



# Virtual Conference on Transportation Planning Research Needs

## Final Report

### *Requested by*

American Association of State Highway  
and Transportation Officials (AASHTO)  
Standing Committee on Planning

### *Prepared by*

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## 1. Introduction/Purpose

Over the past 20 years, changing legislative requirements – from the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) through the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005 – have resulted in an evolution of the roles and responsibilities of state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) related to transportation planning and programming. Recent events, court decisions, and environmental laws have also placed new requirements on transportation agencies.<sup>1</sup> Moreover, limited funding for transportation projects and increased stakeholder demands have shifted traditional ways of planning highway infrastructure into new models of integrated multimodal transportation planning that more effectively account for social, economic, and environmental considerations. The next authorization of surface transportation legislation is likely to yield even greater changes in transportation planning requirements, and associated needs for new tools, resources, and policy approaches. In addition to legislative mandates, economic and environmental concerns, community quality-of-life issues, and funding issues are continuing to propel fundamental shifts in approaches to transportation planning.

As transportation agencies face ongoing and emerging transportation planning issues, research will be vital to help state DOTs and MPOs address these challenges. Ongoing research is one key to assuring that transportation agencies have the best and most current information, processes, and tools they need to successfully meet their planning responsibilities. The return on investment in research can be significant. Planning research can help to improve fundamental knowledge about the relationships between transportation, economic, social, and environmental systems; to develop improved tools and techniques for use in transportation planning, including modeling, simulation, and visualization tools; and to identify and develop innovative approaches for improving planning practices and achieving desired outcomes.

Given limited research budgets for transportation planning, a strategic process for identifying the most critical planning research needs is important to ensure that research is funded that benefits transportation planners across the country. Although the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Planning (SCOP) annually issues a call for project statements under the National Cooperative Highway Research Program (NCHRP) Project 08-36 to address short-term quick-response research needs, there is a need to look at planning research in the broader context of the various entities conducting planning-related research. This includes the Federal Highway Administration (FHWA), under the Surface Transportation Environment and Planning (STEP) Cooperative Research Program; the Transportation Research Board's (TRB) cooperative research programs (National Cooperative Highway Research Program, Transit Cooperative Highway Research Program, and National Cooperative Freight Research Programs), university research centers, and research conducted by state DOTs and MPOs, as well as by AASHTO and other associations.

In the past, TRB has sponsored research needs development conferences, such as the Environmental Research Needs in Transportation Conference held in 2002 in Washington, DC.<sup>2</sup> These conferences allow

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<sup>1</sup> For instance, *Massachusetts v. Environmental Protection Agency*, 549 U.S. 497 (2007), found that the agency has the authority under the Clean Air Act to regulate carbon dioxide and other greenhouse gas emissions.

<sup>2</sup> An Environmental Research Needs Workshop was more recently held in Raleigh, NC as part of the TRB Environment and Energy Research Conference, from June 6-9, 2010. This workshop involved a 4-hour workshop

transportation practitioners to meet face-to-face, typically over a two to three-day period, to identify research gaps and help to define research priorities. Unfortunately, face-to-face conferences are a luxury few state DOTs and MPOs can afford today. Many agencies are precluded from traveling out-of-state and those that can have to balance the benefit gained from attending these conferences with the risk of falling behind in their workload. With DOT participation declining at national meetings, and time and budgets tighter than ever, it is imperative to use resources in increasingly more practical and pragmatic ways.

The SCOP Subcommittee on Research recognized the need to take a new approach to soliciting, gathering, and compiling research needs statements. They also wanted a very inclusive process that would bring in perspectives from State DOT and MPO planners from across the country to identify research needs. The Subcommittee proposed a “Virtual Conference” on Transportation Planning Research Needs where participants gather via the Internet or telephone, since this would offer an opportunity to expand the level of participation in defining research needs and developing research project statements.

A virtual conference potentially can reach audiences more effectively than in-person events and at lower cost because there is no need to plan travel or reserve conference space. Unbound by the restrictions associated with travel budgets, a virtual conference offers the potential for participation by state DOT and MPO transportation practitioners as well as researchers who otherwise may not have had the opportunity to attend an in-person meeting. Use of Web-based technology is efficient, as it allows people in different location to collaborate through a combination of communication over the Internet and phone and to conduct real-time voting and prioritization exercises, all from the convenience of their own desks.

The objective of NCHRP 08-36, Task 95 was to plan and conduct this Virtual Conference on Transportation Planning Research Needs. This report documents the structure of the virtual conference, the resulting research needs statements, and lessons learned from the experience of utilizing a virtual conference format. The research needs and challenges identified through this effort may be a useful starting point for developing research statements for submission to TRB, FHWA, or other research funding entities.

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on June 6, which was used to identify research needs statements, and enabled participants at the conference to vote on research priorities and identify additional research needs.

## 2. Structure of the Virtual Conference

In the process of developing a virtual conference, the NCHRP project panel and consultant team from ICF International developed a structure and selected technology for the virtual conference that would accommodate a wide range of participation, be easy to use, and allow efficient communications to and from participants. Unlike an in-person conference, where participants gather in a conference facility for several days, a virtual conference demands a different structure with shorter periods of focus. For instance, it would be difficult to get participants to spend two full days focused on the development of research needs solely interacting over the phone and internet from their own offices, given the lack of face-to-face interaction and the distractions (e.g., phone calls, e-mails, meetings) that often come up when individuals are in their own offices.

The team, therefore, devised a structure for the virtual conference that involved multiple opportunities for interaction. The structure was as follows:

- **Research Scan** – First, the team conducted an initial research scan to identify on-going and planned research, and research priorities that had already been identified by TRB Committees, FHWA, State DOTs, and MPOs across the country. This research scan was used to develop short PowerPoint briefings that were distributed to participants and were the basis for discussions during the virtual conference.
- **Nationwide Survey** – The team then developed and distributed a web-based survey to planning practitioners. The survey was open for approximately six weeks, from early November to mid-December 2009. The purpose of the survey was to gain an understanding of key transportation planning issues facing transportation agencies that could benefit from further research.
- **Plenary Session** – A “plenary session” was held on March 8, 2010 to kick off the virtual conference. This 2-hour webinar session included presentations from key national speakers about transportation planning challenges in order to generate ideas about research needs. In this session, participants were given the opportunity to identify key research challenges and were encouraged to sign up for “breakout sessions” that followed.
- **Breakout Sessions** – Six interactive web-based “breakout sessions” were held over the remainder of March through early May 2010 (approximately one each week), each focusing on a different set of transportation planning issues and topics. The breakouts allowed focused discussion on specific sets of planning topics, in order to generate ideas about research needs statements. The sessions relied upon the PowerPoint briefings from the research scan as a starting point, and utilized on-line polling to help prioritize and generate discussion around research topics.
- **Website / Discussion Forum** – A website was developed for the virtual conference, and was used by participants to sign up for sessions and download the PowerPoint briefings. Following each session, materials were posted to the website and web discussion forums allowed transportation practitioners to comment upon research needs.

The table below highlights the key purpose of each activity, and time commitment required of participants, as well as the total number of individuals who participated.

**Table 1. Key Activities, Purpose, Time Commitment, and Number of Participants**

Activity	Purpose	Participant Time Commitment	Number of Participants
Survey	Gain initial input on key issues and challenges facing transportation planners	Less than 15 minutes	329 respondents
Opening Plenary	Kick-off the virtual conference: Highlight importance and inclusiveness of this effort; summarize results of survey; engage participants in thinking about research needs and participating in breakouts	2 hours	Approximately 300, 250 individual log-ins (1 to 10+ participants were reported per site)
Breakout Sessions (6)	Focus on specific planning research topics; engage ideas about priority research needs	2 to 3 hours each	436 log-ins, 288 unique log-ins (some sites may have had multiple participants per site)
Blog	Follow up opportunities for participants to review materials (briefing materials, sessions), and post additional ideas and comment on research priorities; provide input to refine the draft research needs	Up to participants	N/A

These activities were designed to provide multiple opportunities for input on research needs, and to allow resulting problem statements to be vetted by other practitioners. The consultant team also conducted outreach over the course of the conference planning effort in order to encourage as broad a level of participation as possible. Summaries of the various activities are discussed further below.

## 2.1. Initial Research Review

Organizers conducted a literature scan and research review to determine previously-identified research needs, completed and ongoing research studies, and current thinking about emerging research issues and topics. Resources consulted as part of this effort included:

- The STEP research program’s identification of research needs, as well as other products and resources created by FHWA;
- TRB’s Research Needs Database;
- TRB’s Research In Progress Database;
- Research needs statements and strategic plans developed by relevant TRB committees; and
- Research needs developed for the Strategic Highway Research Program (SHRP).

In addition to the literature scan, a number of experts in the field were interviewed because of their knowledge of the current state of the practice and research needs in transportation planning. These

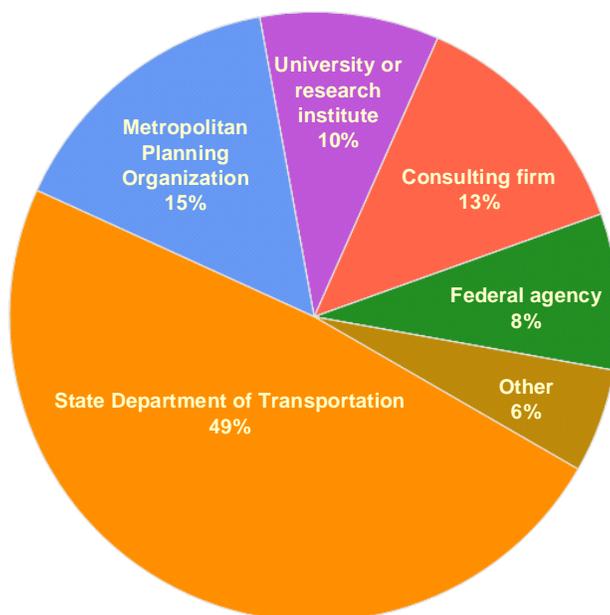
individuals included Jim Cheatham, Harlan Miller, and Kenneth Petty of FHWA’s Office of Planning; Michelle Maggione of the American Association of State Highway and Transportation Officials (AASHTO); and Rich Denbow of the Association of Metropolitan Planning Organizations (AMPO). In addition, the consultant team reached out to the chairpersons for all of the planning-related TRB Committees to gather research needs statements and inform them about the virtual conference effort. The information gathered from this research review was used as the basis for “briefing presentations” that were distributed to participants and used as a starting point for discussion during the virtual conference.

## 2.2. Nationwide Survey

A nationwide web-based survey of DOT and MPO planning practitioners about the issues facing them or anticipated to be facing them in the near future was conducted in order to obtain a sense of important issues and gaps in knowledge or practice. The conference organizers sent out a ten-question survey to gather information about challenging transportation planning issues and experiences with submitting research needs ideas (see Appendix A). The results of the transportation planning needs survey informed the organization of the virtual conference.

In total, 329 individuals took the survey, with approximately 275 completing the full survey. Of those taking the survey, 49 percent were from state DOTs, 15 percent were from MPOs, 13 percent were from consulting firms, 10 percent were from universities/research organizations, and the remaining were from federal agencies or other organization types, as shown in Figure 1 below.

Figure 1. Share of Respondents to Web-based Survey, by Organization Type



The survey focused on the specific issues/challenges they were facing in planning and research’s ability to help with these challenges. Respondents were asked to respond to a list of issues whether they were

“very challenging,” “moderately challenging,” or “not challenging” from the perspective of needing research. The topics included:

- Climate Change
- Community Impacts
- Congestion
- Data
- Economic Impacts
- Emergency Response
- Environmental concerns/issues
- Environmental justice
- Federal planning requirements
- Freight planning
- Funding issues
- Integrated transportation/land use/environmental planning
- Inter-governmental cooperation
- Mobility
- Modeling tools and techniques
- Other planning-based technologies (e.g., visualization)
- Performance-based planning
- Planning for operations
- Public stakeholder involvement
- Safety
- Security
- Social issues
- Sustainability/Sustainable transport

Within the list, the issues that were identified as most challenging (with percentage indicating “very challenging”) included: funding (56%); integrated transportation/land use/environmental planning (52%); climate change (46%); sustainability (44%); data (40%); economic impacts (40%), performance-based planning (37%); and congestion (33%). In addition, respondents also found many of the other topics moderately challenging. In total, 238 respondents provided additional detail on the research gaps associated with their most challenging issues, and 160 respondents identified other emerging issues of concern.

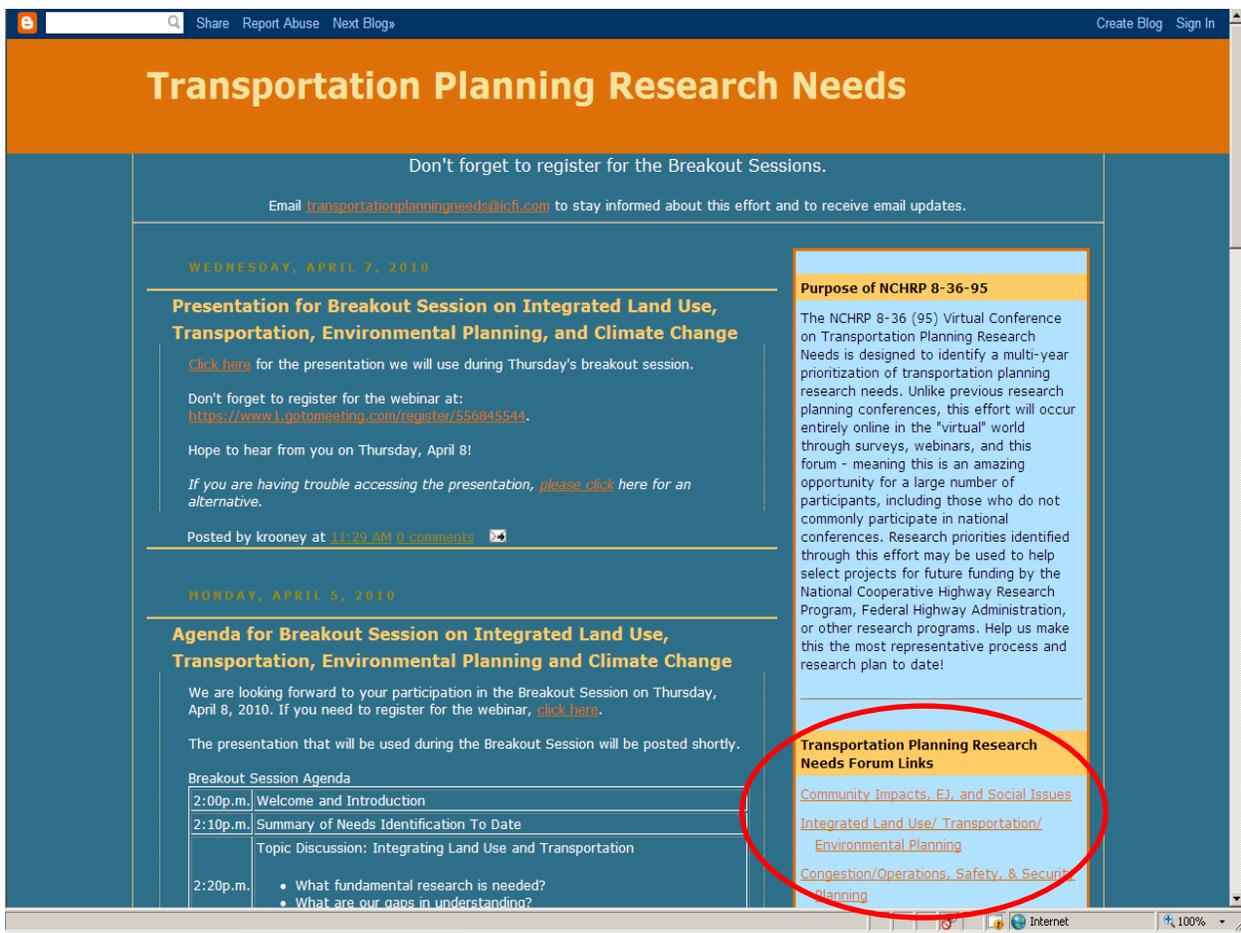
The survey also asked several questions about experiences submitting research needs statements for funding consideration. In total, 53 percent of respondents indicated that they had never submitted a research need statement in the past, suggesting that the survey was successful in reaching out to new audiences. Of those with experience submitting statements, most had submitted statements to NCHRP or other TRB cooperative programs, with a smaller share having submitted statements to FHWA or other research entity. Although respondents generally rated their experience submitting statements as “good” or neutral, suggestions for improvement including making the process more streamlined and transparent with simplified instructions and a clear description of the process and requirements. They also suggested a central clearinghouse for proposals, rather than separate submissions for NCHRP, other TRB programs, and FHWA.

