14** Percent of customers satisfied with the reliability of Mn/DOT communications. (9.1 MNSTP)
Goal/Strategic Direction (s)	Strategic Direction 3 – Make Mn/DOT Work Better
Policy(Policies)	Policy 9 – Inform, involve and educate all potentially affected stakeholders in transportation; Plans and investment decision processes
Sector(s)/Commodity(ies)	Various
Mode(s)	All
Market(s)/Decision Context(s)	Statewide, Regional, Metro/Local
Type of Movement(s)	Both passenger and freight
Usage	Currently being used in Minnesota (9.1 MNSTP)
Domain(s)	Both Public and Private
Maturity	Not Mature
Measurement Source(s)	Freight Advisory Group; Survey of companies, shippers, and carriers
Challenges	Easy to gauge perception of satisfaction by interacting with Freight Advisory Group. Can indirectly provide

Appendix D. Assessment of Measurement Sources

The assessment included looking into data characteristics and significant limitations, what are the costs and benefits, and how relevant and applicable are the sources for developing freight performance measures and indicators for Minnesota. Included in the assessment, were applicability of measurement sources for performance indicators such as shipping rates, modal costs and travel time, the four new performance indicators in Minnesota's Statewide Freight Plan. Data characteristics or attributes included, where information was available or relevant, geographic coverage, issues of aggregation, when was data developed and how often is it updated. It was also assessed how data were obtained. For example, was it viewpoint of stakeholders, routine observation, census survey, special local surveys, or obtained through modeling or some other derivation. It was also important to identify, where clearly known, who were responsible for data that were collected and maintainted. The limitations identified in the assessments were in terms of availability, accessibility, adequacy, exclusions, costs, and calibration and validation needs. The applicability to freight measures--Network or Infrastructure, Safety or damage, Access, Capacity, Commodity, Mode, Market, Shipment Rate/Pricing, Travel Time, Reliability, and Costs—and for Minnesota were the most important part of the assessment. In some instances this assessment ran into several pages, for example CFS data, TRANSEARCH data, Waybill data, and others. In other instances this assessment did not include answers to all the aforementioned questions as data were developed and used for specific purpose rather than developed on regular basis and/or had wide applicability.

1. FEDERAL MEASUREMENT SOURCES

Table D.1. Assessment of federal measurement sources.

Measurement Source	**Commodity Flow Survey (CFS)** **http://www.bts.gov/programs/commodity_flow_survey/**
Nature of Measurement source	**Primary freight data source—a shipper-based survey and is conducted every five years as part of the Economic Census.**
Characteristics & Availability	**1. CFS provides data on the flow of freight by mode of transport and includes commodity volume and value between origin and destinations.** **2. This survey captures shipment data from manufacturing, mining, wholesale and selected retail and service establishments. The shipment data includes distance distributions and origin-destination flows by commodity type, mode, shipment size and value.** **3. The Bureau of the Census conducts the CFS as part of its quinquennial Economic Censuses, with two week samples collected during each quarter of the sample year. Conducts the survey every 5 years.** **4. The tabulations include a 5-digit STCC commodity summary at the national level and a geographic summary (by state and BEA based National Transportation Analysis Regions-NTARS) at the 3-digit STCC level.** **5. Contains originating shipment activity for all US establishments with one or more employees for the industry sectors mentioned above.** **6. Latest data is for 2002 and that for 2007 is being processed now and preliminary data for 2007 will be available December, 2008 and final data will be available December, 2009.**
Applicability & Benefits	**1. Covers all modes.** **2. Good for developing measures/indicators such as market share and mode share by weight and value at statewide level and for inbound and outbound movements**
Costs, Limitations, and Challenges	**1. Survey is limited to shipments by U.S. based establishments, which limits coverage of import shipments.** **2. Aggregation and confidentiality issues make data less useful for substate or local flows.** **3. Data cannot be directly used. It requires examination and costs are involved.** **4. The funding for the survey is debated every 5 years and is supported by public funding. One of the key areas of concern is the sample size.**

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	STB Carload Waybill Sample http://www.stb.dot.gov/stb/industry/econ_waybill.html
Nature of Measurement source	Primary data source—It is compiled by AAR for STB based on the carload waybills submitted by U.S. railroads. It is principal source of data for railroad and some intermodal activity.
Characteristics & Availability	1. Only part of the data is available for public use, which is typically available in July of each year. 2. Data is obtained only from those railroads that moved at least 4500 carloads per year in preceding 3 years or carry at least 5% of total traffic in an state. 3. Data on total rail traffic, commodities, revenues, O-D flows, and routing of railroad shipments are available. In addition, data on shot lane miles, number of interchanges, and rail carrier and equipment are also available. 4. 5-digit STCC used for commodity movements 5. The data on national, state to state, and BEA area to BEA movements can be established.
Applicability & Benefits	Provides information about rail freight movements to and from various Bureau of Economic Areas (BEAs). It can be used to develop market share (in tonnage and value) of rail movements in, out, and through Minnesota.
Costs, Limitations, and Challenges	The data is primarily for Class I railroad since sample size does not allow coverage of Class II and III railroads. Also, if BEA regions have two or less establishments then that data is suppressed. In addition, if number of establishments is less than the number of railroads in the region then that data is not reported.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Army Corps of Engineers Waterborne Commerce Data** **http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm**
Nature of Measurement source	**Primary source--Domestic freight carriers who report their vessel operations and cargo activity directly to the Corps of Engineers in the form of Vessel Operations Reports and U.S. Bureau of the Census: U.S. Waterborne Exports and General Imports.**
Characteristics & Availability	**The Waterborne Commerce and Vessel Statistics database, developed annually by the U.S. Army Corps of Engineers: Navigation Data Center (NDC), provides comprehensive shipment statistics data for domestic and foreign waterborne trade flows across U.S. ports and waterways. The database is the only comprehensive source of data for both domestic and foreign waterborne trade shipments in and out of the United States. Domestic shipment data are collected specifically for the database by the Corps of Engineers from Vessel Operating Reports obtained from domestic carriers. Foreign trade statistics are directly obtained from the U.S. Census Bureau's U.S. waterborne import and export trade statistics. Further enhancements are, however, made to the database in terms of vessel movements.**
Applicability & Benefits	**Useful for developing market share information for goods moved by waterway.**
Costs, Limitations, and Challenges	**This is good data source and is utilized by various commercial vendors as well as by Waterway and Port section of Mn/DOT.** **It is reported annually so data is available. However, there is big lag when data becomes available.**

