

# Integration of Intermodal and Multimodal Considerations into the Planning Process

Lance A. Neumann, *Cambridge Systematics, Inc.*

Over the years, numerous conferences and research agendas have focused on creating a truly multimodal transportation system planning and decision-making process. The issue is once again being examined at a time when it might be argued that more progress has been made toward achieving the objective in the past 5 years than in the previous 20 years. However, it is also believed that we are moving into an era in which the imperative for continued progress has never been stronger and that the risk of business as usual has never been greater. Although the Transportation Equality Act for the 21st Century (TEA-21) significantly increased the funding that is available for surface transportation, needs still outstrip resources. Moreover, global economic trends and the need to respond to a range of economic, social, and environmental objectives create strong incentives to find the right balance and mix of modes to serve a wide variety of market segments. However, a range of institutional, financial, policy, and regulatory barriers remain. Gaps in data and limitations of analytic methods constrain our ability to define and evaluate system choices. The challenge is to define a research agenda that can reduce these constraints and that can accelerate the progress that has been observed over the past several years.

A number of conferences in the early days of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) served as forums for lively debates on the definitions of intermodal and multimodal. To preempt

a return to that discussion, a consensus understanding of the terms is offered here before discussing why we would like to promote them. The transportation system that serves all passenger and freight trips and that connects to international origins and destinations involves all surface and air modes (highway, transit, rail, air, marine, pipeline, and nonmotorized). Some might argue that we need to add telecommunications and information technology to the list as either a substitute or an enabling technology. In some areas, or for some markets, different modes provide competitive service. In other cases, they are complementary. For many trips, few real modal options exist. A truly multimodal planning process provides a forum to consider all modal options for freight as well as for passenger trips. Furthermore, such a process should not unduly constrain our ability to invest in the particular mix of modal options that will best serve different market segments and geographical areas while reflecting diverse economic, social, and environmental objectives.

Within this multimodal planning process as defined, a particular class of solutions known as intermodal solutions, which has received too little attention until recently, can serve freight and passenger trips with a combination of modes. In the past, mode-specific institutional arrangements, regulation, and financing restricted or at least discouraged the consideration of intermodal options. More recently, deregulation, global economic forces, and a logistics and information-sys-

tem revolution have led to dramatic increases in productivity and to great examples of creative and seamless intermodal freight transportation in the private sector. ISTEA has encouraged the public sector to promote similar solutions for both passenger and freight movements.

There are a number of issues that drive the logic for a multimodal system's view of transportation networks and service and seamless intermodal connections as one critical component of that system. These issues are

- *Serving the total trip*—Freight and passenger users of the system are concerned about the quality, safety, cost, and reliability of the overall trip from origin to destination. Trips cut across modes, jurisdictions, and borders, and terminal and transfer points are key system components for improving intermodal connections.

- *Serving different market segments*—On the passenger side, trip purpose, household characteristics, and other demographics define distinct market segments with different sensitivity to various transportation system characteristics and different modal options. On the freight side, very distinct market segments exist as well, depending on the industry and its total logistic costs and strategy and the nature of the commodity (e.g., weight, value, time sensitivity). In both cases, different modes or combination of modes will often best serve different market segments.

- *Responding to diverse objectives*—Although market and economic objectives drive much of the freight transportation business and influence passenger travel as well, the transportation system must support a wide range of objectives that reflect equity, environmental quality, land use, and community livability. Balancing these objectives often requires balancing the mix of modes that are used to respond to different transportation needs.

- *Allocating capacity and service for shared facilities and operations*—The highway system serves a significant portion of passenger (auto and transit) and freight trips. Highway rail-grade crossings create safety and service issues, and bridge clearances often constrain double-stack rail options. Rail lines often serve both freight and passenger movements, and high-speed rail passenger service creates particular challenges. A significant portion of airfreight moves on passenger planes, and intermodal terminals often mix passenger and freight activity.

- *Meeting resource constraints*—Resource limitations are coupled with the need to preserve and maintain investment in a significant portion of the existing system. This situation creates an environment in which the many competing opportunities to improve passenger and freight transportation involve difficult trade-offs. Overall system effectiveness, instead of mode-specific objectives, need to shape these choices.

All these issues indicate a planning process that focuses on system service and performance as a whole for both passenger and freight trips. The issues have been recognized for a long time, and ISTEA took a major step in encouraging such a planning process. The state and the metropolitan planning organization's (MPO's) planning factors, emphasis on performance, funding flexibility, and emphasis on freight and intermodal concerns and interests all have resulted in real progress. Have we made as much progress under ISTEA as we had hoped? If TEA-21 offers the potential to continue to make progress, where should we focus research efforts to make the most progress?

## CURRENT STATE OF THE PLANNING PROCESS

To address the issues that were identified in the previous section, such as serving the entire trip, the planning process must focus on the entire multimodal system, encourage intermodal solutions, and integrate both the passenger and freight elements of the system. The process needs to define key trade-offs and choices and provide a forum in which all interests can search for consensus. Even if consensus is not possible, at a minimum, the process needs to provide information on choices to the broader public political decision-making process and private business decision making as well. If the ideal is a well-informed "level playing field" and the reality is a continuation of fragmented institutions, funding restrictions, and segregated passenger and freight decision making, the question is how have we fared over the past 6 years, and what can that tell us about future research directions?

ISTEA produced significant changes in the planning process. It strengthened the role of MPOs; established a broad set of planning factors to guide both metropolitan and statewide planning efforts; encouraged more explicit consideration of trade-offs through the management systems and the requirement for fiscal constraints in plans, State Transportation Improvement Programs (STIPs), and Transportation Improvement Programs (TIPs); increased funding flexibility and eligibility; and emphasized inclusion of freight interests in the process. Although it is not the intent here to provide a comprehensive summary of the status of the planning process at the state and metropolitan levels, good progress has been made, and it is useful to provide a few examples to highlight this progress and to identify potential next steps. Furthermore, whereas a number of examples of good practice are mentioned, many other states and MPOs also have been making progress in integrating multimodal and intermodal considerations into their planning processes.