## 2.3. Marketing for the Virtual Conference

In order to make the virtual conference a success, it was vital to generate a high level of awareness within the transportation planning community. Organizers first developed a distribution list of interested participants, initially populated by survey respondents who asked to stay informed about the Virtual Conference. The list quickly grew as people visited the online forum as well as AASHTO’s Standing Committee on Planning (SCOP) Website and through word-of-mouth. Ultimately, the distribution list totaled almost 700 contacts.

Organizers next created an online forum – [www.TransportationPlanningNeeds.com](http://www.TransportationPlanningNeeds.com) – to house information about the virtual conference. A homepage included contact information to sign up for the listserv, reminders about up-coming breakout sessions, and a discussion forum (“blog”) to engage participants in follow-up discussions after each breakout session. Each breakout session had its own page, linked from the homepage, which provided information specific to that breakout session. The breakout session pages provided registration information for each breakout session as well as documents from the session. These pages also provided a venue for participants to submit comments and join discussions on various conversations from the breakout session.

Figure 2. Image of Web Site, Highlighting Forum Links



Organizers created promotional flyers as part of the outreach effort to raise awareness about the virtual conference. These flyers were distributed at the AASHTO Annual Meeting (October 2009), the AMPO Annual Conference (October 2009), and TRB Annual Conference (January 2010). These flyers provided the link to the online forum, as well as an e-mail address for interested parties to join the listserv. The conference organizers also had a booth at the TRB Annual Conference and spoke with attendees about the conference. In addition, the team reached out to relevant TRB committees and experts in the field.

## 2.4. Virtual Conference Sessions

Each session of the virtual conference was conducted live over the Internet through Web-based application called GoToWebinar®. This technology allowed participants to call into the session either on a phone line or through voice over IP (VoIP) and to view the presentations over the web. Prior to each session, the agenda and the PowerPoint presentation for the session was emailed to the listserv and posted on the breakout session's page. Following the conclusion of the session, the presentations were also posted on the forum site and an audio recording of the presentation was made available.

### Plenary Session to Kick-Off the Conference

The plenary session, held on March 8, 2010, served to introduce the purpose of the Virtual Conference. During the two-hour plenary session, a discussion of the results of the nationwide survey on transportation planning needs was conducted. Deb Miller from Kansas DOT, Jim Cheatham from FHWA, Michelle Maggiore from AASHTO, Rich Denbow from AMPO, and Lori Sundstrom from NCHRP gave presentations highlighting the importance of the virtual conference and identifying research needs.

### Breakout Sessions

Six breakout session Webinars were held over several weeks, each one focused on a set of planning-related topics.

1. Community, Environmental Justice, and Social Impacts – March 23, 2010
2. Integrated Land Use/Transportation/Environmental Planning – April 8, 2010
3. Congestion/Operations, Safety, and Security Planning – April 14, 2010
4. Data Needs, Modeling, and Planning Tools – April 20, 2010
5. Economic Impacts and Freight Planning – April 28, 2010
6. Performance-Based Planning, Funding, and Other Emerging Issues – May 6, 2010

The purpose of these breakout sessions was to identify relevant research needs and major research gaps, prioritize research needs at a general level, and refine or scope out project statements. A customized agenda was developed for each breakout session to ensure they achieved the purpose.

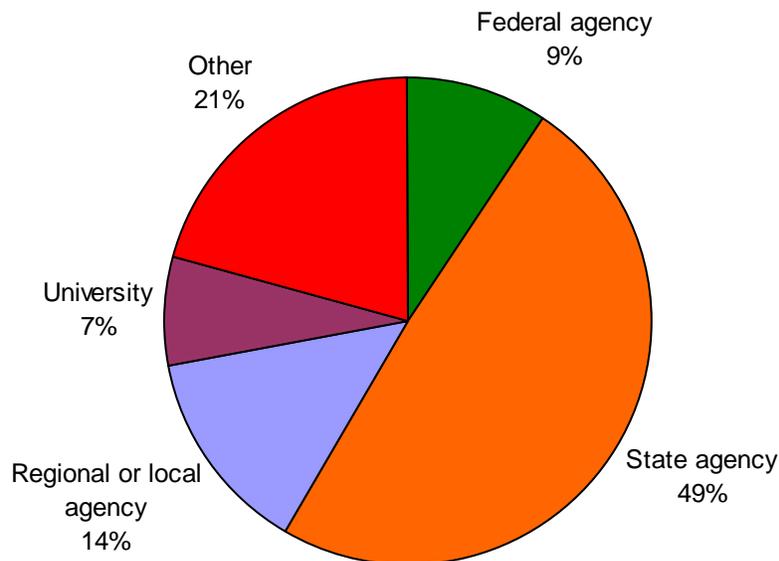
Prior to the breakout sessions, organizers engaged key participants to act as subject matter experts and ensure key discussion points were covered in the presentation. The nationwide survey conducted at the beginning of the process also provided information on content to cover. Participants were asked to register for the Webinar but there was no limit to the number of participants.

The presentation slides, polling questions, and facilitated discussions promoted thoughtful conversation of where research is most urgently needed within the transportation community. Participants were also encouraged to use the chat box feature of the technology to send research statements to the project team, if they did not wish to speak them.

During each breakout session, participants were first treated to a quick tutorial of the technology, including instructions on how to submit research needs comments using the chat function. Next, an overview of the results from the initial research review was presented, stating what the literature review and the nationwide survey results found. The majority of time during the breakout sessions was devoted to gathering input from participants on individual planning topics related to the breakout session theme. The discussion for each topic focused on gathering research needs ideas and statements from participants both by phone and by chat comments and further discussion on comments that were vague and needed more substance. At the end of the topic-specific discussion, participants were requested to submit other research statements via the chat feature. Polls were used throughout to gain a sense of the participants' agreement about research statements and priorities. Finally, participants were asked to complete a survey about both the content of the Breakout Session and the logistics and use of technology.

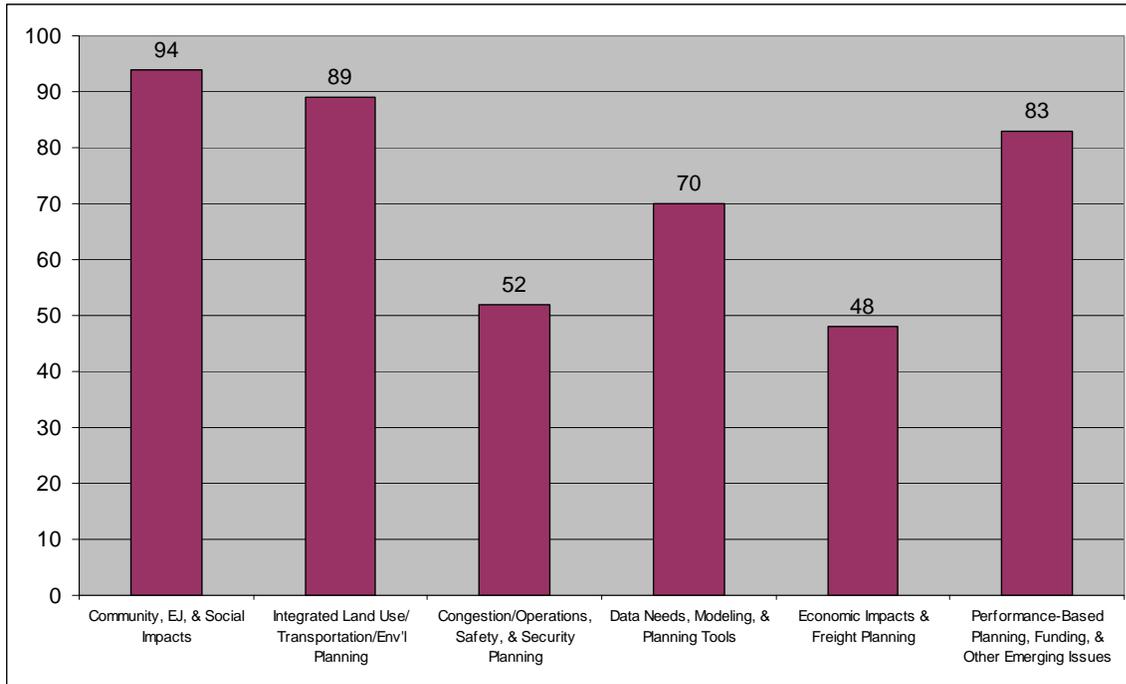
The breakout sessions attracted attendees representing organizations around the country and the world. The chart below shows the total number of participants from the different organizations who attended some part of the Virtual Conference.

**Figure 3. Share of Participants in Breakout Sessions, by Organization Type (based on number of sites)**



The chart below shows the number of sites logging onto each breakout session (number of individual participants may be greater due to multiple people participating at a site).

Figure 4. Number of Sites Participating in Each Breakout Session



### 3. Research Challenges and Needs Identified through the Conference

This section presents the problem statements identified through the Virtual Conference. A large amount of input was received from participants, with over 800 independent statements of research challenges or needs. The problem statements are organized below within categories under each of the breakout sessions. In many cases, however, the individual research statements came from other breakout sessions, the plenary, or the web survey.

**Perceptions of Participants**—It is important to note that these statements reflect the perceptions of workshop participants regarding important challenges or needs that relate to transportation planning. In many cases, there may be existing resources or research efforts that already address these needs, or ongoing research projects designed to fill these gaps. Consequently, further work is needed to determine what research is needed that would not be duplicative of existing efforts. Moreover, in many cases, participants described an issue or need, but did not provide a research statement or identify a product that would help to fulfill the need. As a result, in many cases, more work is needed to define specific research statements.

**Overarching Themes**—While the ICF team attempted to consolidate duplications in research need statements, it should be noted that some needs appear in more than one place (for instance, research statements are provided under the general topic of “data needs”. However, data needs also appear under several other subject matter topics). Clearly, transportation planning involves balancing a wide range of planning factors, and it is not always easy to categorize research under single topics. The order of listing research topics does not necessarily imply priority; however, more fully developed statements of research needs are generally presented toward the beginning of each section.

Some of the common themes or topics that come across in the statements include:

- **Livability and sustainability** – While these topics were discussed individually, they also were highlighted as important issues in the discussion of community, environmental, and social impacts, and integrated land use/transportation/environmental planning, and other sessions. There seems to be a common theme about the need to view transportation planning holistically in the context of social, environmental, and economic issues, and the need for more research to address this challenge.
- **Multimodal considerations, managing travel demand, and operating more efficiently** – While transportation planning has traditionally focused on addressing vehicle travel needs, many research needs focus on developing effective ways to support transit, bicycling, and walking, as well as other strategies to manage travel demand and operate the transportation system more effectively. These approaches came up in discussions of needs related to livability, sustainability, climate change, and travel demand analysis.
- **Data needs** – Although data was discussed as an issue in its own right, it was a common theme in many topic areas, including data related to community characteristics and values, to support integrated transportation and environmental planning, and to support more effective analysis of

freight and system performance issues, such as congestion and reliability. Data was also identified as particularly important in relation to performance-based planning.

- **Effective decision-making approaches, balancing multiple objectives** – In addition to discussion of performance-based planning, there was a great deal of discussion about needs associated with collaborative decision-making to make the most cost-effective investments that meet multiple planning goals. Needs identified by participants included integrated analysis tools, benefit-cost analysis techniques, and visualization techniques to help communicate and assess alternative packages of investments.

Many of the statements coming out of the Virtual Conference support goals and objectives identified in the AASHTO Standing Committee on Planning Strategic Plan, 2008-2009 – particularly, the focus on performance-based planning, integration of climate change into planning, and data requirements.

### 3.1. Community, Environmental Justice, and Social Impacts

**Livability**—The concept of “livability,” and the role of transportation in supporting healthy and vibrant communities that support established communities, that promote equitable and affordable housing, and value neighborhoods and communities, has become a focal point, given the efforts of the Obama Administration to promote transportation decisions that support livability. Transportation planning organizations, including State DOTs and MPOs, are attempting to include a stronger focus on livability in transportation planning, but are challenged by several issues.

- Understanding how to define “livability,” “sustainability,” and “quality-of-life.” There is a general need to have precise definitions of these terms so that planners can make better decisions to support these concepts. Definitions should be applicable across the country in a variety of regions and therefore can be used to communicate these ideas clearly to the public. By investing resources in developing these concepts further into identifiable terms, transportation professionals can use these terms to measure whether project impacts will affect the “livability” or “quality-of-life” of a community. These definitions will include definitions of community characteristics that are considered “livable” and “sustainable.”
- Determine what livability means in rural areas. Livability is often discussed in the context of travel choices, mixed-use development, and other attributes that are often absent in rural areas. Highlight areas that have successfully created livable and sustainable rural communities. Detail the steps these communities took to achieve their results. Specifically discuss how livability could work in rural areas with large distances between neighboring urban areas.
- Develop “livability indicators” for use in planning decisions, particularly noting if there are different indicators or measures in different contexts (urban, suburban, and rural). Provide practitioners with a process or a possible set of indicators or performance measures for both rural and urban areas to determine what constitutes a “livable” community and facilitates community comparison. It could incorporate all the diverse values within a community into livability, sustainability, and related performance measures. These performance measures could be developed for transportation planners as well as elected officials and could consider topics such as connectivity, importance of vehicle travel, congestion, transit dependency, jobs/housing balance, quality-of-life/aesthetics, proximity to

community facilities, and maintenance of historical community demographics. These indicators could ultimately be available for use at the project level as well.

- Analyze the impacts of transportation and land use decisions on community character and livability. Develop a historical analysis of the impacts and consequences of the interaction of land use and transportation planning concerning community character and livability (demographics, economic development, environmental quality, sense of place, etc.). One option could focus on small- and medium-sized communities across the country. Another could also assess the socioeconomic impacts of transportation and land use decisions.
- Identify the effects, benefits, and challenges associated with integrated housing, jobs, and transportation policy and planning efforts. Mixed-use communities include a mix of housing, jobs, and transportation choices. Transportation agencies need to understand better ways to integrate these considerations in planning. For instance, it may be helpful to identify incentives that could be provided at the state level to motivate co-location decisions. Further, explain the link that exists between co-location and livability and quality-of-life efforts. Explore the best ways to expand location- and energy-efficient housing choices
- Investigate further existing and potential policy options, including changes in funding structures and regulation that could help contribute to livability. Specifically, the livability partnership between US DOT, HUD, and EPA has encouraged partnerships among transportation, housing, economic development, and environmental agencies. It will be useful to identify how policies within each of these fields interact. Assess the plausibility of shifting funds across different program areas to invest in healthy, safe, and walkable neighborhoods.

**Environmental Justice / Non-discrimination Issues**—Issues associated with this topic include concerns with environmental justice, limited English proficiency, low-income populations, those with disabilities, and elderly community members.

