
Introduction to Transportation Planning¹

I. INTRODUCTION

The economic health and quality of life of a nation's communities depend on a well-functioning and safe transportation system. For example, following housing costs, transportation is one of the biggest expenses faced by an average household in the United States and in many other countries. This is usually measured by the actual out-of-pocket costs associated with owning and operating vehicles or paying for transit fares. When one considers the value of time it takes to travel from one location to another, often in congested conditions, this cost increases significantly. The cost of freight and goods movement is also an economic cost passed on to consumers that will vary depending on the price of transportation.

The accessibility and mobility provided by transportation systems can influence land use patterns and, thus, over time affect how we live. The best example of this relationship is the large-scale suburbanization of U.S. metropolitan areas and of those in many other countries after World War II when massive investment was made in suburban freeways. Today, transportation investment is often an integral part of economic and development plans, usually including transit, pedestrian, bicyclist facilities, and actions to manage transportation demand. The importance of transportation investment in transforming communities raises questions of who is benefiting and who is carrying additional burdens after the system has changed. These are questions that are part of many transportation planning studies.

The public is also concerned about the environmental impacts linked to transportation systems and their operation. This has been manifested in many environmental laws and regulations that affect how transportation planning is conducted and the types of data and tools that must be used.

These, along with many other reasons, suggest that the transportation system is a critical component of a successful modern community and economy. Thus, anticipating the challenges and opportunities relating to transportation system performance is critical not only to future transportation system effectiveness, but also to the economic and social well-being of our communities.

This handbook examines many facets of transportation planning. Transportation planning can be a highly technical process, which often relies on computer models and other sophisticated tools to simulate the complex interactions of transportation system performance. It is a public relationship-oriented process in that transportation planners often interact with a wide range of stakeholders and members of the public. Transportation planning can also become intertwined with the politics of any given decision.

Some transportation planners and engineers focus on transportation supply—the facilities and services needed to handle expected demands and characteristics of the infrastructure to provide such service. Others are more interested in influencing travel behavior to promote more cost-effective and environmentally sustainable options for travelers.

Given the breadth of topics and issues that transportation planners can become involved in, transportation planning necessarily includes a wide range of interests, skills, and expertise. Perhaps the most important characteristic of any transportation planning process is to remain flexible given the dynamic nature of community planning and decision making, and the importance of transportation planning providing input into this process. This need for flexibility will be particularly important as the types of investment decisions for transportation systems evolve over the next several decades in response to changing demographic and technology factors.

¹The original chapter in Volume 3 of this Handbook was written by Michael D. Meyer, WSP/Parsons Brinckerhoff. Changes made to this updated chapter are solely the responsibility of the editor.

II. ORGANIZATION OF THIS HANDBOOK

This handbook is organized to reflect different levels of user familiarity with transportation planning. Not only do transportation planners need to know about the defining characteristics of the transportation system itself, but given a variety of transportation planning contexts, they must also understand the specific application contexts they are working in. In addition, transportation planning can be applied at a multimodal level, for example, statewide or metropolitan transportation planning efforts where all modes of transportation are considered, or it may target a very specific transportation strategy or element, such as freight planning.

The handbook is organized to answer six major questions:

What is transportation planning?

Chapter 1: Introduction to Transportation Planning

What are the basic concepts for understanding transportation systems and their relationship to the community?

Chapter 2: Travel Characteristics and Data

Chapter 3: Land Use and Urban Design

Chapter 4: Environmental Considerations

Chapter 5: Transportation Finance and Funding

What are the types of tools and analysis methods used in transportation planning?

Chapter 6: Travel Demand and Network Modeling

Chapter 7: Evaluation and Prioritization Methods

Chapter 8: Asset Management

How does one plan for mode-specific transportation networks?

Chapter 9: Road and Highway Planning

Chapter 10: Transportation System Management and Operations

Chapter 11: Planning for Parking

Chapter 12: Transit Planning

Chapter 13: Planning for Pedestrians and Bicyclists

Chapter 14: Travel Demand Management

How does one plan for multimodal transportation networks?

Chapter 15: Statewide Transportation Planning

Chapter 16: Metropolitan Transportation Planning

Chapter 17: Corridor Planning

Chapter 18: Local and Activity Center Planning

Chapter 19: Site Planning and Impact Analysis

Chapter 20: Rural Community and Tribal Nation Planning

Chapter 21: Recreational Areas

What are some special planning applications transportation planners should know about?

Chapter 22: Integrating Freight into the Transportation Planning Process

Chapter 23: Playing it Safe—Safety Considerations in the Transportation Planning Process

Chapter 24: Public Participation and Engagement

Individual chapters provide linkages to relevant information in other chapters of the handbook. For example, transportation professionals interested primarily in chapter 12 on transit planning, will find references to other chapters on travel demand models and data collection that provide more in-depth coverage of a transit-related application. Thus, in some cases, chapters that in other texts would have spent considerable time discussing some aspect of a particular topic (such as transit demand modeling), the reader is directed to other parts of the handbook. Given the breadth of many transportation planning studies, it should not be surprising that, in some instances, almost every chapter in the handbook could be relevant to a particular study.

