230

National Cooperative Highway Research Program

NCHRP Synthesis 230

Freight Transportation Planning Practices in the Public Sector

A Synthesis of Highway Practice

Transportation Research Board
National Research Council

National Cooperative Highway Research Program

Synthesis of Highway Practice 230

Freight Transportation Planning Practices in the Public Sector

MATTHEW A. COOGAN
White River Junction, Vermont

Topic Panel

EDWARD BOYLE, *California Department of Transportation*
JOHN L. DUVE, *San Diego Association of Governments, California*
DANE ISMART, *Federal Highway Administration*
ELAINE KING, *Transportation Research Board*
GERHARDT G. MULLER, *Port Authority of New York and New Jersey*
PAUL M. SCHONFELD, *University of Maryland*
RICHARD A. STEHR, *Minnesota Department of Transportation*
CLYDE E. WOODLE, JR., *American Trucking Associations Foundation*

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PREFACE

A vast storehouse of information exists on nearly every subject of concern to highway administrators and engineers. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire community, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

By Staff
Transportation Research Board

This synthesis describes the process by which state departments of transportation and Metropolitan Planning Organizations (MPOs) integrate freight planning into the surface transportation planning process. It will be of interest to state and MPO planners, port planners; traffic engineers; and to the trucking, rail, and shipping interests in both the public and private sectors.

Administrators, engineers, and researchers are continually faced with highway problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to available practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common highway problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCHRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific highway problems or sets of closely related problems.

This report of the Transportation Research Board discusses the requirements for freight planning resulting from the Intermodal Surface Transportation Efficiency Act (ISTEA) with particular emphasis on the development of an intermodal management system (IMS). In addition, that act narrowed the application of the congestion management system (CMS), which is also discussed in the synthesis. Since enactment of that legislation, another act, the National Highway System Designation Act of 1995 was passed and makes the IMS *optional* rather than *mandatory*. This has not changed the philosophy or the intent of these planning applications, but it has changed the implementation aspects. Many agencies, however, are continuing with the IMS and CMS planning process. This report describes the methods used by selected agencies for forecasting freight flows, data collection practices, and the techniques for integrating freight planning into the established surface transportation planning processes at the state and regional levels.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the research in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

CONTENTS

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Scott A. Sabol, Senior Program Officer, National Cooperative Highway Research Program, assisted the NCHRP 20-05 staff and the Topic Panel.

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FREIGHT TRANSPORTATION PLANNING PRACTICES IN THE PUBLIC SECTOR

SUMMARY

State and Metropolitan Planning Organization (MPO) decision makers have begun the process of the systematic integration of freight planning into the established surface transportation planning process. This expansion of the scope of traditional planning concerns resulted from the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). At the state and metropolitan levels, ISTEA modifies the transportation planning process to incorporate many new factors, which specifically include international border crossings, access to ports, airports, intermodal transportation facilities, and major freight distribution routes, and methods to enhance the efficiency of freight movement and of commercial motor vehicles.

In many states, freight concerns are filtered through the intermodal management system (IMS) for use in the rest of the planning process; in other states, freight issues are also dealt with in the congestion management system (CMS). In each of these systems the emphasis is on the measurement of performance. This synthesis reviews the nature of these two management systems, and also examines the implications of the Environmental Protection Agency's (EPA) General Conformance rules on the implementation of major freight facilities.

The synthesis records that many states are wrestling with the development of freight-based performance measures to help monitor and evaluate the management of urban goods movement as part of the congestion management system, as well as of the intermodal management system. The development of freight-based performance measurements for CMS is highly influenced by a larger debate concerning the proper content of the CMS. Early congestion management efforts (including pre-ISTEA efforts) focused rather narrowly on the concept of level of service (LOS) as the primary descriptor of the quality of vehicle flow. By contrast, the recent regulations emphasized monitoring "mobility of people and goods" in addition to monitoring vehicle flow characteristics. The two methods of observation have fundamentally different characteristics; the determination of the optimum mix of the two methods over the next few years will have profound impact on the formulation of monitoring and evaluation programs.

At present, freight planning considerations enter the planning process at three key points:

1. The use of measures and criteria to determine which freight facilities will be included in the networks of the IMS and in the CMS;
2. The use of measures and criteria to monitor and evaluate the performance of the freight system within the IMS and the CMS; and
3. The use of freight forecasting methods to calculate future flows of freight for use in the two management systems, in the systems planning process, and in the corridor/project level planning process.

The synthesis examines the role of freight considerations at each of these three points.

Because of these challenges, there is a need to examine both the tools for forecasting future year freight flows, and the procedures needed to monitor and evaluate those flows as part of the total transportation planning process. Rapid developments are occurring in both these areas; concerning forecasting, two separate approaches were isolated in previous research. First, a "structured approach" to modeling is attempted as a series of behaviorally accurate replications of actual economic causes. Second, a "flow-based" approach examines data about existing freight flows and the analysis of trends in these patterns to base predictions on. Since that research was undertaken, major efforts have been made to benefit from the best elements of the two approaches; at present several states use approaches that combine both economic forecasting and trend analysis of existing freight flows.

In reviewing the state of the practice in the integration of freight planning concerns into the established surface transportation planning process, four areas of concern emerge: institutional arrangements, procedures used, forecasting tools, and mechanisms for issue resolution.

1. Concerning institutional structures, the case studies show a wide variety of arrangements to make freight planning work. Among these is the unique public-private partnership between the Greater Columbus Inland Port Commission and the Mid-Ohio Regional Planning Commission. Freight advisory councils in this study include Pittsburgh, Philadelphia, and Albany and the states of Wisconsin and California. In some cases, such as Oakland, the Freight Advisory Council is a formal appointed board of the agency. In other cases, the most effective group has not been created by the agency, but acknowledged for its independent role.
2. The synthesis revealed a wide range of evaluative procedures. The regulations call for the application of performance measures to monitor and evaluate the flow of freight. In some states, the performance of the points of connection is monitored, evaluating the quality of the connectors to intermodal transfer points to the rest of the system. In other states, performance of the candidate strategy with systemwide units is measured. Some states are focusing on aggregate levels of performance which emphasize observation of the full system, with, for example, calculation of cost per ton systemwide, effectiveness of delivery systemwide, and impact of system change on economic conditions.
3. A wide variety of approaches to freight forecasting was found, ranging from the early proposal in one state to use a multi-region input-output model, to the use of peer group professional judgment in another state. While some early models for freight forecasting have been developed, more flexible approaches are being explored in academic research centers.
4. Examples of issue resolution for freight planning include the tracking system established by the freight advisory council of the Metropolitan Transportation Commission (MTC) in the San Francisco Bay area. In most case studies, however, the process of integrating freight planning is so new that the issues have not risen to the point of resolution. In many states, no formal mechanism has been established to attract freight interests to the table.

Because freight planning in the public sector is still in its infancy, it will be important for the leaders in surface transportation planning to get actual origin-destination information about inter-city and inter-region commodity flows into the hands of planners soon. Only after state and local planners have become acquainted with the nature of the data will they be able to craft innovative strategies that are based on an understanding of these flows.

Five steps to begin this process were identified:

- Summarize the freight policy issues identified so far by the states and MPOs.
- Examine the extent to which existing planning procedures and data sources have or have not been adequate to support the analysis of the policy issues identified above.
- Develop revised planning procedures and data sources that will be most appropriate for the initial phase-in period.
- Identify the gaps in the training of state and MPO planners and decision makers concerning the incorporation of freight issues into the surface transportation planning process.
- Explore the application of newly available data resources. The FHWA is now in the process of developing county-by-county commodity trip tables designed for use by both state and local planners.

CHAPTER ONE

INTRODUCTION

This synthesis addresses the challenge of integrating freight concerns into the established surface transportation planning process. While there is a wide variety of factors behind the increased level of attention being paid to freight planning, ranging from the restrictions on longer combination vehicles to the national competitive position in a world of new trade agreements such as the North American Free Trade Agreement (NAFTA), this renaissance of interest stems most directly from the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and from ISTEA's incorporation of several of the principles and requirements of the 1990 Clean Air Act Amendments (CAAA). This chapter highlights two of the management systems recommended by this legislation, and explores a little acknowledged requirement in the planning of major freight facilities, the Environmental Protection Agency's (EPA) General Conformance Rules, which will influence the approval of investments in ports, rail facilities, and airports in areas of nonattainment for clean air. A list of acronyms may be found at the end of the synthesis.

ISTEA CONSIDERATIONS

Information contained in this synthesis makes frequent reference to the intermodal management system (IMS) and to the congestion management systems (CMS) that were requirements of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Since enactment of that legislation, another act, the National Highway System Designation Act of 1995, was passed and now makes most of the systems planning *optional* rather than *mandatory*. This has not changed the philosophy or intent of these planning applications, but has changed the implementation aspects. Many planning agencies, however, are continuing with the IMS and CMS planning process.

ISTEA Factors

At the metropolitan level, Section 1024 of ISTEA modifies the established transportation planning process in several ways, including the requirement that metropolitan planning incorporate 15 factors, which specifically include:

- Methods to enhance the efficiency of freight, and
- International border crossings and access to ports, airports, intermodal transportation facilities, major freight distribution routes, national parks, recreation areas, monuments, historic sites, and military installations *(1)*.

At the statewide level, the law calls for a new requirement of a statewide planning process, which makes reference to 23 factors, including 1) international border crossings and access to ports, airports, intermodal transportation facilities, major distribution routes, and 2) methods to enhance the efficiency of commercial motor vehicles *(1)*.

The Factors Applied in the Management Systems

ISTEA called for states to prepare six "management systems" and a program of traffic monitoring. Those systems cover pavements, bridges, safety, public transportation facilities and equipment, traffic congestion, and intermodal transportation facilities. In the last two management systems, freight will become an increasingly important area for consideration. Freight concerns are filtered through the intermodal management system for use in the rest of the planning process *(1)*.

The management systems are seen by the U.S. Department of Transportation (US DOT) as a means of operating the existing system better and of planning for its future. In each of these systems the emphasis is on performance measures. This chapter includes a brief review of the congestion management system and the intermodal management system, and examines the implications of the EPA's General Conformance rules on the implementation of major freight facilities.

CONGESTION MANAGEMENT SYSTEM (CMS)

Throughout the interviews conducted for this synthesis, there were discussions of the applicability of freight in the congestion management system. If freight represents only a minor portion of vehicle flow in the congested urban area at the peak hour, how could it be a major factor in the CMS? The answer lies in the definition of the system, as included in the regulations, and reflects a larger debate about the purpose of the CMS and the issue of freight; the congestion management system examination is supposed to go beyond the mere amount of congestion recorded on a roadway segment. According to the regulations, the CMS is "a systematic process that provides information on transportation system performance and alternative strategies to alleviate congestion *and enhance the mobility of people and goods*" *(2)*.

A close reading of the regulations shows that the CMS is the element in the process that enables planners to examine the performance of the surface transportation system and formulate strategies to enhance the mobility of people and goods. It is clear that some strategies will end up with a measurable improvement in congestion, and some will not. The problem for the process exists when the measurement of roadway congestion is used as the sole evaluative criterion for the "enhancement of the mobility of people and goods."

For example, if a truck averaging 20 mph on a congested highway is replaced by an intermodal rail service, and its commodities can now be carried on a rail line averaging 45 mph, that commodity has received an improvement in its condition of mobility. The regulations call for the measurement of such an "enhancement of the mobility of goods." The improvement of roadway flow which might occur as a result of the strategy being evaluated must also be measured. Thus, monitoring and evaluation measures that simply record the quality of traffic flow on the roadway segment cannot succeed in recording the improvement to mobility that was brought about by that public policy.

The managers of the state and regional transportation planning process have been charged with analyzing the success or failure of their actions in terms of the enhancement of the mobility of goods. Many state and local officials interviewed said that they do not understand how to do this. The development of appropriate measures of freight performance for use in the congestion management system is discussed in chapter 3.

INTERMODAL MANAGEMENT SYSTEM (IMS)

There is some level of ambiguity among state and local officials concerning the role of freight in the intermodal management system. Unlike the CMS, which has an immediately measurable goal of reducing roadway congestion, the IMS calls for the measurement of performance of certain critical parts of the total transportation system, most of which have not been subject to measurement before. The regulations define the intermodal management system as a systematic process that:

- identifies key linkages between one or more modes of transportation where the performance or use of one mode will affect another,
- defines strategies for improving the effectiveness of these modal interactions, and
- evaluates and implements these strategies *(2)*.

While many of those interviewed did not see the importance of freight in the CMS, many states are proceeding with the development of their IMS as a process for the consideration of freight, to the exclusion of passenger issues (which are often treated in the CMS). The development of freight performance evaluation, the backbone of the freight component of the IMS, is reviewed in chapter 3. This synthesis examines two levels of analysis currently being debated for the preparation of the IMS; in one view the IMS takes on the issue of the efficiency of the full freight system, and in the second view, the IMS focuses instead on the actual points of intermodal connection, and tries to produce direct results from those primary observations. The issue of the appropriateness of scale of the IMS has not yet been resolved, and will be treated differently by different states.

CLEAN AIR ACT AMENDMENTS OF 1990 (CAAA)

A major theme of this synthesis focuses on why we should be interested in improving freight planning techniques and which policy issues should be served. In response to what public policy questions are these tools being developed? The role of the Clean Air Act Amendments (CAAA) in the development and review of major freight facilities was clarified in November 1993, when the EPA's General Conformity Regulations were published, covering many major freight facilities, including seaports, rail lines, and airports. These facilities have not traditionally received Federal Highway Administration (FHWA) or Federal Transit Administration (FTA) funding (for which the guidelines had already been in place). In this chapter, the 1993 General Conformance Regulations are reviewed for their relevance to planners considering an investment in a major freight facility.

As the final rulemaking notes, "the general conformity rule covers all other federal actions, including those associated with railroads, airports, and ports" in areas classified as nonattainment for carbon monoxide and ozone. The EPA has made it clear that the general conformity rule will cover not only direct (on-site) emissions but also the indirect emissions caused by vehicles coming to and going from the new freight facility:

> Congress clearly intended the transportation conformity rule to cover the indirect emissions from vehicles that would travel *to and on* highways constructed with Federal support. Thus, the conformity review does not focus on emissions associated with only the construction of the highway project, but includes emissions from vehicles that later travel *to and on* that highway. The general conformity rule originates from the same statutory language and so must meet the same congressional intent. . . As described above, the **transportation treatment provisions of the Act clearly require consideration of indirect emissions. Therefore, EPA concludes that the general conformity rule must also cover indirect emissions** *(3)*.

The key consideration here is that in many cases the off-site, indirect impacts of the freight facility must be documented at a level of detail previously not required by regulation. Many major facility investments will involve a rearranging of some trip patterns, or an aggregate increase in freight flows to the region, or to the site itself. While many of the facilities considered by the freight planner or the manager of the intermodal management system will be planned with the intention of decreasing air pollution, the new regulations will force a high level of proof. Even when the working hypothesis is that the facility is part of an overall strategy to make transportation more efficient, the proposed project will have to be presented and examined for its conformity with the State Implementation Plan (SIP).

These regulations would be particularly important in the development of a freight facility located in or near an area that consistently is in excess of air quality standards. It may result in trucks (and other sources of air pollution) increasing their vehicle miles of travel (VMT) in the vicinity of the proposed terminal. Truck movements are not explicitly modeled in most areas, except as a percentage of overall traffic. An understanding of the origin-destination (O-D) patterns, specific routings taken by trucks attracted to the proposed facility, and the congestion impacts of those routings is made more important by the issuance of the General Conformity Rule. This implies a need for the freight facility planner to achieve a level of integration with the MPO-based planning not attempted before. A significant improvement in the ability to model freight flows under a variety of scenarios is implied by the new General Conformity regulations.

Of greatest interest is the EPA decision to mandate the analysis of indirect or off-site generation of air pollution. The calculation of those off-site impacts may require an improvement in both the quality of freight planning tools and the integration of those tools into the established metropolitan surface transportation planning process. For this reason, progress in developing freight traffic modeling techniques by states and MPOs is reviewed in this synthesis.

OVERVIEW

A series of attempts over the past decade to integrate freight planning into the surface transportation planning process is reviewed in chapter 2. This review uses the interim findings of National Cooperative Highway Research Program (NCHRP) Project 8-30, entitled "Characteristics and Changes in Freight Transportation Demand." Chapter 3 traces progress made since 1992 in the best available practice area (most agencies did not deal with this before that time). In chapter 4 a summary is presented of state level freight planning through case studies of Oregon, Wisconsin, and California, with briefer updates from Florida and Ohio. Chapter 5 presents case studies from Columbus, Ohio, and the San Francisco Bay area of California. Chapter 6 discusses public and private data that support the freight planning process. Chapter 7 presents conclusions drawn from the information analyzed for this synthesis.

CHAPTER TWO

RECENT RESEARCH IN FREIGHT PLANNING

The freight planning process is now evolving on two planes of activity: improvements in the institutional setting (which is discussed in the following chapter) and improvements to the technical tasks of estimation, evaluation, and forecasting. In this chapter, recent critiques of the state of forecasting procedures appropriate for state and metropolitan decision makers is reviewed.

An ongoing debate exists concerning the applicability of techniques developed to forecast passenger flows to the task of freight forecasting. It is a common belief that both kinds of transportation data will be produced by the same process despite warnings, such as this quote from Freisz and Morlok *(4),* who wrote:

> In dealing with questions about the intercity freight system. . . the typical approach has been to attempt to use network models which have been developed for passenger transportation. . . Yet there are fundamental differences between the urban automobile transportation systems for passengers and intercity freight systems. These differences have been largely unrecognized and they have led to great difficulty in realistically portraying the freight system *(4).*

A valuable construct was proposed in a 1983 study, NCHRP Report 260, *Statewide Freight Demand Forecasting (5),* which divided freight planning methods into two basic categories, a "structured approach" and a "direct forecasting approach." As summarized in NCHRP 8-30 *(6),* the 1983 study said this of the "structured approach:"

> The structured approach is comprehensive. It recognizes that freight demand is derived from underlying economic activities and subject to intermodal and intramodal competitive forces and government actions. It involves a comprehensive linkage of current or long range economic activity, production and consumption nodes, distribution or linkages between production and consumption nodes, mode choice and shipment size decisions, vehicle trips and route assignments *(6).*

This dichotomy remains valid today, and is well illustrated in the California case study presented in chapter 3. In that case study, consultants to the state initially proposed the use of a "multi-regional input-output (MRIO) model" as the basis for the prediction of freight flows in California's selected intermodal corridors. In the early phases of that study, a decision was made to deemphasize the importance of the MRIO model and replace it with a process combining both economic modeling and direct input from the freight transportation providers.

ATTEMPTS TO CREATE A "STRUCTURED" FORECASTING PROCESS:NCHRP REPORT 260

Virtually all state and local practitioners requested the development of a "how to" handbook for integrating freight planning into the surface transportation planning process. A major attempt was made in 1983 with the publication by NCHRP Report 260, *Application of Freight Demand Forecasting Techniques (5).* This report presents a carefully argued description of each stage of transportation forecasting, in this case applied to freight.

Throughout the literature reviewed, splitting between the modes caused practitioners the most concern. NCHRP 8-30 reviewed a second article by the authors of NCHRP Report 260, commenting that "the authors note that current techniques for modal choice forecasting remain very elementary, and are not yet suited for inclusion in freight forecasting models" *(6).* Florida's attempt to build a freight forecast model succeeded in forecasting origin and destination volumes by type of commodity, but had more difficulty in the freight modal split area. "The authors also indicate that efforts to develop a modal split model through a logic formulation were unsuccessful. The difficulties associated with development of a modern discrete choice model seem to be a common observation across a number of studies" *(6).* Another paper, by Kurth et al., describes a process recommended for New Mexico with three stages: commodity generation, commodity distribution with mode choice, and assignment. "However, this effort has been placed on hold and no further reports have been issued" *(6).*

On the more practical side, a study by the Kansas Department of Transportation (May 1991) combined a commercially available database ("Transearch Database") for truck movements with Interstate Commerce Commission (ICC) Waybill samples for movements by rail. It is this approach that is now being followed in California and Wisconsin, where new databases will be developed based on the Transearch information *(6).*

The authors of NCHRP 8-30 have traced the development of both methods and stated the conclusions as to their applicability to state and metropolitan planners frankly.