- Clarify the definition of environmental justice and nondiscrimination (age, gender, religion, age, etc.). Make this definition more broad. Consider looking to European definitions, as these are typically much broader and philosophical in nature. Consider how the elderly and those with disabilities are part of environmental justice, in addition to low-income individuals, as there will be differences in planning for each of these groups, and how their changing travel demand will affect other transportation issues.
- Develop tools to measure environmental justice and community impacts accurately. Develop tools to capture more specific community information (race, color, national origin, income data, etc.). This could include the capability to do a post implementation analysis of impact. It could also include analysis of the distribution of both "benefits" of transportation and burdens. The tools could have the capability to do a regional-level analysis as well as project-level analysis.
- Develop a tool with the capability to annotate relevant data for EJ purposes with a Title VI lens. This lens would include factors such as race, color, national origin, income data, etc. The Census provides a rough estimate, but many of these groups are grossly undercounted. Determine the tools or data

gathering methods that need to be developed to capture this information. Examine use of mapping/GIS data to see where sensitive communities are located.

- Develop tools for evaluating the effects of transportation projects on environmental justice communities to support project prioritization. Although Census information regarding various populations is readily available, it is difficult to determine what the effects of projects are on those populations, particularly as it relates to planning decisions. Develop tools for evaluating and considering community response and using environmental justice information for project prioritization, etc. This toolkit could provide alternate sources of data in addition to Census information.
- Develop approaches to evaluate population vulnerability accurately. There is work related to vulnerability to climate change and disaster mitigation. This research would explore both the physical and social impacts associated with these impacts and others that may result in disproportionate and high impacts on specific groups, such as low-income and minority populations.
- Improve the planning process to address the needs of special populations, such as older persons and people with disabilities. Further investigate where/how planning processes typically address the needs of “special populations” such as older persons and/or people with disabilities. Articulate further the difference between non-discrimination considerations during the planning process and non-discrimination in the project’s outcomes.
- Investigate the effects of freight movements on environmental justice populations. In particular, examine the role of freight in relation to community demographics.

**Addressing Cultural, Language, and Communication Barriers**—Communication barriers, particularly with non-English speaking populations, is a concern in transportation planning.

- Determine the cultural, language, and communication barriers that may need to be considered in NEPA and transportation planning. Identify strategies that may be used to overcome these barriers. Particularly focus on non-English speaking populations with Hispanic/ Latino origins, given the high population percentage, but also other types of languages Title VI and the Environmental Justice Executive Order emphasize and require the integration of public involvement in planning and design when minority, low-income, and tribal communities may be affected by a federally funded action. It would be helpful to learn what other states have done to comply with the LEP requirements. More specifically, it would be helpful to know the extent to which language assistance is provided and how it is provided (e.g. publishing legal notices, informational brochures, visual meeting aids, display ads, and/or public announcements in multiple languages). It would also be helpful to know which languages are used. For the meetings themselves, it would be helpful to know if there have been public requests to provide interpreters at any of the states’ public meetings.
- Understand how agencies are managing to engage limited English populations and low-income ones successfully. Discuss how states have complied with the Limited English Proficiency regulations for environmental justice. Examine the provision of transportation information in multiple languages. To what extent is language assistance provided and how is it provided? Are all documents provided in multiple languages? If so, how? Is information on the states’ projects or federally mandated

documents that is published on the states' Websites posted in multiple languages? Are any of the states' federally mandated documents published in multiple languages? What arrangements do the states have for budgeting for and paying for interpretation and translation services? Specifically, does each office within a Department that is responsible for public outreach on projects and documents include in its budget, funds to cover the costs for interpreter and translation services or is there an allocation made within the agency's budget to cover such unknown costs?

**Improving Public Involvement**—Although there has been much work documenting effective public involvement practices, there continues to be a need to understand effective and new innovative techniques for public involvement to ensure a process that is more inclusive of a wider variety of community members and more focused on using community input to make decisions.

- Develop education materials to help community members make informed decisions regarding transportation planning. One of the obstacles to effective public participation involves outreach and education of basic information regarding the organizations involved—who are they and what they do. The public will not be inclined to participate in public outreach efforts if they do not know the purpose of the organization. Identify strategies to communicate transportation planning costs to the public effectively. Increase inter-agency coordination through efforts such as increased education.
  - ◆ Increase public outreach/engagement for targeting involvement from specific segments of the population. Specifically, develop materials targeted to senior community members and those with disabilities. This will assist efforts in communicating more effectively with minority populations and facilitating increased participation. This would include accommodating concerns from elderly populations and those with disabilities.
  - ◆ A grant could be created to develop a brief brochure on “What is an MPO, why do we need one, and who pays for it?” The grant could also pay for the widespread, one-time dissemination of the brochure.
- Identify strategies for communicating model results to the public. The use of models is often contentious because the public needs to understand the results. The public often does not trust transportation agencies, which presents a communication barrier. One solution is to generate locally useful collaborative models generated by the full spectrum of transportation stakeholders. Facilitate substantive education at all levels of an organization (particularly elected officials) to assist in decision-making by providing good guidance
- Evaluate the potential consequences of ineffective/improper public involvement. Research effective implementation techniques. Compare good versus poor public involvement. Include information on how findings and tools have been effectively implemented into practice.
- Identify barriers to successful public involvement. Many cognitive scientists could argue that adults are less susceptible to "education" than young minds. Adults learn and learning is typically the product of inter subjective communication. It could be argued that most public involvement professionals would identify one-on-one communication with people as the best approach. Identify strategies to help overcome these education barriers.

- Outline the basic framework and use of “social media.” Social Media is a new concept and very few agencies understand how to implement it effectively. Some agencies may not be able to implement it due to technical limitations. Provide more information on how it can be used, including benefits and challenges. Investigate the potential role of new social networking sites (Facebook, Twitter, etc). Investigate how new communication forms and social networking conventions impact conventional methods of dialog with the public, and how they can best be put to use in the overall process. Recognize new communication tools and the growth of electronic media and the Internet as a source of information and information exchange between stakeholders and stakeholders and agencies/providers of transportation. Evaluate the effectiveness of Web sites and social media as public involvement tools.
- Develop performance measures for public outreach/involvement. Focus on practical, applied work with open stakeholder performance evaluation. Public monies are spent with too little accountability in transportation design, planning, and investment. There is currently a lack of consultant accountability and publicly available performance indicators with respect to planning at local, regional, and national scales. Establish performance standards for successful public engagement and measures for determining how well agencies are performing in that area
- Evaluate the effectiveness of public engagement. Engaging the public in the decision-making process has gotten increasingly difficult and expensive. There is not currently a good way to determine how effective engagement efforts have been. It is unknown whether those who do not show up can be considered “happy” with the plan and therefore do not show up, or if it is for other reasons. Public meetings are therefore ineffective in gauging community acceptance of a proposed project. Determine cost effectiveness for public involvement activities. Define "successful" public engagement/participation/involvement.
- Determine new avenues for collaboration based on community needs (e.g. role of public education sector and schools in the planning process). For data, there is a need to understand how other industries are using community-based participatory research and the benefits or disadvantages of the approaches. Investigate options for creating more integrated models that look beyond roadways, and consider the community and the environment. These models could focus on involving broader groups of stakeholders and better ways of engaging the public. Identify strategies for road management agencies to conduct consensus building and collaborative decision-making more effectively. Develop tools that can be used for understanding context-sensitive community values, and weighing those values against factors such as increased traffic. Explore effective practices for overlapping problems and authorities. Look to genuine collaborative planning in other planning arenas, such as watershed management, to provide a sound framework.
- Determine the effectiveness of visualization in public involvement, and identify best practices. Research the applications of visualization tools and methods to try to address issues with decision-making and conveying data to public and policy-makers. Examine best practices in visualization.
- Identify what a good transportation system would do for the public, what it costs, and why it is worth the investment. Identify effective ways to communicate effectively with the American public, especially regarding transportation investment needs and maintenance.

**Community Impacts**—Many of these statements focus on the community level impacts of decisions made regarding health, economics, transportation, housing, etc. and how best to address these within the transportation planning process.

- Investigate how “qualitative” data associated with community quality of life and other social considerations can be effectively incorporated into decision-making. This is crucial in working with many types of stakeholders. Further, this is more closely aligned with the direction broader research is taking. Gather information on qualitative "models" or best practices that could be used to evaluate EJ, social, and community issues.
- Measure the potential risks to community health and economy resulting from transportation planning decisions. Identify secondary effects resulting from planning decisions and determine to what extent they could play a role in the initial decision-making process. Provide better information and increased understanding about the broad effects of transport policy and program alternatives. Investigate the role and need for revisiting communities impacted by transportation projects and assessing how the quality-of-life has changed or been impacted. "Revisiting communities impacted" could include those communities that have been left out, bypassed. Identify those long-standing transportation systems that affect quality-of-life of a community.
- Understand the health effects of sustainable practices. More research is needed, and would be very valuable, on the effects that sustainability and livability can have on human health. Particularly focus on effects to disparate populations. Evaluate the potentially disproportionate impacts on lower income populations as impacts and mitigations are considered. Include access to nutritious foods, access to health care, indoor and outdoor air quality, and crime, as these all interact with the physical infrastructure for walking.
- Synthesize how transportation agencies develop community and neighborhood profiles, building on ones already provided by states and the federal government. Determine if “old data” has a place in today’s planning efforts. If so, determine how it can still be valid, and what make it valid. Synthesize how MPOs characterize/profile different communities/ neighborhoods within their jurisdiction and make this information readily available to planners.
- Identify strategies for providing for fast goods movement in a way that improves the life of communities near freight infrastructure. Identify a tool for measuring the impact of freight movements throughout the community. Data gathering on freight movements seems to be an issue.
- Determine how often social reassessments need to be done. Develop better tools to accommodate social reassessments, incorporate updated data, and make tools easier to use and data easier to find. Investigate how mitigation from the natural environment might change the human environment to the point where a social assessment needs to be redone. Identify the frequency with which reassessments could be done.
- Create a process to track changing community context between planning and project development. Identify how this might change the planning "solution set" for a given problem area.
- Examine how best to invest transportation resources to improve social equity.

- ◆ Understand the social and economic effects of tolling, specifically the regressive ones.
- ◆ Investigate ways in which the current transportation system could be made more affordable.
- Investigate ways to measure the outcomes of transportation plans and investments on communities through pre and post-implementation analysis. There is currently very little information on the effectiveness of mitigation strategies. This research would support purpose and need statements that invoke community needs (e.g., economic development, equity issues).
- Identify best practices to help DOTs revitalize and make appropriate transportation investments in areas with declining economic stature. Develop practical tools for connecting land markets, the desire/need for travel, and transportation related services.
- Identify the types of tools needed to analyze housing/transportation options and expenditures.

### 3.2. Integrated Land Use/Transportation/Environmental Planning

**Understanding the Effects of Land Use and Transportation Decisions**—Although much research has been conducted on the impacts of land use patterns on travel behavior, there remains a fundamental need to understand better the interrelationships between transportation investments, land use policy, and transportation system outcomes.

- Summarize the current understanding of how specific built environment factors and transportation policies affect travel activity, fuel consumption, emissions, and pollution exposure. Develop a historical analysis of the impacts and consequences of the interaction of land use and transportation planning on community character and livability. Foster increased research on the synergies between transit, land use, and pricing strategies that reduce greenhouse gas (GHG) emissions Identify methods for predicting land use changes to help direct transportation investments. Measure the relationship between compact urban design and GHG reduction to measure the benefits and potential increases accurately in other air pollutants where the population lives and works. Determine whether smart growth policies actually reduce congestion, minimize travel demand, and/or increase physical activity.
- Understand health effects and risks (e.g., obesity, asthma) of alternative community and transportation plans/design.
- Identify land use factors that affect transportation modal choices. Identify the specific types of land use factors that affect modal travel (e.g., density, design, diversity (mixed land uses), distance to transit, destinations (within easy travel distance), etc. Identify how these factors affect transportation modal choices and rates in various types of areas throughout the U.S. (e.g., urban, suburban, rural). Determine if these effects vary in different parts of the U.S. and which factors have the greatest effect.
- More clearly define the effects of housing and job co-location. Determine the impact of not just vehicle choice, but also residential location choice. Identify the effects of business location on travel patterns and congestion.

- Discuss factors affecting the infrastructure cost savings of smart growth (water / sewer, roads, etc.). Research the implications of linking transportation infrastructure investment to development (e.g. adequate public facilities requirements).
- Gather input from industry—especially development and retailing—on how transportation and land use affects their decisions related to site location. Consider the impacts and needs of goods movement on transportation and land use planning.
- Understand private market preferences better for housing, location, livability, complete streets, and transportation alternatives.

**Modeling and Tools related to Land Use and Transportation**—It is important to not only understand the relationship between land use and transportation, but to have tools to effectively predict and analyze impacts on travel patterns and emissions. Integrated planning for land use, transportation, and environmental issues is being advanced as a way to result in better environmental and community outcomes, and tools are needed to support an integrated approach.

- Determine how information on the relationship between smart growth strategies and VMT reduction can be incorporated into various types of transportation models. This will help to better predict impacts of specific transport/land use policies and planning decisions. Consider that smart growth strategies can result in increased localized traffic congestion in some areas. Include research on the effects of land use patterns and the form and location of more compact, mixed-use development on VMT, energy use, and CO<sub>2</sub> emissions.
- Determine the effect of integrated land use and transportation decisions on equity. One challenge with integrating land use and transportation is maintaining the affordability of new and infill transit-oriented development and avoiding forcing out lower-income housing. Identify strategies to address equity issues, as they are not widely known.
- Improve modeling capability to test alternative land use/transportation scenarios. As part of this, an ITE update would be important. Evaluate the travel, land use, and environmental analysis tools available and determine those applications for which they can be appropriately used. Build a framework for moving away from lane capacity and vehicle-focused travel demand model outputs to a focus on mobility and accessibility that supports investments that advance livability, smart growth, and multimodal options. Identify examples of transportation performance measures that can be used to evaluate sustainability/climate change/environmental considerations. Generate performance metrics to quantify trade-offs between transportation planning alternatives that can be incorporated into planning efforts.
- Investigate the option of collaborative modeling between stakeholders and planners. Overcoming the long-standing separation of land use and transportation planning authority requires extensive learning for all stakeholders. Collaborative modeling could be used as a technical toolbox that local stakeholders could draw from in exploring their own situation. Identify ways to foster integrated decisions between stakeholders, regulators, and constituents, each of which has their own responsibilities, guidance, and agendas. Determine how to account for the variety of overlapping

problems and authorities. There is effective use of genuine collaborative planning in other planning arenas that would provide a sound framework for moving forward.

- Quantify and model the effects of land use transportation strategies. Research should include the effects of increased multimodal options. The data collected from this effort would be particularly helpful for visualization and planning tools for conducting smart growth analysis at the community and regional level.
- Develop tools to model the economic effects of alternative transportation investments on land use. For example, how will a highway interchange investment influence economic development relative to a fixed-guideway transit investment? Tools should include forecasting tools to evaluate the effects of major transportation investments on market forces. New Starts data may provide a good source for public transit investment information.

**Policy Considerations for Land Use Planning**—There is a need to understand and advance policies for integrating transportation and land use planning, particularly as it related to affecting decision-making across multiple jurisdictions, such as local communities within a metropolitan region.