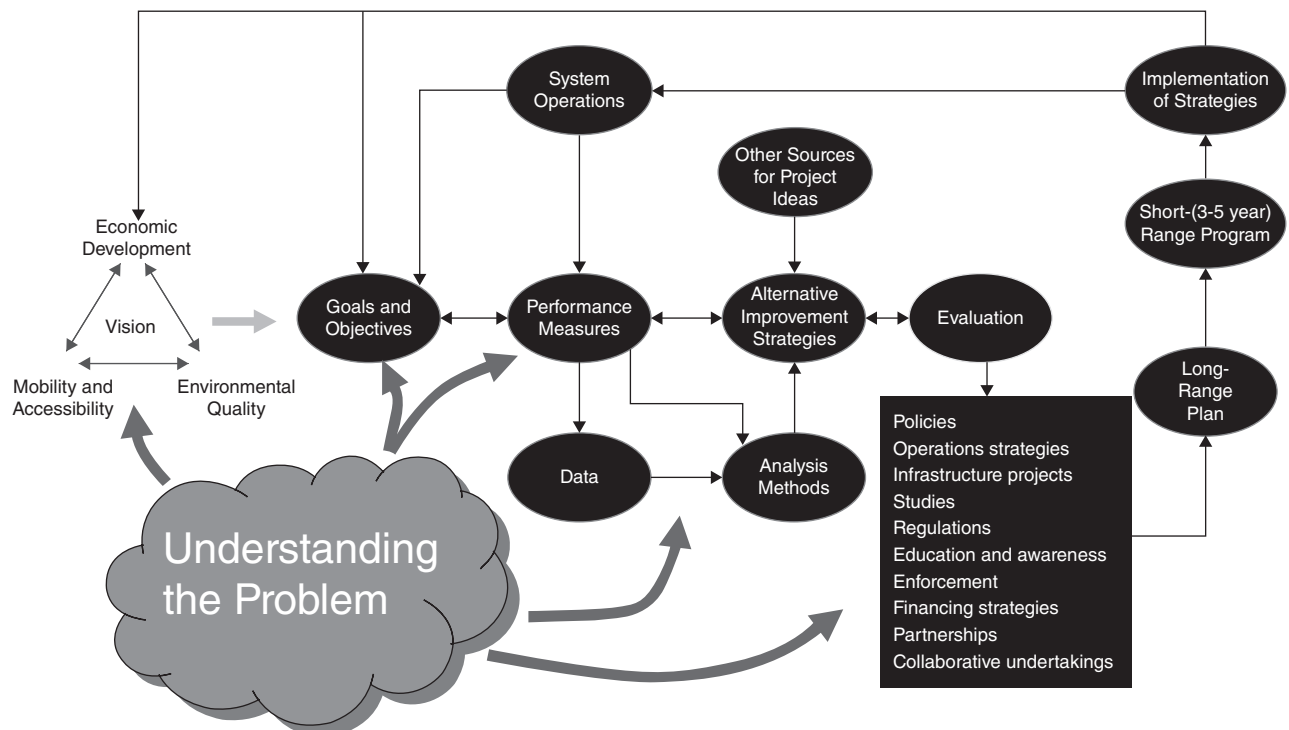
In addition, given the importance of performance measures in today's transportation planning, instead of discussing their definition and role in one chapter, the discussion of performance measures is found in each chapter where appropriate. In this way, performance measures can be discussed with specific reference to how they can be used for different modes and planning efforts.

The remainder of this chapter describes the transportation planning process and the legal/regulatory foundation in the United States for much of what occurs in transportation planning today.

III. THE TRANSPORTATION PLANNING PROCESS

Transportation planning is often portrayed as an orderly and rational process of steps that logically follow one another. In reality, planning and project development are much more complex, often with many different activities occurring concurrently. Shown in Figure 1-1, the planning process starts with understanding the problems facing a community and ending with a solution to identified problems (projects programmed and designed). In a typical planning context,

Figure 1-1. Conceptual Framework for Transportation Planning



Source: Adapted from Meyer and Miller, 2014, Reproduced with permission of M. Meyer.

many of these steps may have already occurred and therefore are not relevant to a particular planning effort. For example, metropolitan planning organizations (MPOs) in the United States have been developing transportation plans for decades, and as a result, a typical planning effort might simply be updating an existing transportation plan. In the context of Figure 1-1, the development of goals, objectives and performance measures might consist of validating those that were developed for the prior version of the plan. Even with these caveats, the planning process shown in Figure 1-1 helps identify important components of the planning process and how they relate to one another. The planning process in Figure 1-1 will be referenced throughout this handbook.

A. Major Steps in Transportation Planning

The planning process begins with an *understanding of the socio-demographic, land-use, and economic context* within which a transportation system operates. This is followed by becoming aware of the problems, challenges, opportunities, and deficiencies of transportation system performance within this context, be it a state, province, region, or community. This usually entails some form of analysis and assessment of the changing context of transportation system performance and an examination of both the existing and expected challenges facing the transportation system. This initial step is important because a planning agency usually begins a planning study based on the planning and analysis that has preceded it. More often, a transportation plan is being updated, or some specific problems have been identified that require a planning effort to be undertaken. Understanding the nature of the challenges facing a community thus becomes an important starting point for the planning steps that follow.

The next step is *developing a community or study area vision*. The dimensions of the vision portrayed in Figure 1-1 reflect the interaction among desired states of economic prosperity, environmental quality, and social equity/ community quality of life. These three factors have been chosen purposely as defining a vision because they are often considered to be the three major elements of sustainable development; a concept well-developed and accepted in recent years (see chapter 3). The vision can consist of general statements of desired end states or can be as specific as a defined land-use scenario. The visioning process often relies on extensive public outreach and is considered one of the most community-interactive steps of the planning process.

Once a vision has been defined, the next step is to *acquire more specific information* about what the vision means. What is the desired performance of the transportation system? What characteristics of community life can be most positively affected by transportation improvements? This more specific definition of a community's future is usually accomplished by *defining goals and objectives* that provide overall direction to the planning process. These goals and objectives not only help define the purposes of the planning process for the public, but can also help identify criteria to evaluate different transportation system options and alternatives.

Goals and objectives can also lead to the identification of *system performance measures*. Using measures to monitor the performance of the transportation system and the progress of transportation plans and programs is relatively new to the transportation field (see, for example, the performance management requirements of the 2012 U.S. federal transportation law—Moving Ahead for Progress in the 21st Century (MAP-21)). The primary purpose of collecting data on key system performance characteristics is to provide information to decision makers on the aspects of performance that are most important to them. Performance measures can be used to monitor whether congestion, average speeds, system reliability, and mobility options have changed over time. Many planning programs have also developed performance measures relating to such things as environmental quality, economic development, and quality of life. In these cases, transportation is just one factor that contributes to achieving overall community goals.

Collecting and analyzing data, the next step of the planning process, is key to understanding the problems and potential challenges facing the transportation system and the surrounding community. This analysis process primarily focuses on understanding how a transportation system and its components work and how changes to the system will alter its performance. A large part of the analysis step is identifying the current status of system performance. Analysis also includes identifying alternative strategies or projects that meet the objectives of the study. Analysis tools, ranging from simple data analysis to more complex simulation models, are used to produce the information that feeds the next step of the process, which is evaluation.

Evaluation is the process of synthesizing the information produced during the analysis step (for example, the benefits, costs, and impacts of different alternatives) so that judgments can be made concerning the relative

merits of different actions. As noted by Meyer and Miller [2014], evaluation should incorporate the following characteristics:

- Focus on the decisions being faced by decision makers.
- Relate the consequences of alternatives to goals and objectives.
- Determine how different groups are affected by transportation proposals.
- Be sensitive to the time period in which project impacts are likely to occur.
- In the case of regional transportation planning, aggregate information in a way that allows planners to assess the likely effects of alternatives at varying levels.
- Analyze the implementation requirements of each alternative.
- Assess the financial feasibility of plan recommendations.
- Provide information on the value of alternatives in a readily understandable form and timely fashion for decision makers.