> Although the structural approach is well represented in the literature, it has found little application in state freight forecasting. The procedure is complex and requires significant expertise and expenditure of resources. Another challenge of effective execution of the structural approach is that data requirements are substantial. Furthermore, there is no consistent source of data for each of the components of the approach. Indeed, most of the existing components are based on national data, not state data. Finally, as discussed by planners at the Florida DOT, the approach is not particularly well suited for very micro questions such as estimating future freight flows over a particular highway *(6).*

The survey work for this synthesis backs up these conclusions. In the state of Oregon, the Port of Portland commissioned a structured approach for the purpose of understanding the macro-level economic forces at play in the global industry. Participating in a locally based examination of future urban form and configuration in Oregon, freight planners wanted to understand the aggregate level needs of their port and port-based transportation network. And, as discussed in chapter 3, they selected a model that "considers the entire trading arena in order to completely understand market dynamics" *(7)*. The model examines worldwide market forces in order to predict the potential role of Portland in that market.

Therefore, when making observations about the appropriateness of any freight forecasting technique, one must first examine the public policy issue at hand. For a state with a major east coast port, both the emerging importance of the Suez Canal route as a preferred path from South and Southeast Asia, and the rise of the competitive importance of the east coast, makes a highly structured forecasting process that considers the changing structure of the global economy desirable. The authors of the Oregon proposal noted that because of land configuration studies coming up in 2040, "the port also wishes to identify major commodities, customers, competitors and industry/economic trends which may impact the 2040 freight planning perspective" *(7)*. This type of analysis could not and should not rely on the manual extension of trends in locally observed phenomena.

There is another important trend emerging from this synthesis, and that is the difficulty of the small-scale direct forecasting approach to produce data at the highway corridor level. Several states are finding that assigning future commodities back to a specific highway link is taxing the ability of the data to support the decisions at hand. In many of the interviews conducted (such as Massachusetts), there was great concern that even the long awaited 1993 Commodity Flow Survey will not be useful in assigning flows to a specific highway link or segment.

The policy maker who needs to understand the role of freight in the state can use sources and methods discussed in this synthesis. For Business Economic Area (BEA) level analysis, freight flow data exist and can be forecast by straightforward, direct methods. In addition, to understand the role of the state or region in the national and global economic system, models based on established practices in economic simulation exist. The problem—and the challenge—is to convince states that the freight planning process can be used for link-by-link traffic network assignment. At the moment, California is undertaking a program to assign freight flows to specific routes and corridors, similar to the recent experience in Wisconsin. This effort will be closely watched by other states as they make decisions about the development of a traffic assignment process for freight flows.

NEW FREIGHT MODEL DEVELOPMENT: RESEARCH IN IOWA

It is clear from the review of available resources that an off-the-shelf model for predicting truck flows is not yet available for application by the states and MPOs. There is significant reliance on outside consultant expertise in this area. However, research now underway in Iowa suggests that freight models should not be structured in the same way as the traditional four-step passenger forecasting model.

The Iowa Transportation Center, which has been working on this issue, has come to three conclusions concerning the state of freight modeling, as summarized by Dr. Tom Maze in a recent presentation *(8)*. First, existing passenger travel demand models cannot be readily adapted to incorporate freight. Freight consists of different commodities, and the factors influencing their transportation patterns are inherently more complex than the variables affecting passenger transportation decisions. The Iowa researchers concluded that there are several false analogies between freight and urban travel demand models. Essentially, the four-step process cannot be transferred directly to freight, because it is necessary to treat all commodities uniquely, while not all modes are practical for all commodities.

Second, the Iowa team concluded that available data on freight movements are inadequate for modeling purposes, and that a better data collecting process is needed. Third, they concluded that there are opportunities for making new freight models. Because freight transportation patterns and trends tend to be pervasive and systematic, they can be represented in analytical models. On the other hand, Maze argues that there also are true analogies, as most freight traffic estimation can be reduced to empirical relationships. Also, models can focus on major commodities, simplifying the problem of addressing commodity-specific characteristics. Finally, models can be adjusted through calibration to approximate actual freight traffic flows, even if input data are flawed *(8)*.

Maze has made several observations concerning data requirements. Although reduced regulation has resulted in the reduced availability of data, the data that are available reflect more logical traffic patterns and are more useful for modeling. He argues that the following types of data are needed for modeling:

- Economic base data, consisting of commodity production and consumption, and commodity attributes,
- Transportation network data, including physical and operational characteristics (for identifying congested routes), and
- Past traffic flow data, including commodity flows, commodity mode relationships, and model performance; these data are needed for model calibration.

Additional data collection is needed to address the above requirements as follows: origin-destination surveys (including times, locations, and quantities of freight), input-output relationships (agricultural, consumer, and industrial sectors), and shipper surveys. With this in mind, researchers in Iowa have been pursuing a new freight forecasting process that is specifically designed to operate with the available data, and does not follow the traditional structure of transportation planning models.

CHAPTER THREE

THE DEVELOPMENT OF FREIGHT-BASED PERFORMANCE MEASURES

The previous chapter explored recent developments in the process of forecasting freight flows from a variety of perspectives. This chapter examines what is actually being measured and observed once the flows are understood. What is being evaluated in the analysis of freight movement?

The quality or efficiency of freight flows is specifically observed in both the congestion management and the intermodal management systems. Both are charged with movement of people and goods, although there is less public perception about the importance of goods flow in the congestion management systems. As previously noted, the quality of freight movement is specifically identified as one of the "factors" to consider in both the statewide and metropolitan-based planning process. Both systems required the designer to develop "performance measures" as a key tool in the analysis of the flow of people and goods. This chapter will focus on those performance measures designed to monitor and evaluate the quality of goods flow. However, in many cases the performance measures under consideration for the flow of goods are derived from procedures originally designed for the flow of persons. There is a significant advantage in having a certain level of similarity between the two sets of indices/measures in terms of cross modal evaluations. Therefore, this chapter includes a discussion of the evolution of passenger-oriented (or in most cases, vehicle-oriented) measures when that evolution affects the development of the freight-oriented performance measures.

PERFORMANCE MEASURES FOR CMS AND IMS: THE ONGOING DEBATE

As noted above, both the CMS and the IMS call for the monitoring and the evaluation of the mobility of people and goods. Just how to measure such mobility has been the source of a debate over the past several years. The problem stems from the decades-old reliance of the traffic engineering profession on the use of the ratio of volume to capacity (V/C) as a major measure of the success or deficiency of a roadway segment; in the minds of some in the traffic engineering community, V/C became synonymous with the mobility provided by the system as a whole. In partial reaction to this trend, movements developed to 1) examine person-throughput in place of vehicle-throughput, and 2) to base a system of evaluation around the experience of the user rather than the observation of the segments of the system.

Richard Pratt and Timothy Lomax have written about the importance of development of good performance measures: ". . . An important aspect of multimodal performance measures is the ability to identify effects on movement of people and goods and on achievement of travel and shipping objectives"*(9)*. They summarized the present condition of the development of performance measures by noting "it is perhaps an exaggeration, but not much, to say that transportation performance measurement is in a state of upheaval." This article is one of the first to bring out the concern that the legitimate use of level of service (LOS) contains a strong potential for misuse as an overall evaluation criterion. "The current state of flux is not caused by any profound inability of the traditional highway capacity oriented measures of the past four decades to perform the tasks for which they were designed. Change is coming because the uses to which performance measures are being put have been broadened" *(9)*. The early experience of California with an LOS-based process was noted in the article:

> California, which went the Level of Service performance measurement route in its pre-ISTEA Congestion Management Program (CMP) has encountered extensive and thoughtful criticism including the charge that the end results may not be consistent with regional mobility and development goals. Since the California CMP has also run afoul of air quality requirements, a study of how to minimize inconsistency between the California CMP and the Federal Clean Air Act has been legislatively mandated, specifically including examination of alternative performance standards *(9)*.

Level of service and indices that describe the functioning of a specific segment of the system can be useful in the overall evaluation of the system. A good example of this is Albany's use of the LOS concept in the observation of delay as a freight performance measure.

"Delay" as a Freight-Based Performance Measure: The Albany Experience

The use of facility-based calculations (as opposed to user-oriented evaluations of mobility) can form the backbone for the evaluation of the system's performance for all vehicles, including those carrying freight. Work in Albany integrates freight performance measures to the rest of the congestion management process.

> For freight movement, it is assumed that the Highway Capacity Manual's LOS standards apply. Freight may experience greater or lesser congestion than auto travelers, depending on the facilities used . . . *"for freight movement, excess delay is defined as the amount of time spent at an intersection or along a highway segment in Level of Service (LOS) E and F conditions that exceed the maximum LOS "D" time"(10)*.

The Albany experience shows a good example of the freight-based performance measure being derived from the same calculations used to measure the success of the vehicle-based system. The use of "delay" represents the application of

V/C methodology with a more responsive index of observation than the simple ratio. Albany's use of this freight performance measure is consistent with a direction currently being examined in a study of urban congestion, NCHRP 7-13 *(11)*.

Thus, in this terminology, Albany's freight performance measures are similar in nature to the concept of "acceptable congestion." However, it can be argued that congestion conditions are poor measures of performance in many applications, including cross-mode comparisons. These considerations "suggest that congestion measures per se have limitations in cross-mode comparisons, even when using common measures such as travel time. Mobility and accessibility address this concern" *(9)*. The argument is made that the concept of mobility is needed in addition to observations of facility conditions associated with congestion.

> Mobility is the ability to move people and goods quickly to where they are destined . . . As such, mobility becomes a value measured in terms of volumes of people or goods and speed of movement. This is a concept applicable across all modes, and when used in concert with a measure such as number of lanes or equivalent is a strong indicator of efficiency *(9)*.

Finally, as the last dimension of performance measurement, the research undertaken for this synthesis revealed a strong interest in the concept of accessibility. "Accessibility is the achievement of travel objectives within time limits regarded as acceptable" *(9)*. From the synthesis interviews, it appears that accessibility is gaining acceptance as the best long-range performance measure, since it focuses on the goal of the transportation system (linking persons or goods with their needed destination) rather than on the symptoms of the system, (maximized speed or maximized VMT.) Pratt and Lomax observe that accessibility "is apparently as close to an ideal measure for multimodal performance analysis as can be achieved from the user perspective. In addition, it allows recognition that travel needs can be more easily satisfied not only if the transportation system is improved, but also if land use arrangement is rationalized" *(9)*.

This may be a major issue in the assessment of freight network performance. If, for example, a freight/rail intermodal transfer facility is 100 miles from the major destinations of the region, the exclusive use of either facility-based measures (LOS, or speed) or mobility-based measures (travel time for the cargo) might divert the decision maker from the most obvious option: moving the transfer facility closer to the destinations. (This concept is only relevant for those transportation facilities that can be moved. Thus, as the concept of "accessibility" as a measure of the success of the system is developed over the next few years, it should be monitored for its application to freight system performance as well as passenger system performance.

In the formulation of the freight-based performance measures, the designer of the freight portion of the congestion management system and the intermodal management system will have to take into consideration the nature of the data and indices used in the rest of the system for monitoring and evaluation. Thus, while several of the concepts in Table 1 were clearly designed for the evaluation of passengers and not freight, several states have successfully adapted these concepts in a manner that allows freight analysis to be consistent with the analysis of the rest of the transportation system (see the California discussion in chapter 4).

In chapters 4 and 5, the performance measures under consideration for IMS work in several states are reviewed. The focus is the selection of performance measures appropriate to guide the observation of freight through the intermodal system; the extent to which these measures are intertwined with non-freight performance measures will be observed.

TABLE 1

BASIC MOBILITY MEASURES *(9)*

Term	Definition
Travel time or difference in travel time	To compare door-to-door travel times by route
The travel rate	Rate of motion in minutes per mile for specified segment
The delay rate	The rate of time loss for person or or vehicles operating in congested conditions, expressed in minutes per mile
Total delay	Sum of time lost due to congestion
Relative delay rate	The delay rate divied by the desired travel time
Delay ratio	Delay rate divided by the actual travel time
Speed of (unit) movement	Passenger volume or ton volume times average speed
Corridor mobility index	Speed of (unit) movement value divided by standard value, such as standard freeway lane capacity
Accessibility	Meausred as average travel time to travel objectives
Congested travel	The amount of travel which occurs in congestion

Note: Pratt and Lomax used the word passenger, not unit.

THE DEVELOPMENT OF FREIGHT PERFORMANCE MEASURES

The development of freight performance measures is a relatively recent phenomenon, occurring in response to the deadlines imposed by both the congestion management system and the intermodal management system. There is a wide range of interpretation about what constitutes a freight-based performance measure. The following section presents a description of different attempts that have been made in this area at various levels of government. There is no implication that all the freight performance measures described are appropriate or should be used in a given analysis. The field is very new and the approaches diverge widely.

One of the earliest descriptions of performance measures and estimated data needs was prepared by the Federal Highway Administration (FHWA). Just after ISTEA's passage, the Transportation Research Board held a conference on "Transportation Data Needs," at which FHWA presented a paper indicating the data that would most likely be needed from the new process.

TABLE 2

FHWA's EARLY VIEW OF PERFORMANCE RELATED TO DATA NEEDS *(12)*

Component	Intermodal System Data Required
"Measures"	cost/ton mile by mode
	cost/passenger mile by mode
	average value/pound
	on time performance
	average transfer times between modes
	average accident cost per trip, by mode
DATA	ton miles
System	passenger transfer
	freight losses from theft
	accident
	useful life of assets
	access facilities under construction (to airport, railroad, harbors, intermodal centers)
Usage of the system	passengers
	freight by category, frequency and duration
	portion of passengers delayed by transfer
	market share
Time or cost to use the system	transfer time–peak and off peak
	headway
	average travel time of freight during peak and off peak
	transfer cost
Location or area of interest	intercity
	intracity
	international
	transfer points
	routes and lines
SOURCES OF DATA	on board surveys
Primary sources	employer surveys
	surveys of intermodal centers
	travel time surveys
	shipping surveys
Secondary sources	census data
	section 15 data
	system inventories (harbor, airport, railroad)
	truck inventory and use survey

Table 2 represents the data needs (including freight) under the category "intermodal" *(12)*.

WHAT SHOULD WE BE MEASURING?

Many state representatives who were interviewed stated that the IMS represents a "data-hunt" that would not relate to actual planning needs; appropriate scale for observation is a common concern. A valuable attempt has been made at the Volpe National Transportation Systems Center to break down this mass of possible information into categories for utilization in the public sector's preparation of the IMS. Norris *(13)* has described three levels of intermodal activity for the application of performance measures:

- System level standards relating to network connectivity, access impediments (e.g., vertical clearances), link capacity, safety, and cross-modal transferability;
- Operational standards relating to the productivity of the service delivery process (e.g., line haul speed, door-to-door delivery time, customer service, real time cargo information, on-time performance); economics of multimodal trade-offs (e.g., cost and revenue per ton mile); and environmental efficiency in resource use (e.g., emissions per ton mile and fuel use);
- Facility level standards relating to terminal accessibility (highway/air/rail/port access), collection-delivery system (e.g., loading/unloading capacity, gate facilities, lift and track capacity); and interchange among modes (e.g., drayage and inter-line transfer practices) *(13)*.

This breakdown of the performance standards into three levels (networks, operations, facilities) reveals the usefulness of data collection for state level IMSs. "All three levels are essential to intermodal connectivity and the efficiency of the operations. For planning purposes, however, initial emphasis might be placed on standards that remove network-level impediments, relegating standards relating to facilities or line haul operations to later stages of planning" *(13)*.

Based on the interviews conducted as part of this synthesis, the lowest level of aggregation ("Facility") is probably inappropriate for inclusion in a systems level statewide analysis.

TABLE 3
PERFORMANCE STANDARDS BY ANALYSIS LEVEL *(13)*

System	Components	Measures
Network Level Standards	Access	vertical clearance
		capacity characteristics (number and width of lanes, speed, etc.)
		bridge rehabilitation for double stacked trains
	Safety	grade crossings
		waiting time at drawbridges
	Transferability	cross modal intersections
		prioritization of track usage
		legal/regulatory restrictions
Operations Level Standards	Service Delivery Efficiency	line haul speed
		door-to-door delivery time
		customer service
		real-time cargo information
		% on time performance
	Economic Efficiency	cost per ton mile
		revenue per ton mile
		operating ratio
		market share
	Environmental Resource Use Efficiency	fuel use per ton mile
		emission per ton mile

Thus, the time that a container spends on the privately owned dock waiting for a truck would NOT be included in the statewide IMS. On the other hand, the time that the container spends on that truck between the gate and the major highway would be included in the statewide IMS. Similarly, if conditions on the publicly owned road impeded access to the private dock, that would be noted in the statewide IMS. And the fact that a truck is being used instead of a rail car (due to of inadequate clearance over the rail lines by the highway system) most certainly would be on the statewide IMS system. Table 3 summarizes the network and operations level standards.

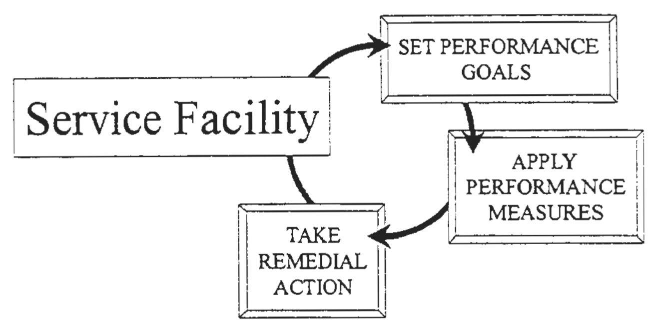

FIGURE 1 Use of performance measures at UPS *(14)*.

THE USE OF FREIGHT PERFORMANCE MEASURES IN THE PRIVATE SECTOR

In a research project undertaken in support of a 1993 TRB conference on multimodal planning needs, the similarities between the multimodal planning practices in the private sector freight industry and those used in the public sector were examined *(14)*. In this study, executives at United Parcel Service (UPS) were quoted concerning how investment decisions descend from a larger management philosophy at UPS, which is based on the application of performance evaluation. Capital investment decisions are made at UPS within the context of performance evaluation. Each UPS facility is constantly evaluated in terms of such performance measures as:

- cost per delivery,
- time per delivery,
- number of deliveries, and
- cost per trip.

Figure 1, from that study, shows the relationship of three elements: set performance goals, apply performance measures, and take remedial action. This pattern of analysis is repeated over and over and over in that organization. It is applied to the management of air facilities and to the management of distribution facilities.

It is important to note that this set of performance measures alone cannot lead directly to the capital investment decision. The boiler that heats the garage can be used as an example. The garage is difficult to heat, and the boiler works well, but the decision maker knows that the boiler is 39 years old and next year it will be ruled unsafe. In addition to observing the performance of the facility, it is also necessary to document the characteristics of the asset, such as its age and condition. The concepts of **performance measures** and **asset characteristics** must be considered simultaneously. When the two are merged, only then can capital investment decisions be adequately made, as illustrated in Figure 2.

These two images suggest how the process of performance evaluation is applied to a service facility, such as a garage, an airport, or a sorting/distribution center. Reliance on this evaluative paradigm goes right up the management chain. A manager at the regional level has to answer to the same process as a manager at the facility level. What is relevant to performance evaluation in freight planning is not what happens at the facility or

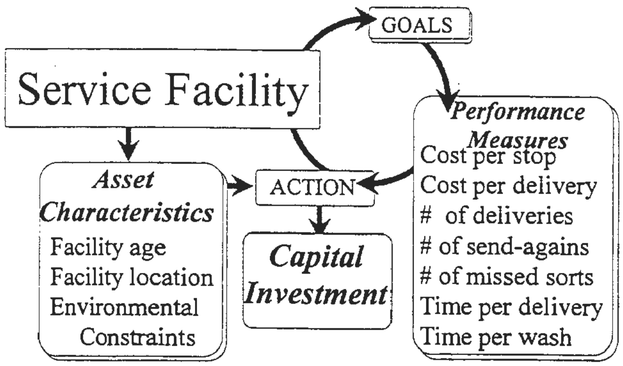

FIGURE 2 Use of performance measures and asset characteristics at UPS *(14)*.