## Multimodal Planning

ISTEA did encourage a new round of multimodal planning at the statewide, metropolitan, and corridor levels, though ownership, operation, and financing of each mode remains fragmented, and freight is still largely in private ownership. The role of MPOs was strengthened by ISTEA, although the ability of these institutions to create a regional framework for decision making and to integrate planning for different modes varies widely. The Metropolitan Transportation Commission of the San Francisco Bay Area (MTC) has a stronger role than most MPOs because it has significant control over some portion of funds that are allocated to the region. MTC has identified a "regional multimodal system" as one tool to help focus investments and operating strategies. However, leadership and innovation are being demonstrated by MPOs in a number of different metropolitan areas, even in areas where their control over funding allocations is much weaker.

The recent *Enhanced Planning Reviews* conducted in 14 metropolitan areas by the Volpe National Transportation Systems Center for the Federal Highway Administration (FHWA) and the Federal Transit Administration reviewed key elements of the planning process in each area. Even though most of areas that were reviewed had entered into one or more major investment studies (MIS), the degree to which these studies were integrated into the metropolitan planning process varies widely. In many cases, a preferred mode, or alternative, is clear in advance, especially for projects already in the pipeline and in situations in which the implementing agency is the lead agency. However, MPOs in St. Louis, Dallas, and the San Francisco Bay Area are cited for clearly linking MIS with the metropolitan plan and for playing an active, coordinating role. In St. Louis, an interagency management group has been established, and in Dallas, the lead agency for each study is selected collaboratively.

In the past most MPOs have dealt with all modes, at least on the passenger side. Today, the extent to which planning is truly multimodal varies widely from place to place and is more a reflection of institutional arrangements and funding constraints. The planning reviews indicate that ISTEA had relatively little effect on MPO structure and governance in most areas and that arrangements and approaches to involve all modes vary as well. Although local elected officials are on the policy boards of each MPO that is reviewed, a transit agency representative sits on only half of the boards. Port and airports are involved formally even less often at the policy level. In states like California, where significant funding and decision-making authority has been delegated to the regional level, a more integrated approach to planning may be encouraged. Certainly the strengthened role of

MPOs has created a new partnership between the state departments of transportation (DOTs) and MPOs in many states, and the congestion mitigation and air quality (CMAQ) and transportation enhancement programs have brought more interest groups to the table. The extent to which these measures have resulted in a more integrated approach to planning versus a finer slicing of the funding pie is arguable. At a minimum, more issues are surfacing and more interest groups are involved, resulting in a broader range of project (if not system) trade-offs that are being considered.

At the state level, ISTEA also created a new round of planning activities. The extent to which these planning efforts are truly multimodal depends on a wide range of institutional and funding arrangements, as well as on each state's unique transportation needs and economic, social, and geographic characteristics. In some states, such as Maryland and Wisconsin, where there is broad state involvement in all modes and funding flexibility at the state level, more integrated plans can be developed and a broader range of trade-offs can be considered. The Wisconsin *Translinks21* document reflects a comprehensive effort to look at all modes for passengers and freight, including intermodal options. The identification of a need for more support for intercity bus service, primarily for social and equity reasons, represents the type of trade-off and choice issues that would not surface in states with much greater restrictions on funding.

The Oregon Transportation Plan, an early state transportation plan adopted in 1992, provided a policy framework and a multimodal system element for guiding further planning throughout the state. The plan identified minimum levels of service for various transportation modes and functions and provided an estimate of the resources that were necessary to meet those service levels. A preferred investment program was also identified that included all modes. Later efforts by the Oregon DOT and by the Oregon Transportation Commission provided greater details in terms of statewide modal plans, including the Public Transportation Plan of 1997 and the Oregon Highway Plan of 1999. Trade-off analyses have been advanced through these efforts, particularly with Oregon DOT's recent development of a "constrained investment strategy," which provides guidance on what will be implemented at different funding levels below what is desirable. All of these efforts featured a broad and comprehensive outreach process.

Colorado DOT is now developing a constrained funding strategy around different concepts that will guide investment choices. The Texas Transportation Plan developed investment programs and was organized around goals and strategies. Texas used a very broad range of committees to develop goals, objectives, and strategies for important topics such as mobility and



accessibility, economic development, trade, and finance. The development of the Texas Transportation Plan was conducted with comprehensive outreach to all interest groups. The Ohio statewide planning effort also was notable for its degree of outreach and public participation. Washington DOT structured its statewide plan around a process that defined the resources required to meet various service levels for different components of the state system and that distinguished between facilities that were state owned versus of state interest.

Many other states have undertaken new and noteworthy planning efforts over the past 5 years. Almost all of these efforts involved a broader range of interests, greater public participation, and consideration of a broader range of modes and issues, including freight, than were reflected in earlier plans. Although the highway mode still dominates state involvement in transportation in most states, multimodal policy plans or system plans have generally been developed to provide a framework within which more specific and detailed modal plans are defined.

## Freight

When ISTEA was enacted, freight was identified as a topic that deserved special attention and focus. One of the conclusions from a conference on ISTEA implementation held by the Transportation Research Board (TRB) in Irvine, California, in 1992, was that few transportation planners knew much about freight or its transportation needs, and seldom did transportation policy boards or other decision-making bodies include representatives from shippers or carriers. A recommendation was made to incorporate freight considerations into transportation planning, not only in the problem identification stage of the planning process, but also in the goal-setting analysis, and evaluation stages. Since 1992, freight transportation has been the subject of numerous initiatives, each one having the goal of maximizing consideration of freight issues in the transportation planning process.