- Identify ways to integrate long-range transportation decisions into the local decision-making processes. In states or regions where land use plans have “less teeth,” many major decisions are made by local officials after a relatively short application process. The local process may be politically decided as well. Regional transportation plans are developed in a different realm with much longer vision. Vice versa, identify techniques for integrating local comprehensive plans into regional transportation planning processes
- Determine the involvement of state DOTs and/or MPOs in integrated land use planning, and investigate whether roles could change. Identify strategies to change existing land use patterns and land use codes to make alternatives to auto-oriented choices feasible in more place. If transportation agencies are to be more involved, determine the correct level of responsibility/involvement. Investigate ways to avoid the issues that arise from a lack of control by state DOTs and MPOs over land use planning and/or regulations.
- Investigate the link between property tax policies and development. Identify how state property tax policies have affected towns' willingness to take actions to encourage higher density and mixed use developments. Include discussion on the interest of locals in making land use decisions that will increase their tax base with new developments.
- Identify ways to coordinate fiscal transportation and land use decisions. When local comprehensive land use plans are being developed, transportation system demands can be modeled to determine the future transportation needs and then phased into the Capital Improvement Program. Alternately, land use proposals could be reduced or phased to be coordinated with financial resources of the jurisdiction. Identify ways to link transportation funding to the development of better land use policies so that coordination remains a priority as staff and elected officials leave office.
- Determine how to promote model city/county ordinances that support a vibrant pedestrian network.

- Investigate how to implement compact development more effectively and how to facilitate land use policies that are compatible with transportation improvements (particularly for states with limited statewide and regional land use planning authority).
- There is a need for tools to translate analysis from the technical information into language that decision-makers can use to explain information to legislators and to the public. Identify ways to successfully educate and engage elected officials who serve on MPO boards in this topic.

**Planning-Environment Linkages / Linking Planning and NEPA**—Traditionally, the long-range planning process and the project development and environmental process have been separate activities. While there has been substantial efforts undertaken to advance integrated planning and planning-environment linkages, including EcoLogical approaches and the collaborative decisionmaking framework being developed under the Strategic Highway Research Program’s Capacity focus area, there continues to be a need to help planners integrate environmental considerations early on provides for a more efficient and effective process.

- Identify strategies to advance early integration of land use, transportation, and environmental planning; help reduce the barriers. Determine how environmental planning can be integrated into the beginning of the planning process to help alleviate the barrier between transportation decisions and land use decisions made by cities and counties. Investigate existing integrated planning tools and inter-governmental cooperation guidance on how to get started. Identify places where and ways in which agreements governing environmental mitigation and minimization commitments have been entered into early in the planning process. Provide real life examples for others to follow. This study will include discussion on how to effectively link land use, NEPA, corridor preservation and transportation planning (all of which are highly politicized) to ultimately end up with realistic outcomes. Identify how to integrate environmental resources into the market-based reality of land use and transportation decisions.
- Develop modeling capabilities to capture the interrelationship between the environment and planning decisions. Determine the steps that need to be taken to create models that can effectively incorporate the cause/effect and iterative relationships between land use, the environment, transportation, climate change, and economics to help facilitate truly integrated planning decisions that support long-term sustainability. This study will include research on developing a new national model of urban design, land development and zoning regulations that integrates transportation and environmental planning to encourage development and redevelopment of ecologically and economically sustainable human built environments. The objective would be to educate and enact a mass paradigm shift to manage impacts of irrevocable climate change, to arrest additional adverse change, and encourage change for the better.
- Balance considerations and trade-offs between mitigation related to natural environment vs. human environment. Identify realistic costs of mitigation to help planners communicate their budgetary needs to politicians.
- Develop a comprehensive and long-term analysis of the overlap between land use, transportation and environment planning to help those involve better understand those processes that will be affected by their decisions, and vice versa.

- Provide guidance on NEPA applications, specifically on how it could be used in preservation projects, and guidance on corridor preservation studies.
- Identify ways to integrate adaptive management practices into the transportation planning and National Environmental Policy Act (NEPA) project development processes.
- Develop a community plan working with community members that identifies existing natural resources and constraints. Obtaining political support and making informed decisions becomes easier when the constituents of the elected officials support policies to protect and enhance the natural environment.
- Address the lack of available information and limited access to information about cultural/ historic resources. As information on other types of resources moves to electronic format, the gap in available information about cultural/historic resources becomes more pronounced and will either be collected under current means, delaying the process or overlooked altogether risking the eventual outcome.

**Integrating Climate Change into Planning**—Climate change is increasingly becoming an important issue in transportation planning, both in the areas of mitigation and adaptation. It should be noted that significant efforts have been made to identify research needs related to climate change, including the recent TRB Special Report: *A Transportation Research Program for Mitigation and Adapting to Climate Change and Conserving Energy*.

- Identify the potential effects of climate change on the existing transportation infrastructure. Looking into the future, new standards need to be developed for the construction of transportation facilities to reduce the danger of adverse impacts from rising temperatures and possible water levels. Climate change scenario planning could be integrated into the transportation planning process. Moreover, approaches need to be developed for maintaining and operating transportation facilities to minimize the impact of rising temperatures and sea levels in an effective manner. Use the results of this study to foster a better understanding among both the public and elected leaders of climate change in general, as well as the relationship between climate change and protecting the existing transportation infrastructure. Include information on increased extremes and uncertainty related to changes in historical patterns in nature (i.e. rainfall). Further,
- Identify GHG reduction strategies that can be incorporated into plans. Include discussion on the use operational strategies in the planning process to improve the efficiency of the transportation system and thereby reduce GHG emissions.
- Develop metrics and establish thresholds for implementing Adaptive Management programs to address climate change impacts on infrastructure.
- Develop methods that can interpret climate change modeling outputs that specifically account for climate change scenarios and different geographies. Collect and develop high-quality data on climate change effects before investing heavily in applications related to climate change. Determine those basic methods that are currently available, as, if more complex methods were developed, many areas do not have staff or modeling capabilities to do many of the more complex analyses. Develop the necessary tools to study before and after affects. This would include performance measures for VMT,

delay, GHG, energy use, etc. This would be a long-term study. Issues of funding and staffing would also be addressed.

- Advance GHG reduction analyses and strategy selection. Investigate the research behind CO<sub>2</sub> reductions that result from implementing GHG reduction strategies. Include co-benefits in the analysis. Consider how to better quantify the potential impacts of carbon sequestration along right-of-way. Further investigate the use of transportation rights of way (plantings, native vegetation, etc.) as a method to capture carbon as part of a GHG reduction strategy. Most climate change research does not address cycling and walking as a viable option for reducing emissions. It is an area that could be addressed to determine if it is an effective option beyond VMT.
  - ◆ Summarize the current understanding of how specific built environment factors (density, mix, transit orientation, walkability, street connectivity, building orientation, etc.) and transportation policies (road pricing, parking pricing, public transit service quality, car sharing availability, etc.) affect travel activity, fuel consumption, and emissions.
- Quantify the effects of various GHG reduction strategies and tradeoffs. Determine how state DOTs can be better prepared to quantify trade-offs between transportation planning alternatives relative to GHG reduction, energy consumption, reducing VMT, etc. There are currently no readily available models to quantify these types of impacts at the statewide system-level scale.
- Collect life cycle GHG data to identify and assess GHG mitigation strategies. Specifically, collect data on construction and maintenance emissions. GHG mitigation strategies could include life cycle considerations, including construction and maintenance practices (warm-mix asphalt / recycled materials).
- Determine the needs around effectively engaging in long-range climate change planning efforts.
- Determine how to motivate consumers to demand development that reduces travel demand and GHGs.
- Conduct research to estimate how much national fuel savings could be accomplished by getting people out of cars where non-vehicular transport is possible.

### 3.3. Congestion/Operations, Safety, and Security Planning

#### Transportation Demand Management (TDM) and Travel Behavioral Changes—

Transportation agencies recognize that “we cannot build our way out of congestion” and innovative approaches are needed to address mobility challenges. Although there is much experience with TDM programs, there remains a more general need to understand what factors would motivate the public to alter their current traveling habits to advance ridesharing, transit, walking, and bicycling.

- Survey market preferences and/or the public’s willingness to change their behavior and adopt more sustainable practices. Identify incentives that could be used to inspire change (in addition to high gas prices) and motivate the public to increase the amount that they currently walk, bike, or use transit to get to a destination. One of the categories for the market preference survey would gather information on the percentage of people who would be willing to move to a higher density location. Additionally,

including a category on private market preferences for smart growth, mixed use, and transit-oriented development. The results would help planners to overcome political resistance to such development patterns. The challenge with this research is to realistically identify those strategies that could alter people's perceptions to overcome resistance to use of transit or increased density.

- ◆ Related to this, there is a need for more tools such as models that take into account the factors that influence people's modal choices and trip making behaviors.
- Determine the impact that levels of change in travel behavior would have on GHG impacts. Ongoing research includes an effort by Volvo Group, Commute Greener, which uses iPhones to help people track the carbon emissions produced by their commute. An increased use of these tools by the public would be helpful in measuring the overall impacts for use in forecasting models.<sup>3</sup>
- Identify methods to encourage increased transit use by elderly populations. Investigate how to resolve the security fears of elderly and handicapped about traveling in inner city neighborhoods using transit and light rail. This study could recognize the absence of bus service in suburbs where many elderly people may live. According to an AARP lobbyist, empty nesters prefer to live in a neighborhood that is adjacent to their present suburb because they want to keep their existing social and/or medical networks. As part of this effort, more research could be conducted on identifying housing preferences of older adults.
- Investigate the influence of advanced technology and new life styles on planning. In addition to cell phone data, other technologies have also had a large influence on travel behavior and trends (e.g. Internet, increase of online purchase, zip-cars).
- Research how social networking could affect transportation. It is already being used by some areas (e.g., Washington State for travel time between point A and B).
  - ◆ Determine how often communications technologies substitute for different kinds of travel. Identify how social networks (Facebook, Twitter, etc) can be accommodated to increase potential for carpool or ridesharing initiatives.
  - ◆ Investigate the use of technology (cell phones, etc.) for real-time info for travel demand management such as on the spot carpooling.
  - ◆ Evaluate the effects of real-time traveler information on travel demand.
- There is a need for better understanding of how age and lifestyle changes affect market demand for various types and locations of housing and associated services (e.g., many younger people and the elderly appear to prefer more centrally located housing close to shopping, services, and jobs as compared to suburban housing). This aspect of consumer choice affects capacity planning and land use decisions.
- Identify effective means to motivate local governments to care about reducing travel demand on the transportation system.

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<sup>3</sup> More information on Commute Greener is available at <http://www.commutegreener.com/#Login-374>.

- Investigate ways to promote support for increasing multimodal options. Understand effective practices for managing travel demand.
- Develop a more detailed understanding of the impacts of TDM strategies in different land use contexts.
- Assess parking requirements that would encourage wider transit use. There is currently a wide range of parking requirements across the country and a greater balance is needed.
- Investigate the use of telework and other non-traditional options as effective congestion reduction strategies. Investigate the role of state DOTs in telecommuting for demand management purposes.

**Mobility Strategies and Tools to Reduce Congestion, including Pricing** —Traditionally, congestion was addressed through added capacity; however, given limited space for adding new lanes, research is needed in non-traditional methods, strategies, and tools for addressing these issues. Challenges include finding cost-effective solutions, given limited state DOT budgets.

- Investigate the trade off in arterial signalization efforts between optimizing total traffic flow versus focusing on non-transit and transit flow separately via Transit Signal Priority optimization in urban areas.
- Investigate ways to right-size projects aimed at solving congestion in order to help focus increased attention on high benefit/low cost projects.
- Investigate opportunities to explore the implementation of mileage-based user fees and road pricing. Investigate potential issues with mileage-based fees for road pricing. The wide range in vehicle/axle weight and mpg presents issues for the old model of tax per gallon of fuel. This model also presents equity issues, particularly for those lower-income persons who may be driving older less-efficient cars. Look at the potential to use congestion pricing alongside mileage based fees.
- Investigate whether improving ease of roadway use and capacity, either through ITS or pricing, will ultimately limit the future use of public transit. Research the tradeoffs of eliminating general-purpose travel lanes for exclusive transit use. Look at urban settings across the nation.
- Understand the long-term effects of congestion pricing. Recent studies have shown that the benefits may diminish over time.
- Investigate the use of new intersection designs and corridor applications to reduce congestion. There is a current need to enhance regional corridors but without the cost of creating an expressway with grade separations or a solution of adding numerous lanes. Investigate the options of using CFI intersections or other designs in sequence to make corridor-wide improvements, not just one intersection.
- Investigate the effects of possible traffic improvements from innovative intersection designs on adjacent land uses and communities. For example, if an intersection in an older neighborhood needs upgrading - which design will have the best impact on the neighborhood (not just the traffic)? Include discussion on the use of standard improvements like turn lanes versus quadrant roadways or median u-turns.

- Assess the impacts of access management techniques. Identify the benefits to traffic flow through access management.
- Identify new tools that could be used to help alleviate congestion. Identify the underlying data that is needed for these tools.

**Linking Planning and Operations**—Planning for operations involves a focus on integrating operations considerations, such as incident management, work zone management, demand management, and traveler information strategies, into the transportation planning process. The challenge is to effectively integrate operations strategies (e.g., incident management, bus rapid transit) into transportation planning and demonstrate their value as cost-effective solutions to address some of the primary sources of congestion - non-recurring events relating to work zone management, weather, and incidents. There is a great potential for overlap and synergy between these two functions and new research can help advance these innovative practices.

- Identify methods to address operations strategies in the planning process.
- Develop tools and procedures to more effectively account for reliability and multimodal system performance issues.
- Identify appropriate multi-modal and mode neutral performance measures for measuring mobility/accessibility.
- Develop improved analytic methods for assessing the reliability impacts of different transportation investments.
- Investigate the increased use of real-time/live data from operations. One option is connecting incidents to traffic volume. There is currently a lag time between the reported time of the incident and the reported upstream and downstream volume.
  - ◆ Identify limitations to ITS data. It is challenging to help people understand ITS data and therefore use ITS information in their research. Archived data is particularly challenging.
- Determine the need for more discussions between planners and operators as to data needs and application.
- Investigate the role of freight in operations and planning efforts.

**Safety Planning**— Safety continues to be the highest priority of transportation agencies, but effective practices and approaches continue to be needed to advance safety in planning. Challenges relate to data, safety, and different populations, best safety practices dissemination, and other diverse issues.

- Investigate options for improving the quality of crash data. Currently, it is very difficult to obtain clean crash data. Texas DOT is currently working on this. Raw reports need to be cleaned up before they can be used by planners, and before they can be made available to public.
- Integrate safety and planning by tying crash data to planning study alternatives and the evaluation of those alternatives.

- Investigate the role that safety improvements to a corridor can have on effectively reducing congestion and allowing corridors to move widening projects further out.
- Identify a balance between concerns to overcome the inherent conflict between the goals of increasing non-auto travel and decreasing non-auto traffic fatalities.
- Identify best practices in reducing impaired driving.
- Investigate methods for improving HOV safety.
- Investigate the prevalence of illegal truck parking along the side of state freeways and methods for reducing the frequency with which it occurs. It is unsafe for the motoring public who could conceivably crash into one of these trucks on the side of the road.
- Investigate the relationship between urban design/development patterns and crash rates. Determine if there are certain development patterns that are inherently safer.
- Investigate the difference in fatality and injury rates for different groups of motorists. For example, motorcyclists versus rural pick-up drivers. Look at the prevalence of seat belt use.
- Look at best practices for improving safety for various populations—including older drivers, youth, unlicensed drivers, etc.
- Disseminate best practices on effective transportation safety planning approaches, including coordination with planning partners.
- Identify the cost savings in reducing crashes as a performance measure for Transportation Management Centers.
- Investigate the relationship between safety, Operations Planning, and multimodal transportation planning.

**Security Planning**—This area includes issues such as evacuations and hazardous material transport. Challenges include responsibility for ensuring security, as roles can be undefined. Security planning is also a relatively new area, and increasing knowledge of best practice techniques would greatly benefit the transportation system.

- Define the role that state DOTs and MPOs play in transportation security more clearly.
- Define a systematic approach on how to coordinate and manage evacuations.
- Demonstrate that emergency response and evacuation plans are directly linked.
- Establish standards across the modes for transportation for security and ensure that all plans include a security component.
- Identify the role of the Transportation Security Administration (TSA) in high-speed rail security. Determine if the security will be similar to commercial aviation. Provide a cost analysis for implementing new regulations.