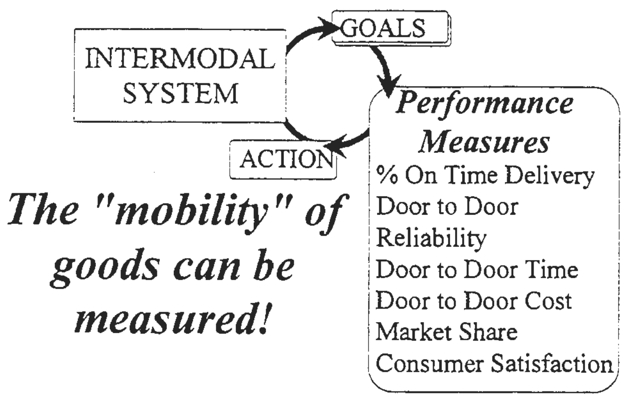

FIGURE 3 Performance measures used to evaluate success of the system *(14)*.

regional management level, however. Figure 3 illustrates the kind of performance measures that can be used to evaluate the success of the total intermodal system. These performance measures are shown in Table 4, which compares those system level indices with the facility level measures discussed above.

Just as the first group of indicators in Table 4 (left-hand column) were designed to reveal the performance of a local segment of the full system, the measures in the right-hand column describe the performance of a full intermodal system. Armed with ability to "take the pulse" of the full system, the manager can then take remedial action based on a solid understanding of the operation of the full system.

The UPS case study shows that managers can understand mobility in the context of the full trip, on a door-to-door intermodal basis and, following performance evaluation, can take

TABLE 4

EXAMPLES OF PERFORMANCE MEASURES BY ANALYSIS LEVEL, FROM THE UPS PRIVATE SECTOR CASE STUDY *(14)*

Facility Level Measures	Intermodal System Level Measures
Delivery or pick-up time	Door-to-door time
Delivery or pick-up costs	Door-to-door costs
Reliability of area service	Reliability of door-to-door service
Load complaints	Consumer satisfaction
Local sales	Market share

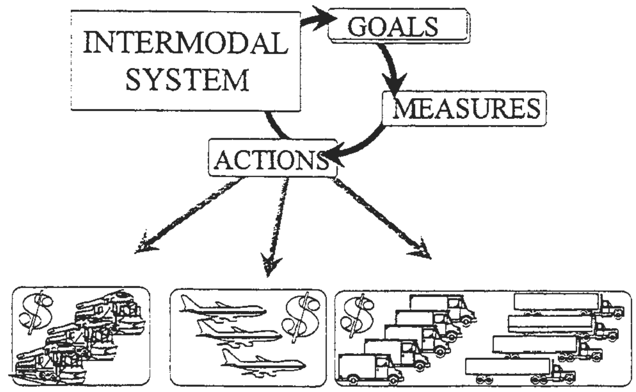

FIGURE 4 Strategic direction—"Top Down" *(14)*.

remedial action to address deficiencies through a strategic top-down process. Thus, the process of performance measurement is applicable in different ways at different levels of the organization. The manager of the regional facility makes decisions about the capital needs for more trucks based on regional analysis. Strategic direction for the company's actions comes about after the application of performance evaluation of the whole system, as illustrated in Figure 4. While the process of capital budget derivation was bottom-up, its strategic planning is definitely top-down. As UPS's Tom Hardeman explained, "While direction comes from the top, accountability stays as low as possible, as close to the actual operational decision as possible" (T. Hardeman, personal communication, 1993).

LESSONS FROM THE PRIVATE SECTOR CASE STUDIES

The lessons from the private sector case studies lead to the following three observations:

- The private sector freight industry has applied the concept of performance-based management and performance-based planning to an extent not achieved in the public sector.
- The private sector has an easier measurement task than the public sector because it can use profit and loss as a measure of success and failure.
- The private sector has more sophisticated methods for measuring mobility that the public sector, which is just beginning to measure mobility as part of the process of evaluating transportation systems.

From the available literature there does not appear to be a consensus on what or how to measure freight performance. Albany's integration of trucking concerns into its observations of congestion management offers a high level of integration with other traffic flow phenomena also being measured. NCHRP studies and other theoretical observations of the problem have proposed a wide range of possible "measures" with which to observe the performance of the transportation system. These range from "corridor level congestion summaries" at the macro level to delay experienced by trucks at intersections at the micro level. Norris has proposed that the focus be on the network and operations levels, leaving the examination of activity at the facility level to others. She proposes that the system be evaluated in terms of its adequacy in physical characteristics such as vertical clearances, bridge conditions, and grade crossings. The various operations in the system would be observed for their "performance" in such dimensions as cost per ton mile, door-to-door delivery time, and percent on-time delivery.

The Variety of Possible Freight Performance Measures

From the study of intermodal planning in the private freight sector, the management information systems can be observed at several levels: at the facility level, at the operations level, and at the network level. And the UPS case study can be used to show how a full system of evaluation needs a combination of performance measures and asset characteristics.

The IMS asked the states to come up with performance measures to be used in the monitoring and evaluation of their intermodal transportation systems. States are wrestling with this task and coming up with mixed results. Three of the most interesting activities in this area are underway in Oregon, Wisconsin, and California; these are presented as case studies in the following chapter.

CHAPTER FOUR

FREIGHT PLANNING IN THE STATES

THE SURVEY OF THE STATES

In mid 1993, NCHRP Project 8-30 undertook an extensive surveying effort. One question asked, "Does your agency have any experience in developing or using freight transportation forecasts?" *(6)*. Table 5 summarizes responses from 17 states. Depending on interpretation, approximately seven replied that they had tried to use freight forecasts in statewide planning, and most of these were dealing with the requirements of the State Rail Plan or with rail line abandonments. As of fall 1993, only five states reported they were preparing a state freight plan (as opposed to planning one or submitting a state rail plan to the Federal Railroad Administration (FRA). This is summarized in Table 6. It is fair to conclude that freight forecasting has not been a major element in the total planning process undertaken by the states. However, a renaissance has begun since the time of that survey. States that one year ago had not included freight considerations in their planning are today preparing to tackle the issue, largely in response to the requirements of the intermodal management system. On the other hand, very few of those state or local professionals interviewed reported a concern with freight as an element of the congestion management system.

TABLE 5

NCHRP SURVEY 8-30; DOES YOUR AGENCY HAVE ANY EXPERIENCE IN DEVELOPING OR USING FREIGHT TRANSPORTATION FORECASTS? *(6)*

State	Response
Florida	Tried it in 1979, inadequate
Hawaii	Have looked at user analysis
Indiana	Yes, for air cargo
Iowa	Yes, extensive use reported
Kansas	Identifies key rail and truck corridors
Kentucky	Looks at coal, but not forecast
Michigan	Looked at truck and rail at project level
Minnesota	Tried extrapolating, but did not forecast
Missouri	Not in system planning
Montana	Some pavement models
Nebraska	Cares about pavement thickness, uses constant averages
Nevada	ICC waybills and rail questionnaires
New Hampshire	Railroads support local freight assistance
New Jersey	Used Reebie Transearch in the past
Oregon	State plan used freight data as available
South Dakota	Used in local rail freight assistance
Washington	Used in freight rail abandonments—integrated into State Rail Plan

In terms of data sources, many states have had experience in the preparation of State Rail Plans, which is a precondition for receiving local freight assistance funds from FRA. Of the 13 states reporting that they have freight data available (see Table 7), 10 responded that they use the ICC's 1 percent Sample Waybills *(6)*. (Some may also have access to the "confidential" waybill files that are available to states that agree to honor the files' rigid terms of non-disclosure.) Given the role of trucking in the analysis of congestion and highway pavement life and other issues of concern to state highway departments, it is interesting that most of the freight data available concerns rails and not highways. Concerning truck flows, three states reported using the services of Reebie Associates, and one reported using DRI/McGraw-Hill. All three of these sources of data, as well as the 1993 Commodity Flow Survey, are described in chapter 5.

TABLE 6

STATES RESPONDING ABOUT STATEWIDE FREIGHT PLAN *(6)*

State	Response
California	Will
Connecticut	Will
Florida	Yes
Illinois	State Rail Plan
Iowa	Under development
New Hampshire	Yes for rail
New Jersey	Yes
Oregon	Yes
Pennsylvania	Draft is starting
Wisconsin	Yes

TABLE 7

NCHRP SURVEY 8-30: WHAT SOURCES OF FREIGHT TRANSPORTATION DATA DO YOU CURRENTLY HAVE AVAILABLE? *(6)*

State	Response
Connecticut	Reebie Transearch
Illinois	Waybill
Indiana	Waybill
Iowa	Iowa O-D studies Waybill sample
Kansas	Waybill (rail) Reebie for truck
Michigan	Waybill
Minnesota	Reebie Transearch, Waybill
Nevada	Waybills
New Jersey	DRI/McGraw-Hill
New York	Waybill
North Dakota	Grain shipments (with market destination)
Ohio	Waybill
Oregon	Waybill

FREIGHT PLANNING IN OREGON: A CASE STUDY

The story of freight planning in Oregon is part of a larger history of refining the planning process to deal with issues of local interest, including an unusually strong interest in land use and urban form. To some in freight planning management, the emergence of ISTEA, with its requirement of an intermodal management system, is just the stimulus that is needed to raise the visibility of freight flows into this ambitious planning process. This section will review the development of freight concerns in Oregon, before and after the passage of ISTEA.

Prior to ISTEA, single modal plans were developed and assembled as multimodal plans (Interview with representatives of the state of Oregon and the Port of Portland, March 1994). Local officials believe that freight planning in Oregon really meant railroad planning. The preparation of the State Rail Plan was driven by concerns for railroad branchline abandonment. Rail people were involved in the process, but they were mostly concerned with port access. Passenger rail was coordinated with freight rail to minimize conflicts on jointly operated rights-of-way. In terms of trucks, the state was involved in two areas: classic regulation through the Public Utilities Commission (PUC), and setting tax policy over the trucking companies.

Officials believe that there has been historically less interest in the freight issue because until recently, transportation has not been a contentious issue. The Oregon highway infrastructure is newer than that of the rest of the country and the roads have not been congested; the railroads are robust and profitable. Interest in highway construction came mainly from the isolated areas without access.

Transportation within the Land Use Planning Context

In the early 1970s, the state of Oregon developed 19 goals to address factors that influence the development of land; one of these concerns transportation. Before the transportation rule, access issues along the highway right-of-way were addressed on a case-by-case basis; they are now handled through the state hierarchy. The state is developing access control strategies for adoption into local land use plans by local agencies; the result is an improvement in throughput. In April 1991 the transportation planning rule was established. Changing state policy to a system approach to transportation reduced reliance on Single Occupant Vehicle (SOV) traffic. The rule was passenger oriented but control of land use is considered one the most powerful tools available to improve the quality of transportation, and freight was added later, partly in response to ISTEA.

The Oregon Intermodal Council

The Oregon Intermodal Council, established in March 1992, was one of the first Freight Advisory Councils (FAC) in the country. (Its leaders helped create the first National Freight Planning Conference in New Orleans in 1992.) The Council has been functioning as a lobbying group, and sometimes takes an opposing political position to the DOT. Nevertheless, this ad hoc group serves as the freight advocacy unit within the Oregon Transportation Plan process.

A citizen board, even one "officially" created, must be balanced in its viewpoints. Yet it is often expedient to receive input from organizations with partisan positions on important issues. State planners meet regularly with this advocacy group to get the freight input they need, but no formal group has been established. Some advocates worry that the council lobbies for SOV solutions, but the argument has been made that trucking interests have just as much to fear from congestion as anyone else, and would be supportive of overall CMS strategies. Airports, inter-city bus, transit, and all non-metropolitan intercity flows are addressed by a passenger task force created by the state.

Freight as a Theme in the Oregon Plan

The Oregon Transportation Plan (December 1992) has four major goals: 1) Characteristics of the System; 2) Livability; 3) Economic Development; and 4) Implementation. Freight is covered under economic development *(15)*.

The state's four policies under economic development are:

a. to promote a balanced freight transportation system which takes advantage of the inherent efficiencies of each mode.
b. to assure effective transportation linkages for goods and passengers to attract larger share of international and interstate trade to the state.
c. to expand the capacity of Oregon's freight industry by facilitating increased cooperation among the providers of transportation facilities and services.
d. to promote intermodal freight and passenger transportation hubs to enhance competitiveness, improve rural access, and promote efficient transportation *(15)*.

Thus, the freight aspect of transportation systems planning is addressed at the highest level.

The plan notes that "in the future, the state can contribute to economic development by facilitating the development of intermodal freight hubs. These hubs can encourage transfer of freight modes for each part of a freight trip. Examples of intermodal transfer facilities include marine ports where ships and barges load and unload to trucks, trains, and pipelines, and airports where goods are transferred from planes to trucks and other modes" *(15)*.

The Purpose of The Oregon IMS

Described in the 1993 Annual Report of the Oregon Transportation Plan, the purpose of the intermodal management system is summarized as follows:

TABLE 8
OREGON'S IMS CRITERIA FOR INCLUSION IN INTERMODAL SYSTEM—SUMMARY *(18)*

System Component	Criteria
Multimodal commodity flow corridors	5 million net tons per year or more
Intermodal rail corridors	Freight rail corridors, branch lines and short lines
Commodity flow highways/corridors	Truck volumes greater than or equal to 15 percent of all (traffic)
	Truck volumes greater than or equal to 1,000 ADT
Intermodal passenger flow corridors	Multimodal corridor with a minimum of two million automobile trips
Modal passenger corridors	All passenger rail corridors
	All intercity bus corridors
Intermodal freight facilities—ports	All ports involved in shipping freight
Intermodal freight facilities—truck/rail	All trucks on flat car (TOFC) and containers on flat car (COFC) facilities
Intermodal passenger facilities and freight—airports	All commercial scheduled service airports
Intermodal facilities—pipelines	All interstate trunk pipelines
Intermodal passenger facilities	All Amtrak stations
	All interstate and intercity bus terminals
	All locations with transit, park and ride, paratransit, and airport services
Intermodal traffic generators—primary industry	Grain elevators
	All lumber reload and transload facilities

The Intermodal Facilities and Systems Management System will provide a basis for better integration of and connections with all transportation facilities and services. Aided by a consultant, this management system will be developed with the Port of Portland and Metro and will provide information for the Intermodal Plan *(16)*.

Criteria for Inclusion in the Oregon IMS

In each state, a formulation must be developed for inclusion of facilities in the IMS network. Oregon has adopted a straightforward approach to establishing the criteria for inclusion in the IMS network, as summarized in the Table 8. Based on the criteria included in this table, it can be observed that the Oregon IMS is following an "inclusive strategy" in the building of its intermodal network. The inclusion of "all lumber reload and transload facilities," for example, results in a considerably larger network than other states, such as California, which has decided to include fewer facilities in its systems.

Selecting Freight-Based Performance Measures: Research from Oregon

States have been working with the original deadlines for the establishment of performance measures for their management systems. Traditional concepts such as highway level of service are now being compared with innovative concepts like "the mobility of freight" and the accessibility of the freight components of the transportation system. The state of Oregon has selected five elements for observation of performance: cost, time, accessibility/availability, reliability, and safety (Table 9).

This summary of potential performance measures provides a good base from which to observe the relative difficulty of obtaining data to support measurement for freight planning needs. Rail, for example, seems to be in good shape. Between ICC waybill data and state PUC data, basic data such as number of tons and number of railcars and trucks are available. Oregon also collects data on system delays and system safety. Port Import Export Reporting Service (PIERS) data, (discussed further in chapter 6) can be combined with other foreign trade data to gain a good description of the operations of significant ports. "Truck traffic commodity flows represent the largest gap of information within the freight transportation system. The lack of information on truck contents and truck trips from origin to destination represents a significant gap in the data availability for the IMS" *(17)*. Data on truck commodity information by origin was only released 2 years after the 1993 Commodity Census.

In Phase One, a consultant under the aegis of the Port of Portland conducted a systems inventory, defined the system, assessed the gaps in data, assessed the policy implications and prepared a work plan for Phase Two, which is now underway. With input from key public groups, freight performance measures were established early for cost, time, accessibility/availability, safety, and reliability.

Major data collection efforts are not part of the early efforts of the IMS process. Criteria have been developed to narrow the content of the intermodal system, and performance measures are being examined in terms of the reasonableness and data availability. Final performance measures will be established after the participants have agreed on the policy questions implied by the facilities selected for inclusion in the system. After that, the effort to collect data to support the application of the performance measures to the policy questions will begin. The first phase of the Oregon IMS process reviewed potential freight-based performance measures in terms of their data availability and relevance of use. Based on that work, performance measures were chosen and data will be collected based on the needs of those measures.

Considerations of Cost and Scale

Initially, state decision makers were concerned with the scale of data collection being planned in other states. But so far, cost has not been a problem. In Phase One, the state gave

TABLE 9
OREGON'S PERFORMANCE MEASURES FOR FREIGHT WITHIN THEIR IMS *(18)*

Key Element	Key Result Area	Performance Measures
Cost	Total shipping cost (producer to user)	Cost per trip
Time	Total time in transit (producer to user)	Average travel time per trip
Accessibility/Availability	Shippers with reasonable access`	Capacity restrictions
		Average transfer time between modes
		Perceived deficiencies and services
		Availability (origin of goods to destination and alternative modes to ship)
Reliability	Negative deviations of time and cost	Delay per VMT
		LOS for intermodal facilities (demonstrates transfer convenience)
Safety	System disruption	Average accident caused delay per trip
	Injury, death, property loss (product, equipment, infrastructure)	Average accident cost (property injury, death) per trip
		No. accidents (per trip, per year)
		No. accidents per VMT
		Some measure of personal safety at terminals

the Portland MPO funds to support the CMS, IMS, improvement of the passenger model, and PTMS. In this 50/50 match, $275,000 of $1 million has been allocated to the IMS.

The Role of the Oregon Commodities Forecast

With the beginning of the IMS process, the Port of Portland proceeded with a consultant contract to look at the future of freight in the region. The Port made this decision in order to improve its ability to participate in a series of studies about the future of land use and urban form in Oregon. "The study will consider the future demand for cargo in the Portland area over a set of alternative land use scenarios, and will assess the area's transportation requirements across these scenarios" *(7)*. The proposal notes that because of the year 2040 land configuration studies, "the Port also wishes to identify major commodities, customers, competitors and industry/economic trends which may impact the 2040 freight planning perspective." While the first phase of the study will focus on trends, the second phase "will include the development of the 2040 commodity forecasts on a detailed level. Forecasts will be developed which disaggregate commodity flows by domestic vs. international, by origin and destination, by commodity, by mode and by specialized handling requirements" *(7)*.

It is important to note that this study is global, not local, in nature. It is about aggregate demand for an expanding port based on an understanding of the world economy. The scale of orientation of the effort is noted by the authors who observe "one must consider the entire trading arena in order to completely understand market dynamics. The implication for the Port of Portland is that it is vitally important to understand how trade between Singapore and Japan, for example, might impact Malaysian exports to the United States" *(7)*. The Port of Portland study was not designed as input to the IMS, but rather to become part of a larger vision to understand the needs of the freight community in alternative futures for Oregon land use configurations.

The consulting team notes that "there is little doubt that the 2040 commodity forecast will predict volumes of cargo flows that are multiples of today's volumes. In a recent study for the US Army Corps of Engineers South Atlantic division, DRI/McGraw-Hill predicted that by the year 2050, international container flows passing through that region's ports could be five to seven times as large as current volumes" *(7)*.