One of the most common ways to ensure that the results of the evaluation process are linked closely to decision making is through the evaluation criteria used to assess the cost-effectiveness of individual alternatives or strategies and that reflect important decision-making concerns. These criteria provide important guidance to planners and engineers on the type of data and analysis tools to be used in producing the desired information.

Note in Figure 1-1 that planning can result in many different products. Studies can recommend the pursuit of specific transportation projects or services; they can recommend changes to institutional structures or funding programs that would make the management of the transportation system more effective. Some studies might recommend specific policy changes, such as how land-use and development plans should be linked to the transportation plan. In the United States, one of the most important products of the statewide and metropolitan transportation planning process is the development of a transportation plan. Much of what is covered in this handbook focuses on the steps necessary to develop such a plan. However, it is important to recognize that the ongoing planning process actually results in many different products aimed at improving the performance of the transportation system and in enhancing the economy and quality of life of the community it serves.

The actual program of action—in the United States called the transportation improvement program (TIP) for a metropolitan area or a state transportation improvement program (STIP) for a state—is connected to the plan through a process called *programming*. Programming matches the most desirable actions that have surfaced through the evaluation process with available funds. Priorities must be set when there are insufficient funds to satisfy all of the funding needs. This process can take many forms, ranging from political considerations to the use of systems analysis tools to assign priorities to different projects or alternatives.

Once a project or action has been programmed for implementation, its design and operation must be further refined, and likely impacts further explored. This process of refinement is called *project development*. Project development takes various forms, depending on the scope and magnitude of the project and the expected effects. Three major steps in project development include: developing project concepts, planning the project in finer detail than typically occurs in systems planning, and preliminary/final engineering. When significant environmental impacts are expected, the project development process will usually (depending on federal and state laws) include an environmental analysis process whose steps are well laid out in rules and regulations.

The final component of the framework is *system monitoring*. Note in Figure 1-1 that system monitoring provides feedback to the definition of goals and objectives and the use of performance measures. Poor system performance can lead to further planning analysis to better understand the dynamics of the underlying problem, or it might very well lead to the identification of new goals and objectives.

The planning process shown in Figure 1-1 is very different from more traditional constructs. First and perhaps most significantly, system planning as shown encompasses a broad set of planning steps. Many books on transportation planning have focused almost exclusively on analysis and evaluation, with the visioning process, program and/or project

implementation, and system monitoring occurring outside the planners' purview. The approach toward planning in this handbook adopts a much broader perspective to transportation planning.

Second, the use of performance measures is a relatively new addition to systems planning, and as shown in Figure 1-1, is a central concept to the overall process. Given the important linkage between planning and decision making that serves as the core concept in the definition of planning used in this handbook, performance measures should focus on the information of greatest concern to decision makers. Performance measures not only help define data requirements and influence the development of analytical methods, but also become a critical way of providing feedback to the decision-making process on the results of previous decisions.

Third, a major purpose of planning is to identify and analyze alternative improvement strategies and projects, which could include traditional infrastructure projects, but also actions to influence travel behavior and system performance. For example, travel demand management (TDM) strategies, such as variable work hours, rideshare programs, and parking pricing, have become important options in many metropolitan areas for reducing demand for transportation. Likewise, many intelligent transportation system (ITS) actions are not really projects as much as they are efforts to better improve transportation system performance through the use of technology. The planning process in Figure 1-1 provides for a much wider consideration of actions and strategies than what is usually considered part of the transportation planning process.

Figure 1-1 was presented primarily as a structure for planning in the United States. Other countries have their own requirements for transportation planning, or in the case of developing countries, they often follow the guidance of international lending institutions, such as the World Bank. However, although the goals and objectives, models and analysis tools, and strategies might be different from those found in the United States, the overall approach to planning in other countries is still similar to what is shown in Figure 1-1.

A final characteristic of planning proposed here is the periodic feedback provided to the original vision definition, goals statement, and identification of performance measures through system management and operations. System management and operations serves as a major source of information on transportation system performance and thus is an important indicator of system deficiencies or opportunities for improvement.

One of the useful aspects of the process shown in Figure 1-1 is that it provides a framework for assessing how comprehensive a planning process is for addressing specific issues. For example, Table 1-1, structured from Figure 1-1, is an example of how to assess the effectiveness of a transportation planning process with respect to safety issues. Similar constructs could be developed for almost any issue of concern to a community.

B. Linkage to Policy and Other Planning Efforts

Because much of transportation planning has developed in response to the needs of a nation, individual states or provinces and municipalities, a great deal of what a transportation professional does is defined by law. In the United States, for example, the Constitution establishes the structure of government and the powers, responsibilities, and limits of the different branches and levels of government. Those powers vested in the federal government take precedence over the actions and authority of state and local governments. Thus, although state departments of transportation (DOTs) and MPOs focus on state and metropolitan/local issues, respectively, federal law often requires that certain actions be taken. For example, federal law requires that each state and metropolitan area have its own transportation plan. Federal law, interpreted through regulations, requires that the process for developing these plans must have certain characteristics, such as an effective public participation process. In those areas that have not attained air-quality standards as set forth in federal regulations, the transportation system plan, improvement program and selected projects must be found to be in conformance to the adopted air quality plan. It is beyond the scope of this chapter to identify all of the U.S. federal requirements that influence transportation planning; however, some additional description of key laws that transportation planners in the United States will be exposed to is important (for more a more exhaustive presentation of relevant federal laws see [Gayle, 2009; Meyer and Miller, 2014]).

Federal guidance on transportation planning is justified by the importance of transportation to the nation—the economy, national security, and health and welfare of its citizens. It is this national purpose that generates the need for an informed and consistent approach to transportation investment across the nation, especially where federal funds are involved. Congress first established a federal requirement for metropolitan transportation planning in the Federal-Aid

Table 1-1. Assessing the Consideration of Safety in the Transportation Planning Process

Vision

- Is safety incorporated into the current vision statement of the jurisdiction's transportation plan? If not, why not?
- Is safety an important part of the mandates and enabling legislation of key agency participants in the planning process?
- Is safety an important concern to the general public and planning stakeholders? If not, should it be?
- How is safety defined by the community?
- What type of information is necessary and desired to educate the community on the importance of a safe transportation system?