One widespread development has been the formation of freight stakeholder groups that are made up primarily of private-sector representatives, often with active participation from government agencies. In general, these groups have served as forums for identifying impediments to efficient freight transportation and as advocates for specific freight infrastructure improvements. The Heartland Freight Stakeholders Coalition in Kansas City, for example, involves a wide spectrum of trucking companies, railroads, and shippers. MPOs in Seattle, Chicago, Philadelphia, and Dallas have established similar groups. New York and Miami have established project-specific advisory committees, and a number of states, such as Ohio and Texas, have con-

ducted significant outreach or have established freight and business advisory committees to assist in developing statewide plans.

Although many freight stakeholder groups are organized by the private sector as advocacy organizations, some have a measure of official status in the planning process. For example, the MTC of the San Francisco Bay Area regularly convenes a group of freight representatives to provide advice on transportation issues that affect their businesses. The group helped establish TIP project-selection criteria, and a portion of that region's CMAQ funds were directed at projects of interest to the freight community. Similar efforts to increase the number of active freight advisory committees have been undertaken by MPOs in St. Louis and in Binghamton, New York.

The freight stakeholder groups have been effective in elevating the discussion of freight transportation issues in areas where they have been established. However, it is important to note that their role is, for the most part, advisory. To date, no state or MPO has provided the freight community with voting representation on its decision-making body for allocating transportation funding, although at least one is actively considering to do so.

Several states and MPOs have taken steps to develop intermodal systems plans that are either focused on freight transportation requirements or on highlighting freight as a major area. For example, the Mid-Ohio Regional Planning Commission conducted an infrastructure study for the Columbus Inland Port. The objective of the study was to develop actions and strategies to position Columbus as a major "inland port" warehousing and distribution center. The study also included forecasts of economic and population growth in the region and translated these into specific infrastructure and service requirements for the Columbus area.

Colorado is also undertaking a freight infrastructure study to be used in developing the freight component of the statewide transportation plan and the freight elements for the 10 transportation planning regions within the state. Florida is just beginning work on a statewide intermodal systems plan for the year 2020. The plan will analyze conditions and trends for the movement of passengers and freight and will define an intermodal system of statewide significance.

Washington, Oregon, and Wisconsin, among many other states, identified the portion of the state transportation system that was most critical for freight movements and intermodal connections. A special commission in Washington State also looked at the state's airport system in terms of intermodal passenger and freight movement and options for improving capacity for both passengers and freight. Other states, such as California and Michigan, also took advantage

of the intermodal management system requirement by building freight and intermodal databases that will continue to be used even though the management system requirement has been eliminated.

At the federal level, FHWA made the identification of connections to intermodal facilities a high priority of the designation of the National Highway System (NHS). Although the connectors themselves were roads and highways, they had the effect of identifying specific intermodal freight facilities as having some level of priority when competing for funding for access improvements.

Under ISTEA a number of freight projects received funding, largely as a direct result of the greater attention paid to freight issues. The majority of these projects involved improvements to highways that served freight facilities and that were identified as intermodal connectors on NHS. Rail projects proved much more difficult to implement. ISTEA did not explicitly name rail freight projects as being eligible for federal funding assistance. Therefore, states and MPOs that wished to advance a rail freight project found it necessary to qualify the project under some other category, usually the CMAQ program.

The highest profile freight project funded under ISTEA was the Alameda Corridor, which serves the Ports of Los Angeles and Long Beach in southern California. The federal support that was provided, however, was not under any ISTEA program. Instead, an innovative federal direct loan was structured, and special legislation was enacted that gave USDOT the authority to enter into the loan. Nevertheless, the policy framework of ISTEA gave the project the visibility it needed to obtain federal support. Moreover, the loan served as a model for one of the credit programs that was included in TEA-21.

TEA-21 continued the planning framework specified in ISTEA, but it also included some new funding provisions that could be beneficial to freight interests. The National Corridor Planning and Development Program is a new discretionary program that will provide funding for the coordinated planning, design, and construction of corridors of national significance, economic growth, and international or interregional trade. The Coordinated Border Infrastructure Program was established to improve the safe and efficient movement of goods at or across the U.S.–Canadian and U.S.–Mexican borders.

These new programs respond to a desire, long expressed by some freight interests, that a dedicated source of funding for freight projects is needed to ensure that these projects receive any funding at all. Although not limited to freight projects, the project-selection criteria favor projects that demonstrate international trade benefits, particularly to motor carriers. The funding level, however, is relatively small. Only \$700 million is authorized over the 6 years of TEA-21.

The Alameda Corridor project, by comparison, has a total project cost in excess of \$2 billion. The challenge will be to use these programs to leverage other funding sources. The danger will be that these programs will evolve as the only potential source of funding for freight projects.

TEA-21 also includes two new credit programs, both having significant applicability to freight projects. The Transportation Infrastructure Finance and Innovation Act will provide direct loans, loan guarantees, and standby lines of credit for large highway, transit, intercity passenger rail, and publicly owned intermodal freight facilities on NHS. The Rail Rehabilitation and Improvement Financing Program (RRIF) will provide direct loans and loan guarantees to public agencies and railroads to acquire, improve, develop or rehabilitate intermodal or rail equipment or facilities, including track, bridges, yards, and shops. Both of these programs will be useful in the appropriation of financing for freight projects, because many of these projects have the potential to generate revenue through user fees or lease payments. To date, however, no funds have been appropriated for RRIF, which means that applicants will need to produce some amount of money up front to cover the credit subsidy before they can receive a loan. It remains to be seen whether this will be a significant disincentive for participation in the program.

TEA-21 does not extend eligibility guidelines for its grant programs to cover privately owned rail and intermodal facilities. Neither USDOT nor Congress was able to develop a reasonable approach for separating public benefit from private advantage, a crucial requirement if public funds are to be used. In the absence of such methodologies, federal grant funding for projects that involve private-sector participants will be difficult to assemble.