- Investigate hazardous material security and the role of state DOTs in ensuring this security. Ongoing research includes NCHRP20-59 on hazardous material security across all modes, including the roles of state DOTs or transportation agencies.
- Document effective roles of transportation agencies in security planning.
- Identify strategies for incorporating disaster risk measurements in transportation plans and the decision-making process.
- Highlight best practices in returning evacuees to their community post-evacuation.
- Investigate options for increasing freight transportation security.

### 3.4. Data Needs, Modeling, and Planning Tools

**Data Sources and Collection Efforts**—Research issues relate to the appropriate data sources and collection techniques, as well as data standardization.

- Determine the potential, existing, and/or future uses of real-time operations data. Identify the application for transportation planners for modeling. One category that should be focused on is speed data, during both peak and non-peak periods. Identifying reliable source of data is an important component of this research.
  - ◆ Investigate new uses for real-time data. Available data sources include movement of select cars, trucks, buses, and shipments.
  - ◆ Identify methods for ensuring that real time data is clean and usable for general purposes such as planning. It often needs to be transformed and maintained. Provide information on who should monitor the data, who is involved in transforming it, and who maintains it.
  - ◆ Analyze how to collect, manage and use real time data for pertinent planning questions that are important to the planning community. Collection, management, integration, and use of real time data from public and private sources are important tools for system management and executive decision-making. Identify opportunities for integrating this data into existing planning tools.
  - ◆ Investigate the limitations of ITS data.
  - ◆ Improve the accessibility of archived data so that it is a valid data source.
- Compile accurate and reliable employment data. This should include an employment location database to provide information on where employment centers are located. This is particularly relevant for transportation planning; however, oftentimes transportation planners are not aware of how to use these data sources effectively or appropriately
- Collect data on elasticities to some of the common policies and planning measures/alternatives currently being considered. Provide data for analysis and tools for validation efforts. Data collection efforts should include a systematic scan of looking at historical data and significant before/after studies of major investments or major changes that have happened.

- Investigate the institutional issues surrounding the use of private data sources. Examine data sources such as speed data (Nokia, Tom Tom, Jam OnStar, cell phone tracking, Inrex). Determine who has access to these data sources, ways in which to access the data while ensuring anonymity, and cost estimates for accessing the data.
- Determine the data sources that support effective monitoring of planning efforts and implementation. These data sources should be applicable at both the state and regional level. Identify how these data sources should be established and necessary data inputs.
- Gather data on multi-modal travel associated with smart-growth land use projects. This data does not currently exist. Such data would also be useful in helping to develop (or at least validate/calibrate) community-scale and regional land use and transportation models.
- Summarize traditional data collection efforts of state DOTs that can be used in a new way to measure livability, mobility, economic strength, and safety. The goal of these research efforts would include enabling transportation agencies to begin measuring performance until better data and analysis tools can be developed and implemented.
- Increase data collection for biking and pedestrian activity. Specifically, investigate crash exposure rates for cyclists and pedestrians. Also, research pedestrian and cyclist traffic counts.
- Investigate methods for standardizing data collection, storage, and maintenance. This will improve data sharing capabilities. This research should include data sharing rules and outline plans for creating a national data-clearing house. There is a particular need for data standardization on a regional level.
- Investigate how data collection efforts can assist in meeting federal requirements. Data collection needs to be very tightly focused on the problem to be solved and not general topics such as modeling.
- Increase data warehousing efforts. As part of this research effort, investigate the metadata behind what is in the warehouse to identify the quality needed.
- Provide information on justifying cost acquisitions for new, expensive data resources. Identify how, where, and in what format these data can be used.
  - ◆ Conduct a cost/benefit analysis on the importance of collecting accurate, quality data so that agencies are encouraged to pay for data collection. Include case study information. If agencies realize that without quality data, they cannot get valid analysis results, they may be more willing to spend funds on data collection.
  - ◆ Discuss the impact of lacking data on data forecasting results and potential effects. Focus on the impact of data availability and quality on travel forecasting results.
- Assess the feasibility of creating a dedicated funding source for collecting data. There is a critical need to develop a dedicated funding source for collecting quality data to measure the relationship between land use and transportation system. This will help transportation planners to increase their understanding of the effects of their decisions.
  - ◆ Identify funding sources for data collection at the MPO level. Data could include household travel survey, land use forecasting, etc.

- Identify committed funding sources to conduct an ongoing National Household Travel Survey. The last round in 2009 faced significant funding barriers. The data provided from this survey is very useful, as it is highly transferable. The survey should be redesigned to incorporate GPS, cell phones, and Web-based approaches.
- Prioritize data needs so that funding is allocated based on need. Identify funding sources so that both the research and obtaining the data are adequately funded.
- Identify how agencies can take the lead in data collection, rather than relying on the Federal government. This should be studied in depth and breadth, with an objective assessment of the advantages and disadvantages of this proposal.
- Generate data inputs for land use models.
- Identify data sources and inputs for modeling air quality conformity for freight projects.
- Update the base land use characteristics needed to support transit. It is currently outdated.
- Investigate the option of using short-term data for Design Hour Volume (DHV) and directional factors
- Gather more granular freight data that can be modeled at the local level, especially for Origin/Destination (O/D) data of local freight trips. Modeling outputs should be integrated into the policy development process.
- Investigate institutional issues for obtaining and using available data.
- Incorporate data for households that only use mobile phones in the household travel survey.
- Identify barriers for data collection for greenhouse impacts and conformity analysis.
- Investigate improved techniques and tools, including industry standard open source software used across states that could be a significant tool to address current challenges with data collection.
- Investigate the data sources needed to assist in future funding mechanisms (e.g. VMT fees).
  - ◆ Gather robust, detailed data on vehicle travel to help develop alternatives to the gas tax.
- Identify methods for displaying the vast amount of information in comprehensible ways.
- Develop data for multimodal options. There is a lack of standard LOS data for sidewalks and bicycle paths. Tools are needed to translate the relationship between land use and transportation decisions into the appropriate methodology to do the analyses. There is specifically a lack of Transit LOS data for use in GIS.
  - ◆ Develop a national pedestrian and bicycle performance monitoring system (possibly coordinated at the MPO level).
  - ◆ Identifying the tools and resources necessary to integrate pedestrian trips into transportation models.

**Analysis Techniques and Tools**—Research in this area would include updating current analysis tools and identifying new ones. Updating existing tools would be particularly helpful for planners.

Challenges include developing tools to evaluate traditionally qualitative factors and making data transferable.

- Create interdisciplinary planning tools that incorporate economic impacts. Research tools that could integrate land use and economic impacts into travel demand models. Research models/tools that enable planners and decision-makers to understand economic costs and benefits of various transportation infrastructure improvements, including effects on land use development location, density, and design, includes the PECAS model<sup>4</sup> that is being implemented in Oregon, California, Ohio, and other places in the U.S. These types of models have been used for many years in Europe and South America. Create travel models that effectively incorporate the iterative relationships between land use, transportation, and economics to help facilitate truly integrated planning decisions that support long-term sustainability.
- Improve models to better assess modal tradeoffs/solutions.
- There is a need for more refined estimates of emissions-related measures that can be applied at the non-metro level. These estimates should be suitable for comparing alternative modes in intercity and rural-urban problems.
- Develop methods for performing trade-off analyses. Unless funding increases drastically, decisions regarding maintaining current capacity versus adding new capacity will become even more constrained and difficult.
- Determine how cell phones could be used to collect data and influence travel behavior. Ongoing research includes Texas DOT efforts looking at the possibility of using people's cell phone data and giving them something in return in terms of trip updates. Challenges include privacy issues about the type of information collected and level of funding required to translate collected data to make usable.
- Investigate the use of linking community indicators to performance measures. This could be immensely beneficial for transportation planning and community stakeholders.
- Develop metrics and associated data sources to assess qualitative factors such as livability, sustainability, and community issues. Research is needed to develop planning products and associated performance measures. Challenges include developing robust, substantive, and quantitative assessments for things that do not lend themselves to that classification. Support data collection efforts to assess these factors.
- Determine the baseline temporal change that could reasonably be expected if no action was taken so that that impact performance measures can be distinguished from baseline results.
- Research methods for advancing the technology implementations to speed up the transportation planning and modeling technical processes.
- Investigate streamlined analysis tools to estimate travel impacts and transportation GHG emissions attributable to alternative development patterns (e.g., transit-oriented development) and multimodal investments.

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<sup>4</sup> <http://pecas.ultrans.ucdavis.edu/doc/pecas>

- Determine tools that should be developed to assess the implications of policies on vehicle technology and consumer vehicle choice.
- Identify methods for overcoming limitations in the level of confidence in model findings. Specifically, the view that the likely volume of bike and pedestrian trips, and sometimes transit, are inconsequential in the findings.
- Identify those aspects of travel behavior that significantly affect climate change and GHG modeling. This will assist in estimation efforts.
- Create practical tools that will help planners assess positive interactions and tradeoffs between multiple planning goals (e.g. mobility, safety) to determine cost-effective investments.
- Identify and synthesize case studies of agencies that have adapted operations/ITS data for strategic decision-making.
- Facilitate the transferability of tools, methods, and processes, so that best practices can be shared throughout the field.
- Improve analysis methods for smart growth land use/transportation projects and programs at both the site-specific levels (e.g., ITE rates that are currently definitely not sensitive to most smart growth strategies) as well as at community-wide and regional levels (via planning tools and models).
- Develop tools to interface and convert inputs and outputs from other tools so that results from different models (land use, transportation, environmental, GHG emission reduction, etc.) can be integrated.
- Determine a process for weighing the effect of the provision of on-street parking against improved bike and pedestrian facilities in constrained "main street" corridors on economic strength.
- Identify tools that could be used to develop GHG reduction targets at both the state and MPO level. These tools should have the capacity to measure the impacts of transit use and smart growth strategies.
- Quantify conditions for walking and metrics to evaluate the pedestrian environment.
- Develop forecasting procedures for modeling inter-city/inter-region passenger traffic.
- Investigate the application of consumer surplus theory to vehicle operating costs and crash costs.
- Investigate the use of destination/spatial choice models.
- Investigate the potential data integration issues when merging traditional data sources (i.e. loop traffic data) and new sources (i.e. blue tooth).

**Improved Travel Modeling**—This research area focuses on improving models used for travel forecasting, including forecasting related to non-motorized modes, freight, and related analyses.

- Discuss the various approaches to incorporating some aspects of signal delay into static assignments. Discuss the advantages and issues of different methods. Research in this area is lacking, as the supply side does not always get adequate attention.

- Identify methods for forecasting bicycling/pedestrian demand. These methods should be applicable regardless of whether it is a more traditional trip-based, aggregate framework or a more disaggregated framework.
- Research network models and ways to evaluate them. There is a need to focus on the supply side, in addition to the recent focus on what/how much to manage these models. Improve network models, such as DTA, for metropolitan level applications.
- Investigate the requirements for integrating complex modeling tools. FHWA has identified a plethora of modeling tools, but there is no clear direction as to how a state DOT should be integrating these tools into their practices.
- Develop models that can account for policy-related issues. Considering that decision-making is based on model results, it is important that the components and variables in the models are sensitive to those policy related issues (e.g., parking, bike/pedestrian, transit, TDM, etc.). These models should include measure the effectiveness of these decisions.
- Update the four-step travel demand models. These models typically lack the ability to adequately analyze impacts and benefits of various types, designs, and locations of land use development in relation to vehicle ownership and use rates, VMT, and multi-modal rates (including transit and non-motorized travel). Although newer activity-based travel models may be more capable of analyzing these situations, they should still be evaluated regarding their sensitivities to land use. This research presents challenges in terms of complexity and cost; however, it is less expensive to develop and implement improved models rather than continuing to build expensive freeways and related infrastructure in response to sprawl.
- Investigate options for integrating state and metropolitan travel demand models within the same state. Identify ways in which these models can be used together or made more compatible with each other so a more complete picture of the transportation system and travel demand forecast is available.
- Explore alternative methods for developing collaborative models for decision-making. Ongoing research at the University of Vermont is looking at agent-based modeling to investigate the complexity of MPOs. The public may not fully trust travel demand models and traditional four-step modeling.
- Provide information on the impacts of different styles/patterns of development on travel demand, or more specifically, on vehicular travel demand. Current travel models are a bit clumsy with this, which means we may still have a tendency to over design/overbuild the roadway network. Research the impact of new technology on travel and mode choice. This includes new modes based on new vehicle types (micro cars) and new blended trips (car sharing) based on communications and GIS technology.
- Investigate funding barriers to validate models. Many agencies do not have the funds to collect adequate behavior and other data to estimate and validate a model. Research staffing and funding needs for updating existing models.
- Better incorporate complex trip patterns, multiple modes, land use scenarios, and strategies into existing models. Evaluate the capability to capture inter-regional travel in the travel demand model.
- Identify the most effective models for modeling freight movement and provide information on each.

- Develop modeling tools that use reasonably available travel data to evaluate the dynamic characteristics of the regional transportation system in a cost-efficient manner.

**Enhanced Use of Visualization, Scenario Planning, and other Technologies**—This research area focuses on the use of tools and techniques, such as visualization, scenario planning, and other technologies.

- Investigate the role of visualization tools. There is a communication gap between data and modeling personnel decision-makers. The results are often communicated in a complex manner. The result is that decision-makers do not engage the results as they should and modelers feel ignored. Improvements are needed in displaying, explaining, and visualizing the data and analysis. Identify trade-offs for applying visualization to demonstrate to the public the lack of investment impacts and capacity reduction.
- Investigate options for the increased use of scenario planning tools that not only provide visualizations but also feedback to meeting attendees and decision-makers (such as iPLACE3S, CommunityViz, etc.). Alternative use options include providing feedback regarding transportation benefits and effects of various land uses, including smart growth strategies.
- Support a crosscutting research study of how data and models achieve legitimacy for decision-making. Focus on the importance of visualization and data legitimacy. Goals of this research effort should include encouraging collaborative practitioners to think in terms of joint fact finding in their practices and tools.
- Provide guidelines on steps to use visualization for objective decision-making. Visualization is susceptible to poor decisions, as the public will often pick the best-looking option, without regard to what might be better or more cost effective. Assist planners in understanding the role that visualization can play in the decision-making process.
- Identify base practices for using data visualization (including GIS) to effectively communicate model results across multiple alternatives/scenarios.
- Conduct a scan of effective visualizations and other tools to help address livability considerations in planning.
- Investigate the issue of linking tools (e.g. GPS, visualization) to real world applications.
- Discuss the effectiveness of communicating data to decision-makers through visualization.
- Develop interactive gaming scenarios to build better mode choice models.
- Develop planning tools to better assess real-time land use changes on travel, VMT and emissions. Most analysis to date is scenario-based and does not incorporate specific actions.
- Document best practices in applying GIS to integrated planning.
- Investigate the role of new technologies in answering GHG and other mobility analysis questions.
- Research best practices for using GPS data to collect household travel survey data.
- Investigate the future use of GPS and cell phone data.

- Use GIS to identify land use changes to assist planners in updating traffic collection needs.

**Education and Communication Support for Effective Use of Tools**—Many planners do not currently understand how to use modeling outputs effectively or the effect that changing modeling assumptions has on the level of effort required by modelers. If planners understood modeling outputs better, they could more effectively engage the public and decision-makers in the project planning process, which would result in more effective final decisions.