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**State and Federal Truck Size and Weight regulations publications**
Nature of Measurement source	Research findings and Regulation
Characteristics & Availability	Several datasets were used for these studies. HPMS, LTPP, State pavement databases, rail to road diversion information, and others.
Applicability & Benefits	Pavement condition data is needed for network and infrastructure related measures and indicators. Market information could be useful for understanding the market and mode share. In addition, modal cost and modal diversion information is also developed.
Costs, Limitations, and Challenges	The development of databases provides a good data for multiple uses. They are based on assumptions and do provide snapshots. Forecast information is developed but sometimes could be questioned.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Long Term Pavement Performance (LTPP) Database** http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=260
Nature of Measurement source	Primary, Research findings
Characteristics & Availability	Traffic data within the LTPP study provides an independent measure of the traffic loads that are applied to the individual pavement sections studied. Axle load distributions represent the loading history for each test section.
Applicability & Benefits	Traffic composition and distribution could help assess pavement damage costs.
Costs, Limitations, and Challenges	Limited value directly. But when combined with other data sources could provided good insights.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Vehicle Inventory and Use Survey (VIUS)** http://www.census.gov/svsd/www/purpose.html.
Nature of Measurement source	Primary--survey
Characteristics & Availability	VIUS provides data on the physical and operating characteristics of the nation's truck population. It provides national and state-level estimates of the total number by type of trucks. This data is gathered through surveys conducted every 5 years as part of the economic census.
Applicability & Benefits	Several performance related to truck movements—average length of haul, percent empty miles, etc.
Costs, Limitations, and Challenges	It has been discontinued even though it was a singlemost source for such information.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Highway Performance Management System (HPMS)** http://www.fhwa.dot.gov/policy/ohpi/hpms/
Nature of Measurement source	Primary, Secondary, Snapshot
Characteristics & Availability	HPMS is both a statewide and nationwide information system used to assess the condition performance of the nation's highways. HPMS data are collected annually by all states and reported to the Federal Highway Administration (FHWA). The data items include pavement condition, traffic volume and capacity, and roadway geometry.
Applicability & Benefits	Can develop network and infrastructure related performance measures and indicators.
Costs, Limitations, and Challenges	Data is not as comprehensive as will be found in state databases. Could be useful for regional and national assessments.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Vehicle Travel Information System (VTRIS)** http://www.fhwa.dot.gov/ohim/ohimvtis.htm
Nature of Measurement source	Primary, Secondary
Characteristics & Availability	This is a database management system designed for vehicle classification and truck weight data. It provides standard weight tables and other reports and graphs. In addition, this system provides data on time on day variations of traffic
Applicability & Benefits	Truck related performance measures/indicators.
Costs, Limitations, and Challenges	Limited in application as far as freight performance is concerned.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Traffic Volume Trends (TVT)** http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm
Nature of Measurement source	Primary
Characteristics & Availability	This system is a monthly report based on hourly traffic count data reported by the States. These data are collected at approximately 4,000 continuous traffic counting locations nationwide and are used to estimate the percent change in traffic for the current month compared with the same month in the previous year. This system provides data on time-of-day variations of traffic.
Applicability & Benefits	Very useful for figuring out degree of congestion and developing v/c ratios. Truck related performance measures and indicators.
Costs, Limitations, and Challenges	Not easily related to freight performance.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Residential Transportation Energy Consumption Survey (RTEC)** http://www.eia.doe.gov/emeu/rtecs/channel/vmt.html
Nature of Measurement source	Primary
Characteristics & Availability	Vehicle-miles traveled (VMT) is probably the most important information collected by the Residential Transportation Energy Consumption Survey
Applicability & Benefits	VMT related performance measures/indicators
Costs, Limitations, and Challenges	Truck movement performance