TEA-21 added freight shippers and providers of freight transportation services to the list of those to be included in the process of developing state and metropolitan long-range transportation plans. However, although the composition of MPOs was considered by FHWA and Congress in the reauthorization process, the final bill did not call for MPOs to be reconstituted, as some freight interests had hoped.

## Tools and Methods

Although a comprehensive review of the status of the tools and methods that are available to support multimodal and intermodal planning is not the objective of this paper, a few observations are useful in the areas of data, travel-forecasting methods, and evaluation-trade-off analysis tools. In general, the capabilities in each area are much more developed for passenger travel than



for freight at the national, state, and metropolitan levels. The reduction of that gap, notwithstanding well-known constraints related to the confidentiality of some freight-related data, is a priority and a necessary step to define more effectively the trade-offs that are associated with freight-related investments.

In terms of data, a number of recent conferences and reports have focused on the information needs of transportation decision makers and on the adequacy of current data sources to meet those needs. At the federal level, the Bureau of Transportation Statistics (BTS) has made significant progress in collecting, organizing, and distributing a range of data and making it more accessible for metropolitan and statewide planning efforts. This information on passenger and freight movements, system conditions and performance, and underlying economic and demographic trends has created a valuable resource for developing a more comprehensive understanding of the system. However, a recent report by BTS identified critical gaps in existing information on freight and passenger movements and in the system itself. In the freight area, these gaps include insufficient information on international trade; on commodity movements for some industries and modes; and on system cost, time, and reliability. The report also emphasizes that significant work still must be done to make national data sets useful at the state and metropolitan levels. This is a significant challenge when statistical sampling is used because site-specific samples can become prohibitively expensive.

A wide variety of new databases also have been established at the state and metropolitan levels as a result of the most recent round of planning. Some of these efforts involved developing more complete inventories of the multimodal system in terms of facilities, services, and conditions, as well as surveys of shippers, receivers, and carriers, to better define freight movements. The extent to which these data become institutionalized remains to be observed. A variety of states and MPOs are also attempting to establish performance-monitoring and planning systems that may refocus existing data-collection strategies and budgets or supplement existing ones. The cost of collecting and maintaining data is a growing concern, and many agencies are questioning the usefulness of some legacy databases. A number of states, such as Michigan and Mississippi, have attempted to create enterprisewide databases both to cut costs and to provide more useful and consistent information to all levels of the organization. The application of better sampling and statistical methods and the use of data from intelligent transportation systems (ITS) applications are also being examined at the national, state, and metropolitan levels.

Most, if not all, MPOs have multimodal passenger-travel-forecasting capabilities for work and nonwork

trips within their regions. Some also have analysis capabilities for examining airport-access issues and mode choice. Most of these models are the traditional four-step process, and a large number of metropolitan areas have been updating and enhancing these procedures over the past 5 years. Improvements in the traditional modeling approach have focused on mode choice, automobile ownership, access modes, nonmotorized travel, and time-of-day modeling for peak and off-peak periods. Some areas have also begun to focus on activity-based and tour-based modeling approaches. To support these model enhancements, some areas are undertaking land use, demographic, and economic data-collection efforts for the first time in 30 years. No MPO has a similar forecasting capability for multimodal freight flows, though truck trips are typically estimated and loaded on networks. At the corridor level, many MPOs are making modeling improvements as part of MIS or broader corridor studies.

At the state level, a number of DOTs have developed statewide passenger models, and a few also have developed some freight-forecasting capabilities. A recent TRB conference on statewide modeling indicated that 14 states currently have such models, and four more are in the process of developing them. While some of these models mirror the four-step urban process, the conference participants generally believed that different approaches are required for statewide modeling. A number of federal efforts to improve the state of the practice support these efforts at the metropolitan and state levels. The Travel Model Improvement Project has developed a number of improvements for traditional urban models, and the TRANSIMS system is about to be deployed in a number of urban areas to test a much more detailed approach to simulating passenger travel in these areas. A variety of freight-forecasting procedures have also been developed, such as the publication of the *Quick Response Freight Manual* under FHWA sponsorship.

A critical need that is frequently cited to improve multimodal planning and decision making is an improvement of evaluation tools for making trade-offs within and between modes or among different modal mixes. In the early days of ISTEA, there was hope that a series of mandated management systems would provide new evaluation tools and information for analyzing trade-offs and resource-allocation decisions for a range of system elements (pavement, bridge, transit) and performance objectives (congestion, safety, intermodal). The nature of the mandate, coupled with the cost and effort that was required to comply, led to the elimination of the requirement for most of these systems as part of the NHS legislation in 1994.

Notwithstanding this change, almost all states have or are developing bridge and pavement management

systems, and some states and MPOs have developed a number of other systems, at least to some extent. Perhaps the most ambitious effort was the Michigan DOT's integrated management system that covered all six system areas. However, although significant effort throughout the country has been devoted to developing some of these management systems, their use in defining key resource-allocation choices and trade-offs has been disappointing. When surveyed as part of a recent National Cooperative Highway Research Program synthesis report, most states reported that they did not use their bridge and pavement systems to select the budget level or projects in these program areas. A continued interest at the state level in better tools and approaches for broader asset management may lead to new tools. Michigan, Wisconsin, and Washington have all made progress in either integrating management system tools or developing a process for more formal program-level trade-off analysis.

A number of other tools have been developed at the national level. The Highway Economic Requirements System (HERS), developed for national needs analysis, has been adapted to meet state highway investment analysis needs in Oregon and Indiana. HERS can deal with trade-offs between rehabilitation and capacity-enhancement (widening) projects. A more comprehensive set of investment actions can be analyzed with the ITS Deployment Analysis System (IDAS) and the Surface Transportation Efficiency Analysis Model (STEAM), both of which are being developed under FHWA sponsorship. IDAS will allow network-level analyses of benefits and costs of ITS deployments at statewide or metropolitan levels. STEAM allows network-level cost-benefit analyses of traditional transit and highway investments. To make the playing field level, intermodal and freight projects need to be analyzed within the same type of network model and evaluation capabilities.

