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INSTITUTIONAL AND LEGAL ISSUES PROGRAM

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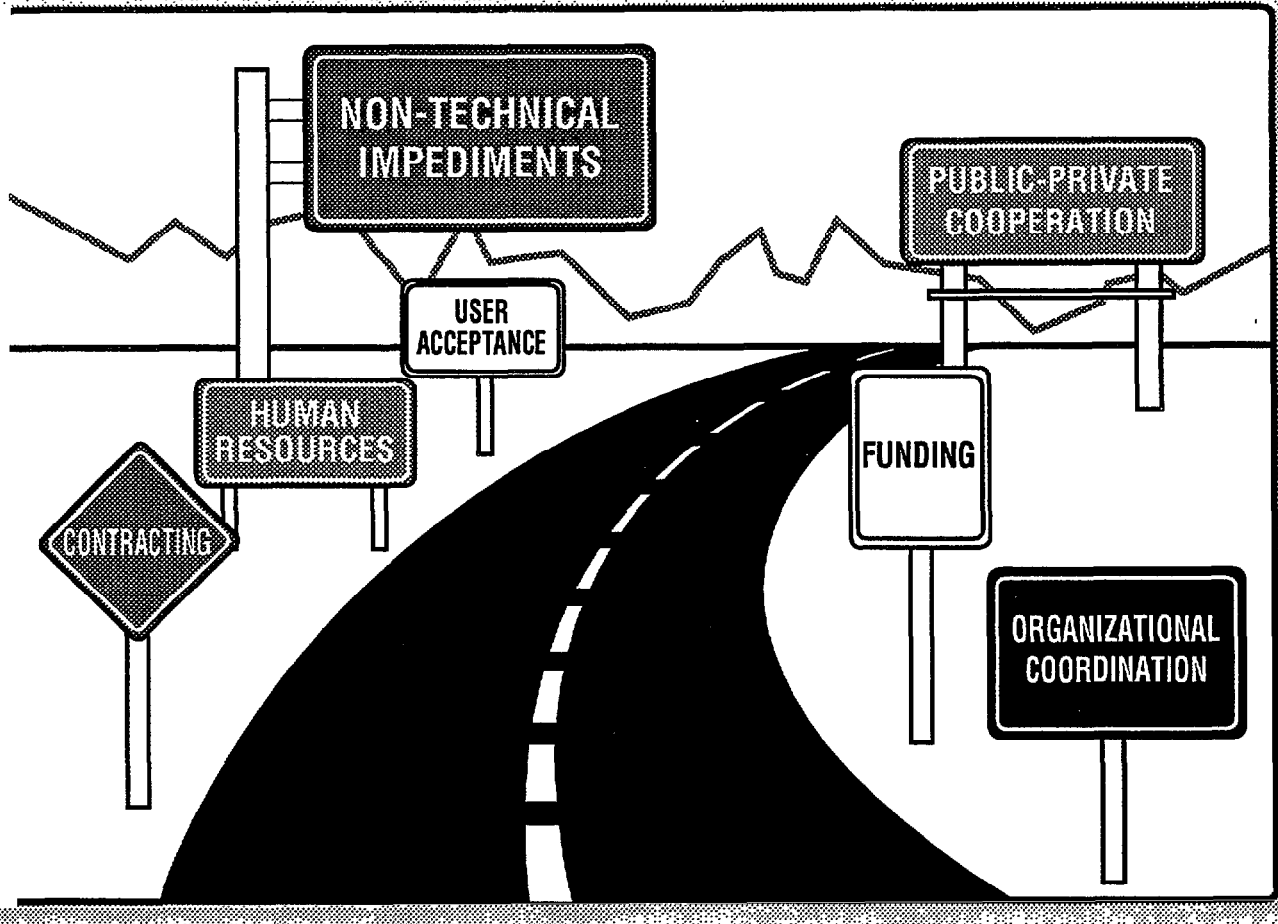
**Final Report
January 1995**

REVIEW OF THE TRAVELAID OPERATIONAL TEST



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13. ABSTRACT (Maximum 200 words)
The TravelAid operational test was chosen by the FHWA to be the subject of a case study. Several case studies were performed under the Intelligent Transportation Systems (ITS) Institutional and Legal Issues Program, which was developed in response to the Inter-modal Surface Transportation Act of 1991. The objective of each case study was to determine (1) the institutional issues and legal impediments encountered during the establishment of partnerships and deployment of ITS 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 case study also describes the operational test and documents its history. Interviews for this case study were conducted during the summer of 1994.

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Final Report

ITS INSTITUTIONAL AND LEGAL ISSUES PROGRAM

REVIEW OF THE TRAVELAID OPERATIONAL TEST

Michael Morrissey
Allan J. DeBlasio

January 1995

Prepared by

U.S. Department of Transportation
Research and Special Programs Administration
Volpe National Transportation Systems Center
Cambridge, Massachusetts

Prepared for

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Federal Highway Administration
Washington, D.C.

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)] ^oF ▫ y ^oC

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)

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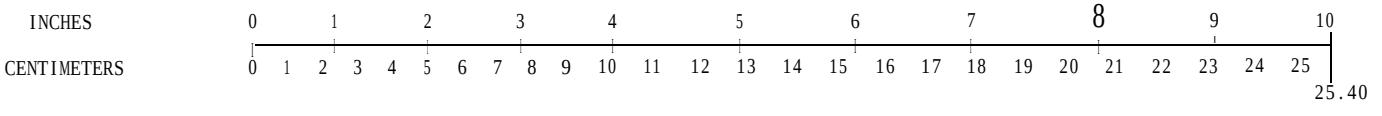
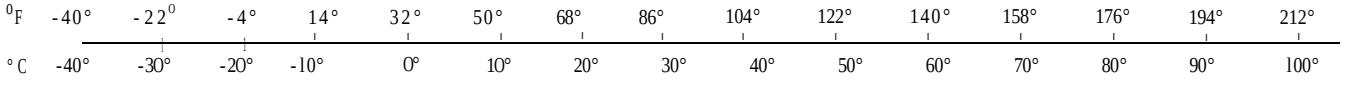
QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELSIUS TEMPERATURE CONVERSION



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.

PREFACE

In response to the Inter-modal Surface Transportation Efficiency Act of 1991 (ISTEA), the United States Department of Transportation (U.S. DOT) developed the *Intelligent Vehicle-Highway Systems (IVHS) Institutional and Legal Issues Program* (now called the *Intelligent Transportation Systems (ITS) 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 nontechnical barriers to ITS deployment, and (3) the lessons that were learned that might expedite the full deployment of ITS technologies.

This report was prepared by the U.S. DOT's John A. Volpe National Transportation Systems Center (Volpe Center) for the U.S. DOT's ITS Joint Program Office (JPO). The Volpe Center is providing analytical support to the JPO 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 will identify 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.

The Volpe Center has assessed ten federally sponsored operational tests with **the primary purpose** of answering four questions:

1. *What nontechnical impediments were encountered establishing partnerships and deploying ITS services and products during the operational test?*

2. *Where in the life cycle of the operational test did these impediments occur?*

3. *What were the causes of these impediments and how were they overcome?*

4. *What lessons were learned in dealing with these impediments that can be applied to future deployments of ITS products and services?*

In order to place the nontechnical issues in the life cycle of the development and the deployment of the ITS product or service, the **secondary purpose** of the assessments is to describe the operational test and document its history. These assessments are intended to be illustrative and descriptive in nature. They are not intended to be evaluative (i.e., comparing an observed outcome of the operational test to an expected level of performance) or show cause-and-effect (i.e., identifying whether the operational test has contributed to changes to a base condition or event). Also, these assessments are not intended to evaluate the technical components of the operational tests.

During the late spring of 1994, a team of analysts, in accordance with the Volpe Center Project Memorandum, *IVHS Institutional Issues - Monitoring Program Framework,* interviewed and sent questionnaires to 14 project participants from the TravelAid operational test and reviewed project documentation. The interviewees represented federal and state governments, academia, electronic and communication companies, and consultants and contractors to the test. These individuals were involved in various aspects of the operational test from policy making to program management to technical and administrative support. They included corporate officials, program administrators, engineers, 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 TravelAid operational test and the ITS program in general.

The authors were sensitive to the criticism that project evaluations either seek out negative aspects of the project with little emphasis on positive lessons, are biased, or lay blame. The authors acknowledge that the assessments were oriented toward finding problems, but these assessments were also structured to identify positive lessons that were learned and that could be shared with others.

The authors thank the interviewees for taking time from their busy schedules to answer our questions and for their openness in doing so. The issues, lessons, and insights that they discussed will benefit the entire ITS effort.

Section 1 of this report is a summary of the project and of the issues and lessons learned that were discussed by the interviewees. **Section** 2 describes the scope, history, management structure, and participants of the TravelAid operational test. It also discusses the stated project goals and objectives, the goals and objectives of the project participants, the benefits the interviewees foresee for participating in the project, the risks that they or their organization may be taking, and what they see as the critical success factors of the project. **Section 3** presents a more detailed discussion of the institutional issues and lessons learned.

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1. SUMMARY

This section presents an overview of the TravelAid operational test and a summary of the issues and lessons learned that emerged from discussion with the interviewees.

1.1 PROJECT OVERVIEW

TravelAid is a federally funded Intelligent Transportation Systems (ITS) [formerly Intelligent Vehicle-Highway Systems (IVHS)] operational test that focuses on a 38-mile section of Interstate 90 (I-90) in the State of Washington. The highway is the primary east-west roadway in the state, linking Seattle and Spokane. The test will extend from North Bend, on the western side of the Cascade Mountains, crossing over the Snoqualmie Pass, to Easton on the Cascades' eastern side.

About 50 miles east of Seattle, and at an elevation of 3,020 feet, Snoqualmie Pass averages an annual snowfall of some 44 feet, with accumulations of 7 to 8 feet near the summit. On average, 60 inches of rain fall each year in the pass; conditions are classified as fog, snow, or rain for some 290 days each year. Under these conditions, the posted maximum speed limits are inappropriate.

The pass is isolated. Excluding a small cluster of commercial operations at the summit for skiers and campers, there are no surrounding communities or services. Adverse winter conditions result in a high accident rate and occasional highway closures. Traveler information reporting driving conditions over the pass currently is provided by four radio stations.

