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TEXAS TRANSPORTATION INSTITUTE • THE TEXAS A&M UNIVERSITY SYSTEM

**Workshop on Intelligent Transportation
Systems and Travel Demand
Management—Workshop Proceedings**

TT/ITS RCE-96/01

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Workshop Proceedings

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Workshop Summary

Katherine F. Turnbull

Division Head

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The *Workshop on Intelligent Transportation Systems and Travel Demand Management* was held in Houston, Texas on September 20 and 21, 1995. The Workshop was sponsored by the Texas A&M Intelligent Transportation Systems Research Center of Excellence and the Texas Transportation Institute, a part of The Texas A&M University System.

The Workshop was held in cooperation with a number of other organizations. These include the Metropolitan Transit Authority of Harris County, the Texas Department of Transportation, the Federal Highway Administration, the *ITS America* Travel Demand Management Task Force, the Institute of Transportation Engineers Travel Demand Management Council, the Transportation Research Board Travel Demand Management Committee, and the Association of Commuter Transportation.

The purpose of the two-day Workshop was to develop a strategic agenda for the deployment of intelligent transportation systems (ITS) technologies to enhance travel demand management (TDM). To accomplish this objective, the Workshop was designed as a working conference. After the opening luncheon, participants spent the afternoon and the next morning in working groups discussing barriers limiting the use of TDM, potential applications of ITS technologies to overcome these concerns, and possible demonstration projects, operational tests, and research activities.

The Workshop brought together key representatives from the TDM and ITS communities. Individuals from federal, state, and local governments, state departments of transportation, metropolitan planning organizations (MPOs), transit agencies, rideshare groups, transportation management associations and organizations (TMAs and TMOs), private businesses, consulting firms, universities and research institutes, and other groups provided a diverse mix of perspectives and opinions. The Workshop provided the opportunity to share ideas and to help build a bridge between TDM practitioners and the ITS community.

The results of the Workshop are summarized in these proceedings. This document provides the basis for the development of a vibrant, multifaceted, ongoing strategic agenda for the deployment of ITS to enhance TDM. The proceedings summarize the comments from the opening and closing sessions, as well as the discussions in the working group sessions. The resource paper on ITS and TDM, developed to help establish a common base for the working group discussion, is also included.

Overview of TDM and ITS

Travel demand management includes a wide variety of techniques and actions aimed at managing the demand on transportation facilities by encouraging commuters to change from driving alone to using a high-

occupancy vehicle or shifting into less congested travel periods. Thus, TDM actions focus on a variety of approaches to encourage ridesharing, transit use, alternative work schedules, parking management and parking pricing, and other techniques. It may also include eliminating trips altogether through telecommuting.

TDM strategies include a wide range of actions focusing on the use of both incentives and disincentives. TDM strategies may include expanded or new transit services, ridesharing programs, parking policies and parking pricing, flexible work hours, telecommuting, walking, bicycling, and other techniques. Incentives—such as employer paid bus passes or employee benefits for using HOVs—and disincentives—such as increasing parking rates or penalizing individuals who drive alone—may be used. Recent TDM programs are also characterized by increased private sector involvement. This may occur through the formation of TMAs and TMOs, employee TDM coordinators, and joint efforts between public agencies and private businesses.

A major focus of recent transportation research and development activities has been on a variety of technologies being examined under the general heading of intelligent transportation systems (ITS). Intelligent transportation systems include the application of a wide range of advanced technologies that share the common goal of improving the effectiveness of the overall transportation system. More specifically, ITS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment. These efforts are being supported by federal and

state policy directives, private industry groups, university research institutions, and others.

The use of ITS technologies with TDM strategies appears to hold promise for making the use of high-occupancy commute modes more convenient and enhancing other TDM actions. Thus, combining the two—ITS and TDM—may help meet the goal of improving the overall efficiency of the transportation system and may assist in meeting other environmental and societal goals. The focus of the *Workshop on ITS and TDM* was on identifying potential applications of ITS technologies to enhance the use and effectiveness of TDM programs.

Current Barriers to TDM

The working groups discussed a wide range of issues, concerns, and barriers to TDM. As highlighted next, most of these relate to the convenience and flexibility of the private automobile, lack of information on alternative modes, and conflicting policies.

- The automobile offers commuters greater privacy, flexibility, and freedom than alternative commute modes such as carpooling, vanpooling, and transit. Enhancing the flexibility and convenience of alternative modes, including making all elements of the transportation system more seamless, would help make them more attractive to commuters.
- Many commuters are unfamiliar with ridesharing and transit, and thus are uncomfortable with trying to use these modes. Providing better information on

all aspects associated with alternative modes would be of benefit to commuters.

- Responsibilities, such as dropping children off at school or day care, influence the mode choices and travel patterns of many commuters. Providing greater flexibility with alternative commute modes and locating facilities in closer proximity could help address these travel needs.
- Commuters are often not aware of the travel times and the costs associated with various modes. Providing real-time information on the status of all modes, and using virtual reality and other visualization techniques to allow individuals to experience alternative modes, would help individuals make more educated travel decisions.
- In some cases, TDM techniques may not be well matched to the needs of specific market segments. There is a need to enhance market research for various TDM programs and use this information to target specific strategies to the identified market segments.
- Some federal, state, and local policies conflict as they relate to parking, land use, transit, and other elements that influence TDM. Addressing these conflicts could enhance the effectiveness of TDM programs.
- The lack of coordination among agencies and governmental units may inhibit the implementation of TDM. Ensuring that all groups are working together toward common goals would enhance TDM efforts.

- Some TDM programs have suffered from the lack of good monitoring and evaluation programs. These problems have resulted in the inability to identify the benefits from specific efforts. Enhanced monitoring and evaluation programs would provide needed information on the benefits of TDM to all groups.
- The changing political environment at the federal level, and in some states and metropolitan areas, may inhibit the development of TDM programs. Information on the benefits of TDM to businesses, individuals, and the transportation system is needed to help overcome some of these changes.
- TDM efforts are focused almost solely on work trips. Non-work trips represent a significant percent of total trips, and are increasing at a more rapid rate than work trips. TDM strategies should consider non-work trips to help address growing off-peak travel demands.
- Many TDM professionals are not familiar with ITS and many ITS professionals are not familiar with TDM. There is a need to bring these two groups together to share problems, ideas, and possible solutions.
- Some businesses and employers perceive that TDM programs may hurt employee recruitment and retention, as well as customer attraction and their overall competitiveness. Information on the benefits of TDM to employers is needed to counteract these perceptions.

Demonstration Projects, Operational Tests, and Research Activities

Workshop participants identified a number of applications of ITS technologies to enhance TDM. Many of these focused on improving market research and targeting services to specific markets, providing real-time information on all modes through multiple media at all points in the travel process, enhancing the convenience of transit and ridesharing, improving connections among all modes, promoting a seamless transportation system, and improving TDM monitoring and evaluation efforts.

A consensus emerged from the working groups that ITS and TDM are closely linked and that numerous opportunities exist to enhance the overall effectiveness of the transportation system by combining ITS and TDM. On one hand, ITS can help define and create TDM products and services for specific market segments; enhance the delivery of these products and services to customers; improve the convenience and ease of use of TDM; and help in monitoring and evaluating TDM efforts to better promote the benefits of such programs. On the other hand, TDM provides a realistic near-term market for ITS technologies. Thus, a synergy exists between ITS and TDM.

The application of ITS with TDM and possible demonstration projects, operational tests, and research identified in the Workshop focuses on the following eight general categories.

- Enhancing market research and target marketing.

- Providing real-time information on all modes.
- Enhancing the convenience of transit and ridesharing.
- Promoting a seamless transportation system.
- Enhancing parking information and parking management systems.
- Enhancing congestion pricing projects.
- Enhancing alternative work schedules, work arrangements, and telecommuting.
- Improving TDM monitoring and evaluation efforts.

The ideas generated from the working groups and the overall Workshop are summarized next by these different areas.

Market Research and Target Marketing

ITS and other advanced technologies can be used to enhance market research activities and to target TDM services and products to specific market segments. The following projects were identified by the Workshop participants for testing.

- Test the use of interactive cable television and other technologies to identify the needs of different market segments and their responses to various commute and TDM alternatives.

- Test the development of a coordinated system to obtain, monitor, and evaluate commuter market segments, their preferences, and their use of specific products and services.
- Develop, test, and evaluate the use of ITS technologies to simulate and visualize travel experiences on different modes and the use of various TDM techniques. For example, the use of transit, carpools and vanpools, HOV lanes, and telecommuting could be simulated through virtual reality or other visualization techniques.
- Use advanced technologies to explain and demonstrate TDM strategies to the public, commuters, employers, and policy groups.

Provide Real-Time Information on All Modes

Providing real-time information on all modes at multiple locations by numerous technologies will allow individuals to make more educated travel choices. Pre-trip, as well as in-route information, could be provided through numerous technologies. The information should include comparisons of the status, travel times, and costs of the various modes. Individuals could use this information to select the appropriate travel mode, travel route, and time of travel. They may also select not to travel if they have the ability to telecommute. The following represent some of the technologies and approaches that could be used to provide real-time information.