Goals and Objectives

- Is safety incorporated into the current goals and objectives set of the jurisdiction's transportation plan? If not, why not? If so, what, if anything, needs to be changed in the way safety is represented?
- How does the safety goal relate to the community understanding of safety as discovered through the vision development process?
- Does the safety goal lead only to recommended project construction and facility operating strategies, or does it also relate to strategies for enforcement, education, and emergency service provision?
- Does the safety goal reflect the safety challenge of all modes of transportation, that is, is it defined in a multimodal way?
- Are there goal-related objectives that provide more specific directions on how the goal is going to be achieved? Are these objectives measurable?
- Do the objectives reflect the most important safety-related issues facing a jurisdiction?
- Can the desired safety-related characteristic of the transportation system be forecast or predicted? If not, is there a surrogate measure or characteristic that will permit one to determine future safety performance?
- What type of information is necessary and desired to educate the community on the importance of a safe transportation system as it relates to planning goals and objectives?
- If target values are defined in objective statements (for example, fatal crashes will be reduced by 20 percent), have these targets been vetted through a technical process that shows that the target value can be reached?

Performance Measures

- What are the most important safety-related characteristics of the transportation system that have resulted from community outreach efforts to date? If performance measures are used, are these characteristics reflected in the articulated set of performance measures?
- Will the safety performance of the transportation system (as defined in the performance measures) likely respond to the types of strategies and projects that will result from the planning process? That is, are the performance measures sensitive enough to discern changes in performance that will occur after program implementation?
- Are the number of safety performance measures sufficient to address the safety concerns identified in the planning process? Alternatively, are there too many safety measures that could possibly "confuse" one's interpretation of whether safety is improving?
- Does the capability exist to collect the data that are related to the safety performance measures? Is there a high degree of confidence that the data and the data collection techniques will produce valid indicators of safety performance? Who will be responsible for data collection and interpretation?
- Can the safety performance measures link to the evaluation criteria that will be used later in the planning process to assess the relative benefits of one project or strategy over others? If so, can the safety performance measures be forecast or predicted for future years?

(continued)

Table 1-1. (Continued)

Analysis—Data

- Given the definition of safety that resulted from the visioning and goals/objectives phases of the planning process, what types of data are needed to support the safety desires of the community?
- Are these data available currently? If not, who should collect these data? Are there ways of collecting these data, or are there surrogate data items that can be used to reduce the cost and burdens of data collection?
- Does the state (or region) have a systematic process or program for collecting safety-related data? If not, who should be responsible for developing one?
- Is there a quality assurance/quality control strategy in place to assure the validity of the data collected? If not, who should develop one?
- Are there opportunities to incorporate data collection technologies into new infrastructure projects or vehicle purchases (for example, surveillance cameras or speed sensors)?
- Does the safety database include safety data for all modes of transportation that are relevant to the planning process (for example, pedestrians, bicyclists, transit, intermodal collisions, etc.)? If not, what is the strategy for collecting such data? Who should be responsible?
- What types of database management or data analysis tools are available to best use the data (for example, a geographic information system)? Are such tools available to produce the type of information desired by transportation decision makers?
- Are there other sources of data in your state or region that might have relevant data for safety-related planning (for example, insurance records, hospital admissions, nonprofit organizations, etc.)? If yes, who should approach these groups to negotiate the sharing of data?
- Are there any liability risks associated with the collection and/or reporting of crash data? If so, how can your agency be protected against such risk?

Analysis—Tools

- What is the scale of the safety problem being faced? Regional? Corridor? Site-specific? Are tools available that analyze safety problems at the same scale of analysis?

Source: Washington, Meyer, et al. 2006. Permission granted by the Transportation Research Board.

Highway Act of 1962. To receive federal transportation funds, this law required urbanized areas with a population greater than 50,000 to develop a *continuing, comprehensive* transportation plan that was a *cooperative* venture with state and local governments. This requirement, known as the 3C planning process, still serves as the foundation of today’s transportation plans.

The 1973 Federal-Aid Highway Act and subsequent FHWA-Urban Mass Transportation Administration (UMTA) Joint Regulations on Transportation Planning had a profound impact on the institutional responsibilities for transportation planning. For the first time, federally supported urban transportation planning was funded separately: half of 1 percent of all federal-aid funds were designated for this purpose and apportioned to the states on the basis of urbanized area population. These funds were to be made available to “metropolitan planning organizations (MPOs) responsible for comprehensive transportation planning in urban areas.” The Joint Planning regulations thus required that an entity called the metropolitan planning organization be established in every urbanized area with a population of more than 50,000.

A multiyear prospectus and annual unified work program had to be submitted specifying all transportation-related planning activities for an urban area as a condition for receiving federal planning funds. The urban transportation planning process was required to produce a long-range transportation plan, which had to be reviewed annually to confirm its validity. The transportation plan had to contain a long-range element and a shorter-range “transportation systems management element” (TSME) for improving the operation of existing transportation systems without new facilities. A multiyear “transportation improvement program” (TIP) also had to be developed consistent with the

transportation plan. The TIP had to include all highway and transit projects to be implemented within the coming five years. The TIP had to contain an “annual element” that would be the basis for the federal funding decisions on projects for the coming year. The consequences of these requirements were that they changed the emphasis from long-term planning to shorter range transportation system management, and provided a stronger linkage between planning and programming. [Weiner, 1992, 2008] Most of these requirements, except the TSME of the long-range transportation plan, are still operative today.

In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) ushered in what many saw as a new era for transportation planning in the United States at both the metropolitan and statewide levels. This law fully established MPOs as the central forum for making transportation planning and investment decisions in metropolitan areas; it required a robust public involvement process, and it provided new flexibility in the use of federal capital program funds so that MPOs and states could find the best solutions to their transportation problems, rather than funding projects that fit the eligibility requirements of specific categorical funding programs. Different planning factors were to be addressed in the transportation planning process, including the need for the plan to be multimodal and intermodal, and to better understand the linkage between land use and transportation. ISTEA also required that both the plan and the TIP be fiscally constrained to only those projects that had a reasonable expectation of funding.

Prior to ISTEA, there was no federal requirement for statewide transportation planning, although many states do such planning. Along with the new requirements for metropolitan planning, ISTEA required states to create a planning process that would produce a long-range, intermodal statewide transportation plan and a short-range program of projects. While the process and content of the statewide plan did not have to be as rigorous as the MPO plan, Congress did include a list of planning factors that states were to consider.