Average daily traffic across the pass in 1991 amounted to approximately 22,400 vehicles. Trucks amounted to about 22% of the volume. Daily traffic is heavily recreational; commuter use is relatively low. The traffic stream is thus composed of many drivers who are unfamiliar with the prevailing weather conditions at the pass. Bad weather and an unfamiliar driver population primarily account for the higher than average accident rate.

The TravelAid system involves implementation of a variable speed limit (VSL) and motorist alerting system, which will provide travelers over the Snoqualmie Pass with information on traffic, weather, and road conditions and closures; traction device requirements; accidents; and avalanche control and snowplow activities – all in a more timely and accurate manner than is currently available.

TravelAid will collect data from traffic detectors and weather sensors along the highway and from the system operator. The system will store and manage this information using a computer database, and distribute advisories through 13 variable message signs (VMS) and VSL signs, as well as through 200 in-vehicle unit (IVU) radio receivers with alphanumeric displays.

Reduced speed limits, based on weather, road, and traffic conditions, will be set by a sensor network and the Washington State Department of Transportation (WSDOT) and Washington State Patrol (WSP). TravelAid's IVUs will transmit information to the drivers of the 200 specially equipped vehicles. The IVUs will evaluate the impact of the signing equipment on driver behavior; their alphanumeric readouts will alert drivers to specific problems and conditions in their vicinity; and IVUs will receive information from roadside transmitters tied to a central computer and from data entered by WSDOT maintenance crews from roadside cabinets. Both the WSP and snow removal personnel will carry portable transmitters for emergency use. A variety of technologies, including dual loop detectors and weather stations, will monitor traffic and weather conditions.

The major TravelAid project participants include the Federal Highway Administration (FHWA), the WSDOT, Farradyne Systems Inc. (FSI), the University of Washington (UW), the National Highway Traffic Safety Administration (NHTSA), and the Washington State Transportation Center (TRAC).

The FHWA is funding development of the TravelAid system and is monitoring the operational test's progress. The NHTSA is funding development and refinement of the evaluation plan. The WSDOT is responsible for project administration and is providing state funding to the project. Further, WSDOT staff preside over the project steering committee, coordinate with other state agencies, and participate in the evaluation. The WSDOT is also responsible for many of the design features of the project (e.g., roadside layout and sign placements, design reports, soil tests for sign and bridge foundations). The agency is responsible for reviewing and approving the system and developing the operations manual.

UW personnel will act as operational test evaluators. They are responsible for writing the evaluation plan, developing a driver simulator, conducting the project evaluation, and assisting with report production. They also serve as a focal point for the coordination of student participation and other resources in the project.

As the prime contractor and lead project administrator, FSI's responsibilities include preparation of a detailed system design, development and integration of software, coordination of all subconsultant activities and deliverables, and development of the plans, specifications, and estimates (PS&E) for the VMS and VSL signing, support structures, and data stations.

Two other organizations – Engineering Research Associates (ERA), and TrafficMaster – are subcontractors to FSI. ERA will develop and supply the portable transmitters for the IVUs, detailed specifications for the portable beacons, 20 portable beacons, and the fixed communication link specification. TrafficMaster will develop and provide 200 IVUs and support for these units. A third organization, Surface Systems, Inc. (SSI), is an equipment supplier under the construction contract for the project. As such, SSI will supply 30 road surface condition and atmospheric detectors and support integration of the project hardware.

Responsibilities for project direction, assuring conformance with project plans, budgeting, and project scheduling are in the hands of a steering committee, made up of one member from each

of the full project partners. The steering committee also oversees press releases and other project publicity. Within the steering committee framework, each of the participating organizations bears responsibility for its own assigned project activities. A representative of the WSDOT Headquarters Traffic Office, who is located at the TRAC office, and a representative of the WSDOT Southwest Region office chair the committee.

In December 1978, changeable message signs (CMS) were installed along I-90 over Snoqualmie Pass advising motorists on traction requirements. In March of that year, two highway advisory radio (HAR) sites were established to provide additional information to drivers concerning traffic conditions over the pass. A third HAR site was installed in 198 1.

In 1983, the system was expanded. Another CMS, a fourth HAR location, and a barrier gate for use during Pass closures were added. Information for system operation is gathered and consolidated at the Hyak control center, where all devices are controlled through radio and leased telephone lines. This system has proved invaluable in making Snoqualmie Pass safer for motorists.

In August 1991, the WSDOT requested federal assistance for the TravelAid project. The FHWA approved $1,579,525 of FY 1992 IVHS funds for the project that same month. The cooperative agreement between the two organizations went into effect September 18, 1992.

The draft system design report received FHWA approval March 3 1, 1993. The Phase 1 construction advertisement ran in July of that year. On August 10, 1993, the WSDOT completed the consultant agreement with FSI, and the initial steering committee meeting occurred August 17, 1993. The project evaluation agreement with the UW went into effect in October 1993.

The PS&E for the system design was completed and the construction contract was awarded on January 3, 1995. The request for proposals (RFP) for the VMS was released, bids have been received, and the final award is pending. The evaluation plan was approved by the NHTSA in January 1995. The UW-developed driving simulator was scheduled to be completed in winter 1994. System software development is continuing. An initial test of the prototype IVU was scheduled for September 1994.

1.2 ISSUES ENCOUNTERED BY PROJECT PARTICIPANTS AND LESSONS LEARNED

This subsection outlines the institutional issues, nontechnical constraints, and lessons learned that were discussed by TravelAid project participants in their interviews and questionnaires. The issues and lessons learned fall into eight categories:

. New Business Relationships

. Organizational Coordination

. Contracting and Accounting

- Funding and Budgets
- Technology and Standards
- Human Resources
- Intellectual Property Rights
- User Acceptance

1.2.1 New Business Relationships

As with other operational tests, issues surrounding the establishment of new business relationships surfaced early. Both public and private sector participants, and participants from the academic community as well, believed the *roles and responsibilities* of the many participants in the project were *unclear,* and that this caused delays and added to costs. While, on the positive side, neither the public nor private sectors viewed this particular issue as playing a significant role in operational test deployment, they did believe that overall project planning and coordination was *disorganized* – partially because project participants did not fully understand *the institutional and organizational structures* required for the project to proceed.

In one instance, some WSDOT officials questioned *lack of formal competition* at the state level in selecting private sector partners; they also questioned the sole source selection process for project evaluator at the federal level. Another issue arose early on, when a partner withdrew from the project and had to be replaced, thus introducing further project delays. Finally, academic participants thought that significant differences existed between the *organizational cultures* of the public and private sectors, and the academic comnmnity as well. While most of their differences were eventually worked out, participants felt that they had often worked according to *conflicting goals, priorities, and timetables,* that public-private partnerships and operational tests are *new* undertakings, and that public and private sector business processes and bureaucratic procedures not only *differ,* but individually add complexity to the undertaking.

Among the **lessons** participants learned were that **significant inter- and intra-agency support and coordination are required** to keep the project moving forward. They agreed that the steering committee is a successful communications and management forum, but felt that, without significant support and coordination, the project would be subject to problems. They stated that **roles and responsibilities needed to be defined at the start of the project.** They also felt that greater senior *management* project *support* was needed – particularly in terms of coordinating work intra-organizationally. Further, they thought that operational test participants in general should realize that they will have to commit to a greater level of effort than they initially expect. Most comments stressed the importance of gaining a good up-front *understanding of the issues and complexities of the project.* Finally, academic participants suggested a lesson – that all academic institutions would benefit from *an organizational interface* like TRAC, as it would permit the academic staff to focus more on research activities.

1.2.2 Organizational Coordination

Allied to the problems surrounding the establishment of new business relationships, specific issues involving organizational coordination concerned the lengthy design review process (described *as cumbersome)* of the WSDOT, the timing and manner of NHTSA's project involvement, difficulties in *communication and coordination* between WSDOT and the various other participants, and the fact that the WSDOT does not have full control over the communications infrastructure that needs alteration for the operational test.

Lessons learned about these issues included **starting design reviews as early as possible.** Others felt that the review process needed streamlining and should be more *flexible* In terms of NHTSA's involvement, participants suggested that a *clearer understanding* of the evaluation plan at the start of the project would have been helpful. They also noted that, after a project is started, **the involvement of additional agencies increases project management complexity and coordination requirements and may result in project delays.** Concerning communication and coordination issues, a public sector participant believed that a *smaller project group* would lead to greater communication and fewer problems. With regard to the WSDOT's lack of control over the communications infrastructure, and again on a positive note, one lesson learned suggests that **if the right people are in the loop and if all the participants have an interest in the success of a project, then problems can be overcome.**

1.2.3 Contracting and Accounting

With the TravelAid project, several contracting and accounting issues tended to overlap. First, the original contracting mechanism and language proved *unacceptable* to a private sector participant, who dropped out of the project altogether. For other participants, contracting issues caused *tension* in negotiations and inter-agency activities throughout the start of the project. The public sector participants were uncertain how to structure contracts with their private-sector partners; the private-sector partners, for their part, were unhappy with fixed-dollar contract mechanisms. Moreover, private-sector participants were *unable* to readily provide financial and accounting data to government agencies.

Private-sector representatives felt there were too many *unknowns* associated with ITS products, and that they needed more *liability protection* when developing new technologies. They believed that Department of Defense (DoD)-style working relationships contain the right sort of liability protection, as opposed to DOT-style relationships. While these issues were resolved, a six-month delay in the project occurred while participants negotiated some compromises.

Interviewees drew an important lesson from these problems: **The contracting mechanism used for operational tests needs to be flexible.** Business must be conducted differently to accommodate public-private partnerships. Participants felt, additionally, that federal and state DOTS needed to protect the ITS industry in the same way as the DoD offers contractors liability protection. They thought that **contracting conditions should be discussed by all participants prior to the project:** to identify problems, to ensure state and federal procedures were completed

properly beforehand, and to achieve more up-front *coordination* within public agencies. They also believed that a contracting *"template"* needed to be developed for operational tests.

One private-sector participant thought that the liability issue could hinder *future* full *deployment* of ITS products and services. Representatives of both sectors offered this **lesson:** State governments, in particular, should revisit arbitrary overhead rates and introduce *more flexibility* when dealing with companies having justifiably greater overhead rates. With regard to federal participation, some participants felt that federal involvement helped mitigate the process. They thought that the possibility of funds flowing directly from the FHWA should be explored.

1.2.4 Funding and Budgets

Project participants focused on three issues in the funding area. They believed that staying within the project *budget* was difficult; that *match requirements* (i.e., 80/20 and 50/50 match requirements) were not clearly defined; and that *funding* for global positioning activities for the system were uncertain.

