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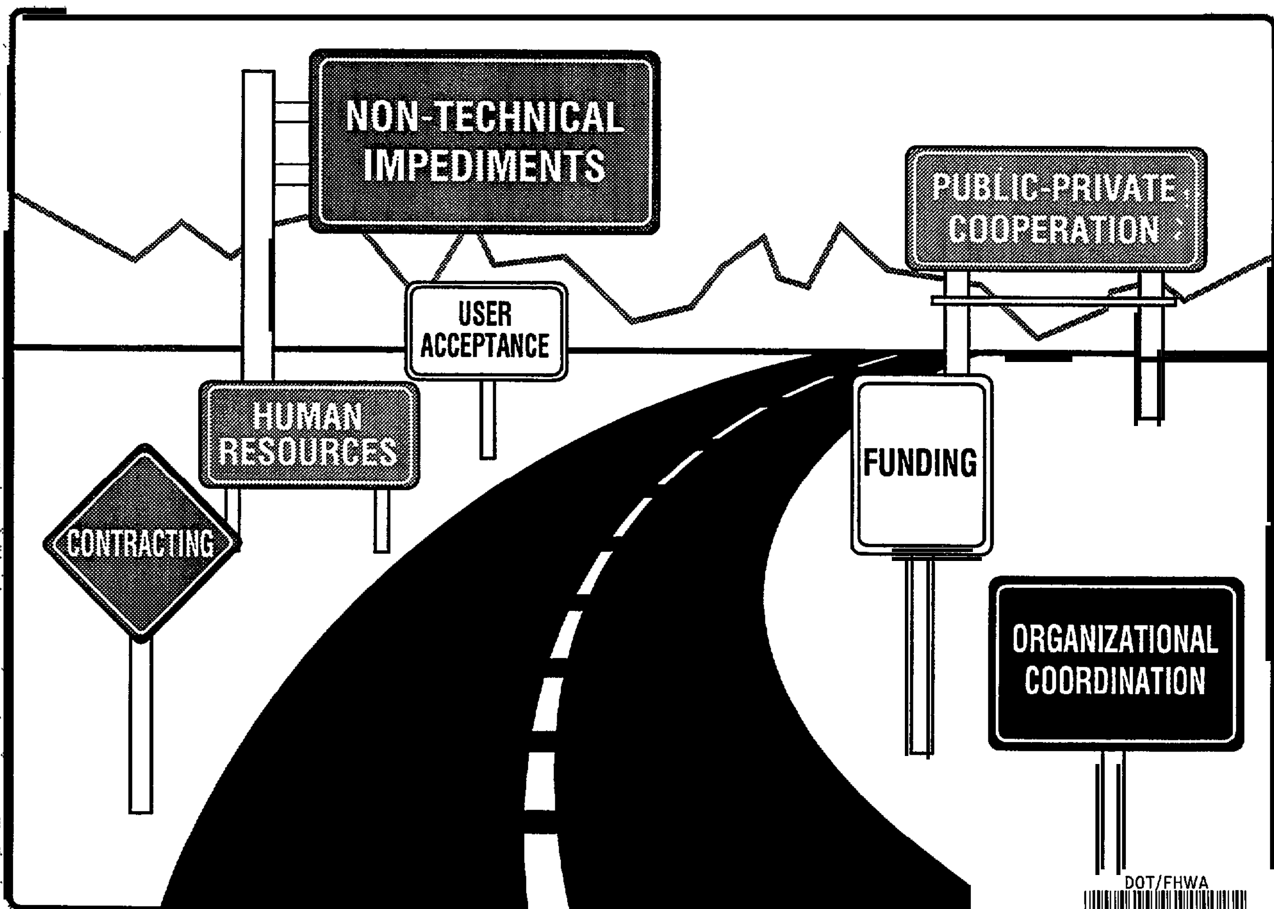
ANALYSIS OF ITS OPERATIONAL TESTS FINDINGS AND RECOMMENDATIONS



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13. ABSTRACT (Maximum 200 words)

Twelve ITS activities were chosen by the Federal Highway Administration to be the subjects of case studies. The case studies were performed under the Intelligent Transportation Systems Institutional and Legal Issues Program, which was developed in response to the Intermodal Surface Transportation Efficiency Act of 1991. The objective of each case study was to determine (1) institutional issues and legal impediments encountered during the establishment of partnerships and deployment of IVHS services and products during the operational test, (2) the point in the life cycle of the operational test at which the impediments occurred, (3) how project partners and participants overcame impediments, and (4) lessons that were learned that are applicable to future deployments of ITS products and services.

This report sumnarizes the institutional issues and lessons learned from six case studies: the Guidestar Program, which includes the Genesis and Travlink operational tests, and the FAST-TRAC, Houston Smart Commuter, SaFIRES, SmarTraveler, and TravelAid operational tests. This report also makes recomnendations for improving the performance of future operational tests and deployments of ITS products and services and presents a comparison of the findings and recommendations of this report and the report which summarizes the first six case studies, Institutional Issues and Case Studies - Analysis and Lessons Learned.

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ITS INSTITUTIONAL AND LEGAL ISSUES PROGRAM

ANALYSIS OF ITS OPERATIONAL TESTS FINDINGS AND RECOMMENDATIONS

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September 1995

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PREFACE

In response to the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the United States Department of Transportation (U.S. DOT) developed *the Intelligent Transportation Systems (ITS) Institutional and Legal Issues Program* (formerly called the *Intelligent Vehicle-Highway Systems (IVHS) Institutional and Legal Issues Program).* This program was designed to identify (1) issues that may constrain the full deployment of ITS products or services, (2) the means to overcome non-technical barriers to ITS deployment, and (3) the lessons that were learned that might expedite the full deployment of ITS technologies.

The U.S. DOT's John A. Volpe National Transportation Systems Center (Volpe Center) provided analytical support to the U.S. DOT's Joint Program Office (JPO) for ITS under the Operational Test Case Studies subject area of the *Institutional and Legal Issues Program.* This subject area calls for a national, independent, and cross-cutting evaluation of several operational tests. This evaluation identified the problems and issues that participants in operational tests encountered when deploying ITS technologies and services and the important lessons that have been learned and may be applied in future deployments of ITS products and services. Other reports produced in the Operational Test Case Studies subject area are listed in Appendix C - Operational Test Case Study Reports.

This *Findings and Recommendations* report summarizes the institutional issues and lessons learned from six case studies of ITS activities: the Guidestar Program, which includes the Genesis and Travlink operational tests, and the FAST-TRAC (Faster and Safer Travel through Traffic Routing and Advanced Controls), Houston Smart Commuter, SaFIRES (Smart Flexroute Integrated Real-Time Enhancement System), SmarTraveler, and TravelAid operational tests. This report also makes recommendations for improving the deployments of ITS products and services. The Volpe Center had previously assessed six other ITS activities and the results of *these case* studies *are* summarized in the report, *IVHS Institutional Issues and Case Studies - Analysis and Lessons Learned (SAIC,* 1994). Comparisons between the findings and recommendations of these two reports are pointed out throughout this report.

In 1993 and 1994, a team of analysts interviewed and sent questionnaires to 95 operational test participants and reviewed project documentation. The interviewees represented federal, state, regional, and local transportation and transit agencies; county and local governments; electronic, manufacturing, communication, and automotive companies; transportation information providers; academia; and consultants and contractors. These individuals were involved in various aspects of the operational test from policy making to program management to technical and administrative support. They included chief executives, corporate officials, agency managers, program administrators, engineers, planners, public relations personnel, attorneys, professors, researchers, and evaluators. Many were involved in the initiation of the project while others were involved in day-to-day project activities. This diverse group of individuals provided the study team with a broad range of views about the individual operational tests and the ITS Program in general.

The case study team was sensitive to the criticism that project assessments either seek out negative aspects of the project with little emphasis on positive lessons, are biased, or lay blame. The team acknowledged that the case studies were oriented toward finding problems, but the team structured the assessments to identify positive lessons that were learned and that could be shared with others.

The team members thank the interviewees for taking time from their busy schedules to participate in these evaluations and for their openness in doing so. The issues, lessons, and insights that they discussed will benefit the entire ITS effort.

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INTRODUCTION

The United States surface transportation system, long considered one of the best in the world, is feeling the impact of increased traffic congestion, especially in urban areas and heavily-traveled intercity routes. Congestion costs the country billions of dollars each year in lost productivity, wasted energy, and increased vehicle emissions. Safety continues to be a major concern; even though highway accidents have been declining in recent years, the margin of safety needs to be increased to reduce the number and severity of accidents. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was enacted to "...develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner."

To support the ISTEA, Congress created *the Intelligent Vehicle-Highway Systems IVHS Program,* now called the *Intelligent Transportation Systems (ITS) Program. The* ITS Program encourages the use of innovative computer, electronics, and communications technologies to increase the effectiveness of the entire transportation system. Types of innovations include traffic management systems that monitor and adjust road conditions, electronic collection of transportation user fees, on-line information advising travelers and drivers about traffic conditions, on-board navigation systems, and dynamic ride-sharing. Through such technologies ITS can improve safety, reduce congestion, enhance mobility, minimize environmental impact, save energy, promote economic productivity, and create a major new industry for hardware, software, and services.

OPERATIONAL TEST CASE STUDIES

The United States Department of Transportation's (U.S. DOT's) mission is to provide leadership in developing the national ITS Program through four major areas: research and development (R&D), operational tests, the Automated Highway System Program, and deployment support. *This* report focuses on *operational tests,* which use cooperative partnerships among the U.S. DOT, other public agencies, and the private sector to evaluate new technologies and system concepts in an operational environment under "live" transportation conditions. Tests can also evaluate innovative institutional arrangements and assess public reaction to ITS.

The U.S. DOT implemented the *Institutional and Legal Issues Program* to assess the major non-technical constraints to implementing ITS. Within the Operational Test Case Studies subject area of this program, the U.S. DOT's John A. Volpe National Transportation Systems Center (Volpe Center) conducted a national, independent, and cross-cutting evaluation of several operational tests. During this evaluation, Volpe Center analysts identified the issues facing operational test participants deploying ITS technologies and services, the causes and the effects of these issues, and the lessons learned that may be applied to future deployments.

Eleven federally sponsored ITS activities and one locally funded ITS deployment were evaluated by the Volpe Center. Findings from six case studies are presented *in the* report, *IVHS Institutional Issues and Case Studies -Analysis and Lessons Learned Report. This Findings and Recommendations* report summarizes issues, lessons learned, and recommendations from six additional case studies. Both reports identified similar institutional issues and lessons learned, and made similar recommendations.

CASE STUDY TEST SUMMARIES

ITS technologies fall into six functional areas: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Advanced Public Transportation Systems (APTS), Advanced Vehicle Control Systems (ACVS), and Advanced Rural Transportation Systems (ARTS). The six case studies summarized in this report represent ATMS, ATIS, and APTS. ATMS provides transportation network management and control to handle changes in traffic patterns. ATIS provides transportation users with information on traffic conditions, routes, and schedules. APTS provides mass-transit and ride-sharing information to systems operators and users of high-occupancy, shared-ride vehicles.

The six case studies include *the Faster and Safer Travel through Traffic Routing and Advanced Controls (FAST-TRAC), Houston Smart Commuter(HSC), Smart Flexroute Integrated Real-Time Enhancement System (SaFIRES), SmarTraveler,* and *TravelAid* operational tests and the *Guidestar* Program.

- *FAST-TRAC* is an operational route guidance and traveler information system in Oakland County, Michigan, for improving traffic mobility and safety using ATMS and ATIS technologies.
- *Guidestar* is the Minnesota Department of Transportation's ITS program. *Travlink* and *Genesis* are the two operational tests in the Minneapolis/St. Paul area from the Guidestar program that were evaluated. Travlink provides travelers with real-time data on transit connection times and service performance using APTS technologies. Genesis examines the market and technical potential of an ATIS that provides users with real-time traffic data on highway conditions and travel advisories. Both tests are about to be implemented.
- *HSC* encourages greater use of high-occupancy commute modes (buses, car-pools, vanpools) in the Houston, Texas area using APTS and ATIS technologies. It is currently in the planning phase.
- *SaFIRES* evaluates the integration of an enhanced ridesharing route deviation transportation system with conventional transit and ridesharing in a suburban-to-rural

Prince William County area of Northern Virginia using APTS technologies. The test is about to be implemented.

- *SmarTraveler* is an operational telephone-based audiotext traffic information service in Eastern Massachusetts that provides commuters with up-to-the-minute traffic information using ATIS technologies.
- *TravelAid* is a variable speed limit alerting system in the Cascade Mountain area of Washington State for improving the distribution of traffic, road, and weather conditions using ATIS technologies. The test will be implemented shortly.

For each operational test, goals, benefits, risks, and critical success factors (CSFs) were identified by the project participants. The top *two goals* were *improving safety* and *evaluating ITS effectiveness.* Even though representatives of the public and private sectors identified the same goals, the public sector emphasized policy-related goals, such as *improving safety* and *developing an ITS industry,* whereas the private sector emphasized marketing-related goals, such as *understanding the market.* There were two major obstacles to achieving test goals: *developing partnerships with other organizations or agencies* and *applying ITS technologies.*

Operational test benefits were closely related to test goals. *Learning new ways of doing business, acquiring knowledge of new technologies,* and *improved mobility and safety* were mentioned most often. Both sectors emphasized *new ways of doing business, creating newpartnerships,* and *creating new business areas.* To the public sector, *increasing mobility and safety, improving customer service, increasing mass transit ridership,* and *improving transit awareness* were more important. In contrast, *creating new products and markets* was more important to the private sector. Policy makers from both sectors stressed *gaining experience in ITS technologies* and *understanding the market,* whereas *enhancing the project's reputation* was more important to technical staff

The most important risks were *damage to an organization 's image and reputation* and *failure of technology.* Together, the public and private sectors agreed on most of the risks. The public sector felt that a *lack of public acceptance, damage to inter-agency relationships,* and *impact of poor test results on future ITS projects* were the most important risks. For the private sector, the greatest risks were *a damaged reputation* and a *possible loss of a partner ' s financial investment and increased exposure to liability.*

CSFs are key areas that must be successfully completed before the project can be considered successful and are closely tied in with risks. *Working technology, establishment of good partnerships, and public acceptance* were the most important CSFs. The public and private sectors were in agreement on most of the significant CSFs Separately, the public sector emphasized *continued funding* and *good project management* while the private sector emphasized *successful partnerships* and *markets for products and services.* Within the project team, the focus varied. For project administrators, *adequate funding* and *working technology* were high on the list. In contrast, *accurate evaluations* and *market acceptance* were more important to both policy makers and project administrators, while policy makers felt *demonstrated benefits* and *on-schedule implementation* were critical

INSTITUTIONAL ISSUES

Operational test participants identified a wide range of institutional issues impacting either the success of ITS operational field tests or the deployment of ITS technologies. These issues are classified into *five* categories: *organizational and managerial, procedural and regulatory, human resources, funding,* and *technology.*

Organizational and managerial, All operational tests experienced problems *in developing new business relationships.* Public agencies and private firms were working together for the first time as partners and had to adjust to each other's styles. Within this new business relationship, partnership roles and responsibilities were not clearly defined, competition between some private sector partners existed, and difficulties in managing projects with multiple partners arose. Improved communication among the partners has resolved this issue at most operational tests. Second, *inter-agency coordination* was an overwhelming concern for most test participants. Poor communication among organizations affects operational tests, as does a lack of support from operating agencies, and the difference in cultures among the academic, public, and private sectors. Despite improved communications, there are still concerns over conflicting philosophies and priorities. Third, within individual organizations, there *are intra-agency coordination* problems because of conflicts over roles and responsibilities, a lack of upper management support for the ITS project, and uncertainty over managing the ITS program. This issue has been partly resolved by improving staff cooperation and coordination. Fourth, there were difficulties in *managing operational tests.* ITS projects require new organizational structures to reflect the new engineering and development partnerships in which private sector partners are equals, not contractors. There are also problems with partners joining the project late and delaying project implementation. This issue has been partially resolved with the hiring of project managers and improved partner participation.

Procedural and regulatory. Current *contractingprocedures* are unsuitable for prototype projects because of their orientation towards construction and consulting services. Partners are also unfamiliar with each other's procedures, the private sector is sometimes reluctant or unable to provide required financial data, and there are conflicts when one partner becomes a vendor to another partner. This issue has been mostly resolved by partners working out their differences and becoming more familiar with the requirements. Second, the receipt of federal funds or the addition of new partners resulted in *changes in the scope of the evaluation* plan. Participants also experienced difficulties in using evaluation procedures. At most tests this has been resolved by improving how the evaluation process is defined. *Third, intellectual property rights* was an issue because of ambiguities over ownership and use of the products and information developed for the operational test. This has been resolved when contracts are executed that specify property rights in detail. Fourth, *non-competitive selection* of private partners was an issue to public sector partners who felt sole-source contracts promote favoritism, unlike the competitive bidding process. This has been resolved at several tests by recognizing contracting flexibility is needed.

Human resources. At several operational tests, participants did not have *the technical expertise* required for ITS projects. Public sector agencies focus on program development and everyday systems operations and have little experience in systems development and the latest technologies. This has been resolved by bringing in additional technical and administrative expertise from the private sector and offering training to public sector staff. Another issue was the impact of ITS projects on the public partner's daily *workload* while the level of resources and staffing stays the same. Hiring additional operational and administrative staff has resolved this issue at several tests.

Funding. One issue at the beginning of many projects was *unclear match requirements.* What constituted a match, the percentage match share, and value of each partner contribution was unclear, leading to confusion among the partners. The issue has been resolved by partners being more flexible, identifying the matching requirements in more detail, and acquiring additional funding. Second, partners had *different funding expectations* for funding levels and the timely release of funds and were concerned about project delays. Even though this issue has been resolved by modifying funding procedures, there are still concerns that similar issues could affect other ITS projects. Third, at several tests there were negative impacts *of funding limitations* on operational test functionality and full scale deployment. Frequently partners' funding level objectives conflicted with each other. This issue was only partly resolved. Despite more detailed reviews of the different functionalities, the private sector still believes the FHWA should amend its funding policy and expand the use of funds for operations and maintenance. Finally, funding constraints hinder *local government participation* in ITS. Not all local governments are convinced ITS could benefit them, nor do feel they have any project ownership and therefore hesitate to allocate their limited resources to ITS projects.

Technology. A major issue is the *lack of ITS program standards* and existing technology standards that are constantly being changed. Standards have an important role in product development and in ensuring system compatibility, and a lack of standards impacts operational test system architecture. This issue has yet to be resolved. Second, there *are difficulties in selecting appropriate technology* Wrong selection of a product affects not only its use but also the evaluation and project results. One resolution has been to separate the ITS technology procurement from the original construction contract and issue a separate RFP. Third, there were difficulties working with *telecommunications regulations.* Telecommunications systems are complex to design and regulate. Upcoming reassignment and redistribution of existing radio frequencies by the Federal Communications Commission will further complicate systems design. This issue has yet to be resolved.

LESSONS LEARNED

Operational test participants identified a range of lessons learned during the process of addressing institutional issues. In general, participants felt that operational tests are working and successful partnerships are being established. They did identify one overall lesson:

THE NEWNESS OF INTELLIGENT TRANSPORTATION SYSTEMS AND THE ASSOCIATED PARTNERSHIPS CREATES SIGNIFICANT YET SURMOUNTABLE CHALLENGES

The key to a successful deployment is to accept that it takes *time* to build support, develop plans, work out the details, and manage the ITS program. Principal lessons are broken down into five categories, resembling the chronology of an operational test: *Building Support, Developing Plans, Working Out the Details, Managing the Project,* and *Maintaining Support.*

Building Support. These lessons are critical for ensuring the success of an ITS project. First, *public andprivate sector partners learned to work together* and play an active role in the decision making process. This was the most important lesson identified by participants, despite its time-consuming nature and difficulties in developing a partnership among the various sectors. Second, *having a project champion and securing upper management support* contributes to a successful project. A lack of support could mean a lower project priority, which ultimately could affect deployment. Third, *public sector agencies and their staff should be encouraged to become more involved in ITS* by promoting the program and educating officials and staff about the benefits of ITS.

Developing Plans. These lessons evolved from the disorganized project planning and coordination at the start of the project caused by the newness of the ITS concept. The most important lesson in early project planning *was partner roles and responsibilities should be defined at the beginning of the project* to avoid turf battles, possible duplication of work, and delays in initiating partnerships. Second, recognize that *conflicts may arise when developing a partnership,* leading to test delays and possibly partners leaving the project.

Working out the Details. These lessons evolved from procedural difficulties within the ITS operational test environment. The most important lesson *was* that *contractingprocedures must be open and flexible* to address issues relating to software design, intellectual property rights, liability, and proprietary data. Second, *operational and evaluation components must be in place at the same time* to ensure that contracts can proceed simultaneously and that the evaluation is an integral part of the project. Third, *matching requirements must be identified early in a project* by defining the project team and match requirements, and obtaining partner commitments. Fourth, *use ofproprietary material and assignment of intellectual property rights must be addressed early in the project* using partner agreements to clarify current partner ownership and use and to encourage potential partners to participate.

Managing the Project. These lessons evolved from the need for new management styles and organizational structures not found in traditional government-contractor relationships. Project management is extremely complex and, in many cases, it was unclear who was in charge of the project and who controlled funding. **The most important lesson offered was a full-time project manager is essential to the success of the project.** Managers are needed to motivate others and expedite the project. They must be knowledgeable about ITS concepts and practices and be able to convince decision makers and users of the benefits of ITS. Second, partners *must have the required technical expertise* to implement ITS projects. Many public sector agencies are unfamiliar with ITS technical innovations because of their focus on day-to-day operations rather than system development. Third, *new management styles may be needed when dealing with partnerships.* The traditional government-contractor relationship in which the public sector controls project administration and funding does not work in the new partner relationships involving system development and deployment.

Maintaining Support. These lessons relate to providing support at the national, state, and local levels to successfully move ITS products and services into the mainstream of transportation activities. First, *good communication within the project is essential,* because it results in good coordination and cooperation; both keys to a successful test. This is critical given the complexity of project support, funding, evaluation, and management of public-private partnerships. Second, *operations and maintenance (O&M) funding is critical to successful ITS deployments.* The current policy of no long-term O&M funding raises concerns over the quality and level of future deployments. Third, *ITS products and technology must be promoted* to users, technology developers, and project implementors to develop support for an ITS industry. Fourth, *national standards are important and should be developed quickly* to promote the widespread use of ITS technologies and avoid ITS technologies under development either not meeting standards when they are finally written or being tied to an obsolete standard. Fifth, a *nationalperspective of ITS must be developed* to generate a "what's good for the nation" enthusiasm among transportation agencies and industry. It is not in the national interest if test participants do not share the experience gained from their ITS activities.

RECOMMENDATIONS

Recommendations were developed by the study team investigating institutional issues affecting operational tests. Many reflect suggestions made by operational test participants. Only recommendations identified by the largest number of participants and that could be implemented are included. These recommendations focus on facilitating the deployment of ITS products and services and promoting the ITS Program. Principal recommendations are broken down into the same categories as the lessons learned.

Building Support. These recommendations focus on promoting ITS projects and motivating project participants at the local level. Strong ITS support during deployment is critical to ensuring the project's success. First, *foster ITS program champions* at the state level and within large metropolitan areas to improve the visibility of ITS among key area leaders and agency staff. Project champions should be provided with training and materials to ensure that they are knowledgeable about ITS concepts and practices. Second, *develop educational materials for state and local agencies* to help agency staff promote ITS to the public, private, and academic sectors; upper management; the media; and the general public.

Developing Plans. These recommendations focus on better defining the project scope to facilitate project start-up and avoid the types of unnecessary delays that early operational tests experienced due to the newness of the ITS concept. First, *ensure project details are adequately defined* and, where appropriate, are in place before full federal funding is approved. Second, *facilitate the initiation ofpublic-private partnerships.* If a project involves a partnership, funding agencies should sponsor retreats, seminars, or other similar activities to discuss project details specifically relating to partnerships, such as contracting and intellectual property rights.

Working out the Details. These recommendations relate to communicating project procedures and requirements to test participants to allow them to transition to an ITS work environment. First, *promote and encourage innovative procedures* in such areas as contracting, procurement, and match requirements. Second, clearly *specify the requirements for matching federal funds* according to each project, including the types of non-cash contributions and a process for determining product value. Third, *facilitate the assignment and use of intellectual property rights* and encourage other agencies to adopt a similar policy. In addition, structure projects to separate tasks for which copyrights and patents can be obtained; this will allow organizations most suited to obtaining the property rights to fund the tasks.

Managing the Project. These recommendations require participating agencies to take a new approach to project management and to learn the skills for implementing new technologies. **The most important recommendation made by all operational tests is to identify a full-time project manager.** Involvement of a full-time project manager increases the likelihood of a successful project. A good manager will facilitate communication and coordination between partners and keep the project on schedule. The manager should have strong leadership skills and be supported by all partners. Second, *develop a fellowship program* for state, regional, and local public sector agencies currently working or who will be working on ITS projects to ensure that agency staff have the skills required to manage ITS projects and implement new and evolving technologies.

Maintaining Support. These recommendations focus on moving ITS into the mainstream of transportation activities. First, *develop national standards* for ITS technologies as quickly as possible. Standards would promote a broader use of ITS products due to increased compatibility. They would also encourage public sector agencies to implement ITS technologies and private sector firms to invest in R&D. Second, *provide O&M funding* for ITS projects. Poorly operated or maintained deployed systems will discourage potential ITS participants from initiating or funding ITS projects. Existing funding sources should be identified and new sources considered.

CONCLUSION

Operational tests evaluate new technologies and system concepts in a real world setting and play a critical role in transitioning an R&D system into operational use. To date, 74 operational tests have been approved by the U.S. DOT. This report points out the most important institutional issues and lessons learned relating to several ITS operational tests, and makes recommendations for addressing the most important issues.

Overall, participants concluded that ITS operational tests are working and successful partnerships are being established, despite the risks associated with committing resources and entering into a new type of business relationship. They asserted that the principal lesson learned was that **institutional issues will be encountered and can be overcome.** A little flexibility among partners goes a long way to resolving these differences and successfully deploying ITS products and services. Hopefully, potential project partners will view addressing these issues as part of the learning process associated with deploying ITS rather than as deterrents to participation. Successful deployment of these new technologies will give the public solid information for making more informed choices about travel and route alternatives.