- Research ways to bridge the knowledge gap between those who do detailed modeling work and their ability to develop complex models, and those involved in planning who are often representing what model outputs mean to policy-makers. Develop workshops for planners focused on communicating model outputs and applications. Focus on explaining how transportation investments relate to decisions made regarding the system's infrastructure. This will assist in communicating outcomes to the public. Planners are not always familiar with the effects and requirements of changing an assumption, outputs, and limitations of a four-step demand process and how that is different from a dynamic traffic assignment. There is need to help bridge the communication gap between those representing model output/facilitating policy-maker process, and those who are doing the technological development.
- Assist planners on developing practical methods for modeling decisions. Oftentimes, complex models are built, but planners do not know how to use them or there is difficulty calibrating them for specific regions.
- Provide education on complex models as well as sketch planning tools.
- Provide education to policy-makers on modeling sensitivity. Specifically, discuss the uncertainty associated with modeled results.
- Discuss the challenges and best practices for successful communication efforts.
- Address how to communicate more effectively to the public and actively engage the public in the planning process (e.g., visualization, social networking)
- Assist understaffed agencies in translating available data and models so that they are able to take advantage of available resources.

### 3.5. Economic Impacts and Freight Planning

**Understanding Freight Movement**—These statements focus on better understanding freight travel needs and demands, as well as factors that influence freight movement. Some areas of interest include examining international best practices and a better understanding of the supply chain and its impact on freight.

- Discuss the increased use of and strategies for constructing inland ports. The majority of our ports are currently built out to capacity, as the land around them has been sold and developed. These ports are unable to expand adequately to meet future needs. Research should address the challenges associated with locating and developing new port facilities, especially inland ports. Identify who has ultimate

priority: state and regional freight movement or local jurisdiction. Discuss potential security issues involved.

- Examine global best practices, specifically in China. There is a significant opportunity to learn about freight goods movement overseas, specifically from one of our largest trading partners, China. However, language barriers and scant documentation present hurdles. Comparative assessments on foreign practices would be helpful, as would identification of international research resources related to freight transport best practices.
- Provide a comprehensive overview of how the supply chain works. Until this is well understood, focusing on modal choice (‘getting trucks off the road’; ‘focusing on rail improvements to benefit air quality’; etc) is rather shortsighted. Focus research on the supply chain and shippers rather than on the carriers. Map out the supply chain for each state.
- Discuss the disconnect between understanding the supply chain and what can be done by agencies to help increase this understanding, particularly concerning mode choice. Traditionally, suppliers are not concerned with mode, but rather use whatever mode is most convenient. Freight shipped by rail is not something that can necessarily be incentivized, as consumer goods cannot be moved effectively over long or short distances. Industry has long been pursuing and continues to pursue energy efficient opportunities. Carriers traditionally carry out demands placed on them by shippers and do not have significant decision-making power.
- Conduct a global scan of freight technologies and policies that could be applied to the U.S.

**Freight Planning**—This areas focuses on research related to improving freight planning and methods, including models and tools used to evaluate efficiency, the relationship between freight and passenger planning, performance of the freight system, and communication efforts with the public and decision-makers.

- Determine the overlap between freight planning and plans made by the freight industry. For the industry, “long-term” is three to five years, while for freight planning, that is considered short-term.
- Identify methods for discussing renewal and re-use of low-use rail lines within communities. Research on the renewal of limited-use rail lines and their impacts on communities should be explored. Many communities have reacted negatively to increased rail line use and to engine idling.
- Discuss the challenges for freight planning presented by heavy regulation and high competition.
- Improve freight planning techniques. There is a significant difference between freight transport and passenger transport. However, research is needed to recognize that traditional planning concerns such as air quality and EJ are also a part of goods movement planning. Research could identify methods for simultaneously achieving goals for both freight and passenger transport. Identify methods for improving community quality-of-life in areas of high goods movement while not hindering freight transport.
- Identify evaluation criteria to prioritize freight projects (by mode or across modes).

- Identify methods for helping agencies preserve freight facilities in urban areas where there may be local opposition. Specifically, identify methods to address the “good for the region, bad for the town” predicament.
- Identify public outreach methods for communicating the importance of freight (through data, analysis, and performance measures). Developing tools to collect data does not tell the whole story to the public. Communication methods and freight messages need improved development. Develop strategies to communicate the value of transportation investments to policy-makers and the public. Include case studies of good freight planning with highlighted benefits and impacts.
- Identify short- and long-term performance measures that make sense for long-term planning and at the project level. Beyond reliability and safety, identify other factors that make sense (e.g., impact on economic development). Determine how project considerations guide measures and tools under fiscal constraints.
- Identify how a state DOT or MPO can select between various existing cost/benefit analyses for use in transportation planning decision-making. Identify how these analyses can help identify the most critical freight infrastructure projects, and provide support for why these are the most important projects.
- Identify methods for synchronizing freight planning and the traditional planning process. For the freight industry, a long-term perspective is anywhere from 18 months to 3 years (maybe up to 5 years). Traditional planning operates on a 20-year timeframe.
- Identify methods for increasing communication efforts between the freight community and planners. Provide outreach to colleagues, either inter- agency, neighboring agencies, and/or voting members. Continual outreach is needed to maintain an ongoing conversation and discussion about freight challenges. The I-95 corridor coalition should be included in communication efforts.
- Identify/develop tools for communicating the relationship and importance of the freight transportation system to the economy.
- Discuss the role of the new, green economy in freight transportation. Focus on the economic viability/sustainability for regions.
- Identify methods for increasing safety on roadways between truckers and passenger traffic—particularly during peak commute times. On highways, trucks operate in a slim margin.
- Assess the feasibility of developing simpler, but more accurate models.
- Research how to link the data collected on economic impacts to practical planning applications.
- Discuss strategies for proper goods movement planning, including air quality mitigation for communities near infrastructure.
- Identify methods for facilitating commodity flows for statewide applications.
- Build regional transportation models that extend beyond state boundaries.
- Support tools and approaches for better freight planning so that current investments can adequately support future growth.

- Discuss methods for addressing freight components in the reauthorized transportation bill. Supply chain management professionals will need assistance in getting a head start on responding to likely requirements. Identify how the focus on sustainability/green transportation that will likely be in the new authorization bill will map to planning and delivering freight transportation infrastructure at the state, regional and local levels.
- Discuss potential impacts of regulations on freight system performance.
- Streamline regulations (from the federal level to municipalities) for efficient operation of freight truck movements.

**Data to Support Freight Planning**—Data collection for freight planning, employment, and economic investments. Challenges include data privacy, competition within the freight industry, the feasibility of data collection given current staff and financial resources, forecasting efforts, and integrating real-time information into existing models.

- Discuss challenges surrounding the confidentiality of data. Identify possibilities for obtaining carrier data and using it in a technical framework.
- Identify opportunities for collaboration on private data collection and access. Rather than have each area individually arrange for private data access, it would be useful to have a dependable, strong database that had guaranteed funding support over time. Without guaranteed access to private data, it will be a constant issue.
- Determine potential collection methods and uses for GPS data. For freight, ATA has an agreement to get data from GPS-equipped trucks, but is required to work through the American Transportation Research Institute (ATRI) and is not able to use the data if it could possibly be used for regulation purposes. There is a significant challenge with maintaining privacy.
- Determine how to gather better data for freight planning, particularly access to proprietary private sector information. Identify strategies/solutions for overcoming the competition barrier, which prevents private freight companies from sharing/releasing detailed data.
- Identify concerns related to areas that are not major freight hubs, but that still experience major throughput.
- Integrate real-time data into existing transportation models.
- Use classification count data for truck model estimation.
- Identify effective data collection and techniques to forecast freight travel demand.

**Economic Analysis to Support Investment Decisionmaking**—These topics focus on assisting planners in making targeted transportation investments and analyzing investment tradeoffs.

- Develop the modeling capability to conduct a modal trade-offs analysis so that transportation investments can be targeted based on benefits. Models tend to promote all modes as equally valid. Planners need to understand the potential to divert traffic from one mode to another and the factors/conditions that need to be present for that to occur.

- Determine the economic value of travel time for passengers and trucks. This value varies dramatically based on context and methodology. Reexamine some of the assumptions made regarding the value of time and the value of reliability.
- Develop tools to help forecast future investments based on changes in market force that might result from these investments. This tool should account for those investment decisions that differ from past investments. Investigate how to measure cumulative effects of decisions.
- Provide guidelines and recommendations on how to integrate economic aspects under fiscally constrained situations. Identify realistic strategies.
- Monetize the benefits of land use decisions in the transportation cost decision process.
- Determine if it is possible to develop national/regional standards to encourage more efficient resource allocation within the transportation industry.
- Further investigate the link between human economic behaviors to transportation mode choice.

**Economic Impacts of Transportation**—These topics focus on understanding and analyzing the economic benefits of transportation, and approaches for supporting economic vitality and growth.

- Compile existing research on the economic impacts of transportation investments, as it has been extensively researched in the past 30 years. Analyze the role that this research can and should play regarding future decisions.
- Determine how transportation infrastructure investment affects the economy short-term and long-term. More effectively measure the return on investment of project decisions.
- Provide support for AASHTO to update their “Red Book” on user benefit analysis (traditionally for highways). This should be broadened beyond highways.
- Analyze disproportionate impacts of transportation decisions. Areas of poor economy tend to overemphasize economic impacts over other impacts; therefore, nothing can happen in many poor areas without strong economic justification. In wealthier areas, considerations such as quality-of-life, efficiency, and sustainability have more effect. Overall, this economic impact argument will have the weightiest message for poorer areas.
- Identify strategies for overcoming the lack of consistency for measuring economic impacts. Everyone brings their own numbers of economic benefit provided by the same investment, which presents challenges for effectively comparing merits of projects.
- Identify strategies for planning in conjunction with the business cycle. For example, making investments during flush periods and anticipating when a recession may hit so that funding does not decline substantially for one or more years.
- Investigate best practices for calculating consumer benefits. Calculating benefits is difficult, as they are non-linear. There are also challenges as to how consumer surplus theory should be applied. In particular, impacts to freight carriers could use more attention.
- Quantify economic issues (including productivity) related to freight issues.

- Conduct an economic analysis of the impact/importance of efficient transportation for specific industries in the U.S.
- Explain the difference between short-term (Keynesian) job impacts and long-term (Neoclassical) job impacts of transportation facilities.
- Identify consistent modeling approaches for both construction/ implementation impacts as well as longer-term community impacts on employment. These are needed for discretionary grant programs such as Transportation Investment Generating Economy Recovery (TIGER) grants.
- Develop improved analytic methods for assessing the economic benefits of reliability improvements.
- Disseminate best practices on effective coordination with private industry, freight shippers, and economic development organizations to support economic growth.
- Conduct a state of the practice assessment of how states and localities are assessing economic issues related to goods movement. From this assessment, draw research conclusions as to what research or information is needed on a national policy level. If there is a disconnect, it indicates that further research is needed.
- Encourage more accurate assessment of economic impacts of transportation decisions. The language, tools, and methodologies associated with evaluating the economic impacts of transportation choices and investments are absent from most planning processes and alternatives evaluation.
- Develop effective approaches to estimate economic benefits. Clarify how the economic impact of transportation (theoretical and methodological) should be estimated. Political considerations further complicate this issue and should be discussed.

### 3.6. Performance-Based Planning, Funding, and Other Emerging Issues

**Performance-Based Planning**—Performance measures provide a rational way for decision-makers to quantify and objectively compare projects that best meets local needs. Focusing on outcomes could improve transportation investment decision-making. From the direction that Congress is taking, as well as the public, more emphasis in the future will be placed on transparency, accountability, and on outcomes from transportation planning with less emphasis on process. There is an increased recognition within the transportation industry of the value in making the planning process more performance-based. Research is needed on the types of performance measures to use, the data to feed them, and how best to use performance measures effectively.

- Clearly identify how performance measures will be developed and used. More information is needed on how to develop effective performance measures regarding freight, economic development, community livability, and major environmental issues (e.g., climate change). Research would discuss performance measures in terms of how they address needs once projects are selected, funded, and implemented. Research on the use of performance measures is needed: was the right measure used, was it effective. A measure's relevance within the planning process should be assessed. For example, are measures intended to be applied when decisions are made, after they are made, or both? The decision-making process that is taken will be different depending on the answer to this question.

“Back of the envelope” techniques for quantifying impacts are no longer appropriate once the use of performance measures becomes ingrained.

- Assess which performance measures are actually used to select projects and which should be used, but currently are not. While transportation agencies use a variety of performance measures, not all measures are actually used in project selection. It may be the case that only a few critical measures are actually used in determining what projects to fund. Project selection can just as likely also be affected by other influences (e.g., local elected officials) that have nothing to do with performance. Research is therefore needed on prioritization of performance measures, especially in project selection.
- Broaden performance measures to include consideration of demographic changes. Research is needed to see if performance measures used today reflect recent changes in our society (e.g., shrinking household sizes, fewer “nuclear” families, more single person households, influx of new immigrants to suburban cities). Research should determine the degree to which these changes affect travel and housing demand.
- Better address data. This study would identify the data needed for performance-based planning but address the reality that the more involved performance-based planning becomes, the more pressure there will be to collect and update data on a regular basis. This pressure is a challenge for transportation agencies on a tight budget, which is why another part of this study would identify resources to fund data collection efforts as well as ways to help the public and elected officials understand the importance and usefulness of this data in identifying projects. This study might also explore the best ways to maximize the use of existing data so measures better reflect the experiences of the traveling public. Results of this study might cause the transition toward using real-time data, especially in light of new and emerging technologies such as GPS and camera readers that can collect data easily. Research should also focus on how to manage and use data to effectively evaluate and prioritize projects in such a way that transportation dollars are spent more efficiently: investigate the ability to incorporate new (cheaper, more automated) data for performance-based planning (e.g. remote sensing, probe vehicles).
- Conduct case studies on use of performance-based planning. Analysis might look at organization that: (1) combine different performance measures together in project selection criteria; (2) analyze project impacts together to develop criteria to identify and rank different corridors in transportation system; and (3) combine performance measures into an overall set of criteria. Studies might research agencies that successfully reached agreement with elected officials to use specific measures to plan and allocate funding. Other research might show how different state DOTs do performance-based planning with the idea of creating a common template or consistency across states in the development and use of performance measures. This would lead to better understanding of how transportation decisions are made overall.

- Use new tools. Research is needed to educate planners on the latest performance-based tools available to them. Analysis should determine the value of new tools to incorporate sharing or joint development of performance (e.g., Web-posted data, mashup tools<sup>5</sup>, automated markup of meta data).
- Develop mode-neutral performance measures. Regions are looking to incorporate sustainable, mode-neutral, or quality-of-life type of performance measures – especially in light of the recent Partnership for Sustainable Communities. Agencies want to know how to balance developing new measures and planning practices to address livability and sustainability goals in this fiscally constrained environment. Research focused on preferred measures to use and their potential tradeoffs is needed. Research could include a comparison to mode-specific measures.
- While there is a lot of documentation regarding performance-based planning, research should look at case study implementation/best practices. Document differences from actual process. In terms of performance-based planning, there is likely a lot of untold stories that would be helpful to investigate
- Identify those areas for which the public will hold transportation agencies accountable. There is a need to run the data through a performance-based process and communicate the process to public. The transparency issue means practitioners must explain how they got to decisions and the outcomes of those decisions.
- Identify measures appropriate for assessing system performance across various dimensions. Determine if there is a way to cull useful data out of existing data sources instead of trying to obtain new data.
- Conduct legal research on the liability of transportation agencies that do not meet performance criteria, especially safety and security measures.
- Develop baseline data for bicycle/pedestrian usage and determine correlation between increased bike/pedestrian usage and reduced VMT.
- Develop analytic tools. Current analytic methods were not designed and are not capable of addressing many of these issues like transit oriented design or pedestrian/bike forecasting.
- Determine how to value and measure non-traditional transportation options. For example, what is a successful complete street system and how would you measure that?
- Recommendations on generating support for this approach are needed. Without decision-makers' support, it will be extremely difficult to implement the performance-based planning approach.
- Investigate the role of benefit-cost analysis for transportation planning, recognizing political decision-making.
- Build on the work of the private sector and others in use of performance measures. For example, the American Society of Public Administration has a section that focuses on performance measurement.