The primary **lesson** offered by participants **was** that **project management needs to periodically reexamine the proposal and scope of work to determine if the project can be completed within budget.** Also, participants felt that projects should have *good cost estimates* early in the process and that project participants need a better understanding of the design process, in general. They suggested that funding *priorities* must be set and options and risks *clearly defined.* They believed that changes in project scope may cause delays and increase costs and that ITS projects – which *are not traditional,* low-bid awards – need to be accommodated at both the state and federal levels. **Deployment** of the TravelAid operational test, they believed, would be affected if costs continued to rise, and no new funding became available.

With regard to match requirements, participants felt primarily that **it is important to obtain commitment up-front.** Some interviewees suggested documenting this commitment in a memorandum of understanding (MOU) or partner agreement. Further, they suggested that the match for project funds be *auditable,* and that private funds be used to match federal funds. They argued that a higher funding commitment might be required to provide *more balance* between private-sector and public-sector partners. Issues around the shifting of funds within the project produced the observation that funding must be *tracked* more closely.

1.2.5 Technologies and Standards

Project participants encountered four primary issues in the technology and standards area. Representatives from all three sectors cited *the communications component* as presenting many technological and institutional difficulties. Some believed there may be unrealistic *expectations* for IVUs. Others saw problems developing around the multitude of "not precisely compatible" VMS technologies and the difficulty in producing a workable specification for acquiring VMS

signs. Again, private-sector participants found fault *with inflexible funding mechanisms* that could impede deployment of an optimal communications system.

Neither the complexities of the communications system design nor the intricacies around FCC licensing requirements were fully understood or anticipated at the project's outset. Because of this, interviewees expressed one principal **lesson: When wireless communications are an element of an operational test, the participants should realize that significant complexities lie ahead.** As with other issues, participants again stressed the importance of defining all critical elements *as early as possible.* Although there will always be unforeseen problems in operational tests, participants maintained that the communications system design should have started earlier. Having communications expertise within the WSDOT at the start of the project would also have been a plus, some interviewees pointed out. They further argued that this issue could affect system **deployment,** and that the problem will remain alive until the FCC reassigns frequencies.

Doubts concerning the efficacy of IVUs surfaced among several participants. The WSDOT staff was unclear as to the units' role in the project; they stated that the IVUs are subject to too many *external* factors, and the effectiveness of IVUs is unknown. Also, the interviewees stated that no cost-benefit analysis had been conducted for IVUs and the limited sample of IVUs may not be large enough to be statistically significant.

Difficulties arising over the variety of "not precisely compatible" VMS technologies were ultimately resolved, but participants suggested two **lessons.** First, the basic hardware *requirements* of the system should be established through the steering committee, and second, only industries and technologies that *are readily available* should be promoted.

With regard to inflexible funding mechanisms, one private-sector participant observed that the FHWA must realize that an extensive operational and maintenance component is required for the deployment of high-technology communications systems. In this participant's view, the FHWA will continue deploying overly expensive, and possibly not maintainable, systems unless the funding *policy is changed.*

1.2.6 Human Resources

Human resource issues focused on a lack of communications and computer-based expertise, both among contractors in the field and within the WSDOT. The first **lesson** learned in this area, as stated by a public sector participant, is that technical resources, qualified contractors, and systems designers are not readily available in rural areas for the implementation of such projects, and that this could have a negative impact on **future** ITS **deployment.**

Initially, WSDOT did not have adequate communications resources, and this led to delays and gaps in the original system design. In considering this issue, project participants offered the following **lessons: State DOTs need internal communications expertise** (even when projects have contractors). Further, private-sector participants *are* going *to* have to *verify data* given to them by the public sector.

1.2.7 Intellectual Property Rights

Regarding intellectual property rights, project participants were concerned that *ownership* and *use* of intellectual property *was unclear.* Retention of intellectual property rights for products and technologies developed for the project was a point of contention between public and private sector participants. Because TravelAid was funded by a mix of private and public funds, the original contract was *ambiguous* about the ownership and future use of the products and data developed during this operational test. Also there is *no clear guidelines* on mixing funds to develop ITS technologies. This issue delayed signing of consultant agreements.

The issue was resolved when the FHWA allowed changes to the contract language to state that private-sector-developed intellectual property with federal funds would be used by federal agencies for federal applications only.

The **lessons** that grew out of discussion included the need to state that there will be *no competition* between public and private sectors in deployment of ITS products and services; that the public sector should focus on *demonstrating the benefits* of ITS and not on product development; and that profit and intellectual property rights *are important* private sector *issues* and are not always taken into account by the public sector.

1.2.8 User Acceptance

Participants discussed only one issue in the user acceptance area; their major concern was that the public could *react negatively* to the project. They thought the public might perceive the project as a waste of tax dollars. While large amounts of money are being spent, the technology being tested might appear to the public to have limited applications.

Project participants stressed the **lesson** that **there is a great need to educate the public about ITS.** They had two other observations. First, a need exists to *examine fund* expenditures to ensure that they are spent responsibly and effectively, and second, the industry is so *new* that no one is completely aware of future opportunities for ITS. Finally, with regard to **deployment,** a participant felt that a negative public reaction might effectively *cut the project* short.

2. PROJECT OVERVIEW

This section describes the scope, history, participants, and management structure of the Travel-Aid operational test. It also discusses the stated project goals and objectives, the goals and objectives of the project participants, the benefits the interviewees and questionnaire respondents foresee for participating in the project, the risks that they or their organization may be taking, and what they see as the critical success factors of the project.

2.1 PROJECT DESCRIPTION

TravelAid is a federally funded ITS operational test along a 38-mile section of Interstate 90 (I-90) in the State of Washington. The highway is the primary east-west roadway in the state, linking the cities of Seattle and Spokane. The test will extend from North Bend on the western side of the Cascade Mountains, through the Snoqualmie Pass, to Easton on the eastern side. I-90 is a six-lane facility from North Bend to Hyak and a four-lane facility from Hyak to Easton.

Approximately 40 miles east of Seattle, I-90 enters the Snoqualmie National Forest which is part of the Cascade Mountain Range. I-90 crosses the Cascades at the Snoqualmie Pass. Located approximately 50 miles east of Seattle and at an elevation of 3,020 feet, the pass experiences average annual snowfall of some 44 feet, with accumulations of 7 to 8 feet in the vicinity of the summit. On average, 60 inches of rain fall each year in the pass and conditions are classified as consisting of fog, snow, or rain for some 290 days each year. These conditions are inappropriate for the posted maximum speed limits; 60 miles per hour (mph) for trucks and 65 mph for all other vehicles.

The pass is an isolated area with no surrounding communities or services except for a small cluster of commercial operations at the summit. It is a popular recreational area for both skiers and campers. The adverse winter weather conditions result in a high accident rate and occasional closures of the facility. Traveler information about driving conditions over the pass is currently provided by four radio stations.

Average daily traffic across the pass in 199 1 was approximately 22,400 vehicles. Trucks comprised some 22% of the volume. Daily traffic is heavily recreational with relatively low commuter use. Thus, the traffic stream is comprised of many drivers who are unfamiliar with the prevailing weather conditions. This combination of adverse weather conditions and an unfamiliar driver population are the primary causes for the higher than average accident rate along the pass.

The TravelAid system involves the implementation of a variable speed limit (VSL) and motorist alerting system. This system will provide several types of information to travelers over the Snoquahnie Pass in a more timely and accurate manner than is currently available:

- traffic conditions
- weather conditions
- road conditions and closures
- traction device requirements
- incidents
- avalanche control activity
- snowplow activity.

The TravelAid system will collect the data from traffic detectors and weather sensors placed along the highway and from the system operator. It will manage and store this information in a computer database and will distribute regulatory and advisory information through 13 variable message signs (VMS) and VSL signs and 200 in-vehicle unit (IVU) radio receivers with alphanumeric displays.

VSL signs will be installed after each on-ramp to I-90 between North Bend and Easton, a distance of approximately 20 miles. Reduced speed limits based on weather, road, and traffic conditions will be set by a sensor network and the Washington State Department of Transportation (WSDOT) and Washington State Patrol (WSP) personnel.

The IVUs will transmit information to the drivers of the equipped vehicles. The IVUs will also evaluate the impact of the signing equipment on the drivers behavior. The IVU alphanumeric readout will alert drivers to specific problems and conditions in their vicinity. The IVUs will receive information from roadside transmitters tied to a central computer or from data entered by WSDOT maintenance crews from roadside cabinets. Both the WSP and snow removal personnel will carry portable transmitters for emergency use. A variety of technologies, including dual loop detectors, weather stations, radar traffic detection, and radio communications, will monitor traffic and weather conditions.

2.2 PROJECT PARTICIPANTS

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

The **FHWA** and the **NHTSA** are full participants in the project. The FHWA is providing federal operational test funding for the development of the TravelAid system and monitors the progress of the test. The NHTSA is providing funds for the development and refinement of the evaluation plan.

The WSDOT is responsible for the project administration and provides state funding to the project. WSDOT staff established and preside over the project steering committee, coordinate with other state agencies, and participate in the evaluation. The WSDOT, primarily through the Southwest Region office, is also responsible for many of the design features of the project, such as developing the roadside layout and sign placements, preparing the design reports, testing soils for sign and bridge foundations, and developing structural designs for sign bridges. The agency is responsible for reviewing and approving the system and developing the operations manual.

UW personnel are the operational test evaluators. UW staff are responsible for writing the evaluation plan, developing a driver simulator, conducting the project evaluation, and assisting with the report production. They also serve as a focal point for the coordination of student participation and other resources in the project.

FSI is the prime contractor and lead project administrator. In this role, the company's responsibilities include the preparation of a detailed system design, the development and integration of software, the coordination of all sub-consultant activities and deliverables, and the development of the plans, specifications, and estimates (PS&E) for the VMS and VSL signing, support structures, and data stations.

Three other organizations also are participating in the operational test. **Engineering Research Associates** (ERA) is a sub-contractor to FSI. ERA will develop and supply the portable transmitters for the IVUs, supply detailed specifications for the portable beacons, supply 20 portable beacons, and provide the fixed communication link specification. **TrafficMaster** is also a subcontractor to FSI. Their role is to develop and supply 200 IVUs and provide support for these units. **Surface Systems, Inc.** (SSI) is an equipment supplier under the construction contract for the project. In this role, their responsibilities are to supply 30 road surface condition and atmospheric detectors and to support the integration of the project hardware.