1. INTRODUCTION

This section provides an introduction to the United States Department of Transportation's (U.S. DOT's) Intelligent Transportation Systems (ITS) Program, ITS operational tests, and three ITS functional areas: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), and Advanced Public Transportation Systems (APTS), represented by the operational tests discussed in this report. It also introduces Operational Test Case Studies and presents a description of the 12 case studies carried out to evaluate institutional and legal issues connected to operational tests.

1.1 INTELLIGENT TRANSPORTATION SYSTEMS PROGRAM

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was enacted to "...develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner," In support of the ISTEA, Congress created the Intelligent Vehicle-Highway Systems (IVHS [now called ITS]) Program and appropriated $660 million over a six-year period between 1992 and 1997. ITS uses advanced computer, electronics, and communications technologies to increase the effectiveness of the surface transportation system. Technologies are being applied to all types of vehicles (trucks, buses, and cars), to information devices (computers, kiosks, and hand-held devices), and to all parts of the surface transportation system (freeways, urban arterial roads, city street, rural roads, and intermodal connections) (IVHS America, 1992). Some systems, products, and services are already on the market while others are still under development.

There are six principal goals of the ITS program:

- *Improve the safety of surface transportation.*

  ITS can decrease traffic accidents and fatalities by providing the driver with more traffic-related information and augmenting driver control of the vehicle. Features include warning systems that activate when cars get too close to another vehicle or the edge of the road, and enhanced traffic control systems that decrease stops and allow for vehicle speed variations. Future collision avoidance technologies are also expected to substantially reduce entire classes of accidents.

- *Increase the capacity and operational efficiency of the surface transportation system.*

  ITS can reduce costs associated with congestion by rapidly detecting and clearing incidents that cause delays. Also, enhanced public transit systems will reduce the volume of highway traffic (single occupant vehicles [SOVs] in particular) and real-time traffic control systems will improve the traffic volume by automatically reflecting changing conditions. ITS can also even out highway demand by providing travelers with information to help make decisions on whether to use high occupancy vehicles, use public transportation, or not travel at all.

- *Enhance mobility and the convenience and comfort of the surface transportation system.*

  ITS can improve accessibility to all surface transportation systems for users at all income and age levels throughout the country, including the physically challenged. Such technologies as in-vehicle routing systems or infrared sensing devices for the visually-impaired driver will also improve travel time predictability and reduce the level of travel-related stress.

- *Reduce the environmental and energy impacts of surface transportation.*

  A smoother traffic flow and fewer vehicle miles traveled by automobiles are critical to the reduction of energy consumption and improved air quality. ITS can accomplish this using traffic management, navigational aids, and high occupancy vehicles, and by supporting transit and paratransit and encouraging their use. ITS can also modify additional transportation demands that might reduce environmental and energy efficiency gains.

- *Enhance the present and future productivity of individuals, organizations, and the economy as a whole. ,*

  An efficient surface transportation system can reduce costs and improve the effectiveness of all system users. Traffic congestion currently costs the U.S. $100 billion yearly through lost productivity. Accidents cost an additional $140 billion in lost wages and other direct costs, while compliance with commercial vehicle regulations costs nearly $7 billion. ITS can enhance economic productivity through better routing of vehicles, automated toll collection, safety enhancements, and by streamlining commercial vehicle regulatory enforcement and compliance.

- *Create an environment in which the development and deployment of ITS can flourish.*

  ITS has the potential to create a major new domestic industry for hardware, software, and services with an estimated market of $209 billion over the next 20 years. Revitalizing the transportation profession by transferring knowledge and resources from defense, aerospace, and other advanced technology industries to ITS and creating a completely new institutional structure of partnerships between the public, academic, and private sectors can help meet this goal (U.S. DOT, 1992), (IVHS America, 1992).

1.2 OPERATIONAL TESTS

In response to the ISTEA, the U.S. DOT established a delivery process consisting of four major components: (1) research and development (R&D), (2) operational tests, (3) the Automated Highway System program, and (4) deployment support (U.S. DOT, 1992).

Operational tests are designed to evaluate applications of new technologies and system concepts, facilitating the transition from R&D into operational use. An operational test integrates existing technologies with new R&D products, institutional, and perhaps financial or regulatory arrangements to evaluate one, or usually more, of these elements in an operational environment under “live” transportation conditions. Operational tests also provide further opportunities for R&D as the operational impacts of proposed ITS concepts become known.

ITS operational tests are conducted as cooperative partnerships between the U.S. DOT and a variety of public and private partners, including state and local governments, private companies, and universities. In the context of the ITS Program, a partnership exists when project participants establish a win-win or lose-lose situation in which they share both benefits and costs. Funding, technical, and administrative responsibilities for the operational tests are shared among the partners. These tests are needed to evaluate advanced systems in real-world situations to assure public safety benefits, to determine whether the expected public benefit can be achieved at the expected cost, and to heighten awareness and serve to educate the public about the potential of ITS.

Operational tests also assess public reaction to ITS systems and examine market support for a particular system or for some element of the system. The tests are used to gather data costs, benefits, and operational performance and reliability. The tests also offer the opportunity to evaluate innovative institutional arrangements, to promote intergovernmental cooperation, to investigate privatization opportunities, and to determine the implications of various legal issues. To date, 74 ITS operational tests have been approved by the U.S. DOT.

ITS may include different kinds of technologies, including electronics, computer hardware and software, control, and communications. Several functional areas have been identified to which these technologies can be applied. The operational tests discussed in this report represented three ITS functional areas: Advanced Traffic Management Systems, Advanced Traveler Information Systems, and Advanced Public Transportation Systems:

- *Advanced Traffic Management Systems (ATMS).*

  These systems provide behind the scenes network management and control to handle changes in traffic patterns caused by accidents, rush hour volume, and public events. Types of traffic management include traffic surveillance, signal control, and data management. Surveillance systems detect traffic conditions over a geographic area and transmit the information to a traffic management center where it is combined with information from other sources, including vehicles in traffic acting as probes. The processed information is used to manage the surveillance system through such techniques as adjusting signal timing, managing incidents, or selecting ramp metering rates.

- *Advanced Traveler Information Systems (ATIS).*

  These systems provide information to help drivers reach their destination. Surveillance systems collect traffic conditions over a specific geographic area and transmit the information to a traffic management center where it is combined with related information from other sources. Through such technologies as portable receivers, highway advisory radio, changeable message signs, kiosks, and teletext, users are advised on traffic conditions, alternative routes, current vehicle location, and where to find parking or other services.

- *Advanced Public Transportation Systems (APTS).*

  These systems provide customer and fleet management information to the traveling public; systems operators; and users of high-occupancy, shared-ride vehicles (buses, rail vehicles, rideshare vehicles, carpools, vanpools, and paratransit vehicles) using advanced communications, navigation, and information systems technologies. ARTS technologies include informing travelers of alternative schedules, routing, and costs for a trip; automatic handling of trip fees; informing travelers, in real time, of system changes; responding to changes in traveler's plans; and helping to manage a safe and efficient fleet. The overall effect will be an increase in the use and productivity of high occupancy vehicles (IVHS America, 1992).

The three remaining functional areas are Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), and Advanced Rural Transportation Systems (ARTS).

1.3 OPERATIONAL TEST CASE STUDIES

The U.S. DOT developed *the ITS Institutional and Legal Issues Program* to assess the major institutional and legal impediments to implementing ITS. The program was also designed to analyze the impacts and benefits ITS deployments could have on air quality, privacy, user acceptance, and other areas of concern to society at large. Under the Operational Test Case Studies subject area, *as* part of *the Institutional and Legal Issues Program,* a national, independent, and cross-cutting evaluation of several operational tests was conducted. This evaluation identified the problems and issues that participants in operational tests encountered when deploying ITS technologies and services and the important lessons that have been learned and may be applied in future deployments of ITS products and services.

The reviews of these ITS activities followed a illustrative *case study* approach and were descriptive in nature. These case studies were not intended to replace or duplicate the internal evaluations that the participants in each operational test are conducting but were designed to answer four specific questions:

- What non-technical impediments were encountered establishing partnerships and deploying ITS services and products during the operational test?
- Where in the life cycle of the operational test did these impediments occur?
- What were the causes of these impediments and how were they overcome?
- What lessons were learned in dealing with these impediments that can be applied to future deployments of ITS products and services?

The case studies were performed in two stages. In the first stage, analysts from the Science Applications International Corporation (SAIC) conducted six case studies:

- ADVANCE,
- Advantage I-75,
- Heavy Vehicle Electronic License Plate (HELP)/Crescent,
- Transportation Operations Coordinating Committee /TRANSCOM's System for Managing Incidents and Traffic (TRANSCOM/TRANSMIT),
- Travel Technologies (TravTek), and
- Westchester Commuter Central (WCC).

The findings of these case studies are presented in the report, *IVHS Institutional Issues and Case Studies - Analysis and Lesson Learned (SAIC,* 1994).

In the second stage, analysts from the Volpe Center conducted six case studies:

- Guidestar Program, including the Genesis and Travlink operational tests,
- Faster and Safer Travel through Traffic Routing and Advanced Controls (FAST-TRAC),
- Houston Smart Commuter (HSC),
- Smart Flexible Integrated Enhancement System (SaFIRES),
- SmarTraveler, and
- TravelAid.

The findings of these case studies are presented in this report. The characteristics of all 12 case studies are found in the following table.

Both reports have analyzed the case studies in the context of three goals:

1. Assess the non-technical constraints encountered at several operational tests and identify any patterns among the tests.
2. Determine the lessons that were learned by the participants in dealing with non-technical constraints and their approach to address these constraints.
3. Make recommendations to minimize the impacts of these constraints on future ITS deployments.

This report also points out any similarities and differences relating to issues, lessons learned, and recommendations between *this Findings and Recommendations* report and the *Analysis and Lessons Learned* report.

ACTIVITY	LOCATION	FUNCTIONAL AREA	TYPE
ADVANCE	Suburbs northwest of Chicago, Illinois	ATIS	Operational test
Advantage I- 75	I-7.5 Corridor from Florida to Canada	CVO	Operational test
FAST-TRAC	Oakland County, Michigan	ATMS, ATIS	Operational test
Guidestar Program	State of Minnesota		Statewide program
Genesis	Minneapolis/St. Paul area	ATIS	Operational test
Travlink	Minneapolis/St. Paul area	ATIS, APTS	Operational test
HELP/Crescent	I-5 and I-10 Corridors from Washington to New Mexico	CVO	Operational test
Houston Smart Commuter	Houston, Texas area	ATIS, APTS	Operational test
SaFIRES	Prince William County, Virginia	APTS	Operational test
SmarTraveler	Eastern Massachusetts	ATIS	Operational test
TRANSCOM TRANSMIT	New York City area	ATMS	Operational test
TravTek	Orlando, Florida	ATIS	Operational test
TravelAid	Snoqualmie Pass, I-90, Washington	ATI, ATIS	Operational test
WCC	Westchester County, New York	ATIS	Deployment

1.4 ORGANIZATION OF REPORT

Section 2: Case Study Overview, summarizes each ITS case study and ITS participants. Goals, benefits, risks, critical success factors, and milestones are described and any similarities among the operational tests are identified.

Section 3: Institutional Issues and Constraints, defines the types of institutional issues identified, then describes each major issue in detail and how effective each operational test is in addressing the issue. Issues within a category are listed based on the number of times they were identified by operational test partners.

Section 4: Lessons Learned, describes major lessons learned by operational test partners in dealing with institutional issues and constraints. Lessons within a category are listed based on the number of times they were identified by operational test partners.

Section 5: Recommendations, presents the recommendations for actions to address the negative impacts of institutional and legal impediments. Recommendations were developed by the team who have studied institutional issues affecting operational tests and are based on suggestions offered by the operational test participants.

2. CASE STUDY OVERVIEW

This section summarizes each of the operational tests that were the subject of a case study. A project overview of each case study is followed by a discussion of the management structure, goals, benefits, risks, critical success factors, and milestones for all six operational tests. Differences and similarities among the operational tests are also pointed out.

2.1 PROGRAM SUMMARIES

Six case studies are summarized: the Faster and Safer Travel through Traffic Routing and Advanced Controls (FAST-TRAC): the Guidestar Program, which includes the Travlink and Genesis operational tests; Houston Smart Commuter; Smart Flexroute Integrated Real-Time Enhancement System (SaFIRES); SmarTraveler; and TravelAid.

2.1.1 FAST-TRAC

The FAST-TRAC operational field test began in June 1992 in Troy, Michigan. FAST-TRAC is a route guidance and traveler information system whose mission is to improve traffic mobility and safety using ITS technologies. There are three major technological components to this test. First, the Ali-Scout dynamic route guidance system is an ATIS technology that uses a system of roadside infrared beacons, specially equipped vehicles with on-board computers, and a traffic operations center with a central computer linked to the vehicle and beacons to exchange route guidance and travel information. Second, the Sydney Coordinated Adaptive Traffic System (SCATS) is an ATMS technology that monitors traffic flow and adjusts signal timing in response to changes in traffic flow. Third, the AutoscopeTM - 2003 (AUTOSCOPE) Video Vehicle Detection System uses a digital video camera to detect vehicles and transmits traffic information to the SCATS. Major project partners include local, state, and federal government; transportation industry representatives, and academia.

Phase I of FAST-TRAC was initiated in June 1992 in the city of Troy and became fully operational at the end of 1993. Ninety-five intersections were controlled by SCATS; 30 Ali-Scout beacons were installed; 60 vehicles equipped with Ah-Scout on-board computers, also knows as IVUs (in-vehicle units); a traffic operations center (TOC) established; and AUTOSCOPE detection installed. Phase II was broken down into two stages (IIA and IIB) to coincide with the funding approvals. Preliminary engineering for Phase IIA began in June 1993. FAST-TRAC was expanded to the surrounding communities of Pontiac, Auburn Hills, and Rochester Hills during Phase IIA. Phase IIB began in January 1995 with the expansion of FAST-TRAC to South Lyons, and planning is underway to further expand FAST-TRAC to additional communities. With the completion of Phase IIB in December 1996, a total of 295 intersections will be under SCATS control (there are currently 195) supported by 100 Ali-Scout beacons (there are currently 40) and 800 Ali-Scout equipped vehicles. The surface street ATMS integration with freeway operations and the TOC link with the State's Metropolitan

Transportation Center (MTC) will also begin during Phase IIB. Further expansion of FAST-TRAC throughout Oakland County, Michigan is planned for Phase III, which is scheduled to begin in July 1995. Another 100 (bringing the total to 395) SCATS-controlled intersections are projected. The emphasis of Phase III will be to develop the communication infrastructure and provide user services. In addition, a fully functioning TOC will be linked to the MTC and all freeway and surface street operations will be integrated.

2.1.2 Guidestar Program

Guidestar is the Minnesota Department of Transportation's ITS program, funding research and development and operational tests for a variety of ITS projects, including Travlink and Genesis.

The Travlink operational test was initiated in 1992 and is an automated vehicle location (AVL) and ATIS system that will provide travelers with real-time data on transit connection times and service performance using videotext and audiotext systems, cable TV, and "smart" information kiosks and terminals located in homes, work places, transit stations, and other public locations. Transit operators will also use this real-time transit vehicle location data for improved on-time performance and fleet management and as inputs to the traveler information systems. The pilot test on Interstate 394, connecting Minneapolis-St. Paul with the western suburbs, was initiated in December 1994 to evaluate the influence of transit information on commuter mode choice and single occupancy automobile travel. As of March 1995, electronic signs at park and ride lots, electronic monitors at a downtown transit center, and three touch screen kiosks at centralized public areas have been installed. Use of in-house videotext systems are still under review.

The Genesis operational test was initiated in 1991 to examine the market and technical potential of an ATIS that provides users with real-time traffic data on highway conditions and travel advisories using alphanumeric pagers and personal digital assistants (PDAs), and personal communications devices (PCDs). Genesis collects, processes, and manages real-time traffic data from transit and other "probe" vehicles, as well as from conventional sources, and is directly linked to the Travlink APTS network. Major project partners include local, state, and federal government; private industry (communication and manufacturing); and academia. The detailed design phase was completed in March 1994. The system contractor was approved in August 1994 and initial deployment is scheduled for the summer of 1995. Recruitment of participants to use the 350 alphanumeric pagers and the 50 Apple Newtons with paging cards has been on-going since late 1994. An assessment to determine the need for expanded project implementation will occur in late 1995.

2.1.3 Houston Smart Commuter

The Houston Smart Commuter operational field test was initiated in 1991 to assess the potential for encouraging greater use of high-occupancy commute modes (buses, carpools, vanpools) using APTS and ATIS technologies to provide information. There are two components to the field test. The bus component focuses on the suburb-to-downtown travel market and will encourage commuters using the I-45 North (I-45N) highway to change modes from driving alone to using the bus or other high-occupancy modes of travel. Commuters will be provided with real-time traffic and transit information through the use of touch-tone and cellular telephones, cable television, videotext, or pocket systems. The carpool component focuses on the suburb-to-suburb travel market and will encourage commuters using the I-10 West (I-10W) highway to change modes from driving alone to carpooling, using real-time rideshare matching services. The telephone system will be used to provide carpool matching. Major project partners include regional, state, and federal government, and university-based transportation researchers.

The I-10W and I-45N components are scheduled to be operational by late 1995. A rideshare computer system for the I-10W and other metropolitan ridesharing programs was fully functional in mid-l 995. The technical specifications for the I-45N information delivery system were completed in late 1994 and a request for proposals was issued in March 1995. The signing of an inter-agency funding agreement between two of the four partners - the Texas DOT and the Metropolitan Transit Authority (METRO) of Harris County should be signed shortly and is the last major obstacle to deploying the operational test. The tests are scheduled to run for at least three years with evaluations of each component occurring after six months, one year, two years, and three years. Future project expansion will be reviewed after the first year evaluation.

2.1.4 Smart Flexroute Integrated Real-Time Enhancement System (SaFIRES)

The SaFIRES operational test was initiated in January 1994 to evaluate an enhanced ridesharing-route deviation transportation system integrated with conventional transit and ridesharing in the suburban-to-rural Prince William area of Northern Virginia. Using advanced APTS routing and scheduling technologies such as global positioning system-based (GPS-based) automated vehicle location (AVL), real-time scheduling software, geographic information system (GIS) mapping and digital communication through mobile data terminals, the test will provide door-to-door transportation for system users using both public and privately owned vehicles. Small, multi-purpose vehicles will switch between service types as needed, allowing the best vehicle to respond to each request in real time using the integrated computerized dispatching software. Route deviation up to 3/4 of a mile will enable the service to reach a far larger market and minimize the need for complementary paratransit services required of fixed route systems. Major project partners include local, state, and federal government, and private industry (communication and computers).

Project hardware and software was delivered in March 1995. GIS and GPS systems are scheduled to be installed by November 1995. “Non-ITS enhanced” local bus service under the SaFIRES project began in December 1994. By the end of July 1995, five flex-routes and five commuter rail feeder routes will be in operation using 22 dedicated vehicles. All vehicles and project services will be ITS-enhanced by the end of November 1995. As more vehicles are added to the project, additional routes will be added, leading to the ultimate full deployment objective of operating 50 ITS-enhanced vehicles in the SaFIRES project. The project’s “test” phase is scheduled to run for 30 months, initially scheduled to end in July 1996. Due to the delay in the test startup, local project partners are contemplating requesting a “time-only” extension from the FTA and the FHWA.

2.1.5 SmarTraveler

The SmarTraveler operational test was initiated in October 1992 to evaluate public acceptance and the potential traffic impacts of a telephone-based audiotext traffic information service in eastern Massachusetts. Using land-line or mobile telephones, commuters are provided with up-to-the-minute information on traffic, road, and transit operating conditions; travel times; transit options; construction sites; and information on special events impacting commuting. Transportation data is collected using such ATIS technologies as video cameras, mobile phone and two-way radio probes, two-way radio hookups with express buses and a helicopter fleet, electronic scanners monitoring radio frequencies, fixed wing aircraft, and hard-wire connections with state transportation agencies and the state police. Major partners included state and federal government and private industry.

Phase I, the two-month scale-up period began in October 1992 and ended in December 1992. Phase II, the operational test, began in January 1993 and ended in December 1993. The test continued for another year after state and federal officials decided more time was required to develop a wider-scale public acceptance of the project. State funding for the SmarTraveler system will continue through December 1995.

2.1.6 TravelAid

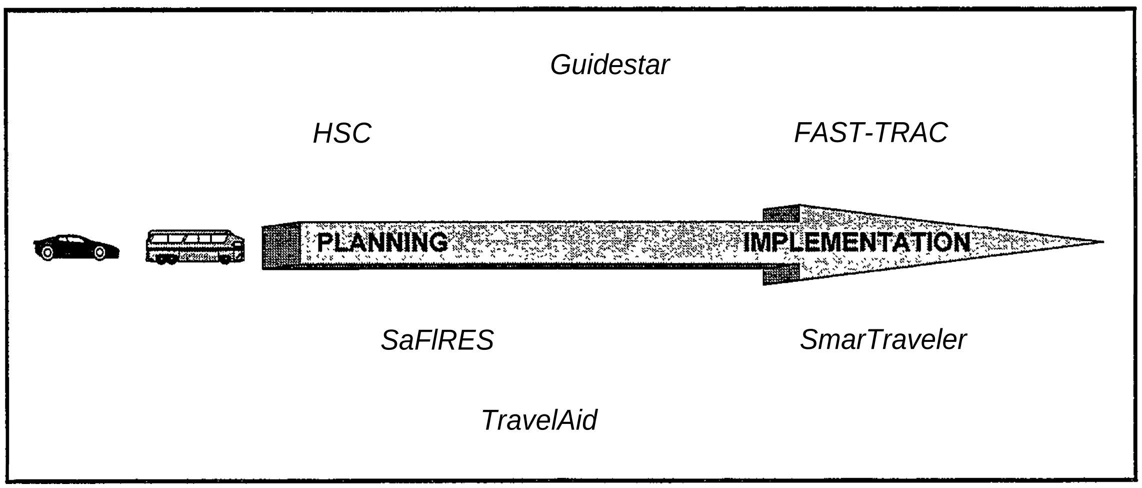
The TravelAid operational test was initiated in November 1992 to evaluate the implementation of a variable speed limit (VSL) and motorist alerting system along a section of I-90, the primary east-west roadway in the state of Washington that cuts through the Cascade Mountains and links the cities of Spokane and Seattle. I-90 crosses the Cascades at the Snoqualmie Pass, an isolated area with no surrounding communities and few services. This area is popular with skiers and campers. The pass frequently experiences adverse weather conditions, which, when combined with a high percentage of recreational drivers who are unfamiliar with the prevailing weather conditions, account for the higher than average accident rate along the pass.

TravelAid will collect data from traffic detectors and weather sensors placed along the highway and from the system operator. ATIS technologies such as variable message signs (VMS) and VSL signs, and in-vehicle unit (IVU) radio receivers will be used to distribute information to drivers on traffic, weather, and road conditions; traction device requirements, incidents, avalanche control, and snowplow activity. VSL signs will be installed on each on-ramp, with speed limits based on weather, road, and traffic conditions. Two hundred IVUs will transmit information to drivers of the equipped vehicles with read outs alerting the driver of any specific problems and conditions in their vicinity. Major partners include state and federal government, private industry, and academia.

The *draft* system design report was produced in January 1993. The plans, specifications, and estimates (PS&E) for the system design was completed and the construction contract was awarded in January 1995 with construction due to begin in spring 1995. Testing of the in-vehicle communications began in the winter of 1994-95. A final draft of the evaluation plan was submitted in November 1993. VMS and VSL will be in full operation by the winter of 1995-96.

2.1.7 Case Studies by Project Phase

The following figure illustrates the current project status of operational tests for each case study. One case study is still in the planning phase, three studies are about to transition to the implementation phase, and the remaining two studies are operational.



2.2 MANAGEMENT STRUCTURE

Operational tests are cooperative partnerships and, at a minimum, involve the U.S. DOT and another public sector agency. Partners within an operational test can include state, regional, and local transportation agencies, and private sector firms. In such partnerships, funding, technical, and administrative responsibilities are shared among the partners. Private sector companies are also involved as consultants, vendors, or contractors.

Several patterns emerged when comparing the management of the different operational tests. First, many tests were managed hierarchically. One top-level committee made up of representatives from all major partners manages the overall program. Second, the day-to-day project management relating to design, implementation, and operation of the operational test is the responsibility of a single public agency. Third, technical or project teams, coordinating hardware and software support and implementation, were made up of both public sector partners and private sector partners, if the private sector is involved as a partner.

2.2.1 FAST-TRAC

FAST-TRAC is managed by the Executive Committee, made up of members from the Road Commission for Oakland County (RCOC), Siemens Automotive L.P. (Siemens), developer of the Ali-Scout route guidance system; the Federal Highway Administration (FHWA), the Michigan Department of Transportation (MDOT), Oakland County, Michigan State University, University of Michigan, Ford, General Motors, Chrysler, and Nissan. There are three *Subcommittees:* Evaluation, Vehicle Operations, and Systems Integration. The Systems Integration Subcommittee has four working groups: ATMS/ATIS Integration, Communications, TOC Functions, and Freeway/Surface Street Integration.

RCOC has overall management responsibility for administering the project. The FAST-TRAC *Program Manager* is an RCOC employee, reporting to the Executive Committee and the chairs of the Evaluation and Systems Integration subcommittees, and oversees implementation of the ATIS and ATMS work orders, which are approved by the FHWA and MDOT prior to execution. Both the FHWA and MDOT approve work plans, contracts, and work orders developed by the RCOC. Siemens executes work orders relating to the ATIS, and the ATIS program manager is a Siemens employee. The SCATS ATMS technical representative is AWA Traffic System America. The system integrator for the Ah-Scout-SCATS integration is Rockwell.

2.2.2 Guidestar Program

Principal participants in the Guidestar Program are the Minnesota Department of Transportation (MnDOT), the FHWA, and the University of Minnesota Center for Transportation Studies (CTS). The management structure of Guidestar is somewhat different from the other five operational tests in this report because Guidestar is a program that manages two operational tests: Guidestar and Travlink, in addition to other metropolitan ITS projects.

Guidestar is managed hierarchically *with* four levels of authority. *The Executive Committee* is managed by chief administrative officers and senior managers. Next in line is the *Steering Committee*, directing Guidestar's day-to-day management activities, and managed by representatives from academia and federal, state, and local government agencies. Reporting to the Steering Committee is the *Planning and Program Management (PPM) Committee* which coordinates program planning. Five *Working Committees also* report to the Steering Committee: Rural ITS Applications, Transit Innovations (overseeing the Travlink project), Communications and Navigation (overseeing the Genesis operational test), Freeway and Arterial Management, and ITS Research and Development whose members are experts in specific ITS fields and who are responsible for individual projects. There *are two Project Teams* for the Genesis and Travlink operational tests who coordinate day-to-day management of the projects and report to a working committee. Project teams also include private partners.