Translating these visions of the future into implications for infrastructure planning will be done at a sketch planning level: "For example, given an *n-fold* increase in commodity flows on a particular corridor which may already be viewed as significantly congested, how many highway lanes might be required to meet the demand of the year 2010 or 2040?" The purpose of the study is not to be an input to the corridor specific highway planning process, but to broaden the land use configuration process. The study will "highlight the major assumptions captured in the scenarios, and discuss potential risks and opportunities on commodity flows, transportation needs, customer groups, and employment, which would be available to the region as a result of the base case or alternative scenarios" *(7)*.

Next Steps in Freight Forecasting

The Portland MPO has begun to prepare a program for the integration of freight forecasting into the region's established traffic modeling process; it will be one of the first MPOs to undertake this task. Up to this point, the city has developed a truck-routing model for application in one particular corridor, but nothing on the scale presently contemplated. It will take several years for the program to be developed, and the work plan calls for the Metro staff to develop the model with available resources, using specialized consulting "peer review" input.

Lessons from Oregon

A central theme that emerged from the synthesis interviews is that data collection should only occur after there is a consensus that it is needed to support actual policy decisions. It might initially seem that the consultant's long range commodity forecast was an example of premature data collection. But a closer view shows that it was oriented to the establishment of scale for long-term considerations of the land use configuration studies, not immediate support of the management systems. The approach taken by the Port of Portland toward long-range coordinated planning is demonstrated by their contribution of the commodities study to the region's land use configuration study process. The early establishment of a Freight Advisory Council, the advanced IMS, the Commodity Study and the recent decision to begin to model freight flows—all these speak of Oregon's commitment to integrating freight considerations into the planning process.

Officials at the Port of Portland believe the task of pulling the modes together for integrated multimodal planning has not yet been accomplished. Federal regulations for an IMS are viewed positively by the Oregon IMS managing team. While a lack of interest in freight issues has existed up until now, Oregon's leaders realize that the economy relies on freight transportation, and that the national intermodal system is poised to choose between west coast ports. This decision will be made on the basis of mere hours' differential in processing time. Shippers realize there is no more slack in the system. Access to ports has become a matter of economic survival, and ease of connection between freight facilities and long-distance services is the key (Interview with representatives of the Port of Portland, March 1994).

FREIGHT PLANNING IN WISCONSIN: A CASE STUDY

The TRANSLINKS 21 Concept

The state of Wisconsin has undertaken one of the most ambitious programs in the country to create a performance-based, multimodal transportation plan. Statewide freight planning is part of Wisconsin's TRANSLINKS 21, the State Multimodal Transportation Planning Program. The program consists of three concurrent activities: strategic planning, MPO planning, and intercity planning. Strategic planning would normally precede the other two activities, but a court order requiring a completed plan in 1994 compressed the process. The recently completed plan is multimodal, including both freight and passenger transportation elements and all relevant passenger and freight modes are included. Multimodal issues are addressed both in terms of modal shares and connectivity between modes, the latter being the subject of the intermodal management systems defined in ISTEA *(19)*.

The plan identifies recommended improvements in infrastructure and associated impacts on levels of service, as well as public and private sector roles. Defining the public interest is a key freight interest, going beyond what the marketplace can do.

Within the passenger and freight planning elements, alternative multimodal scenarios were defined within the passenger and freight planning elements, and consist of alternative sets of infrastructure improvements and their corresponding modal shares. Passenger transportation alternatives were analyzed with standard travel demand modeling techniques applied on a statewide, intercity basis.

Wisconsin's Freight Forecasting Process

The Wisconsin team concluded that there were no models that could be used to forecast freight usage by mode. Thus, preliminary projections of freight traffic were developed through extrapolation of historic trends. An innovative approach was used to refine initial projections of freight traffic flows. This approach involved review of the initial projections by a panel of freight experts. The expert panel included representatives of different shipping groups and freight facility operators. An advantage of this approach is that it created a forum for communication with public and private interest groups. Until now, there have been few opportunities for this type of cooperative effort between the DOT and outside interests.

A parallel effort developed a freight database; a consultant team assembled data on motor carrier commodity flows, as well as data on air, rail, and waterborne freight movements. These flows were mapped to a principal arterial network, with analysis conducted at the corridor level.

The end result was a first-generation multimodal plan that will guide future system planning and multimodal corridor planning. The plan is intended to provide a snapshot of transportation infrastructure in the year 2020, including highway, rail, ports, and airports. The plan will identify the levels of capital investment needed for infrastructure improvements and annual operating costs.

The Wisconsin Freight Policy Forum

Wisconsin DOT developed materials to provide the state's MPOs with general guidance on public participation in the planning process. These materials explain public participation techniques and ISTEA public participation requirements. The DOT worked with freight constituencies, and developed the materials in regional and thematic forums (including a 1993 Freight Policy Forum) *(20)*. Freight industry representatives, and interest groups considered such topics as economic development, transit, environmental issues, and rural transportation.

Wisconsin's Integrated Work Plan

An elaborate flow chart of the TRANSLINKS 21 Wisconsin Multimodal Transportation Plan describes the parallel

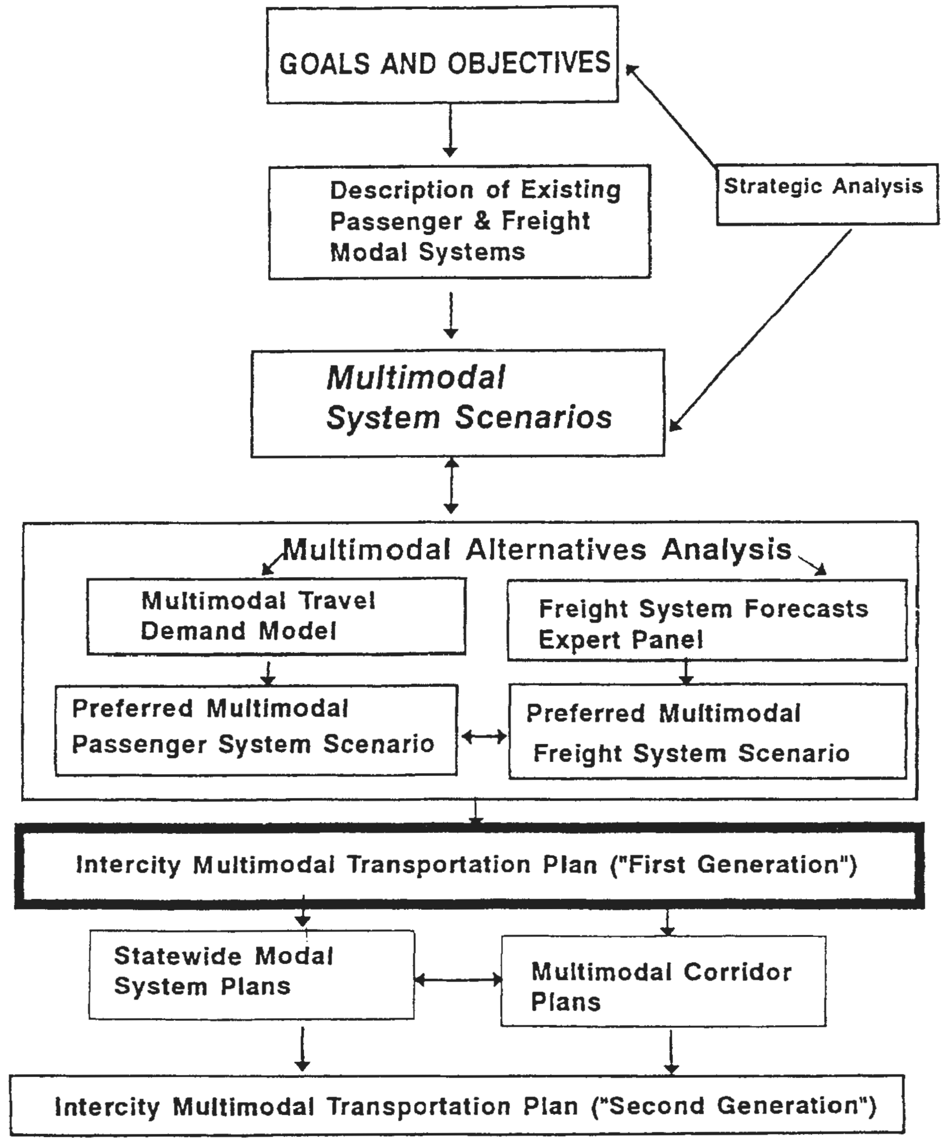

FIGURE 5 Wisconsin intercity multimodal transportation planning process *(21)*.

paths of passenger and freight planning *(21)*. (See Figure 5) The project, commenced in February 1993, has now concluded. In order to understand the technical steps of the freight planning process, this section of the synthesis summarizes the "Integrated Staff/Consultant Work Program" (October 1993) in terms of its milestones. This study is carefully thought out in its approach to freight planning and is a good example of the integration of freight planning efforts into the established transportation planning process. It melds a combination of known transportation planning techniques with human judgment at critical points where the accuracy of advanced modeling is not currently established.

A summary of the six steps outlined for the freight planning process is provided below:

In step one, "Develop Transportation Goals and Socio-Economic Environmental Values," five transportation goals are set, applicable to both passenger and freight.

In step two (freight only), "Inventory Existing Freight Systems and Usage," the staff assemble historic and base year modal systems and collect data for each freight mode from readily available sources.

In step three, "Compile Commodity Flow Data," DOT staff assemble commodity flow for rail, air, and water. A consultant assembles commodity flow for trucks. The DOT identified key individuals from the Wisconsin transportation and shipping sectors to advise the staff and consultant on preparing and evaluating forecasts of future commodity movements under different multimodal scenarios.

In step four, "Trend Line Forecast by Mode," WISDOT staff prepare trend line forecasts for air, rail, and water; the consultant prepares the same for trucks to the year 2020. In this step, data are organized for assignment on the state highway model. The consultant develops interstate and international trend line forecasts.

Step five, "Develop Scenarios," relies on input from a strategic planning task that examines economic development, pricing, urban mobility, the environment, and rural transportation. The plan was to "develop four multimodal intercity freight scenarios and component sketch systems for the highway/truck/air cargo, freight train and waterborne modes." Here the Wisconsin strategy is guided by human judgment rather than a quantitative model. In the original work program the consultant was to "conduct 30 interviews with prominent national freight transportation professionals to assess the change elements affecting the future of the industry. Elements will be translated into probable effects on modal economics and competitiveness with consequences for modal shifts in Wisconsin." In 1994 Wisconsin revised this element to Wisconsin-based group of experts rather than national experts. The full team developed "an initial set of multimodal forecasts of commodity flow movements for each of the four scenarios." These sets of flows were reviewed and refined by the staff, consultants, and the Wisconsin expert panel.

For step six, "Evaluate Scenarios," three tasks are undertaken. The consultant develops estimates of the public costs of each of the four scenarios for all modes except for the truck/highway mode, whose costs are estimated by the WISDOT Staff. The team "will jointly develop and apply a methodology for performing a multidimensional analysis of the four scenarios" to identify a preferred freight scenario.

In approximately one year, the freight scenarios are evaluated. Three months after that, a preferred scenario is selected. Only after the selection of the freight plan is the freight element added back into the integrated intercity system plan.

From the Intermodal Plan to the Intermodal Management System

For many states, the IMS base of data and monitoring will support the development of a Statewide Intermodal Plan. In several states, including Ohio and Wisconsin, the statewide planning efforts preceded the creation of an IMS. The result is creation of an IMS that benefits from existing experience in working with intermodal data.

Purpose of the Wisconsin IMS

> A primary goal of Wisconsin's intermodal management system is to develop system level performance measures and to identify system level deficiencies in intermodal connectivity. The emphasis will be on analyzing the intermodal efficiency of the transportation system in its entirety, rather than focusing on assessing the performance of individual terminals and facilities.
>
> Each freight and passenger modal system will be assessed with regard to deficiencies in intermodal access and connectivity using system level performance measures developed as part of the IMS. On the freight side, the focus will be on truck/rail terminals (TOFC/COFC and major built transfer facilities), all ports and harbors, all airports with scheduled air cargo service, and other intermodal freight facilities *(22)*.

The Wisconsin IMS work program has four work elements. Element I, "identification of intermodal facilities," evolves directly from the existing TRANSLINKS effort, and will create the inventory of facilities included in the IMS. The survey will "request information on intermodal deficiencies with regard to highway, rail transit access. . . . The intent is to determine, in a rudimentary fashion, where system level deficiencies in intermodal connectivity seem to exist" *(22)*.

Element II will develop system level performance measures, system level deficiency analysis, and data collection systems. In this element, "performance measures and other analytic techniques will be developed for determining the need for new intermodal facilities and possible consolidation of existing ones." Linked to a main theme of this synthesis is, "The type of data collected will depend on the performance measures and the analytic processes which are adopted" *(22)*.

In the third phase of the Wisconsin IMS program, the team will apply the above process "to determine the deficiencies in current intermodal access and connectivity or the need to build new facilities, or to consolidate existing ones." The process would result in the creation of an on-going process of identification of intermodal strategies and actions, described as the fourth element in the program. From this ongoing process will come recommendations for "an intermodal plan for a limited number of specific facilities."

Lessons from Wisconsin

Wisconsin has taken the integration of freight into their statewide planning effort to a state-of-the-practice level. In the forecasting of freight flows, they have adopted an interesting balance between areas in which the value of quantification is clear and areas in which best professional judgment is appropriate. In their IMS, they are carefully focusing on the performance of the system, and more specifically to the performance of specific links connecting the facilities to the rest of the system. This focus on the weak links surrounding the points of connectivity represents an unusual strategy for an IMS, but one which may focus scarce resources on those elements of the total system that most need attention. There is a similarity between this approach and that taken in Florida, which is discussed later in this chapter.

FREIGHT PLANNING IN CALIFORNIA: A CASE STUDY

The state of California's unique effort is to develop an intermodal planning tool that could be applied in the IMS process, the policy analysis, and the corridor analysis phases of planning. In its attempts to predict impacts at a system planning level, it could emerge as one of the most comprehensive efforts ever to incorporate freight considerations into systems level multimodal planning. The focus of this new activity is the development by Caltrans of the Intermodal Transportation Management System (ITMS), an innovative program to integrate multimodal and intermodal transportation performance measurement and analysis into one usable process.

Unlike most states, California began work on the ITMS soon after enactment of the ISTEA with its implementation deadline of January 1995. This early start benefited California because it provided time to secure funding and develop software platforms and a comprehensive intermodal management system. In December 1993 FHWA issued their Interim Final Rules phasing-in implementation over a longer period of time.

Purpose of the ITMS

The purpose of the ITMS is summarized in the Study Design dated June 9, 1993. Concerning the Federal requirements of ISTEA, the ITMS is to:

- . . . be used by federal and state entities, Metropolitan Planning Organizations (MPOs) and other local agencies in considering project selection decisions;
- Provide quantifiable modal data, inventory, database analysis methodology, forecasting capability and evaluation process for making efficient and cost-effective decisions in urban and rural areas of the state at the system level and an improvement level;
- Provide the necessary information so the results of the various required management systems can be accounted for in the California Transportation Plan (CTP);
- Provide intermodal information so these data can be furnished to the federal government's Office of Intermodalism and Research Program involving intermodal data and performance measures; and
- Develop intermodal transportation information that may be useful to other interested public and private entities *(23)*.

Concerning its application by the state of California, the Study Design states that the ITMS is being designed to:

- Serve as an integral element of the ITMS which is an initial step in developing the state's intermodal transportation planning process and the CTP;
- Be used by the state for consideration of project selection decisions and monitoring systems performance;
- Provide some input to the first CTP; and
- Develop recommendations identifying needs for computer support, expert systems and outlining a training program for instructing intermodal planning staff in the use and maintenance of the ITMS element *(23)*.

Structure of the Project

Development costs of the ITMS span seven tasks. Task 1 developed the study design. Task 2 develops the inventory and data. Task 3 develops the database and Geographic Information System (GIS) components. Task 4 develops the analysis methodology, performance measures and algorithms. Task 5 develops the forecasts. Task 6 uses the ITMS and projects from the State Transportation Improvement Program (STIP) to evaluate intermodal effectiveness of proposed improvements and to make adjustments to the ITMS. Task 7 develops recommendations for an ITMS user's training program and future system enhancements, and provides complete documentation on all deliverables and system features and updating requirements.

The project is guided by the 80-plus member ITMS Advisory Committee, representing federal, state, regional and local transportation agencies, airports and seaports, transit interests and transportation interests in the private sector. The consulting firm of Booz•Allen & Hamilton, Inc. and the ITMS staff meet regularly with the project managers of the other five management systems and with representatives from the MPOs, RTPAs and local agencies. The Department's ISTEA Steering Committee and Directorate provide overall policy guidance.

A flexible and expandable architecture for the ITMS permits Caltrans district offices and regional agencies to expand coverage in their areas. The project has identified the ITMS system of major intermodal corridors and facilities, the Relational Database Management Systems (RDBMS), and GIS platforms, data sources, performance measures, and analysis methodology. The project team has also identified its approach to forecasting, much of the attribute and spatial coverage for freight and person travel, and a Phase 1 Prototype. Interviewing potential public and private sector users of the ITMS provides information on how its strengths and weaknesses are perceived.

The Caltrans team considers ITMS a tool for intermodal planning and a decision support model for system and corridor planning. In this program, the model will have supply data, (geometry, speeds, rails, and access roads to corridors of statewide significance) and will include demand data by mode. In a given corridor, such as Sacramento to Los Angeles, it will predict shift between modes for both passenger and freight as a result of changed input assumptions in terms of adding capacity, adding services, or through management techniques. It is important to note that ITMS is not an example of a management system per se, but a planning tool which incorporates the function of a management system and serves as a policy level corridor planning tool (Interview with Caltrans project staff and consultants, March 1994).

The Timing of Data Collection

Caltrans' ITMS managers are very clear on the subject of data collection and its role in the overall process. In 1994, well into the process of ITMS, no new data had been collected to support its operations. For the first segment of the process, an 80-person advisory process focused on the network and facilities to be included in the system. After it was clear what network and facilities were being analyzed, performance measures were proposed and reviewed for their usability to address public policy issues. This review included a thorough search for sources of existing data.

Criteria were used to define the scope of the network, as shown in Figure 6. With the image of that network and its problems firmly established, the issues relevant to those problems could be defined. After that, the application of specific performance measures followed. The data collection effort to enable the analysis will begin once the selection of the mode specific performance measures is made.