2.3 MANAGEMENT STRUCTURE

A steering committee, comprised of one member from each of the full project partners, is responsible for project direction, assuring conformance with project plans, budgeting, and project scheduling. The steering committee also is responsible for approving press releases and other project publicity. Within the steering committee framework, 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.

2.4 PROJECT HISTORY

In December 1978, changeable message signs (CMS) were installed along I-90 over Snoqualmie Pass to alert motorists of traction requirements. In March 1979, two highway advisory radio (HAR) sites were installed to provide additional information to the motoring public regarding traffic conditions over the pass. A third HAR site was installed in 1981.

In 1983, the system was expanded with the addition of another CMS, another HAR location, and a barrier gate to **be used** during Pass closures. Currently, information for the system operation is gathered and consolidated at the Hyak control center which also controls all devices through radio and leased telephone lines. The existing system has proved to be an invaluable tool for improving safety over the Snoqualmie Pass.

In August 1991, the WSDOT submitted a request for federal assistance for the TravelAid project. The FHWA approved $1,579,525 of Fiscal Year (FY) 1992 IVHS funds for the TravelAid project on August 5, 1992. The cooperative agreement between the FHWA and the WSDOT was signed on September 18, 1992.

The draft system design report was produced on January 4, 1993 and approved by the FHWA on March 31, 1993. The Phase 1 construction advertisement was issued on July 5, 1993. On August 10, 1993, the WSDOT executed the consultant agreement with FSI. The initial steering committee meeting was held on August 17, 1993 The agreement with the UW to perform the project evaluation was executed in October 1993.

The PS&E for the system design was completed and the construction contract was awarded on January 3, 1995. The request for proposals (RFP) for the VMS was released, bids have been received, and the final award is pending. The evaluation plan was approved by the NHTSA in January 1995. The UW-developed driving simulator was scheduled to be completed in winter 1994. System software development is continuing. An initial test of the prototype IVU was scheduled for September 1994.

2.5 GOALS AND OBJECTIVES

The project goals and objectives were taken from the original proposal for the TravelAid project, *A Proposal for the Implementation of an Intelligent Vehicle Highway System in the State of Washington,* prepared by the WSDOT and FSI. The following three objectives were stated in the proposal:

- The enhancement of motorist safety on freeway facilities.
- The reduction in accident rates associated with excessive speeds for existing geometric, traffic, and environmental conditions.

- The reduction in accident rates due to vehicle speed differentials.

These three project goals were compared to the goals stated by the interviewees and questionnaire respondents to identify possible conflicts. No conflicts were found; however, most participants expressed goals beyond those stated in the project proposal. In addition, only public sector participants stated safety as being part of the set of project goals. Five goals and objectives were stated three or more times:

(The numbers in parentheses in the following sections represent the number of times an item was mentioned and the number of individuals who mentioned it.)

- To test the application of ITS technologies. (9-6)

  Five participants from the public sector and one from the private sector stressed the testing of different technologies as a project goal. The public sector participants mentioned the technologies associated with the communications systems and the VSL and VMS technologies. The private sector participant focused on the communications systems.

- To increase safety on the roadway. (6-5)

  Five public sector participants emphasized increased safety for travelers as a project goal. One interviewee mentioned that the system was a cost effective way of improving safety.

- To examine and develop a position in the ITS market. (5-3)

  Three private sector participants stated that the goal of their organization for participating in the project was to examine ITS market potential. One participant saw the project as a mode of entry to the market. Another participant stated that if the project was a success, then that organization would be a leader in the market.

- To gain experience in ITS. (3-3)

  Two participants from the private sector and one from the academic community saw gaining experience as a goal of their organization for participating in the project.

- To evaluate the effectiveness, costs, and benefits of the proposed technology. (3-2)

  Two public sector participants saw the opportunity to evaluate the effectiveness of technologies as a goal of the project. One participant at the policy level stressed that a goal of the project was to examine the costs, benefits, user acceptance, and impacts of the technology.

2.6 BENEFITS

The benefits discussed by the interviewees and the questionnaire respondents were closely related to the goals that they expressed. Gaining experience and expertise, improving safety, developing business contacts, and benefiting travelers were emphasized. Four benefits were mentioned three or more times:

- The project participants will gain experience and knowledge in a variety of areas. (9-6)

  Six participants from the academic, private, and public sectors noted that they will gain experience in new areas. One academic participant commented that the project will provide experience in the application of new technologies. Two private sector participants noted that the project will provide feedback on the performance of specific technologies. Another private sector participant commented that the test will provide information on the ITS industry demand curve. Two public sector participants stressed that their organizations benefited by gaining experience with advanced technologies. One public sector participant stated that the project provides experience in public relations.

- The project will improve safety on the roadway. (5-5)

  Five participants from the academic and public sectors emphasized that a benefit from the project was increased safety.

- Travelers will benefit. (3-3)

  Three participants from the public sector noted that travelers would realize benefits from the project. One participant mentioned that the project would provide a valuable service to travelers, while another participant commented that by providing travelers with better information they could make better decisions.

- The project provides business opportunities. (3-2)

  Two participants from the private sector commented on the potential business-related benefits from participating in the project. One participant noted that the project expanded the organization's business network.

  Academic participants stressed that the project provided the opportunity to interest students in a new field and to perform interesting research. The private sector representatives saw the primary benefits as potential future business opportunities and gaining experience about the ITS technology and industry characteristics. The public sector representatives saw the primary benefits from the project as the acquisition of ITS experience, increased safety, and better information for travelers. Policy makers and technical staff from both the public and private sectors identified gaining experience in ITS technology as a significant benefit.

2.7 RISKS

The interviewees and questionnaire respondents identified several risks that they or their organization may face because of their participation in TravelAid. The risks that they mentioned most frequently were associated with the innovative nature of the test and its possible failure. Five risks were mentioned three or more times:

- The participants could incur a loss on their investment in the project. (6-6)

  Policy makers and administrators in both the public and private sector stressed the risk of losing their financial investment. Public agency participants commented on the required capital investment for the project while private sector participants stressed the potential for loss on their investment.

- The reputation of the participants' organization could suffer if the project fails. (5-5)

  Both public and private sector representatives emphasized the possibility of damaging the image of their respective organizations. Private sector comments reflected the damage to the reputation of the organization should the project fail. One public sector participant spoke of the risk of losing credibility with drivers.

- The system may fail or the participants may not have the ability to successfully design and implement the system. (3-3)

  Two public sector participants commented that the unique nature of the project could lead to an increased risk of failure. One private sector participant noted that the partners may not be able to integrate the system components.

- The project may exhaust its funding without achieving results. (3-3)

  One public sector participant expressed concern that if the schedule was not met, then the project could lose funding. Another public sector participant noted that if the construction was not completed, then funds may have to be returned. A private sector participant commented that the construction budget could be exceeded.

- The success of the project relies on other participants fulfilling their roles. (4-2)

  Two participants, one academic and one private sector, noted that the ultimate success of the project was out of their control and dependent upon the other participants.

2.8 CRITICAL SUCCESS FACTORS

The interviewees and questionnaire respondents discussed those areas they regard as critical success factors (CSFs) For the purposes of this report, a CSF is defined as a key area that must be completed successfully in order for the project to be considered a success. Seven CSFs were discussed three or more times:

- There must be effective project management. (6-4)

  Four public sector participants stressed the necessity of keeping the project on schedule and within budget and achieving specified project milestones. Three of the participants emphasized that the project schedule must be maintained.

- The evaluation plan must be structured correctly and implemented. (4-4)

  Three public sector participants and one private sector participant discussed the need for a properly designed and implemented evaluation plan.

- The required radio frequencies must be approved by the Federal Communications Commission (FCC). (4-4)

  Three participants from the public sector and one from the academic community stressed the approval of radio frequencies by the FCC as critical to the success of the project.

- The system must operate reliably and provide accurate information to travelers. (5-3)

  Three participants, one from each of the private, public, and academic sectors, stressed the need for the system to provide accurate information to drivers in order for the test to be a success. The private sector emphasized that the VMS, VSL, and IVU elements of the project must deliver usable information to travelers.

- There must be an adequate sample size of users so as to verify the test results. (4-3)

  One representative from each of the three sectors emphasized the need for an adequate survey sample size of users to effectively evaluate the project. A private sector participant also noted that the statistical data should show the impact of the system.

- The communications system must work as designed. (3-3)

  One private sector and two public sector participants emphasized the importance of the communications system. The private sector participant stated that the communications network must operate correctly. One of the public sector participants stressed the need for compatibility between the roadside transmitters and the IVUs.

- There must be adequate resources for the project. (3-2)

  Two public sector participants identified sufficient funding as critical to the success of the project. One participant noted that participants must gain experience with mixing and leveraging funds. Another participant stressed the need for senior management commitment to provide the resources required for continuing ITS projects in the future.

2.9 MILESTONES

The interviewees and questionnaire respondents discussed those events they regard as project milestones. The milestones are not necessarily events as set out in the project schedule, but are the set of important activities which have either already occurred or need to occur from the perspective of the project participants. The participants addressed fourteen different areas three or more times when recounting project milestones:

- Completion of system design. (9-6)

  Representatives from both the public and private sectors at the policy making, administrative, and technical levels cited various design deadlines as project milestones. These participants saw the completion of the system design and the development of the PS&E as important milestones. A private sector participant viewed the draft conceptual design report as a milestone.

- Communications system design. (9-6)

  Both public and private sector participants also saw events associated with the design and development of the communications system as milestones. Two private sector participants saw the completion of the communications design and architecture as a milestone. A public sector participant saw the installation of the communications hardware, including the weather stations and computer control as a milestone. Another public sector participant saw the development and selection of a data transmission plan for the project as a milestone.

- Development and implementation of the project evaluation plan. (S-7)

  Representatives from the academic community and the public and private sectors viewed aspects of the evaluation plan as project milestones. One academic participant saw the establishment of the evaluation team as a milestone. Representatives from both the public and private sector saw the evaluation itself as a milestone. Academic community participants and representatives from the public and private sectors saw the completion and results of the evaluation plan as important milestones.

- Field test. (8-5)

  Representatives from the academic community and the public sector saw events associated with the operational test as important milestones. Academic and public sector representatives saw the initiation of the field test as a milestone. One public sector participant saw the start and finish of the IVU test as milestones. This participant also mentioned the start of the VMS and VSL test as a milestone.