## Challenges and Barriers

Although progress has been made in further integrating multimodal and intermodal considerations into the planning process over the past 10 years, significant barriers remain. On the passenger side, continued fragmentation of responsibility for the planning, operation, and maintenance of different modal facilities and services among a variety of state, regional-metropolitan, and local agencies and special authorities is a well-known fact of life. This fragmentation, while often an impediment to multimodal planning and decision making, is unlikely to change dramatically and requires a constant examination of the incentives and disincentives for creating a more integrated system. Similarly, the degree of funding flexibility at the state, regional, and local levels

varies widely and constrains the range of solutions and trade-offs that can be considered.

The effectiveness of the link between state and metropolitan system planning can also be questioned in terms of the degree to which investments and operating strategies that are examined at the system level effect project-by-project decision making in the context of TIPs and STIPs. Finally, the degree to which a range of nonautomobile options can be given serious consideration is often constrained further by trip-making patterns. In some fast-growing decentralized metropolitan areas across the country, the effectiveness of nonautomobile options may depend critically on our ability to further integrate land use and growth management policies with transportation.

Notwithstanding these challenges that are related to passenger travel, a more significant set of challenges confront efforts to integrate freight transportation into the public-sector multimodal planning process. As a result, the rest of this section focuses on the key barriers to addressing freight issues more effectively.

It is clear that the topic of freight transportation has received significant attention from policy makers since ISTEA was enacted. However, actual progress in integrating freight transportation needs into the planning process has been more limited. Freight transportation is a complex area with different players, funding mechanisms, and market characteristics than what most states and MPOs are familiar with. Moreover, in terms of transportation planning, the years since ISTEA was enacted indicate a relatively short period of time to implement fully the policy framework that was originally envisioned. Looking ahead, there are a number of challenges and barriers that need to be addressed if freight is to be integrated more completely into transportation plans and funding programs.

In terms of institutional structure and decision making, ISTEA and TEA-21 both delegated principal responsibility for transportation planning and project selection to state DOTs and MPOs. Although this makes sense for evaluating the ability of projects to address regional traffic congestion, it does not work as well for freight issues. Freight transportation is driven by the private sector and encompasses national and international economic impacts. Whereas many freight projects have local impacts, either on congestion or air quality, the beneficiaries are often located elsewhere. For example, some of the major beneficiaries of improved links between coastal ports and railroads are shippers and consignees that are located in the Midwest. An MPO board member might focus less on this sort of project than on a project that would have more tangible benefits for his or her constituents.

The new programs aimed at trade corridors and border areas could help address these problems by focusing



federal attention on them. But on the larger question of the representation of freight interests, neither ISTFA nor TEA-21 called for state and MPO decision-making bodies to be reconstituted to include freight interests. For now, it will be necessary to find ways to improve on the existing institutional arrangements. This area should be looked at with an eye toward the next reauthorization to see if changes are warranted.

Limitations of the tools and methods that are appropriate to support freight planning is another barrier to integrating freight into the planning process. ISTFA and TEA-21 both operate under the premise that state and local decision makers are in the best position to develop plans and to establish project priorities because they are "closer" to the needs of the traveling public. However, our experience has been that, although there have been examples of freight projects being added to transportation plans, they have not necessarily been substituted for or prioritized ahead of projects already included in these plans.

The tools and methods that could be used by transportation planners to evaluate freight projects relative to one another and relative to other transportation needs are still lacking. States and MPOs find it difficult to evaluate trade-offs between different types of projects. As a result, a project's relative ranking has more to do with how long the project has been around and its political support instead of any transportation benefit.

Since the enactment of ISTFA, there have been calls for better tools for evaluating trade-offs and relative benefits of different investments. Recognizing that transportation decision making is a political process, it is fair to ask whether these tools will actually be used by transportation decision makers. While it is probably unrealistic to assume that an "optimized" project portfolio could be developed, it is nevertheless important to illuminate the discussion of project priorities with good technical information on the relative impacts of alternative investments.

Financing freight infrastructure projects represents a significant challenge for state DOTs and MPOs. Often these projects require blending funds from a variety of public and private sources. The most sensitive issue, funding rail projects and rail intermodal access, was expanded somewhat in TEA-21 by making publicly owned facilities eligible at least for credit programs. However, eligibility questions will continue to plague many worthwhile projects.

The fact that many freight projects involve a private-sector participant raises questions about public versus private benefits. Separating the benefits and costs is time consuming and may lead decision makers, in both the public and private sectors, to decide that it is not worthwhile. Research on how best to approach this question is certainly warranted.

Finally, it is important to recognize that although many freight projects are modest in scope, a significant number constitute very large projects. The \$2-billion Alameda Corridor project is only one of several port-access projects that is under active consideration around the country. For the most part, these projects are too large to fit comfortably into state and MPO planning frameworks, and the federal funding that is available for these projects is extremely limited. Not every project can cover its cost, even in part, through user fees. Financing large freight-oriented infrastructure projects is likely to continue to be a major problem in the coming years.

## TRENDS

A review of the state of the planning process suggests that significant progress has been made but that significant barriers to further integration of multimodal and intermodal concerns into that process remain. On both the passenger and freight side, these barriers involve institutional issues, financing constraints, and limitations to available data and analytic methods. However, before suggesting future research directions, it is useful to look at a number of issues and trends that will affect passenger and freight transportation in the future. Many of these trends are not new and will continue to create pressures on the system that we have experienced during the ISTFA era. However, continuation of these trends, coupled with the pervasive influence of technology in both passenger and freight transportation, will accelerate the need to take full advantage of existing infrastructure and all modes. These trends also will generate pressure to develop more creative approaches for problems for which traditional solutions are not having an impact.