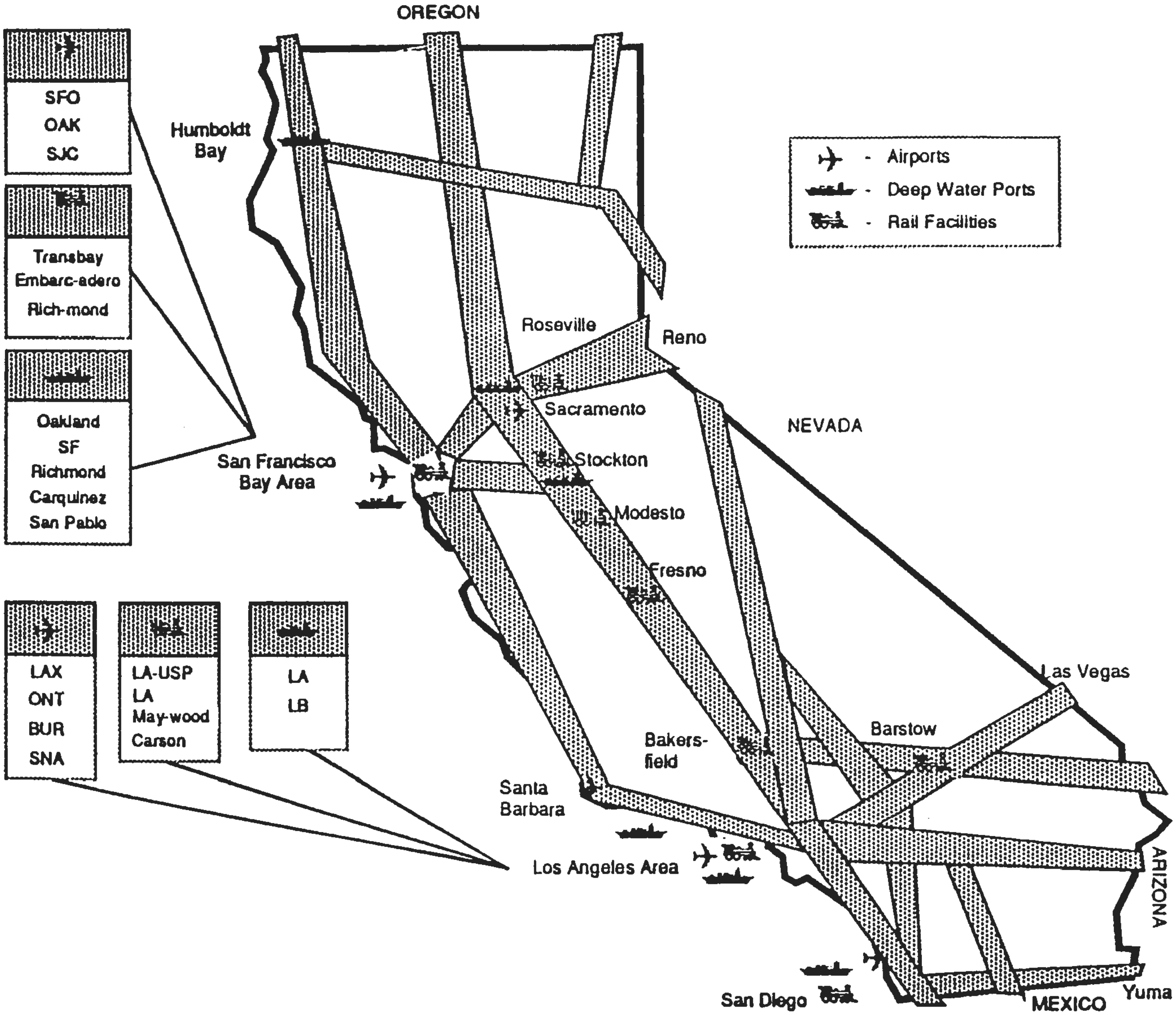

FIGURE 6 Major intermodal facilities in California *(23)*.

The first premise in the Caltrans ITMS process is that the data already exist. The working assumption will be that refinement and further analysis of the data may be required, but not new collection. There has been a direct interaction between the quality of support data and the selection of the proposed performance measures. To minimize the effects on the performance measures when data are missing or weak, the consultant will provide a "best estimate" or "surrogate" along with a flag to indicate this is "soft" data. This process will identify data areas in need of strengthening and potential future data collection efforts. In the areas of quality of life and economic impact, the team is still looking for effective performance measures: currently, the concepts of availability and affordability are being explored for use in analyzing the quality of life issues. The team stressed that the model was a mode split change model, not a predictor of future economic conditions.

Defining the System

The California team strongly opposes the concept of collecting the data first, and then defining application to issues later. The performance measures were adopted after the definition of the system was established, and the list of desired data was developed after the performance measures were established. As shown in Figure 6, about 40 to 50 facilities and 15 corridors have been selected for inclusion in the system. A major task for the team was to convince the 80-person committee to keep the system manageable. Major truck-to-truck transfer points have been identified but not smaller truck terminals. Major ports and airports, and truck-to-rail transfer points are included. Initially, the development of the network sparked some controversy. Some of the MPOs were resistant to the concept of the state examining public policy options that were located, at least partially, within their local jurisdictions.

TABLE 10

CALIFORNIA'S POTENTIAL PERFORMANCE INDICATORS FOR FREIGHT *(23)*

Category	Freight Performance Measure
Mobility	Mobility index
	$\frac{\text{Ton Miles}}{\text{Vehicle Miles}}$ x average speed
	Lost time (per trip or mile)
Financial	AEC/ton mile
	Average cost per ton mile (including change in lost time)
Environmental	Change in tons of pollution
	Change in tons of greenhouse gases
	Change in fuel consumption per ton mile
Economic	Jobs supported
	GSP impacts
	Economic costs of pollution, accidents, fatalities and lost time
Safety	Accidents per million ton miles
Quality of Life	Availability of and restrictions on service (measures under development)
Other	Ton mile per capita, value per ton
Intermodal transfer facilities	Tons transferred per hour, average transfer time, capacity utilization for access roads (expressed as a volume to capacity ratio, V/C)

However, these issues were worked out to the mutual satisfaction of all parties.

Freight Performance Measures for California

The ITMS team was careful to develop methods of performance measurement that went beyond the traditional reliance on the concept of vehicle movement, as opposed to unit movement (both persons and commodities). Thus, person miles of travel is used in place of vehicle miles of travel; commodity miles of travel rather than truck miles of travel. This stems from a long-running controversy in California concerning the measurement of congestion; the original view of congestion management was based on the observation of volume over capacity (v/c) calculations. Thus, when v/c ratios became high, capacity was supposed to be added. With the systematic addition of capacity, concern was raised that overall VMT generation might increase as a result of improved network performance. Thus, in the minds of some participants, the initial congestion management concept, with its reliance on overly narrow evaluation criteria, might lead to a net increase in VMT, and to more congestion. Pratt and Lomax have noted that "California, which went the Level of Service performance measurement route in its pre-ISTEA Congestion Management Program (CMP), has encountered extensive and thoughtful criticism including the charge that the end results may not be consistent with regional mobility and development goals" *(9)*. The observation here is that California has years more experience than most states working with the concept of congestion management, and has already experienced the kind of debate that is now occurring in other states.

California has worked hard to resolve performance measurement issues, with promising results. Table 10 shows the freight planning performance measures selected in California. All modes (person and goods) were examined in terms of six overarching or cross modal variables. They are:

- Mobility
- Financial
- Environmental
- Economic
- Safety
- Quality of Life.

Included in the table is a "mobility index" concept for freight that was developed to parallel indices for passenger traffic. That index, Ton Miles per VMT times Average Speed, is designed to measure the "freight throughput" of a given facility segment. It can be expressed as:

$$\frac{\text{Ton Miles}}{\text{VMT}} \times \text{Average Speed}$$

or,

$$\frac{\text{Container Equivalents}}{\text{VMT}} \times \text{Average Speed.}$$

This formula grew out of the adoption of the mobility index for passengers, which can be expressed as:

$$\frac{\text{Person Miles of Travel}}{\text{VMT}} \times \text{Average Speed.}$$

In this system, a four-person carpool at 50 mph is generating twice the "mobility" of a two-person car at 50 mph. The index is designed to bridge the two philosophies of mobility. It breaks down the barrier of vehicle-based observations, and replaces it with person-throughput.

California's proposed performance standards for freight are summarized in Table 10.

The California ITMS process gives the economic analysis of the output for the policy change being tested. For example, the model could look at a policy of allowing additional truck weight on the highways. Additional truck weight implies greater throughput per labor (and propulsion) dollar. If the price of trucking comes down, the cost of consumer goods to the local population goes down. If the cost of these goods goes down, the effective spendable income goes up. This can be translated by a factor to an improvement in Gross State Product (GSP). If greater weight increases the cost of highway or bridge repair, upkeep, and replacement, the cost to the highway department goes up. If more bridges are rebuilt as a result, the new jobs will stimulate the economy.

On the other hand, the model is not designed to calculate longer term economic change. The ITMS manager stresses that the primary transportation planning element of the model is its ability to predict a shift in mode for a given set of flows, not to predict the change in the set of commodity flows resulting from the scenario tested. For example, if the lowering of consumer price (tested in our scenario of decreased trucking costs) causes the industry to grow, and the industry becomes more important in the overall economy (and in land use), the ITMS process will not predict this effect (interview with Caltrans project staff and consultants, March 1994).

The Freight Element of the ITMS Planning Process

It is important to note that the ITMS will attempt to predict changes in freight mode. Most of the research reviewed for this synthesis suggests that this will be a challenging task. To help in this undertaking, the ITMS Freight Database uses the Reebie Transearch Database to develop its freight database (including a 10-, 20- and 30-year forecast). Supporting intermodal infrastructure planning requires an understanding of the volumes of freight being moved in a corridor by commodity and mode. The basic Transearch Database used by commercial customers for 15 years is being enhanced in areas of agriculture products, forest products, mines and quarries, waste and refuse, services, and secondary movements. The ITMS Freight Database will also include movements within California, through the state as well as imports and exports. The 20- and 30-year forecasts are an extrapolation of the standard Transearch 10-year forecast. They are developed using econometric models such as those provided by World Economic Forecasting Association. The sheer size of the state (California has eight BEA zones) allows for greater utilization of BEA-based data than is the case in most states. Thus, much of the economic data used as input to the freight forecasting process is already available for eight subsections of California. The existing ITMS database includes eight BEAs in California and 47 in other states, creating matrices with 64 intrastate cells and 752 interstate cells. Cross checking will be done with PIERS and Waybill samples. The data will be further reorganized to a 58-zone county-by-county level and assigned to the corridors.

The California team stressed that the ITMS model need not be wedded to any elaborate GIS system, even though they have elected to do so. The network described is similar to that used on the metropolitan level, but applied to a statewide corridor. However, linking the ITMS model to a statewide GIS is a major goal of California's multimodal corridor analysis process. The statewide network will incorporate the use of several separate GIS technologies in separate metropolitan areas. Ultimately, this will allow a high level of coordination with demographic variables regarding population characteristics and geographically based impacts.

Lessons from California

Of all the government entities and levels studied in this synthesis, the California ITMS demands the most from its models. Freight forecasting starts with the most difficult step—understanding today's flows. Their county-based 58-zone simulation will be one of the most thorough in the nation. Their freight performance measures parallel performance measures being applied to passenger transportation; this should allow many cross-modal decisions to be observed from a common base of forecasted information. The unique element seems to be the attempt to quantitatively model change of freight mode as a function of alternative policy scenarios tested. By contrast, Wisconsin assembled a panel of experts to agree on modal shift for freight, and manually applied those results to its forecasts; the ITMS will attempt this within the disciplined structure of a mathematical model to support investment decisions.

Perhaps the most important lesson from the California experience stems from the carefully phased development of the network, the issues, and the performance measures before the collection of the data. Because of the scale of the task, several of the interviewees considered the California process extremely costly in terms of data collection. The project is proceeding on schedule and has not required any new data collection yet.

The project had its obstacles to overcome. Substantial delay occurred when the DOT adapted its software to corporate database and GIS standards. Difficulties were encountered in developing comparable data that is consistent but needed in cross-modal analysis. And solutions were needed for public and private access issues: computer equipment, networks, connectivity, security, and overall systems integration. But the problems are now behind the ITMS team, and it is moving ahead rapidly.

FREIGHT PLANNING IN FLORIDA

The state of Florida undertook important research in IMS preparation strategies, and has developed a set of tools to help planners weigh strengths and weaknesses of intermodal connections for both passenger and freight facilities. Funded by an early FHWA grant to create "model" intermodal management systems, Florida assembled a "Pre-IMS Strategies and Actions" program. Its purpose was to commence certain activities that would later be combined in a mature IMS. Some analysts have suggested that Florida's pre-IMS approach, which relies on existing data and primary observations about facility connectivity, represents a realistic level of effort for the first years of IMS preparation.

Table 11 summarizes the pre-IMS approach to creating statewide freight flows for the analysis of intercity movements. Florida's work program notes that "data collection should be targeted for two purposes—to define statewide freight flows and the potential use of intermodal facilities."

Florida's "Pre-IMS Strategies and Actions" document proposes early performance measures for use in the IMS process. It notes that "the evaluation process will identify the impacts of the project, which will be used to develop strategies and prioritization of the projects" *(24)*.

Florida's Use of Deficiency Analysis

While the approach suggested in Table 11 (using the performance measures described in Table 12) focuses on statewide flows and networks (macro level), the pre-IMS strategy also proposed useful tools to observe individual facilities and the quality of their connections. Similar in approach to Wisconsin, Florida is now undertaking an analysis of key points of the system's intermodal connection. The process uses a "Data Inventory Spreadsheet" which focuses attention not only on the facility itself, but also on the quality of the connection between the facility and the major transportation routes, such as those included in the National Highway System (NHS). The data collection form includes a simple matrix required for each project. The matrix presents the connecting modes (access by rail, by road, by pedestrian) against various attributes (physical characteristics, service characteristics, usage characteristics) in columns. This creates a summary of the salient characteristics of connectivity, by connecting mode, for the intermodal facility being analyzed. The data collection form next calls for an assessment of "current linkage deficiencies for available modes." The next question concerns "possible future mode requirement or need" for improved connections with the rest of the intermodal system *(24)*.

Florida's emphasis on the operations of the facility at the point of interconnection is demonstrated by the facility performance measures summarized in Table 13. The questions posed at the facility connection level are "strategic" in nature. Rather than focusing on highly replicable statistics, the questionnaire asks such questions as, "Do trucks encounter difficult turns?" While allowing for subjective responses, the questions focus on immediately attainable information from those who have experience with the system and its component parts.

Florida's Pre-ISTEA Experience with Structured vs. Extrapolated Freight Forecasting

Like several other states, Florida had a difficult time making the quantitative modeling approach work. Florida built a multimodal commodity flow model in 1979. As reviewed by NCHRP 8-30, "the extrapolation of traffic count data proved more accurate and useful than the comprehensive flow model for forecasting truck traffic. This suggests that complex structural forecasting models may not be of great use to the states" *(6)*. The difficulty in obtaining data is a great concern; many feel that "anything we could do to put truck flow data in the hands of the states would be useful" *(6)*.

Lessons from Florida's IMS

Florida's approach to data collection focuses on the points of interconnection, rather than on the full performance of the larger system. It will be interesting to see if this strategy is a cost-effective way to concentrate efforts on points of interconnection. In the minds of many participants in this synthesis process, this focus is the best way to begin the IMS process.

INTEGRATION OF FREIGHT PLANNING INTO OHIO'S STATE PLAN

For many states, interest in freight is defensive or re-active (fear of damage to pavements, fear of noise and congestion, fear of branch line abandonment). An energetic exception to this trend is Ohio. The concept of freight for its positive or

TABLE 11

FREIGHT FLOW SKETCH PLANNING GUIDELINES, FROM FLORIDA'S PRE-IMS STRATEGIES AND ACTIONS *(24)*

Step 1	Examine all available freight data for all modes (air, water, highway, rail)
Step 2	Identify data gaps
Step 3	Devise means to fill gaps such as the use of commodity production and consumption data, industry specific sources and others
Step 4	Determine modal splits from existing trends and port characteristics
Step 5	Identify origin-destination pairs
Step 6	Identify, obtain and use existing forecasts; use trend analyses where other forecasts do not exist
Step 7	Identify likely impacts on intermodal facilities

TABLE 12

PERFORMANCE MEASURES FOR THE EVALUATION PROCESS, FROM FLORIDA'S PRE-IMS STRATEGIES AND ACTIONS *(24)*

Criteria	Measure
Improved roadway LOS	Average travel time
Reduced SOV travel	Mode switches
Improved utilization of existing capacity	Volume/Capacity ratio
Reduced shipping or passenger trip costs	$/passenger or freight unit
Travel time reductions	Time saved, percent reduction
Improved service reliability	Percent down time
Reduced energy consumption	Fuel cost/trip
Maximized benefits or return on investment	B/C
Stimulates private investment	$
Improved air quality	National Ambient Air Quality Standards
Promotes equity and social welfare	Subjective evaluation
Available expansion space	Acres
Adaptability to other modes	#, type
Condition	Condition rating
Environmental impact	Permitability
Safety	Expected accident reductions
Regulatory barriers	Description

TABLE 13

RECOMMENDED INTERIM (FREIGHT-ORIENTED PERFORMANCE MEASURES FLORIDA STATEWIDE INTERMODAL PLANNING PROCESS *(24)*

Facility	Performance Measure
Port access	Is the access road operating at worse than LOS C?
	Do trucks encounter difficult turns on the main access roads?
	Is rail available?
	Is the drayage distance between rail/port more than . . . miles?
	Is the drayage time between rail/port more than . . . minutes during peak periods?
	Does the main access road pass through principally residential areas?
Bulk transfer facilities	Is the access road operating at worse than LOS C?
Rail TOFC/COFC facilities	Is the access road operating at worse than LOS C?
Rail/highway conflicts	Does the vertical clearance of the bridges exceed . . . feet on main lines?
	Do trains occupy at-grade crossings more than . . . minutes per day?
	Do accidents exceed . . . per million vehicles at an at-grade crossing?
Draw bridges	Are there more than . . . bridge openings per hour?
	How often do they stay open more than . . . minutes?

proactive aspects is the motivation behind the Access Ohio project. For that effort, five goals were identified:

1. System Preservation and Management
2. Economic Development and Quality of Life
3. Cooperative Planning Process/Transportation Efficiency
4. Transportation Safety
5. Funding *(25)*.

Several policies under No. 2, "Economic Development and Quality of Life," relate to the major themes of this synthesis. Policy Statement "A" proposes to "target the states financial and technical assistance to those transportation corridors, facilities, and services that will encourage economic growth and business development." Included among the initiatives under this policy are:

a. Eliminate railroad bridge clearance restrictions based on highway bridges so that tri-level, double stack, and Amtrack superliner trains are not impeded from crossing Ohio.
b. Identify grade crossings with inadequate clearances and eliminate them on a prioritized basis.
c. Develop standards and a process that will ensure that all future projects involving grade separations will result in adequate vertical and horizontal clearance to accommodate foreseeable demands.
d. Work with rail industry to develop an information sharing program with ODOT *(25)*.

Freight Performance Measures in Ohio

In the development of the Access Ohio plan, great effort when into establishing the statewide intermodal system for

TABLE 14

CRITERIA FOR INCLUSION IN OHIO INTERMODAL NETWORK *(25)*

Points	A. Roadways
5	≥ 10,000 commercial truck traffic
4	5,000—9,999 commercial truck traffic
3	1,000—4,999 commercial truck traffic that exceeds 30% of total ADT
2	1,000—4,999 commercial truck
1	300—999 B&C commercial with bus point if B&C ≥ 35% of total ADT
Points	**B. Rail Lines (Average yearly traffic in mission gross, MG, ton miles)**
5	Class I/II Rail Lines ≥ 100 MG Ton Miles
4	Class I/II Rail Lines ≥ 75-99 MG Ton Miles
3	Class I/II Rail Lines ≥ 50-74 MG Ton Miles
2	Class I/II Rail Lines ≥ 25-49 MG Ton Miles
1	Class I/II Rail Lines ≥ 5-24 MG Ton Miles

TABLE 15

OHIO'S FREIGHT-ORIENTED PERFORMANCE MEASURES AND STANDARDS *(25)*

Category or Issue	Measure	Performance Standards	Rating
Transfer of bulk freight commodities between modes (individual measure by type of modal transfer)	Amount of time required to transfer bulk freight commodities between each type of mode (ship to rail, truck to rail, ship to truck)	< 5 minutes/ton	100
		< 10 minutes/ton	50
		< 15 minutes/ton	25
		> 15 minutes/ton	0
Transfer of containerized freight between modes (individual measure by type of modal transfer)	Amount of time required to transfer containerized freight between each type of mode (ship to rail, truck to rail, ship to truck)	< 3 min/container	100
		< 5 min/container	50
		< 10 min/container	25
		> 10 min/container	0
Railroad/highway safety at grade crossings to ports, airport, intermodal facility	Accidents per Million Vehicles of Exposure	< 2/mve	100
		< 5/mve	50
		< 8/mve	25
		> 8/mve	0

analysis in the process. As part of this effort, there was a highly quantitative process that included the use of performance criteria to determine which facilities should be included in the macro-level plan:

> The process of identifying and designating macro-level hubs and corridors was undertaken in a manner designed to establish the principal physical framework of Ohio's intermodal transportation system from a statewide perspective. This perspective required focusing on intermodal-interstate-, and intra-state-scale considerations, thereby distinguishing the macro level system from local, intra-urban, and related regional considerations which are more appropriate to a micro-level system *(25).*

An extensive examination of the state system was undertaken to determine eligibility for inclusion in the macro-level system. The full system of evaluation that was developed to determine which "nodes" and "links" should be included in the macro level system for Ohio's statewide transportation planning is beyond the scope of this synthesis. However, it is worthwhile to note the extent to which freight planning considerations were worked into Access Ohio's system of macros—corridors and hubs. Five corridor identification criteria were established: traffic, population, economic activity, trade/international centers, and natural resources/agriculture. Of the total weight assigned to these considerations, commercial truck traffic was weighted at 20 percent of the total, while Class I/II freight rail was weighted at 5 percent of total evaluation (shown in Table 14). Interestingly, passenger flows were not given any weighting in the determination of corridors for inclusion in the statewide system.

