Transportation Planning Process

Introduction

Transportation occupies a high place in modern life. Advancement in all spheres of life has been to a large extent influenced by transportation. A transportation planning is a science that seeks to study the problems that arise in providing transportation facilities in an urban, regional setting and to prepare a systematic bases for planning such facilities. Since the developed countries where this sciences has evolved are mainly urban- oriented the emphasis is more on urban transport planning. However the principles of urban transport planning can be applied to regional or national transport planning as well with due change wherever called for.

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, 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.

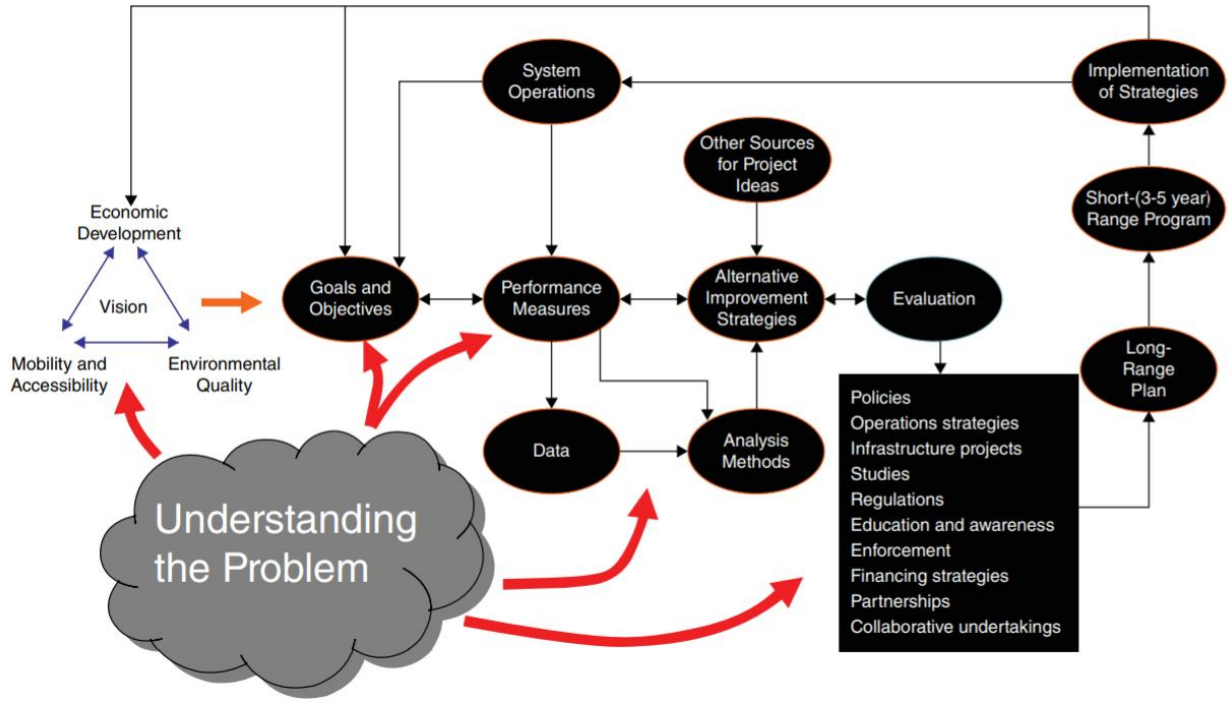

Figure 1-1. Conceptual Framework for Transportation Planning

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. 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 (H.W, explain and give examples). 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.

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.

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 below, 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.

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?

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?

The transportation goals specified

- "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.

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, and 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.

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:

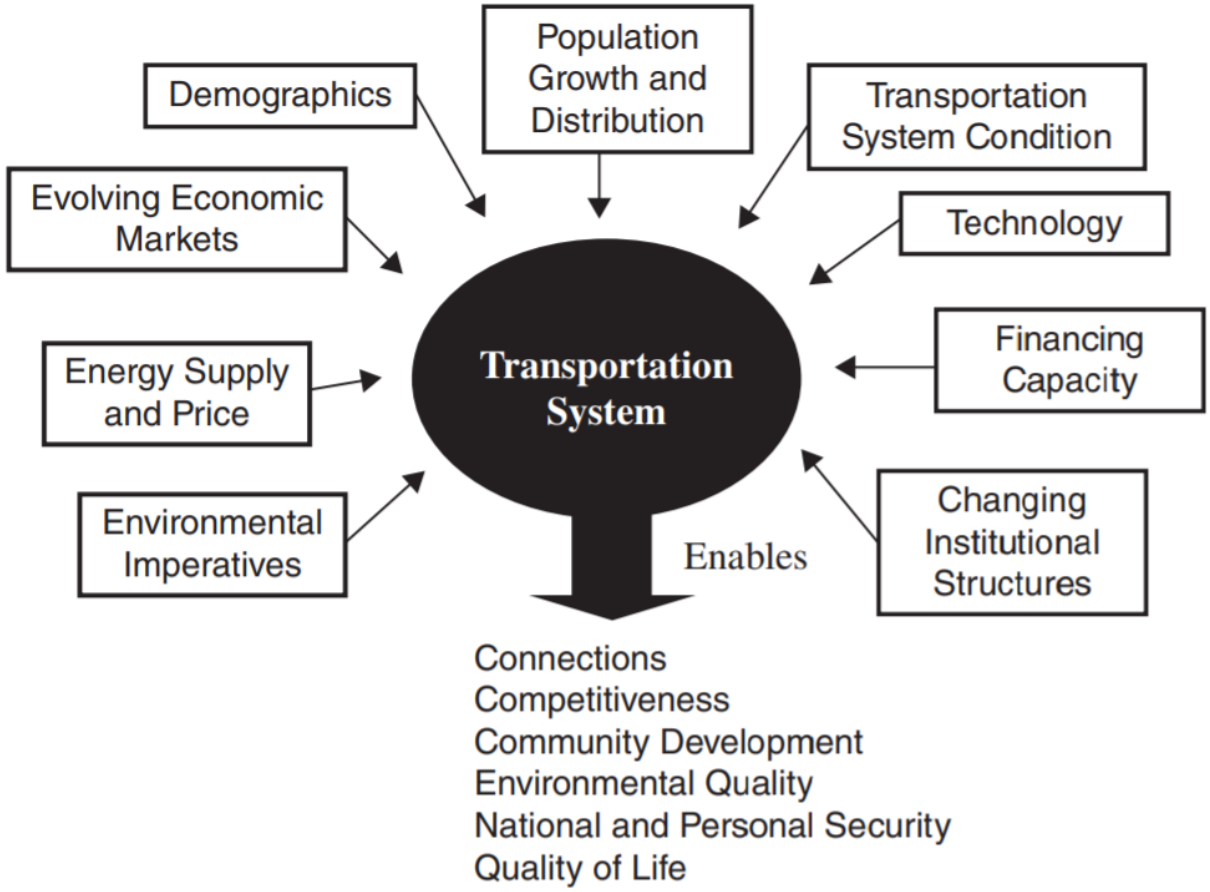

Figure 1-2. Changing Context of Transportation Planning (*Source: Meyer, 2007, reproduced with permission of M. Meyer).*

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. 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.

2. Changing Demographics

The aging and changing demographics of the 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. 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 economic success will be tied closely to the ability of the nation's economic centers or megaregions to connect to the global economy. [Ross and Woo, 2011] 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; [U.S. DOT, 2015] 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. 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. 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

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 [U.S. DOT, 2015].

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 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 transportation system. 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.

Additional Source 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.