### Passenger

A variety of recent research reports and data summaries have characterized the status of passenger travel and demographic trends. The intent here is not to repeat the results of these studies in detail but to simply summarize a few trends and issues on which the planning process will need to focus in the next decade. Addressing these issues may require a reexamination of the appropriate mix and balance of modes and may create the need to integrate transportation more effectively with broader economic and land use planning.

Although not as dramatic as the statistics for freight transportation, passenger travel continues to grow, though the trend varies by mode. Highway person-miles-of-travel and vehicle-miles-of-travel have continued to grow, though vehicle-miles-per-vehicle have



leveled off. Household vehicles that are available per person of driving age now reflect almost saturation levels of automobile and light truck ownership. Automobile and light truck ownership exceeds the number of licensed drivers. Less than 10 percent of households do not have an automobile or light truck, and only 6 percent of the population is in a household without access to an automobile or light truck. While total transit ridership declined by 11 percent from 1985 to 1995, overall transit-person-miles of travel remained constant, with bus and urban rail declining and other modes, such as commuter rail and light rail, showing increases. Long-distance travel (trips greater than 100 miles in length) has been increasing. While the bulk of these trips are served by automobiles, air travel also has been increasing and accounts for a significant share of the total number of miles a person travels for intercity trips. Travel on other intercity modes has been declining, though this trend may change as the population ages.

The overall growth in personal travel is driven by a number of factors: strong economic growth, population growth, greater female participation in the workforce, and a growth in households that has exceeded population growth and has resulted in smaller-than-average household size. The growth in automobile-ownership levels cited earlier is also contributing to the trend. The most tangible result of this growth in person travel, whether the specific indices used in various report cards are embraced, is an increase in the level of congestion and in the duration of peak periods that are experienced in many large urban areas. More problematic is the fact that the majority of the employment and population growth that drives the increases in personal travel has been in suburban and low-density urban areas where options to the automobile often are not available and where traditional transit service concepts are not effective. As a result, the percentage of trips that are served by nonautomobile modes is declining. As a result of the shift to automobile travel, growth focused in suburban areas, and longer peak periods, the average travel speed of commuters has increased, while both the average length of a commute trip and, to a lesser extent, the time that the commute trip takes have increased.

A number of challenges exist that are created by both the growth and shifting pattern of personal travel. First, in many suburban and low-density areas, traditional transit services may have little potential, but highway capacity and operational improvement alone also may have limited impact. A mix of different modal options, balancing capital and operational improvements and increasing the emphasis on linking transportation with growth management, land use, and economic development planning, as suggested by Vice President Gore's recent announcement, may all be required. Second, in

denser urban areas and for the trips traditionally well served by transit, the national trend in terms of ridership should not mask the critical role that transit plays in some of the country's most important economic centers. Such service is essential to making the multimodal system work in these areas, for both passenger and freight transportation, by relieving pressure on the highway system while giving individuals mobility options. However, continued success for high-capacity transit involves addressing a key intermodal issue—adequate parking facilities at transit stations, which often are the only effective access mode. Finally, both within urban areas and for intercity and international travel, continued growth will increase pressure to take maximum advantage of existing infrastructure and service. Expanding capacity alone will not solve the problem. Improved intermodal connections, operational improvements, and potentially more segregation of freight and passenger travel in both facilities that are used and in hours of operation will continue to be an appropriate focus.

In addition to a variety of factors that affect the growth of personal travel, a number of other trends exist that are influencing the pattern or nature of personal travel and that are placing new demands on the system and the planning process. All of these trends have been well documented in a number of recent studies:

- Increased female participation in the workforce and growth in households headed by women, which has contributed to overall growth, also has tended to result in more linked trips and more complicated trip chaining behavior. This trend influences mode choice, time of travel, schedule constraints, and the potential for more integrated transportation and land use strategies.

- The aging of the population will become a more important determinant of transportation issues as the baby boom generation reaches retirement age. Income, physical vitality, and life expectancy of this group, coupled with an increase in leisure time, will create new demands on the system as well as create potential safety issues. The per-person long-distance travel by those individuals over age 65 almost doubled over the last two decades.

- Employment growth has outstripped population growth over the past 20 years. However, more significant than the growth in jobs is the changing nature of the job market. Dramatic growth in the service sector has resulted in three out of four civilian jobs being service related. A growing component of this workforce, particularly at the lower end of the pay scale, involves variable work hours, part-time employment, and workers holding more than one job.

- Information technology is having a dramatic effect both on location of jobs, the extent to which work is done

in the home or at some location other than a central job site, and flexibility of work schedules.

These and other factors will continue to change the demands that are placed on the transportation system and the nature of the transportation strategies that will be most effective in meeting these demands. They will also create a stronger need to integrate planning and decision making for freight and passenger travel as competition for shared facilities increases.

## Freight

Similar to passenger travel, a number of trends are influencing freight transportation and have significant implications for the transportation system now and in the future. Freight movements have been growing dramatically, even more than personal travel. The preliminary results of the 1997 Commodity Flow Survey (CFS) indicate that freight shipments may have increased by 30 percent in value, 19 percent in tons, and 16 percent in ton-miles during 1994 to 1997. During this same period, intermodal shipments (trips using more than one mode) may have increased by as much as 44 percent by value, 17 percent by tons, and 20 percent by ton-miles. These figures do not include shipments that involve air and truck movements. Air shipments, while representing a very small percent of total freight on any dimension, grew the fastest of any mode. Small-package deliveries also grew dramatically. The value and ton-miles that were shipped by every major mode (truck, rail, water, pipeline, and intermodal) also increased.

The dramatic growth in small-package deliveries bears particular attention. As users of the freight transportation system have come to depend on frequent and smaller shipments, it is reasonable to expect that this segment will continue to grow. However, this means that larger shipments to warehouses and manufacturing and retail establishments are being replaced, to some extent, by smaller, more random shipments that are carried in increasing numbers of small trucks. The effect of the growth of small-package deliveries on urban congestion may become a significant question in the future.