MnDOT is the Guidestar program leader, responsible for overall program management responsibilities. The FHWA provides financial support, in addition to strategic input, as does the

University of Minnesota CTS These principal participants also have similar roles within the Travlink and Genesis projects, supported by other sponsors. Additional public sponsors for Travlink include the Federal Transit Administration (FTA), the Metropolitan Council, the Metropolitan Council Transit Operations (MCTO); private sponsors include US West, 3M , Rennix, and Transportation Management Solutions, Inc. (TMSI, formerly Westinghouse). Private sponsors for Genesis include Motorola, Loral (formerly IBM), JHK and Associates, MinnComm Paging, and BRW.

The local evaluation for TravLink will be conducted by Cambridge Systematics, Inc. and for Genesis by SAIC. Both parties will coordinate their work with the project leader (MnDOT), the firm conducting the national evaluation, and the federal sponsors (the FHWA and the FTA).

2.2.3 Houston Smart Commuter

The Houston Smart Commuter management structure includes *an Executive Committee*, funding agencies, daily project management staff, a technical *Project Management Team (PMT),* and national and local evaluation agencies. The *Executive Committee is* made up of senior staff members from the Texas Department of Transportation (TxDOT), the METRO, the Greater Houston Transportation and Emergency Management Center (GHTEMC), and other local and regional agencies. The Executive Committee has executive oversight of the Houston Smart Commuter project and other ITS projects in the Houston area. Unlike the other five operational tests, the Houston Smart Commuter is entirely a public partnership.

Day-to-day project management for the design, implementation, and operation of the operational test is the responsibility of the project management staff under *the Project Manager*, a METRO employee. The Project Manager reports to the Executive Committee and the federal sponsors, in addition to staffing the *PMT.* The PMT is made up of technical staff members from the various agencies involved in this project and plays an important role in developing the technical specifications for the I-45N information delivery system, and implementing and evaluating the operational test. The FTA has overall federal monitoring responsibility with project monitoring being performed by the FHWA regional office. Project funding is provided by the FTA, FHWA, TxDOT, and METRO. TTI is in charge of the local evaluation of the Houston Smart Commuter, whereas the FTA coordinates and contracts for national evaluations of federally sponsored APTS operational tests.

2.2.4 SaFIRES

The FTA is the overall *Program Manager* for the Northern Virginia SaFIRES operational test, providing technical guidance and project evaluation in conjunction with the FHWA, the major funding source. The Potomac and Rappahannock Transportation Commission (PRTC) is the lead partner, and, as *Project Manager*, is responsible for project oversight and operation of the transit service. The Virginia Department of Rail and Public Transportation (VDRPT) is the funding channel between the FHWA and the PRTC, in addition to being responsible for grant management and project oversight.

Tidewater Consultants, Inc. reports to the PRTC, and is responsible for coordinating the hardware and software technical support provided by two other private partners; UMA Engineering (now called Trapeze Software, Inc.) and Gandalf Mobile Systems, Inc. (now called GMSI). SG Associates, reports to the PRTC and Tidewater on project-related tasks and provides transportation consulting services. The Northern Virginia Planning District Commission (NVPDC) also provides technical support and reports to PRTC via TCI. NVPDC has also been given the role of local project evaluator and will coordinate test information with the PRTC, the FTA, and the FTA's national evaluator.

2.2.5 SmarTraveler

The *Project Management Team* is made up of representatives from the FHWA, the Bureau of Transportation Planning (BTP&D) within the Massachusetts Executive Office of Transportation and Construction, the Massachusetts Highway Department (MHD), and SmartRoute Systems Limited Partnership (SRS).

The FHWA provides funding, technical, and program assistance and coordination with other ITS projects. The BTP&D administers the SmarTraveler contract and is a liaison between SRS and the MHD, the contracting agency. The BTP&D also provides technical assistance and program management. *The* MHD is *the Contracting Agency* for the operational test and is the funding mechanism between the FHWA and SRS, and is also a member of the project evaluation team. SRS is responsible for operating the SmarTraveler service. Two planning agencies of the Boston Metropolitan Planning Organization (MPO) also negotiated and then executed the contract for the local evaluation. Within the operational test, several public transportation agencies and private sector firms provide in-kind services, such as marketing, advertising, and traffic and transit information.

2.2.6 TravelAid

The major participants in TravelAid include the FHWA, the Washington State Department of Transportation (WSDOT), Farradyne Systems Inc. (FSI), the University of Washington (UW), the National Highway and Traffic Safety Administration (NHTSA), and the Washington State Transportation Center (TRACY). The TRAC is a cooperative transportation organization supported by the UW, Washington State University, and the WSDOT.

A *Steering Committee,* made up of one member from each of the partners, is responsible for overall project direction, project plan conformance, budgeting, and project scheduling. The steering committee is also responsible for approving press releases and other project publicity. Within the steering committee, each of the participating organizations retains technical responsibility for its own assigned project activities. This committee is chaired by one representative of the WSDOT Headquarters (HQ) Traffic Office, who is located at the TRAC office, and one from the WSDOT Southwest Region office.

The FHWA and the NHTSA are full participants in the project. The FHWA is funding the operational test and on-going monitoring. The NHTSA is funding development, refinement, and performance of the evaluation plan.

The *Project Administrator* is the WSDOT, who, in addition to project administration and state funding, is also responsible for many of the design features of the project, such as developing structural designs for sign bridges. WSDOT also has the lead role in system review and approval. UW personnel are the operational *test evaluators*, both planning and conducting the evaluation. Staff are responsible for writing the evaluation plan, developing a driver simulator, evaluating the project, and assisting with the report production. They are also the focal point for coordinating student participation and other resources in the project.

Private partners are responsible for system design and software development. FSI is the prime contractor and lead *Project Administrator,* supported by sub-contractors Engineering Research Associates, TrafficMaster, and Surface Systems, Inc.

2.3 GOALS

During the review of the operational tests, two sets of goals were defined: goals listed in project documentation and goals stated by the operational test participants. Goals listed in the project documentation were ranked by the number of times they were listed. Some goals were generic in nature, for example, improve safety; other goals were project-specific, for example, improve the efficiency of the I-45 travel corridor using ITS technologies. The Volpe Center analysts compared documented project goals with the project goals stated by the interviewees of the operational tests to see if there were any conflicts; there were none.

2.3.1 Goals Listed in Project Documentation

The project goals are ranked by the number of times they were identified in the project documentation:

- *To improve mobility and safety in congested areas* (identified by all programs except SmarTraveler).
- *To evaluate the effectiveness of an integrated ITS on transportation operations* (FAST-TRAC, SaFIRES, and SmarTraveler).
- *To promote public acceptance of ITS technologies* (Guidestar and SmarTraveler).
- *To assess the performance of ITS technologies* (FAST-TRAC and SmarTraveler).
- *To reduce environmental impacts* (Guidestar and SaFIRES).

- *To find an early winner for the ITS program* (FAST-TRAC).
- *To increase ITS exposure* (FAST-TRAC).
- *To build international ITS linkage* (FAST-TRAC).
- *To promote a role for academia* (Guidestar).
- *To maintain ITS leadership* (Guidestar).
- *To promote ITS research* (Guidestar).
- *To increase the number of transit* Users (Houston Smart Commuter).
- *To increase the efficiency of the travel corridor* (Houston Smart Commuter).
- *To develop a state-of-the-art ITS system and improve the accuracy of travel information using new technologies* (Houston Smart Commuter).
- *To evaluate the cost effectiveness of ITS applications* (SaFIRES).
- *To create new types of public transportation (SaFIRES).*
- *To integrate ITS functional areas (SaFIRES).*
- *To evaluate technology 's impact on ITS operations* (SmarTraveler).
- *To promote privatization* of *an ITS* (SmarTraveler).

2.3.2 Goals Stated by Participants

In comparing documented project goals with goals identified by project participants, most documented goals were mentioned by at least one participant. Some new goals were also identified. Stated goals are broken down by individual tests and ranked by importance with each test. Ranking is based on the number of times the goal was identified by test participants. Any heavy emphasis on a specific goal by either the public or private sectors is pointed out. Obstacles to meeting a stated goal are also discussed.

Based on the number of responses, there were six important goals for the majority of participants:

- *To improve safety.*
- *To evaluate the impacts, and effectiveness of new technologies.*
- *To test ITS products andprocedures.*
- *To improve transportation systems by applying ITS technologies.*
- *To find new ways of doing business.*
- *To understand the marketfor ITS.*

It is interesting to note that *improving safety* and *evaluating the ITS effectiveness* were the top two goals for both project documentation goals and individual participant goals. Even though the public and private sector representatives identified the sarne goals, the private sector tended to focus on marketing-related issues, such *as understanding the market,* whereas the public sector emphasized policy-related issues such as *improving safety* and *developing an ITS industry.* For several agencies there were two major obstacles to achieving operational test goals:

- *Developing partnerships with other organizations or agencies.*
- *Applying ITS technologies.*

Goals for each operational test are summarized below along with any identified obstacles to meeting these goals.

2.3.2.1 FAST-TRAC

Operational test participants strongly supported two of the documented project goals: *improving mobility and safety* and *evaluating benefits.* In general they also supported two others: *integrating an ATMS and an ATIS* and *demonstrating technical features.*

Nine goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To understand the market for traveler information and guidance systems.*
- *To develop an ITS industry in Oakland County and the US.*
- *To improve the Oakland County transportation system using ITS technologies.*
- *To improve safety.*
- *To work within the national ITSprogram.*
- *To identify costs and benefits of deploying an integrated system.*
- *To gain real world knowledge.*
- *To provide opportunities for university staff and students to gain experience in a new field.*
- *To make FAST-TRAC the best operational test in the nation.*

In general, even though participants from the public and private sectors identified similar goals, there were differences in emphasis. The public sector tended to emphasize *improving the transportation system, developing an ITS industry,* and *improving safety,* whereas for the private sector, *understanding the market* had the greatest emphasis. Policy makers within both sectors felt that *understanding the market* was the most important, whereas technical support participants emphasized *improving the transportation system* and *developing an ITS system.*

2.3.2.2 Guidestar Program

Operational test participants strongly supported three of the documented project goals: *promoting new institutional relationships, developing public-private partnerships,* and *enhancing mobility and reducing congestion.* To a lesser degree, they supported *two* others: *improving safety* and *maintaining leadership in ITS.*

Ten goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To foster product and market development.*
- *To evaluate the impacts, and effectiveness of the operational test.*
- *To promote new institutional relationships and public-private partnerships.*
- *To realize operational improvements.*
- *To enhance mobility and reduce congestion.*
- *To facilitate and encourage mass transit.*
- *To find new ways of doing business, expanding roles, and creating new business opportunities.*
- *To improve safety.*
- *To improve customer service.*
- *To maintain a leadership role in ITS.*

Participants from the public and private sectors together identified two goals, both relating to business: *fosteringproduct and market development andfinding new ways of doing business, expanding roles, and creating new business opportunities.* The difference in emphasis was the private sector view of ITS as a profitable venture. All other goals were supported only by the public sector. Within this group, two goals were supported by state-level participants only: *operational improvements* and *maintaining a leadership role in ITS.*

2.3.2.3 Houston Smart Commuter

Operational test participants overwhelmingly supported the documented project goal: *encouraging mode of travel.* Even though test participants did not mention the remaining goals verbatim, all components of the goals were cited in one form or another.

Six goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To increase HOV usage.*
- *To test products and procedures and learn what works.*

- *To expand the HSC concept regionally and apply knowledge gained from the HSC operational test nationally.*
- *To reduce pollution.*
- *To reduce traffic congestion.*
- *To perform a successful project.*

Participants unanimously identified the number one goal of *increasing HOV usage.* There were some concerns expressed over the lack of incentives for commuters to change travel modes and patterns, participant's discomfort with riding buses or carpooling, and lack of consumer interest in changing travel patterns due to poor quality travel information.

Participants mentioned several other goals. One goal, *testing products and procedures,* relates to perfecting the HSC operational test. Several obstacles were identified over how the information is distributed: the lack of direction over the type of device technology to use, the potential for poor product performance, and the possibility that the information is not presented in a user-friendly way. This would affect consumer participation, as would a lack of public education and consumer resistance to change. Another goal, *expand the HSC concept regionally and nationally,* according to one project administrator, can only be realized if the private sector can produce the desired innovative products and approaches.

The goal to *reduce pollution* was not originally part of the documented project goals but evolved as a result of the Houston metropolitan area's status as a severe non-attainment (ozone) air quality region. Obstacles to meeting this goal included the potential for additional environmental regulations that could force the HSC test to be replaced by a program specifically addressing air pollution. In addition, air pollution may not be reduced simply through the HSC program because other sources in the Houston area, such as petrochemicals, pollute at greater levels than motor vehicles.

Finally, *performing a successful project* was important to administrators and policy makers, with success being defined as staying within the cost estimates, political expectations, and legal constraints while the test is taking place, or being able to implement the project and conduct the test evaluations. Obstacles included the inability to communicate information to all primary parties and project delays, both of which could result in an unsuccessful test.

2.3.2.4 SaFIRES

Operational test participants supported the documented project goals of *creating new types of public transportation* and *integrating new services into existing transit andparatransit modes.* No conflicts were found with the remaining goals, although most participants expressed goals beyond those originally documented.

Six goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To improve the organization 's business prospects or staff experience.*
- *To improve the transportation options in the region.*
- *To make a positive contribution to either the project or to ITS.*
- *To improve access to public transportation in the region.*
- *To network with other organizations or agencies.*
- *To apply new ITS technologies.*

Participants from the public and private sectors together identified the first four goals. The only difference in emphasis was in the first goal of improving the organization's business prospects or staff experience. The private sector focused on new product development and marketing whereas the public sector emphasized human factors: improved skills, involvement in ITS, productivity, and job satisfaction. Two goals were supported by public sector participants only; *networking with other organizations* and *applying new ITS technologies.*

Participants identified several obstacles to meeting some of the goals. *Improving transportation options* may not be possible if the technology does not work. In addition, *apositive contribution to the project or to ITS* depends on staff ability to execute their organization's role effectively. More obstacles were seen in meeting some of the other goals. *Improved access to public transportation* would be affected by budgetary or resource limitations in addition to any difficulties in integrating transportation options.

Obstacles were *also* seen to *networking:* the tendency of agencies to focus on their own goals and objectives, poor inter-agency communication, and the jeopardy of future partnership if project technology fails. *Applying new ITS technologies* generated the most obstacles of any goal. These included system incompatibility between regions, poor marketing, lack of public sector coordination, and technical failure. Additional obstacles were also identified that were general in nature and not tied to any goals. Private sector participants focused on business practices, such as marketing and liability; whereas the public sector focused on human factors, such as product acceptance, consumer preferences, and workforce technical skills.

2.3.2.5 SmarTraveler

Public and private sector operational test participants supported the documented project goals. Even though test participants did not mention the goals verbatim, all components of the goals were cited in one form or another.

Five goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To determine the public demandfor traveler information and users ' response to such information.*
- *To increase the traveling public 's awareness of alternatives to the single-occupant vehicle.*
- *To provide readily available and accurate information to the public.*
- *To provide new business opportunities.*
- *To determine the potential of an ATIS.*

Participants from the public and private sectors together identified two related goals: *determining the demandfor information* and *providing the information.* There was no difference in emphasis between the sectors. Two goals were supported by public sector participants only: *provide alternatives to the SOV* and *assess the potential of an ATIS* (project administrators only). The private sector alone supported *new business opportunities,* looking at a new market for advanced data collection technologies and spin-off projects.

Participants identified minor obstacles to achieving several goals. There is limited market research experience in *determining the information demand* in addition to the inexperience of the public sector in determining product acceptance and the possibility that the operational test may not last long enough to allow commuters to modify their travel behavior. Difficulties were also seen in *increasing public awareness of alternatives to the SOV* if data, especially transit data, was inaccurate or untimely and there were few alternative routes proposed. The only other obstacle mentioned was the cost of providing *available and accurate information* to the user at home, at work, or in a vehicle via such technologies as telephones, cellular phones, and the electronic media. No obstacles were seen in meeting the last *two goals of new business opportunities* and *ATIS potential.*

2.3.2.6 TravelAid

Operational test participants from the public sector strongly supported the documented project goals, all of which related to safety. Most participants in both sectors also expressed goals beyond those in the project proposal.

Five goals were mentioned by three or more individuals and are listed in order of importance based on the number of times mentioned:

- *To test the application of ITS technologies.*
- *To increase safety on the roadway.*
- *To examine and develop a position in the ITS market.*
- *To gain experience in ITS.*
- *To evaluate the effectiveness, costs, and benefits of the proposed technology.*

Participants from the public and private sectors unanimously identified the number one goal of *testing ITS technologies.* The only difference in emphasis was the public sector focus on technologies relating to communications systems, VSL, and VMS; whereas the private sector focused on communications systems *only. Increased safety* for travelers was supported by the public sector, as was *evaluating the technology,* in relation to costs, benefits, user acceptance, and impacts. The public sector only supported *the ITS market positioning,* looking at the potential for market leadership if the project was a success. In conjunction with academia, the public sector also saw *experience in ITS* as an important goal.

2.4 BENEFITS

Benefits discussed by the operational test interviewees and questionnaire respondents were closely related to the operational test goals. Based on the number of responses, there were nine important benefits. These benefits are listed by the number of times they were mentioned by the project participants

- *Experience with new ways of doing business* (identified by all programs)
- *Knowledge of new technologies* (identified by all programs)
- *Improved mobility and safety* (identified by all programs)
- *Formation of new partnerships* (identified by all programs except TravelAid)
- *Development of new products and markets* (identified by all programs except FAST-TRAC)
- *Improved transportation systems for the commuter* (FAST-TRAC, Guidestar, Houston Smart Commuter)
- *Improved air quality* (FAST-TRAC, Guidestar, Houston Smart Commuter)
- *Increased visibility for the organization* (SaFIRES and SmarTraveler)
- *Development of the ITS program both regionally and nationally* (FAST-TRAC and Houston Smart Commuter).

The following benefits were identified in one program and are judged equally important:

- *Improved reputation and visibility of the partnership* (FAST-TRAC)
- *Leverage of resources for participants* (FAST-TRAC)
- *Ability to assess marketing strategy* (SmarTraveler)
- *Improved awareness of transit* (SmarTraveler)
- *Increased mass transit use* (Guidestar)
- *Increased HOV usage* (Houston Smart Commuter)
- *Improved staff skills* (SaFIRES)

- *Achievement ofprogram goals and objectives* (SaFIRES)
- *Development of* a *transferable model* (SaFIRES).

Together, the public and private sectors identified several common benefits from the operational tests. *Learning new ways of doing business, establishing new partnerships,* and *creating new business areas* were all emphasized. Separately the different groups attached a different level of importance to other benefits. The public sector saw *increasing mobility and safety, improving customer service, increasing mass transit ridership,* and *improving transit awareness* as benefits. In contrast, to the private sector *creating new products and markets* was the most important benefit. Policy makers from both the public and private sectors identified *gaining experience in ITS technologies* and *understanding the market* as significant benefits, whereas technical staff stressed *enhancing the project s reputation,*

2.5 RISKS

There were several risks identified by the interviewees and questionnaire respondents in the six operational test programs. Based on the number of responses, there were seven important risks. These risks are listed by the number of times they were mentioned by the project participants.

- *Image and reputation of the organization may be damaged if the project fails* (identified by all programs)
- *Possible failure of technology* (identified by all programs except SmarTraveler)
- *System may not be accepted by the public* (FAST-TRAC, Guidestar, Houston Smart Commuter, SaFIRES)
- *Possible loss of partner' s financial investment and increased exposure to liability* (FAST-TRAC, Guidestar, TravelAid)
- *Expected benefits may not result* (FAST-TRAC, Guidestar, Houston Smart Commuter)
- *Poor test results may affect future ITS projects* (Houston Smart Commuter, SmarTraveler)
- *Interagency relationships may be damaged* (Houston Smart Commuter, SaFIRES).

The following risks were identified in one program and are judged equally important:

- *Increased workload may hinder performance of other operations within the organizations* (FAST-TRAC)
- *Funding is not guaranteed* (Guidestar)
- *Legal and ethical concerns may be raised over partnering agreements* (Guidestar)
- *Program or project concept may be skewed* (Guidestar)
- *Opportunities in other areas may be lost (Guidestar)*

- *Project schedules may not be maintained (Guidestar)*
- *New marketplaces and business areas may have to be entered (Guidestar)*
- *Participants may withdraw from the project (Guidestar)*
- *Other tests may duplicate work (Guidestar)*
- *Benefits of ITS may not be proved (Guidestar)*
- *Public may see test as a waste of resources (Houston Smart Commuter)*
- *More resources than originally expected may be required (SaFIREs)*
- *Test may not be fully deployed after completion (SmarTraveler)*
- *System information may be inaccurate (SmarTraveler)*
- *Approved work may not be reimbursed (SmarTraveler)*
- *Funding may be exhausted before benefits seen (TravelAid)*
- *Test success depends on other participants who may not perform (TravelAicl).*

Together, the public and private sectors agreed on most of the same risks. Only the public sector felt the greatest risks were *lack of public acceptance, damage to inter-agency relationships,* and the *impact of poor test results on future ITS projects* Separately, the private sector identified *damage to image and reputation* and *possible loss of a partner ' s financial investment and increased exposure to liability* as the greatest risks.

2.6 CRITICAL SUCCESS FACTORS

Critical success factors (CSFs) are key areas that must be successfully completed before the project can be considered successful. Two of the CSFs most frequently mentioned by interviewees relate to two of the most frequently mentioned risks: technology and public acceptance. Based on the number of responses, there were nine important CSFs. These CSFs are listed by the number of times they were mentioned by the project participants:

- *Working technology that provides accurate information* (identified by all programs except Guidestar)
- *Establishment of good partnerships* (FAST-TRAC, Guidestar, Houston Smart Commuter, SaFIRES)
- *Public 's use and acceptance of the service* (Guidestar, Houston Smart Commuter, SaFIRES, SmarTraveler)
- *Positive public perception of the project* (FAST-TRACY, Houston Smart Commuter, SmarTraveler)

- *Properly conducted evaluation* (FAST-TRAC, Guidestar, Houston Smart Commuter)
- *Adequate project funding* (FAST-TRAC, Guidestar, TravelAid)
- *Implementation on schedule (FAST-TRAC, Guidestar, TravelAid)*
- *Clearly demonstrated benefits* (FAST-TRAC, SaFIRES)
- *Successfully managed projects* (Houston Smart Commuter, TravelAid).

The following CSFs were identified in one program and are judged equally important:

- *Successful integration of an ATMS and an ATIS (FAST-TRAC)*
- *Use of technology and services beyond the test (Guidestar)*
- *Well-defined product specifications (Houston Smart Commuter)*
- *Qualified users of project technology (Houston Smart Commuter)*
- *Change in commuter's travel behavior after using product* (Houston Smart Commuter)
- *Transferable system technology* (Houston Smart Commuter)
- *Established market for information* (SmarTraveler).

Together, the public and private sectors were in agreement on many of the most significant CSFs, including *technology, public acceptance, cooperation*, and *benefits.* Separately, the public sector, saw *continued funding* and *successful project management* as important, while the private sector emphasized *partnerships* and *markets for products and services.* Policy makers and project administrators both saw *accurate evaluations* and *market acceptance* as important. Policy makers listed only *benefits* and *scheduling* as critical, while for project administrators, *funding* and *technology* were high on the list.

3. INSTITUTIONAL ISSUES

In the context of this report, institutional issues are non-technical impediments that impact either the success of ITS operational field tests or the ultimate deployment of ITS technologies. This section discusses the institutional issues identified by operational test participants when interviewed by Volpe Center analysts or when responding to a questionnaire as well as issues that may be encountered by future operational tests or deployments. The causes of the issue, the effect of the issue on the operational test, and the resolution of the issue are discussed. This section also includes a comparison between issues identified in *this Findings and Recommendations* report and *the IVHS Institutional Issues and Case Studies -Analysis and Lessons Learned* report (SAIC, 1994). Institutional issues have been classified into six categories:

- *Organizational and Managerial*

  Issues relating to new business relationships, inter-agency coordination, intra-agency coordination, and managerial processes.

- *Procedural and Regulatory*

  Issues relating to contracting, evaluation, intellectual property rights, and non-competitive selections.

- *Human Resources*

  Issues relating to technical expertise and staff resources.

- *Funding*

  Issues relating to funding requirements and partner contributions.

- *Technology*

  Issues related to standardization, product technology, and system integration.

- *User Acceptance*

  Issues relating to public acceptance of ITS products and services.

3.1 ORGANIZATIONAL AND MANAGERIAL ISSUES

There are four categories of issues relating to how operational tests are organized and managed: new business relationships, inter-agency coordination, intra-agency coordination, and managerial processes.

3.1.1 New Business Relationships

Participants from all six tests identified several issues occurring in the early stages of developing new business relationships. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

NEW BUSINESS BELA TIONSHIP ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Newness of the partnership	✓	✓		✓	✓	✓
Ill-defined roles and responsibilities	✓	✓	✓	✓		✓
Competition between partners		✓		✓		
Partnerships with multiple partners		✓	✓	✓		

ISSUE 1: WORKING IN A PARTNERSHIP WAS NEW AND DIFFERENT FOR PRINCIPAL PARTICIPANTS

For many operational tests, issues relating to partnerships emerged in the early stages. Large bureaucracies and small entrepreneurial firms were now working together for the first time. For the partnership to work, participants had to learn to overcome sector biases towards each other, to understand each other's responsibilities, and establish a cooperative relationship. Working in a partnership was an adjustment for participants at FAST-TRAC, SaFIRES, Guidestar, TravelAid, and SmarTraveler.

One major **cause** of this issue was the newness of a public-private partnership. Implementing a new ITS system using the latest technologies brought together as partners several governmental agencies and private fnms who had previously only worked together in a customer-vendor role. All partners had to adjust to a new business style and working environment. The newness of the partnership also made public partners aware that private partners were entitled to provide input in the decision-making process. Likewise, private partners had to learn about local, state, and federal procedures and contracting requirements. Another major cause for this issue was *difference.* The public and private sectors have a different business culture and biases towards each other. Some public sector participants noted that private partners are not totally aware of the political realities faced by public agencies and only focus on business issues. In response, some private sector participants characterized public agencies as being unreceptive to innovation and making decisions too slowly because of bureaucratic review processes. There were also conflicts between public sector concerns of protecting the public interest and private sector concerns of proprietary interests and intellectual property rights.