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Freight Analysis Framework (FAF)** http://ops.fhwa.dot.gov/freight/freight_analysis/faf/
Nature of Measurement source	Secondary, snapshot
Characteristics & Availability	FAF integrates data from a variety of sources to estimate commodity flows and related freight transportation activity among states, regions, and major international gateways. The database contains commodity flows between domestic origins and destinations, exports between domestic origins and foreign destinations, and imports between foreign origins and domestic destinations. Each record contains zone of origin, zone of destination, port of entry or exit (which applies only to export and import flows), type of commodity, mode of transportation for domestic portions of the flow, value in millions of dollars, and tons in thousands of short tons.
Applicability & Benefits	Very useful data source for developing market and mode share information.
Costs, Limitations, and Challenges	FHWA has made lot of investment in developing these data from a combination of public and private data sources. There is a learning curve in using these data effectively. It does provide forecast information too.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**North American Transportation Statistics** http://nats.sct.gob.mx/lib/toc/defaulttoc.asp?s=nats&tc=1&h=0&i=
Nature of Measurement source	Secondary, snapshots
Characteristics & Availability	It presents information on transportation and transportation-related activities among Canada, the United States and Mexico, both within individual countries and between the countries. This database is accessible in table and time series formats, and covers twelve thematic areas, including transportation and the economy, transportation safety, transportation's impact on energy and the environment, passenger and freight activity, and transportation and trade.
Applicability & Benefits	Transportation Trends as well as trends in factors that affect transportation
Costs, Limitations, and Challenges	Snapshots and Trend information

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Transborder Surface Freight Data** http://www.bts.dot.gov/programs/international/transborder/
Nature of Measurement source	
Characteristics & Availability	The Transborder Freight Data provides North American merchandise trade data by commodity type, by surface mode of transportation (rail, truck, pipeline, mail and other), and with geographic detail for United States (U.S.) exports to and imports from Canada and Mexico. The purpose of the data, updated on a monthly basis, is to provide transportation information on North American trade flows. This type of information is used to monitor freight flows and changes to them since the signing of the North American Free Trade Agreement (NAFTA) by the United States, Canada and Mexico. The data are also being used for trade corridor studies, transportation infrastructure planning, marketing and logistics analyses, and other purposes.
Applicability & Benefits	Market Share, Mode Share information
Costs, Limitations, and Challenges	BTS develops the information periodically so it is easily accessible.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Truck Transportation, Messenger Services and Warehousing Annual Survey** http://www.census.gov/svsd/www/services/sas/sas_summary/48summary.htm
Nature of Measurement source	
Characteristics & Availability	The Service Annual Survey (SAS) provides data that help to measure America's current economic performance. The government uses the data to determine economic policy; private industry relies on these data for planning and research. Trade and professional organizations use these data to analyze industry trends and benchmark their own statistical programs, develop forecasts, and evaluate regulatory requirements.
Applicability & Benefits	Business, Freight and Transportation Trends
Costs, Limitations, and Challenges	Accessible and useful

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**USDA's -- Fresh Fruit And Vegetable Shipments by Commodities, States, And Months http://www.ams.usda.gov/AMSv1.0/**
Nature of Measurement source	**Secondary and Snapshot** Tonnage of Export and Import of Fresh Fruit and Vegetable Shipments Developed by USDA and reported in March of the following year. USDA develops this information based on the information obtained from Federal Marketing Order Administrative Committee, Federal State Inspection Service (FSIS), Shippers, and transportation agencies.
Characteristics & Availability	Reports domestic shipment data for all rail-refrigerated and piggyback shipments.
Applicability & Benefits	Mode share and pricing information
Costs, Limitations, and Challenges	Reported periodically and accessible

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**USDA Transportation Services Branch (e.g. the weekly *Grain Transportation Report*) http://www.ams.usda.gov/AMSv1.0/**
Nature of Measurement source	Secondary and Snapshot A weekly reporting of the latest volume and price movement data for barges, railroads, trucks, and ocean vessels involved in the transport of grain. The data is developed based on information provided by shippers, AAR (rail shipments), U.S. Army Corps of Engineers (barge movements), Federal Grain Inspection Service (export inspetions) and St. Lawrence Seaway Authority.
Characteristics & Availability	The weekly Grain Transportation Report (GTR) covers developments affecting the transport of grain, both in the domestic and international marketplace. This weekly publication reports on the latest volume and price data for barges, railroads, trucks, and ocean vessels involved in the transport of grain. Truck, Rail, Waterway
Applicability & Benefits	It can provide good information market share, mode share, and pricing for agriculture transportation.
Costs, Limitations, and Challenges	O-D information of grain shipments cannot be figured out. Important statistics of grain shipments not captured.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**USDA's –Ocean Rate Bulletin-- http://www.ams.usda.gov/AMSv1.0/**
Nature of Measurement source	Secondary and Snapshot
Characteristics & Availability	The Ocean Rate Bulletin (ORB) is a quarterly publication which tracks high-value, containerized agricultural shipments to various Asian and European markets. The publication provides a side-by-side comparison of the rates and services provided for each commodity exported during the preceding quarter. The following commodities are tracked by the ORB: apples, cotton, grapes, grapefruit, lemons, pears, potatoes, oranges, almonds, raisins, pistachios, frozen beef, frozen poultry, lettuce, animal feed, wine, lentils, onions and soybeans.
Applicability & Benefits	Rate information
Costs, Limitations, and Challenges	Needs to be analyzed

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	U.S. International Freight http://www.bts.gov/programs/international/
Nature of Measurement source	Secondary, Snapshot
Characteristics & Availability	The Bureau of Transportation Statistics (BTS) compiles, disseminates, validates, and analyzes a wide variety of data captured from various sources detailing trade trends; movement of goods by land, sea, and air; and personal travel.
Applicability & Benefits	Market share High quality international data and analysis are available to all levels of government, the private sector, and individuals studying trade and transportation.
Costs, Limitations, and Challenges	Data quality is good. A very important source for international freight movement.