The Moving Ahead for Progress in the 21st Century Act (MAP-21) passed in 2012 consolidated numerous categorical funding programs into a much smaller number of programs. For transportation planning, its biggest impact was in its requirement for state DOTs and MPOs to adopt performance measures. [FHWA, 2014a] The U.S. DOT was required to establish performance measures for safety, pavement conditions, bridge conditions, operational performance of the Interstate, operational performance of the non-interstates on the National Highway System (NHS), freight movements, mobile source emissions, and congestion. For transit, the U.S. DOT must “establish a national transit asset management system and performance measures for keeping transit in a state of good repair.” States and MPOs were to establish targets for each performance measure, and adopt a “performance-based approach” in planning and programming transportation projects. This performance-based planning and programming approach was more than just imposing performance measures on states and MPOs; it also required MPOs to measure and report on the outcome of investments from the TIP/STIP as they affected the travelling public. [FHWA, 2014a]

In recognition of the important role that freight plays in the national, state, and regional economies, MAP-21 required the U.S. DOT to report biennially on the conditions and performance of the “national freight network,” and to develop tools for “an outcome-oriented, performance-based approach to evaluate proposed freight-related and other transportation projects.” The transportation goals specified in this law for the federal highway programs included:

- *Safety*— To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- *Infrastructure Condition*— To maintain the highway infrastructure asset system in a state of good repair.
- *Congestion Reduction*— To achieve a significant reduction in congestion on the National Highway System.
- *System Reliability*— To improve the efficiency of the surface transportation system.
- *Freight Movement and Economic Vitality*— To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
- *Environmental Sustainability*— To enhance the performance of the transportation system while protecting and enhancing the natural environment.
- *Reduced Project Delivery Delays*— To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies’ work practices.” [FHWA, 2014b]

The most recent federal transportation legislation (as of the date of publication of this handbook) is the Fixing America's Surface Transportation (FAST) Act. This law reaffirmed the planning requirements of MAP-21 and added the following requirements to the metropolitan planning process.

- “Continue to require metropolitan transportation plans and transportation improvement programs (TIPs) to provide for facilities that enable an intermodal transportation system, including pedestrian and bicycle facilities. It adds to this list other facilities that support intercity transportation (including intercity buses, intercity bus facilities, and commuter vanpool providers).
- Expand the scope of consideration of the metropolitan planning process to include: improving transportation system resiliency and reliability; reducing (or mitigating) the stormwater impacts of surface transportation; and enhancing travel and tourism. Specifically, it required the consideration of strategies to reduce the vulnerability of existing transportation infrastructure to natural disasters. [FHWA, 2016]
- Add public ports and certain private providers of transportation, including intercity bus operators and employer-based commuting programs to the list of interested parties that an MPO must provide with reasonable opportunity to comment on the transportation plan.”

Given that transportation plays such a critical role in a nation's economy and in promoting the well-being of its citizens, it should be no surprise that transportation is part of many other legislative initiatives aimed at achieving nontransportation goals such as economic development and environmental quality. Again, it is beyond the scope of this handbook to identify all such laws. In terms of impact on transportation planning and project development, the most notable are the National Environmental Policy Act (NEPA), the Clean Air Act (and its amendments), and the Americans With Disabilities Act (ADA). [Gayle, 2009] Chapter 4 on environmental considerations in the planning process discusses these and other laws and regulations relating to environmental factors; chapter 12 and chapter 13 on transit planning and pedestrian and bicycle planning, respectively, describe ADA requirements for transit and pedestrian facilities; and chapter 15 and chapter 16 discuss the laws and regulations relating specifically to statewide and metropolitan transportation, respectively.

State governments also create and enforce laws relating to transportation (where not superseded by federal law). For example, a state can pass laws regulating the licensing and operations of trucks or other vehicles moving freight, but state laws cannot impede interstate commerce, which is protected by the Constitution. State laws are important in transportation for several reasons. First, they create the institutional structure for transportation planning at the state and, in many cases, metropolitan levels. That is, state DOTs and their roles and responsibilities are defined in state statutes, as are the roles and responsibilities of MPOs. Second, local units of government such as cities and counties are created by state governments. These local governments often cannot adopt laws and policies or raise taxes without enabling legislation from the state legislature. For example, in most states, a city cannot adopt a sales tax for transportation purposes without approval from the state. Third, state governments pass laws that can have significant impact on transportation planning. In Washington state and California, for example, state environmental laws require that statewide and metropolitan transportation plans undergo an environmental review to determine potential environmental consequences of the plan's proposed investment strategy. Finally, state governments establish their own sources of funding for transportation investment, which are even more important than federal sources for supporting a state's transportation system.

Similar to federal laws that recognize transportation's influential role in achieving nontransportation goals, other types of state-mandated planning often include transportation as a means of accomplishing program goals and objectives. Some examples of the linkage between transportation planning and other planning efforts are provided below to illustrate how transportation planning influences, and is influenced by, other planning activities.

Oregon: In many states, land use planning is the responsibility of local governments with only minimal guidance from state law. In 1973, the state of Oregon established the Land Conservation and Development Commission along with fairly rigorous (at least by the standards of most states) policy requirements for local planning. Subsequent goals adopted by the commission, which by reference have the force of law, cover numerous topics including the relationship between transportation and urbanization. The adopted transportation goal spells out the required content of transportation plans, while the urbanization goal includes adopting urban growth boundaries. In Oregon, state law clearly influences the range of actions to be considered in the transportation planning process. [Abbot, 2014]

New Hampshire: Transportation plans often demonstrate the need for future travel corridors in a metropolitan area or state, whether highway or transit. However, once a corridor is designated in a plan, developers may see it as a preferred

development site because of improved access. If future rights of way are built upon, the construction of the planned facility will be more expensive because of higher land acquisition cost. The New Hampshire legislature passed a law permitting the commissioner of transportation to designate corridors for planning purposes that provides both funding flexibility and land use protection (called corridor preservation). [New Hampshire Statutes, 1993]

Georgia: Many states require local jurisdictions to conduct comprehensive planning and to prepare plans that foster orderly growth. Georgia's local comprehensive planning law requires the evaluation of the following transportation assets as part of a community's comprehensive plan. [Georgia DCA, 2013]

- Road network: Roads, highways, and bridges.
- Alternative modes: Bicycle, pedestrian facilities, public transportation, or other services for populations without automobiles.
- Parking: Areas with insufficient parking or inadequate parking facilities.
- Railroads, trucking, port facilities, and airports.
- Transportation policies, programs, and projects and their alignment with local land use development policies.

Many states have passed smart growth legislation whose purpose is to guide development in the state and in communities where transportation or other infrastructure already exists or where it can be provided through developer contributions. Chapter 3 describes smart growth efforts in more detail.