The **effect** has been a *long learning* curve for participants to learn about each other's procedures and contracting requirements, which led to a clearer understanding of each other's culture. The result was *delays* in initiating and implementing projects, and *strained relationships* among partners. At two operational tests, several partners even left the project. A lack of understanding between the public and private sectors early in one operational test also created a *negative working environment,* in which there was no cooperation or flexibility between the principal partners, This issue also caused *uncertainty* over funding sources, the private sector share of the project costs, and reimbursement procedures.

In time, most participants did eventually **resolve** the issue by *building trust* between the two sectors and working out *mutually acceptable workplans.* Partnerships were established, local funding was approved, and funding matches were made. Although it took some time, project participants adjusted to the new role of the private sector as partner instead of contractor. At one operational test, a participant cautioned that the issue had not been completely resolved. State contract law may allow a "letter of no prejudice" and permit a contractor to accumulate billable hours prior to the execution of the contract. This option is not available to the public sector. Public sector partners may be expected to work on ITS projects before the cooperative agreement is signed and not be reimbursed for this work. This could result in public partners initially giving ITS project work a lower priority and limiting staff hours on the project. One resolution would be to grant *the same reimbursable allowance* given to the private sector to the public sector.

ISSUE 2: THE ROLES AND RESPONSIBILITIES OF THE PARTNERS WERE NOT CLEARLY DEFINED

For most ITS projects, there are several federal, state, and local agencies and private sector partners. The issue identified by participants from all sectors at FAST-TRAC, SaFIRFS, Houston Smart Commuter, Guidestar, and TravelAid was confusion over the roles and responsibilities of the partners in the early project phase.

There were two major **causes** to this issue. First, the ITS program was *new* and there was no precedent for this type of public-private partnership. This led to *confusion* among and within partnering organizations over the roles and responsibilities of the large number of participants and their diverse perspectives. For example, in one state DOT, the Traffic Office was responsible for the state's ITS program, but was not an implementing agency. A regional office had to implement the components of the operational test. In another operational test, two partners executed separate contracts with a third organization to perform similar work. For several operational tests, the lack of a full-time project manager exacerbated the problem, creating confusion for the participants over who was managing the project.

Second, private sector partners were also sensitive about their *roles* and had different opinions over which partners should have the leadership and which the supportive role. Participants at Guidestar and FAST-TRAC have used memoranda of understanding (MOU) between private and public sector partners as a solution to defining the roles and responsibilities. However, some participants have had difficulty in trying to reconcile the requirements of multiple parties with different objectives and expectations. Others participants have not understood why partnering is required and some were unable to differentiate between a partner and participating vendor.

The overall **effects** were *delays in project schedules* because of turf battles, *duplication of work, additional staff resources* to resolve MOU disagreements, *increasedprogram costs,* and *delayed implementation.* There was a positive impact to the project delay; project partners had time to *learn about each other* and projects were able to move forward.

This issue has been **resolved** for some operational tests by *improving the administrative processes.* At one operational test, partners hired a technical manager (TM) to address project management concerns. However, several test participants were not convinced that the TM would resolve the issue, nor were they convinced that the many involved organizations would be willing to maintain their assigned project role. At another test, the partners formed a steering committee to improve communication between participants and keep the project on track. Neither sector saw this issue significantly affecting test deployment. In other operational tests, even though participants identified difficulties executing MOUs, disagreements over language and implications have resulted in some MOUs not being signed. Participants at one test offered several solutions: ranging from *training* in the role and purpose of partnerships, *and forming partnerships* with contractors who can produce and accelerate public service, *to forming partnerships* around mutual needs, such as the private partner need for information and the public partner need for technology.

ISSUE 3: SOME PARTICIPANTS WERE COMPETITORS TO OTHER PARTICIPANTS

Competition between private sector partners and its impact on the partnership was a concern of both public and private sector participants at SaFIRES and Guidestar. This issue surfaced several times during the early stages of the partnership and again, more recently.

At one operational test, **this** issue was **caused** by two private sector partners being *competitors.* Partners differed over who should be responsible for product development and were unwilling to share information. In another operational test, a private partner had similar concerns over sharing information with other private partners who may be competitors, and revised a draft agreement that would have prohibited sharing information. This would have made it impossible for partners to access information without fear of litigation. More recently, the issue of competition arose again after project partners hired a TM who was a direct competitor of one of the partners. This occurred because participants in the selection process overlooked the possibility that the TM may be a competitor to a partner, and did not include the input of all partners in the decision making, despite the fact that the TM would have access to the technical information of other partners.

The **result** was *project delays,* which led to increased costs and confusion among the partners over the project *status.* There were *also* concerns over *the* amount *ofproprietary information* to exchange, which created a need for non-disclosure agreements, especially when software had to be shared by several partners.

The issue was **resolved** at one operational test, when *two partners left the project.* They were replaced by new participants who were not competitors. The issue was also resolved at the second test when one *partner did not contest* the decision to hire a TM that was a competing firm. Non-disclosure agreements, however, had to be executed to resolve the issue.

ISSUE 4: PROJECTS WITH MULTIPLE PARTNERS ARE DIFFICULT TO MANAGE

Both public and private participants at Guidestar, Houston Smart Commuter, and SaFIRES addressed the issue of multiple partners. When several agencies share responsibilities for funding, project support, and evaluation, the task of managing the project becomes difficult, slowing down progress and creating conflicts among the management of the various participants. The principal **cause** of this issue is *the project organization structure* that includes all partners and is often unwieldy. Second, for some operational test participants, there were concerns over a loss in *accountability* from all partners because one agency was not in charge of assigning responsibilities to other partners.

Third, the same participants also mentioned difficulties in controlling their funds and how their funds were spent. In a project with an APTS component, one agency felt the lead agency would make inappropriate decisions because transit was not the lead agency's area of expertise. At another operational test, the FTA and FHWA were providing funds and the regulations of both agencies had to be met. This funding arrangement also meant that *multiple agreements* had to be executed by the federal agencies and the other project partners. Fourth, *overlapping jurisdiction* between agencies caused difficulties in decision making. Some participants felt that too many agencies, and too many individuals within each agency, had become unnecessarily involved. Fifth, participants at another operational test mentioned difficulties in establishing and maintaining *communication* among many partners. These include judging how dependable the information or commitments supplied by a new partner were, when an existing partner had no prior experience with the new partner.

The **effect** on all operational tests has been *lengthier project review* and *approval cycles,* which in *turn,* have *delayed the implementation.* At one operational test, there was *also friction* between participants at two agencies over a perceived loss in control over one partner's contribution of funds, which ultimately resulted in project delays.

Better definition of the project and more *clearly defined roles and responsibilities* have **resolved** this issue for most operational tests. Participants at one operational test pointed out that even though the hiring of a lead project manager reduced the involvement of some individuals, too many parties are still involved in the planning stage of the project. They also agreed that multiple-agency involvement will delay the full deployment of the ITS service, but were optimistic that this can be overcome, based on the cooperative history of the agencies.

Comparison with Analysis **and** *Lessons Learned Report*

Both reports discussed similar issues occurring in the early stages of developing new business relationships.

NEW BUSINESS RELATIONSHIPS ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Newness of the partnership	✓	✓
Ill-defined roles and responsibilities	✓	✓
Partnerships with multiple partners	✓	✓
Insufficient criteria on partner selection	✓	✓
Competition between partners	✓	

One similarity *was the newness of the partnership* and the *difference* in the ways the partners did business. Governmental agencies and private firms who had previously worked together in a customer-vendor role were now working together as partners. Partners had to adjust to a new business style and working environment. Partners also had to recognize there were differences in how the public, private, and academic sectors conducted business. These cultural differences are described in more detail in section 3.1.2. Second, both reports identified *unclear and changing definition of partners' goals, roles and responsibilities* as an issue. The newness of the ITS program and sensitivity towards which partners should take the lead role and which the supporting role, were both factors during the early project phase. The *Analysis and Lessons Learned* report also pointed out that changes in a project's objectives negatively impacted the project. Third, each report cited *difficulties in managingpartnerships with multiple partners.* Funding from multiple sources, the volume of administrative paperwork, and the lack of a full-time project manager create hardships for the partnership. Fourth, there *also was insufficient criteria for selecting partners* Problems exist when there is an insufficient number of partners or when one partner has too many agencies to represent. The solution is to either include new partners or to modify the partners' organizational structure. Partners are selected using either competitive bids or the sole source process. Section 3.2.4 describes sole-source contracting and the difficulties in selecting partners. Guidelines were needed for selecting partners using the competitive bidding process

Competition between private sector partners and its impact early in the partnership was an issue in the *Findings and Recommendations* report. Some private sector partners were unwilling to share information with other private sector partners who were possible competitors.

3.1.2 Inter-Agency Coordination

Participants from all six tests identified issues relating to improving the coordination among different partners. This was an overwhelming concern for most project participants. One participant at Guidestar offered an observation on inter-agency coordination issues; *issues may never be fully resolved because agencies may continue to have Conflicting philosophies and priorities.* The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

INTER-AGENCY COORDINATION ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Poor communication among organizations	✓	✓	✓	✓	✓	✓
Lack of operating agency support		✓		✓	✓	
Organizational culture of academic sector		✓				✓

ISSUE 1: POOR COMMUNICATION AMONG ORGANIZATIONS CAN AFFECT PROGRESS

ITS is a program that includes all sectors of government and the private sector and requires strong inter- and intra-agency coordination. Failure to communicate can affect the progress of the program. Participants at all six operational tests cited lack of communication as an issue, especially during the early phases of the project.

Operational test participants identified several **causes** for the communication problems among the project participants. First, at the start of most operational tests, a *mechanism to foster communication was not in place.* Second, prior to the operational test, the *distinct agendas and separate functions* of the different transportation agencies precluded the need for coordination among these agencies. Third, at one operational test, *the physical distance* between participants, the *tiered contract structure,* and *other project demands* meant that it was difficult for the state agency to communicate with the consultants and track the progress of the contract. Fourth, one participant stated that difficulties in communication were caused by *human nature.* This participant noticed that people leave meetings hearing what they wanted to hear. Finally, at one operational test, participants felt *the lack of a multi-modal and cross-jurisdictional state ITS office* hindered the communications of the various state level transportation agencies.

The **effect** of this issue on the project was seen in several ways. *Friction* developed among participants. There were also *project delays* because agencies were duplicating each other's efforts. At one operational test, the exclusion of some participants from the decision-making loop resulted in project delays. This, in turn, created additional *pressure* on the participants to submit incomplete or incorrect documentation to speed up their review. Lack of communication also prevented individuals within the different partner organizations from being fully *aware of* *what others were doing.* In one case, a state DOT was developing an ITS plan that did not include the ITS of a county within that state. In another example, two state agencies submitted competing proposals for ITS funding. At a third operational test, poor communication led to some partners attending an important meeting inadequately prepared to make the expected presentations.

Over time, the issue has been mostly **resolved** at the operational tests. Different strategies were used. At most operational tests, a mechanism to foster communication was established. This mechanism is usually a *multi-tiered committee structure.* Also, a *lead agency orproject manager* was usually assigned and this agency or manager was responsible for coordinating communications.

At one operational test, private sector participants *met individually* with representatives of several state transportation agencies. This action gained the cooperation of the agency officials and promoted good working relationships. The only drawback was that information cannot be directly shared among the agencies, and the functional and financial resources of the other agencies are not discussed. At another operational test, representatives of the public agencies *became more knowledgeable* of each other's plans and were instrumental in developing plans to link the state transportation center with the project's operations center run by the county agency. Communication has improved to the extent that the program is now expanding to other local communities earlier than planned.

ISSUE 2: OBTAINING THE SUPPORT OF OPERATING AGENCIES WAS DIFFICULT

Guidestar, SaFIRES, and SmarTraveler participants identified difficulties in obtaining state and local operating agency support for the operational tests and ITS. This issue is significant because of the important role of local and regional governments in increasing road capacity and implementing ITS and other products and services.

There were several **causes** to this issue. Operating agencies design, build, maintain, and operate transportation systems. It was extremely difficult for many agencies to incorporate ITS technologies into daily operations for several reasons. The agency *in&structure* set up to handle traditional operations was inadequate for the short life cycle of ITS technologies. Participants are used to procedures and processes *with* a slower turnover and to *management styles* that are very different from private *firms. The differing goals and objectives* of a large state transportation agency and smaller transit agencies also impacted transit agency support of ITS for one operational test. Participants felt that transit agencies focused on increased ridership and daily operations whereas state agencies were more interested in how well the technology worked and investing in new equipment. This resulted in friction between the state DOT and two transit agencies, with several local participants feeling a *lack of appreciation* for the operational constraints encountered by a transit agency. Operating agencies work within a short-term time frame, whereas ITS project designers view projects from a long-term perspective.

Resistance to change as well as the fear of *engaging in riskyprojects was* also very significant for some participants. Operating agencies involved in one operational test had standard procedures for distributing information, which had to be changed when they joined the operational test, and started providing information to a private firm. There were misconceptions that participation in the operational test would negatively affect agency staff positions and staff questioned why an outside firm should provide information normally distributed by the agency.

Another reason for limited agency support was the *lack of a sponsor* with multi-modal and cross-jurisdictional authority. In one state, several transportation agencies have always had distinct agendas and separate functions, resulting in little inter-agency communication. Agencies had the misconception that the ITS operational test belonged to one agency (the original supporter) and felt there was too much emphasis on highways. The sheer *number* of state and local agencies and their various agendas had an impact on the implementation of the operational test, making it difficult for the private sector to interact consistently with the public sector. *Lack of ownership* was also a factor in the limited public sector interest. Local government officials thought of ITS as a highway program and not as a local program benefiting them. Lack of *local expertise* and *funding constraints* and *an inability to envision* how ITS could be applied locally also impacted the public sector's participation in ITS. Law enforcement agencies had their own reasons for not supporting ITS operational tests. These included *turnover* in top management, state *budget cuts, resistance to automation, differing priorities,* and *risk aversion.*

The **effect** has been *difficulties in soliciting operating agencies* for an ITS project and working towards the common program goal of reducing single occupancy vehicles. Transit agencies are primarily operational agencies with few resources for advanced planning and are not risk takers. This means that demand-responsive and out-of-route services needed by transit agencies have not been developed. Even when agencies do work together on ITS projects, relationships become strained as participants work out their differences, resulting in the schedule slipping. Because of this lack of program support, state and federal transportation officials realized that the *ITS' program must go beyond highways* and incorporate local and transit needs. Finally, limited participation by law enforcement agencies has meant there *are* few, if *any, enforcement-related ITS projects.*

The issue was **resolved** in the SmarTraveler operational test by *improved communications* between agency liaisons to the operational test and agency employees. Also, *direct links* were established between the private partner and several state transportation operating agencies. The principal state government partner for one operational test also gained the support of other transportation agencies by ensuring that the test covered as many modes as possible. To actively encourage local governments to participate in ITS, Guidestar officials developed *new ITS projects* that focus less on infrastructure and more on in-vehicle equipment. State officials are also actively encouraging *the involvement of developmental and operating organizations.* However, there are still concerns about the overall success of the ITS program if local governments and operating agencies are not widely involved. Funds may be endangered if local projects cannot be developed and completed. This issue has yet to be resolved but state officials will continue their commitment to involve transit agencies in ITS activities, as demonstrated by its sponsorship of a transit-related operational test. State officials are also continuing to work with law enforcement agencies to encourage participation in ITS.

ISSUE 3: THE ORGANIZATIONAL CULTURE OF THE ACADEMIC SECTOR DIFFERS FROM THE PUBLIC AND PRIVATE SECTOR CULTURES

At several operational tests, academic partners worked with public sector agencies. A bureaucratic organization has very different needs and priorities from a research-oriented organization. Project participants at TravelAid and Guidestar saw significant differences in the organizational cultures of both of these sectors.
One cause of this issue was *the differing goals andpriorities* between the academic sector and project implementors from the public and private sector. Some interviewees stated that academic faculty effectiveness is evaluated according to the number of grants received, the number of students supervised, and the number of papers written. To public sector participants, these are not correct measures of effectiveness for performing a task within an operational test. Another cause was the tendency of the academic sector *to focus on the research* itself rather than the application of the research findings. Taking technology as an example, researchers develop technology only to the point where it works technically, not to the point where it can be implemented. Participants felt that very few academic products have ever been applied. In contrast, project implementors deploy technology and do not want to sacrifice deployment for more research.

The potential **effect** of this issue has been a perceived *lack of cooperation* between the academic sector and project implementors. Operations personnel may view research work as irrelevant, just as researchers may view operational personnel as uncooperative. This skepticism carries over to funding and some participants have questioned whether resources are being spent effectively.

One way these differences *me* being **resolved** is by *monthly meetings* between project managers from the public sector and principal investigators from the academic sector. At TravelAid, academic participants point to the cooperative transportation research center supported by two universities and the state DOT as being an effective liaison between the academic sector and other organizations.

Comparison With Analysis and Lessons Learned Report

Both reports identified the same issues relating to improving communication among different partners.

INTER-AGENCY COORDINATION ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Poor communication among organizations	✓	✓
Lack of operating agency support	✓	✓
Differing cultures among sectors	✓	✓

One similarity was the *poor communication among the partners* during the early phases of the project. The lack of communication protocols ultimately affected the progress of some operational tests. Second, difficulties in obtaining the *support of operating agencies* was an issue, either through agency resistance to change or differing agency agendas. This issue is significant because operating agencies play an important role in implementing ITS. Third, there were *differences in organizational cultures* between public and private sector partners. The *Findings and Recommendations* report focused on the academic sector, pointing out the different needs and priorities that a research-oriented organization has compared to the bureaucratic public sector or the for-profit private sector. The *Analysis and Lessons Learned* report, in contrast, looked at all sectors and pointed out that organizational differences foster stereotypical thinking that affects the ability of partners to communicate with each other.

3.1.3 Intra-Agency Coordination

Participants from all six tests identified issues relating to improving the coordination among different participants within the same group. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

INTRA-AGENCY COORDINATION ISSUES	***FAST-TRAC***	***Guidestar***	***HSC***	***SaFIRES***	***SmarTraveler***	***TravelAid***
Lack of upper management support	✓	✓	✓			✓
Ill-defined roles in organization	✓	✓		✓	✓	
Federal agency management uncertainty	✓	✓	✓	✓		✓

ISSUE 1: LACK OF UPPER MANAGEMENT SUPPORT WILL AFFECT PROJECT PARTICIPATION

For public and private sector participants at Guidestar, Houston Smart Commuter, FAST-TRAC, and TravelAid a potential lack of upper management support for ITS operational tests is a concern.

This issue was **caused** by several factors. Obtaining upper management approval is *time consuming* Top managers keep *busy schedules,* ITS projects *are low in priority,* the organization is *involved in many areas,* and there is often *a physical separation* between top managers and the ITS project. *Skepticism* of the project's value, *reluctance* to enter a new area, the need to *produce revenues in a short period of time,* and *delays in demonstrating project results are* other reasons impacting the level of management support for ITS. At one operational test, the executive board of a public agency had concerns over *risingproject costs* and what was perceived as *an out-of-Control project.*

The worst **effect** of a reduction in top management support is the withdrawal of the organization from the operational test. Other impacts would be a lowering of the priority given the project and limiting the resource dedicated to it. In all cases, these impacts delay project implementation.

To date, even though this issue has not had a great impact, it has yet to be **resolved.** Although the management of several organizations have considered withdrawing their support, most are still participating in the operational tests. At operational tests where firms did leave, remaining project *participants recruited new firms* for the partnership. One interviewee noted that results must be demonstrated in order to maintain upper management support.

ISSUE 2: ILL-DEFINED ROLES WITHIN AN ORGANIZATION CAN RESULT IN CONFLICTS

At FAST-TRAC, Guidestar, SaFIRES, and SmarTraveler, there were conflicts in partnering organizations over roles and responsibilities within the framework of the operational tests.

A major **cause** to this issue was *duplication of roles* For the past 20 years, an agency within a state DOT had developed expertise in ITS through hands-on experience, and had a sense of ownership in the technology. After the DOT was reorganized, the agency was responsible for daily operations, and a newly created office was responsible for new technologies and services. The lack of a process to administer or set priorities for proposed ITS projects meant that there were potential coordination problems between the two groups. Both groups sent proposals to the FHWA and ended up competing against each other for federal funds. Public sector agency participants also saw conflicts with duplicating R&D activities, despite one agency's operational focus and the other's R&D approach.

In another operational test, an agency within the DOT was initially responsible for the project. After a reorganization, a unit of this agency was transferred to another agency within the DOT. This caused *an overlap in agency roles.* Although the transferred unit was responsible for monitoring the contract requirements and reviewing progress, only the original agency could reimburse the partners and contractors for expenditures.

Interviewees identified another example of conflicting roles. Some university staff members felt that university staff could participate in both the design and evaluation of an operational test. Because the FHWA participants wanted an unbiased evaluation, they recommended that organizations involved in the design should not be involved in the test evaluation. Because the university did not have a central organization that oversaw contracting, the principal investigator for the evaluation contract did not have direct authority over other staff members and their pursuit of design activities.

The **effect** of these role conflicts is seen in several ways. At the operational test where roles were duplicated, some participants feel their contribution to ITS had been *overlooked* because the other agency appeared to have become the focal point of ITS. *Strained relationships* developed between the two agencies, especially when one agency's proposal was accepted by the FHWA and the other's was not. Some participants see another negative fallout from this impact; the FHWA may think the state DOT *does not "have its act together"* and may delay test approval. At another operational test, participants felt the university evaluation contract could have been canceled.

Intra-agency conflict has been **resolved** by *increasing the level of coordination and cooperation* between organizations where roles are duplicated. An example of this cooperation was seen when university staff members agreed not to perform or procure design work activities. Another example was the use of a facilitator by the two agencies working together on a project to set priorities and improve communication. At a third test, anticipated problems between the FHWA and the state agency, because of their new cooperative relationship, never developed.

ISSUE 3: INITIALLY, FEDERAL AGENCIES WERE UNCERTAIN HOW TO MANAGE THE ITS PROGRAM

The newness of the ITS program and its unique partnering has meant that federal agencies have to take totally *new approaches* to managing agency programs because current procedures lack the flexibility for the evolution needed for the ITS program. Participants in both the private and public sectors at FAST-TRAC, Guidestar, Houston Smart Commuter, and SaFIRES identified federal program management difficulties. They noted that the federal agencies were not prepared for a new program and a new form of doing business.

One major **cause** of these management difficulties for several operational test participants in both the public and private sector was the *unclear roles and responsibilities* within the FHWA. Participants noted that because of the size and newness of the project, the FHWA HQ staff retained full *management control.* Division office personnel referred all actions to HQ through the regional office, contrary to normal federal-aid procedures of Division offlice staff working directly with state DOTS. Participants at individual tests also pointed out HQ staff uncertainty over handling *earmarked funds,* difficulties in transitioning to *the new engineering and development partner relationship,* and reluctance in *passing federal funds* directly to a private company for services and other non-tangibles. A second cause was some operational tests involved both the FHWA and the FTA. The FHWA usually worked with the state highway agency while the FTA usually worked with the local or regional transit agencies. When both agencies provide funding to a project, the requirements of both agencies, which sometimes differ, must be followed by the project participants. *The delegation of decision-making authority between these two agencies was usually unclear* at the start of a project.

For many operational test participants, **the effect** is *uncertainty* over which federal agency is responsible for project administration. At one operational test, the Division Office thought FHWA HQ was monitoring the project, while smaller public sector agencies and the private sector were uncertain over who was in charge. For participants at another operational test, the confusion was over who was in charge of a test funded by the FHWA but administered by the FTA. Another effect pointed out by private sector participants was *project delays* because of differing funding procedures that require several rounds of contract reviews among numerous levels of management at different agencies. Finally, the effect of the FTA's limited involvement in ITS projects, because of resource constraints, is *the negative perception* that the agency is non-participatory, unresponsive to the project, and lacks vision.

Confusion over FHWA project management responsibilities has since been **resolved** at several operational tests. FHWA HQ and field office personnel have *learned to work together* and trust each *other*. At one operational test, HQ has overall management responsibility, the Division office is responsible for day-to-day management, and the state DOT contacts HQ when necessary. At another operational test, the FHWA HQ delegated project management to the Region Office, which in turn delegated it to the Division office. In the opinion of one operational test participant, federal agencies have a strong interest in seeing the ITS project implemented, and they have made a great effort to resolve obstacles at the federal level. At two operational tests, issues relating to the FTA's limited project involvement because of budget constraints have yet to be resolved. FTA staff have requested support from the FHWA Division Office for help in resolving this issue.

Comparison With Analysis and Lessons Learned Report

Both reports presented similar issues relating to improving the coordination among different participants within the same organization.

INTRA-AGENCY COORDINATION ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Lack of upper management support	✓	✓
Ill-defined roles in organization	✓	✓
Federal agency management uncertainty	✓	✓
Poor intra-partner communications		✓

One similarity was the impact of *upper management support* on ITS operational tests and the resulting project implementation delays resulting from a potential lack of support. Second, for both reports, *ill-defined organizational roles* resulted in conflicts between divisions within the same agency. Agency roles either were duplicated, overlapped, or conflicted with another agency. Third, federal agencies had to take new approaches to managing agency programs because current procedures were not flexible enough to transition to the ITS program. There was *uncertainty over managing the ITS program* because the agencies were unprepared for a new program and a new way of doing business. Fourth, the *Analysis and Lessons Learned* report pointed to a *lack of intra-partner communications.* The greatest communication problems existed in the public sector and especially in CVO projects.

3.1.4 Managerial Processes

With the exception of SmarTraveler, all operational test participants identified issues relating to managing ITS operational tests. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

MANAGERIAL PROCESSES ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
New management structures	✓	✓	✓	✓		✓
Outside parties brought in late		✓	✓			✓

ISSUE 1: ITS PROJECTS REQUIRE NEW MANAGEMENT STRUCTURES

Participants in the FAST-TRAC, Guidestar, Houston Smart Commuter, SaFIRES, and TravelAid operational tests are working within new organizational structures that are very different to the way business had previously been carried out. The traditional customer-vendor relationship has been replaced by an engineering and development partnership, in which operational test managers must deal with private sector partners as equals, not as contractors. To make these organizational structures work, participants must forge new relationships, using pro-active management styles and flexibility, and move away from procedures that are not suited to the deployment of ITS products and systems.