With this classification system established, the roadways and rail lines of Ohio could be quickly categorized for their potential inclusion in the macro level system.

Even with this rigorous examination of truck and rail data in the process, the authors still noted that "many potential criteria were eliminated due to data... limitations. Useful data, for example, were lacking on truck freight movements. . . . " *(25).* Reasonably available truck movement has been a common concern among states that have attempted to upgrade their freight planning process.

To monitor and evaluate the performance of the system, Ohio has proposed a series of performance standards and measures, shown in Table 15.

With this solid orientation to freight information, it is interesting that the Access Ohio plan did not describe itself as particularly focused on rail freight issues. The document states:

> The rail freight initiatives tend to focus on how state government can enhance private rail freight services so that it remains

as an alternative for Ohio businesses. The initiatives focus on keeping rail competitive in Ohio, on ensuring that railroad bridges are of sufficient clearance so that new large loads can be transported and on ODOT being a broker of last resort if important freight lines are to be closed. ODOT has acted as a broker when major carriers were to close a line by finding new operators for the segment. Access Ohio also stresses the importance of good rail, highway, air and water connections. Its initiatives stress the role government can play in supporting intermodal connections at water ports, at airports and at major commercial centers *(25)*.

Lessons from Ohio

The Columbus Inland Ports Study (discussed in the following chapter) shows that Ohio has managed to examine freight's role in the state's economic development in a proactive light, and was doing so before ISTEA mandated such an approach. Ohio has shown, first with Access Ohio and now with its IMS process, the value of early integration of freight planning concerns into the statewide planning process.

CHAPTER FIVE

FREIGHT PLANNING AT THE MPOS

One MPO director commented that "there is a high stakes poker game going on, and not only isn't the goods movement industry at the table, they don't even know the game is happening" *(26)*. This chapter will explore the exceptions to this observation, including case studies of innovative freight planning in Columbus, Ohio, and the San Francisco Bay region, with short summaries of other regions.

THE SURVEY OF THE MPOS

A 1993 survey asked MPOs questions about their involvement with freight planning activities. Table 16 summarizes the source of freight data for responding MPOs; five MPOs were actively involved in collecting data for their area, three purchased the data from private sources, such as Reebie Associates. It is fair to conclude from the responses that most MPOs did not collect or organize freight data. An open-ended question concerning plans for the future freight planning activity revealed that two MPOs (New York and Washington, DC) had intentions to develop freight trip tables for integration into the traditional surface transportation planning process.

TABLE 16

NCHRP 8-30 SURVEY; PRINCIPLE SOURCES OF FREIGHT DATA USED BY YOUR MPO? *(6)*

New Jersey	Got it from state
Bay Area	SF Bay Area cargo forecasts
Washington, DC	Truck survey (1968)
Philadelphia	DVRPC Surveys as needed
Savannah	Reebie
NYMTC	"Lorden survey"
Maricopa/Phoenix	Reebie Transearch
Pittsburgh	SPRPC Freight Transportation Data Base

Presented in Table 17 are the positive responses to the question "Are any freight related facilities and issues included in your Transportation Improvement Plan (TIP) at this time?" Responses showed that many MPOs were actively involved in capital programming activities that seek to improve the quality of access to airports and seaports. As expected, there were no reported activities to support intermodal rail transfer facilities, which has emerged in the last 3 years as a major issue in some areas.

TABLE 17

NCHRP 8-30 SURVEY; RESPONSE TO FREIGHT RELATED ACTIVITIES IN THE TIP? *(6)*

NJTCC	Landside access to ports and air freight
Bay Area	Intermodal facility planning study
Kansas City, MO	Bypass road would help trucks
Philadelphia	Access to port/intermodal facility
Sacramento	Roadways serving the Port of Sacramento
Atlanta	Intermodal passenger terminal will affect freight
Savannah	Port access
Denver	Airport access
Hampton Roads	Access improvements
Indianapolis	Airport access
Louisville	Access roads to intermodal transfer sites
NYMTC	Freight barge project (CMAQ)
Central Oklahoma	Airport terminals
Seattle	Port landside access
San Diego	Rearrange freight and commuter rail
Southern Wisconsin	Airports, seaports, major truck terminals
Toledo	Intermodal truck/rail 3 bridges for Port of Toledo

FREIGHT PLANNING IN COLUMBUS, OHIO

ISTEA mandates that the private sector world of freight planning be integrated with the public sector world of surface transportation planning. Work underway in Columbus, Ohio is bringing together elements of public and private sector planning in a major freight study. A group of business and freight logistics experts decided to determine whether Columbus' natural advantage due to its strategic location as a freight distribution center could be enhanced. The business group joined analysts working on public sector transportation systems to initiate the Inland Port Infrastructure Improvement Study. The study's goal was to determine whether five separate freight facilities could be operated together with the efficiency of one. This effort represents a marriage of two public and private sector resources, public sector travel demand studies, including computerized forecasting networks, and private sector advanced freight logistics capabilities.

An important benefit from the Columbus study has been increased political awareness, resulting from the integration of freight logistics and information management with public sector transportation models. The mobility of goods is being documented and integrated into the public sector decision-making process.

Purpose of the Study

The purposes of the MPO-funded Inland Port Study are as follows:

- Inventory and review inland port resources and freight infrastructure assets, which include a commercial cargo airport, three intermodal rail yards, numerous trucking terminals, and a freeway/arterial roadway network;

- Project growth in regional goods movement, and its impact on the port's infrastructure assets;
- Prepare a plan of action for improving infrastructure assets; and
- Create a joint public/private oversight committee; develop a working relationship between the MPO and the private trucking industry.

The study's goal is to establish the foundations for future infrastructure improvements and development strategies to be carried out in Central Ohio. It is organized around five major issue areas:

- Economic structure of the region,
- Business logistics,
- Transportation systems,
- Intermodal facilities,
- Organization and public policy.

After examining these issue areas, the study would make recommendations for capital improvements. "The resultant infrastructure improvement recommendation will be assessed and incorporated in the TIP for future programming and funding" *(27)*. As stated:

> The objective of the study is to establish parameters for efficient and cost-effective intermodal movement of goods through the facilities that consist the Inland Port, and to address frequently asked questions such as: how important freight transportation is to the central Ohio economy, how it is currently conducted, what are the deficiencies, what are the opportunities, . . . *(28)*

The MPO's Role in Economic Development

ISTEA has allowed the MPOs to play a greater role in economic development. The Mid-Ohio Regional Planning Commission (MORPC) improves the local economy through transportation planning *(27)*. The Columbus MPO has a history of cooperating with the private sector in projects such as highway facilities planning. In 1973, the MPO collaborated with the Chamber of Commerce, Ohio DOT, and the City of Columbus on a new radial highway connecting the downtown area with the airport. As an example of a current interagency planning effort, the MPO is assisting the Central Ohio Transit Authority in planning Columbus' first light rail line. Work also is underway with the Chamber of Commerce to plan and fund a new convention center. Public/private partnership is at the heart of the effort to expand Columbus' role as a freight distribution hub.

To fill the gap left when Columbus' major air cargo carrier was moved to another city, the Chamber of Commerce, a private logistics firm, and Ohio State University conceived the idea of an international inland port. This concept brings together air, rail, and trucking terminals to support international trade. The MPO used $240,000 from an STP transfer (as provided under ISTEA) to fund an intermodal study to support the inland port project. A joint public/private Inland Port Commission was established to provide marketing and coordination of port development and operations.

Project managers feel the MPO has achieved many benefits from intermodal planning. A new economic emphasis has been introduced into regional transportation planning. The relationship between the MPO and the Chamber of Commerce has been strengthened. Relationships developed with the freight industry through regional councils have provided an ongoing exchange of information that is critical to the MPO's understanding of freight planning issues. The MPO has anchored public investment in the inland port and started the Inland Port Commission. Overall, the Inland Port is a good example of an ISTEA-created opportunity in transportation and economic development.

The Freight Advisory Roles in Columbus

MORPC is involved in freight issues through its membership in two sub-committees of the Inland Port commission the Greater Columbus Inland Port Transportation Council and the Shippers Council. The Transportation Council consists of representatives of the providers of transportation and freight transfer services. The Shippers Council comprised the shippers and receivers of freight services, including large retailers and manufacturers. Together, these groups provide the input needed by MORPC to set up the infrastructure study and to help with longer term planning functions. With the cooperation of these groups, "infrastructure deficiencies, and other institutional barriers to trade will be identified, taken into consideration in the metropolitan transportation planning process, and eventually be considered into MORPC's Transportation Improvement Program" *(27)*.

The results of the partnership are already tangible; MORPC has defined as "our Number One Priority a $25 million arterial street improvement running through the heart of our intermodal facilities" *(27)*.

Institutional Structure: The Port Commission

The study is sponsored by the Inland Port Commission. The commission, which has 40 members, includes large public- and private-sector representation. According to advisors to the commission, its goal is to expand the number of shippers and the volume of shipments transported through the inland port. Improving coordination of intermodal services is crucial. The commission's Program Review Committee provides public/private coordination to resolve problems. The commission's work includes promotion (brochures and directory production) and marketing efforts, which include identification of constituencies and future business prospects *(29)*.

Program Objectives

The overall objective is to enhance Columbus' position as a world-class distribution center by exploiting its unique location. Columbus is within 500 miles of 16 percent of the U.S.

population, and 60 percent of its gross domestic product. The underlying goal is to create 5,000 new jobs and $900 million in corporate revenues through improved transportation of freight over the next five years. New York, Chicago, and Atlanta are all within 500 miles of Columbus, but none of these major cities is as close to one another as Columbus is. The study supports the efforts of the MPO and the Inland Port Commission to enhance the role of Columbus as a freight transportation hub. This involves identification of the actions and investments the public and private sectors should undertake to develop an intermodal freight infrastructure network that functions efficiently.

One participant observed that freight transportation planning will be far more effective if viewed as part of a larger effort, such as the development of a world class distribution center, and promoting regional economic growth. He emphasizes that inclusion of shippers and carriers in the freight planning process provides better information on how congestion management and intermodal systems operate. It also facilitates participation by these groups in the oversight of system operations. He observed that a successful freight planning process depends on the participation of private sector shippers and carriers and has additional benefits, "The inclusion of shippers and carriers, especially private and for-hire trucking organizations, in planning opens the door to including them in congestion and intermodal management systems" *(29)*.

The Study Approach

The study approach consisted of five elements *(30)*. 1) First, economic conditions were analyzed. Using available projections of economic activity, it was determined that retail and service sectors would grow, while manufacturing activity would decline. These projections were transformed into forecasts of freight activity. 2) Industry logistics were studied including the pricing, environmental, and regulatory factors that motivate the timing of freight movements and modal choice. Shippers were interviewed to determine the origins and destinations of cargo. 3) Information on logistics was considered in relation to the characteristics of rail lines, terminals, warehouses, and other infrastructure elements. 4) The volume of projected traffic generated was compared to facility capacities in order to determine whether service levels were adequate. This analysis was based on interviews with facility operators who provide information on existing capacity to accommodate projected growth in freight activity. 5) Institutional structures, public policies, the regulatory environment, and business structures were factored into the analytical considerations.

Relationship to Highway Improvements and ISTEA Management Systems

The study posed several questions concerning the link between freight planning and infrastructure planning. Will physical improvements in the region's transportation improvement program (TIP) help freight transportation? When interviewed, roadway facility managers and drivers identified roadway deficiencies that delay truck operations and could lead to the relocation of truck terminals. Projects to address these deficiencies could be added to the TIP.

Chamber of Commerce and MPO personnel indicated that it was not just the importance of the technical data that was drawing people to the study; once various participants heard about international freight patterns, they talked about intersections and substandard clearances. The technical process increased political awareness of the issues of freight. In the words of one official associated with the project, "I don't know why this project is so popular, but it is."

Lessons from the Columbus Experience

In Columbus, a technical process is generating increased political awareness of freight and its role in the regional economy. The study applies new logistical and economic forecasting tools and documents the mobility of goods. The process provides a marriage between the two sectors. In some areas, such as the application of logistics techniques, public sector managers need the input from private sector colleagues. Similarly, private managers need help from public sector colleagues. For example, although private sector analysts do not know how to forecast congestion coming out of a freight facility in the year 2010, the MPO does. This may be a harbinger of a kind of partnership that will be happening soon all over the country.

FREIGHT PLANNING IN THE SAN FRANCISCO BAY AREA

There have been two themes in this synthesis concerning methodologies in freight planning—the need for analytical tools and the need for institutional commitment. The Metropolitan Transportation Commission (MTC) in Oakland stresses the importance of carefully structured participation by the users and providers of freight services in the region. This case study examines the role of the freight advisory committee in MTC's planning process for the San Francisco Bay region. The two points of focus are the use of the participatory process and the timing of the development of a quantitative forecasting process in the Bay area's planning for freight.

Purpose of the Freight Advisory Council

On February 2, 1994, the MTC Freight Advisory Council adopted a mission statement "to build consensus among public and private sector freight interests for improving the safety and efficiency of freight movement" *(31)*.

The MTC Freight Advisory Council's primary objectives are:

- To **advise** the Metropolitan Transportation Commission and other public agencies about specific freight concerns, issues and priorities,

• To **educate** each other and the broad spectrum of interests that the Council represents about issues which affect freight mobility,

• To **advocate** for specific changes to policies and practices which would improve freight mobility,

• To **participate** in MTC transportation planning and investment decision process, and

• To **identify, support** and **implement** promising and effective strategies to improve freight mobility *(31)*.

Deliberations of the Freight Advisory Council

The Freight Advisory Council working plan was divided into four categories: 1) projects that were already in the pipeline; 2) long-range planning issues; 3) short-term issues that could be worked on with other ongoing processes, and 4) issues that were beyond the scope of the MPO (Interview with MTC, March 1994).

The MPO first asked the freight community about their problems; this got the MPO involved in their issues. Next, the members of the freight community gave the MPO staff input into the congestion pricing study, and then became interested in planning for IVHS. A rapport was established with the California Trucking Association, which became interested in possible advances in weigh-in-motion studies.

Another example of this cooperative approach was a freight workshop sponsored by Alameda County. The freight community explained the importance of reliability of arrival time (particularly off peak) to policy makers. The private sector participants were able to demonstrate the difficulty of altering mode from a market perspective.

The MTC staff feels that there have been several victories. Projects have made it to the priority plan and two port projects emerged as viable candidates for funding. Two truck projects were advanced; one was a weigh-in-motion study, the other was a truck bypass of a freeway interchange. The I-580/205 Truck Bypass has been added to the TIP.

What is the value of the group? As focus shifts away from new construction to management of the existing system, understanding the nature of a significant portion of the flows of the system becomes critical. With this input, the group will develop a workable systems management perspective.

Examples of Intermodal Investment in the Bay Area

One of the most significant projects under discussion is a joint intermodal freight terminal in Oakland. Three railroads serve the port of Oakland. Union Pacific and Southern Pacific both have good access to the port, but the Santa Fe Railroad has to dray trucks for 15 miles. If it can get the three railroads to agree to work together, the Port of Oakland has the land for a joint rail yard and maritime storage. ISTEA funding has been proposed and funding for road access and grade crossing elimination can come from traditional highway sources. Congestion Mitigation and Air Quality Program (CMAQ) funds are also being considered. In one case study, freight rail needs had to be combined with light rail system needs in order to maximize chances of funding.

The study managers found that, while there was much support for the concept of using public funds to fund a joint facility used by all railroads, procuring the public funds for the separate facilities posed problems. The Freight Advisory Council has avoided areas involving controversial railroad buyout negotiations.

The Quantitative Freight Planning Process

The committee is taking a wait-and-see stance concerning the establishment of a highly quantified freight forecasting and analysis process. The upcoming congestion pricing study will have a truck component, and it is expected that the members of the Committee will be asked to contribute information in support of the process; they are willing to share data.

There is a clear understanding of how important the freight forecasting and analysis process can be. In the long term, MTC staff members agree that truck flows should be modeled in the same 1000 zone to 1000 zone process used for the rest of the system. As examples of the need for this, the process is used for:

1) preparation in handling the increase in truck flows;
2) better air quality modeling; and
3) performance evaluation of freight based on information about truck use of HOV facilities (e.g., by time of day).

MTC proposes to develop a freight forecasting model incrementally, focusing initially on the flow of trucks over the Bay Bridge, as part of a larger study of congestion pricing.

Lessons from the Bay Area

The MTC program is careful to emphasize the participation of "stakeholders" in the freight planning process. The MTC believes that total integration of freight forecasting into the rest of the surface planning process will be developed, but a better understanding of policy questions should come first; therein lies the value of the advisory group.

MPO FREIGHT PLANNING IN ALBANY, NEW YORK

Following the passage of ISTEA, the Albany, New York Capital District Transportation Committee did not wait for regulations to be issued before beginning work on a new transportation plan. The MPO did benefit in this undertaking from a history of working in close cooperation with state and local agencies, as well as having a strong background in the technical methods of transportation planning.

The freight community has much at stake with regard to the content and flavor of the management systems. The freight

> community must help the states and MPOs identify the proper performance measures that indicated the performance of the transportation system in the eyes of the freight user. Without that involvement, the focus of congestion management system will continue to be on peak hour personal travel—perhaps to the detriment of the freight community *(10)*.

It was decided early in the process that the most effective outreach approach would involve public participation at ground level: defining goals, and a vision for the region; it would be articulated through the long-range planning process. A management systems structure was created to address the technical analysis requirements associated with development of the plan, including data collection, processing, and the identification and application of appropriate analytical procedures.

The public was invited to suggest potential projects for inclusion in the TIP; the MPO received over 100 submissions. These projects were evaluated using quantitative measures or qualitative analysis as appropriate. A 10-year mobility strategy had recently been completed by the MPO, but it was decided that this document did not adequately address the long-term needs of the region. A top down decision-making approach in the development of a new long-term plan was replaced by task forces to integrate the concerns of other agencies and private citizens into the planning process. As a whole, the process emphasized attaining consensus through the task forces.

Freight Performance Measures in Albany

The work in Albany ties freight performance measures to the rest of the congestion management process:

> For freight movement, it is assumed that the Highway Capacity Manual's LOS standards apply. Freight may experience greater or lesser congestion than auto travelers, depending on the facilities used. "For freight movement, excess delay is defined as the amount of time spent at an intersection or along a highway segment in Level of Service (LOS) E and F conditions that exceed the maximum LOS "D" time." *(10)*

Thus, the congestion management approach allows the analysis of freight flows in terms compatible with non-freight flows. The MPO has identified two goals for congestion management:

1) to support growth in economic activity and to maintain quality of life by limiting excess delay encountered in the movement of people, goods, and services and
2) to shift drivers to high-occupancy modes, and shift discretionary travel to off-peak periods.

Both of these goals have positive implications for the freight community *(10)*.

MPO FREIGHT PLANNING IN WORCESTER, MASSACHUSETTS

The Worcester, Massachusetts MPO, in cooperation with the ATA Foundation, has undertaken a significant study of freight needs. Work done in support of Worcester MPO's development of its Transportation Improvement Plan provides a good example of the potential for integration of freight into the urban transportation planning process *(32)*.

ISTEA explicitly recognizes the importance of freight movement in the transportation system. In response, the Worcester MPO requested assistance from the ATA Foundation in developing information on freight flows that could be used for planning purposes. Information requested included major routes of travel, impediments to travel, origins/destinations, intermodal operations, and companies' future plans.

The Worcester Truck Survey

To obtain the information that was requested by the MPO, a survey of motor carriers in the Worcester area was undertaken. The survey was distributed to 85 trucking operations in the Worcester area. Results from the 20 respondents are summarized below.