Local governments, such as counties, cities, towns, and municipalities, also pass laws to protect the health, safety, and general welfare of their citizens. Local governments can influence transportation planning through their control of local street systems as well as their legal responsibilities for land-use zoning. Zoning ordinances empower local governments to take actions that protect the health, safety, and general welfare of their populace. These local policy and regulatory roles are critical to metropolitan transportation planning because of the close linkage between transportation and land use. As comprehensive plans and zoning codes define the location of different land uses and the density of development, they create over time an urban form that places demands and constraints on the transportation system. In addition, the provision or improvements to the transportation system can influence where development occurs. If both do not proceed in a coordinated fashion, the respective decisions may not always be compatible.

Local governments use a number of legal tools to address traffic impacts, including access management regulations, Complete Street requirements, impact fees and adequate public facilities ordinances. Some notable examples include:

- *Access management* is a strategy to reduce the number of conflict points on arterial streets, thereby increasing both capacity and safety. It is applied primarily where there is continuous retail and commercial development along an arterial road, where the tendency is for each site to have its own driveway access points.
- *Adequate public facilities ordinances* were developed in response to the need for public agencies to provide infrastructure to accommodate the needs of private development. Such ordinances are used to assure that public schools, roads, sewers, police and rescue response times, and/or other infrastructure or services are "adequate" to support proposed new development. For example, large subdivisions were often built with the developer providing only the internal infrastructure. The presumption was that the local government, pleased with the addition to its property tax base, would solve any resulting problems of traffic congestion, overcrowded schools, lack of public parks, demands on sanitary sewers and treatment plants, and so forth. Local governments in growing regions came to understand that the cost of providing all of the supporting infrastructure and services could outweigh the tax benefits of the development. The response was adopted ordinances requiring developers either to demonstrate the availability of adequate public facilities or to build whatever may be necessary to accommodate the needs of the new residents.
- *Traffic or transportation impact fees* are used by governments to internalize the cost of transportation improvements associated with development proposals. Such fees are typically enabled by state law and created by local government ordinance. The revenue generated by the fee is used by the local government to defray the cost of off-site transportation improvements. This model is most often used in high-growth areas as a way to capture the cumulative impact of numerous individual site developments.

More is said about the tools available to local communities and their impact on transportation planning in chapter 3 on land use.

The preceding discussion focused on the U.S. policy and legal context for transportation planning. Other countries have similar structures establishing the legal foundation for planning activities (countries in the British Commonwealth, for example, have a long legacy of comprehensive planning legislation that has included transportation in significant ways). Transportation planning, no matter where practiced, reflects the institutional structure for such planning established by national, state/provincial, and local governments. In addition, transportation planning is influenced by the societal, economic, and technological factors that define the context within which transportation planning occurs. As such, it is important for transportation planners to think about those trends and the likely characteristics of the future that will influence the use and performance of the transportation system.

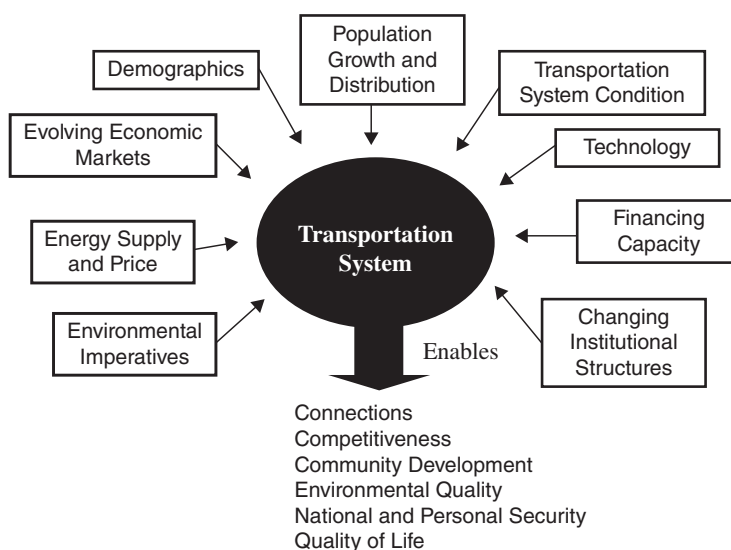
IV. CHANGING CONTEXT FOR TRANSPORTATION PLANNING

The issues considered in a transportation planning process often reflect the changing characteristics of society as a whole. In addition, changes in economic markets and transportation technology often provide challenges as well as opportunities to enhance transportation system performance. Figure 1-2 presents one way of looking at how these changes feed into a planning vision. As noted by Meyer (2007), the 10 factors likely to influence how transportation systems are planned and perform in the future include:

1. Population Growth

Population growth and where populations locate place increasing pressures on governments at all levels to provide transportation infrastructure and services, even though the mechanisms for providing this service might be very different from historical practice. The United States will see an increase in population over the next several decades, with immigration providing a large portion of this increase. For example, the 30 years between 2015 and 2045 will see 70 million more people added to the U.S. population, more population than currently in New York, Florida, and Texas combined. [U.S. DOT, 2015] In the absence of policies that influence development patterns, a large portion of this growth will likely continue to occur in suburban areas. However, center cities are also likely to experience growth (depending on the metropolitan area), especially as “empty nesters” move back into urban centers.

Figure 1-2. Changing Context of Transportation Planning



Source: Meyer, 2007, Reproduced with permission of M. Meyer.

2. Changing Demographics

The aging and changing demographics of the U.S. population will have profound and lasting effects on personal transport and will increase demands for services to population groups that could be very different than today, such as the elderly. For example, on average, Americans over the age of 65 drive half the amount of Americans aged 25 to 64. In 2009, Americans between the ages of 18 and 34 drove 21 percent fewer miles than those in that age group did in 2001. Between 2000 and 2013, the population of low-income Americans in suburbs grew twice as fast as low-income populations in cities. [U.S. DOT, 2015] New demands for housing choices and community services; improved access to cultural and recreational sites; and easy access to interstate travel all lead to a transportation system that is not focused as much on aggregate flows as it is on individual and group travel patterns.

3. Evolving Economic (and Thus Geographic) Markets

Future U.S. economic success will be tied closely to the ability of the nation’s economic centers or megaregions to connect to the global economy. For example, in 2008, eleven identified megaregions in the United States included 75 percent of the U.S. population and employment, more than 80 percent of the gross regional products, 92 percent of the Fortune 500 company headquarters, and were the source of over 92 percent of the patents issued in the United States. [Ross and Woo, 2011] This suggests that not only should transportation investment be focused on the nation’s major ports of entry and the transportation facilities serving them, it should also be focused on the effectiveness of the internal transportation system in these economic centers.