The main **cause** of this issue for public and private sector participants early in the project development at several operational tests was *disorganized project planning and coordination.* The newness of the ITS project meant there were no previously established administrative processes in place. At one operational test, the execution of the cooperative agreements between the FHWA and a state agency, and between the state agency and the private sector took much longer than expected. The state agency started work on the project regardless. Because contractors could not commit resources without a contract, the agency worked on preliminary tasks with minimal support and coordination from the private sector. Decisions were either delayed until contracts were signed, or changed after contractors joined the project.

At another test, the FHWA was concerned over what it perceived as *an insufficiently defined cooperative agreement* between a state and a local agency, both of whom were making decisions. It appeared that neither of these agencies was willing to relinquish any responsibilities to streamline project management. At yet another operational test, after an additional funding partner joined the project, there was confusion over the previously approved plans. Project participants had to address a new set of comments and requirements.

A *unique management structure* at several operational tests created difficulties for operational test participants. In the first instance, the FTA and the FHWA were both involved in the projects and there were no previously established processes that governed projects funded by the FHWA and administered by the FTA. The use of highway rules and procedures in a transit project was a new experience. The situation intensified with public sector distrust of the private sector, the private sector's perceived focus on competition and profit, and the need to pass federal funds to the partners. In the second instance, a local agency was managing a federal-aid project. Under normal circumstances, projects funded by the FHWA are administered by the state DOT or highway agency. The agency was burdened with an increased workload and placed in an uncomfortable situation when dealing with other partners; they were a partner as well as a contract "supervisor."

Other factors impacting project planning identified by operational test participants were *too many specialists* involved in the project and not enough generalists, *the time consuming* nature of program management, *the conflicting* goals, priorities, and timetables of the different participants, private sector *inexperience* in dealing with the public sector, and the public *sector's limited knowledge of the* technology.

At several operational tests, the **effect** of these management issues had been *confusion and project delays,* both in executing contracts and completing procurements, and in establishing trust between the partners. At one operational test, delays caused one of the private sector partners to withdraw from the project. At a second project, participants stated that confusion over project management contributed to the slow rate with which the FHWA HQ approved funding for the project. Other participants felt that management structures required more staff time and paperwork than originally expected to manage the project. A positive effect was seen at FAST-TRAC, where a local agency was managing a federal-aid project. Interviewees felt that the project moved along *faster* because some reviews and prior approvals by state and federal government were eliminated.

The issue of inadequate administrative procedures has been **resolved,** to some degree. At one operational test, the *hiring of a project manager, drafting of a project management structure,* and *signing of an inter-agency agreement* has resolved the initial confusion over project management. However, state and federal participants have pointed out that nationally, other ITS projects will require similar agreements, and that a lack of a cohesive management structure could effect the decision-making process tied to the deployment of ITS products and services. A participant at the same test asserted that new standard procedures need to be developed before the issue can be resolved. At another operational test, several participants expressed concerns over the issue's impact on full deployment. One concern was that the issue is a "potential show stopper," another was that existing procedures would limit the ability of partners to work together easily. Participants at a separate operational test also pointed out that project management issues would continue as new participants joined the project.

ISSUE 2: FAILURE TO INVOLVE OUTSIDE PARTIES IN A TIMELY MANNER WILL DELAY THE PROJECT

Involvement of all partners in a timely manner, especially during the early stages of the project, is an important issue at Guidestar, Houston Smart Commuter, and TravelAid. Good communication is critical to a successful project implementation.

Operational test participants identified several causes for participants joining the project late and delaying project implementation. At one test, *operations personnel* were not included in project planning. The planning staff made several decisions directly impacting fleet operations, but did not consider operational requirements in the concept design. This resulted in a plan that was not operationally practical. Operations personnel were only consulted after plans were developed and objected to specific actions. Participants from the same test identified similar problems during partnership negotiations. State DOT technical staff were concerned that outside agencies might slow down negotiations during the early stages did not include *legal and contract personnel* in partnership negotiations. At another operational test, the most important issue of the entire test for all participants, was the *delay in signing an inter-agency agreement* between the two major implementing public agencies. The agreement was critical because it will allow a local agency to use federal and state transportation funds for the project. Delays were caused by differing funding requirements of two federal agencies and the need for the legal staffs to resolve these differences. An MOU, outlining the roles and responsibilities of all partners, was drafted to resolve the delay, but state legal staff did not believe it satisfied the requirements of the inter-agency agreement.

The late or delayed entry of personnel had several **effects** on the operational tests. At one test, the *project scope* and *cost increased* after operations personnel modified the project requirements. This resulted *in project delays.* At another operational test, the continued delay in completing an inter-agency agreement meant that only limited funds were available and only preliminary work could take place. The request for proposal (RFP) could not be issued and the project could not be deployed for testing.

A state agency partially **resolved** the issue of involving partners in the early stages of one operational test by recognizing that innovative methods were required to develop public-private relationships and by obtaining outside support. Legal and contract personnel now participate early in the negotiation process, and a multi-disciplinary team, made up of members from the transportation, administration, and legal offices, works out issues relating to the ITS program. However, the issue of involving operational staff in the early planning stages has yet to be resolved. At another test, delays in signing an inter-agency agreement are being addressed by having the technical and legal staffs work together. Operational test participants were optimistic that the inter-agency agreement would be signed soon and most agreed the effects were minimal.

Comparison Wth Analysis and Lessons Learned Report

Both reports presented similar management issues for ITS operational tests.

MANAGERIAL PROCESSES ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
New management structures	✓	✓
Outside parties brought in late	✓	✓
Lack of a full-time project manager	✓	✓
Aggressive project schedule		✓
Policy committee size		✓

One similarity was *the* need for *new management structures* to reflect the new engineering and development partnerships, in which the public sector works with private sector partners as equals, not as contractors. Disorganized project planning and a lack of partner leadership were major factors. Second, a successful project implementation depends on the timely involvement of all appropriate parties. Each report pointed out that *failure to bring in outside parties early in the project* will delay project implementation. The *Analysis and Lessons Learned* report also identified *the lack of a full-time project manager* as a major problem during the implementation and test phase. When a project manager was not on-site, the quality of the effort was undermined. Even though *the Findings and Recommendations* report did not specifically mention the lack of a full-time manager as an issue, it was, nevertheless, cited as the cause of several issues.

The Analysis and Lessons Learned report saw *an aggressive project schedule* impacting the early operational testing phase because there was insufficient time and resources for a shakedown of the equipment. *Policy committee* size was another issue in the same report. At one operational test, the large number of committee members created difficulties in setting the overall project direction and slowed down issue resolution.

3.2 PROCEDURAL AND REGULATORY ISSUES

There are four categories of issues relating to operational test procedures and regulations: contracting, evaluation, intellectual property rights, and non-competitive selections.

3.2.1 Contracting

Participants from all six tests identified several issues occurring in the early stages of contract development. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

CONTRACTING ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Current procedures unsuitable	✓	✓	✓	✓	✓	✓
Partner unfamiliarity with procedures	✓	✓			✓	
Inability to disclose data	✓	✓			✓	✓
Partner as a vendor	✓				✓	

ISSUE 1: CURRENT CONTRACTING PROCEDURES ARE NOT SUITED TO ITS PROJECTS

The same contracting procedures used to acquire construction and consulting services were also used to recruit partners for development-oriented operational tests. These procedures were cumbersome and time consuming, and did not address such private sector concerns as intellectual property rights, liability, and proprietary data. As a result, it has been difficult for the public sector to react quickly to new ways of doing business and to recruit contributing partners. Several operational test participants went as far to say that the contracting process was a "nightmare" and needed to be reinvented to accelerate public-private partnerships. Operational test participants at FAST-TRAC, Guidestar, Houston Smart Commuter, SaFIRES, SmarTraveler, and TravelAid all identified this issue.

The most significant **cause** of this issue for participants at several operational tests was the *newness* of the ITS program. Very few project partners knew how to handle unique ways of doing business in a public-private partnership or an inter-agency partnership in which partner roles were still being defined. A private sector participant felt that federal agencies were more familiar with the program than the state agencies. Others felt it was difficult for well-established bureaucracies to handle changes, and state agencies were not geared to operating in a new area. Questions arose over which agencies should be the funding mechanism, the private sector share of the project costs, and private sector reimbursement procedures; questions for which there were few precedents. A second factor at several operational tests *was unsuitability ofgovernment regulations.* Current public sector contracting procedures were developed to hire firms to design and build bridges and roadways and were unsuitable for prototype ITS projects. ITS technology turns over much faster than the roadway infrastructure for which the contracts were originally designed. This meant that construction *performance* requirements were inappropriate for contractors hired to develop, implement, and test ITS technologies. *Auditing* requirements were also inappropriate for some private sector partners. Private partners had to follow the Federal Acquisition Regulation (FAR). Some private sector partners were unfamiliar with the FAR and were reluctant to be audited, not wanting to disclose financial information, including their cost structure, in case rival companies requested the information under the Freedom of Information Act. In effect, the contracting procedures were meant for a vendor relationship, not a partnership.

Third, government contracts often restrict flexibility. Some private sector participants found the *fixed-dollar* contract procedures unacceptable for a development project. They stated it was difficult to estimate the cost of R&D projects and that flexibility was needed. Several public sector participants at another test also felt contracting procedures were inflexible and created difficulties for the private sector partner. They cited the length of time to process invoices and obtain pre-approval for expenses. Fourth, at one operational test, *liability* was a factor. Because some private sector partners believed the public sector partners were assuming none of the liability, these private sector participants believed others would interpret the liability clause to mean that the contractor would be responsible for all misinformation or accidents associated with the ITS technology. Private sector firms needed more liability protection when developing new technologies. Fifth, public sector participants at another test cited the *lack of competition* in selecting private sector firms as another factor. State DOT HQ questioned sole-source contracts and the high overhead rate of a selected partner.

At all operational tests, the **effect** of this issue was a *delay* in contract signing and project implementation as partners took time to learn about the other's procurement methods. At one operational test, the contract hierarchy included the FHWA, a state DOT, a local agency, and a private firm. The contract between the local agency and the private firm could not be signed until two cooperative agreements were signed. It took one year to execute the contract. This delay increased project costs and caused some partners to work without a contract, which damaged the credibility of the ITS staff within a private partner. At another operational test, funding delays resulted in cash-flow problems for the private partner and late payments to vendors, some of whom refused to perform. At several operational tests, another effect was *strained relationships* between both sectors. The private sector resented the decrease in flexibility required in R&D programs and felt they committed more money to the match than initially expected. At one operational test, a private sector partner eventually withdrew from the project.

There were positive effects at several operational tests. At one test, discussions between the private partner and the local agency resulted in *changes* to the intellectual property rights clause in the contract. At another test, *better communications* and *improved working relationships* were also outcomes.

The issue has been **resolved** at several instances. At one operational test, state and federal agencies are *working together* to obtain cost structure information for a private sector participant and have agreed to accept a higher than normal overhead rate. At another test, the prime contractor is *assuming a greater degree of risk* for liability. The state DOT at yet another test is *modifying* the pre-approval requirements and *speeding up* the payroll and invoice processing time. One public sector participant felt that the overall issue can be resolved by bridging the contracting regulations *with innovations* without overstepping an agency's authority. As partners gain more experience in negotiating contracts, the level of flexibility and entrepreneurial opportunities will increase. The contract structure will evolve and probably become less restrictive.

Several public and private sector participants were concerned that these difficulties in structuring contracts between the partners may *hinder the full deployment* of the operational test and result in the deployment of old or dated technology. Participants at one operational test noted that the lack of private sector input into the pre-bid technical design limited the public sector's technical committee in developing innovative approaches. Yet another participant cautioned that *liability concerns* may hinder the full deployment of ITS products and services. At another operational test, public sector participants had concerns over long-term government contractors (defense, aerospace) bidding on ITS projects and using their technical expertise and political clout to raise their original contracted price. The increased project budgets may impact full scale deployment.

ISSUE 2: SEVERAL PARTNERS WERE UNFAMILIAR WITH THE REQUIRED CONTRACTING PROCEDURES

The public and private sectors each have different types of contracting procedures. Because several partners had never worked with other partners before, they were unfamiliar with each other's contracting procedures. This created conflicts between the partners. Several public sector participants felt that the private sector did not understand the time-consuming nature of reimbursement-based projects. This was reflected in private sector accounting systems which were not set up to accommodate federal and state reporting requirements. Participants at FAST-TRAC, Guidestar, and SmarTraveler all had concerns over this issue of unfamiliarity with contracting requirements.

A major **cause** of this issue was public and private sector *inexperience* in dealing with the other partner's contracting regulations. Some private participants were concerned about their inexperience with the FAR and the possibility of accidentally breaking regulations. Others felt that working under the FAR was too complex and costly. Public sector partners also had concerns over the different contracting procedures of other public partners. At one operational test, the state agency had only worked on FTA grant programs and was unfamiliar with FHWA requirements. At another operational test, a local agency had never been the lead agency in federal-aid highway projects and had to learn the detailed federal and state contracting requirements There were also several other causes identified by specific operational tests. At one test, the private sector was unfamiliar *with funding mechanisms* and misunderstood which agency was directly funding the project and the length of the contract approval cycle. They also were considered *a fledgling company* and unprepared to administer a multi-million dollar contract.

For all test participants, the **effect** was a *delay* in signing contracts. At one operational test, the state DOT initially spent more time on administrative matters than on technical project oversight. For example, after the pre-award audit, a state auditor had to train the private sector partners in government accounting procedures and federal standards. At the same test, the private sector partner did not wait for the state DOT contract approval and signed a *subcontracting agreement.* Even though subcontracts could now be negotiated more quickly than by using the normal review procedures, the agreement was not acceptable under the terms of the contract. The subcontracts also had rates higher than allowed under normal procedures. Even though the subcontracts were approved, the private partner did receive a letter of admonition from the state General Counsel. *Friction* developed between partners and state officials developed a *negative attitude* towards the operational test and the private partner.

This issue was **resolved** at two operational tests. State and local agencies quickly learned federal and state contracting requirements and modified their procedures.

ISSUE 3: SOME PRIVATE SECTOR PARTNERS WERE UNABLE OR UNWILLING TO PROVIDE REQUIRED FINANCIAL DATA

Private sector partners were reluctant to provide certain kinds of financial information, such as overhead rates, to local, state, and federal government auditors, because of concerns that the information could become public. Private firms viewed the information as proprietary and felt it could be used by a competitor. They were also concerned that government auditors would have access to the financial records of the entire company, not just the unit working on the ITS project. Some private sector partners were unable to provide auditors with financial data in the required format. This issue was a concern for participants at FAST-TRAC, Guidestar, SmarTraveler, and TravelAid.

A primary **cause** of this issue was federal and state procurement *requirements* requiring contract costs and local matches to be documented and financial records audited. At one operational test, a state law required an audit clause in the contract for an audit of records relating to the contract, yet the audit systems of some partners were not set up for state audits. Second, partners at another test questioned what was considered *proprietary information* and what information should be made public. Third, the same partners had different *interpretations* of the FAR and federal accounting procedures. Fourth, even though a division of one private firm had previously conducted business with the public sector, a division with no prior federal *experience* was selected to participate in the ITS project. Finally, at a third operational test, data format concerns were caused by the private sector's familiarity *with **DOD** contracting requirements,* which differ from state DOT contracting requirements. Contractor accounting rates are structured specifically for DOD contracts, not state contracts.

The project was **effected** by this issue in several ways. The primary impact on all three operational tests was a *delay in executing contracts.* At one test, private sector overhead had to be verified, which required lengthy negotiations and reconciliation by a third party. At another test, the state hired an attorney to examine contracts before they left the department. These delays gave senior managers at one of the private sector firms the impression that the *opportunity cost* of the project had significantly increased. This issue *also strained relations* between the public and private sectors. A side effect to this issue was the private sector *public relations* concern that they would be viewed as a profit-making firm and not as a partner donating funds.

This issue was partly **resolved** at one operational test when participants decided that *a DOD audit agency* would audit the private sector firm. This solution presented its own institutional issues because there were *deZays* in the DOD audit agency sending information to the state DOT and *confusion* over who would pay for the audit. At another operational test, a private partner created a separate *entity* for the project, with its own auditing system. A private partner in a separate operational test is also looking into the option of using an independent third-party audit. Participants at several operational tests were also concerned that this issue may *discourage* potential private partners from participating, which could affect the full-scale deployment of ITS.

ISSUE 4: A PARTNERSHIP IS STRAINED WHEN ONE PARTNER BECOMES A VENDOR TO ANOTHER

According to one operational test participant, "a partner is responsible for contributing resources, planning general progress of projects, and concurring with project elements; a vendor is responsible for implementing a specific task within the project for a fee." Participants at both FAST-TRAC and SmarTraveler identified problems when a partner became a vendor.

This issue was **caused** when the partner administering the project signs a contract with another partner to procure equipment or provide services. This created a *customer-vendor relationship* between the partners.

The **effect** of this issue was *an unclear legal distinction* between a partner who was also a vendor. Public sector partners at one operational test noted that *significant effort and expense* were required to negotiate these new procurement practices and explain the nature of the partnership to other partners. A customer-vendor relationship also caused *confusion* over the roles of the partners. At one operational test, two partners dealt with each other in a customer-vendor relationship on contract issues, but worked as partners on program issues.

Public and private sector partners worked together to **resolve** this issue, but there was a negative effect. Even with granting waivers, *project start up was delayed* at one operational test. Despite the drawback, partners are comfortable with the customer-vendor relationship, yet several participants remain concerned that the issue may cause the relationship with a partner to change. At another operational test, one interviewee did not view the customer-vendor relationship as an issue. This participant regarded public-private relationships as similar to normal vendor contracting relationships. However, the private sector may have *different expectations,* and emphasize being a partner rather than a vendor. This could lead to a *misunderstanding of roles.*

Comparison With Analysis **and** *Lessons Learned Report*

Both reports discussed several major issues occurring during contract development.

CONTRACTING ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Current procedures unsuitable	✓	✓
Inability/unwillingness to provide financial data	✓	✓
Contractor selection process	✓	✓
Partner unfamiliarity with procedures	✓	
Partner as a vendor	✓	
Access to contract materials		✓
Disagreements over scope of work		✓

Three issues were identified by both reports. First, the same contracting procedures used to acquire construction and consulting services were used for development-oriented operational tests. The cumbersome and time consuming nature of these *procedures were unsuitable for ITS projects* and caused project delays. Second, some private sector partners were *unwilling or unable to provide financial data.* Some private firms viewed their information as proprietary and did not trust the public sector to keep the information confidential. Regardless of the level of public sector contracting experience, several private sector partners had difficulties with financial requirements. Government accounting requirements were unclear and different partners had different interpretations of the FAR and federal accounting procedures. Third, at several tests, partners were excluded from *the contractor selection process.* The poor technical performance of the selected contractor left partners feeling they could have selected a more qualified partner if they had been part of the contracting process. At one operational test, excluding some partners resulted in the hiring of a technical manager who competed directly with one of the existing partners.

A separate issue *in the Findings and Recommendations* report was *the unfamiliarity ofpartners with each other's contractingprocedures.* Public and private sector contracting procedures are different; this created conflicts when the two sectors worked together. A second issue was the strain on the partnership when *one partner became a vendor to another.* A customer-vendor relationship is created, resulting in an unclear legal distinction between the partners. The *Analysis and Lessons Learned* report identified additional contract-related issues. One was *access to competition-sensitive materials.* At one operational test, non-federal partners were not allowed to retain SOWS and RFPs; this impeded communication between partners relating to technical issues. A second issue was *disagreements over scope of work* along *with insufficient contractor performance.* Conflicts between the contractor and partnership led to a stop-work order from the partners.

3.2.2 Evaluation

Participants from four tests identified several issues occurring during project evaluation. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

EVALUATION ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Change in evaluation scope	✓				✓	✓
Evaluation difficulties		✓			✓	

ISSUE 1: THE SCOPE OF THE EVALUATION CHANGED DURING THE COURSE OF THE OPERATIONAL TEST

The evaluation plan should be part of the operational test design right from the beginning of the project and an integral part of the rest of the project. This means the evaluation plan and the contract between the project partners and the evaluation team should be in place at the same time, or before implementation. Participants at FAST-TRAC, SmarTraveler, and TravelAid all identified issues relating to how changes in scope impacted the operational test.

Interviewees from both the public and private sector identified several **causes** for this issue. One, *the receipt of federal funds* changed the scope of one operational test from a local to a national project. During initial discussions between the FHWA and other project participants, *the differences* in the major interests of the parties became clear. One very visible difference was over the amount of money to be allocated for the evaluation and whether, as stated by one operational test participant, "the budget rules the evaluation or the evaluation rules the budget." The original project participants focused on funding field deployment activities. After the FHWA joined the project, project participants eventually agreed that evaluation is also a critical component of the operational test and should be funded appropriately. Second, at several operational tests, the evaluation start date was *delayed.* This resulted from delays in signing cooperative agreements between federal, state, and local agencies. Third, at one operational test, a controversy over whether the evaluator should be authorized to conduct the evaluation because of its past role in project definition and its possible future role in project design delayed the evaluation.

A third reason was the *Zate entry* of a major public partner at one operational test. The new partner's focus was safety performance, in contrast to the other partners' focus on technology performance. Fourth, at another operational test, there were differences in *partner focus.* The private sector's focus was market issues, while the public sector's was technology. Fifth, the public and private sector had *different evaluation objectives.* Private sector participants used evaluation findings to change and improve the service as quickly as possible, whereas the public sector focus used them to evaluate how the original system operated.

One **effect** of a change in scope at several operational tests was that *differences* in the major interests of the partners and in slow feedback in communications resulted in *strained relationships.* Some partners had to take on additional work to meet the expanded evaluation plan. The delayed start to the evaluation also resulted in a lack of "before" evaluation data. The research plan also had to be modified. The late entry of a partner resulted in *difficulties* in coordinating the project since new staff had to be included. At another operational test, the *project evaluator* was selected after the test began and was unable to collect "before" data and develop a good baseline, This may limit the extent of the evaluation. Some public officials were skeptical of the evaluation but as the evaluation got underway, this decreased. At another operational test, the differences in evaluation objectives between the two sectors resulted in the private sector *making changes* to the ITS service during the operational test, before the original test design evaluation was completed.

This issue has been **resolved** at several operational tests by developing an evaluation plan that is *acceptable* to all project participants. Participants warned that the lack of good evaluation data may make justifying additional expenditures for ITS difficult.

ISSUE 2: OPERATIONAL TESTS ARE DIFFICULT TO EVALUATE

During the evaluation of an operational test, data is collected to understand what works so that the test can be improved. Private and public sector participants at SmarTraveler and Guidestar both identified difficulties in evaluation procedures, especially for those tests with user acceptance and marketing components.

There were several **causes** for these evaluation difficulties. Operational test participants felt the *newness of* the ITS program was a factor as was the *lack of apre-existing model* on which to base the evaluation. Participants also said the *lack of adequate tools* may also hinder the evaluation. An another operational test, participants felt *benefits were hard to quantify* and it was difficult to isolate shifts in transit caused by the operational test from shifts caused by other factors. A *difference in opinion* between the FHWA and a state agency over test objectives was another cause.

The **effect** of this issue at one operational test has been that the evaluation *may not show* that using the ITS service results in a change in driver behavior, which in turn, results in reduced congestion. At SmarTraveler, there was no way to determine if the increased number of calls was the result of bad weather or displaying messages on VMS. At the same test, participants also stated there was *no clear definition* as to what can be called a success in a market in which the end user is not paying for the service. At another test, participants believed differences over test objectives might result in a *lack of data* that could impact the evaluation of an ITS technology.

The issue has been **resolved** at one test by *clearly defining benefits* through market research and focus groups. After a market survey showed that information was less useful at home than at work, the project focus shifted to downtown distribution of data.

Comparison with Analysis and Lessons Learned Report

The reports identified three issues relating to evaluating operational tests.

EVALUATION ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Change in evaluation scope	✓	✓
Evaluation difficulties	✓	✓
Late evaluation design		✓

One similarity was *the scope of the evaluation changed during the course of the operational test,* leading to program delays and increased costs. Changes in federal funding, the evaluation start date, partner focus, and evaluation objectives all had an impact on implementing the evaluation plan. Another similarity was *difficulty in evaluating* operational tests. There were no pre-existing models on which to base the evaluation, inadequate tools, diffkulties in quantifying benefits, and inter-agency communication problems. The *Analysis and Lessons Learned* report also pointed out the need to define the term "evaluation" more precisely to allow partners to communicate more effectively. The design of the evaluation after the operational test design was completed was a separate issue for the *Analysis and Lessons Learned* report. *Late design* impeded data collection and analysis.

3.2.3 Intellectual Property Rights

Participants from three tests identified the definition of intellectual property rights as an issue. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

INTELLECTUAL PROPERTY RIGHTS ISSUE	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Ownership and use unclear	✓	✓				✓

ISSUE 1: THE OWNERSHIP AND USE OF INTELLECTUAL PROPERTY WERE NOT CLEARLY DEFINED

Intellectual property refers to the ownership of products and information developed for operational tests. Many operational tests are funded by a mix of public and private sector funds. Contracts are often ambiguous over the ownership and future use of the products and information developed for the operational test. Participants from both sectors at FAST-TRAC, Guidestar, and TravelAid operational tests identified difficulties in determining who owned intellectual property rights for technology developed with public funds.

The principal **cause** of this issue for all test participants was the conflict between private partners wanting to make products and technologies developed for the project *proprietary,* and public partners wanting publicly-funded products to remain in the *public domain.* Even though the public sector usually reserves the right to use a product developed with public funds, the private sector believes if a company invests in a project and provides services, it would not be fair for the public sector partner to profit from a private company's investment and development. A lack of *guidelines* on mixing public and private sector funds when developing ITS technologies was another factor at one operational test. A participant from the private sector predicted a future scenario of the private sector competing against the public sector on a future project in which the public sector was offering technology developed by the private sector during the operational test.

At one operational test, the **effect** of *disputes* over ITS technology ownership threatened to paralyze the entire project. At another operational test, the issue *delayed* signing of the consultant agreements.

The issue was **resolved** by changing the contract language to *specify property rights* in detail. At one operational test, the contract stated that the private sector owns the rights and can sell them. At another test, the agreement was that intellectual property developed by the private sector with public funds would be used by federal agencies for federal applications only. To alleviate this issue in the future, one public sector participant suggested that private partners first patent or copyright pre-existing inventions, and second, separate from other tasks those project tasks from which products could be copyrighted or patented. One partner would fund these tasks and would own the invention. Public sector participants at the same test saw this issue affecting deployment. Private sector partners may not want to participate in future projects and develop systems if there is no *protection* from public sector competition.