- Provide real-time information on all modes in the home, in the work place, at major activity centers, at transit stops, in

transit vehicles, and in personal automobiles. Developing, implementing, and evaluating projects focusing on different techniques is appropriate. This information could be provided through a number of different technologies, including the following:

- Cable television and interactive television.
- Computers, Internet, and World Wide Web.
- Touch tone and cellular telephones.
- Personal paging devices.
- Information screens and interactive kiosks.
- Changeable message signs.
- Highway advisory radios.

- Develop, test, and evaluate a demonstration project that provides premium real-time transportation information and notification services. This demonstration would expand on the real-time information described in the previous item by providing a premium service tailored to an individual's needs. For example, such a service might notify an individual subscriber of major incidents on the roadway system, a bus approaching their stop, or a carpool approaching their home. It might also include automatic notification of an employer, day care, or school of a late arrival or delay due to travel problems.
- Develop, implement, and evaluate a demonstration project that targets specific information to high-occupancy vehicles to provide an additional incentive to using these modes. A possible demonstration project could test

the provision of preferential information on congestion levels, incidents, and alternative routes to carpools and vanpools.

- Develop, implement, and evaluate a “GIS yellow pages” with information on all modes and other services.

Enhancing the Convenience of Transit and Ridesharing

There was agreement among participants that ITS and other advanced technologies offer great potential to enhance the convenience of transit and ridesharing modes, making these alternatives more attractive to existing riders and potential customers. There was also agreement that ITS can improve the operations and management of these services. The following demonstration projects and other activities emerged as priorities from the working groups.

- Provide real-time information on the status of buses and rail services to transit riders. Conduct a series of demonstration projects to test and evaluate the use of automatic vehicle location (AVL) systems linked to passenger information systems. A variety of demonstrations should be implemented using different AVL technologies and different information delivery systems, including kiosks and signs at major stops and activity centers, in home and in office devices, and on-vehicle systems.
- Develop, implement, and evaluate the application of AVL with a timed-transfer bus system in a suburban setting.

- Develop, implement, and evaluate the use of AVL and other ITS technologies to enhance coordination among public and private travel modes.

- Develop, implement, and evaluate real-time ridematching systems. Different approaches and technologies should be tested. Possible tests could focus on the use of e-mail, centralized matching, and in-route information.

- Develop, implement, and evaluate a non-work or non-commuter ridematching system using the same technologies. Possible tests could focus on the use of e-mail, centralized matching, and in-route information.

- Develop, implement, and evaluate the use of ITS and other advanced technologies for remote sensing of vehicle occupancy levels for enforcement of HOV facilities and congestion pricing projects.

- Develop, implement, and evaluate the applications of ITS and other advanced technologies to enhance guaranteed ride home programs. Possible projects could focus on real-time service requests and trip matching, monitoring and tracking of use, and *Smart Card* payment systems.

Promote a Seamless Transportation System

There was agreement among workshop participants that ITS provides significant opportunities to develop and promote a more seamless transportation system and enhance intermodal connections. The following projects were identified to improve coordination among all modes and to promote a seamless transportation system.

- Develop, implement, and evaluate universal travel cards that include transit, toll facilities, parking, and other services. Multiple demonstrations are appropriate focusing on different approaches, combinations, and technologies.

Parking Information and Parking Management Systems

A number of projects focusing on the use of advanced technologies to enhance parking information and parking management systems were identified by workshop participants. These included efforts aimed at providing preferential treatment to carpools and vanpools, as well as programs to improve parking information for all travelers.

- Develop, implement, and evaluate the use of advanced parking management or information systems. A variety of different approaches and technologies could be tested. These could include providing real-time information on the location and space availability at park-and-ride lots, downtown parking facilities, special event parking, airport parking, and other facilities. Changeable message signs, highway advisory radio, in-vehicle devices, and other technologies could be used to provide this information.
- Develop, implement, and evaluate parking management systems. A number of projects could be conducted to test different approaches and technologies for better managing parking facilities and providing incentives or preferential treatment to carpools and vanpools. For example, *Smart Cards* or debit parking

cards could be used to provide access to preferential spaces for carpools. Another project could focus on limiting the number of entries into a parking facility to less than 5 a week to encourage carpooling. Using a multi-purpose *Smart Card* for parking, transit, and other services represents still another approach.

Enhancing Congestion Pricing Projects

The use of congestion pricing as a TDM technique was discussed in most of the working groups. There seemed to be general consensus that technologies were available to implement congestion pricing projects, but numerous policy questions related to this approach needed to be considered. The following activities were suggested to promote the use of ITS with congestion pricing projects.

- Monitor and evaluate the current congestion pricing projects underway, as well as those in the development stage.
- Examine the policy and political concerns associated with congestion pricing projects and identify approaches to address these issues.
- Develop, implement, and evaluate additional congestion pricing projects as appropriate.

Enhancing Alternative Work Schedules, Work Arrangements, and Telecommuting

The use of advanced technologies to encourage telecommuting and other alternative work arrangements was discussed in the working groups. The following projects and research needs were identified to help advance the use of telecommuting and other work schedules.

- Research and develop an advanced work scheduling system that would better track and coordinate alternative work schedules (flexible work hours, staggered work hours, compressed work weeks), job sharing, satellite offices, and telecommuting. Implement and evaluate the use of this system in multiple areas.
- Continue to utilize advanced technologies for telecommuting and other alternative work arrangements. Conduct ongoing monitoring and evaluation programs of different telecommuting projects.

Improving TDM Monitoring and Evaluation Efforts

There was agreement among the workshop participants that ITS and other advanced technologies could greatly enhance the ability to monitor and evaluate TDM programs. The lack of good evaluations of TDM activities was one of the major issues identified in all three working groups. The following suggestions were made for applying ITS to improve TDM program monitoring and evaluation.

- Include a monitoring and evaluation component in all of the demonstration projects and other activities identified

previously. This program should use the advanced technologies being tested to monitor the use and effectiveness of the project.

- Research and test specific technologies and approaches for monitoring different TDM strategies. Implement and evaluate these approaches in a series of tests.
- Use advanced technologies to document and show the results and benefits of TDM to the public, commuters, employers, and policy makers.

Kickoff Luncheon

Workshop Welcome

*Dennis L. Christiansen
Deputy Director
Texas Transportation Institute*



It is a pleasure to welcome you to the *Workshop on Intelligent Transportation Systems and Travel Demand Management*. The Workshop is sponsored by the Texas Transportation Institute (TTI), a part of The Texas A&M University System, and the Texas A&M Intelligent Transportation Systems (ITS) Research Center of Excellence.

Three years ago, the Federal Highway Administration (FHWA) selected three universities through a competitive process to serve as ITS Research Centers of Excellence. The Texas A&M University System, the University of Michigan, and the Virginia Polytechnic Institute and State University, were the three universities chosen.

The Texas A&M ITS Research Center of Excellence is housed at TTI. The research funding for the Center comes from FHWA and the local partners, which include the Texas Department of Transportation (TxDOT), the Metropolitan Transit Authority

of Harris County (METRO), and the Corpus Christi Regional Transit Authority (RTA). Research at the Center focuses on the three main areas of public transportation, transportation management, and international border transportation.

One of the projects in the public transportation focus area is examining the application of ITS technologies with travel demand management (TDM) strategies. This Workshop represents an important component of the project. Your participation is critical to help identify current barriers to TDM programs and ways ITS technologies can be deployed to overcome these. The results from the Workshop will be used to guide future research and deployment activities at the Center and at other agencies and organizations.

The Workshop also offers the opportunity for you to interact with others involved in TDM and ITS. Enhancing communication and coordination among all groups is another objective of TTI and the ITS Research Center of Excellence. The involvement of the *ITS America* TDM Task Force, the ITE TDM Council, the TRB TDM Committee, and the Association for Commuter Transportation in the Workshop provides an indication of the support needed to advance ITS and TDM.

I hope you find the Workshop to be both interesting and productive. Thank you again for participating.

Workshop Introduction

C. Kenneth Orski

*Consultant, and Chairman, ITS America
TDM Task Force*



On behalf of *ITS America*, I want to thank Katie Turnbull, the Texas Transportation Institute, and the ITS Center of Excellence for organizing and hosting this Workshop. *ITS America* is pleased to be a co-sponsor of the Workshop. One benefit of being a co-sponsor is that you get the credit without doing any of the work. All the credit for the Workshop belongs to Katie and TTI, without whose initiative and hard work this meeting would not have taken place.

I have been asked to say a few words of introduction. I will take the opportunity to tell you about the *ITS America* TDM Task Force and what it hopes to accomplish. I will also mention some of the activities of the ITE TDM Council related to ITS.