4. *Transportation System Preservation*

It is safe to say that system preservation already dominates transportation program expenditure in many countries; this is not an emerging issue as much as a consequence of the age of infrastructure building boom of the 1960s–1970s. Of the 607,000 public road bridges in the United States, about 67,000 were classified as structurally deficient in 2012 and another 85,000 were classified as functionally obsolete. Over the past 10 years, more than 15 percent of state capital spending on highways has gone to bridge rehabilitation and replacement. [U.S. DOT, 2015] Although certainly not one of the most stimulating issues in political forums, preserving and maintaining the existing transportation system infrastructure will increase in importance even more during the next several decades. In most states and metropolitan areas, these needs will dominate investment priorities in the near future.

5. *Transportation System Resiliency*

Transportation systems tend to be vulnerable to disruption from natural or man-made causes. It is not surprising that the largest number of targets for terrorist attacks around the world is some component of a transportation system. . . . buses in Israel, the Tokyo subway system, buses in London, commuter rail in Madrid, and reported attempts to derail Amtrak trains in the United States. Extreme weather events, such as hurricanes, heavy precipitation storms resulting in floods, extreme temperatures, drought, and tornadoes, also often cause major disruptions to a transportation system. Hurricanes Katrina and Sandy in the United States, for example, caused billions of dollars in damage to roads, bridges, railroads, airports, and ferry terminals. Over the longer term, climate change could exacerbate the risk of transportation system disruption from weather events. Transportation planners and engineers need to be concerned about how to plan and design transportation systems that are not only resilient—that is, systems that can survive and/or recover quickly from disruptions—but also systems that can act as lifelines for emergency relief and recovery after a disaster occurs.

6. *Technology*

Modern society is largely defined by the technologies used to support individuals' everyday activities and the foundational technologies that keep communities functioning, such as water, transportation, waste removal, and power technologies. Absent any major disruption in the nation's economic structure, new technologies will likely play a significant role in how the nation and individual citizens conduct their business in future years. This is likely to be especially true for the management and use of the transportation system. Of particular interest today is the rapid technological advancements in autonomous (self-driving) vehicles, the application of vehicle-to-infrastructure technologies, and 3D printing (used in long-distance manufacturing). A recent U.S. DOT report on the future of transportation identified the following likely characteristics of technology applications in transportation. [U.S. DOT, 2015]

- Data collection and analysis will become cheap and widespread.
- Payment (for transportation) will be easy, frequent, and inexpensive.
- New methods of payment will enable transportation agencies to develop more targeted user-fee-based revenue streams.
- 3D printing has the potential to disrupt traditional supply chains and counteract the growth of imports by reducing the need for large-scale manufacturing, transportation, and storage.
- Robotics research is advancing across all transportation modes.
- Automation will have a potentially transformative impact across all transportation modes, increasing productivity, improving safety, and enhancing the capacity of existing infrastructure.
- The automation of motor vehicles is likely, and has the potential to revolutionize ground transportation.
- While many emerging technologies could have major safety and security benefits when applied to transportation, in some cases they could also create new vulnerabilities.
- Rapidly evolving technology will demand government flexibility: regulations may be necessary, but in order to advance and encourage innovation, not prevent it. Government must also ensure the primacy of safety as new technologies are implemented.

The implications of these new technologies on transportation system decision making and finance are largely unknown.

7. Financing Capacities

Increasing vehicle fuel efficiency and reduced vehicle miles traveled resulted in an inflation-adjusted federal gas tax revenue decline of \$15 billion, or 31 percent, from 2002 to 2012. Over the same period, state gas tax revenues decreased by \$10 billion, or 19 percent, adjusting for inflation. The FHWA has estimated that at least \$24 billion in additional capital spending would be required from all levels of government to improve highway system performance. [U.S. DOT, 2015] The future will see a much wider variety of financing strategies used to support the transportation system. In the short term, however, the gasoline tax will likely continue as the major source of road financing. New finance strategies will include a combination of public and private initiatives and the application of pricing schemes resulting in some additional financial resources.

8. Changing Institutional Structures

Due to the changing financing strategies of future investment programs and the geographic definition of markets, future institutional arrangements will likely include many different structures and strategies than are seen today. For example, one is likely to see more regional organizations focusing on problems and challenges that cross jurisdictional boundaries. Likewise, given the local nature of many transportation problems, many regions will likely see a growth in transportation-related civic groups. In addition, as noted above, private companies and firms will play a more important role in transportation finance.

9. Environmental Imperatives

One of the most significant factors affecting the future of transportation decision making is likely to be the continuing public and policy concern for preserving and enhancing environmental quality. Traditionally, this has included concerns for air quality, noise, water quality, habitat and wildlife preservation, and the like. In the future, this concern will likely include attention to the emission of greenhouse carbon gases and their long-term impact on the climate. Many areas of the world and in the United States are already experiencing higher-than-normal extreme weather events. Such events coupled with the longer-term challenges given a changing climate (for example, sea level elevation for coastal communities) represent one of the most important emerging environmental imperatives in many communities around the world.

10. Energy

Energy supplies and pricing in the long term could be one of the defining characteristics of how the U.S. transportation system is managed and used. Moving toward energy independence will require a concerted effort over many decades in both developing and implementing new technologies to transform the U.S. transportation system. With the discovery of new sources of petroleum in the United States, it is not clear whether future prices will increase (in relative terms), fluctuate as they have in the past, or remain at low levels due to overproduction. Given that the transportation system is one of the highest consumers of petroleum-based fuels, the price of fuel, and/or the substitution of petroleum-based fuels with alternative fuels, could be one of the most important factors influencing future transportation demand and travel behavior.

Many issues unforeseen today could also become critical considerations for transportation planning in the years ahead. No matter what form these issues take, this handbook's basic approach is that the planning framework shown in Figure 1-1 can be used to provide the best possible approach to problem solving.

V. ADDITIONAL SOURCES OF INFORMATION

Many different organizations provide information on transportation planning and on the various aspects of how transportation affects a community. Every state DOT and MPO has information on their respective websites relating to the issues facing the state or metropolitan area. Federal agencies such as the U.S. DOT, FHWA, Federal Transit Administration (FTA), and Environmental Protection Agency (EPA) also produce technical guidance and reports on transportation planning topics. For example, one of the most recent reports from the U.S. DOT, *Beyond Traffic*, provides an excellent background on the trends that are likely to affect the future of transportation. [U.S. DOT, 2015]

Among professional organizations, the American Association of State Highway and Transportation Officials (AASHTO), the American Planning Association (APA), the Association of Metropolitan Planning Organizations (AMPO), the National Association of Regional Councils (NARC), and the Institute of Transportation Engineers (ITE) provide books and reports on different aspects of transportation planning.