Even though intermodal shipments grew rapidly, they still represent a relatively small, albeit growing, percentage of total shipments. From 1994 to 1997, the value of intermodal shipments grew from 11.3 to 12.5 percent of the total value, and the share of ton-miles increased from 7.9 to 8.2 percent. The share of tons that were moved stayed constant at 2.3 percent. Even if all air shipments are assumed to involve some truck movement, the intermodal share of total shipments would not change significantly in terms of percentage.

However, the share of intermodal shipments is expected to continue to rise over the next decade and to continue to represent higher-than-average value freight.

A key component in the overall growth in freight shipments has been international trade. The value of U.S. imports and exports grew by 45 percent from 1992 to 1996. In terms of tonnage, about 95 percent of these shipments were by water. Over the past 25 years, international waterborne shipments have doubled in tons, while domestic shipments have grown 15 percent. The 10 largest ports account for the vast majority of these shipments and account for close to 75 percent of the total port capital investment over the past 5 years. During this same time frame, the regional shares of this port traffic have shifted dramatically from East Coast to West Coast ports. Similarly, on the air side, over the past 15 years, freight revenue ton-miles on passenger carriers grew twice as fast in the international market as in the domestic market. All cargo carriers grew even faster, and once again growth in international shipments out paced domestic growth. The air share of the value of total imports and exports has increased from 11 to 25 percent from 1970 to 1994. The 15 largest gateways accounted for more than 91 percent of all air shipments by weight in 1994. Of the nation's top 20 gateways for imports and exports by value, 5 are airports and 15 are ports.

The concentration of international trade at a relatively small number of ports, air gateways, and border crossings creates unique demands on key intermodal facilities and corridors. It also reflects the fact that origin and destination patterns for both international and domestic freight movement involve a different portion of the transportation system and geographic area than the typical "commuter shed" that the MPO transportation planning process addresses. While the preliminary results of the 1997 CFS suggest that the average miles per shipment have decreased overall, and for most modes, a large amount of shipments cross metropolitan and state borders. Only 7 states had within-state shipments that represented more than 50 percent of the value of total shipments, and 25 states had through-state shipments that represented more than 50 percent of the value of total shipments.

The growth of freight movement has been fueled by a number of factors that include a strong global economy, international trade agreements, and emerging markets, particularly in Asia and South America. These factors, coupled with a logistics revolution that has been enabled by dramatic improvements in information technology, have changed the location of global industry activities and the way in which these activities manage an increasingly integrated supply chain. While the cost of logistics, as a percent of total product costs, varies widely by industry, total logistics costs (inventory, carry-

ing costs, and transportation) were \$797 billion in 1996 and represented 10.5 percent of the gross national product. Transportation represented about 57 percent of this total (\$455 billion), of which 80 percent were trucking costs.

Even though worldwide expenditures for logistics have more than doubled over the past 25 years, increasingly sophisticated logistics strategies are allowing many industries to trade off information for inventory and dramatically reduce logistics costs per unit of production. As a result, average inventory turnover is expected to double, and order cycle time is expected to decrease by 40 percent over the next decade. To take advantage of these logistics strategies, many shippers are reducing in-house logistics capability and capacity and are using third party logistics providers to manage their supply chain. As a result, many of these shippers have less of a direct connection to the transportation system than they did a decade ago.

Both the dramatic growth in freight transportation and the change in logistics strategy are placing new pressures and demands on the system. The increase in freight movement makes increases in capacity and operational efficiency critical for individual modes, as well as for intermodal connections, services, and terminals. The trend toward specialty manufacturing, just-in-time manufacturing, and the dramatic increase in small-package deliveries all place pressure on the system for reliability and time and cost efficiencies.

## Implications

The future trends in both passenger and freight will continue to put more pressure on the transportation system and to increase the need for development of a more integrated and effective multimodal and intermodal planning process. The need to address the barriers to the development of this process, identified in a review of the state of the planning process, will become even more critical as these future trends unfold. Specifically, the implications of these trends include

- Both passenger travel and freight shipments are expected to continue to grow, placing more pressure on system capacity and preservation.
- Operational improvements, as a means to better manage existing capacity and to improve system reliability, especially for freight shipments, will continue to increase in importance.
- Growth in international trade will increase congestion at key gateway airports and ports and at related intermodal access facilities. Serving this trade efficiently will be critical to the national economy and competitiveness. Growth in international person travel will

have broader impacts on the air system and intermodal connections to that system.

- Growth patterns and other factors are increasing automobile use, but system capacity and management strategies cannot keep pace. This situation is likely to encourage continued decentralization of jobs and housing unless new approaches to growth management are adopted.

- Aging of the population may shift both trip patterns and mode usage, especially for long-distance travel.

- Concerns for environmental quality, equity, social objectives, and community livability will continue to create advocates for particular and often conflicting transportation objectives and often for modal strategies that require more complex choices and trade-offs.

- Technology will continue to change the nature of global businesses and personal travel patterns and to increase the importance of real-time information on system conditions and status.

## RESEARCH PRIORITIES

Progress has been made under ISTEA in the integration of multimodal and intermodal concerns into the planning process. TEA-21 offers the opportunity for further progress, but some significant barriers remain. On the basis of the recent trends in freight and passenger travel and the implications of those trends for the future, addressing the barriers to a more integrated transportation planning process becomes even more important.

Suggestions for some candidate research topics that are provided in this section were guided by the need to address some broad themes. Summaries of these themes are

- Further integration of transportation, economic development, and land use planning will be required to address some key emerging transportation issues and to receive full benefit from the entire system.

- Our understanding of the freight system, of the logistics strategies that drive demand for that system, and of the impact of various capital and operating options is insufficient and not nearly as developed as our understanding of passenger travel. Nonetheless, we are moving into an era in which integrated freight and passenger planning will be essential.