Two years ago, *ITS America* developed an inventory of potential users of ITS technologies as part of an effort to define a National ITS Program Plan. The inventory took the form of a list of 29 user services or specific applications of ITS technology. These user services were grouped into seven service bundles. Travel demand management (TDM) represents one of the seven bundles.

Included in the TDM bundle are the user services of demand management operations, pre-trip travel information, ridematching, and telecommuting. TDM is thus officially recognized as one of the objectives and clients of the national ITS program.

The purpose of the *ITS America* TDM Task Force is to further clarify and strengthen the relationship between ITS and TDM. Specifically, the Task Force was instructed to investigate and publicize innovative uses and applications of ITS technologies in travel demand management, and to identify operational tests and deployment opportunities for TDM services utilizing ITS technologies.

A second major charge to the Task Force is to serve as a bridge between professionals working in the TDM field and members of the ITS community. You must realize that the acronym TDM is not exactly a household word among engineers from Motorola, TRW, and Siemens — anymore than loop detectors and radio data systems are terms familiar to TDM practitioners. I hope that through meetings such as this we shall at least learn each other's language and come to appreciate each other's perspective.

One of the first things the Task Force did was to undertake a survey of ITS applications in travel demand management. This survey was conducted in cooperation with the ITE TDM Council. We were pleasantly surprised to see the extent to which advanced communication technologies are being used in managing travel demand. Projects identified included a number of publicly-sponsored traveler information systems, as well as applications in the private sector

related to interactive online ridematching systems and other components.

One challenge facing the Task Force and this Workshop is to determine the boundaries around TDM and ITS. Should we limit ourselves to the traditional TDM techniques, such as ridematching and telecommuting, or should we adopt a more expansive view that embraces traveler information, in-route transit information, parking management, and other ITS user services? I hope that you will give this issue some thought, as it will affect the way we are perceived by the ITS community.

I also hope this Workshop will provide new insights into the way advanced technologies can enhance TDM effectiveness and how TDM, in turn, can create new markets for ITS technologies. Together, TDM practitioners and the ITS industry can then begin shaping a common agenda that will advance the interests of both groups.

The results from this Workshop will benefit numerous groups, including the *ITS America* TDM Task Force and ITE's TDM Council. I look forward to being part of this Workshop and the exciting new frontier we are entering.

Charge to Working Groups

Katherine F. Turnbull

Division Head

Texas Transportation Institute



I would also like to welcome you to the *ITS and TDM Workshop*. As Dennis and Ken noted, the Workshop represents an important step in helping to advance the deployment of ITS with TDM programs. Your participation in the working group sessions will be critical to the success of the Workshop.

As noted in the letter of invitation and the registration information, this Workshop is intended to be a working conference. This afternoon and tomorrow morning will be spent in breakout groups discussing barriers to TDM strategies, potential applications of ITS technologies to overcome these concerns and to enhance TDM programs, and the identification of demonstrations, operational tests, and research activities.

The results from the working groups will be presented at the closing luncheon tomorrow. The presentations and the breakout group discussions will be documented in the workshop proceedings. The proceedings will be used by the Texas A&M ITS Research Center of Excellence to develop a strategic agenda for ITS and TDM. The strategic agenda will help guide future projects and activities at the Center. The

proceedings and the strategic agenda will also be available to other groups to assist in advancing the deployment of ITS with TDM programs.

You have been invited to participate in the Workshop because of your expertise and experience in TDM or ITS. The Workshop is intended to provide you with the opportunity to share your ideas with others and to help build a bridge between TDM practitioners and the ITS community.

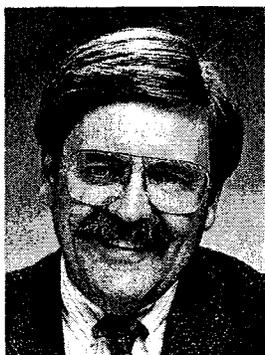
I hope you will find the discussions in the working groups to be stimulating and thought provoking. Thank you again for participating in this Workshop. I look forward to continuing to work with all of you in this exciting and challenging area.

Closing Luncheon

Working Group Highlights

Working Group 1

*Byron York
2 Plus*



Participants in working group 1 discussed a wide range of issues associated with TDM and possible solutions utilizing ITS. Short-term approaches using existing technologies were identified, as well as longer term solutions requiring more advanced technologies. I will focus my comments first on the near term strategies and close with a few longer term projects.

Using existing technologies to provide information on all modes to encourage transit, carpooling, vanpooling, and other commute alternatives was one of the short-term applications identified by participants in working group 1. Enhancing the availability of information through multiple technologies will allow commuters to make more educated travel choices. For example, as the AM radio band becomes more of an information band and cellular telephones become more widespread and cheaper, these two technologies could be utilized to disseminate all types of information. Further, a number of technologies could be used to provide information on all modes to commuters in

their homes and offices, in-route, at major activity centers, and at other locations.

ITS technologies were also suggested for enhancing rideshare and vehicle matching and telecommuting. Further, advanced technologies could be used to simulate alternative modes and to provide information on TDM effectiveness to the public and policy makers. Using information gathered through ITS for identifying potential markets and targeting specific products to these groups was also discussed. Longer term strategies focused on the use of satellite networks, projects addressing non-work trips and home-delivery services, and programs focusing on the needs of the elderly and individuals with special needs.

Working Group 2

*Jim Sims
Southern California Association of
Governments*



Focusing ITS on the end users and providing benefits to these individuals were the overriding ideas discussed in working group 2. To accomplish these objectives, the challenges to TDM programs include dealing with information, promoting individual and institutional change, targeting customers,

providing user-friendly services, involving the private sector, and improving evaluations of TDM effectiveness.

Working group 2 identified a number of ways ITS technologies could be applied to enhance TDM programs. These included the use of both existing and lower cost technologies, as well as approaches involving more advanced technologies. ITS applications were suggested for service enhancements, data collection and analysis, and streamlining user interfaces. Participants stressed the importance of fitting solutions and technologies to specific problems. They also noted that addressing institutional issues and coordination are often more critical than technology concerns.

A number of possible ITS and TDM project areas were identified by the working group. These included GIS-based yellow pages; real-time transit information at multiple locations; simulation of ridesharing, HOV lane, and transit use; simulations of HOV operations and impacts; data gathering to identify markets and targeting promotional efforts; remote sensing of vehicle occupancy levels; enhanced project evaluations; parking guidance and management systems; do-it-yourself ride matching; work scheduling technologies; and in-vehicle navigation incentives for carpoolers.

Working Group 3

Dee Angell

Association for Commuter Transportation



I am pleased that this Workshop was held in conjunction with the National ACT Conference and that I had the opportunity to participate. The Workshop has helped to foster cross-fertilization between the TDM and ITS communities.

After discussing some of the barriers associated with TDM, working group 3 focused on identifying possible ways to overcome these concerns through the application of ITS. Many of the suggestions related to enhanced information sharing and the development of a seamless transportation system. I would like to highlight a few of the ideas identified by working group 3.

The first area focused on enhanced information sharing. ITS provides the opportunity for commuters and travelers to obtain current information on the status of all modes. Real-time information allows commuters to make more educated travel decisions. Projects which provide this information to individuals at all points in the travel decision-making process were supported.

Second, ITS technologies can be used to improve data collection and analysis associated with TDM programs. The lack of data to evaluate the effectiveness of different TDM strategies has been a limitation in the past. ITS may help address these problems.

Third, ITS can be used to build a seamless transportation system. *Smart Cards*, pre-trip and route planning programs, and other technologies can all promote a more integrated and seamless transportation system. Demonstration projects focusing on these technologies were supported by participants in working group 3.

I think it is important, however, to raise a word of caution with these approaches. We need to ensure that information focuses on a specific purpose and is not just “data collection for the sake of collecting data.” We also need to ensure that technologies are being applied to address real problems and concerns.

I would like to encourage more workshops like this one and the ongoing collaboration among all groups. We are all interested in enhancing mobility and addressing other transportation issues. I look forward to working together on these important issues.

Federal Perspective
Wayne Berman
Federal Highway Administration



I am pleased to participate in the closing session of this Workshop. I believe that this workshop is extremely important to the future of TDM. It has provided a greater focus on an area that I think will be especially important to TDM — making TDM work better through the use of Intelligent Transportation Systems (ITS).

As most of you know, I have been working in TDM-related activities from the Federal perspective for many years. I am very aware of the history behind TDM and the current status of many TDM programs around the country. I also have given a lot of thought to the future of TDM and would suggest that TDM and ITS are closely linked.

Two years ago, the Transportation Research Board sponsored a Symposium on TDM Research and Innovation. In one of the keynote speeches, Dennis Judycki, FHWA Associate Administrator for Safety and Systems Applications, stressed the importance of TDM “hitching its wagon to the ITS star.” There are traffic management, traveler information, customer service, and funding opportunities for TDM by realizing

the role that ITS can play. That message is still true today and this Workshop represents an important step in creating a greater understanding of ITS and enhancing interaction between representatives from the ITS and TDM communities.