- The execution of the cooperative and consultant agreements. (8-4)

  Four public sector participants at both the federal and state level recognized the execution of the initial agreement with FHWA as a significant project milestone. The state level public sector participants also regarded the supplemental agreement after the withdrawal of the private sector partner as a milestone.

- Data collection. (7-3)

  Participants from the academic community regarded the initiation and continued collection of highway, driver, speed, volume, global positioning system (GPS), and accident data as project milestones. These participants also cited the establishment of an accident database as important for the project. Public sector participants also saw the start of data collection as a project milestone.

- IVU development and deployment. (5-5)

  Five participants saw events associated with the IVUs as project milestones. A public sector participant saw the development of the IVUs as important. A private sector participant saw the delivery of the prototype IVU as a milestone, while a public sector participant viewed the installation of the IVUs in vehicles as an important event. Another public sector participant viewed the IVU test as a milestone while an academic participant saw the in-depth analysis of accident data with the IVUs as important.

- Purchase of the VMS. (6-4)

  Three public sector and one private sector participant cited issues associated with the procurement of the VMS as milestones. All these participants saw the development of the RFP and the actual acquisition of the VMS as milestones. A private sector participant saw the selection of a VMS vendor and the resulting identification of the communications software as important points. A public sector participant saw the production and acceptance of the first VMS as a milestone.

- Delivery and installation of system hardware. (6-4)

  Both public and private sector participants saw the delivery and installation of project hardware as milestones. These representatives viewed the delivery of portable and fixed

units and computer hardware to the WSDOT as important steps in the project. Both public and private sector participants saw the integration of the project hardware and software as a milestone.

- Change of partners. (4-4)

  Three public sector participants saw the withdrawal of a private sector participant as a major project milestone. Another public sector participant viewed the recruitment of new project partners to replace the private sector participant as a milestone.

- Project construction. (3-3)

  Public sector participants cited construction-related activities such as the start and end of project construction as project milestones. One public sector participant saw the construction of the VMS footings as a milestone.

- Funding. (3-3)

  Three public sector representatives cited funding issues as milestones. One participant saw the initial funding commitment as a milestone. The other representative saw the participation of the NHTSA and the obtaining of funding for the test in a modified agreement as significant. One participant also saw the partnership obtaining matching funds after the withdrawal of a private sector participant as a milestone.

- System documentation and personnel training. (3-3)

  Two public sector and one private sector participant saw the completion of the system documentation and personnel training as milestones.

3. ISSUES AND LESSONS LEARNED

This section presents the institutional issues or non-technical constraints that the interviewees and questionnaire respondents discussed. It also includes the lessons that they learned when they addressed these issues. The issues and lessons learned were divided into eight categories:

- New Business Relationships
- Organizational Coordination
- Contracting and Accounting
- Funding and Budgets
- Technology and Standards
- Human Resources
- Intellectual Property Rights
- User Acceptance.

3.1 NEW BUSINESS RELATIONSHIPS

This section discusses the issues that the project participants encountered and the lessons that were learned addressing the issues in the area of developing new business relationships. Six institutional issues were encountered in this area:

ISSUE 1: THE ROLES AND RESPONSIBILITIES OF THE PARTICIPANTS WERE UNCLEAR

Participants from both the public and private sector and the academic community noted that the roles and responsibilities of the many different participants in the test were *unclear* A private sector participant cited the *large* number of participants and *their diverse perspectives* as the primary cause of this issue. This participant also noted that because there was *no* formal management *structure,* this issue became apparent relatively early in the project. The public sector participant noted that this issue is to be expected as the operational tests provide an opportunity for interested parties to be involved with ITS. The organizational structure of the government agencies is such that many *different departments* become involved. For example, the WSDOT HQ Traffic Office is responsible for ITS, but it is not an implementing agency. The WSDOT Southwest Region had to be the implementing agency. Other government agencies wanted to be involved for different reasons. For example, the FHWA Division Office wanted to be involved with the application of an advanced technology.

The effect of this issue was that it *took longer* than expected to reach decisions with associated delays and additional costs. The steering committee was established to serve as a communications mechanism between the participants. A public sector participant noted that WSDOT Southwest Region personnel played a key role in keeping the project on track. Neither the public

nor the private sector representatives saw this issue playing a significant role in the deployment of the operational test.

The project participants offered several lessons with respect to this issue:

- A significant amount of inter- and intra-agency support and coordination are required to keep the project moving forward.
- Without the support and coordination of all the parties, the project would not be resilient to problems.
- Operational test participants should realize that they need to partake at a greater level of effort than they initially expect.
- The steering committee is a successful communications and management forum.
- All participants must believe in the benefits of ITS.
- There was a willingness among the three FHWA offices to cooperate.

ISSUE 2: EARLY PROJECT PLANNING AND COORDINATION WAS DISORGANIZED

This issue became apparent early in the project development. A number of factors contributed to this issue. First, TravelAid was one of the first operational tests and the concept of operational tests was new to all parties. There was a *lack of understanding* on the part of the project participants of the institutional and operational structures required for the project to progress. For example, the FHWA had not determined what the cooperative agreement between the FHWA and the WSDOT should include.

Second, the WSDOT staff started work on the project before the cooperative agreement and contracts with the private sector partners were signed. Because the prospective contractors could not commit resources without an executed contract, the WSDOT worked on the preliminary engineering, project scoping, and budget estimates *with minimal support and coordination* with them. Some decisions were delayed until the consultant contracts were signed, while other decisions were changed after the contractors became more involved.

Third, there was confusion regarding *the evaluation plan* The plan was submitted early in the project and approved by the FHWA, but later had to be reviewed and approved by the NHTSA when this agency became involved in the project. The project participants had to address a new set of comments.

One public sector participant noted that another factor which contributed to this issue was that there were *too many specialists* involved in the project and not enough generalists. Another contributing factor was that the participants had conflicting goals, priorities, and timetables. For example, one participant was focused on deploying the system as quickly as possible, while another participant favored delaying deployment so as to gather more baseline data for the IVU

evaluation. Another public sector participant added that the WSDOT organizational structure is hierarchical and sometimes the lower levels cannot interact directly when required.

The overall effect of this unanticipated issue was that it produced significant and compounded *delays.* These delays made it impossible for the management team at one private sector participant to justify continued participation in the project. This issue is on-going as new participants join the project.

Four participants from the public sector and one from the private sector offered several lessons with respect to project planning. Almost all of these comments stressed the need for a good up-front *understanding* of the issues and complexities of the project. A participant from the public sector stated that this understanding can be ensured by having the required expertise in-house or by having a good working relationship with contractors. A private sector participant stressed the need for the development of a project *budget and schedule* as early as possible.

The interviewees also offered these lessons:

- Coordination and cooperation are the keys to a successful test.
- Partners should be willing to invest resources and participate in early planning and design even before formal contracts are signed.
- There has to be senior management support for the project, especially to coordinate the work of different sections within the same organization.
- Evaluation requirements from all funding agencies should be clear from the beginning of the project.
- The roles and responsibilities of the participants should be defined at the start of the project.
- When a project team is established, the participants need to develop a mechanism to resolve issues.
- Participants need to appreciate the complexity of communications systems and the different types of equipment requirements.

ISSUE 3: A PARTNER WITHDREW FROM THE PROJECT

This event occurred before the consultant agreement between the WSDOT and the partner was signed. The issues which led to the withdrawal of this partner from the project are discussed in other areas of this document. These issues were *problems* with the accounting, auditing, and contracting mechanism of the WSDOT. (These issues are discussed in detail in Section 3.2.) The *delays* associated with working through these issues increased the opportunity cost of the project for the private sector partner. The combination of increasing opportunity costs, discomfort with the contractual arrangements, and the resulting stress on the public-private relationship all *combined* to make the private sector partner withdraw from the project. One

public sector interviewee added that the company was going through a *restructuring,* and this may have limited the funding that the private sector partner had available for the project.

The immediate effect of the partner dropping out was *delays* to the project as the remaining participants searched for a replacement. The issue was resolved when two new partners were found by the prime consultant to replace the original partner. Off-the-shelf hardware, however, had to be substituted for the equipment that the original partner would have provided. Also, this partner was to be a major contributor of the private sector funding. Replacement funding was supplied by the pre-existing and new partners and the WSDOT.

With regard to this issue, a public sector participant offered two lessons:

- A memorandum of understanding (MOU) or partnership agreement should be signed within two weeks of notification that the proposal has been accepted. The MOU should be developed at the same time that the cooperative agreement is being developed.
- Lack of commitment on behalf of a partner can jeopardize the entire operational test.

ISSUE 4: SOME WASHINGTON STATE DEPARTMENT OF TRANSPORTATION OFFICIALS QUESTIONED THE LACK OF COMPETITION AT THE STATE LEVEL IN SELECTING PRIVATE SECTOR PARTNERS

There was *no formal competitive* bid process for the project at the state level causing some WSDOT officials to become concerned that private sector partners were not selected competitively. Other WSDOT officials and FHWA staff felt that the competition occurred at the federal level. Prospective project teams submitted proposals to the FHWA; the FHWA then selected the teams which would receive operational test funding. WSDOT officials were unsure whether to follow the state-level interpretation of competition or the federal-level interpretation as it related to TravelAid.

The main cause of this issue was that public-private partnerships and operational tests are relatively *new* undertakings. In addition, *no parameters* were in place for developing public-private partnerships. The issue was resolved. After discussions with FHWA personnel, the WSDOT officials agreed that the selection process was competitive at the federal level.

ISSUE 5: SOME WASHINGTON STATE DEPARTMENT OF TRANSPORTATION OFFICIALS QUESTIONED THE SOLE SOURCE SELECTION PROCESS FOR THE PROJECT EVALUATOR AT THE FEDERAL LEVEL

The state was uncertain as to why the *sole source* selection process was employed and was unsure whether the contracting process used was in conflict with Brooks Act, which establishes guidelines for the procurement of engineering consulting services. Given that each participant in the project had a *different requirement* for the evaluation plan, the project partners must be *comfortable* with the evaluation team. Thus, there is a definite requirement for an independent review and analysis of the project.