Table D.1. Assessment of federal measurement sources, continued

Measurement Source	**Transborder Freight**
Nature of Measurement source	Primary, Snapshot
Characteristics & Availability	The Transborder Surface Freight database is developed on a monthly basis by the Bureau of Transportation Statistics (BTS) at the U.S. Department of Transportation (USDOT) under a contract with the U.S. Bureau of the Census. The Census Bureau provides BTS with detailed reports of U.S. international trade statistics collected as part of its Foreign Trade Statistics program. Using the Census reports, BTS develops tables of U.S. import and export trade flows with Canada and Mexico, including shipment characteristics by commodity type and surface modes of transportation. Development of the Transborder Surface Freight database was initiated in 1993. The objective was to study the impacts on U.S. surface trade flows with Canada and Mexico as a result of the North American Free Trade Agreement (NAFTA) signed by the U.S., Canada, and Mexico in December 1993, and enacted on January 1, 1994.
Applicability & Benefits	Moder share and Market Share
Costs, Limitations, and Challenges	Data quality is good and is reported periodically and accessible.

2. STATE MEASUREMENT SOURCES

Table D.2. Assessment of state measurement sources.

Measurement Source	**Mn/DOT Highway Facility or Network Inventory**
Nature of Measurement source	Primary, Secondary
Characteristics & Availability	Contains information about physical and geometric and control conditions of highways, roads, ad bridges.
Applicability & Benefits	Useful for developing freight performance measures and indicators for Minnesota related to network and infrastructure, access, safety and capacity.
Costs, Limitations, and Challenges	This is good source, is comprehensive, and accessible.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Mn/DOT Highway Pavement Management Database**
Nature of Measurement source	Primary, Secondary, Snapshot, Research findings
Characteristics & Availability	The roadway inventory and pavement data is quite extensive and has been maintained good. Several research studies have used the data for developing findings useful in making investment decisions. Mn/ROAD facility generates research data based on which design models and practices can be improved. characteristics, how data were obtained;
Applicability & Benefits	Many of the performance measures/indicators related to network and infrastructure can be developed using this measurement source. Not all information in this measurement source has been used. There is potential to make greater use of this measurement source.
Costs, Limitations, and Challenges	There is excellent commitment to maintain this measurement source and Mn/DOT invests heavily into it. Maintaining accurate inventory of extent and condition of roads and bridges and other infrastructure within Minnesota is top priority.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Mn/DOT Safety Database**
Nature of Measurement source	Primary, Secondary, Snapshot, Research Findings Department of Public Safety collects the data and maintains it. Mn/DOT Operations office analyzes and compiles statistics from this data that could be used by various stakeholders or users.
Characteristics & Availability	There is comprehensive data and has been collected regularly since at least 2000. 2003 data was somewhat problematic.
Applicability & Benefits	This data can be used effectively to develop several safety measures and indicators that are in STP, IRC Plans, LRTP, and even SFP in Minnesota.
Costs, Limitations, and Challenges	The data quality needs to be maintained. One of the key concerns is with the location of accident, particularly how it is coded in the database using mile markers. There is a videolog database which can be used to view locations on trunk highway system. Often times it is difficult to match safety database to videolog database. Mn/DOT has strong commitment to maintaining and even expanding this data collection.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Mn/DOT Freight Facilities Database**
Nature of Measurement source	Primary, Secondary, Snapshot
Characteristics & Availability	The database includes freight-generating facilities in Minnesota, categorized by business type, commodity, and/or location. Maps and attribute tables can be generated to support integrated, multimodal transportation planning.
Applicability & Benefits	With this information, Mn/DOT is able to develop, evaluate, and prioritize investment decisions and infrastructure needs that consider freight; Identify corridors of high freight activity and plan growth along priority corridors; and Create the foundation for commodity flow modeling. Thus performance measures/indicators related to market share, mode share, access can be developed.
Costs, Limitations, and Challenges	Office of Freight has ongoing commitment to develop and maintain this database and also has a dedicated staff to carry this responsibility. Cost is moderate. This can provide good snapshots and illustration how things are at present. The database needs to be updated.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	Mn/DOT Waterway Data
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot
Characteristics & Availability	Mn/DOT has one of the best waterway data among all DOTs. U.S. Army Corps waterway data an others are used along with information from private companies (shippers and carriers) to develop a very good set of waterway data. There is good inventory of ports, waterways, channels, and pipelines.
Applicability & Benefits	Performance measures related to waterway's network and infrastructure, access, travel time, reliability, capacity, modal share, market share, costs, and rates can be developed using the data that are available. However, there are not many performance measures and indicators related to waterway in STP or SFP currently.
Costs, Limitations, and Challenges	The Director, Dick Lambert, has good relationship with freight industry, which enables him to get good cooperation and data from the industry. This makes data so much more useful. Such partnerships need to be continued and maintained in future.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	Mn/DOT Freight Planning Information System
Nature of Measurement source	Secondary, Anedoctal, Snapshot Office of Freight at Mn/DOT maintains it.
Characteristics & Availability	This data tool assists Mn/DOT in making informed, efficient, and effective decisions and investments regarding modal and intermodal freight needs. This tool is used to capture data about goods movements, particularly origins and destinations of major freight flows; develop commodity flow modeling; and support Mn/DOT's focus on corridor-level management and analysis.
Applicability & Benefits	Several performance measures/indicators related to freight significant corridors (IRCs) can be developed using this measurement source. This is recently established so there is going to evolution to a more mature measurement source in future.
Costs, Limitations, and Challenges	The commitment of Office of Freight by dedicating a staff to this endeavor indicates it is an important priority. Over time the data from such system can be adequate and accurate. The use of local data from local facilities and private entities will be very useful to go beyond the information that CFS or even Global Insight data provides for Minnesota.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Mn/DOT Rail Grade Crossing Improvement Program (RGCIP)**
Nature of Measurement source	Secondary, Anedoctal, Snapshot
Characteristics & Availability	RGCIP is a tool that maintains an accurate, timely and consistent grade crossing and rail infrastructure inventory as well as project, financial, and crash information. This is maintained by Office of Freight at Mn/DOT.
Applicability & Benefits	This could be useful in developing performance measures/indicators related to network and infrastructure and also safety. Railroad crossing and its safety is an important concern within Mn/DOT.
Costs, Limitations, and Challenges	This measurement source has recently been developed and over time can provide more and accurate information and historical information developed could be useful in developing an understanding of performance and setting targets.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Minnesota Twin Trailer Networks**
Nature of Measurement source	Snapshot; Office of Freight at Mn/DOT
Characteristics & Availability	Maps of Minnesota's twin trailer network is put out by Office of Freight at Mn/DOT. This is a recent activity and could be a good source of information in terms how trucks are constrained or how infrastructure needs to be maintained.
Applicability & Benefits	It can used to develop some notion about the capacity and access of highway infrastructure for freight (truck) movement. Such visual illustrations can provide a better insight to legislators and policy makers regarding the constraints on freight movement.
Costs, Limitations, and Challenges	The data is merely a snapshot and hence development of such information involves low cost. It is factual information so not much derivation needed.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Minnesota Train Volume and Speed Map**
Nature of Measurement source	Secondary, Anedoctal, Snapshot Office of Freight at Mn/DOT puts these out.
Characteristics & Availability	The data is in form of a map showing how extensively rail infrastructure in Minnesota is being used. Also speed information provides an insight where there constraints of speed being less than 25 mph. Geographic scope is statewide.
Applicability & Benefits	Some performance measures related to network and infrastructure, travel time, acess related to rail can be developed. Similarly, volume information can provide insight where most market share of rail movements are by rail.
Costs, Limitations, and Challenges	The cost involved is low and utility of information is limited to as it is merely factual information provided as an illustration. Historical records could be useful to observe and develop trends.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Metro Railroads Train Volumes and Speeds**
Nature of Measurement source	Secondary, Anedoctal, Snapshot Office of Freight at Mn/DOT puts these out.
Characteristics & Availability	The data is in form of a map showing how extensively rail infrastructure in Minnesota is being used. Also speed information provides an insight where there constraints of speed being less than 25 mph. Geographic scope is metro area.
Applicability & Benefits	Some performance measures related to network and infrastructure, travel time, acess related to rail can be developed. Similarly, volume information can provide insight where most market share of rail movements are by rail.
Costs, Limitations, and Challenges	The cost involved is low and utility of information is limited to as it is merely factual information provided as an illustration. Historical records could be useful to observe and develop trends.