Comparison With Analysis and Lessons Learned Report

Both reports identified the assignment of intellectual property rights as an issue.

INTELLECTUAL PROPERTY RIGHTS ISSUE	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Ownership and use unclear	✓	✓

There were contract ambiguities in determining *who owned intellectual property rights* for products and information developed with a mix of public and private sector funds. Public partners wanted publicly-funded products to remain in the public domain; private sector partners wanted to make products and technologies developed for the project proprietary; and academic sector partners wanted to ensure they could publish or copyright their products. The lack of guidelines on mixing public and private sector funds when developing ITS technologies also contributed to this issue.

3.2.4 Non-Competitive Selections

Participants from four tests identified the signing of sole-source contracts with private sector partners as an issue. The causes of the issue, the effects of the issue on the operational test, and the resolution of the issue are discussed.

NON-COMPETITIVE SELECTIONS ISSUE	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Project and partner selection questioned	✓	✓			✓	✓

ISSUE 1: THE SELECTION OF PROJECTS AND PARTNERS OUTSIDE OF THE COMPETITIVE PROCESS WAS QUESTIONED

The competitive bidding process was designed to avoid favoritism toward individuals or companies. Even though some public sector agencies prefer using competitive bids when initiating contracts, the nature of the public-private partnerships of the ITS projects has resulted in public sector agencies signing sole-source contracts with private sector partners. Sole-source contracts make it easier to develop partnerships, share costs among the two sectors, and obtain the services of well qualified companies. This way of negotiating contracts was not without its problems, and the frequent use of sole-source contracting at the federal, state, and local level concerned some public sector participants, who felt partners were not selected competitively. This was an issue for interviewees at FAST-TRAC, Guidestar, SmarTraveler, and TravelAid early in the project.

One **cause** of this issue for all participants was the *newness* of public-private partnerships and operational tests with their unique management styles and organizational structures and the lack *ofparameters* for developing these partnerships. At one operational test, public sector participants at the state level was unsure whether or not the sole-source procurement was in *conflict* with the Brooks Act, which establishes guidelines for procuring engineering services. Another cause at one operational test was *ethical concerns* over forming partnerships. Participants felt that sole-source contracts did not treat all vendors equally since other private companies were not given an equal opportunity to participate in projects. In one operational test, the state law requiring an open and competitive bidding process was in direct conflict with the concept of public-private partnership. A third cause was *the Congressional earmarking* of funds for several operational tests. This action superseded normal federal-aid procedures.

There were several **effects** to this issue. First, *conflicts* have resulted from federal agency openness towards sole-source contracts and state and local agency leanings towards an open and competitive bidding process that avoids favoring either individuals or companies. State contracting personnel have challenged the sole-source selection process, saying other private firms could perform the tasks less expensively. Second, sole-source contracts are seen as *lacking cost controls* or *operating inefficiently* Several operational test participants felt they might be taken advantage of by sole-source contractors. Third, sole-sourced contractors had to take *time* to build strong working relationships with the public sector. Fourth, sole-source contracts may result in *lost opportunities* to the awarding party. Fifth, at one operational test, the ***release of federal funds was delayed*** following a long FHWA review. Sixth, other potential vendors of ITS services might ***sue*** public agencies over the lost opportunity to bid. Several participants also identified several positive effects from sole-source contract awards. It is easier for the contractor to *developpartnerships,* have *input* into project planning, and *share costs.* At one operational test receiving earmarked Congressional funding, participants felt congressional interest and cooperation had helped make the project successful.

At several operational tests, the issue has been **resolved.** At one test, some participants felt congressional funds made the recipient more committed to making the ITS project successful. At another operational test, where state law requires a competitive bidding process, the issue is on-going. In the short term, the state DOT has written sole-source agreements but recognizes in the long term, partner selection criteria need to be established. At one test, a private sector participant pointed out that, although public procurement policy has been identified as an institutional impediment for some time, there have been no *improvements* in this area. A public sector participant countered by saying that the FHWA ***was flexible*** over deviations from standard operating procedures, i.e., sole-source contracts.

Comparison With Analysis and Lessons Learned Report

Only the *Findings and Recommendations* report identified issues relating to non-competitive selection. There were concerns over a lack of parameters for developing partnerships, equal treatment for vendors, and funding that superseded normal federal-aid procedures. Guidelines were needed for selecting both partners as well as participants. As discussed in section 3.1.1, the *Analysis and Lessons Learned* report also addressed the lack of criteria in the selection of partners.

3.3 HUMAN RESOURCES ISSUES

Participants from five tests identified two issues relating to expertise and staff workload. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

HUMAN RESOURCES ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Participants skills for ITS projects lacking	✓	✓		✓		✓
Affect of ITS projects on partners' workload	✓	✓	✓			✓

ISSUE 1: PROJECT PARTICIPANTS DID NOT POSSESS THE SKILLS REQUIRED FOR ITS PROJECTS

For most publicly funded projects, staffing responsibilities are broken down into distinct areas of responsibility. Federal and state agencies focus on program development, and local agencies on day-to-day systems operations. ITS projects, with their innovative public-private partnerships and technical innovations, **were** a challenge for many public sector partners, many of whom had little experience in systems development and the latest technologies. This issue was identified by public sector participants at FAST-TRAC, Guidestar, SaFIRES, and TravelAid.

Several public sector partners saw the *newness of the ITS program* as one **cause** of this issue. The ITS program requires new technical and administrative skills, which many federal, state, and local staff did not have. At one operational test based in a rural area., project personnel worked with local contractors and a small local phone company, neither of whom were familiar with the latest technological developments. This was also evident at the state level, where the DOT had more expertise in traditional civil engineering than in communications and computer science. At another operational test, the ITS partnership agreement required contract negotiations, with which state DOT operations personnel were unfamiliar. Another cause pointed out by some public sector participants is *reluctance* to adopt state-of-the-art solutions recommended by the private sector. They suggest some operational staff feel ITS is taking work away from them. Public sector participants also pointed to *limited funding* resources at the local level as another reason for limited project support.

One **effect** of a lack of technical and administrative expertise throughout the various public sector agencies was *project delays.* Most of the FHWA technical experts are based at headquarters, with some in the regional office. State and local agencies had to contact ITS "experts" at either headquarters or in the regional offices; this added time to the review process. At another operational test, a public sector participant felt that the inability to locate or develop a work force with both transit and computer skills may severely delay project operations. At one operational test, the lack of expertise led the project participants to underestimate the complexity of the communications requirements. A participant at another test went one step further and stated that project operations could be severely hindered because the workforce does not have the necessary transit skills and computer skills. At another operational test, delays in purchasing and installing communications equipment caused delays in the collection of "'before" data, which in turn will directly impact the evaluation. Second, at one operational test, the local agency had to set aside *significantfunding* and *train* the staff in ITS technologies. Additional staff also had to be cross-trained, to minimize the risk to the project in case key technical personnel left the agency. There was a positive side effect to the training. Staff became *challenged* and *motivated* and are invested in the system. One participant noted that "involved employees become motivated and are a key to the success of the system."

The issue was resolved at several operational tests by bringing in *additional technical and administrative expertise* from the private sector and *trainingpublic sector staff* At one operational test where operations personnel were unfamiliar with negotiations, a senior contract administrator was been assigned to handle contracts and the program is back on track. At another operational test, the issue has been resolved *by pre-qualifying* contractors.
A public sector participant from this test was concerned that technical resources, qualified contractors, and designers were not readily available in rural areas for implementing ITS projects and said this could have a negative impact on **the future deployment** of ITS projects in rural areas. Another public sector participant stated a worst case scenario of project delays to the point where funding is lost. A private sector participant wondered if communications expertise would exist at state DOTS in the future and if state DOTS would be able to maintain and operate the ITS once it is deployed.

ISSUE 2: ITS PROJECTS AFFECT THE WORKLOAD OF THE STAFFS OF THE PARTNERS

Public sector participation in the ITS program has increased the day-to-day staff workload at the local, state, and federal level. At many operational tests, staff took on new responsibilities without any change in the level of resources and staffing. This affected the project's reporting requirements and data distribution to other partners. Staffing was a concern for public sector participants on the local and state levels at FAST-TRAC, Guidestar, Houston Smart Commuter, and TravelAid.

This issue was **caused** by a variety of factors. At one operational test, the local agency staff were given the additional responsibility for ITS *program administration* without any increase in *staffing levels.* Second, at another operational test, the operational staff resisted *change.* They viewed the ITS project as low priority and an add-on function to be assigned to staff members, rather than as an eventual change in the way the agency did business. Some did not consider ITS as an important part of their work, others did not have time to work on ITS projects. Third, at the same test, state agencies were hindered by freezes in hiring and pay raises. The staff could not grow professionally with the program. Fourth, at two operational *tests, funding uncertainty* reduced the project participants' ability to staff the projects, especially during the initial stages. Fifth, at one test, *staffing turnover* and the time to replace the former staff and get the new staff up to speed, was a factor. Sixth, limited *staff expertise* in certain disciplines, such as marketing, and the exclusion of the private sector from project discussions, also affected the staff workload at one operational test.

The issue of increased workload has had several **effects.** At several operational tests, there has been a *slowing down* of the test. Project deadlines were not being met, no one would act on committee decisions, data was more difficult to access, and activities that could have been done in parallel were handled in series instead. Another effect at several tests has been the inability of agencies to take on new projects without adding new staff or cutting other projects, which in *tum, delays further growth* and increases the stress levels of the project manager and agency staff At one operational test, there have also been *difficulties* in involving staff in ITS and expanding their knowledge of the project. Not all effects were negative. At one operational test, a *lead department* for the ITS project was established and *a project manager* was hired to expedite the project. At another operational test, upper management in the local agency were made more aware of the workload and the need to hire additional staff. They submitted a *federal grant* to fund increased staffing, education, and training. There was a side effect to the agency receiving these additional resources; other agency departments were ***jealous.***

The staffing issue has been **resolved** at two out of three operational tests. At one test, additional staff were *hired,* such as management consultants to complete action items and write grants, project managers to oversee the project, and operational staff for everyday operations. After being given more hiring responsibility by the FHWA, a state DOT also developed a new staffing plan and hired a facilitator to set priorities and improve communications.

At another test, most public sector participants did not believe that this issue will have any effect on the full **deployment** of the ITS project, unless individuals or agency *are unwilling to take charge.* Other participants were less optimistic and voiced several staffing concerns, all of which would impact deployment on the local and national level. One concern was that if results are not soon demonstrated, project administrators may lessen the project's *priority* and reduce *staffing.* Another was that the federal government has been providing ITS funding for capital improvements without any long-term operating or maintenance funding. This lack of funding at the local level will greatly affect national ITS deployment. Finally, at a third operational test, even though staffing changes have been made, several participants felt the issue has not been resolved.

Comparison With Analysis and Lessons Learned Report

Both reports identified issues relating to staff expertise and workload.

HUMAN RESOURCES ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Participant skills for ITS projects lacking	✓	✓
Affect of ITS projects on partners' workload	✓	
Personality conflicts among key players		✓
Inappropriate personnel on project		✓

In both reports the newness of the public-private partnerships and technical innovations was viewed as a challenge for many public sector partners working on ITS projects. Public sector agencies are set up to manage highway construction programs, not ITS operational tests. Consequently, *someprojectparticipants did not possess the necessary technical skills* to work on ITS projects. There was also reluctance within the public sector to acquire new skills and adopt the innovative solutions recommended by the private sector because of the fear that ITS could take work away. The *Analysis and Lessons Learned* report identified a lack of specialty support in three functional areas: system integration, system evaluation, and system installation and maintenance.

The *Findings and Recommendations* report pointed out *the impact of ITS projects on the workload* of the public sector partners. Staff took on new responsibilities without any change in the level of resources and staffing. This affected the project's reporting requirements and data distribution to other partners. *Personality conflicts among key players* was a separate issue in the *Analysis and Lessons Learned* report Some staff persons had the appropriate technical qualifications but were uncooperative when working with other team members, causing project disruptions. Another issue identified in *the same* report was the *assigning of inappropriate personnel* to the project. At the time committees were being formed, the projects were not yet fully defined, making it difficult to assign people with the "right" expertise, interest, and political clout.

3.4 FUNDING ISSUES

The complexity of funding a public-private partnership with funds from multiple sources created its own set of issues. Public and private participants from all six tests identified several issues relating to funding. These issues occurred at various stages during the project. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

FUNDING ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Match requirements undefined/not understood	✓	✓		✓		✓
Funding expectations not always met	✓	✓	✓			
Funding limitations negative impact on test scope		✓			✓	✓
Funding constraints impact on local govt. participation	✓	✓				

ISSUE 1: THE MATCH REQUIREMENTS FOR THE PROJECT WERE NOT CLEARLY DEFINED OR UNDERSTOOD

Project matches can be time or service (a "soft" match), material, or cash. At the start of many projects, it was apparent that the percentage match share and value of each partner contribution was unclear to many participants. One example was seen in match values; how did a partner make an equal match using soft matches rather than material or cash. This was an issue for public and private sector participants at FAST-TRAC, Guidestar, SaFIRES, and TravelAid. There were several **causes** for this issue of local match requirements. Federal government policy requires that federal funds be leveraged with state and local funds. One major factor for public and private sector participants at several tests was the partners' *lack of experience* with federal contracting procedures and the concept of matching. It was difficult to determine the *value* of partner contributions because the process was *new* to most partners. Product scarcity and the market-bearing price were all factors partners now had to consider when assigning **a** value to a service or product. Second, even though partners were required to provide some type of match, *requirements varied* for many partners based on the partner contribution, the method for calculating the contribution, and the overhead rate. The goal of the ITS program was to maximize federal funding by recommending a 50%/50% match. Several tests followed this ratio, while others had an 80%/20% split.

Third, *complex funding* procedures were a factor at several operational tests. Accounting departments at many small private companies had difficulties in documenting matches, especially soft matches. At one test, federal and state partners did not even specify standard accounting practices for partners to follow when tracking activities eligible for local matches. Fourth, *matchingfunds were difficult to define* according to participants at one operational test. It was unclear which contributions would qualify as matching funds and if the private sector partners could apply the costs of startup activities as a percentage share of the local match. Fifth, at one operational test, the private sector found it difficult to provide *detailed documentation* during the early project phases.

At several tests, the **effect** of unclear match requirements on the partners *was confusion* and stress during the extended period of time it took to reach an agreement. A major private sector partner even withdrew from one operational test. Some partners may have overestimated their ability to provide a 50%/50% level match in their haste to look good and improve the chances that the project would be selected for federal funding. The side effect was *locking in* federal expectations for a high level of matching *and fixing* the total funding for the operational test. Second, lengthy discussions at several operational tests over defining acceptable contributions and their value ultimately *slowed down* several projects. Not all effects were negative; at one operational test, some participants felt the 80%/20% match ratio would make the federal government pay *closer attention* to local match activities and to future work plans. At the same test, *other federal-aid funds* were released as a match.

At several operational tests **the** issue has been **resolved** for many participants through flexibility. At one test, partners agreed to *meet the matching requirements.* At another test, new partners were brought *in* and *additionalfinding* was acquired to meet the match requirement. Public sector partners even accepted rates from private sector partners that previously they would not have accepted. At a third test, the FHWA drafted detailed *match requirements* and set up meetings between private partners and the state DOT to explain funding in more detail. Some participants were also concerned that the funding parameters developed from the high local match could *negatively* impact deployment. Funding may end up being inadequate, resulting in project revisions and a smaller project scope.

ISSUE 2: FUNDING EXPECTATIONS ARE NOT ALWAYS MET

The funding approval cycle for ITS operational tests is an extensive process, further complicated by different funding contributions from public and private partnerships. Partners have different expectations over level of program funding and timely release of funds. Public and private sector participants at Guidestar, Houston Smart Commuter, and FAST-TRAC all expressed concerns that funding would not be up to expectations and would negatively impact the ITS program.

One of the main **causes** of this issue was private and public sector *funding uncertainty.* At one operational test, funds earmarked by Congress were approved incrementally, one year at a time and successive fiscal year funding was not guaranteed. At the same test, a local agency took over program administration but overlooked the fact that their assumption of administration costs reduced the funding for the technical and evaluation parts of the project. At another operational test, private sector partners were willing to make soft match contributions but not hardware or cash. Participants at a third operational test also identified difficulties in obtaining state and federal funding commitments, because of competing ITS projects within the state and the unwillingness of the federal agency to fund the project.

Another cause was *slow release of funds* for individual operational tests. State DOT participants at several tests had concerns over federal funds not being released as quickly as expected. However, participants at one test did acknowledge difficulties in the new way of initiating ITS projects with the FHWA and obtaining project approval. The FHWA was also concerned over the state DOT's test plan objectives and their process for selecting consultants and partners. They did not want to earmark additional funds to fund the state DOT's Five-Year Plan. At another operational test, participants felt delays in federal funding by the FTA was due to the agency's perception that the FTA project role would be minor. Participants also felt the FHWA's Division Office was more supportive of the project than HQ. This resulted from HQ combining funds for the ITS operational test with another FHWA project located in the same geographic area that still was in the planning stage. Before ITS funds could be released, all details for the other FHWA project had to be completed. The FHWA's extended program review slowed the process even further.

At several operational tests, **the** main **effect** of these funding uncertainties was project *implementation delays.* At one test, only state funds have been used to date since inter-agency funding agreements were signed late and federal funding was unavailable. Individual tests were also affected in different ways. At one test, the FHWA and state DOT had lengthy *discussions* to identify mutually acceptable projects. Another effect was state DOT funding of some projects using only *state funds.* Participants at the same test also felt the FHWA would be more likely to *accept the ITS project* if the private sector increased its contribution and that a project with little or no private funding would not be funded. At another test, the reallocation in funding for project administration reduced the amount available to the project.. Private sector participants were concerned that the remaining funds would be *insufficient* to adequately support the technical part of the program. They also felt funding uncertainties affected *project planning* for private partners. Private partners need advance planning to balance project implementation with the funding, but this planning cannot take place until funding levels are known.

At several tests, the issue was **resolved.** At one operational test, the state DOT worked out funding issues by developing *work andprogram plans* and initiating a *new process* to review proposals. At another test, local, state, and federal funding is now secured, and, after the inter-agency agreement is signed, the funding issue should be resolved. Participants did caution that similar federal funding issues may affect other ITS projects and delay full **deployment,** especially if the project participants are not prepared for an extended funding process.

ISSUE 3: FUNDING LIMITATIONS CAN NEGATIVELY IMPACT THE SCOPE OF THE OPERATIONAL TEST

Partners had their own objectives on funding levels for the operational tests, which at times were in conflict with each other. Data collection funding might have been a priority for a private firm whereas technology evaluation was more important for the FHWA. Participants at Guidestar, SmarTraveler, and TravelAid all expressed concerns over the impact of funding limitations on operational test functionality and, ultimately, full scale deployment.

Participants at one operational test identified the main **cause** for funding limitations as *reduced federal funding* As the funding level decreased, so did the level of functionality for the tests. The project scope was also impacted because the cost for new technologies was unknown. Second, participants at one operational test felt the FHWA did *not fully support* data collection. The FHWA felt the goal of the operational test was to evaluate ITS technologies, not to collect data. Other project participants disagreed, emphasizing the importance of data collection and the inadequacy of federal funding. Third, at several operational tests, partnersfound *technology costs prohibitive* and were concerned that this may exclude expensive technologies from being used. Fourth, the policy of the FHWA is not to fund *operations and maintenance* of the operational test equipment.

Funding limitations had several **effects** on operational tests. At one operational test, there were *budget overruns, fewer vehicles equipped with ITS equipment,* and a *smaller test area.* It also became *harder to sell the project* to private partner decision makers and to public agencies. Ultimately, the FHWA decided *not to participate* in a later project phase. At another test, a private sector participant felt that because the FHWA did not fund equipment operation and maintenance, *sub-optimal systems* would be deployed. At a third test, private sector participants believed the exclusion of costly technologies may affect the *level of information* collection and distribution. They also believed there are not enough operational tests, which may hinder *determining which technologies* would be the best way to distribute information to travelers.

This issue was partly **resolved.** Participants at one operational test *reviewed costs* and *benefits* of different levels of functionality and *cut areas* that only provided marginally incremental benefits. At a second operational test, funding was still a negative influence. The private sector believed until the FHWA amended its funding policy towards equipment operation and maintenance, overly expensive systems will continue to be deployed, which may not be maintained in the long run.

ISSUE 4: FUNDING CONSTRAINTS HINDER LOCAL GOVERNMENT PARTICIPATION IN ITS

City and county governments play an important role in expanding road capacity and implementing ITS and other products and services. Unfortunately, not all local governments are convinced that the ITS Program could benefit them, some just regard it as a highway program. They do not feel they have any project ownership, and, more importantly, they feel financially constrained, which ultimately impacts project participation. Funding constraints were an issue for participants at both FAST-TRAC and Guidestar.

Limited budgets and staff is one major **cause** of the issue. Local agencies do not feel they can match federal funds, nor can they provide funds for travel and training, with the result that many choose not to spend their limited resources on ITS activities. Some participants at one operational test felt local agencies do not recognize the authority they have over their own resources, because if they did, they could make ITS a priority and assign resources. At the same test, participants also felt *inefficient channels* for passing ITS funding to local agencies deter local agencies from participating. At another operational test, participants felt local agencies were constrained by *an unprecedentedfunding request* for a program using new technologies that was limited to one community.

At one operational test, one **effect** of this issue has been *aperceived lack of coordination and cooperation* between state and local governments. Second, local governments have not been able to join new programs and attend conferences to *learn about* national ITS trends. At another operational test, the effect was more positive with local and private partners *getting together* to discuss funding levels. Local approval of funding meant the project got off the ground and showed Congress the local commitment to ITS.

This issue has been partially **resolved.** At one operational test, a local agency *committedfunds to* the ITS project that served as seed funding for earmarked Congressional funding. These funds were also accepted as the local match for the first federal appropriation for the operational test. At another test, participants *suggested simplifying the channels* for providing ITS funds to local agencies and improving communication by establishing a *local ITS council* to offer local information forums and training sessions. These have not yet gone into effect.

Comparison *With Analysis and Lessons Learned Report*

The reports highlighted similar issues relating to funding operational tests.

FUNDING ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Match requirements undefined/not understood	✓	✓
Funding limitations negative impact on test scope	✓	✓
Funding expectations not always met	✓	
Funding constraints impact on local government funding	✓	

Differences in how the public and private sectors conducted business resulted in *diverse cost sharing approaches.* Both reports pointed out difficulties in measuring a partner's contribution because of the newness of the private sector contributing matching funds and varying partner requirements. The *Findings and Recommendations* report stated that project participants had difficulties placing a value on "soft" matches and on products contributed by a private sector partner. The *Analysis and Lessons Learned* report pointed out difficulties in determining the funding share of academic partners because of the differences in doing business between the academic, public, and private sectors. A second concern listed in both reports was *the impact of funding limitations.* Reduced federal funding, prohibitive program costs, and uncertain federal support for data collection and operations and maintenance all had an impact on the scope of the operational test. The *Analysis and Lessons Learned* report stated that this issue could be a "potential show stopper."

A separate issue in *the Findings and Recommendations* report was *meeting funding expectations.* The funding approval cycle for operational tests is extensive, further complicated by the different levels of public and private partner contributions. Expectations that there will be an adequate level of program funding and that federal funding will be released quickly have not always been met. Another concern in the same report was the impact of *local government funding constraints* caused by limited budgets and staff, inefficient funding channels, and costs of new technologies. Not all local governments feel the ITS program can benefit them nor do they have a sense of project ownership. Therefore, they are not willing to invest their limited resources in ITS projects.

3.5 TECHNOLOGY ISSUES

ITS success depends on the successful integration of advanced technology and information with the conventional transportation infrastructure. Public and private participants from five tests identified several issues relating to the impact of integrating technology into the ITS program. The causes of each issue, the effects of each issue on the operational test, and the resolution of each issue are discussed.

TECHNOLOGY ISSUES	*FAST-TRAC*	*Guidestar*	*HSC*	*SaFIRES*	*SmarTraveler*	*TravelAid*
Lack of ITS program standards	✓	✓			✓	
Technology selection difficulties			✓	✓		✓
Telecommunications regulations difficulties		✓				✓

ISSUE I: THE ITS PROGRAM LACKS STANDARDS

Standards play an important role in product development and in ensuring system compatibility. An ISTEA requirement is to develop standards and protocols to promote the widespread use of ITS technologies and allow consumers to purchase units that can operate in different locations. ITS program standards have not yet been developed and existing technology standards are constantly being changed. This impacts the system architecture for the operational test. Public and private sector participants at FAST-TRAC, Guidestar, and SmarTraveler all identified this issue. A related issue is whether implementing individual operational tests on a small scale complicates standardization. The only **cause** for the issue is the *newness* of the ITS program, which results in different technologies being developed and tested, some of which may not meet future ITS standards or current standards.

The full **effect** of this issue on the operational tests and deployment sites will not be known until standards are developed. At one operational test, participants felt nationwide standards may be developed that may *differ* from ITS technologies used in individual operational tests. At one operational test, current protocols for data transmission are slower than those required by the test. Even though these standards will probably be replaced in the future, there is the potential risk that they might be *obsolete* in relation to the ITS technology being developed. This would limit the technology in the long run. Operational test partners would have to decide on either a default standard or use military specifications, if there were no ITS standards in use at that time. Another possible effect identified by participants at several operational tests is that the lack of standards may *stifle R&D* since private firms may be reluctant to invest in a technology that does not meet the standards. This would also restrict the potential expansion of products and services to other agencies and geographical areas. A third effect may be on *system architecture.* Technological advances may outpace developments in system architecture. A side effect related to *standardization* was identified by participants at one operational test. They pointed out the current test focus is to test technologies on a small rather than a large scale and work out a standard approach. This means cost advantages for standard production and distribution are not available to the private sector.

The standards issue has yet to be **resolved** and there is every likelihood it will impact future operational tests and deployments. Participants at one operational test noted that many states and regions plan to implement and expand systems developed in the tests. They pointed out the need to decide on whether establishing standards is to be a goal of the operational test because federal funds may be unavailable for deployment.

ISSUE 2: SELECTING THE MOST APPROPRIATE TECHNOLOGY IS DIFFICULT

Selection of the most appropriate technology for operational tests is an important component of all operational tests. Wrong selection of a product could affect not only the participants' use of the product but also the evaluation and project results. ITS participants at Houston Smart Commuter, SaFIRES, and TravelAid all identified this issue.