The challenge will be to take the results from this Workshop back to your agencies and businesses to help create the opportunities and partnerships that will integrate ITS into the operating practices of TDM professionals. We need to focus on making ITS a reality today and the applications with TDM will be an integral approach to accomplish this goal.

Many of the ITS applications with TDM strategies focus on providing enhanced information to the traveling public and improving communications among modes. The technologies for these applications are available today and represent key components of the core ITS infrastructure. Applying these technologies to TDM can help advance the deployment of ITS and enhance customer acceptance.

Workshops like this one also help build the national coalition needed to advance the deployment of ITS. TDM has historically involved both public and private sector groups. The public and private partnerships of successful TDM programs may serve as a good model for ITS projects.

This Workshop has also enhanced communication among TDM practitioners and the ITS community. We need to continue this effort and reach out to additional groups such as the National Association of Regional Commissions (NARC), the National League of Cities

(NLC), and other organizations. A national coalition will be needed to help advance ITS.

Many people think of ITS in terms of the more futuristic applications. ITS is really about smart investments and operations today, as well as advanced systems in the future. ITS applications with TDM strategies provide the opportunities for near-term enhancements in mobility and better management of the transportation system.

The vision of TDM is expanding to include mobility management, congestion management, and other applications. Recent TDM efforts have also taken a more customer oriented approach. These match well with the focus of ITS programs.

A number of existing ITS and TDM projects have been discussed in the working groups. Many of the current efforts and the potential projects outlined by the previous speakers focus on information sharing. Providing real-time information on traffic conditions and the status of various modes represents a major opportunity in urban and rural areas.

In closing, I would like to challenge you to continue to work together to advance the introduction and advancement of ITS with TDM programs. I would also challenge you to focus on the end user of both TDM and ITS as you move forward with possible projects. Both TDM and ITS are critical to addressing the issues facing major metropolitan areas, small communities, and rural areas. Thank you.

**Research Center of Excellence
Perspective**
Raymond Krammes
Director
*Texas A&M ITS Research Center of
Excellence*



I am pleased that the Texas A&M ITS Research Center of Excellence was able to sponsor this Workshop on ITS and TDM. Enhancing communication and cooperation among all groups responsible for deploying ITS is one of the goals of the Center. This Workshop has been an excellent opportunity to foster greater interaction among the TDM and ITS communities. I would like to thank the organizations who co-sponsored the Workshop, and all of you for participating.

I enjoyed the opportunity to attend the Workshop and I hope you found it beneficial. The discussions in the breakout sessions were very stimulating, and I commend all of you for openly sharing your thoughts and ideas. As highlighted by Byron, Jim, and Dee, many good suggestions were identified for possible demonstration projects, operational tests, market assessments, and further research.

The challenge will now be to translate these suggestions into action. The Texas A&M ITS Research Center of Excellence

will use the results from the Workshop to identify future projects and research activities. As Wayne mentioned, we hope FHWA, FTA, *ITS America*, ITE, TRB, ACT, and many other groups will also find the Workshop proceedings of benefit.

The Center will continue to play a significant role in the deployment of ITS and TDM, as well as fostering ongoing communication among all groups. Thank you again for your participation and I look forward to working with you in the future on advancing ITS.

Working Group Summaries

Working Group 1

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Barriers to Use of TDM Strategies and Other Issues

Workshop participants identified a number of issues related to various TDM strategies and potential barriers that may limit more widespread use of some techniques. The discussion focused on issues common to all TDM strategies, as well as concerns unique to individual techniques. The following concerns and barriers were identified by participants in working group 1:

- TDM should focus on products and services that commuters and travelers want and will use.
- The changing political environment may result in a need to refocus TDM.
- Alternative commute modes, including carpooling, vanpooling, and transit, are often less convenient and have less flexibility than using a personal automobile.
- Transit services focusing on the suburb-to-suburb travel market are not available in many areas.
- Parking management and pricing techniques have not been used extensively. Many companies and agencies still provide larger subsidies for parking than for transit use.
- Businesses may feel TDM strategies will reduce employee recruitment and retention.

- There are still a number of misperceptions about telecommuting. These include perceptions that employers lose control, telecommuters are not productive, and telecommuters lose touch with the workplace. Educational efforts are needed to provide realistic information on telecommuting.
- Congestion pricing may be feasible from a technology standpoint, but there are numerous political, equity, and other issues that will need to be addressed before it is seriously considered in many areas.
- The lack of good evaluations has made TDM programs hard to promote with many groups.
- There is a need to focus on incentives, as well as disincentives, with TDM.
- There is often a misunderstanding about TDM. This may also be true of ITS.
- TDM and ITS should focus on specific problems and market segments.

Demonstration Projects, Operational Tests, and Research Activities

Workshop participants first identified a number of ITS technologies that could be applied to enhance TDM. They also discussed a wide range of potential demonstration projects and operational tests, as well as areas for additional research. The following suggestions were made by working group 1 participants.

- Communicate real-time traffic information to the general public through

a variety of delivery mechanisms. Provide pre-trip information in the home and in the workplace, and provide en-route and in-vehicle information at major activity centers, in transit vehicles, and in automobiles.

- Provide premium subscription services for real-time transportation information and notification. Such a service might include personalized notification of major incidents affecting an individual's commute trip, and notification of employers, day care, or others of possible delays.
- ITS technologies appropriate for application with TDM include AVL systems, cellular telephones, pocket or personal paging devices, changeable message signs, *Smart Cards*, highway advisory radio, satellites, electronic kiosks, in-car information systems, microcomputers, visualization and simulation techniques, and a variety of other technologies and approaches.
- Utilize real-time ride matching for non-work trips. For example, real-time ride matching could be used to help provide group rides to shopping areas or other activity centers. Develop, test, and evaluate demonstration projects focusing on non-work trips.
- Focus specialized services on the elderly population. Potential services would address both enhancing the mobility of elderly individuals and improving their accessibility by bringing goods and services directly to them.

- Conduct market assessments and market research on the demand for the ITS and TDM products and services.
- Provide corridor specific highway advisory radio (HAR) targeted toward specific destinations.
- Test and evaluate dynamic electronic ridesharing for intercity and intracity trips. This approach could be tested initially in a university or college environment.
- Test and evaluate enhanced video conferencing capabilities to overcome potential managerial resistance to telecommuting.
- Develop and disseminate information on the benefits of telecommuting and the various approaches that can be used.

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Barriers to Use of TDM Strategies and Other Issues

Participants in working group 2 identified a wide range of barriers and issues associated with TDM strategies. The group also discussed some of the factors limiting the development and deployment of ITS, as well as possible barriers to combining ITS and TDM. The following issues and barriers were highlighted by participants:

- Transit systems are often not “user friendly.” For example, it may be difficult for a first time rider or infrequent riders to understand how to use a system, what the fare is, and where the stops are located.
- It is difficult to change long-standing commuter behavior oriented toward driving alone.
- Competition or disagreements among agencies and institutions may cause problems with the delivery of TDM programs and services in some areas. There is a need to enhance and improve coordination and cooperation among the agencies and groups involved in TDM.
- TDM strategies are new concepts in many areas. Further, many people do not think there are congestion, mobility, and air quality problems and therefore, do not see the need to change their travel behavior.

- The benefits of TDM programs have not been well documented or publicized. There is a need to communicate the benefits to all groups — commuters, policy makers, and employers.
- TDM should focus on more than just the commute trip. TDM programs should also start to consider non-work travel.
- Many people view TDM as infringing on their individual choice.
- People view TDM and transit as less predictable and less reliable than their private automobile.
- TDM is often viewed as a low priority by businesses and public agencies. It is often difficult to show the impact from the diverse TDM techniques in use because of limited monitoring and evaluation programs.
- It is difficult to get businesses to participate in TDM programs. There is a need to identify and communicate the benefits of TDM strategies to businesses, employers, and employees. The involvement of high level business executives is also necessary.
- There is a need to build ongoing monitoring and evaluation efforts into TDM programs. Measured benefits and impacts can be used to promote TDM activities with all groups.
- Commuters often do not have the information they need to make educated decisions related to commute modes, travel routes, and time of travel. ITS can help provide real-time information, but

many people do not know or understand the various technologies, which can limit the use of some approaches.

- Many TDM professionals do not understand ITS, and ITS vendors do not understand TDM. The two groups do not speak the same language. There is a need to bring the two groups together.
- There is a need to focus ITS on real problems rather than technologies looking for problems.
- An important issue with ITS will be how to ensure that all groups have access to products, information, and services. There may be too many acronyms used with ITS, and it is viewed as exclusionary — rather than inclusionary — by many groups.
- There is still a lack of understanding about what information people really want, what information they will use, and what the best methods are to provide it.

Demonstration Projects, Operational Tests, and Research Activities

The following demonstration projects, operational tests, and research activities were identified for further consideration by participants in working group 2:

- Develop, test, and evaluate real-time trip planning services for all travel modes.
- Test the provision of real-time information on the status of buses to individuals in their home and in their office, at bus stops, and other locations.