**Funding / Financing Issues**—Transportation funding is an on-going challenge. While participants felt that research will not be able to solve financial difficulties, it can help to identify innovative

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<sup>5</sup> A mashup tool is a Web page or application that uses or combines data or functionality from two or more external sources to create a new service.

approaches. The gas tax is not keeping pace with growing transportation needs, and its viability as a funding source over the long-term is problematic. Research in this area may be helpful to identify new and effective approaches.

- Research on innovative funding approaches is very important, but subject to local context and politics. It is difficult to research alternative funding sources without confronting public expectations and political feasibility. Research should identify effective ways to achieve consensus with respect to funding among interests group with differing agendas. Educate practitioners so that they will understand pricing impacts on travel demand. Determine what funding or federal regulatory support is needed to facilitate inter-agency collaboration.
- There also is a need for researching interaction in complex systems. This relates to funding in that parts of the system like rural access have low use and limited market for pricing but could be critical to the value of the national system. Better integrate road pricing into the transportation planning process. Document the role of pricing in addressing revenue needs. Understand behavioral economics and how the economy helps people react to economic situations. People's reaction to issues of tax increases, VMT taxes, or other innovative means for raising revenue is unknown.
- Better integrate road pricing, public-private partnerships, and other financing approaches in transportation planning.
- Identify new funding sources and innovative financing measures. Identify funding sources for multimodal transportation, particularly walking and bicycling.
- Develop a better behavioral model of travel price sensitivity that includes the quality of travel as well.
- With respect to funding-related research, more research is needed on the use of "value capture" as a means of funding both transit and affordable housing near transit-oriented development.
- Identify tools and techniques that planners can use to integrate alternative revenue sources into the planning process.
- Identify challenges for the future feasibility of the existing fuel tax structure given alternative fuels and taxes. Determine whether it is possible to seek out additional sources of revenue in the future.
- Discuss economic barriers to creating an efficient transportation system. In raising revenue sources, there is a disconnect between the need for an efficient transportation system and a lack of resources.
- Discuss the relationship between finding alternative sources of revenue and the economic impact of the transportation system. There is a need for adequate funding for the transportation system due to the proven importance it has for national and states' economies.

**Sustainability**—Sustainability (along with livability) was one of the most common emerging issues heard during the Virtual Conference. Transportation planning organizations, including State DOTs and MPOs, are attempting to sustainability in transportation planning. They are challenged by several issues, such as having a clear definition of sustainability and indicators to use in making planning decisions.

- Standardize definitions for livability and sustainability. Livability is community focused; it is measured differently for each community. Sustainability may be more system focused and therefore

applies on a broader scale. However, research should standardize definitions of livability and sustainability to the extent it can. Research is needed to better define livability for rural and urban areas. There are different criteria for both that should be more fully defined. What are the key indicators for livability? How are these indicators related to the community values? How do you prioritize limited funds to achieve livability goals?

- Identify how sustainability can be addressed through the transportation planning process. Identify those factors that could be considered and incorporated when making transportation and land use decisions.
- Ensure that models can answer simple questions so non-technical people may understand. Research should determine how modeling can be applied to areas of livability and sustainability. The questions that the models should answer are unclear. For example, travel models look at travel and system performance, but how can we develop better analytic techniques to look at livability? Or is it a less technical need and more qualitative? Sometimes people get too technical in trying to address this issue. Why does it need to be quantitatively defined? Models should be able to incorporate the cause/effect and iterative relationships between land use, the environment, transportation, climate change, and economics to help facilitate livable communities.
- Determine how sustainability can be integrated into the beginning of the planning process to help alleviate the disconnect between transportation decisions made by MPOs and state DOTs and land use decisions made by cities and counties.
- Synthesize best practices to build missing sidewalks along existing roadways. As used in practice, livability and sustainability are tied to a “modal agenda.” Very much tied to streetcars, bikes, pedestrians—“anti-car.” Research question on how to broaden those issues to encompass more highway-specific concerns.
- Determine if innovative funding mechanisms could be implemented on sidewalks. Non-motorized modes can be cheaper solution overall. Is there a way to recoup those cost savings and put that toward other modes?
- While livability can be defined as better access to jobs, housing and public transportation, the main issue is how transportation investments affect livability? For example, does adding another bus stop impact people moving into the area, switch from modes from auto to bus – thus resulting in reduced traffic congestion and reduced emissions.
- Gather public opinion on priorities for livability and then gather information correlating transportation practices to livability/sustainability metrics.
- Research on international actors may indicate how other nations are addressing livability and sustainability issues.
- Research is needed on before-and-after studies that examine the economic and social impacts of transit-oriented development.

**Multimodal Planning**– Another theme that emerged out of the conference was the need for more effective multimodal planning. These concepts are sprinkled throughout many of the other research need areas. Some specific statements are noted below.

- Develop tools to measure the effects of multimodal transportation development. Measure both benefits and costs. Identify areas that have already developed models that can incorporate multimodal considerations so that others can build off these efforts, including the ITE Trip Generation Manual so that it provides multimodal trip generation estimates (e.g., walking, bicycling, transit, as well as automobile). Improve travel demand models to incorporate multimodal considerations and mode neutral decision-making.
- How does transportation affect "quality-of-life" - what is it and how can it be measured? How to combine transit funding and highway funding to create the best multi-modal solution (a multi-modal programming and project development process)? What are the existing conditions where transportation investments will (or will not) cause an increase in economic activity?
- Research market incentives for the private sector to become involved in providing transit alternatives and infrastructure.

**Demographics and Community Characteristics** – Changing demographics will have important implications on travel demand and transportation/housing needs in the future. Thought should be given to the aging population, shrinking household sizes and changing nuclear family dynamics, and how transportation can best address needs of a changing population.

- Understand travel needs and how best to accommodate the travel needs of a changing American traveling population / different demographic groups (elderly, immigrants, low income).
  - ◆ Promote mobility planning for a growing older population. Accessibility 'conflicts' (USDOT vs. Access Board). Evaluate the impacts this group may have on the overall transportation system. Assess their mobility and coordinated transportation/land use planning. Identify ways to increase engagement from transportation planners in assessing the needs of older adults and disadvantaged.
  - ◆ Investigate increased mobility options for elderly persons. Some elderly persons will continue driving, in which case the focus could be on identifying ways to keep them driving safely. Invest in educating elderly persons on transit as an alternative to driving so that they feel more comfortable using it as an option.

### Other Emerging Issues

- **Mega-regions.** Identify the tools and data that are needed to consider broad-scale planning for mega-regions. Identify effective approaches to facilitate interstate planning across mega regions to support economic growth, goods movements, and effective mobility. Modeling requirements are needed.
- **New planning emphasis areas.** Develop approaches to more effectively integrate high-speed rail planning with traditional transportation planning. Develop improved coordination among DOTs, transit agencies, municipalities, and others to support non-motorized transportation and transit use.

- Effects of new vehicle technologies. Create tools that are valid, practical, and will help planners consider the impacts of new transportation technologies (vehicles, communications) on the transportation system. Create models that can effectively incorporate the cause/effect of using new transportation technologies.

## 4. Conclusions

### 4.1. Survey Responses

At the end of each breakout session, participants were asked to complete a survey (see Appendix B). This survey provided participants an opportunity to submit additional research statements and comment on whether the issues discussed during the session were important to the overall topic. The survey also allowed for feedback on how to facilitate the next session. The survey results are informative for conducting Internet-based presentations and conferences. In general, respondents found the Web-based technology easy to use.

The table below shows the number of survey respondents for each Breakout Session

**Table 2. Number of Survey Respondents**

Session	Number of Survey Respondents / Number of Participants
Community, EJ, & Social Impacts	80 / 94
Integrated Land Use/Transportation/Environmental Planning	79 / 89
Congestion/Operations, Safety, & Security Planning	50 / 52
Data Needs, Modeling, & Planning Tools	70 / 70
Economic Impacts and Freight Planning	43 / 48
Performance-Based Planning, Funding, & Other Emerging Issues	65 / 83

### Suggestions for the Virtual Conference

Some key suggestions that came out of the survey are noted below:

- Inform participants that research statement will be requested so that participants can prepare these ahead of time.
- Send potential questions, discussion topics, and the presentation ahead of time.
- Allow participants to see and engage in the full conversation in the chat boxes so that they can see the written research statements that others are providing and so that they can carry on a separate discussion about specific research statements that capture their interest.
- During the presentations, acknowledge the written research statements so that the discussions do not involve only spoken research statements.

In general, survey respondents were satisfied with each Breakout Session; only two respondents reported being dissatisfied (with the Performance-Based Planning, Funding, and Other Emerging Issues Breakout Session).

Additional and external analysis about the research needs statements is also available in Appendix C.

## 4.2. Lessons Learned

### **An inclusive and flexible process enabled more participation by a wide variety of audiences.**

In the past, participants may not have been available due to costs of travel and lodging to attend a conference in-person, time commitments required to attend a conference, and inability to obtain permission to attend the conference. The virtual conference format overcomes these barriers. This virtual conference was broken down into several separate sessions held over many weeks, which is unlike the traditional conference in which the sessions would have been back-to-back over several days. The fact that the conference takes place online means that participants do not have to be concerned with travel and lodging costs and the time commitment (length of the Webinar) is minimal compared to traveling and attending a conference.

A virtual conference is probably easier to obtain permission to attend as well, because the only resource being strained is the trade-off between the conference time and the participant's other work responsibilities. This very open and inclusive process of conducting the Virtual Conference allowed people who have not been able to participate in the past to join in the discussion and opened up the universe of participants. In total, over 300 people participating in the conference, representing well over 150+ State DOT representatives, as well as substantial numbers of staff from MPOs, federal agencies, research institutions, and consulting organizations. Indicative of the broad level of participation is that participants were not only from the United States; there were even participants from the University of New Brunswick and University of Manitoba in Canada. Because the PowerPoint presentations and audio recordings were made available after each session and the online forum provided a platform for further discussion, this Virtual Conference further enabled more participation by accommodating participants whose schedules did not allow them to attend the live sessions.

### **Holding a virtual conference rather than a traditional in-person conference is very cost-effective, and generated many research statements.**

This type of conference was cost effective and the set-up was well suited to a limited budget. Not only did participants and conference providers not have to spend resources on travel and lodging costs, there was also no budget spent on securing a conference facility and related amenities. While Webinars do cost money, they are still much less expensive than the cost of hosting a conference, when all of the individual participants' costs are included. The online forums were hosted on a Blogspot site, a free blog-hosting site. Again, because this type of technology is freely accessible on the Internet, it hugely reduces any costs of hosting a conference.

The virtual conference was very successful in generate many research needs. At least 800 individual research need statements were recorded through the web survey, plenary session, and breakout sessions. These varied in scope, with some simple statements of transportation planning challenges that may benefit from research to specific ideas about a type of research project.

### **It is important to allow multiple venues for input and engage participants in active ways.**

Unlike an in-person conference, where participants can see each other face-to-face, the virtual conference format as implemented allowed a more limited exchange of ideas back and forth between participants. While the breakout sessions were designed to allow anyone to generate ideas and build off the ideas of others, many participants seem to prefer to submit written statements submitted via the chat function, rather than providing spoken statements during these sessions. Given the limitations of the technology used, participants were not able to see the written statements of all of the other participants, and some participants felt that it would have been beneficial to see all of the research statements submitted by chat format from all of the participants. The facilitators attempted to address this concern by reading statements coming in through the chat feature, but it may have been difficult for some participants to follow. Furthermore, because nothing was visually recorded for the participants, it was hard for some to follow the discussion, discern what priority research statements were, and identify the level of multi-dimensional issues.

While the online forums did not draw any further discussion around the Virtual Conference's topics, this may be due to the new and unfamiliar way on conducting conferences, rather than an indication that the online forums were unneeded. As people become more accustomed to participating in online discussions and feel more comfortable engaging in online conversations, online forums may become a common way to promote discussion and disseminate information cheaply and efficiently. Furthermore, that many survey respondents suggested better use of the chat box feature so participants could hold separate discussions shows that participants are not against holding "written" discussions among themselves.

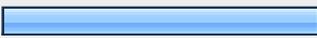
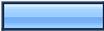
### **Basic research needs were identified, but additional work is required to produce stronger, more directive research statements and to prioritize research needs.**

Even though the Virtual Conference was broken up into breakout sessions that focused on specific topics, those topics were still very broad. While the discussion in the sessions produced a large number of research needs statements, many are not strong enough to stand alone as a research statement and will need additional work to develop them into statements that could turn into funded projects. Part of this stems from the limited amount of time available to discuss the statements during each breakout. While the breakout sessions built upon the statements submitted through the web survey and plenary session, the short format was not conducive to truly prioritizing or fleshing out research needs statements. The breakouts served as an effective mechanism for generating ideas and gathering quick reactions in a real-time format. Additional follow-up through more detailed briefings and smaller workgroups could help turn the research concepts and ideas into more robust statements that will guide transportation planning research in the future.

## Appendix A: Web Survey Responses

The web survey responses are on the next page.

# Challenges in Transportation Planning

1. What type of organization do you work for?			
		Response Percent	Response Count
State department of transportation		48.6%	159
Metropolitan planning organization		15.3%	50
University or research institute		9.5%	31
Consulting firm		12.8%	42
Federal agency (e.g., FHWA, FTA)		8.3%	27
Other (please specify)		5.5%	18
		<b>answered question</b>	<b>327</b>
		<b>skipped question</b>	<b>3</b>

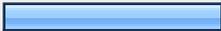
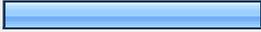
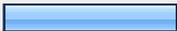
**2. Please rate the following transportation planning issues on how challenging they have been for you. These challenges should relate to gaps in knowledge, tools, or approaches that research could help to address. Not challenging means they are issues you deal with successfully and little or no research is needed. Moderately challenging means that they are issues you sometimes struggle with and research would be helpful. Very challenging means that they are issues you struggle with and research would be helpful. N/A (Not applicable) means you do not deal with this issue.**

	<b>Not Challenging</b>	<b>Moderately Challenging</b>	<b>Very Challenging</b>	<b>N/A</b>	<b>Rating Average</b>	<b>Response Count</b>
Climate Change	9.9% (32)	23.3% (75)	<b>46.3% (149)</b>	20.5% (66)	2.46	322
Community impacts	10.4% (33)	<b>56.8% (180)</b>	22.1% (70)	10.7% (34)	2.13	317
Congestion	17.9% (57)	<b>38.4% (122)</b>	32.7% (104)	11.0% (35)	2.17	318
Data	12.3% (39)	<b>42.6% (135)</b>	40.1% (127)	5.0% (16)	2.29	317
Economic impacts	8.7% (28)	<b>41.7% (134)</b>	39.6% (127)	10.0% (32)	2.34	321
Emergency response	25.1% (79)	<b>35.2% (111)</b>	10.2% (32)	29.5% (93)	1.79	315
Environmental concerns/issues	14.6% (46)	<b>49.4% (155)</b>	28.7% (90)	7.3% (23)	2.15	314
Environmental justice	25.4% (80)	<b>43.8% (138)</b>	17.5% (55)	13.3% (42)	1.91	315
Federal planning requirements	31.7% (100)	<b>39.4% (124)</b>	19.7% (62)	9.2% (29)	1.87	315
Freight planning	13.2% (42)	<b>37.7% (120)</b>	24.5% (78)	24.5% (78)	2.15	318
Funding issues	8.6% (27)	26.2% (82)	<b>55.6% (174)</b>	9.6% (30)	2.52	313
Integrated transportation/land use/environmental planning	8.3% (26)	34.5% (108)	<b>51.8% (162)</b>	5.4% (17)	2.46	313
Inter-governmental cooperation	18.6% (58)	<b>45.2% (141)</b>	28.2% (88)	8.0% (25)	2.10	312
Mobility	18.4% (57)	<b>48.7% (151)</b>	20.0% (62)	12.9% (40)	2.02	310
Modeling tools and techniques	16.6% (52)	<b>43.3% (136)</b>	29.0% (91)	11.1% (35)	2.14	314
Other planning based technologies (e.g. visualization)	28.0% (87)	<b>41.5% (129)</b>	19.3% (60)	11.3% (35)	1.90	311
Performance-based planning	13.2% (41)	35.2% (109)	<b>36.5% (113)</b>	15.2% (47)	2.27	310
Planning for operations	17.0% (52)	<b>43.1% (132)</b>	16.0% (49)	23.9% (73)	1.99	306
Public stakeholder involvement	33.2% (103)	<b>39.4% (122)</b>	17.1% (53)	10.3% (32)	1.82	310
Safety	26.3% (82)	<b>43.6% (136)</b>	14.7% (46)	15.4% (48)	1.86	312