- The locations and types of travel impediments were identified and mapped. The most common problems reported were poor ramp design, bridge height and weight limitations, poor bridge conditions, traffic running red lights, restriction of use due to weather conditions, congestion, and poor road conditions.
- An origin/destination matrix was constructed for regional commodity flows.
- An inventory of intermodal facilities was assembled, and the following usage patterns were reported: 44 percent use intermodal movements involving rail and 28 percent use rail operations at least once per day.
- No peak travel times were identified for trucks. Truck traffic appeared to be fairly constant throughout the day. Lack of parking represented a problem for pick-ups and deliveries.
- Nearly 70 percent expressed plans to expand their operations; no contractions were contemplated. Over 30 percent of rail users plan to increase their use of rail, none plan to decrease rail use *(32)*.

A database, statistical analyses, and reports were provided to the MPO, which included this information in the highway section of the Transportation Improvement Program. The public participation process for the TIP included circulation of the draft document and public hearings prior to transmittal to the state. The MPO has requested future studies for continued use in planning.

MPO FREIGHT PLANNING IN PITTSBURGH

The Southwestern Pennsylvania Regional Planning Commission has taken a cautious approach to integrating goods movement into the planning process in order to build an understanding of the real policy issues involved. This is similar to the Bay Area case study presented above *(33)*.

In southwest Pennsylvania, separate rail, truck, and air task forces have been established. Initially, they are looking at modest-scale problems that are project-oriented. Some of the projects considered have been included in the region's TIP. It is essential that those with an interest in the transportation system participate in the process because the task force will play an even greater role in the future. The MPOs are inexperienced in freight planning and need help from the private sector. Short-term expectations should be modest and the process will also have to make allowances for both vested and proprietary interests.

The MPOs have the decision-making role once denied to government in the areas of planning comprehensive, regional, long-range transportation and air quality control. The process is participatory and subject to fiscal constraints and rigid deadlines. Although some wonder if the task is possible, it can work if a number of conditions are met. Those involved must have the conviction that ISTEA has staying power. Education, understanding, time, and patience are required of both public and private sector participants. Pittsburgh's conservative approach to the creation of a freight advisory board first, with quantification to follow later, is an example of such a "patient" strategy.

MPO FREIGHT PLANNING IN PHILADELPHIA

The Delaware Valley Regional Planning Commission (DVRPC) has created a Goods Movement Task Force. One of the members of that task force summarized their progress:

> DVRPC's planning process is something of a case study for the national process in goods movement planning. For 25 years we have provided effective passenger transportation planning, but have lacked a goods movement strategy. Our new 2020 long range plan will incorporate goods movement. By 1995 we will have a strategic goods movement plan *(34)*.

The commission asked the task force to determine the adequacy of existing terminal capacity in the Philadelphia area, as part of a larger study to determine whether the Philadelphia naval base should be converted to a terminal facility. The task force also has developed a Freight Program Game Plan for Philadelphia, consisting of the following sequential elements:

1) Refine plan,
2) Disseminate information on freight needs,
3) Transportation improvement program,
4) Implement improvements. *(35)*

The MPO in Philadelphia, like the one in Columbus, is becoming actively involved in improving conditions that affect freight transportation. The actions of these MPOs embody ISTEA's goal to provide for private sector participation in metropolitan transportation planning *(35)*.

MPO FREIGHT PLANNING IN BOSTON

The Central Transportation Planning Staff (CTPS), which supports the Boston area MPO, has hired a freight planning expert to increase their freight capability. The regional/statewide project manager for development of an intermodal management system defines the IMS as a "system of software and data to support intermodal strategic decision making" (Interview with CTPS, April 1994). He believes this information would be used in the analysis of the following issues:

- Doublestacking,
- Trade off/mode split (as in diversion to rail),
- Regional airport freight issues, and
- Landside access issues.

In addition, the role of freight in the analysis of congestion and railroad abandonment will be a major consideration in the development of the Massachusetts IMS. The CTPS team has assembled an exceptional literature search and bibliography to aid MPOs in the analysis of freight issues, and is working on a handbook for IMS preparation.

A major concern of the Massachusetts team was where the IMS process ends. Some thought that the IMS created a program of projects for consideration in the capital prioritization process. This suggests that the IMS would prioritize each of these projects at the appropriate stage of the planning process. The alternative interpretation sees the IMS as a systems-level policy analysis tool, which must leave project development activity to the corridor planning process and the project level planning process.

CHAPTER SIX

SOURCES OF DATA

As state and local decision makers approach the task of integrating freight concerns into their established surface transportation planning process, their overriding concern was revealed in the interviews—fear of the cost and the difficulty of obtaining data to support the process. This chapter, and the material presented in Appendices A and B, reviews the major sources of data available to state and MPO decision makers.

THE DATABASE DESCRIPTIONS, FROM NCHRP 8-30

In its review of major data sources, NCHRP 8-30 created a summary of modal coverage of each separate source, reproduced here as Figure 7. That chart summarizes the modal coverage of each of the data sources reviewed in the study. It is interesting to note that only four sources exist that cover both truck and rail modes for all commodities; two of these are public and two are private. The National Transportation Statistics Annual Report, while covering all modes, does not provide the kind of origin-destination data examined here.

Of the three remaining sources, the most important source did not become available until the end of 1995. The 1993 Commodity Flow Survey will be of great value to state and MPO freight planners when it is fully operational in 1996; it is described in two fact sheets attached to the end of this chapter.

Therefore, the planner looking for workable origin-destination data about trucks and rail has only two sources, and both of these are private. This section briefly summarizes the most up-to-date information available for 1) the Transearch Database of Reebie Associates, and 2) the DRI/McGraw-Hill Database, as most recently organized for the New Jersey Goods Movement Project. In addition to these sources, planners interested in the details

	Modal Coverage							
Data Base	A	T	R	IW	OW	All	Other	Intermodal
1993 Commodity Flow Survey (CFS)	X	X	X	X	X		Pipeline, parcel	Container Weight
TRANSEARCH (Reebie)	X	X	X	X	X			No. of Containers
Freight Transportation and Logistics Service (DRI/MH)		X	X	X				
U.S. Imports/Exports of Merchandise on CD-ROM	X				X	X		Container weight (vessel)
U.S. Exports by State of Origin (Census)	X				X	X		Container weight (vessel)
U.S. Exports by State of Origin (MISER)	X				X	X		Container weight (vessel)
U.S. Exports and Imports Transshipped via Canadian Ports							Surface total	
The Directory of U.S. Importers/Exporters							List of modes	
National Transportation Statistics, Annual Report	X	X	X	X	X		Pipeline, parcel	
U.S. Air Freight Origin Traffic Statistics (Colography)	X							
U.S. Air Carrier Traffic and Capacity (T-100) Data	X							
FAA Airport Activity Statistics (T-3)	X							
Worldwide (North American) Airport Traffic Report (ACI)	X							
ICC Carload Waybill Sample *			X					No. of trailers/containers
Freight Commodity Statistics (AAR)			X					
North American Trucking Survey (NATS)		X						
LTL Commodity and Market Flow Database		X						Identified
Truck Inventory and Use Survey (TIUS)		X						
Nationwide Truck Activity and Commodity Survey (NTACS)		X						
Port Import/Export Reporting Service (PIERS)					X			Container no., size and volume
U.S. Waterborne General and Intransit Shipments					X			
Waterborne Commerce and Vessel Statistics (ACOE) *					X			
Ship Movements Database (Lloyd's)					X			
World Sea Trade Service (DRI/MH)					X			Containerloads
Lock Performance Monitoring System (PMS) *				X				
St. Lawrence Seaway Traffic Reports				X				Container weight
Lake Carriers' Association Annual Report				X				
Exports from Manufacturing Establishments						X		
Fresh Fruit and Vegetable Shipments	X	X	X		X	X		Piggyback identified
Fresh Fruit and Vegetable Arrival Totals for 23 Cities	X	X	X		X			
Quarterly Coal Report		X	X	X	X	X	Slurry	
Natural Gas Monthly					X		Pipeline	
Natural Gas Annual					X		Pipeline	
Petroleum Supply Monthly				X	X		Pipeline	
Grain Transportation Report			X	X	X			

FIGURE 7 Modal coverage of major data sources *(6)*.

of freight shipments at international ports can use the PIERS database, as processed by the Journal of Commerce.

ICC WAYBILL SAMPLES

The Interstate Commerce Commission, in cooperation with the Association of American Railroads (AAR), produces a stratified sample of rail carload waybills containing data on traffic commodity, revenue, and routing characteristic. This is based on a sample of actual waybills provided by terminating railroads that carry over 4,500 carloads per year, or 5 percent of any state's traffic. The full waybill files can be used by states but not by the private sector. The public use tape is provided by the AAR. In addition, ALK Associates produces an annual summary with density maps by commodity and car type, commodity carload volumes, and level inbound and outbound volumes by commodity.

The Federal Railroad Administration has offered to help states get access to data in a form adaptable to the transportation planning process. To help planners understand the potential of this data source, the Federal Railroad Administration is preparing a synthesized example of the data available to states from the confidential waybill files. This example contains artificial values substituted in cells where publication of data would have violated the confidentiality of sources.

THE TRANSEARCH DATABASE

Currently the Transearch database is being used by DOTs in Wisconsin, Florida, Ohio, California, Louisiana, Michigan, and Nevada. It is being used by MPOs in Portland, Albany, Rochester, New York, and Rochester, Minnesota and is the private data source most widely used by state and local planners. As shown in Table 18, the Transearch database merges data from both publicly available and private (proprietary) sources. The process by which the Transearch database is developed is summarized in Figure 8; it merges both methods isolated in earlier NCHRP studies *(5)*. The process uses economic modeling (including the use of input-output modeling) and empirical observations of actual freight flows. A key element of this multi-disciplined process is its use of the "Motor Carrier Data Exchange," a cooperative effort of the consultant and private trucking organizations. This suggests that the field has developed considerably since the 1983 NCHRP study, which classified most freight forecasting approaches as either a "structured approach" or a "direct forecasting approach." The present Transearch database combines both economic simulation and empirical observation.

"Reports" Generated from the Transearch Database

The consumer (including state and local planning agencies) can buy this data in two forms. The unformatted form can be used directly on the purchaser's spreadsheet (Table 19 demonstrates this). The series of preset formats is summarized below.

The Traffic Lane Flow Report displays commodity movement between origin and destination districts. Seven modes are shown by tons, and a summary at the 2-digit SPCC level is provided. For example, from BEA 18, which includes Philadelphia, to BEA Zone 55, which includes Memphis, 136,724 tons of freight are carried in toto. Of these 36,568 are chemicals. Of those chemicals, 18,630 tons go by rail, and none of those are intermodal. On the highway, 6,322 tons were carried by private truck, 507 tons were carried by a less-than-truckload truck, and 11,109 tons were carried by truckload truck. None were carried by air, and none by water.

The Market Commodity Report starts with a given origin BEA and presents for each commodity the destinations and the modes to those specific destinations. This organization of the data is particularly helpful in understanding what a given area within a state produces and how it leaves the state.

The Market Profile Report defines the level of freight movement into or out of a single market area. For a specific BEA, the Market Profile Report describes all the flows to that market, by origin, by commodity, and by mode. This is similar to the Commodity Report above, which stratifies its data first by commodity and then by destination. The Market Profile Report stratifies first by destination and then by commodity.

The Summary Terminal Area Report shows all destination zones for outbound tonnage, for a specified single origin BEA zone, with total tons and the two most important commodities for that O-D pair. This looks like a three-

TABLE 18
SOURCES OF DATA IN TRANSEARCH DATABASE *(36)*

Domestic Traffic Flow	Primary Production and Shipments
Annual ICC railroad waybill sample	Census/Annual survey of manufacturers
Proprietary motor carrier shipment information	Annual Motor Carrier Industry Financial and Operating Statistics
Annual Federal Aviation Administration Airport activity statistics	Annual Railroad Freight Commodity Statistics
Import/export trend statistics and inland traffic	Federal Reserve Board Industrial Production Indices
Annual Department of Energy coal movement statistics	Survey of Current Business
Annual Department of Agriculture Produce movement data	Trade Association Production and Shipment Reports
Census of Transportation—Commodity Movement Survey	Annual County Employment and Population Data
	State economic output by industry
	Inter-Industry Trade patterns (input output table)

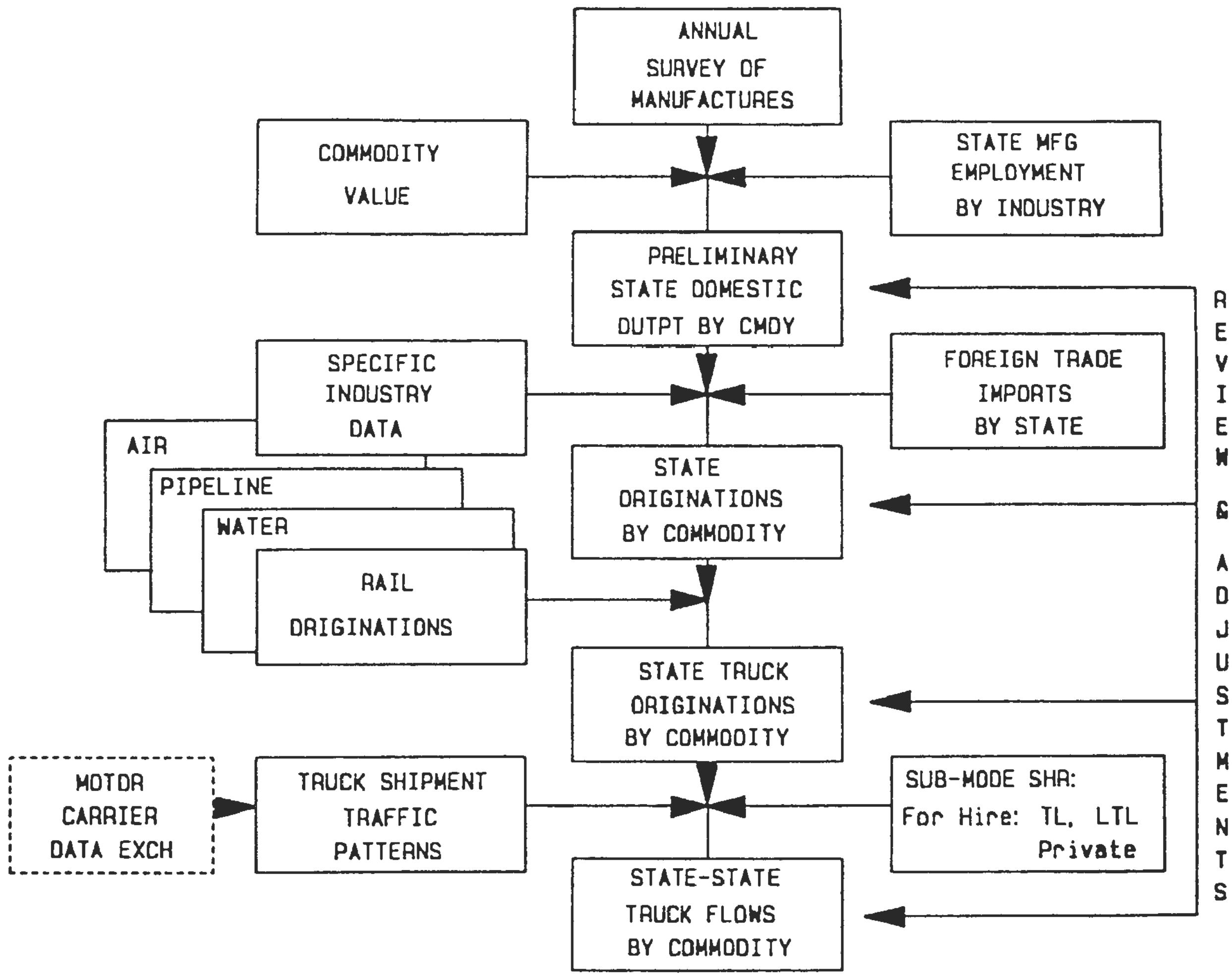

FIGURE 8 Development of Transearch state—state flows *(36)*.

TABLE 19

AN EXAMPLE OF TRANSEARCH DATA *(37)*

Aggregated Data for Lumber Shipped from Duluth by Mode of Transport Data File MNTLFT.PRN (1990)

BEA Destination	Total	Rail Carload	Rail Intermodal	Truck for Hire	Truck LTL	Truck Private	Air	Water
Total tons	710,186	4,345	0	167,620	798	527,361	0	10,062
Lacrosse, WI	1,753	0	0	490	0	1,263	0	0
Duluth, MN	298,391	0	0	65,689	238	22,402	0	10,062
Minneapolis/St. Paul	384,200	4,345	0	93,681	560	285,614	0	0
Rochester, MN	8,643	0	0	2,770	0	5,873	0	0
Sioux Falls, SD	4,398	0	0	1,402	0	2,996	0	0
Fargo/Moorehead	8,062	0	0	2,152	0	5,910	0	0
Grand Forks, ND	4,739	0	0	1,436	0	3,303	0	0

dimensional trip table, with the third dimension being the two commodities *(36)*.

THE DRI/McGRAW-HILL DATABASE

The DRI/McGraw-Hill database is being used by local planners in Los Angeles; Portland, Oregon; and the state of New Jersey. The New Jersey program best illustrates the capabilities of this database. The New Jersey Goods Movement Project has four goals:

- To help NJDOT develop a comprehensive perspective of goods flows in, out, and through the state to support policy making and strategic evaluation of the state's fourth largest industry

Part: Total	Orig: NJ	Mode: Total	Conc: Total	

Comm	Total	New England	South Coast	Midwest	US Other
-Total	190,726.0	21,191.3	13,947.8	5,769.0	27,464.1
+ 01-Farm Product	1,888.8	52.1	259.9	236.0	343.2
+ 13-Crude Petrol	17,778.2	230.4	251.7	0.1	10,060.2
+ 20-Food and Kin	13,557.8	1,161.5	2,008.2	831.0	2,036.9
+ 23-Apparel	242.3	16.7	17.7	12.8	36.6
+ 24-Lumber and W	849.7	45.2	90.5	72.5	58.5
+ 25-Furniture an	361.0	36.8	32.4	31.2	46.8
- 26-Pulp and Pap	3,959.1	335.8	375.6	410.2	328.1
+ 261-Pulp or pu	103.4	20.1	2.1	1.4	8.4
+ 262-Paper	1,551.3	61.8	151.3	258.6	166.5
+ 263-Fiberboard	115.8	20.3	15.7	22.3	5.0
- 264-Converted	956.7	126.4	127.5	77.5	58.1
2642-Envelope	0.8	0.0	0.1	0.1	0.0
2643-Paper ba	62.6	7.1	7.9	5.5	6.4
2644-Wallpape	3.5	0.1	0.5	0.1	0.6
2645-Die cut	59.7	7.7	6.4	4.2	0.2
2646-Pressed	2.7	0.0	0.1	0.2	0.2
2647-Sanitary	107.7	[illegible]	[illegible]	[illegible]	[illegible]
2649-Miscella	719.8	[illegible]	[illegible]	[illegible]	[illegible]
+ 265-Containers	984.8	[illegible]	[illegible]	[illegible]	[illegible]
+ 266-Building p	247.2	[illegible]	[illegible]	[illegible]	[illegible]
+ 27-Printed Matt	1,037.4	[illegible]	[illegible]	[illegible]	[illegible]

This screen depicts two, three and four-digit STCC flows originating in New Jersey and destined for hinterland regions

Part: Total	Comm: Total	Orig: NJ	Dest: US Other	

Mode	Total	N Americas	Exp Water	Imp Water	Canada
-Total	27,464.1	4,194.9	1,657.6	21,611.7	NA
- Rail	12,305.1	487.5	218.7	11,598.9	NA
Railcar	11,753.4	355.9	91.9	11,305.6	NA
RailIModal	551.7	131.6	126.9	293.3	NA
- Truck	15,159.0	3,707.4	1,438.8	10,012.8	NA
ForHireTL	11,209.9	1,717.6	1,314.8	8,177.6	NA
LTL	3,286.1	1,326.8	124.1	1,835.2	NA
PrivateTL	663.0	663.0	NA	NA	NA
Air	31.5	31.5	NA	NA	NA
Water Other	NA	NA	NA	NA	NA

This screen depicts goods originating in New Jersey and destined for the region west of the Mississippi, and include:

- **North American** flows are domestic freight
- **Exp Water** are New Jersey cargoes which leave the U.S. through gulf and west coast ports
- **Imp Water** are goods entering New Jersey ports destined for the western US

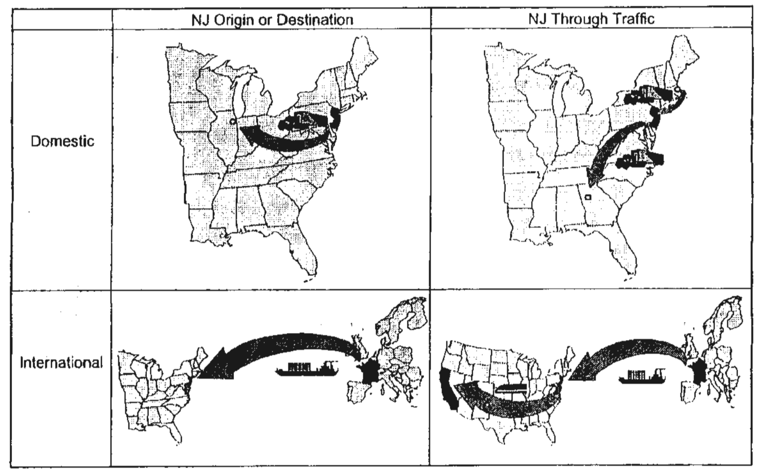

FIGURE 9 Examples of data outputs from NJDOT project *(39)*.