This could include developing, testing, and evaluating a GIS “yellow pages.”

- Test and evaluate the use of pager technologies to provide real-time information to commuters.
- Develop and evaluate the use of ITS technologies to simulate travel experiences on different modes. For example, the experience of being in a carpool or vanpool or using an HOV lane could be simulated. CD Roms, virtual reality, videos, or other technologies could be used at transportation fairs, public events, and in businesses.
- Use computers and other technologies to explain and demonstrate TDM strategies to the public, commuters, employers, and policy makers.
- Investigate the possibility of using an existing electronic database or other new technology to identify markets for TDM. Develop, implement, and evaluate a program which aids in identifying target markets for TDM and promotes specific products and services.
- Use ITS and other advanced technologies to translate data into marketing information. Advanced technologies provide the opportunity to gather a great deal of information on commuters, their travel patterns, and other characteristics. This information could then be used to better develop and match services to the needs of different market segments.
- Use advanced technologies to enhance the monitoring and evaluation of TDM programs. ITS may improve the ability

to document the results and benefits of TDM strategies. Develop, implement, and evaluate the use of different approaches and technologies.

- Test and evaluate the use of advanced technologies for remote sensing of vehicle occupancy levels for HOV enforcement or congestion pricing projects. Additional research may be needed to develop the necessary technologies.
- Use advanced technologies to better coordinate, book, and dispatch both public and private travel modes. Develop, implement, and evaluate demonstration projects focusing on different approaches.
- Develop, implement, and evaluate parking guidance, allocation, and management systems. These could include providing preferential treatment or pricing for high-occupancy vehicles.
- Conduct a policy analysis of ITS and TDM strategies. This analysis could help identify the combinations that best meet local, regional, and national goals.
- Develop, implement, and evaluate ridematching programs focused on non-commuter and non-work trips.
- Develop, implement, and evaluate the use of a universal travel card that includes all HOV modes, such as transit and toll roads, as well as parking and other services.

- Develop, implement, and evaluate an advanced work scheduling system that would better coordinate alternative work schedules, telecommuting, and job sharing.
- Provide in-vehicle navigation equipment to carpools. This approach would give carpools a travel time advantage over single-occupant vehicles. Develop, implement, and evaluate different demonstration projects.

Working Group 3

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Barriers to Use of TDM Strategies and Other Issues

Participants in working group 3 spent a good deal of time outlining the various issues often associated with TDM programs. Potential concerns were identified from the perspective of commuters, employers, and public agencies. Participants also discussed possible ITS applications to enhance TDM programs and to overcome the identified barriers.

Participants in working group 3 identified the convenience, comfort, and tradition of the personal automobile as the major barrier

to implementing TDM strategies and alternative commute modes. Commuters associate flexibility and autonomy with the private automobile, while inconvenience, inflexibility, and increased effort are often associated with TDM programs. Working group 3 used the following four general categories of individuals, businesses, the public sector, and technologies to help categorize the major barriers to TDM.

Individuals

- Comfort, convenience, and tradition of personal automobile use.
- Reluctance to give up flexibility and independence provided by personal automobile.

- Perception that ridesharing is an “all or nothing” option.
- Fear and uncertainty of riding with others.
- Unfamiliarity with other modes and uncertainty surrounding their use.
- Lack of timely and accurate information on alternative modes and TDM programs.
- Inconvenience of trip planning associated with alternative modes.
- Even under the best conditions, alternative modes are usually less convenient than private automobiles.
- Unaware of the true costs associated with owning and operating an automobile, including maintenance, insurance, and parking.
- Unaware of the true costs associated with building and maintaining the roadway infrastructure.
- The public is unfamiliar with the negative environmental impacts of congestion created by automobile use.
- The public is unaware of the need to reduce travel.
- Some of the reasons used to promote ridesharing may actually work against its use.
- Many people have the mind set that the use of private automobiles on free roadways is an inalienable right.
- Individuals may have the perception that they are doing enough for the environment by participating in recycling programs or other activities.

Businesses

- TDM is not yet perceived as good business, as the return on investment

- and benefits of TDM have not been well documented and communicated.
- Some TDM strategies — such as telecommuting, alternative work schedules, and changing parking policies — may challenge traditional management practices.
 - Perception that TDM may hurt employee recruitment and retention, customer attraction, and overall competitiveness.
 - Few incentives for business participation.
 - Conflicting public sector messages and requirements may cause confusion and add complexity.
 - Current legislation places employers in a non-traditional role by adding responsibilities for employee travel, reducing the use of single-occupant vehicles, and educating employees.
 - Current infrastructure, facilities, and policies support driving alone.
 - There is often a lack of incentives for developers to incorporate TDM support facilities and amenities into new buildings.
 - Parking policies, availability of transit services, and other elements often differ significantly between downtown and suburban businesses.

Public Agencies and Public Policy

- There is often a lack of coordinated approaches and policies among the public agencies responsible for the different roadway, transit, and TDM elements.
- Strong highway and automobile lobbying efforts may act against TDM.

- Conflicting policies, programs, and ordinances may hurt TDM. Examples include minimum parking space requirements, parking policies, and land use regulations.
- Trip reduction requirements are often not accompanied by supporting laws and programs.
- Effective public information programs on the need for TDM are absent in many areas.
- Funding sources to support alternative modes are often uncoordinated. Some modes and agencies may be in competition for the same funds, and different match requirements may be associated with various programs.
- There is a lack of coordination between land use, development, and transportation planning in many areas.
- Currently, tools and techniques to quantify the benefits of TDM, including emission and air quality, are inadequate.
- Poor marketing of alternative travel modes and TDM.
- Cost and funding of technology may be a concern for governments, businesses, and individuals.
- There is a need to overcome some people's fear of new technologies.
- Technologies need to be available, convenient, and easy to use.
- There is a need to determine what information people want, how much information they want, and how they would like it delivered.
- Potential concerns about privacy and "big brother."
- Good products and applications should bring good results, but care needs to be taken to make sure bad products or technologies do not negatively influence the perception of TDM.
 - There is a need for seamless technologies to support a seamless transportation system.
 - Use ITS and advanced technologies to enhance TDM program monitoring and evaluation.

Demonstration Projects, Operational Tests, and Research Activities

Participants in working group 3 discussed a variety of potential applications of ITS technologies with TDM. The following seven general projects represent the major focus areas identified by the group.

Technologies

- Potential for technology obsolescence — technologies may be obsolete by the time they are implemented. The length of time between concept development, research, marketing, and implementation may be too long.
- There is a need to provide flexibility and options with technologies.
- Equity of access to technologies may be a concern.

- A number of ways to utilize ITS and advanced technologies to enhance ridematching services were identified. These included informal programs using e-mail, real-time ridematching services, real-time information on the status of a ride, and real-time route alternatives for carpools. A variety of demonstration

projects and operational tests should be undertaken focusing on different approaches and technologies.

- Potential applications of ITS technologies to improve Guaranteed Ride Home Programs included real-time service requests and trip matching, monitoring and tracking of use, and *Smart Card* payment systems. Developing, testing, and evaluating enhanced Guaranteed Ride Home Programs should be pursued.
- Using ITS to provide real-time information on the status of transit and traffic conditions was identified as a priority for testing and deployment. Demonstrations could focus on the use of various technologies (cable television, cellular telephones, personal pager devices, and computers) in different locations (home, office, in-route, major activity centers, and other sites), and in different combinations. Information and services could include pre-trip planning, in-route travel changes, real-time status of all modes, and travel time and costs of various modes. The development of a transportation channel on cable television was also suggested. Testing and evaluating different approaches was identified as a priority.
- ITS applications can be used to provide advanced information on the location of parking facilities and real-time information on parking space availability. *Smart Cards* and other ITS technologies could also be used to provide preferential treatment and pricing to HOVs and to better manage parking facilities. These approaches could minimize the cost and inconvenience of parking programs,

monitor SOV and HOV use, and help promote greater equity in parking. A variety of demonstration programs and operational tests focusing on these approaches were deemed appropriate.

- A seamless *Smart Card* could be used for multiple purposes, including transit, parking, tolls, and non-transportation purposes, such as banking and purchases. A number of demonstrations, utilizing different *Smart Card* technologies and combinations of services, should be pursued.
- Test and evaluate the use of Automatic Teller Machines (ATMs) to deliver transit and ridesharing information. In some areas, such as Seattle, bus passes can be purchased from ATMs. Testing and evaluating this approach in other areas was supported, along with testing the use of ATMs to provide transit and ridematching information.
- The use of simulation techniques and virtual reality were suggested as one approach to introduce commuters to TDM programs and alternative commute modes. Developing, testing, and evaluating simulation, visualization, and virtual reality techniques to provide individuals with the experience of carpooling, vanpooling, using HOV lanes, taking the bus or rail service, and utilizing other TDM programs was identified as a priority.