Participants also had general comments on the nature of public and private sector business processes. A private sector participant stressed that state regulations should be *amended* to facilitate operational tests. This participant also noted that although public procurement policy has been identified as an institutional impediment for some time, *no advances* have been made in this area. A public sector participant stated that all participants must appreciate that there are bureaucratic and organizational issues in both the public and private sectors. Another public sector participant noted that the FHWA was *flexible* with respect to deviations from standard operating procedures.

ISSUE 6: THERE ARE SIGNIFICANT DIFFERENCES BETWEEN THE ORGANIZATIONAL CULTURES OF THE ACADEMIC COMMUNITY AND THE PUBLIC AND PRIVATE SECTORS.

An issue discussed by academic participants was the difference between the organizational cultures of the respective sectors of the participants. The academic participants noted that the TRAC organization was a great asset in acting as liaison between them and the other participants. A lesson offered by the academic participants was that all academic institutions should have an organizational *interface* similar to TRAC as this allows the academic staff to focus on research activities.

3.2 ORGANIZATIONAL COORDINATION

This section discusses the issues and lessons learned in the area of organizational coordination. There were four issues that the project participants encountered in this area:

ISSUE 1: THE DESIGN REVIEW PROCESS WITHIN THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION IS CUMBERSOME

The WSDOT standard operating procedures presented problems when applied to *non-standard* situations such as public-private partnerships. The review process involves the Region Office and different divisions in the WSDOT HQ. The review process was also hampered because project specifications were still being developed after the project went into review. In addition, a private sector participant observed that some public sector personnel *are overly cautious* in recommending solutions or changes to the PS&E to include new technologies. They are worried about the *perception* that they may be favoring a specific private firm.

The result of this issue was to *delay* the project. After a lengthy review, the WSDOT determined that the communications specifications as developed were not acceptable. At the time of this interview, the construction contract was not signed. The public sector's *reticence* to approve certain technologies may result in a sub-optimal system being deployed. In addition, the lead times to start construction have become longer than anticipated. The issue is on-going.

Public sector participants offered three **lessons** with respect to this issue:

- Start design reviews as early as possible.
- Streamline the existing review process.
- Ensure that project schedules include adequate time for reviews.

A private sector participant also offered two lessons:

- The system specifications should be as detailed as possible until the existing procurement policies are changed.
- The policy should be changed to make it flexible enough to accommodate the modification of technical specifications without appearing to favor a certain firm.

ISSUE 2: THE ADDITION OF SAFETY-RELATED ACTIVITIES TO THE EVALUATION PLAN INVOLVED A NEW PARTICIPANT

Two public sector participants stated that there were issues associated with the evaluation of safety-related activities. The NHTSA, the agency charged with oversight of these activities, entered the project at a relatively *late stage* and offered $250,000 to fund the project evaluation. The agency was particularly focused on the performance of the *IVUs*. It wanted specific information from the evaluation and had a *different agenda* from the original sponsoring agency, which was not strictly focused on the IVU performance. The original evaluation plan was developed before the FHWA placed a strong emphasis on the evaluation plans. This issue was compounded because any changes to the original evaluation plan had to be reviewed and approved by the NHTSA staff.

As a result of the change in the evaluation strategy, the evaluation plan was *delayed* and had to be rewritten. At the time of the interviews, an evaluation plan had not been approved. This caused *frustration* among the project partners. The WSDOT and UW staffs had to take on additional work to meet the expanded evaluation plan. The UW staff also assumed *an additional responsibility* of developing a driving simulator. Project coordination became *more difficult* as the number of participants increased. Participants from the TRAC and UW wrote a detailed evaluation plan in an effort to satisfy the NHTSA requirements. This plan was approved in January 1995.

The public sector participants offered three **lessons:**

- There needs to be a clear understanding at the start of the project as to what is required from the evaluation plan.
- Different agencies have dissimilar review procedures which result in varying amounts of time in which comments are received.

- The involvement of additional agencies or partners increases project management complexity and coordination requirements and may result in project delays.

ISSUE 3: THERE WERE PROBLEMS IN COMMUNICATION AND COORDINATION BETWEEN THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND THE CONSULTANTS

This issue surfaced during the process of selecting the radio frequencies. Some causes of this issue are the fact that the project participants are located *three time zones* from each other, the *tiered structure* of the contract, and the *demands* of other projects on all of the participants. The effect was to make it difficult for the WSDOT staff to communicate with and track the progress of the other participants. This resulted in *delays* of three to five months because key people were excluded from the decision-making loop. Also, it put *pressure* on participants to submit incomplete or incorrect documentation to expedite their review.

A public sector representative offered *this* **lesson** on *this* issue: A *smaller* project group and *closer* proximity of participants leads to greater communication and less opportunity for problems to occur.

ISSUE 4: THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION DOES NOT HAVE COMPLETE CONTROL OF THE COMMUNICATIONS INFRASTRUCTURE

As part of the project, the existing communications infrastructure must be upgraded. The U.S. Forest Service and King County operate two of the communications sites. Thus, the WSDOT must work with these agencies to get these locations upgraded. The US Forest Service wants to restrict the number of facilities located within the National Forest boundaries. A public sector participant offered *this* **lesson:** If *the rightpeople* are in the loop and if all the participants have *an interest* in the success of the project, then problems can be overcome.

3.3 CONTRACTING AND ACCOUNTING

This section discusses the issues and lessons learned in the areas of contracting and accounting. The project participants discussed several overlapping issues in this area. Because of this overlap, the causes and effects of these issues are similar:

ISSUE I: THE ORIGINAL CONTRACTING MECHANISM AND LANGUAGE WERE UNACCEPTABLE TO A PRIVATE SECTOR PARTICIPANT

This contracting mechanism and language issue contributed significantly to *the withdrawal* of a private sector partner and created *tension* in negotiations and inter-agency interaction throughout the project. There were several areas that private sector representatives found unacceptable. First, some representatives found the original *fixed-dollar* contract mechanism unacceptable for a development project. They felt that it is difficult to estimate the cost of a research and

development (R&D) project and that some flexibility was needed. The FHWA, however, only awarded a fixed amount for the project.

Second, project participants were concerned about *liability.* Some private sector participants felt the contract presented a stumbling block for a private sector participant because it could be interpreted to mean that the contractor would assume all responsibility for any misinformation or accidents associated with the IVU technology. It appeared that the public sector partners would assume none of the liability. Some WSDOT members concluded that the ITS equipment did not significantly increase the liability they normally experience with traffic control devices as long as the devices are operated properly.

According to a private sector participant, the perceived distribution of liability precludes the good working relationship occurring with state DOTs that contractors have with the Department of Defense (DoD). Private sector representatives felt that with all the unknowns associated with the ITS products, private sector firms need more liability protection when developing new technologies. In an effort to resolve the issue, the prime contractor proposed to assume a greater degree of risk.

Third, some private sector participants said that the identification of *"key personnel"* was problematic for a corporation which used a matrix management structure. A private sector representatives thought that a "key personnel" clause would be included in the contract, while a public sector represented said that it was not a requirement.

Fourth, this issue also manifested itself when a private sector participant could not disclose its cost structure in the manner requested by the WSDOT. Contractors who have previously worked with the DoD have their cost structures formatted specifically for DoD contracts. Some companies in the private sector may be *reluctant* to divulge their cost structure. Also, some private sector participants felt that the WSDOT procurement rules and regulations are more *restrictive* than the Federal Acquisition Regulation (FAR).

This situation created an awkward predicament as the WSDOT, FHWA and DoD staffs worked together to obtain cost structure information for a private sector participant. A six-month *delay* resulted as the participants negotiated how to address this area. It was ultimately resolved. A DoD audit agency conducted an audit of the private sector participant. The WSDOT contracting personnel *compromised* by accepting an overhead rate in excess of what it traditionally accepts. *Delays* in the project and other factors, however, caused the partner to withdraw from the project.

Interviewees from both sectors offered one important **lesson** that **they** learned: **The contracting mechanism used for operational tests needs to be flexible.** To accommodate public-private partnerships, business must be conducted differently than in the past. Participants must learn to *let* go of some of their traditional management paradigms and be more *flexible* when putting contracts together without compromising on key issues. The private sector, however, needs to understand the rules and regulations under which the state DOTs must operate.

The interviewees offered some additional lessons:

- Because operational tests are funded for a fixed dollar amount, project participants must make sure that their proposal covers all costs for which they anticipate reimbursement.
- The fixed dollar funding method may increase the chances of a project failing if funding is insufficient and the participants choose not to make up the difference.
- The federal and state DOTs should protect the ITS industry in a manner similar to the way the DoD offers liability protection.
- The contracting conditions should be discussed by all participants prior to the project.
- There needs to be an appreciation of the private sector business mode.
- A contracting template should be developed for operational tests.

One private sector participant felt that the liability issue may hinder **the** full **deployment** of ITS products and services.

ISSUE 2: THE PUBLIC SECTOR WAS UNCERTAIN HOW TO STRUCTURE THE CONTRACTS WITH THE PRIVATE SECTOR PARTNERS

This issue surfaced after the cooperative agreement was signed, and the WSDOT was developing contracts for consultants and sub-consultants. Because WSDOT procurement procedures were not developed for *development-type projects,* WSDOT staff encountered some impediments when they applied the standard contracting procedure to the operational test. Interviewees suggested that a major cause of this issue was that state DOTs are used to buying construction, traditional engineering consulting, and operation and maintenance services and not developmental products and services. This meant that the WSDOT was not accustomed to working with large, complex technology-development corporations.

Also, sole source contracts had to be approved by the WSDOT HQ contracting personnel. These staff members questioned the *lack of competition* in the selection of the private sector firms. They also questioned the overhead rate of a partner which was over the 165% rate allowable by the WSDOT.

The issue resulted in incremental *delays* to the project *and frustration* on the part of the private sector partners. They felt they were dealing with a slow bureaucracy. There was *frustration* on the part of the public sector with respect to the unclear corporate rate structure.

The issue was ultimately resolved. The WSDOT used a different, *innovative,* contract structure which established a prime contractor with authority to sub-contract. The WSDOT HQ personnel agreed that the FHWA RFP process provided sufficient competition. Both the FHWA and the WSDOT agreed to accept an overhead rate in excess of 165%.

The project participants offered these **lessons** with respect to this issue:

- To identify potential problems, all partners should meet as early in the process as possible, even before the cooperative agreement is signed.
- Confer with the relevant participants to ensure that the program can get through state and federal procedures before proposing to perform work.
- There should be more up-front coordination within the public agencies, involving senior management and other key departments.
- Federal involvement in this process provided a mitigating mechanism.
- An analysis should be made with respect to having a direct flow of funds from the FHWA to the private sector participants.