Table D.2. Assessment of state measurement sources, continued

Measurement Source	**Department of Employment and Economic Development (DEED)** **http://www.deed.state.mn.us/**
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot, Research findings
Characteristics & Availability	This department provides quite useful information, which is very relevant to freight travel, even if not relevant to freight productivity. It routinely puts out information about business climate in Minnesota, particularly in Metro area. It provides information about transportation choices available to businesses and freight shippers and carriers. The department compares 362 metropolitan areas in 10 transportation measures and provides information regarding where Minneapolis-St. Paul metro ranks in all the measures. Department also puts out several economic indicators routinely.
Applicability & Benefits	The information about markets served and dependent on by Minnesota businesses provides insight about trading partners and in developing notions about market share and possibly mode share.
Costs, Limitations, and Challenges	The information is routinely put out so it is an information source available to Mn/DOT to understand the origins and destinations of freight in Minnesota, particularly in metro area. However, this information needs to be tied with CFS data, Global insight data, freight advisory group insights, and possibly local shipper surveys to develop a better understanding about market and mode share of freight movement in terms of both tonnage and value. In addition, some economic indicators can provide insight into the emerging trends in freight travel.

3. REGIONAL MEASUREMENT SOURCES

Table D.3. Assessment of regional measurement sources.

Measurement Source	Upper Midwest Freight Corridor Study http://www.uppermidwestfreight.org/ http://www.mrutc.org/
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot, Research findings
Characteristics & Availability	The consortium has developed a repository of regional data. Minnesota is included in this respository. So information on regional movements, multistate movements on freight significant corridors is available. It is not new data but data derived from existing public freight data gathered from diverse sources (e.g., FAF, HPMS, Geofreight, BTS T-100 Air Data and Airports, BTS Port Data, Census Bureau, and some commercial sources).
Applicability & Benefits	Performance measures/indicators for regional freight movements from, to and through Minnesota can be developed, particularly in area of market and mode share.
Costs, Limitations, and Challenges	Since it uses existing public freight data, it includes the limitations inherent in data due to suppression of data due to confidentiality and competition issues. Over time this may be improved.