APPENDIX A

**WORKSHOP ON
INTELLIGENT TRANSPORTATION SYSTEMS
AND TRAVEL DEMAND MANAGEMENT**

**Westin Galleria
Houston, Texas**

September 20-21, 1995

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Sponsored by
Texas A&M Intelligent Transportation Systems Research Center of Excellence

in cooperation with
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Texas Department of Transportation
Federal Highway Administration
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APPENDIX B

INTELLIGENT TRANSPORTATION SYSTEMS AND TRAVEL DEMAND MANAGEMENT

Resource Paper

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INTELLIGENT TRANSPORTATION SYSTEMS AND TRAVEL DEMAND MANAGEMENT

INTRODUCTION

Many metropolitan areas throughout the United States are facing serious problems related to increasing levels of traffic congestion, declining mobility, and air quality and environmental concerns. In response to these growing issues, numerous areas are focusing on better management of the overall transportation system, rather than the construction of new facilities. Travel demand management (TDM) is a pertinent technique being actively pursued in many parts of the country. Travel demand management covers a variety of actions that better manage the demand on transportation facilities by acting to shift more commuters into transit and multi-occupant vehicles and into less congested travel periods. TDM strategies focus on providing inducements to ridesharing, transit use, and peak-period travel spreading, combined with deterrents to driving alone.

Another approach being actively pursued in numerous areas is the use of a wide range of advanced technologies to better manage all aspects of the transportation system. Commonly referred to as intelligent transportation systems (ITS), a variety of advanced technologies are being developed, tested, implemented, and operated with the common goal of improving the efficiency of the overall transportation system. More specifically, ITS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment.

Although approaching current transportation issues from different perspectives, the use of both TDM strategies and ITS technologies focus on improving the efficiency of the existing transportation system through better management, rather than building new capacity. Further, the use of ITS and other advanced technologies appears to hold promise for enhancing the successful implementation of TDM strategies. Many potential applications of ITS technologies with TDM actions are just beginning to be explored and implemented by public and private sector groups. This resource paper is intended to help foster, enhance, and expand this discussion, and to assist in bringing together the different groups involved in both ITS and TDM.

To accomplish this objective, the paper is divided into three sections following this introduction. The next section provides a brief overview of TDM strategies and ITS technologies. The major elements of both are summarized to provide a common understanding of the depth and breath of the two approaches. This section also reviews the different groups involved in funding, research and development, implementation, and evaluation of ITS technologies and projects. This is followed by a discussion of techniques to utilize ITS technologies to enhance the use of TDM actions. This section includes a review of examples of current state-of-the-art projects and discusses other potential applications. It also summarizes some of the major issues associated with the possible development of ITS and TDM projects and approaches for addressing these concerns. The paper concludes with a

summary of the major topics covered and the identification of areas where further research is needed.

OVERVIEW OF TDM AND ITS

What Is TDM?

Travel demand management (TDM) includes a wide variety of techniques and actions aimed at managing the demand on transportation facilities by encouraging commuters to change from driving alone to using a high-occupancy vehicle or shifting into less congested travel periods. Thus, TDM actions focus on a variety of approaches to encourage ridesharing, transit use, alternative work schedules, parking management and parking pricing, and other techniques.

TDM strategies include a wide range of actions focusing on the use of both incentives and disincentives. TDM strategies may include expanded or new transit services, ridesharing programs, parking policies and parking pricing, flexible work hours, telecommuting, walking, bicycling, and other techniques. Incentives—such as employer paid bus passes or employee benefits for using HOVs—and disincentives—such as increasing parking rates or penalizing individuals who drive alone—may be used. Recent TDM programs are also characterized by increased private sector involvement. This may occur through the formation of Transportation Management Associations or Organizations (TMAs/TMOs), employee TDM coordinators, and joint efforts between public agencies and private businesses.

As discussed in this paper, the use of ITS technologies with TDM strategies appears to hold promise for making the use of high-occupancy commute modes more convenient and enhancing other TDM actions. Thus, combining the two—ITS and TDM—may help meet the goal of improving the overall efficiency of the transportation system and may assist in meeting other environmental and societal goals.

What is ITS?

A major focus of recent transportation research and development activities has been on a variety of technologies being examined under the general heading of intelligent transportation systems (ITS). Intelligent transportation systems include the application of a wide range of advanced technologies that share the common goal of improving the efficiency of the overall transportation system. More specifically, ITS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment. These efforts are being supported by federal and state policy directives, private industry groups, university research institutions, and others.

Before discussing the wide range of technologies and potential applications of ITS, it is first important to have an understanding of the different groups involved in funding, research and development, implementation, operation, and evaluation of ITS. The interest in ITS and the development of projects and operational tests has accelerated rapidly over the past few

years. Numerous federal, state, and local agencies, private consultants, private industries and vendors, defense industries, university research institutes, and other groups are all actively involved. Further, the development of many ITS technologies, products, and tests are being jointly funded and conducted by consortiums involving both public and private sector groups. In addition, numerous ITS projects and research activities are being conducted in European countries and Japan. The major roles and activities of these different groups are briefly summarized next to help individuals involved in TDM better understand the functions of each.

U.S. Department of Transportation

The U.S. Department of Transportation (DOT) and the modal administrations—the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), and the National Highway Traffic Safety Administration (NHTSA)—are responsible for the federal ITS program. The Intermodal Surface Transportation Efficiency Act (ISTEA) established an ITS Program and authorized \$600 million in funding for the 6-year period (1). Although recent Congressional actions have raised some questions about future funding for ITS, it appears that there is still support for ITS research, development, and deployment activities.

The ISTEA required that the U.S. Department of Transportation submit to Congress a strategic plan for the federal ITS program within one year of passage of the Act. The Department's *ITS Strategic Plan: Report to Congress* (2) contains the mission statement, goals and objectives, program organization, and program milestones for the federal ITS program. Overall leadership and coordination for the Department's ITS program is through the DOT ITS Coordinating Group, the DOT ITS Working Group, and the Joint Project Office (JPO). Various ITS projects are being funded and administered by both FHWA and FTA, with FHWA designated as the lead agency for coordinating the Department's ITS program.

ITS America

ITS America is a non-profit educational and scientific association formed to plan, promote, and coordinate the development and deployment of ITS in the United States. *ITS America* resulted from the work of Mobility 2000, an informal assembly of interested individuals in the public and private sectors who met periodically between 1989 and 1990 to help advance ITS. *ITS America* is designed as a utilized Federal Advisory Committee to the U.S. Department of Transportation.

Membership in *ITS America* is open to public and private sector groups interested in all aspects of ITS. The structure of *ITS America* is focused on a series of technical committees and task forces composed of voluntary members. The work of the technical committees is organized through the Coordinating Council, which in turn reports to the Board of Directors. *ITS America* completed a *Strategic Plan for ITS in the United States* (3) and a *Federal ITS Program Recommendations for Fiscal Years 1994 and 1995* (4) in 1992. Both of these documents were forwarded to the U.S. Department of Transportation. Although many of the *ITS America* committees may address TDM-related activities, the three that are most focused on TDM are the TDM Task Force, the APTS Committee, and the Advanced Traveller

Information Systems (APTS) Committee. In addition, state and regional chapters have been formed in many areas to help expand ITS activities at the local level.

Private Sector Groups

A wide variety of private sector groups have been and will continue to be involved in ITS activities. These include transportation consulting firms, automobile manufacturers, electronic companies, communication-related business, other technology firms and vendors, and defense industries. Recent interest at the federal level has focused on the potential conversion of defense industry products to transportation and other domestic uses.

State and Local Governments and Agencies

Many State departments of transportation (DOTs) have become actively involved in ITS activities and projects. For example, state DOTs in California, Texas, Minnesota, Colorado, Washington, Florida, and Virginia are developing, implementing, operating, and evaluating different ITS technologies and projects. Local governments and agencies are also involved in ITS activities in many areas. These include transit agencies—such as those in Houston, Ann Arbor, Minneapolis-St. Paul, and the San Francisco area—and local units of government.

Universities and University Research Institutes

A number of universities and university-based research institutes have been actively involved in a wide range of ITS activities. Universities are currently playing important roles in many of the ITS operational tests, demonstration projects, and research and development activities. In 1993, the FHWA selected three schools—The Texas A&M University System, the University of Michigan, and Virginia Polytechnic Institute and State University—through a competitive process as ITS Centers of Excellence. In addition, a number of universities in California, the University of Minnesota—which was given funding for ITS through ISTEA—and other schools will continue to be actively involved in many ITS projects.

ITS Technology Classifications

Two different classification schemes are being used to describe ITS technologies. The first divides ITS into six broad categories focusing on general applications. The second focuses on ITS technologies from a user perspective. The six general categories used to describe ITS technologies are advanced traffic management systems (ATMS), advanced traveler information systems (ATIS), advanced public transportation systems (APTS), advanced vehicle control systems (AVCS), commercial vehicle operations (CVO), and advanced rural transportation services (ARTS). There is overlap among the categories and many technologies within each are in the research and development stage. A brief description of each of the six categories is provided next.