One participant believed that this issue affected **the full deployment** of TravelAid because it delayed the implementation of the project. Another participant stated that delays to the project may result in the deployment of old or dated technology.

ISSUE 3: FINANCIAL AND ACCOUNTING INFORMATION WAS NOT READILY AVAILABLE FROM SOME PRIVATE SECTOR PARTICIPANTS

Some private sector participants were *unable* to provide accounting data in the required format for the state government contract, A primary cause of this issue was that private sector companies who have previously worked with the DoD are accustomed to providing accounting data in accordance with *DoD contracting* requirements, which *differ* from those required by state DOTs. The accounting rates of these contractors are structured specifically for DoD contracts. The WSDOT employs different criteria than DoD in calculating overhead rates and its allowable overhead rate of 165% is lower than that of the DoD.

This issue resulted in the WSDOT having a *difficult* time in *verifying* private sector overhead rates and required lengthy *negotiations* and the involvement of a third party to reconcile it. Overall, the issue caused an approximately six-month *delay.* The issue was partially resolved when the participants decided that a DoD audit agency would audit the private sector participant. This course of action presented its own institutional issues as it was unclear who was to pay for the audit. Also, the local office of the DoD audit agency was very slow in providing the information to the WSDOT.

The resulting delays negatively influenced the opinion of senior management at one of the private sector participants. The delays significantly increased the opportunity cost of the project from the perspective of senior management. In addition to delays, this issue caused relations between the public and private sector to become *strained.* Also, in an effort to resolve this issue, the WSDOT granted *an exemption* with respect to overhead rates to the contractor.

Representatives of both sectors offered this **lesson: State governments should review arbitrary overhead rates and introduce more flexibility when dealing with companies which have** a

greater overhead rate for justifiable reasons. This is especially true for firms performing R&D. They also stated that the need for exemptions should be established as early in the process as possible.

One private sector participant believed that this issue could discourage DoD contractors from participating in the industry, thereby affecting the full-scale **deployment** of ITS.

3.4 FUNDING

The project participants discussed three issues and several lessons in the area of funding:

ISSUE 1: STAYING WITHIN THE PROJECT BUDGET HAS BEEN DIFFICULT

This issue has yet to be resolved, because the estimated project *costs* have continued to *rise* and the project did not receive the anticipated amount of federal funding. The cost estimates developed during the design phase for the VMS and communications systems were low; in particular, the VMS costs were significantly underestimated. Also, some tasks now required were not anticipated previously, such as revising the evaluation plan for U.S. DOT approval.

Another factor contributing to this issue was that the project had *several funding sources* each with different goals and objectives. The preliminary engineering funds had to be used for project development. NHTSA funding was to be used to investigate driver-vehicle interaction and the performance of the IVUs. FHWA IVHS funding was to be used to review broader areas of ITS, such as VSLs and driver information. The private sector funding contributions were to be used for market research and product development. Interstate funds were to be used for construction. These funds had to be allocated by September 1994 or else they would be lost. The WSDOT provided highway funds for the operations and maintenance of the system.' These multiple funding sources and their interactions have the potential to delay the project.

The primary **lesson** that was offered by the participants **was** that **the project management needs to periodically reexamine the proposal and scope of work to determine if the project can be completed within budget.** Funding also must be *reevaluated* whenever the project scope changes. They also recommended that funding agencies should consider using a *contingency budget* to provide additional funding if needed. The participants stated that it is not feasible to cap the budget when entering a R&D project. If additional funds cannot be provided, the funding agencies *risk* receiving an inadequate product or service.

The interviewees offered several additional lessons:

- Delays add to costs.
- Projects need good cost estimates early in the process.
- The project participants need a better understanding of the design process.

- If all parties maintain an open agenda at meetings, then a better consensus about costs can be reached.
- Priorities must be set for the use of funds, and the options and risks involved must be clearly defined.
- Changes in the project scope may result in time delay and increased costs which may have an impact on the tasks of other participants.
- There is a need for special programs and enabling instructions at both the federal and state level to accommodate ITS projects which are not traditional, low-bid awards.

This issue **will** effect **the** full **deployment** of the TravelAid operational test because some TravelAid tasks will not go to bid this year as scheduled. If costs continue to rise and no new funding becomes available, some tasks may never go to bid.

ISSUE 2: THE MATCH REQUIREMENTS FOR THE PROJECT WERE NOT CLEARLY DEFINED

This became an issue when the contractor team was selected. There was *confusion* over the 80/20 and the 50/50 match requirements and the *mixing of* public and private *funds* in this innovate process. The exact amount that each partner would contribute and the method to calculate the contribution was not clear. The use of an overhead rate by one partner which was greater than that allowed by the WSDOT also contributed to this issue.

The effect of this issue was to *delay* the project. The WSDOT had *difficulty* in developing the contract language and the project participants experienced difficulties with writing agreements. *The* issue led to *uncomfortable* negotiations between the public and private sector participants. Eventually, one private sector participant *withdrew* from the project. This participant was contributing a significant amount of the private sector match. The loss of this partner created a lot of uncertainty within the project.

The issue has been resolved. The prime contractor obtained *new partners* and enough *funding* to meet the 20% match requirement. Both the WSDOT and FHWA have accepted rates from the private sector participants which they would not have accepted previously.

Public sector participants offered some **lessons** that they learned:

- The match for project funds, especially in-kind contributions, must be auditable.
- Private funds can be used to match federal funds.
- It is important to obtain commitment up-front from the participants through the use of a MOU or partner agreement.
- A higher funding commitment may be required to provide more balance between the private sector and public sector partners.

ISSUE 3: FUNDING FOR THE GLOBAL POSITIONING SYSTEM ACTIVITIES IS UNCERTAIN

Early in the project, $150,000 was allocated for the use of automated vehicle identification (AVI) technology. The project participants later decided not to use AVI and the allocated funds were *shifted* to general project funds. The project participants now want to use the funds originally earmarked for AVI for a GPS component of the project. The status of the former AVI funds, however, is *not clear.* If the funding for GPS does not materialize, then funds may have to be shifted from other tasks which, in turn, could impact the other participants. One interviewee stated an obvious **lesson.** When the decision was made not to go with AVI, the AVI funding should have been *tracked* more closely.

3.5 TECHNOLOGY AND STANDARDS

This section discusses the issues and lessons learned in the areas of technology and standards. The project participants encountered four issues in these areas:

ISSUE 1: THE COMMUNICATIONS COMPONENT OF THE OPERATIONAL TEST PRESENTED TECHNOLOGICAL AND INSTITUTIONAL DIFFICULTIES

Participants from all three sectors cited the communications component as presenting many problems. This issue recurred throughout the communications design process starting when the participants determined that the existing communications were not configured as originally perceived. The *complexity* of the communications system design, the design parameters, and the *FCC licensing* requirements were not fully understood or anticipated at the start of the project. In particular, obtaining licenses for the communications technology developed for the test was a major impediment in this area. There were also numerous problems associated with selecting an appropriate frequency for the IVUs. In addition, the upcoming reassignment and redistribution of existing radio frequencies by the FCC may further complicate the design process.

The length of time and *level of effort* associated with the licensing procedure for the communications frequencies are viewed by the participants as impediments. One of the major causes of the problems was that the existing frequencies have multiple users, and the databases that track their usage and availability are not very effective. One public sector participant felt that the root cause of the issue was that the project participants *did not understand* the complexity of the communications design.

The effect of this issue has been to *delay* the project. The design of the communications system slowed down when a private sector participant, whose responsibility it had been to design the communications system, withdrew from the project. The remaining private sector participants did not have that expertise in-house. After new participants entered the project, the original design concept and scope underwent *numerous revisions.* The result was that frequency-dependent purchases were delayed. Because of the impending FCC reallocation of the frequency bands, the

project may, in fact, be using a temporary frequency. The project participants may have to apply for a new frequency, which would require additional costs and possibly new hardware.

The interviewees offered one principal **lesson: When wireless communications are an element of an operational test, the participants should realize that significant complexities lie ahead.** Complex systems are comprised of a multitude of specialty areas. The implementation of such systems is not trivial and *much coordination* is required in several areas.

The participants also offered some lessons in the area of design. They stressed that it is essential to *define* all critical design elements *as early as possible.* This will help to identify potential problems well in advance of their occurrence. One public sector representative felt that the original proposal should have been *more detailed.* One private sector representative suggested that a design must be resilient to externalities if it is to hold up over a period of time.

The interviewees offered several other lessons:

- There will always be unforeseen problems in operational tests.
- The design of the communications system should have started earlier.
- It would have mitigated the problem to have had communications expertise within the WSDOT at the start of the project.
- There should be a more effective process to track existing frequency usage.
- Inter-agency communications should be maintained at all times.

When asked if this issue would affect the full **deployment** of the system, interviewees noted that this issue could impede the operational test in achieving the project goals and objectives. A public sector participant declared if the communications system does not work, the project will fail. He also mentioned that further delays will result if the license application is rejected. A private sector participant noted that this issue will remain until the FCC definitely reassigns the frequencies.

ISSUE 2: THERE MAY BE UNREALISTIC EXPECTATIONS FOR THE IN-VEHICLE UNITS

A public sector participant expressed concern about the IVU component of the project. Those advocating *the* use of *the* IVUs were expecting a *complete product,* while the WSDOT was still unclear as to the role of the units in the project. The IW component initially appeared to have long-term potential, but this use may be restricted by the existing contract schedule and budget. It also appears that the IVUs are subject to too many *external factors.* It is not known if the IVU technology is effective or if the communications link will work. Also a cost-benefit analysis has not been performed for the IVUs. One interviewee was concerned that the limited number of IVUs may not be a large enough sample to verify their performance statistically.

One public sector participant offered two **lessons** with respect to this issue:

- All participants should be involved in open communication and be able to re-evaluate the goals and scope of the project periodically.
- Issues and problems should be discussed early in the project.

One participant felt that **this** issue will affect **the full deployment** of the operational test. This participant noted that the IW component may not function as expected or may be too cumbersome to use. Unless the limitations of the IVUs are recognized, there could be a misinterpretation of the results and the deployment may move in the wrong direction. The small number of units may provide data that are inconclusive.