Table D.3. Assessment of regional measurement sources, continued

Measurement Source	Upper Great Plains Transportation Institute (UGPTI)—Elevator Surveys
Nature of Measurement source	Primary, Secondary, Snapshot
Characteristics & Availability	This is one of the best data source for agricultural freight movement into, from, and through Minnesota, where origins or destinations is some elevator in North Dakota. In fact, such data have been used in regional freight flow studies (northwest regional flow study) that Minnesota has conducted in past.
Applicability & Benefits	The performace measures/indicators related to market and mode share of agricultural freight can be developed when used in conjunction with STB Waybill data and CFS data.
Costs, Limitations, and Challenges	The data is good in some case but does not cover Minnesota adequately. But is very good for looking into agricultural flows from North Dakota. This is also an excellent example of public-private partnership between UGPTI and ND Public Service Commission to deal with confidentiality issues. There is cost invovled in developing these surveys.

4. LOCAL MEASUREMENT SOURCES

Table D.4. Assessment of local measurement sources.

Measurement Source	**Metro Council Land Use Data**
Nature of Measurement source	Primary, Secondary, Snapshot, Research findings
Characteristics & Availability	Land use data is very important to determine where freight clusters are and where truck movements will be. Information about establishment location is important.
Applicability & Benefits	Understanding freight significant nodes and related accesses
Costs, Limitations, and Challenges	Needs to be updated

Table D.4. Assessment of local measurement sources, continued

Measurement Source	Economic Data for Metro Area
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot
Characteristics & Availability	Data is usually available at state level. As one goes to lower level availability of data. Survey of County Business is good source for such economic data, including data on establishments.
Applicability & Benefits	Useful in understanding freight generation.
Costs, Limitations, and Challenges	Current information is good. Forecast information is usually not as good.

Table D.4. Assessment of local measurement sources, continued

Measurement Source	**Metropolitan Council**
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot
Characteristics & Availability	Transportation Model produces good information for Metro area transportation movements; not necessarily just truck movements
Applicability & Benefits	Many of measures related to access, capacity, and travel time can be assessed for various scenarios.
Costs, Limitations, and Challenges	Truck movement information is not the best. Currently, Metropiltan Council developed a truck component of the transportation model.

Table D.4. Assessment of local measurement sources, continued

Measurement Source	Metro Area Travel Time
Nature of Measurement source	Primary, Secondary
Characteristics & Availability	Travel time information is available in certain corridors in metro area and is communicated via variable message signs.
Applicability & Benefits	Performance measures/indicators related to travel time and reliability
Costs, Limitations, and Challenges	Data is good.

5. PRIVATE MEASUREMENT SOURCES

Table D.5. Assessment of private measurement sources.