There were a variety of **causes** relating to difficulties in selecting ITS technologies at some operational tests. First, participants recognized the *variety* of technologies, not all of which are compatible, as a major factor. Rapid technological advances in ITS products likewise added to the confusion. Second, participants wanted to purchase the "best" technology for the test, but found *cost constraints* a factor. Third, there was too much *emphasis* on designing a product rather than describing product functions. Fourth, there was limited *consumer andprivate industry input* in identifying and selecting the appropriate technology. Fifth, differing opinions over *product functionality only* added to the confusion.

At one operational test, the main **effect** was *delays* in developing the RFP. Specifications were *revised* to reflect the quickly changing ITS technology and make the RFP process more flexible; this took time. There were also delays in signing an inter-agency agreement, which meant the RFP could not be issued. Fortunately, changing the RFP has had a minimal effect on the project schedule, although participants did caution that the RFP could still result in a sub-standard product being selected. A poor selection could then affect product use, followed by inaccurate evaluation and project results. There were several other effects relating to technology selection. At one operational test, project participants found it difficult to develop a *specification* for one component of the test, and be guaranteed a satisfactory product. They also could not specify the requirements until the design was completed. At the other test, participants pointed out limited consumer input meant they were unable to *narrow the test scope* to meet consumer needs and specification. They also felt the lack of private industry input would result *in continued uncertainties* over the technical specifications.

At one operational test, this issue should be **resolved** soon with the completion of the project RFP. At another test, the issue was resolved after procurement of the ITS technology causing specification difficulties was separated from the original contract. An RFP for a prototype was then issued. This RFP added a subjective evaluation to the selection process and provided for the modification or rejection of the prototype.

ISSUE 3: OPERATIONAL TEST PARTICIPANTS FOUND WORKING WITH TELECOMMUNICATIONS REGULATIONS DIFFICULT

At the beginning of an operational test, the communications system has to be designed, the design parameters set, and the Federal Communications Commission (FCC) licensing requirements determined. These telecommunications systems are extremely complex to design and regulate. The upcoming reassignment and redistribution of existing radio frequencies by the FCC is likely to further complicate systems design. Operational test participants from both the public and private sector at Guidestar and TravelAid identified difficulties in working with telecommunications regulations.

Operational test participants from both tests identified several **causes** for this issue. First, existing *radio frequencies* have multiple users, and the databases that track usage and availability are not very effective. Participants at one operational test stated an adequate radio frequencies for the test did not even exist. Second, *the* FCC has *removed radio frequencies* but has not reassigned them. Third, project participants did not understand how *complex the* telecommunications design was. Fourth, at one operational test, project participants found it difficult to *comply with regulations* relating to telephone company operating privileges. The geographic area of the test is within one regional local access transport area, but is also served by some independent telephone companies.

A major **effect** of this issue at one operational tests was *project delays.* At one operational test, the telecommunications system design slowed down when a private sector telecommunications system designer withdrew from the project. The remaining partners were unable to take over because they did not have in-house expertise. Side effects included *numerous revisions* in design concept and scope and delays in frequency-dependent purchases. At the other test, redesign of the trunk radio system as a backbone for future ITS requirements has been difficult, because the responsible state agency does not know what their long-term ITS requirements will be. Because of the upcoming FCC reallocation of frequency bands, the operational test may be using a temporary frequency. This would mean project participants would have to apply for a new frequency, resulting in additional costs and possibly new hardware.

This issue has yet to be **resolved.** At one operational test project participants noted that difficulties in working with telecommunications regulations could prevent the test from achieving its program goals and objectives. A public sector participant went one step further and said the project will fail if the telecommunications system does not work and that there will be further delays if the license is rejected. A private sector participant was not as pessimistic, but noted that the issue will remain until the FCC reassigns radio frequencies. At the other operational test, this issue may be resolved by two public sector agencies *sharing a telecommunications backbone.* Finally, difficulties with telephone company operating privileges were resolved after *all* parties agree to *follow individual company regulations* and *restrict market size.*

Comparison With Analysis and Lessons Learned Report

Both reports discussed several major issues relating to technology.

TECHNOLOGY ISSUES	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Lack of ITS program standards	✓	✓
Technology selection difficulties	✓	
Telecommunications regulations difficulties	✓	
Database selection conflicts		✓

The *lack of ITS technology standards* was a major issue for both reports because of the important role of standards in product development and in ensuring system compatibility. The *Analysis and Lessons Learned* report stated this issue "has the potential to become the biggest institutional impediment to the successful deployment phase of the majority of IVHS projects." The *Findings and Recommendations* report raised the question of whether implementing individual operational tests on a small scale complicated standardization. The newness of the ITS program meant that different technologies were being developed and tested, some of which may not meet future ITS standards or current standards.

Difficulties in selecting appropriate technologies was *an* issue in *the Findings and Recommendations* report. Wrong selection of a product could affect not only the travelers' use of the product but also the evaluation and project results. Many technologies are available but not all are compatible. Cost constraints, the manufacturers' emphasis on product design over product function, limited consumer and private industry input in identifying and selecting appropriate technology, and differing opinions over product functionality further complicated the selection process. The same report also pointed *out difficulties in working with telecommunications regulations.* Telecommunications systems are complex to design and implement. The upcoming reassignment and redistribution of existing radio frequencies by the FCC is likely to further complicate systems design. The *Analysis and Lessons Learned* report pointed out conflicts between partners in one operational test over *database selection* and the considerable amount of time to resolve the issue. The report also had concerns over an *overdependence on unproved technology.* Technical risks were being taken without fallback plans for more conservative technological approaches

3.6 LIABILITY ISSUES

Only the *Analysis and Lessons Learned* report identified liability-related issues. Prototype ITS systems use innovative approaches to meet ITS program goals. Not surprisingly, partners are concerned about *the safety and liability* of these prototype systems. There are many unknowns about the safety of ITS systems and how the public will react after they use the systems.

3.7 USER ACCEPTANCE ISSUES

Only *the Analysis and Lessons Learned* report identified user acceptance issues. A potential for *negative public reaction to ITS technologies* could result in public complaints to elected officials, who in turn, could enact new legislation or change public policy through new or changed regulations. Concerns fell into three categories: redistribution of congestion-causing traffic to local arterials, use of technologies that compromised privacy, and lack of data concerning the environmental impacts of ITS. A second issue in the same report is the *market uncertainty for* ITS. There are concerns over consumer unwillingness to pay for ITS products and services because of the high user costs and the lack of consumer information on their value. This is a critical issue, affecting full-scale deployment of ITS.

4. LESSONS LEARNED

The previous chapter identified the institutional issues encountered by operational test participants in the process of establishing partnerships and deploying ITS services and products. For each issue, the causes, the effects, and whether the issue had been resolved were discussed. This chapter describes the lessons learned by the operational test participants in dealing with these impediments; lessons that can be applied to other deployments of ITS products and services. For each issue encountered, participants were asked if they learned any lessons as a result of addressing the issue. Participants were also asked to identify the most important lesson they learned and would want to share with others in the ITS community deploying ITS products and services. Also included is a comparison between lessons learned identified in this report and the IVHS *Institutional Issues and Case Studies - Analysis and Lessons Learned* report (SAIC, 1994).

To identify the lessons learned during various stages of the test, the principal lessons are broken down into five categories, resembling the chronology of an operational test:

- *Building Support*

  Lessons relating to promoting ITS projects and motivating project participants.

- *Developing Plans*

  Lessons relating to defining the project scope.

- *Working Out The Details*

  Lessons relating to advancing the project.

- *Managing the Project*

  Lessons relating to project management and technical skills.

- *Maintaining Support*

  Lessons relating to providing continued support for the ITS Program.

Overall, participants felt that operational tests are working and successful partnerships are being established, but they did identify several drawbacks and offered many lessons that they learned. One overall lesson was identified:

THE NEWNESS OF INTELLIGENT TRANSPORTATION SYSTEMS AND THE ASSOCIATED PARTNERSHIPS CREATES SIGNIFICANT YET SURMOUNTABLE CHALLENGES

The ITS concept is based on using computer, electronics, and communications technologies to increase the effectiveness of various modes of transportation. Use of these technologies is new to the surface transportation industry. The ITS concept also requires new institutional relationships to be formed. The traditional way of doing business with the government was through a customer-vendor relationship. The new concept *ofpartnerships* between industry and government has changed that. Because implementing ITS may involve the partnership concept, in which relationships are established and benefits and costs shared, both groups are having to adjust to a new business style and work environment. The public sector is learning that private partners can provide valuable decision-making input. Likewise, the private sector is learning about public sector procedures and contracting requirements.

ITS deployments can only work if all partners are engaged in the decision-making process, goals and concerns are identified early in the project, all partner concerns are addressed, project goals are developed and accepted, and partners are educated about other partners' operations, are open to new ways of doing business, and are flexible. It takes *time* to achieve these suggestions for the ITS program: time to build support, develop plans, work out the details, and manage the program.

LESSONS LEARNED

BUILDING SUPPORT

- ***Public andprivate sector learned to work together***
- ***Project champion and upper management support contributes to a successful project***
- ***Public sector agencies and staff must be encouraged to be part of the ITS Program***

DEVELOPING PLANS

- ***Partner roles and responsibilities must be defined clearly and early***
- ***Conflicts may arise when developing a partnership***

WORKING OUT THE DETALLS

- ***Contracting procedures must be open and flexible***
- ***Operational and evaluation components must be in place at the same time***
- ***Matching requirements must be identified early in a project***
- ***Use of proprietary material and assignment of intellectual property rights must be addressed early***

MANAGING THE PROJECT

- ***Projects need a full time manager***
- ***Partners must have required technical expertise***
- ***New management styles may be needed***

MAINTAINING SUPPORT

- ***Good communication within theproject is essential***
- ***Funding for operations and maintenance is critical to a successful deployment***
- ***ITSproducts and technology must be promoted***
- ***National standards important and should be developed quickly***
- ***National perspective of ITS must be developed***

4.1 BUILDING SUPPORT

One central issue identified by several operational test participants was that several segments of the public sector are not interested in either participating in ITS activities, nor in developing partnerships with other public agencies or with private partners. Likewise, in the private sector, there are difficulties in building support for ITS. Many companies still prefer the traditional customer-vendor relationship. Others are not committed to ITS, are looking for work, or are trying to sell a product. Building support for ITS therefore becomes critical for ensuring the program's success.

LESSON 1: PUBLIC AND PRIVATE SECTOR PARTNERS LEARNED TO WORK TOGETHER

Once partners decide to participate in ITS, it is critical they stay part of the project by learning to work together and having an active role in the decision making process. Several operational test participants identified this lesson as the most important, despite its time-consuming nature and difficulties in developing a partnership among public, private, and academic sectors. As one participant stated, "cooperation among partners and the sharing of resources are vital."

A successful partnership depends on several factors. First, develop a team of participants that are *compatible* and work closely together rather than having each partner interested only in their own part of the project. At one test, a small entrepreneurial firm was able to work with a large bureaucracy. One participant went so far as to say that this was a real testament to the flexibility of ITS programs. Second, consider the concerns of both sectors and ensure each sector *educates the* other as to how it operates. Third, identify any *competition and conflict* early on to reduce stumbling blocks and address conflicts as they arise. This is critical to partner cooperation. Fourth, build a close *working relationship* among the involved parties.

LESSON 2: HAVING A PROJECT CHAMPION AND SECURING UPPER MANAGEMENT SUPPORT CONTRIBUTES TO A SUCCESSFUL PROJECT

An operational test needs one or more strong local champions for the duration of the project to aggressively push the project forward. These champions must learn about ITS concepts and practices, and develop a standing and competence in ITS so that they can convince government officials, upper management, and others of the benefits of ITS. When upper management supports a project, they then communicate their support to the staff and stress that the project is an agency priority. This has the effect of building staff ownership more quickly. At several tests with active project champions, the ITS concept has been successfully sold to officials and upper management. The lack of a project champion or upper management support has the potential to reduce the project's priority; which ultimately could affect deployment.

Upper managers at several operational tests were uncomfortable with the newness of the public-private partnership concept. At one public agency, the policy making board did not see the benefits of ITS, were skeptical of the project's value, and considered withdrawing its support. In another instance, the executive board of a public agency was not fully committed to the project at the start and had concern over increased costs and additional risks. This lack of commitment increases the likelihood for an agency to drop out of the project.

To achieve a higher probability of success, the participants made several suggestions. In this instance, the overall lesson learned is to foster *a project champion* and secure *upper management support.* First, designate *a project champion* at each operational test to push the project forward from start to finish. Second, the project champion must *coordinate the ITS plan* with upper management and other key departments within the public and private sector early in the project. Upper management acceptance gives the ITS project additional visibility within the organization and builds support at the middle management level. As one participant expressed, "Project participation is not assured unless the support of upper management is secured." Third, during the test, keep upper management *up to date* on the ITS program; their support may be needed to resolve bureaucratic roadblocks or personnel and financial issues and keep the project on track.

LESSON 3: PUBLIC SECTOR AGENCIES AND THEIR STAFF MUST BE ENCOURAGED TO BE PART OF THE ITS PROGRAM

For several operational test participants, the lesson learned from an initial lack of public sector support is to encourage public officials at the local and state levels to become more involved in ITS. It is equally important to encourage the staff of the agencies. Training in the new ITS technologies has an important role in challenging and motivating the staff and in developing staff appreciation for the system. According to one participant, "involved employees become motivated and are key to the success of the project."

There are several ways of encouraging ITS involvement. First, *promote the* program so everyone feels they are part of the bigger scheme or goal. Second, *educate* officials and staff about the project's benefits. Education is central to a successful program, but the education process takes time. Third, give each partner a *meaningful role* in the project. Fourth, provide *adequate training* in ITS technologies; learning "new things" helps to build morale. Finally, do not be afraid of *taking the initiative* and becoming a driving force within the operational test.

Comparison With Analysis and Lessons Learned Report

The reports highlighted various lessons learned relating to building support for operational tests.

BUILDING SUPPORT LESSONS LEARNED	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Partners learned to work together	✓	✓
Project champion and upper management support results in successful project	✓	✓
Public sector involvement in ITS	✓	

Two lessons were identified by both reports. First, a successful partnership depends on the *public andprivate sectors learning to cooperate* with each other. Trust, understanding, commitment, and communication keep the project moving towards deployment. *The Findings and Recommendations* report felt this lesson was the most important, despite its time-consuming nature and the difficulties in developing partnerships among public, private, and academic sectors. Second, successful projects depend on *havingproject champions and securing upper management support* to push the project forward. Project champions are key; not only must they be competent in ITS, they must also be able to communicate the benefits of ITS to upper management. According to the *Findings and Recommendations* report "project participation is not assured unless the support of upper management is secured." Upper management acceptance then increases the visibility of ITS within the organization and builds middle management support.

A separate lesson in the *Findings and Recommendations* report was *encouraging state and local agencies to be part* of *ITS.* It is equally important to encourage the staff of these agencies to participate. Involved employees become motivated and are key to the success of the project.

4.2 DEVELOPING PLANS

Another issue identified by most operational tests was that project planning and coordination was disorganized at the start of the project, caused mainly by the newness of the concept of ITS. New organizational structures were created that differed from the way business had previously been carried out. The private sector was now a partner instead of a vendor. Within the public sector, there were similar changes. Individual federal, state, and local agencies, each with their own organizational hierarchy, were now partners. This meant that the issues and complexities of the project also had to be understood early in the project. Partners also have to recognize there are potential conflicts in developing a partnership.

LESSON 1: PARTNER ROLES AND RESPONSIBILITIES MUST BE DEFINED CLEARLY AT THE BEGINNING OF THE PROJECT

Most operational test participants identified this Zesson as the most important in early project planning. Partner sensitivity over leadership versus supporting roles and the poorly defined responsibilities of participants working on project tasks can lead to turf battles and possible duplication of work. This leads to significant delays in initiating partnerships, which in turn leads to increased project costs.

The project participants stressed that it is important to define the nature of the project, the roles and responsibilities of the partners, and the contracting process as soon as possible. First, develop a *work environment* that is acceptable to all partners. Second, assign *meaningful roles* to all partners. Third, be as specific as possible when *clarifying partner roles* and spell this out in a formal document, such as a contract or MOU. Fourth, the partners should appoint a full-time *project manager* early in the project with authority to commit resources, establish project milestones, and be committed to achieving those milestones.

Fifth, each partner should identify *a point of contact* who has authority to commit the resources of the partner's organization. Sixth, *convene the key players early,* even before agreements are signed. This will ensure that project details are addressed and the project is kept moving. Seventh, investigate *procurement andpartnership agreements* that do not place one partner in a subordinate role to another. Eighth, ensure partners *clarify* their policies, processes, practices, expectations of contracting, funding, and auditing requirements and *educate* operational test participants about these requirements. Ninth, state and federal laws should permit ITS project participants to be reimbursed for all pre-contract and pre-funding agreement work. Finally, meet regularly to facilitate communications and develop a better understanding among the partners.

LESSON 2: CONFLICTS MAY ARISE WHEN DEVELOPING A PARTNERSHIP

Early project planning and coordination at several operational tests were disorganized due to the newness of the operational test concept. In some cases, there have been conflicts over partner selection, responsibilities, and goals; and contract negotiations, leading to test delays and even partners leaving the project.

The main lesson learned is to recognize there *are conflicts* when putting together a partnership. Second, understand that the project will not fail if a partner leaves Find new partners who will stay committed. Third, *pick the team carefully,* paying particular concern to each partner's compatibility and expertise. Fourth, partners should meet as early in the process as possible to *identify potential problems* and *address conflicts* as they arise. Fifth, recognize the possibility that some partners may be *competitors* and include criteria in all RFPs to address *this.* Sixth, *confer* with the relevant participants to ensure the program can get through state and federal procedures before proposing to perform the tasks. Seventh, once a project team is established, develop a *mechanism* to resolve issues.

Comparison With Analysis and Lessons Learned Report

The reports highlighted the same two lessons learned relating to developing plans for operational tests.

DEVELOPING PLANS LESSONS LEARNED	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Partner roles and responsibilities definition at beginning of project	✓	✓
Conflicts when developing partnership	✓	✓

First, one of the most important lessons in early project planning was to *clearly define partner roles and responsibilities* in a formal document to avoid turf battles and duplication of work. Second, accept that there *are potential conflicts when developing a partnership.* Partnerships are innovations and require building trust, understanding, commitment, and communication. When of any of these requirements are missing, project planning and coordination becomes disorganized, leading to delays and even to partners leaving the project.

4.3 WORKING OUT THE DETAILS

Project participants encountered several issues while working within an operating environment of an ITS partnership. Participants found procedures for operations, contracts, evaluations, funding, and intellectual property rights were all very different than those with which they were familiar, and spent a large amount of time modifying these procedures to reflect the ITS environment. They considered several lessons learned critical to a successful operational test.

LESSON 1: CONTRACTING PROCEDURES MUST BE OPEN AND FLEXIBLE

Most operational test participants identified this Zesson as the most significant in working out project details. According to one test participant, "the technical part of the operational test has been easy; the contractual portion of the project has been the challenge."

Several ITS operational tests use the same cost-reimbursable contracting procedures that are used to acquire construction and consulting services; procedures that are unsuitable for the operational tests for several reasons. ITS technology turns over more quickly than the roadway infrastructure for which the original contracts were designed. In addition, contracting procedures do not address the issues related to software design, intellectual property rights, liability, and proprietary data. Private partners working with these standard contracts find them time-consuming and cumbersome. Innovative contracting mechanisms are needed to meet these needs.

One of the key lessons learned is recognizing that *contractingprocedures used for operational tests with public-private partnerships need to be flexible.* Some operational test work cannot be defined because it involves developing and testing new technologies. Participants must learn to let go of some of their traditional management practices and be more flexible when putting together contracts, without compromising key issues. They should review public sector contracting requirements and change them if they are too rigid for research-and-development type programs, A flexible contracting process will allow timely modifications to be made to existing contracts and fast execution of new contracts to meet unanticipated needs. However, the private sector still needs to understand the rules and regulations under which the public sector works.

There are other lessons relating to flexibility in contracting procedures. First, involve *legal counsel* in early contract negotiations; the unique nature of ITS partnerships and the inapplicability of standard procurement or construction contracting procedures require new approaches to developing public-private partnerships. Second, *educate* public and private sector personnel about the other partner's contracting requirements, and recognize this takes time. Third, expect unanticipated *changes in project scope* and initiate a process to speed up these changes. Fourth, look at *different procurement practices,* such as cooperative agreements and grants. Fifth, consider *non-standardpractices* and plan how goods and services will be acquired to complete the project.

LESSON 2: OPERATIONAL AND EVALUATION COMPONENTS MUST BE IN PLACE AT THE SAME TIME

Project evaluations are a critical and challenging component of the operational test. At several tests, evaluations were not viewed as an integral part of the project concept and the evaluation was delayed. At some operational tests, project participants initially focused on technical aspects of the project and selected an evaluator after the operational test started. Several operational test participants disagreed with this approach, feeling the test evaluation should be "inextricably intertwined" with the rest of the project.

There are several key lessons to successfully integrating the evaluation into the project concept. First, *design* the evaluation plan at the same time as the technical plan is designed and have all operational and evaluation components in place at the same time. This will ensure contracts can proceed simultaneously and that the evaluation is an integral part of the project. Second, have a *clear understanding* at the start of the project as to what is required from the evaluation process. Third, partners must *value* the evaluation. Fourth, without good *baseline data,* it will be more difficult to justify additional expenditures for ITS because it will be more difficult to identify benefits.

LESSON 3: MATCHING REQUIREMENTS MUST BE IDENTIFIED EARLY IN A PROJECT

The nature of an operational test partnership requires partners to contribute matching funds or goods and services ("soft" matches). At some operational tests, match requirements were difficult to understand and determine, leading to project uncertainty and delays, partner frustration, and, in one case, withdrawal of a partner from the test.

The lesson learned is to define matching requirements at the beginning of the project. First, *identify the project team,* especially at the federal and state levels, so knowledgeable partners can help develop the project and interpret the federal funding and operational requirements. Second, provide a "guardian" angel to take the *initiative* in explaining government mandates and highlighting changes in project requirements. Thiid, determine what constitutes the *local match* and obtain up-front *commitments* from the participants using an MOU or partner agreement. More leeway is needed in determining the local match and eligible activities to allow more public and private sector organizations to participate. Fourth, *plan in advance,* to ensure that realistic estimates for schedules, funding, and non-federal matches are obtained. Fifth, no two projects are alike, *so tailor funding and matching* structures for each project. Sixth, initiate a *good accounting system* to track matching funds.

LESSON 4: USE OF PROPRIETARY MATERIAL AND ASSIGNMENT OF INTELLECTUAL PROPERTY RIGHTS MUST BE ADDRESSED EARLY IN THE PROJECT

There is a conflict between the private partner desire to make some work proprietary and the traditional thinking that products developed in publicly-funded projects remain in the public domain. Private partners do not want the public partner or other private sector partners to profit from their company's investment and development. At several operational tests, the issue of proprietary material was further complicated by mixing public and private funds. This left partners unclear over ownership and use and deterred potential partners from participating.

There are several ways of resolving these ambiguities. First, identify what *material* private partners consider proprietary and specify *ownership rights* in the agreements. Second, include *legal counsel* early in the negotiations. Third, recognize that *information sharing* is a critical part of partnerships and understand other partners' expectations. This will build trust among the partners and overcome differing goals. Fourth, in an agreement, spell out there will be *no competition* between the public and private sectors in fully deploying ITS products and services. Fifth, encourage the public sector to focus on demonstrating the *benefits of ITS* rather than product development. Sixth, use intellectual property rights as an incentive for *encouraging* the private sector to participate.

Comparison With Analysis and Lessons Learned Report

The reports highlighted similar lessons learned relating to working out the details for operational tests early in the project.

WORKING OUT THE DETAILS LESSONS LEARNED	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Contracting procedure flexibility	✓	✓
Operational and evaluation integration	✓	✓
Matching requirements identification	✓	
Proprietary material and intellectual property rights use and assignment	✓	

Two lessons were identified by both reports. First, one of the key lessons when working within an operating environment of an ITS partnership was recognizing *the importance of contracting flexibility* Unanticipated changes to the contracting schedule or contract scope of work are not unusual, given the uniqueness of public-private partnerships. Private partners view standard contracting procedures as time-consuming and cumbersome; innovative contracting processes are needed to support operational tests. Second, *the evaluation plan must be integrated with the project design* at the start of the project. This will ensure partners allocate sufficient resources and that the necessary types of data for the evaluation are collected. The *Analysis and Lessons Learned* report also pointed out the need to bring the system integrator and evaluation contractors on-board early to ensure that there is the necessary expertise to plan operational test activities including evaluation and possibly full deployment.

The Findings and Recommendations report identified two additional lessons. First, the difficulties in understanding and determining match requirements leads to project uncertainty and delays, partner frustration and even partner withdrawal. *Defining matching requirements early* in a project becomes crucial. Another lesson from *the same* report was *the* need to *address intellectual property rights* and *proprietary material use early in the project.* Ambiguities between the private sector desire to protect proprietary material and the public sector belief that products developed using public funds are public property can be resolved by identifying what material is considered proprietary, and by specifying ownership rights in an agreement.

4.4 MANAGING THE PROJECT

Public-private partnerships require management styles and organizational structures not found in traditional government-contractor relationships. A new management style dealing with partnerships is a necessity. Partners must learn the needs of the other partners and have the flexibility to work with those needs in mind. Many project participants felt the management structure was extremely complex. In some cases, it was unclear who was in charge of the project, and who controlled the funds. This made the project difficult to manage, slowed progress, and created conflicts among the management of the various partners.

LESSON 1: PROJECTS NEED A FULL-TIME MANAGER

Because of its great impact on the success of the project, many participants stated this Zesson as being extremely important. The lack of a full-time manager resulted in several problems occurring: establishing and maintaining communication among the partners was difficult, the roles and responsibilities of the partners were not defined clearly, and the project lacked direction. Often, the partners were uncertain who was managing the project and to whom they should report.

An important lesson is to assign *a full-time project manager* at each operational test at the project start-up to motivate others and expedite the projects. Managers must be knowledgeable about ITS concepts and practices and be able to convince decision makers and users of the benefits of ITS. Second, allow *the* manger to take *independent action* or call upon partners to take action to resolve problems. Third, provide the manager *with additional staff or* outside consulting support; for example, hiring a system integrator to develop specifications. Fourth, provide sufficient overhead or administrativefinding for a full-time project manager. Fifth, *support* the project manager.