The Transportation Research Board (TRB) is one of the major sources of information on the latest concepts and approaches used by transportation planners. The TRB *Journal of the Transportation Research Board* annually

publishes articles on a wide-ranging set of topics as well as research reports from the National Cooperative Highway Research Program (NCHRP), Transit Cooperative Research Program (TCRP), National Cooperative Freight Research Program (NCFRP), and the Strategic Highway Research Program 2 (SHRP 2). For example, NCHRP recently published a series of future-looking reports focusing on the following topics that are highly relevant to transportation planning:

- Freight: Economic Changes Driving Future Freight Transportation
- Climate Change: Climate Change and the Highway System: Impacts and Adaptation Approaches
- Technology: Expediting Future Technologies for Enhancing Transportation System Performance
- Sustainability: Sustainability as an Organizing Principle for Transportation Agencies
- Energy: Preparing State Transportation Agencies for an Uncertain Energy Future
- Socio-Demographics: The Effects of Socio-Demographics on Future Travel Demand

Interested readers are referred to: <http://www.trb.org/NCHRP750/ForesightReport750SeriesReports.aspx>.

SHRP also produced a useful web tool called *Plan Works*, which allows planners to identify different components of the transportation planning process to obtain information on the data and tools that are available (see <https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide>).

It is also not unusual for nonprofit organizations to produce technical guides and information reports on targeted topics, such as pedestrian and bicyclist planning, transit planning, and public participation.

The reader is encouraged to search these and other sources for the latest information on transportation planning.

VI. SUMMARY

The rest of this handbook describes key components of the transportation planning process and presents tools that transportation planners can use to provide information for those who make decisions. Any transportation planning process consists of multiple steps, with the scope and scale of each step depending on the context of a planning study. Planning begins with “understanding the problems,” which could include nothing more than an analysis of the latest data (for example, crash statistics) to a much more involved public participation process that provides planners with a range of input on the challenges facing a study area. The next steps in the process include identifying goals, objectives, and performance measures. This step is critical for defining the criteria to be used later to assess the relative effectiveness of different alternatives and thus in identifying the types of tools and data to be used during the analysis. The following analysis step consists of the data, analysis tools, and models used to identify the likely impacts or consequences of implementing different strategies or actions. This is the step that has received most attention through the decades in terms of model enhancements and improved data collection techniques.

The next step, evaluation, is perhaps most closely linked to the major purpose of planning, that is, to provide information to those making decisions. Evaluation takes the information from the analysis step and determines the trade-offs associated with pursuing one alternative versus another. This usually involves extensive public engagement as well as the application of methodologies, such as benefit/cost analysis, that allow the planner to assess the relative merits of alternatives. The results of evaluation then feed into a plan (in a more formal planning process) or in reality can lead to a range of actions ... additional studies, investment strategies, enforcement/education efforts, and so on. In the United States, a formal plan is required for every urbanized area over a 50,000 population. In addition, a transportation improvement program (TIP) is required that lays out the project priorities and agency responsibilities for delivering the capital program. Over time, the impact of these new investments on the performance of the transportation system are reflected in the ongoing monitoring program and then fed back into performance measures ... and the planning process begins again.

The transportation planning process lays the foundation for the decisions to improve the transportation system. Accordingly, it is important that transportation professionals understand the key components of the process, and are familiar with the analysis and evaluation approaches that are typically used as part of this process. The following chapters provide such an understanding.

VII. REFERENCES

- Abbott, C. 2014. "Senate Bill 100." *The Oregon Encyclopedia*. Portland State University. Portland, OR.
- Federal Highway Administration (FHWA). 2014a. *Statewide and Nonmetropolitan Transportation Planning*. Accessed Jan. 29, 2016 from <http://www.fhwa.dot.gov/map21/factsheets/snmp.cfm>.
- _____. 2014b. *National Goals*. Accessed Jan. 31, 2016, from <http://www.fhwa.dot.gov/tpm/about/goals.cfm>.
- FHWA. 2016. *Metropolitan Planning*. Accessed Feb. 8, 2016, from <https://www.fhwa.dot.gov/fastact/factsheets/metropolitan/planningfs.pdf>.
- Gayle, S. 2009. "Legal framework for transportation planning." In *ITE Transportation Planning Handbook*, Washington, DC: Institute of Transportation Engineers.
- Georgia Department of Community Affairs (DCA). 2013. Chapter 110-12-1, *Minimum standards and procedures for local comprehensive planning*, Effective January 1, 2013, Accessed Feb. 4, 2016, from <http://www.dca.state.ga.us/development/planningqualitygrowth/DOCUMENTS/Laws.Rules.Guidelines.Etc/DCARules.LPRs.pdf>.
- Meyer, M. 2007. "Toward a Vision for the Nation's Surface Transportation System: Policies to Transcend Boundaries and Transition to a New Era," Paper presented at the forum on Developing a National Transportation Vision, Regional Plan Association and Lincoln Institute of Land Policy, Tarreytown, NY. February 20–22.
- Meyer M. and E. Miller. 2014. *Transportation planning: A decision-oriented approach*. Accessed Jan. 31, 2016, from <http://mtsplan.com/services.html>.
- New Hampshire Statutes. 1993. REV. STAT. ANN. §§ 230-A:I to A:I7.
- Ross, C., and Woo. 2011. "Megaregions and Mobility." *The Bridge, Linking Engineering and Society*, National Academy of Engineering, Washington, DC. Accessed Jan. 31, 2016, from, <http://www.nae.edu/File.aspx?id=43182>.
- U.S. Department of Transportation. 2015. *Beyond Traffic 2045, Trends and Choices*. Washington D.C. Accessed Jan. 30, 2016, from, https://www.transportation.gov/sites/dot.gov/files/docs/Draft_Beyond_Traffic_Framework.pdf.
- Weiner, E. *Urban Transportation Planning in the United States, An Historical Overview*. Report DOT-T-93-02. U.S. Department of Transportation. Accessed Jan. 31, 2016, from, <http://ntl.bts.gov/DOCS/UTP.html> (2008 edition is also available from <http://www.amazon.com/Urban-Transportation-Planning-United-States/dp/144192647X>).