- More integrated multimodal and intermodal planning implies more explicit consideration of trade-offs that will cut across modes, freight and passenger travel, and operating and capital strategies. Our ability to develop and communicate the implications of these system trade-offs is too limited.



To respond to these broad themes, a number of more specific research topics are suggested. Within each topic, a range of more detailed research projects can be defined.

### **Broad Economic Impacts of Transportation**

Even though a lot of work has been done on this topic over the past 10 years, it is worthy of continued attention. At the root of the concern, with the development of a better understanding of the freight system and with giving more emphasis and priority to the examination of potential improvements to that system, is the connection between the efficiency of the freight system and economic competitiveness. However, strengthening our understanding of the connection between transportation and the economy as a whole involves both the passenger and freight systems. Projects that have analyzed the economic impact of dramatic decreases in transit service in dense metropolitan areas have made this point clearly. In addition, issues that involve labor force productivity and accessibility, as well as facilities and services that provide both passenger and freight movement on the highway, rail, and air systems, make the connection as well.

### **Strategies for Personal Mobility**

The challenges facing the transit industry as a whole have been well documented, and there are ongoing efforts at both the national and state levels to reexamine the role and structure of the industry and to define a "new transit paradigm." Although there is a range of opinions on the nature of the problem with appropriate responses, the problem of congestion and personal mobility is growing rapidly in areas where nonautomobile solutions are limited. Some, of course, may not see this as a problem, but environmental, social, and resource constraints will pressure communities to examine ways to do a better job of integrating economic, land use, and transportation strategies. The current initiatives on livable communities will provide useful experience, as will the regions that have implemented growth management policies. Still, more work needs to be done.

### **Planning and Decision-Making Structure for Freight**

Much of the freight transportation system is in private ownership. Shippers, third-party logistics providers, freight forwarders, and private carriers make daily decisions on transportation choices. Yet, public infrastructure is critical for freight movement, and public policy

on both freight and passenger issues influences the capacity and service characteristics that are available for freight movement. The freight system is going to have to handle significant growth over the next decade. It will continue to be under pressure to reduce costs and to improve or maintain reliability, and it will have to respond to continued restructuring of global businesses and improved information technology. How does the public sector respond to these issues and reflect freight transportation issues and concerns in the planning and decision-making process? Are further adjustments to the existing state and MPO structure adequate? Specific topics might include

- How do we reexamine the appropriate structure and public- and private-sector roles for freight planning to include changing the role and status of freight in the current process and its structure at the state and MPO levels?
- Given the pattern of freight trips within state and metropolitan areas, as opposed to the pattern of the majority of personal travel, how do we define planning approaches that involve all beneficiaries of freight improvements when they involve multistate regions and corridors and the national level?
- No matter what the forum, can we improve the ability to get freight interests "to the table," where they could have a stake in the decisions and where the time-frame for operating decisions and longer-term capital improvements are recognized?
- What is required to build a better consensus concerning priority freight improvements, and what information is required to let these improvements compete with other projects in the current process?
- Given the dramatic differences between personal travel and freight travel, in the extreme, do we need to consider a separate process for planning and funding freight-related projects? How would the separate processes be reconciled?

### **Data, Analysis Tools, and Evaluation Methods**

We need to improve our understanding of the freight system and our tools to better evaluate the impact of system capital and operating improvements on freight transportation. Some specific areas of emphasis include

- Development of better information on how the freight system works at the national, regional, state, and metropolitan levels. This approach needs to go beyond just the movement of goods to include the logistics strategies and rationales that drive private-sector decision making.

- A key area already identified by BTS is to supplement existing national data-collection and data-distribution methods and to develop a set of tools and potentially supplementary data-collection efforts to make this information more useful at the state and metropolitan levels.

- Freight-forecasting methods lag behind comparable techniques for passenger travel at both state and metropolitan levels. Given the nature of freight movements, what multistate and national efforts make sense?

- Tools used for freight project evaluation, including benefit and cost analysis and other impacts, need to be strengthened because the distribution of benefits and costs between geographic regions and the public and private sectors may be very different than for passenger-oriented improvements.

- Freight-oriented system performance measures should be defined and integrated into existing efforts so as to develop performance measure systems at the state and metropolitan levels.

### Increasing Funding Flexibility and Innovative Financing Approaches

A lot of progress has been made in the development of more funding flexibility and credit reform programs at the national level. More work needs to be done because funding eligibility constraints and restrictions on public and private partnerships still limit the range of solutions that can be considered in many areas or that require a tremendous effort to patch together financing programs for nontraditional projects. As mentioned in the previous section, the expansion of funding eligibility for public investments in private facilities may be particularly important for some components of the freight system, though it will be sure to create a lively debate within the freight community and elsewhere.

### Tools for Trade-Off Analysis

The issue of providing better information for making investment and operating resource allocation decisions cuts across modes, passenger and freight travel, and jurisdictional levels. In most cases, these trade-offs do not involve the choice of one mode or another to provide the same service to the same set of market segments. Instead, they involve a complex set of choices that concern the right mix of modes and services to meet a variety of objectives and to serve diverse market segments. Much like the need to define objectives before one begins to develop system performance measures, it is necessary to define the types of trade-offs that the decision-making process is likely to deal with or to want bet-

ter information on, before plunging into tool development. Typical trade-off issues that could be the subject of better information and evaluation tools include

- Maintenance and operating versus capital investment within a mode,
- System preservation versus passenger mobility versus freight-efficiency improvements,
- Appropriate mix and balance of modal investments in a particular corridor or area to serve diverse market segments,
- Benefits of investments in intermodal facilities and services versus modal improvements, and
- Equity in providing service to urban and rural passenger and freight needs or service to groups and industries with constrained modal options.

In each of these cases, the trade-off process has a technical and political component. The issue is how the planning process can both develop and communicate information that effectively characterizes the choice, and how it can provide a better forum for understanding these choices and building consensus.

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