Security	27.4% (85)	<b>34.5% (107)</b>	11.6% (36)	26.5% (82)	1.79	310
Social issues	24.1% (75)	<b>43.1% (134)</b>	15.4% (48)	17.4% (54)	1.89	311
Sustainability/Sustainable Transport	11.9% (37)	30.5% (95)	<b>43.7% (136)</b>	13.8% (43)	2.37	311
<i>answered question</i>						<b>330</b>
<i>skipped question</i>						<b>0</b>

<b>3. Of those topics above that you found challenging, please discuss your top three most challenging issues in greater detail, indicating why they are challenging and what the research gaps are.</b>	
	<b>Response Count</b>
	238
<i>answered question</i>	
	<b>238</b>
<i>skipped question</i>	
	<b>92</b>

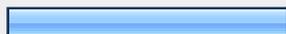
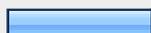
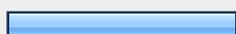
<b>4. What other, new, or emerging planning issues are you concerned about?</b>	
	<b>Response Count</b>
	160
<i>answered question</i>	
	<b>160</b>
<i>skipped question</i>	
	<b>170</b>

5. Please check off any of the following web sites you have used to find useful planning-related information.			
		Response Percent	Response Count
AASHTO's Statewide Planning site - www.statewideplanning.org		44.8%	124
FHWA/FTA Transportation Planning Capacity Building program - www.planning.dot.gov.		52.7%	146
<b>Transportation Research Board www.trb.org</b>		<b>82.7%</b>	<b>229</b>
TRIS, the National Transportation Library http://ntlsearch.bts.gov/tris/index.do		35.0%	97
Highway Community Exchange http://knowledge.fhwa.dot.gov/cops/hcx.nsf/home		13.4%	37
Other Online Resources? Please list.		29.6%	82
		<b>answered question</b>	<b>277</b>
		<b>skipped question</b>	<b>53</b>

6. Have you ever submitted a research needs statement for funding consideration?			
		Response Percent	Response Count
<b>No, I have never submitted a research needs statement.</b>		<b>53.3%</b>	<b>176</b>
Yes, to NCHRP or other TRB cooperative program?		34.8%	115
Yes, to FHWA (e.g. the STEP program)?		11.2%	37
Yes, to another research entity?		15.2%	50
		<b>answered question</b>	<b>330</b>
		<b>skipped question</b>	<b>0</b>

7. Please rate your experience submitting a research need in the following categories?					
	Poor	Neutral	Good	Rating Average	Response Count
Ease of Submission	6.1% (9)	40.1% (59)	<b>53.7% (79)</b>	2.48	147
Clarity of Process	19.7% (29)	<b>46.9% (69)</b>	33.3% (49)	2.14	147
Time Required	16.3% (24)	<b>56.5% (83)</b>	27.2% (40)	2.11	147
Overall	7.2% (10)	<b>58.3% (81)</b>	34.5% (48)	2.27	139
Any suggestions you would like to share?					37
<i>answered question</i>					<b>147</b>
<i>skipped question</i>					<b>183</b>

8. Do you have any suggestions for making it easier and more accessible to submit research needs ideas?		
		Response Count
		79
<i>answered question</i>		<b>79</b>
<i>skipped question</i>		<b>251</b>

9. Would you be interested in participating in a blog or other interactive electronic forum devoted to transportation planning issues?			
		Response Percent	Response Count
Yes		43.0%	120
No		21.9%	61
Not Sure		35.1%	98
Other suggested electronic forums?			22
<i>answered question</i>			<b>279</b>
<i>skipped question</i>			<b>51</b>

10. Please include your contact information if you would like to stay informed about the results of this survey and this effort overall.

		Response Percent	Response Count
Name:	<input type="text"/>	99.5%	198
Title	<input type="text"/>	93.0%	185
Organization	<input type="text"/>	96.5%	192
Email Address	<input type="text"/>	98.0%	195
Verify Email Address	<input type="text"/>	97.5%	194
Phone Number:	<input type="text"/>	88.4%	176
		<i>answered question</i>	199
		<i>skipped question</i>	131

11. If you would like to send this survey on to other colleagues, please input their email address here and we will send them this link.

		Response Count
		20
		<i>answered question</i>
		20
		<i>skipped question</i>
		310

## Appendix B: Surveys Following Breakout Sessions

The following tables show the questions asked in the feedback survey following each Breakout Session. There were some questions common to each session and some questions that were specific to each Breakout Session.

Table 3. Survey Questions Common to All Breakout Sessions

Survey Question	Response Options				
What type of organization do you represent	Open-ended				
I found the Webinar software to be easy to use or easy to use after some instruction.	Strong Agree	Agree	Neutral	Disagree	Strongly Disagree
Please rate your level of satisfaction with this Webinar.	Very satisfied	Moderately satisfied	Neither satisfied nor dissatisfied	Moderately dissatisfied	Very dissatisfied
Do you have any suggestions on how to make these Breakout Sessions more effective?	Open-ended				
Have we captured the primary challenges and issues related to these topics?	Yes	Not Sure		No	
Have we captured the major research needs related to these topics?	Yes	Not Sure		No	

Table 4. Survey Questions Specific to Community, EJ, and Social Impacts Breakout Session

Survey Question	Response Options				
How import is research to support livability considerations in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research to support decision-making approaches and institutional issues related to these issues?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research to develop/improve tools and analytic methods related to social, community, and EJ issues in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing fundamental knowledge about social, community, and EJ issues?	Extremely important	Very important	Somewhat important	Not very important	Not important at all

Table 5. Survey Questions Specific to Integrated Land Use/Transportation/Environmental Planning Breakout Session

Survey Question	Response Options				
How import is research addressing the integration of land use and transportation?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing the integration of environmental and transportation planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
Which of these types of research related to land use, transportation, and environmental planning is most important to address?	Data, tools, and analysis techniques	Fundamental knowledge	Decision-making and institutional issues	All equally important	Unsure

Table 6. Survey Questions Specific to Congestion/Operations, Safety, and Security Planning Breakout Session

Survey Question	Response Options				
How important is research addressing security issues in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing safety issues in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing congestion/operations in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
Which of these types of research related to congestion/operations, safety and security is most important to address	Data, tools, and analysis techniques	Fundamental knowledge	Decision-making and institutional issues	All equally important	Unsure

Table 7. Survey Questions Specific to Data Needs, Modeling, and Planning Tools Breakout Session

Survey Question	Response Options				
How import is research addressing modeling issues in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing data needs in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all

Table 8. Survey Questions Specific to Economic Impacts and Freight Planning Breakout Session

Survey Question	Response Options				
How import is research addressing freight in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing economic/fiscal analysis?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing economic impacts (jobs, development) in planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
Which of these types of research related to economics and freight planning is most important to address?	Data, tools, and analysis techniques	Fundamental knowledge	Decision-making and institutional issues	All equally important	Unsure

Table 9. Survey Questions Specific to Performance-Based Planning, Funding, and Other Emerging Issues Breakout Session

Survey Question	Response Options				
How import is research addressing performance-based planning?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing livability and sustainability?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
How important is research addressing funding/financing issues?	Extremely important	Very important	Somewhat important	Not very important	Not important at all
Which of the following types of research related to performance-based planning and funding is most important to address?	Data, tools, and analysis techniques	Fundamental knowledge	Decision-making and institutional issues	All equally important	Unsure

## Appendix C: Additional Analysis

Performed by Anne Dunning from Clemson University, this analysis offers some additional insights about participation in the Virtual Conference and the prioritization of the research needs. The following two charts provide an indication of the number of participants in the virtual conference from different types of organizations. It should be noted, however, that these figures represent the number of sites logging onto each Webinar, but do not necessarily reflect the number of individual participants in each session. It is known that several of the sites logging onto the plenary session contained more than one person at the site.

Figure 5. Distribution of Contributors: Plenary Attendees

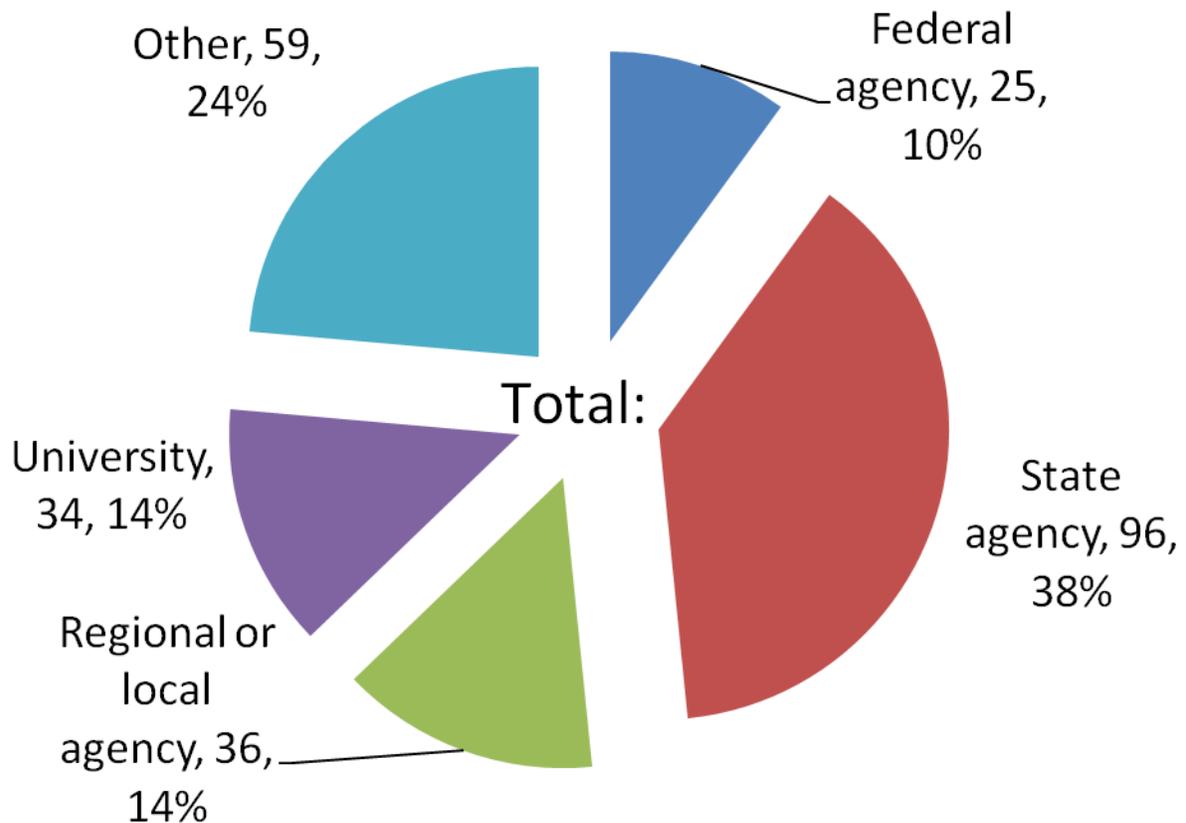
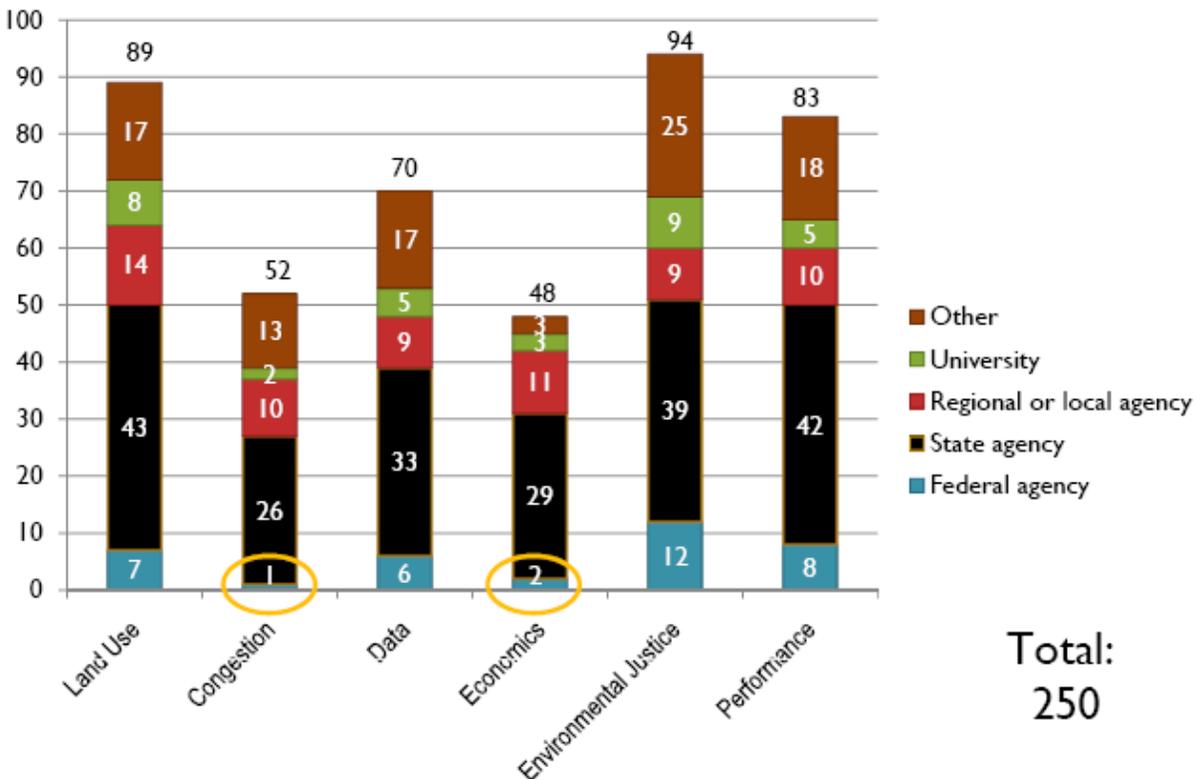


Figure 6. Distribution of Contributors: Session Attendees



The following chart shows the ranking that breakout session participants provided in response to polls regarding the importance of each topic. It should be noted that polling questions regarding the importance of each issue were used primarily as a means to generate discussion, and elicit comments from those who felt that an issue was particularly important. Since a different set of individuals participated in each breakout session, comparisons should not necessarily be made between topics from different sessions. Moreover, since participants were able to select breakout sessions to attend, it is not unexpected that most participants felt the topics addressed in these sessions were important or very important. There likely was some self-selection bias in that people most interested in a particular topic chose to participate in that session. Furthermore, since the technology is limited to a one computer, one vote system, sites with multiple participants may be under-represented. One person at one computer has as much voting power as 10 people at one computer host. Consequently, although these findings are interesting, these results should not be used to prioritize across all of the planning topics. The web-based survey allowed individuals to rate the most challenging planning issues and may provide a better basis for prioritizing among topics.

Figure 7. Interest Magnitude and Prioritization: Relative Importance