- To serve as a critical resource to the development of an intermodal strategy plan and intermodal management system, part of the ISTEA federal requirements
- To provide NJDOT staff with a readily available retrieval and analysis tool to respond to inquiries and initiatives and to monitor market changes and trends
- To support current and anticipated corridor capacity studies *(38)*.

The database was designed to provide freight flow estimates at the county-to-county level for New Jersey counties and New York City area counties, Northern Pennsylvania and Delaware. It includes rail, truck, water, air, and submode (truck load, less than truck load, for hire, and rail intermodal) at the four-digit SPCC code level.

The database was assembled from DRI's FreightScan, ICC Confidential Waybill samples, Department of Commerce 305/705 Ocean trade data, Journal of Commerce PIERS data, U.S.-Canada gateway, and intransit flow and statistics. In addition, 1,000 major shippers in New Jersey were surveyed for sub-modal splits and verification of other data. Because data from disparate sample sizes was being assembled together, the challenge was "to develop and implement a sound methodology to convert from state, BEA, or MAS to produce credible county level freight origins and destinations—conversely, other data required the conversion from zip code level to county level" *(38)*.

The New Jersey Goods Movement Information System will be used as the basis for freight forecasting, which can be used for MPO planning. The managers believe the system will help facility operators monitor and assess the performance of key intermodal facilities. The data will be used to create trip tables by zone and assign the trucks to corridors as part of a broader effort to forecast the capacity needs of those corridors.

The New Jersey project data tables, reproduced from the computer screens, are found in Figure 9.

CHAPTER SEVEN

CONCLUSIONS

The case studies and examples selected for this synthesis show that there is no definitive model to use when analyzing the integration of the freight transportation planning process. Each state develops its own approach. The variety of approaches can be grouped by issue into four categories: institutional arrangements, procedures used, tools for freight forecasting, and resolution of issues.

Because resolving freight issues requires input from the freight community, and because their valuable contributions have not been given ample hearing, the creation of a freight advisory council or committee by the state or MPO is vital to the surface transportation planning process. This is exactly what was done by Oakland's Metropolitan Transportation Commission (MTC).

The Mid-Ohio Regional Planning Commission, by serving as a member organzation of the Greater Columbus Inland Port Commission, gained valuable citizen input. From this group of civic leaders came the most far-reaching technical study observed in this survey, developed in tandem with members of the Columbus Chamber of Commerce.

One of the most effective freight advisory councils in the country is the Intermodal Transportation Council in Oregon. It is an independent, issue-based advocacy group (its members were not selected by the state DOT) whose work ranges from giving input into the design of the state intermodal system to taking a position against the state's proposed taxation procedures.

Until recently, there was no significant work underway to establish mechanisms to monitor and evaluate freight flows in a way that could be integrated into the rest of the surface transportation planning process. Today, virtually all the states are trying to determine the best way to proceed with their congestion management systems and intermodal management systems. What is key to these monitoring and strategy evaluation programs is the development of performance measures. First, systemwide measures, then freight performance measures within the total package of standards and performance measures.

The case studies show that freight measures are a subset of a larger debate about the appropriate method of congestion management system (CMS) observation. Regulations establishing that system call for both the observation of the monitoring and evaluation of roadway congestion and the monitoring and evaluation of systemwide, user-experienced mobility. The slow development of freight-based performance measure is due to the CMS debate between roadway-oriented indices and user-based descriptions of mobility.

The case studies also suggest that two modes of observation are being examined to develop performance evaluation for inclusion in the intermodal system (IMS). The first observes performance of the system (i.e., cost per ton shipped, safety per ton shipped, timing of flows from door to door, etc.). The other is a more facility-based approach. Instead of focusing on total efficiency of goods movement for the state, a "deficiency analysis" notes such information as truck difficulties experienced getting out of facilities and truck delays at drawbridges. There is a need for both levels of analysis, micro and macro.

The on-going NCHRP 8-30 project has provided a review of two approaches to freight forecasting. In one view, causal economic forces are modeled in a structured manner, and from this analysis comes a prediction of future freight flows in a corridor. In the second view, data about actual flows on the highway (and rail) are observed, and from these observations estimates are made about future changes in those flows. The authors of NCHRP 8-30 have drawn some important conclusions about the difficulty for states and MPOs in carrying out the economically based process on their own. The individual states, through the NCHRP 8-30 surveys, are reporting better progress from a process based on the examination of existing flows.

While no complete "guidebook" exists to help the local planners through a full process of economic simulation, these services are currently provided by a small number of specialized consultant firms. Various public clients, such as the state of New Jersey and the Port of Portland, Oregon are currently seeking information about the future of international freight flows that would not be available from the study of existing traffic patterns. Thus, before sweeping generalizations are made about the right and the wrong approach to freight forecasting, the real questions are "What are the policy issues being examined?" and "What are the data needs to support those policy questions?"

Various efforts reported in this synthesis are designed to bridge the gap between the two forecasting approaches. At the academic level, Iowa State University is developing a procedure based not on simulation of economic causes, but on the availability of data to support the analysis. At the practicing level, the Wisconsin DOT's freight forecasting system built a carefully calculated future of expected change in land use, extrapolated commodity flows based on that predicted description of economic growth, and then used human judgment to apportion the division of flows over the proposed modes.

The efforts at integrating freight planning into the full planning process are so new that there are no consistent patterns of conflict resolution reported. The San Francisco Bay Area MTC has gone farther than other MPOs in the integration of freight concerns into the process of capital prioritization.

Other than the MTC experience, most of the case study examples have not arrived at the conflict resolution stage. The incorporation of the Columbus study's recommended road improvements moved to the Transportation Inprovement Plan (TIP) process with little need for conflict resolution. The values expressed by the freight-oriented ITC in Oregon have caused concern among transit, pedestrians, and bicycle advocates. In this case, the state is formally appointing advocates of this viewpoint into a "passenger oriented" advisory group which generally parallels the functions of the ITC. This structure attempts to bring to the table a wide variety of values, in anticipation of the later need for conflict resolution.

It is clear from the synthesis process that states and MPOs are currently pursuing two separate paths to achieve the vision of freight planning, as encouraged in the intermodal management system. On the one hand, ISTEA legislation calls for a systemwide evaluation of the success or failure of the full system's ability to provide for the mobility of goods. This implies examination of the door-to-door performance of the system, including all of its component modes. Most states are not prepared to undertake this kind of "macro" analysis, but many states have chosen to analyze the individual points of strategic interconnection within their full systems, and to make observations about the "deficiencies" associated with their connections to the rest of the system.

Assessment of both the "macro" and "micro" levels of performance is being pursued at the state level. However, guidance on the methods to bring these two levels of observation together into one meaningful planning process is lacking. Further research is needed. First, what are the real data needs of the decision maker with respect to the application of "deficiency analysis" to the connections at specific points of intermodal connection? Second, what are the real data needs of the decision maker to evaluate the efficiency of the operations of full systems?

A review of the literature shows that improvements to data describing the flow of commodities are being analyzed in several research forums. It is clear that there is a need for more research in the area of the immediate needs of the public practitioner. With the release of the 1993 Commodity Flow Survey, and the development by FHWA of additional origin-destination data by commodity, the practicing planner will have more freight-oriented data available for use than ever before. But what kind of information will really be needed and really be used by the practitioner in the field?—this question itself awaits analysis and a conclusion.

The general need is for immediate, practical, non-academic, and non-theoretical help for practitioners trying to integrate freight planning concerns into the established surface transportation planning process. Five opportunities were identified:-

- Summarize the freight-oriented policy issues identified so far by the states and MPOs.
- Examine the extent to which existing planning procedures and data sources have or have not been adequate to support the analysis of the policy issues identified above.
- Develop revised planning procedures and data sources that will be most appropriate for the initial phase-in period that will be required to bring the state of the practice of freight-oriented planning up to the current level of vehicle-oriented planning.
- Identify the gaps in the training of state and MPO planners and decision makers concerning the incorporation of freight issues into the surface transportation planning process.
- Explore the area of application of newly available data resources. The concept of appropriate "research" must not be narrowly interpreted to refer only to the development of future tools and data sources. There is a great need to distribute existing data to the practitioners in the field, and existing tools and procedures shared among a wider audience.

Commodity flows need to get into the hands of state and local planners as soon as possible. The Intermodal Division of the FHWA has recognized the urgency and is in the process of developing county-by-county commodity trip tables designed for use by both state and local planners. To parallel this important effort, research could develop prototypical applications for this data, from the perspective of state and local practitioners. Researching the realistic capabilities of the users to incorporate the new data resources could prove to be a boon to the process of phasing-in the implementation of meaningful freight planning in the public sector.

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LIST OF ACRONYMS

ADT	Average Daily Traffic
BEA	Business Economic Area
CAAA	Clean Air Act Amendments
CALFED	California Freight Energy Demand
CFS	Commodity Flow Survey
CMAQ	Congestion Mitigation and Air Quality Program
CMP	Congestion Management Program (California)
CMS	Congestion Management System
COFC	Containers on Flat Car
CTP	California Transportation Plan
CTPS	Central Transportation Planning Staff (Massachusetts)
DOT	Department of Transportation
DVRPC	Delaware Valley Regional Planning Commission
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
GSP	Gross State Product
ICC	Interstate Commerce Commission
IMS	Intermodal Management System
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITMS	Intermodal Transportation Management System
LOS	Level of Service
MORPC	Mid-Ohio Regional Planning Commission
MPO	Metropolitan Planning Organization
MRIO	Multi-Regional Input-Output
MTC	Metropolitan Transportation Commission
NAAQS	National Ambient Air Quality Standards
NAFTA	North American Free Trade Agreement
O-D	Origin-Destination
PIERS	Port Import Export Reporting Service
PUC	Public Utilities Commission
RDBMS	Relational Database Management System
SOV	Single Occupancy Vehicle
TIP	Transportation Improvement Plan
TOFC	Trailer on Flat Car
UPS	United Parcel Service
V/C	Volume to Capacity
VMT	Vehicle Miles of Travel

APPENDIX A

Description of the 1993 Commodity Flow Survey

UNITED STATES DEPARTMENT OF COMMERCE
Bureau of the Census
Washington, D.C. 20233

1993 COMMODITY FLOW SURVEY

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. It continues statistics collected in the Commodity Transportation Survey from 1963 through 1977, and includes major improvements in methodology, sample size and scope. This CFS is planned to become a regular part of the quinquennial Economic Censuses. The 1993 CFS is being conducted by the Bureau of the Census with additional funding and support from the U.S. Department of Transportation.

Sample: Approximately 200,000 domestic establishments were selected randomly from a universe of about 900,000 establishments engaged in mining, manufacturing, wholesale, and selected retail and service activities. Also included were auxiliary locations (warehouses) of multi-establishment companies. The CFS does not cover farms, forestry, fisheries, governments, households, foreign establishments, and most establishments in retail and services. The sampling frame was the Standard Statistical Establishment List (SSEL) of business establishments with paid employees, maintained by the Bureau of the Census.

Survey Methodology: Each selected establishment will report a sample of about 30 of their outbound shipments for a two week period in each of the four calendar quarters of 1993. This will produce a total sample of 20 to 24 million shipments. Establishments' reporting periods will be equally distributed over the 13 weeks in each quarter to minimize seasonal bias. The sample of shipments will be expanded to industry aggregates based on establishment level results from the 1992 Economic Censuses.

Data Collected: For each sampled shipment the following information will be collected: zip code of origin and destination, 5-digit Standard Transportation Commodity Classification (STCC) code, weight, value, and modes of transport. Information on whether the shipment was containerized, a hazardous material, or an export will also be obtained. The port of exit, export mode of transport, and the city and country of destination will be collected for export shipments.

Data Products: Information from the CFS will be available in printed reports and electronic form. Data products will be released beginning in 1995. Planned tables include tons, miles, ton-miles, and value by mode of transportation (including intermodal combinations), shipment distance and shipment size. Geographic information will be available by State and by National Transportation Analysis Region (NTAR) of origin and destination. NTARs are 89 groups of BEA Economic Areas designated by the U.S. DOT. Publication of hazmat, containerization, and export information will depend on actual responses, as the CFS sample was not designed to produce publication quality results at subnational levels for these items. Some detail may be aggregated to protect confidentiality of responses, or data quality levels.

Supplemental Data: During the fourth quarter, a subsample of establishments will be asked for information on their transportation equipment and access to shipping facilities. This information will be available at the U.S. level.

For Further Information: Please contact the Commodity Flow Survey Branch, Census Bureau, (301) 763-1923.

April 1993

UNITED STATES DEPARTMENT OF COMMERCE
Bureau of the Census
Washington, DC 20233-0001

April 1993

1993 Commodity Flow Survey (CFS) Publication Plans

The Census Bureau will publish the results of the 1993 CFS beginning in 1995. Publication plans have not been finalized at this time. We will provide data by three major geographic categories: U.S. level, state, and National Transportation Analysis Regions (NTAR). The amount of detail provided at each level will depend in part upon the quality of the tabulated results from the 1993 CFS (in order to meet Census Bureau publication standards) as well as the need for disclosure and confidentiality protection.

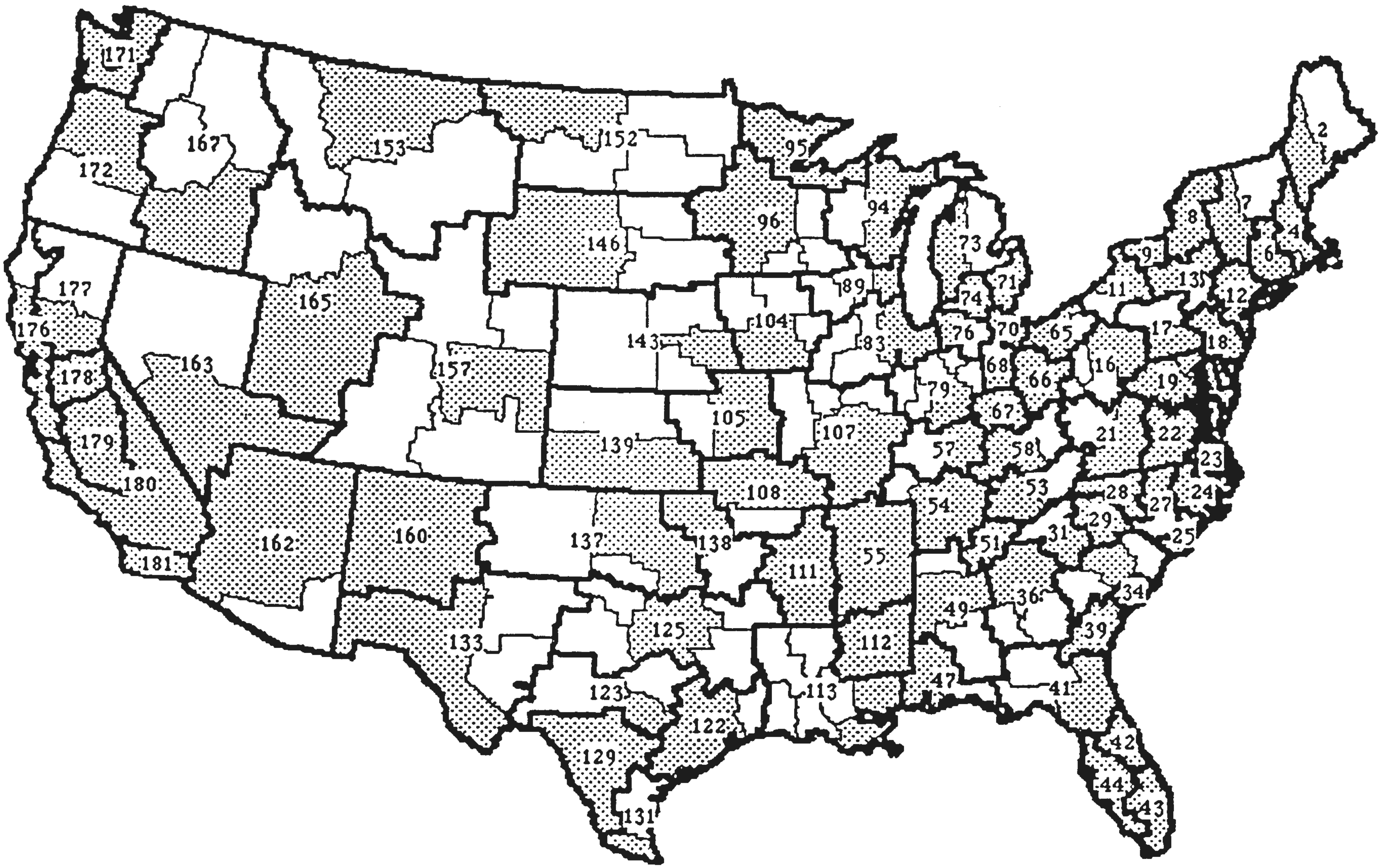
We plan on using the results of the Economic Censuses to ensure the data from the CFS sample are accurately adjusted to represent the defined universe of shipments.

The U.S., state, and NTAR level reports will be organized both by types of commodities shipped, using Standard Transportation Commodity Classification (STCC) codes, and as aggregates by major groups such as manufacturing, wholesale, etc. Shipment characteristics provided will include tons, ton-miles, domestic origin and destination, and value. We will also publish data related to the shipment of hazardous materials, the use of containerization, and export shipments.

Publication tables at the state and NTAR level will include tables describing data within states and NTAR's as well as state to state data and NTAR to NTAR data. Shipment characteristics provided for these tables will be the same as those listed for the U.S., state, and NTAR level reports.

The CFS program includes a supplemental questionnaire which will quantify the use and availability of transportation facilities and equipment. The supplemental questionnaire will be mailed to a subsample of the CFS sample in the fourth quarter only. Results from this questionnaire will be published only at the national level.

Our publication plans include tables on CD ROM, which will provide additional detail beyond the printed reports. We also anticipate a range of special tables at the U.S. level focusing on such issues as: modal combinations, hazardous materials shipped, and export shipments.



Shaded areas are NTAR cores.

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THE TRANSPORTATION RESEARCH BOARD is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. It evolved in 1974 from the Highway Research Board, which was established in 1920. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 400 committees, task forces, and panels composed of more than 4,000 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without compensation. The program is supported by state transportation and highway departments, the modal administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

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

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

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

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Bruce Alberts and Dr. William A. Wulf are chairman and interim vice chairman, respectively, of the National Research Council.

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

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