LESSON 2: PARTNERS MUST HAVE THE REQUIRED TECHNICAL EXPERTISE

Many state DOTS did not have the technical skills needed to implement ITS projects. Because they were structured to implement civil engineering projects, these agencies did not have computer and telecommunication expertise. In addition, many divisions within a state DOT are involved in the operations of the transportation system. The focus of many local agencies is also on the day-to-day operations of the transportation system rather than on system development. Tight local budgets impede the acquisition of technical expertise and it is, therefore, not unusual for local agencies to be unfamiliar with ITS technical innovations. This lack of in-house expertise is not limited to the public sector. At one operational test in a rural area, local contractors were unfamiliar with the latest technological developments.

A significant lesson is to identify the *skills and expertise* that are needed to deploy an ITS and obtain them. As one participant stated, "Most importantly, do not go it alone; get help as early as possible." First, if the participants do not have the required *technical expertise,* they must develop it in-house or procure it through consultant support. Second, if consultant support is obtained, some expertise must be established *in-house* to coordinate the work and review the consultant's recommendations. Third, understand that *training* is not a luxury; provide as much training as is required by the project. Fourth, cross-train staff to avoid staff shortfalls if a critical position becomes vacant. Fifth, recognize that *technical resources* required for a project may not be available in rural areas.

LESSON 3: NEW MANAGEMENT STYLES MAY BE NEEDED WHEN DEALING WITH PARTNERSHIPS

Public-private ITS partnerships are new to all participants. The private sector is uncertain how to invest in a public venture while the public sector does not know how to request financial support and services from the private sector. The traditional government-contractor style in which project control and funding remains in the public sector does not work in the new engineering and development partner relationships.

The participants emphasized the importance of using new *management styles* to deal with partnerships. First, be open to *new* ways of doing business. A lack of flexibility can kill a project. Second, public sector managers must deal with private sector partners on *an equal basis,* not as contractors. Third, ensure that the *goals* of all partners are identified and try to meet these goals. Fourth, use existing and evolving *project management tools and methods* to implement large-scale ITS projects.

Comparison With Analysis and Lessons Learned Report

The reports strongly agree on one lesson learned relating to managing the project.

MANAGING THE PROJECT	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Full-time manager necessary	✓	✓
Partners' technical expertise	✓	
New management styles and partnerships	✓	

Both reports identified one important lesson that had a major impact on a project's success; a *full-time manager is key to a project's* success. The manager should be brought on-board at the beginning of the project to motivate decision makers, staff, and users about the benefits of ITS and to keep the project on track. Managers must be knowledgeable about ITS concepts and practices and should have the autonomy to take independent action to resolve problems. The *Analysis and Lesson Learned* report discussed the importance of having the "right person for the right job." Without such leadership qualities, the project could be delayed or halted.
The *Findings and Recommendations* report also brought up two additional lessons. First, the focus of many local agencies is on civil engineering projects rather then computer and telecommunications expertise. Since many agencies are unfamiliar with ITS technical innovations, partners must have *the appropriate technical expertise* to implement ITS projects. Second, public-private partnerships are new to all participants; *new management styles* may be needed when dealing with partnerships. These include being open to new ways of doing business and public sector acceptance of private sector partners as equals, not as contractors.

4.5 MAINTAINING SUPBORT

On-going financial, technical, and institutional support at the national, state, and local levels is necessary to successfully move ITS products and services into the mainstream of transportation activities.

LESSON 1: GOOD COMMUNICATION WITHIN THE PROJECT IS ESSENTIAL

Even though communication is an important factor in many previously identified lessons learned, it is included here as a separate lesson to reinforce its importance. Good communication results in good coordination and cooperation, and, as one participant stated, "coordination and cooperation are the keys to a successful test."

Many ITS projects have several partners from both the public and private sectors. This increases the complexity of project support, funding, evaluation, and management. In some cases, the ITS project overlaps the jurisdiction of many agencies, making accurate understanding and clear communication even more difficult to establish and maintain. At some operational tests, partners were not aware of what the other partners were doing outside the project.

The most important lesson relating to improved communication is to *meet regularly* to facilitate communications. Second, develop a better understanding among the partners and encourage project participants to *learn more* about each other's activities and requirements. Third, *multi-jurisdictional* cooperation is possible. Involve all parties and pursue one-on-one discussions if necessary. Fourth, appoint *a full-time manager* to enhance communication between the partners and address problems quickly. Fifth, project participants should take the initiative and *educate* decision makers and the general public about ITS by communicating information about project plans. According to one participant, "education is at the heart of everything, but the education process just takes time."

LESSON 2: FUNDING FOR OPERATIONS AND MAINTENANCE IS CRITICAL TO THE SUCCESS OF ITS DEPLOYMENTS

Funding for the O&M of ITS systems and for the training required by the staff who will operate and maintain these systems is critical to ensuring that deployed systems are used optimally. The current funding policy of federal agencies is to fund capital improvements and some short-term O&M; the policy does not permit funding O&M over the long term. This raises concerns that sub-optimal systems will be deployed to reduce the cost of O&M or full deployments will not be properly operated or maintained in the long run causing a degradation of the service that was being provided.

A significant lesson learned by participants at several operational tests is agencies planning to deploy ITS must give *more consideration* to O&M issues. They also learned that funding agencies must *amend their policies* and provide long-term O&M funding to support deployed systems and the staff operating and maintaining these systems. These actions will permit an optimal system to be deployed, operated, and maintained.

LESSON 3: ITS PRODUCTS AND TECHNOLOGY MUST BE PROMOTED

ITS products and technology should be promoted to several groups: the general public as the user, private companies as developers of technology, and public agencies as project implementors.
An important lesson is to develop *support* for an ITS industry. First, establish local and state *ITS organizations* and get large companies and entrepreneurs involved *in* ITS. Second, *educate the* public about ITS and its benefits. Third, increase the *private sector involvement* in ITS. Fourth, *commit funding* for outreach and education programs that promote ITS.

LESSON 4: NATIONAL STANDARDS ARE IMPORTANT AND SHOULD BE DEVELOPED QUICKLY

The ISTEA requires standards and protocols to be developed to promote the widespread use of ITS technologies. National standards have not yet been developed. This could result in ITS technologies currently under development either not meeting the standards when they are finally written, or being tied to an obsolete standard.

The participants stressed that standards are very important and should *not be overlooked.* Because private sector firms, especially smaller ones, are not sure what technologies will be used, they are reluctant to invest in R&D. Public sector agencies may be reluctant to implement ITS projects because, if the technologies they select do not meet the national standards, the technology would have to be replaced. The lack of standards will also restrict the expansion of products and services to other agencies and geographical areas.

LESSON 5: A NATIONAL PERSPECTIVE OF ITS MUST BE DEVELOPED

ITS visibility should not be limited to operational test participants. It is not in the national interest if test participants do not share their ITS activities.

The lesson is to *develop a national* perspective of ITS and generate a "what's good for the nation" enthusiasm among transportation agencies and industry. First, operational test participants must *interact* at the national level, gain knowledge from that interaction, and apply that knowledge to the local project. Second, they must understand what lessons have been learned at their operational test and be willing to *share* that information at a national level.

Comparison Wifh Analysis and *Lessons Learned Report*

The reports proposed two similar lessons learned relating to maintaining support for the ITS program.

MAINTAINING SUPPORT	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Project communication	✓	✓
ITS products and technology promotion	✓	✓
O&M funding criticality	✓	
National standards importance and development	✓	
National perspective of ITS	✓	

Two lessons were identified by both reports. First, *good communication within the project* is essential, resulting in improved coordination and cooperation. Regular meetings, a better understanding of each other's activities, and the appointment of key advocates to quickly address problems all enhance communication among the partners. Second, the *benefits of ITS products and technologies must be promoted* to ITS users, product developers, and project implementors. This will develop support for an ITS industry and keep the project moving forward.

Three additional lessons were identified by *the Findings and Recommendations* report. First, *O&M funding is critical* to a successful ITS deployment. A lack of long-term O&M funding could result in improperly operated or maintained systems, causing a degradation in the service provided. Second, *develop national standards* as quickly as possible. Standards are very important because of their role in promoting the widespread use of ITS technologies, and should not be overlooked. Third, operational test participants should share their ITS activities at the national level and develop a *national perspective of ITS* among transportation agencies and industry.

5. RECOMMENDATIONS

This section presents recommendations for addressing the institutional and legal impediments presented in Chapter *3: Institutional Issues.* Recommendations were developed by the study team that investigated institutional issues affecting the operational tests. Many of these recommendations reflect suggestions made by operational test participants and are discussed in Chapter *4: Lessons Learned.* Given the large number of suggestions and ideas offered, only recommendations that were identified by the largest number of participants and that could be implemented are included. Recommendations focus on facilitating the deployment of ITS products and services and promoting the ITS program. Also included is a comparison between recommendations identified in *this Findings and Recommendations* report and the *IVHS Institutional Issues and Case Studies - Analysis and Lessons Learned* report (SAIC, 1994).

Principal recommendations follow the same categories as the lessons learned in Chapter 4: *Building Support, Developing Plans, Working Out The Details, Managing the Project,* and *Maintaining Support.*

RECOMMENDATIONS

BUILDING SUPPORT

- ***Foster ITS program champions***
- ***Develop educational materials for state and local agencies***

DEVELOPING PLANS

- ***Ensure project details are adequate& defined***
- ***Facilitate the initiation of public-private partnerships***

WORKING OUT THE DETAILS

- ***Promote and encourage innovative procedures***
- ***Clearly specify the requirements for matching federal funds***
- ***Facilitate the assignment of intellectual property rights***

MANAGING THE PROJECT

- ***Identify a full time manager***
- ***Develop a fellowship program***

MAINTAINING SUPPORT

- ***Develop national standards***
- ***Provide operations and maintenance funding***

5.1 BUILDING SUPPORT

There are many difficulties in building support for ITS within public sector agencies and private sector companies. Strong ITS support during deployment is essential to ensuring the project's success. ITS support can be built on two levels: locally at the project level, and nationally. The recommendations in this subsection address building support at the project level.

RECOMMENDATION 1: FOSTER ITS PROGRAM CHAMPIONS

The U.S. DOT and other funding agencies shouldfoster full-time program champions to improve the visibility of ITS among key area leaders and agency staff. The focus should be on developing project champions at the state level and within large metropolitan areas. The US. DOT and other agencies should provide these champions with training and materials to ensure they have a good knowledge of ITS concepts and practices. These champions would promote the deployment of ITS, be a resource for educating others about ITS products and services, foster inter-agency cooperation and public-private partnerships, and encourage staff ownership of ITS projects.

RECOMMENDATION 2: DEVELOP EDUCATIONAL MATERIALS FOR STATE AND LOCAL AGENCIES

The VS. DOT and other agencies involved in implementing ITS should develop educational materials for state and local public sector agencies. This material would assist agency staff in promoting ITS to the public, private, and academic sectors; upper management; the media, and the general public. It may include information on ITS products and services, benefits of deploying ITS, identification of successful ITS deployments, explanation of federal and state policies and procedures, and formation of public-private partnerships.

Comparison With Analysis and *Lessons Learned Report*

The reports highlighted three recommendations relating to building support for operational tests.

BUILDING SUPPORT RECOMMENDATIONS	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Develop educational materials	✓	✓
Foster ITS project champions	✓	
Develop and implement a deployment strategy		✓

One lesson was identified by both reports; *develop educational materials promoting ITS.* The *Findings and Recommendations* report focused on providing ITS-related information to state and local public sector agencies to allow them to promote ITS to the public, private, and academic sectors; upper management; the media; and the general public. The *Analysis and Lessons Learned* report focused on organizing new partnerships and guiding them through project start-up activities.

The *Findings and Recommendations* report recommended *the fostering of ITS program champions* at the state level and within large metropolitan areas to improve the visibility of ITS among key area leaders and agency staff. These leaders would be trained in ITS concepts and practices. A separate recommendation by the *Analysis and Lessons Learned* report was to *develop and implement a national IVHS deployment strategy.* Public outreach programs are needed on the national, state, regional, and local levels. Each public-private partnership should develop an outreach plan to support individual project goals and objectives.

5.2 DEVELOPING PLANS

The newness of the ITS concept caused project planning and coordination for the early operational tests to be unclear and disorganized. Project planning and coordination of the partners needs to be better defined at the beginning of the project to facilitate project start-up and avoid unnecessary delays.

RECOMMENDATION 1: ENSURE PROJECT DETAILS ARE ADEQUATELY DEFINED

The US. DOT should ensure that all significant project requirements are defined and when appropriate, are in place before fill federal funding is approved. These requirements may include identification of a project manager, documentation of support from local officials and upper management, a project management and communication structure, the project evaluation plan, and documentation of approval of state, local, and private sector funding. The U.S. DOT should consider granting a "no prejudice" reimbursable allowance to both the private and public sectors for costs which may be incurred prior to full funding approval. These may include costs incurred in developing project plans and other project requirements and for coordination among project participants.

RECOMMENDATION 2: FACILITATE THE INITIATION OF PUBLIC-PRIVATE PARTNERSHIPS

The U.S. DOT and other agencies involved in implementing ITS shouldfacilitate the initiation of public-private partnerships within a project. If a project involves a partnership, the funding agencies should sponsor retreats, seminars, or other methods of facilitation to develop the details of the partnership. Several topics should be addressed: partner roles and responsibilities, differences in operating methods between the public and private sectors, contracting procedures, procurement requirements, matching criteria, assignment of intellectual property rights, and project management and coordination.

Comparison With Analysis and Lessons Learned Report

Both reports made the same two recommendations relating to project planning and coordination for operational tests.

DEVELOPING PLANS RECOMMENDATIONS	*FINDINGS AND RECOMMENDATIONS*	*ANALYSIS AND LESSONS LEARNED*
Facilitate public-private partnerships	✓	✓
Define project details adequately	✓	✓

First, the U.S. DOT and other agencies involved in implementing ITS should *facilitate the initiation ofpublic-private partnerships* within a project. ITS projects are susceptible to institutional problems because of the diverse interests of the partners; this could impact deployment. Second, the U.S. DOT should *ensure project requirements, including the evaluation plan, are adequately defined.* A better defined project plan at the beginning of the project will facilitate project start-up and avoid unnecessary delays.

5.3 WORKING OUT THE DETAILS

Deployment of ITS products and services may involve changing current procedures or developing new ones. Project participants must ensure a smooth transition from their current work environment to one that includes ITS. Project procedures and requirements must be explained and understood by the participants.

RECOMMENDATION 1: PROMOTE AND ENCOURAGE INNOVATIVE PROCEDURES

The U.S. DOT and other funding agencies shouldpromote and encourage innovative practices in contracting, procurement, auditing, assignment of intellectual property, and match requirements. Successful and innovative procedures used in operational tests and other ITS deployments should be documented and presented to project participants. Also, staff of the funding agencies should be encouraged to be creative, take risks, and identify changes to current regulations that would facilitate the deployment of ITS.

RECOMMENDATION 2: CLEARLY SPECIFY THE REQUIREMENTS FOR MATCHING FEDERAL FUNDS

The U.S. DOT should clearly define the requirements for matching federal finds on a project-by-project basis. These requirements include the types of non-cash contributions that will be accepted as a match and a process to establish the value of products provided by the project participants. If a project is funded from a program that does not have a fixed matching ratio, then the percentage of non-federal match must be defined clearly.

RECOMMENDATION 3: FACILITATE THE ASSIGNMENT OF INTELLECTUAL PROPERTY RIGHTS

The U.S. DOT and other finding agencies shouldfacilitate the assignment of intellectual property rights. The U.S. DOT should explicitly state U.S. DOT policy on the assignment and use of intellectual property and encourage other funding agencies to adopt a similar policy. Projects should also be structured to separate from other tasks those tasks for which copyrights and patents can be obtained. These tasks should then be funded by the organization most suited to obtain the intellectual property rights.

Comparison With Analysis and Lessons Learned Report

Only the Findings and Recommendations report made recommendations relating to working out the details for operational tests.

5.4 MANAGING THE PROJECT

The uniqueness of ITS projects require participating agencies to take a new approach to project management and to learn the skills for implementing new technologies.

RECOMMENDATION 1: IDENTIFY A FULL-TIME MANAGER

Project participants must ensure that a fill-time manager is assigned to the project. Because of the relationship that a full-time manager has to the success of a project, **this is the most important recommendation made.** The manager will facilitate communication and coordination between partners, assist in defining partner roles and responsibilities, and provide the necessary momentum and organization in keeping projects on schedule. The manager must be an effective communicator and have good leadership skills. The manager must have extensive decision-making authority and support from all partners to build and maintain the project momentum. Involvement of a good full-time manager increases the likelihood of success.

RECOMMENDATION 2: DEVELOP A FELLOWSHIP PROGRAM

The US. DOT and other agencies involved in implementing ITS should develop an educational program for staff members of state, regional, and local public sector agencies currently working or who will be working on ITS projects Employees would be encouraged to attend formal degree-granting or certificate programs as well as seminars, conferences, and workshops covering ITS and related job skills. This training will ensure that agency staff have the skills required to manage ITS projects and implement new and evolving technologies.

Comparison With Analysis and Lessons Learned Report

Only the *Findings and Recommendations* report made recommendations relating to project management for operational tests.

5.5 MAINTAINING SUPPORT

Supporters of ITS are responsible for keeping ITS projects visible at a national level and facilitating the development and deployment of ITS products and services. On-going support is required to move ITS into the mainstream of transportation activities.

RECOMMENDATION 1: DEVELOP NATIONAL STANDARDS

The U.S. DOT should develop national standards for ITS technologies as quickly as possible. This action would promote a broader use of ITS products due to increased compatibility. It would also encourage public sector agencies to implement ITS technologies and private sector firms to invest in R&D because the fear of advancing outdated technologies or technologies that will not meet future standards will be overcome. Although the U.S. DOT is sponsoring the systems architecture program, interviewees recommended that some preliminary standards be developed now rather than waiting until the architecture is completed.

RECOMMENDATION 2: PROVIDE OPERATIONS AND MAINTENANCE FUNDING

Visible ITS projects should be properly operated and maintained. *Funding agencies should therefore provide funds to operate and maintain ITS.* Systems #at are deployed but are poorly operated or maintained will discourage potential ITS participants from initiating or funding ITS projects. Existing sources of O&M funding should be identified and new sources should be considered.

Comparison With Analysis and Lessons Learned Report

Only the Findings and Recommendations report made recommendations relating to maintaining support for operational tests.

APPENDIX A

ACRONYMS AND ABBREVIATIONS

AVCS	advanced vehicle control systems
APTS	advanced public transportation systems
ARTS	advanced rural transportation systems
ATIS	advanced traveler information systems
ATMS	advanced traffic management systems
AUTOSCOPE	AUTOSCOPE™ - 2003 Video Vehicle Detection System
AVL	automated vehicle location
BTP&D	Bureau of Transportation Planning and Development
CSF	critical success factor
CTS	Center for Transportation Studies
C V O	commercial vehicle operations
DOT	Department of Transportation
FAR	Federal Acquisition Regulation
FAST-TRAC	Faster and Safer Travel through Traffic Routing and Advanced Controls
FCC	Federal Communications Commission
FHWA	U.S. Department of Transportation Federal Highway Administration
FSI	Farradyne Systems Inc.
FTA	U.S. Department of Transportation Federal Transit Administration
GHTEMC	Greater Houston Transportation and Emergency Management Center
GIS	geographic information system
GMSI	Gandalf Mobile Systems, Inc.
GPS	global positioning system
HELP	Heavy Vehicle Electronic License Plate
HQ	Headquarters
HSC	Houston Smart Commuter
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991

ITS	intelligent transportation systems
IVHS	intelligent vehicle-highway systems
IVU	in-vehicle unit
MCTO	Metropolitan Council Transit Operations
MDOT	Michigan Department of Transportation
METRO	Metropolitan Transit Authority of Harris County, Texas
MHD	Massachusetts Highway Department
MnDOT	Minnesota Department of Transportation
MOU	memoranda of understanding
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Center
NHTSA	U.S. Department of Transportation National Highway Traffic Safety Administration
NVPDC	Northern Virginia Planning District Commission
O&M	operations and maintenance
PCD	personal communications device
PDA	personal digital assistant
PMT	project management team
PPM	planning and program management
PRTC	Potomac and Rappahannock Transportation Commission
PS&E	plans, specifications, and estimates
R&D	research and development
RCOC	Road Commission for Oakland County
RFP	request for proposal
SaFIRES	Smart Flexroute Integrated Real-Time Enhancement System
SAIC	Science Applications International Corporation
SCATS	Sydney Coordinated Adaptive Traffic System
s o v	single occupant vehicle
s o w	statement of work
SRS	SmartRoute Systems Limited Partnership
TM	technical manager

TMSI	Transportation Management Solutions, Inc.
TOC	traffic operations center
TRAC	Washington State Transportation Center
TRANSCOM	Transportation Operations Coordinating Committee
TRANSMIT	TRANSCOM's System for Managing Incidents and Traffic
TRAVTEK	Travel Technologies
TxDOT	Texas Department of Transportation
UM	University of Michigan
U.S. DOT	United States Department of Transportation
U W	University of Washington
VDRPT	Virginia Department of Rail and Public Transportation
VMS	variable message sign
Volpe Center	U.S. Department of Transportation John A. Volpe National Transportation Systems Center
VSL	variable speed limit
WCC	Westchester Commuter Central
WSDOT	Washington State Department of Transportation

APPENDIX B

REFERENCES

ITS America, "ITS Architecture Bulletin," January 1994, No. 1.

IVHS America, "Strategic Plan for Intelligent Vehicle-Highway Systems in the United States," IVHS America, Washington, DC, 1992.

Science Applications International Corporation (SAIC), "IVHS Institutional Issues and Case Studies - Analysis and Lessons Learned," Volpe National Transportation Systems Center, FHWA-SA-94-061, Final Report, April 1994.

U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, and National Highway Traffic Safety Administration, "Department of Transportation's Intelligent Vehicle Highway Systems Projects," HTV-10/4-94 (7M) QE, March 1994.

U.S. Department of Transportation, Office of the Secretary, " Department of Transportation's ITS Strategic Plan: Report to Congress," FHWA-SA-93-009, December 1992.

Volpe National Transportation Systems Center, "Intelligent Transportation Systems - Institutional and Legal Issue Program - Review of the Houston Smart Commuter Operational Test," FHWA-JPO-95-007, Final Report, June 1995.

Volpe National Transportation Systems Center, "Intelligent Transportation Systems - Institutional and Legal Issue Program - Review of the SaFIRES Operational Test," FHWA-JPO-95-008, Final Report, June 1995.

Volpe National Transportation Systems Center, "Intelligent Vehicle-Highway Systems - Institutional and Legal Issue Program - Review of the FAST-TRAC Operational Test," FHWA-SA-94-067, Final Report, June 1994.

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Volpe National Transportation Systems Center, "Intelligent Vehicle-Highway Systems - Institutional and Legal Issue Program - Review of the TravelAid Operational Test," FHWA-JPO-95-003, Final Report, January 1995.

Volpe National Transportation Systems Center, "Intelligent Vehicle-Highway Systems - Institutional and Legal Issue Program - Review of the Travlink & Genesis Operational Tests," FHWA-SA-94-071, Final Report, June 1994.

APPENDIX C

OPERATIONAL TEST
CASE STUDY REPORTS

IVHS Institutional Issues and Case Studies - ***ADVANCE*** *Case Study*
FHWA-SA-94-055
DOT-VNTSC-FHWA-94-9
NTIS Number: PB 94-l 86160

IVHS Institutional Issues and Case Studies ***-Advantage I-75*** *Case Study*
FHWA-SA-94-056
DOT-VNTSC-FHWA-94-10
NTIS Number: PB 94-186145

IVHS Institutional Issues and Case Studies - ***HELP/Crescent*** *Case Study*
FHWA-SA-94-057
DOT-VNTSC-FHWA-94-11
NTIS Number: PB 94-187101

IVHS Institutional Issues and Case Studies ***- TRANSCOM/TRANSMIT*** *Case Study*
FHWA-SA-94-058
DOT-VNTSC-FHWA-94-13
NTIS Number: PB 94-1835 14

IVHS Institutional Issues and Case Studies ***- TravTek*** *Case Study*
FHWA-SA-94-059
DOT-VNTSC-FHWA-94-12
NTIS Number: PB 94-186111

IVHS Institutional Issues and Case Studies - ***Westchester Commuter Central*** *Case Study*
FHWA-SA-94-060
DOT-VNTSC-FHWA-94-14
NTIS Number: PB 94-186152

IVHS Institutional Issues and Case Studies ***-Analysis and Lessons Learned***
FHWA-SA-94-061
DOT-VNTSC-FHWA-94-15
NTIS Number: PB 94-l 84322

IVHS Institutional and Legal Issues Program - Review of the ***FAST-TRAC*** *Operational Test*
FHWA-SA-94-067
DOT-VNTSC-FHWA-94-17
NTIS Number: PB 94-186103

IVHS Institutional and Legal Issues Program - Review of the ***Travlink and Genesis*** *Operational Tests*
FHWA-SA-94-071
DOT-VNTSC-FHWA-94-18
NTIS Number: PB 94-203296

ITS Institutional and Legal Issues Program - Review of the ***Houston Smart Commuter*** *Operational Test*
FHWA-JPO-95-007
DOT-VNTSC-FHWA-95-4
NTIS Number: PB 95-239646

ITS Institutional and Legal Issues Program - Review of the ***SaFIRES*** *Operational Test*
FHWA-JPO-95-008
DOT-VNTSC-FHWA-95-3
NTIS Number: PB 95-239638

ITS Institutional and Legal Issues Program - Review of the ***SmarTraveler*** *Operational Test*
FHWA-JPO-95-002
DOT-VNTSC-FHWA-94-24
NTIS Number: PB 95-179131

ITS Institutional and Legal Issues Program - Review of the ***TravelAid*** *Operational Test*
FHWA-JPO-95-003
DOT-VNTSC-FHWA-95-2
NTIS Number: PB 95-l 89536

METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd □ 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2 = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2 = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (Lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp □ 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] ^{o}F □ y ^{o}C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

1 milliliters (ml) □ 0.03 fluid ounce (fl oz)
1 liter (1) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

[(9/5) y + 32] ^{o}C □ x ^{o}F

QUICK INCH-CENTIMETER LENGTH CONVERSION

INCHES 0 1 2 3 4 5 6 7 8 9 10

CENTIMETERS 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 25.40

QUICK FAHRENHEIT-CELSIUS TEMPERATURE CONVERSION

°F	-40°	-22°	-4°	14°	32°	50°	68°	86°	104°	122°	140°	158°	176°	194°	212°
°C	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°

For more exact and or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10286.