- Advanced Traffic Management Systems (ATMS) - development and operation of advanced transportation surveillance and monitoring systems to provide detection, communications, and control functions in major travel corridors.
- Advanced Traveler Information Systems (ATIS) - provision of pre-trip and in-vehicle information to motorists on current traffic and other conditions and real-time guidance on route information.
- Advanced Public Transportation Systems (APTS) - use of advanced technology to improve the delivery of transit services and enhance the cost-effective and efficient provision of these services.
- Advanced Vehicle Control Systems (AVCS) - use of advanced technologies to enhance vehicle control and operation, thus providing a “Smart Vehicle.”
- Commercial Vehicle Operations (CVO) - utilization of ITS technologies to improve the efficiencies and effectiveness of commercial vehicles.
- Advanced Rural Transportation Services (ARTS) - improve the safety and efficiency of the rural transportation system through the use of advanced technologies.

The second approach to defining ITS technologies focuses on describing the different services from a user’s perspective. This approach was used in the development of the *National ITS Program Plan*. This plan, developed by the United States Department of Transportation and *ITS America*, identifies the near-term program for ITS development and deployment. The 27 user services highlighted in this plan are summarized next.

- Pre-trip travel information
- Enroute driver information
- Enroute transit information
- Traveler services information
- Route guidance
- Ride matching and reservations
- Incident management
- Travel demand management
- Traffic control
- Electronic payment services
- Commercial vehicle preclearance
- Automated roadside safety inspections
- Commercial vehicle administrative processes
- Onboard safety monitoring
- Commercial fleet management
- Public transportation management
- Personalized public transit
- Emergency notification and personal security

- Public travel security
- Emergency vehicle management
- Longitudinal collision avoidance
- Lateral collision avoidance
- Intersection crash warning and control
- Vision enhancement for crash avoidance
- Impairment alert
- Pre-crash restraint deployment
- Fully automated vehicle operation

Detailed user service plans have been developed for each of these areas. These plans include a description of the operational concepts, possible technologies, potential costs and benefits, the roles of different groups, milestones and activities, and related projects. A number of these user services focus specifically on features that are directly related to or are supportive of TDM actions. First, travel demand management is one of the user services. This user service focuses on the application of a wide range of technologies to enhance TDM actions, including mode change support services, HOV facility management and control, parking management and control, congestion pricing, and air pollution and emission detection (5). Further, other user services, such as those oriented toward pre-trip travel information, enroute driver and transit information, ride matching and reservations, electronic payment services, personalized public transit, and public travel security, all support TDM strategies. Thus, as discussed more extensively in the next section, there appears to be numerous opportunities to utilize advanced technologies to enhance TDM actions.

The U.S. Department of Transportation has also identified nine first-level ITS components as part of the intelligent transportation infrastructure (ITI). It is envisioned that these components, which can be implemented over time, will form the platform for numerous ITS products and services provided by both the public and private sectors. The following represent the nine ITS core infrastructure components.

- Traffic Signal Control Systems
- Freeway Management Systems
- Transit Management Systems
- Incident Management Systems
- Electronic Fare Payment Systems
- Electronic Toll Collection Systems
- Regional Multimodal Traveler Information Centers
- Railroad Grade Crossings
- Emergency Response Providers

COMBINING ITS AND TDM

This section discusses the potential of combining ITS technologies and TDM strategies to better manage commute travel in congested areas. The use of ITS and other advanced technologies appear to offer numerous opportunities to enhance the successful implementation

of TDM actions. This section reviews the general concept of combining ITS and TDM, examines current and planned projects, and identifies other potential applications.

The Concept of Combining ITS and TDM

Advanced technologies can be used in numerous ways to enhance the implementation, operation, management, and evaluation of TDM actions. First, ITS technologies can be used to provide pre-trip and enroute real-time information to commuters on traffic conditions, transit alternatives, weather, and other elements to help individuals select the most appropriate travel mode and to encourage greater utilization of high-occupancy vehicles. Second, the application of advanced technologies can enhance the convenience and ease of use for all types of HOVs. Third, ITS technologies can be used to help manage and enforce TDM strategies related to HOV use, parking, and congestion pricing. Finally, a wide range of advanced technologies is enhancing the potential for telecommuting.

The provision of real-time information on traffic conditions and transit alternatives to individuals in their home and work place represents an important step in making commuters more aware of both current conditions and the options available to them. In order to influence commuters to change from driving alone to using some form of high-occupancy vehicles, this information needs to be provided in advance of the first mode selection. Thus, as discussed under the examples of current projects, some operational tests are focusing on the provision of real-time traffic and transit information to individuals in their home and work place to allow commuters to make more informed decisions regarding their travel and mode choices. The real-time traffic and transit information may be obtained and coordinated through the use of advanced traffic management systems (ATMS), automatic vehicle identification (AVI), automatic vehicle location (AVL), and other advanced technologies. The information could be provided to individuals through the use of touch-tone telephones, cellular or pocket telephones, television, microcomputers, and videotex terminals. Ensuring that the information provided is accurate and timely appears to be critical to continued use by individuals (6).

The application of ITS technologies can also make using all HOV modes more convenient and attractive to commuters. For example, fare payment methods can be simplified and made more convenient through the use of *Smart Cards* and other automatic fare payment methods. These techniques focus on the use of pre-paid fare media ranging from a relatively simple pass to a more advanced programmable memory chip card. Further, *Smart Cards* could be used to provide integrated fare payment among different transit modes in an area. In addition, *Smart Cards* could be expanded into multi-purpose cards linking transit, parking facilities—including the ability to charge lower rates for carpools and vanpools—and other services such as banking and credit card purchases. *Smart Cards* could also be used by businesses to help track the use of HOVs by employees as part of incentive programs or to charge more for the use of parking for drive alone commuters. Other ITS technologies could be used to provide real-time carpool matching capabilities, enhanced guaranteed ride home programs, and other techniques to make the use of all high-occupancy vehicles more convenient.

ITS technologies may also be appropriate to assist with the management, operation, and enforcement TDM actions related to HOV facilities, parking management, and congestion pricing. A wide range of advanced technologies, including AVI tags, *Smart Cards*, remote sensing, and other devices may be used to help operate and enforce various TDM strategies. For example, AVI tags are currently in use on a number of toll facilities throughout the country to provide electronic toll collection. Individuals purchase AVI tags which are encoded with a prepaid toll value. The AVI tags, which are usually located on the front windshield, are read by receivers at special toll plazas, allowing vehicles to pass through the plaza without stopping. This approach is currently being used with buses equipped with electronic tags on the Route 495 HOV lane on the approach to the Lincoln Tunnel in New York City. The potential for other applications using ITS technologies to better manage and enforce TDM actions are discussed more extensively later in this paper.

Finally, advanced technologies are being used to enhance the use of telecommuting. Advances in telephone, fax, video conferencing, and other technologies are allowing increasing numbers of workers to spend one or more days a week working at home or at a remote job site. Although the exact number of telecommuters is not known, it appears that the use of telecommuting is increasing. In addition to the TDM benefits of removing trips from the roadway system, telecommuting offers businesses the potential to realize savings in real estate costs. For example, AT&T estimates that it has saved approximately \$24 million in real estate costs through telecommuting programs since 1992 (7).

Current and Planned Examples

There are a number of projects throughout the country in different phases of planning, implementation, and operation that focus on the use of ITS and other advanced technologies to enhance TDM actions. Examples of a few projects currently moving forward throughout the country that combine different aspects of ITS and TDM are briefly summarized in this section. The projects described are intended to provide an indication of the variety of applications currently being considered. Projects in Houston, Seattle, the San Francisco-Bay area and other parts of California, the Minneapolis-St. Paul area, and Dallas are briefly highlighted next.

Houston Smart Commuter ITS Operational Test

The Houston *Smart Commuter* ITS Operational Test is examining the potential for gaining more efficient use of major travel corridors through greater utilization of high-occupancy commute modes, shifts in travel routes, and changes in travel time through the application of innovative approaches using advanced technologies. The operational test is based on the hypothesis that commuters who have quick and easy access to relevant, accurate, and up-to-date information on existing traffic conditions, bus routes, bus schedules, how to use the bus, and instant ridematching services in their home and work place will be more likely to use public transportation and other high-occupancy commute modes. The travel time savings and travel time reliability offered by the Houston HOV lanes provide further incentives for

changing travel modes. In addition, individuals may alter their travel time or route based on this information.

The Houston *Smart Commuter* ITS Operational Test has been developed and is being implemented through the joint efforts of the Texas Department of Transportation (TxDOT), the Metropolitan Transit Authority of Harris County (Houston METRO), the Federal Transit Administration (FTA), the Federal Highway Administration (FHWA), and the Texas Transportation Institute (TTI), a part of The Texas A&M University System. The first phase of the operational test is currently moving forward.