Measurement Source	TRANSEARCH – Global Insight Data
Nature of Measurement source	Primary, Secondary, Snapshot, Research findings
Characteristics & Availability	The TRANSEARCH database, developed by Reebie Associates, is one of the most widely used commercial sources of freight movement data in the U.S. The development of the TRANSEARCH database involves the fusion of various freight traffic data sources into a common framework for planning and analysis. The database provides detailed U.S. and cross-border origin-destination freight shipment data at the state, Business Economic Area (BEA), county, metropolitan area, and zip-code level detail by commodity type and major modes of transportation. The freight traffic data in the TRANSEARCH database is used by leading freight carriers and by private and public sector agencies for market analysis, policy analysis and assessment, and decision making for a wide range of transportation planning issues. This database is now acquired by Global Insight and called TRANSEARCH-INSIGHT
Applicability & Benefits	Performance measures/indicators related to market share and mode share by tonnage and value can be developed for international, national, multi-state, and statewide flows. However, data is not totally adequate for substate and local flows.
Costs, Limitations, and Challenges	The cost is high and data is proprietary in nature. Nonetheless several DOT and other agencies have used this data for developing base and forecast commodity flow information at various levels.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**AAR –RAILROAD PERFORMANCE DATA**
Nature of Measurement source	Primary, Secondary, Anedoctal, Snapshot
Characteristics & Availability	It is reported as national or regional averages periodically.
Applicability & Benefits	Performance data related to volume, travel speed, on-time performance, dwell time, freight loss, and others are reported.
Costs, Limitations, and Challenges	The regional data is the best that can be used for Minnesota. Question still remains if that is applicable for Minnesota. Several useful trends can be determined.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**Intermodal Association of North America: http://www.intermodal.org/**
Nature of Measurement source	The Intermodal Association of North America (IANA) is the premier trade association representing the combined interests of the intermodal freight industry. IANA programs and services keep members informed of industry trends, crucial legislative and regulatory issues, and provide educational forums, networking opportunities, news and vital industry information.
Characteristics & Availability	IANA is a leader in analyzing industry data reflecting key facets of intermodalism and producing statistical reports and publications. The Intermodal Market Trends and Statistics products include: Intermodal Market Trends & Statistics, Five-Year Data File of Industry Activity, and Equipment Type, Size and Ownership.
Applicability & Benefits	Performance measures and indicators related to intermodal transportation
Costs, Limitations, and Challenges	Cost of membership to utilize the benefits and get industry reports.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**Journal of Commerce: http://www.joc.com/**
Nature of Measurement source	Anedoctal, Snapshot
Characteristics & Availability	***The Journal of Commerce*** is a leading weekly magazine for international logistics executives that covers all modes of international transportation, global trade, logistics strategy, technology, supply chain management, finance, insurance, legislative issues, regulatory developments and more. **The Journal of Commerce Online** (www.joc.com) provides breaking logistics news throughout the business day. As a companion to the print publication, the website offers current editorial features, searchable archives, advertising information, subscription information and more. The Journal of Commerce Online also distributes a daily e-mail newsletter and provides many online resources, including the Global Transport Analyzer(GTA).
Applicability & Benefits	Provides anecdotal evidence regarding several freight performance measures
Costs, Limitations, and Challenges	Cost of subscription and is available both as hardcopy and online.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**PIERS Global Solutions: http://www.piers.com/**
Nature of Measurement source	The Port Import/Export Reporting Service (PIERS) database, developed by Commonwealth Business Media, Inc., is one of the most comprehensive databases on U.S. foreign waterborne imports and exports. The database also reports trade shipment statistics for cargo movements between ports in Mexico and South America to major trade partners around the world. The PIERS database was originally developed by The Journal of Commerce Group before the group was purchased by Commonwealth Business Media, Inc. in November 2001. With the purchase of the JOC Group, Commonwealth Business Media, Inc. not only obtained ownership of the PIERS database, but also the JOC magazine and JOC online Web site **www.joc.com**, thereby becoming one of the leading information service providers in the areas of global trade and transportation sectors. Primary, Secondary, Anecdotal
Characteristics & Availability	Waterborne By weight and value
Applicability & Benefits	Useful for developing market share information for goods moving by waterway and vessels. PIERS Maritime Research Services produce a number of reports, which are extremely valuable to decision-makers in many different business sectors, particularly for those involved in international container trade. Some examples of the businesses that benefit from these reports include ship lines, railroads, trucking companies, port authorities, manufacturers, large retailers, investment banks and consulting and law firms.
Costs, Limitations, and Challenges	Cost of subscription. Data quality is very good.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**Logistics Management: http://www.logisticsmgmt.com/**
Nature of Measurement source	Anedoctal, Snapshot
Characteristics & Availability	***Logistics Management*** from Reed Business Information is a monthly magazine for supply chain professionals. **LogisticsMgmt.com** is a Web-based extension of the magazine that includes additional resources and links to other news sources. It offers industry news and in-depth analysis on the major forms of freight transportation (truck, maritime, air and rail/intermodal), plus information on products, technologies, government regulations and international logistics.
Applicability & Benefits	Anecdotal evidence regarding several freight performance measures.
Costs, Limitations, and Challenges	Cost is low and information is easily accessible.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**Traffic World: http://www.trafficworld.com/**
Nature of Measurement source	Anedoctal, Snapshot
Characteristics & Availability	**Traffic World** has been the transportation community's weekly source of industry news since 1907. While it has changed dramatically in recent years, in line with changes in regulation and in the businesses it covers, Traffic World remains the only paid-subscription magazine in the transportation and logistics field. And it's the only weekly that covers the gamut of freight transportation and logistics news.
Applicability & Benefits	Anecdotal evidence regarding several freight performance measures.
Costs, Limitations, and Challenges	Cost of subscription and information is objective.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**Transport Topics (Publication of American Trucking Associations): http://www.ttnews.com/**
Nature of Measurement source	Anedoctal, Snapshot
Characteristics & Availability	Several news and industry trends are reported.
Applicability & Benefits	Useful in understanding the emerging issues facing trucking and other transportation industry. How diesel prices are affecting trucking industry has been widely reported.
Costs, Limitations, and Challenges	Majority of information is anecdotal and trend information. Such information provides insights into the key issues and changes occurring in the transportation industry.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	Reed Business – Pricing Trends
Nature of Measurement source	Anedoctal, Snapshot, Trends
Characteristics & Availability	The pricing trends are reported every month inform of graphs and charts.
Applicability & Benefits	Useful in understanding how different modes pricing has changed over last several months.
Costs, Limitations, and Challenges	Key question is if such trends also apply to Minnesota.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	LOGISTIC MANAGEMENT'S ANNUAL TRANSPORTATION AND LOGISTIC SURVEY
Nature of Measurement source	Secondary, Viewpoints of Stakeholders
Characteristics & Availability	Capgemini, Logistic Management, and University of Tennessee conducts this annual survey of thousands of companies regading various trends and performance measures pertaining to freight industry.
Applicability & Benefits	Provides perspective of freight industry and provides numerous freight industry performance measures and indicators
Costs, Limitations, and Challenges	Very good source to get insight into what freight industry and businesses consider important and judge themselves by.

Table D.5. Assessment of private measurement sources, continued

Measurement Source	**DOW JONES TRANSPORTATION AVERAGE/INDEX (DJTA/DJTI)**
Nature of Measurement source	Snapshot, Index
Characteristics & Availability	The Dow Jones Transportation Average (also called the "Dow Jones Transports;" DJTA) is the oldest U.S. stock market index. 22 different transportation providers contribute data for this.
Applicability & Benefits	It provides an indication of overall transportation industry's performance.
Costs, Limitations, and Challenges	It is an index and can trigger concern if it falls below.