The *Smart Commuter* ITS Operational Test includes two different, but compatible, components. Both components are intended to make better use of the Houston HOV facilities, which have been developed and funded as multi-agency projects. The bus component focuses on the traditional suburban-to-downtown travel market in the I-45 North corridor. This element focuses on encouraging a mode shift from driving alone to using the bus, changing travel times, and shifting travel routes. These changes in travel decisions will result from the provision of current traffic and transit information to individuals in their home and work place through state-of-the-art videotex and telephone technologies.

The second component focuses on the suburb-to-suburb travel market in the I-10 West corridor to the Post Oak/Galleria area. This corridor, which is more difficult to serve with traditional regular-route bus service, provides the opportunity to test the use of a comprehensive employer-based carpool matching service. This system will include the ability to provide real-time carpool matches and is structured to encourage a mode shift from driving alone to carpooling and also to encourage an increase from 2 to 3 person carpools (8).

University of Washington Smart Traveler Project

The SWIFT Smart Traveler (SST) is testing the use of dynamic ridesharing among employees and students at the University of Washington (UW) in Seattle. The University is the largest employer in Seattle, with some 50,000 faculty, staff, and students. Most of these individuals commute to and from the campus on a daily basis.

The SST will use multiple communication technologies to promote dynamic ridesharing at UW. Communication methods will include electronic mail (e-mail), wrist pagers, and telephones. The use of the different technologies to access potential dynamic ridesharing matches, the number of rides requested, the number provided, and the number of dynamic ridesharing matches actually formed will be monitored over a one year period. The effectiveness of the different technologies and the reaction of users will be evaluated. The cost to develop and operate the system and any issues emerging during the test will also be examined.

Minneapolis - St. Paul *TravLink*

The *TravLink* project represents one element of the larger *Minnesota Guidestar* program, which is a multifaceted ITS program in Minnesota. The *TravLink* program is being developed and implemented through the joint efforts of the Minnesota Department of Transportation (MnDOT), the University of Minnesota (U of M), the Metropolitan Council Transit Operations (MCTO), and the Federal Highway Administration (FHWA).

A major component of the *TravLink* project focuses on the provision of transit and traffic information to transit users and carpoolers in the I-394 corridor. This is a radial route corridor linking the western suburbs to downtown Minneapolis. The corridor contains a freeway HOV lane, park-and-ride lots, and transit stations. The HOV lanes, which include segments of both concurrent flow and reversible, barrier separated lanes, are connected to three major parking garages on the edge of downtown Minneapolis. The parking garages contain bus waiting and transfer areas and provide reduced parking rates for carpoolers and vanpoolers using the I-394 HOV lanes.

The *TravLink* project is attempting to increase the use of high-occupancy commute modes in the corridor through the provision of transit and traffic information to individuals at home, at work, and at major transit terminals. In addition, transit users at transit stations along the corridor and at the transit terminals in the parking garages are being provided with real-time information on bus arrival and departure times (9).

San Francisco Bay Area

A number of projects are moving forward in the San Francisco Bay area focusing on improving access to transit information and integrating fare payment among multiple transit providers. One project is examining the potential to coordinate the provision of transit information among all providers in the region. Currently, different services have their own information numbers. This may require a potential transit user to call multiple providers in order to obtain the desired information. A study was conducted to examine different approaches to providing one common information number. The results of this study are being examined, and it is anticipated that a decision will be made to select and implement one approach (10).

Transit systems in the San Francisco area are also considering coordinating fare collection through the use of a common fare prepayment method. The *Translink* project currently involves the Metropolitan Transit Commission (MTC), Central Contra Costa County Transit (CCCT), and Bay Area Rapid Transit (BART). The use of a stored value fare card, which could be upgraded at a later point to a *Smart Card* is anticipated. Additional providers are also expected to be added in the future (11).

California *Smart Traveler*

The California *Smart Traveler* contains numerous advanced public transportation system (APTS) elements as part of the California Department of Transportation's (Caltrans) overall ITS program. The California *Smart Traveler* project focuses on the design, testing, and evaluation of a variety of ITS technologies to transit, paratransit, and ridesharing. The first phase of the project included the evaluation of potential test sites and technologies. Five sites have been identified for the actual implementation and evaluation of operational tests. It is anticipated that these will involve a partnership between public and private sector groups (12, 13).

Dallas HOV Monitoring and Enforcement

A research study is being conducted in Dallas examining the potential use of ITS technologies to enhance the monitoring and enforcement of the vehicle occupancy requirements on the East R. L. Thorton Freeway HOV lane. The project is being conducted jointly by the Texas Transportation Institute, Dallas Area Rapid Transit (DART), FHWA, and DTA. The intent of the study is to assess the applicability of various automated enforcement technologies and to test the use of the most promising alternative on the East R. L. Thorton HOV lane. It is hoped that the use of advanced technologies can reduce enforcement costs and police exposure to traffic and weather. Technologies currently being examined for possible use include AVI tags, imaging systems, and infrared applications (14).

Other Potential Applications

The projects described previously provide an indication of a few applications of ITS technologies focusing on TDM related actions. In addition to these projects, other activities are being conducted around the country which focus on related types of applications and other approaches combining ITS and TDM. Further, there appears to be a great deal of potential for other applications of ITS technologies to enhance TDM actions. A few suggestions for additional research, operational tests, and demonstration projects are provided in this section.

- **Real-Time Transit and Traffic Information.** Although there are a few projects focusing on the provision of real-time traffic and transit information to individuals in their home and work place, additional projects testing other technologies appear appropriate.
Combining real-time transit information on the status of buses, obtained through AVL systems, with real-time traffic data from ATMS and providing both to individuals in different locations through numerous technologies could be considered.
- **TDM Multi-Purpose *Smart Cards*.** A series of operational tests could be conducted focusing on the use of multi-purpose *Smart Cards* for TDM programs. These operational tests would develop, implement, and evaluate the use of *Smart Cards* for transit use, HOV and SOV parking, and other commute modes. The cards could be

used to both pay for and access the different modes and for organizations to track use of these modes by employees. Multiple tests using different approaches, different sizes and types of businesses, and alternatives combinations of incentives and disincentives could be explored.

- **HOV Toll Pricing.** Currently, preferential pricing for HOVs is provided at some toll facilities in the United States. The use of AVI tags provides the opportunity to greatly enhance and expand the use of HOV discounts and HOV preferential treatment at toll plazas. Operational tests could be conducted to test and evaluate the use of HOV pricing strategies and preferential treatments with toll roads, bridges, and tunnels in this country.
- **Enhanced Ridesharing.** Rideshare matching software has improved significantly over the last 5 years. The potential exists to combine this software with GIS and other technologies to greatly enhance response time for ridematching services and provide real-time matches. A few operational tests are currently focusing on this area, but more projects appear appropriate.
- **HOV Facility Monitoring and Enforcement.** The results of the Dallas project described previously should provide a good deal of information on possible ITS technologies to enhance the monitoring and enforcement of HOV facilities. Additional operational tests and projects could be developed in this area.
- **Telecommuting.** Rapid advances in communications technology are making telecommuting more easy and more wide spread. Additional projects testing different approaches to telecommuting, as well as monitoring and evaluating existing programs, appears appropriate.
- **Air Pollution and Emission Detection.** ITS technologies could be used to identify air quality hot spots and air pollution violations on a real-time basis. Projects could be developed to first identify actions to be taken in response to these situations and then to implement the recommended projects when air quality incidents occur.

Potential Issues Associated with Integrating ITS and TDM

A number of issues may emerge as projects and operational tests combining ITS and TDM are planned, implemented, operated, and evaluated. Although technology problems may emerge—especially those relating to testing new products and approaches—it appears that most of the concerns will focus on institutional and organizational issues.

Individually, both TDM and ITS projects usually involve a diverse group of individuals and organizations from the public and private sectors. Projects which combine the two will require that even more diverse groups work together. Further, to date, individuals in the TDM and ITS areas have not worked together on many projects and may not be aware of the other area. Thus, building a strong working relationship between the different groups, which

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includes an understanding of the roles, responsibilities, strengths, and weakness of each group, will be critical to advance projects integrating ITS and TDM.

CONCLUSION

This paper has presented a discussion of the potential for greater integration of ITS technologies with TDM actions to better manage the demand on transportation facilities in congested areas. It has presented a brief overview of TDM strategies and ITS technologies, identified the different groups involved in ITS, discussed the concept of integrating ITS and TDM, and illustrated a few examples of current projects. Further, suggestions for additional demonstrations and projects were identified.

The current projects and possible applications outlined in this paper provide a strong indication of the potential benefits the use of a wide range of ITS technologies may have on the successful implementation of TDM actions. As noted in this paper, additional research projects, operational tests, and full deployment are needed to help advance the state-of-the-art in integrating ITS and TDM. This paper has helped foster, expand, and enhance the discussion of greater integration of ITS and TDM and has assisted in furthering activities focused on this area.

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