6. PUBLIC-PRIVATE MEASUREMENT SOURCES

Table D.6. Assessment of public-private measurement sources, continued

Measurement Source	**FHWA-ATRI Travel Time Measurements**
Nature of Measurement source	Primary
Characteristics & Availability	1. Uses Trucks as probes to measure the performance of the Interstate System. 2. Monitors the velocity and reliability of truck movements on the Interstate System. 3. All identifying information is cleansed from the data stream so FHWA has no knowledge of which trucks are providing the data points. 4. The FAF was used to select five freight significant corridors (I-5, I-10, I-45, I-65 & I-70).
Applicability & Benefits	Performance measures/indicators related to travel time and reliability can be developed for interstates (freight significant corridor or link)
Costs, Limitations, and Challenges	FHWA has invested millions in and is developing this in partnership with ATRI. This is a good example of public-private partnership. ATRI has been able to deal with privacy and competition issues by appropriately cleansing the data.

7. SPECIALIZED STUDIES AS MEASUREMENT SOURCES

Table D.7. Assessment of specialized measurement sources.

Measurement Source	**Spring Load Restriction Study**
Nature of Measurement source	Secondary, Research findings
Characteristics & Availability	Included in this study was a shipper survey which provided insight into truck O-D movement. It also provided insight into whether the spring load restriction was a constraint on truck movements.
Applicability & Benefits	This study provided information related to network and truck O-D movements in certain region of Minnesota.
Costs, Limitations, and Challenges	The data is limited to the region studied.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**STP, SFP, District Plans, LRTPs, IRC Plans** **Office of Investment Management (OIM)**
Nature of Measurement source	Secondary, Anedoctal, Snapshot Mn/DOT continulally develops and updates its plans and policies to reflect the need of the state, districts, regions, and metro area
Characteristics & Availability	The data contained in such documents are snapshots of state of transportation system and its performance and trends in various socio economic indicators and transportation indicators. It also provides goals, objectives, performance measures, priorities, and policies. In other words, it has information regarding where the system was and where it should be.
Applicability & Benefits	These documents and more importantly interactions among private sector and various level of public sector that is involved provide a basis for developing appropriate measures and effective policies for investment.
Costs, Limitations, and Challenges	There is institutional commitment to provide resources to develop these documents and foster such communications. The information that goes into the development of these documents and the information it contains should be examined very closely.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**Braslau and Fruin's Minnesota Northwest Freight Flow Study-1998** **C.J. Petersen et al. Minnesota Northwest Freight Flow Study-1997—data collection activities**
Nature of Measurement source	Secondary, Snapshot, Research findings
Characteristics & Availability	UGPTI Grain elevator and other data, including Input-Output tables were used to develop northwest freight flows.
Applicability & Benefits	The study provided information related to performance measures/indicators related to market share and mode share.
Costs, Limitations, and Challenges	The study provided a snapshot of the freight flow in northwest Minnesota, which may not be true in present day.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	ARDC's North Shore Commodity Movement Study
Nature of Measurement source	Secondary, Snapshot, Research findings
Characteristics & Availability	Freight flow information was used to assess the needs.
Applicability & Benefits	Freight flow information in Duluth area. To some extent provided information of market share and mode share.
Costs, Limitations, and Challenges	The study findings limited to the time when it was done.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**ARDC's Regional Goods Movement Study**
Nature of Measurement source	Secondary, Snapshot, Research findings
Characteristics & Availability	It is a research report which documents findings as well as research approach and data used for the research.
Applicability & Benefits	Freight flow information in Duluth area. To some extent provided information of market share and mode share. One of the most important piece of information found in the report was that dealing with shipping times to major markets for both truck load and LTL and it ranged from 3 hours to 7 days when shipped nationally.
Costs, Limitations, and Challenges	Freight flow information may be outdated but shipment times may still have relevance.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**Beier's "The Feasibility of a Shipper Panel to Measure Transportation Services"**
Nature of Measurement source	Secondary, Research findings
Characteristics & Availability	Shipper panel surveys
Applicability & Benefits	Getting freight generation information.
Costs, Limitations, and Challenges	This merely explored the utility of shipper panel survey.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**Cambridge Systematics – Statewide Multimodal Freight Flows Study, 2000**
Nature of Measurement source	Snapshot, Research findings. It provides information about freight flow into, out of, and through Minnesota. CFS and Transsearch data were used and analyzed.
Characteristics & Availability	Statewide assessment.
Applicability & Benefits	Market and mode share.
Costs, Limitations, and Challenges	Used TRANSEARCH data

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**Cambridge Systematics & SRF – Truck Size and Weight Study**
Nature of Measurement source	Research findings—an assessment was done to understand the impact of truck size and weight regulations on truck movements.
Characteristics & Availability	Truck movement data can be obtained. The report is available online as well as in Mn/DOT library.
Applicability & Benefits	It provides information which is related to transportation infrastructure that supports truck movements. It is directly relevant to Minnesota.
Costs, Limitations, and Challenges	Several assumptions are made.

Table D.7. Assessment of specialized measurement sources, continued

Measurement Source	**Freight Market Segmentation Study for Manufacturing Industries -- 1998**
Nature of Measurement source	Secondary, Anedoctal, Snapshot, Research findings, Specialized Study. A special local survey was conducted and it provided viewpoint of manufacturers in Twin Cities area.
Characteristics & Availability	Data was obtained through survey and the report is available in Mn/DOT library. The data pertains to manufacturing sector and indicates their perception regarding how well the freight transportation system works ofr them. It is relevant to Metro area in Minnesota.
Applicability & Benefits	It is applicable to metro freight movement—within, inbound, and outbound.
Costs, Limitations, and Challenges	The limitations are obvious—it just provides a snapshots. Much has changed since 1998.