ISSUE 3: THE VARIETY OF AVAILABLE AND FEASIBLE TECHNOLOGIES MADE THE DEVELOPMENT OF A WORKABLE SPECIFICATION FOR THE ACQUISITION OF THE VARIABLE MESSAGE SIGNS DIFFICULT

There is a *multitude* of VMS technologies which are *notprecisely compatible*. This made it difficult for project participants to develop a specification for the VMS and be guaranteed a satisfactory product. Also, some of the requirements could not be specified until the communications design was completed. The WSDOT staff wanted to increase the *competition* for the VMS contract and lower *the* price. They also wanted the *opportunity to modify the* sign, if needed, after the contract was awarded. Thus, the WSDOT could not go with a low-bid contracting process. If the agency arbitrarily chose a sign, it could face a lawsuit.

This issue was resolved when the WSDOT staff *separated* the procurement of the VMS from the sign infrastructure construction contract. They then issued an invitation to supply the signs and added a subjective evaluation to the selection process. The procurement process provided for the development of a prototype which could be modified or rejected.

A public sector participant offered the two **lessons:**

- Establish the basic hardware requirements of the system through the steering committee.
- Promote industries and technologies that are readily available.

ISSUE 4: INFLEXIBLE FUNDING MECHANISMS IMPEDE THE DEPLOYMENT OF AN OPTIMAL COMMUNICATIONS SYSTEM

The FHWA, and often the local agencies, do not provide funding for *the operation and maintenance* of the equipment used in the operational test. Satellite and cellular communications systems are not used because their costs are prohibitive and the cellular phone tariff systems are structured for voice rather than data transmission.

In the view of one private sector participant, the effect of this issue is the deployment of *sub-optimal* systems. The same private sector participant offered this **lesson** with regard to operations and maintenance funding: **The FHWA must realize that an extensive operational and maintenance component is required for the deployment of high-technology communications systems.** With respect to ITS **deployment,** this participant expressed the opinion that until the funding policy is amended, the FHWA will continue to deploy overly expensive systems which may not be maintained in the long run.

3.6 HUMAN RESOURCES

This section discusses the issues and lessons learned in the area of human resources. The project participants encountered two issues in this area:

ISSUE 1: THE CONTRACTORS IN THE VICINITY OF THE OPERATIONAL TEST WERE TECHNOLOGICALLY UNSOPHISTICATED

There is a *lack* of in-house *expertise* on the part of local contractors in the Snoqualmie Pass area. Project personnel are working with local contractors and a small local phone company. These firms, in general, are *not familiar* with the latest technological developments. This resulted in *delays* of the purchase and installation of the communications modems necessary for the project. This, in turn, delayed the collection of "before" data which will have a direct impact on the evaluation.

This issue has been resolved by conducting *a pre-qualification* of contractors. This action increased the level of technical support required by the project. A public sector participant stated that the **lesson** learned from this issue is that technical resources, qualified contractors, and designers are not readily available in rural areas for the implementation of ARTS projects. This participant also noted that this could have a negative impact on **the future deployment** of ARTS projects in rural *areas.*

ISSUE 2: INITIALLY THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION HAD LIMITED RESOURCES IN THE AREAS OF COMMUNICATIONS AND COMPUTER SCIENCE

At the start of the project, the WSDOT communications lacked the resources to fully support the project. Because state DOTs have traditionally been focused on infrastructure development, maintenance, and rehabilitation, state DOTs have required mostly *traditional civil engineering* expertise. They normally did not employ communications expertise and generally do not attract communications personnel.

Further compounding this situation is the fact that conservative state spending places limits on the *resources* available to the WSDOT communications section. This results in a limited amount of time available for staff to give to projects; key personnel are spread thin supporting several projects. This forces the WSDOT to rely on outside contractors and vendors. Protracted contract

negotiations, however, delayed the communications contractor from starting work on the TravelAid project.

This issue first became apparent when the project participants began to work on the communications system design. This lack of resources *delayed* some processes which should have started earlier. It also resulted in *gaps* in the original system design. WSDOT personnel were not capable of asking the correct questions of the contractor as to what was required for the system design. As a result of this lack of expertise, one private sector representative stated that the private sector had to *educate* the public sector about the communications issues.

Another effect was that the private sector had to perform work *with outdated* and inaccurate information and data. This lack of expertise led the project participants to *underestimate the* complexity of the communications requirements. The project participants had to perform additional data collection to verify the existing conditions. The participants had to *redesign* the communications component. This resulted in a greater investment in time and money by the participants and more complex interactions with the FCC. To resolve this issue, the WSDOT hired a communications expert to assist ITS projects.

The project participants offered these **lessons:**

- Even when the project has contractors, the state DOT must still have in-house expertise.
- State DOTs need internal communications expertise.
- Private sector participants should verify the data given to them by the public sector.

With respect to full **deployment** of the operational test, a public sector participant stated that, at best, this issue has delayed deployment; while, in a worst case scenario, it could potentially delay the project to the point where it loses funding. A private sector participant raised two questions with respect to deployment: Will the required expertise exist within state DOTs in the future and will the state DOTs have the expertise to maintain and operate the ITS once it is deployed?

3.7 INTELLECTUAL PROPERTY RIGHTS

The project participants discussed one issue in the area of intellectual property rights:

ISSUE 1: THE OWNERSHIP AND USE OF THE INTELLECTUAL PROPERTY WAS UNCLEAR

The intellectual property rights for technologies developed on the test were a point of *contention* between the public and private sector participants. The private sector was concerned over the retention of the intellectual property rights for products and technologies developed for the project. Ideally, the private sector would like *exclusive rights* to whatever it developed in the operational test. The public sector, however, usually *reserves the right* to use a product developed with public funds. If the private sector made investments and provided development services,

the private sector representatives felt that they would not have ownership of the intellectual property rights. It is not in the private sector's interest for the public sector partner to profit from the company's investment and development.

This issue surfaced when WSDOT was developing the consultant agreements. Because the TravelAid project is funded by a mix of public and private sector funds, the original contract was *ambiguous* as to the ownership and future use of the products and information developed for the operational test. There were *no clear guidelines* on mixing public and private sector funds in developing ITS technologies in operational tests. A private sector participant interpreted the original contract language as meaning that, in the future, they might have to *compete* against the public sector who might be offering technology that the private sector developed for the operational test. This issue *delayed* the signing of the consultant agreements.

The issue was partially resolved as the FHWA allowed *changes* to the contract language to say that intellectual property developed by the private sector with federal funds would be used by federal agencies for federal applications only. A representative of the public sector suggested two **actions** to alleviate this issue. First, to establish clear ownership, private sector participants should patent or copyright any pre-existing inventions that will be used in the project. Second, project tasks for inventions that later could be patented or copyrighted, could be separated from other tasks and funded by one partner. The party funding the task would have ownership of the invention.

A private sector participant offered these lessons:

- There needs to be a delineation that there will not be competition between the public and private sectors in the full deployment of ITS products and services.
- The public sector should concentrate on demonstrating the benefits of ITS and not on product development.
- Profit and intellectual property rights are important issues for the private sector and are not always taken into account by the public sector.

With regards to **deployment** of the operational test, a public sector participant noted that if intellectual property rights become an issue for TrafficMaster, then the company may not want to deploy the in-vehicle unit. With respect to the deployment of other ITS, a private sector participant saw this issue as a potential impediment to private sector participation. The private sector may not want to participate in future projects and develop systems if it does not receive some protection from public sector competition in the marketplace.

3.8 USER ACCEPTANCE

The project participants discussed one potential issue in the area of user acceptance:

ISSUE 1: THERE MAY NEGATIVE PUBLIC REACTION TO THE PROJECT.

The public and media may *perceive* the project as a waste of tax dollars. The technology being tested might appear to the public to have *Zimited applications* even though large amounts of money are being spent on it. The public may perceive traditional infrastructure maintenance as a greater priority.

The project participants stressed an important **lesson: There is a great need to educate the public about ITS.** The participants felt that the public has not been educated about ITS and its benefits. One participant noted that the goals and objectives of the test must be adequately communicated and must be accepted. The interviewees offered two other lessons:

- There is a need to examine funds expenditures to ensure they are spent in a responsible and effective manner.
- The industry is so new that nobody is completely aware of the opportunities that lie in the future.

With respect to the full **deployment** of the TravelAid operational test, one participant stated that if the project were to receive a negative public reaction, it might not proceed.

APPENDIX A

ACRONYMS AND ABBREVIATIONS

ATIS	advanced traveler information system
ATMS	advanced traffic management system
AVI	automated vehicle identification
CMS	changeable message sign
CSF	critical success factor
DoD	U.S. Department of Defense
DOT	Department of Transportation
ERA	Engineering Research Associates
FAR	Federal Acquisition Regulation
FCC	Federal Communications Commission
FHWA	U.S. Department of Transportation Federal Highway Administration
FSI	Farradyne Systems, Inc.
FY	fiscal year
GPS	global positioning system
HAR	highway advisory radio
HQ	headquarters
ISTEA	Intermodal Surface Transportation Efficiency Act of 199 1
ITS	intelligent transportation system
IVHS	intelligent vehicle-highway system
IVU	in-vehicle unit
mph	miles per hour
MOU	memorandum of understanding
NHTSA	U.S. Department of Transportation National Highway Traffic Safety Administration
OFT	operational field test
PS&E	plans, specifications, and estimate
R&D	research and development

RFP	request for proposals
TRAC	Washington State Transportation Center
U.S. DOT	U.S. Department of Transportation
u w	University of Washington
VMS	variable message sign
Volpe Center	U.S. Department of Transportation John A. Volpe National Transportation Systems Center
VSL	variable speed limit
WSDOT	Washington State Department of Transportation
WSP	Washington State Patrol

APPENDIX B

REFERENCES

Barfield, Woodrow and Fred Mannering. "In-vehicle Signing and Variable Speed Limit Evaluation," Washington State Transportation Center, August 1993.

Farradyne Systems Inc. "TravelAid Washington; System Design Report - Draft," prepared for the Washington State Department of Transportation, January 1993.

JHK & Associates, et al. "IVHS Strategic Plan for Washington State," Washington State Department of Transportation, November 1993.

Washington State Department of Transportation. "Venture Washington - Status Report for Active Projects," May 1994.

Washington State Department of Transportation and Farradyne Systems, Inc. "A Proposal for the Implementation of an Intelligent Vehicle Highway System in the State of Washington."

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 94-183514

*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-94-06 1
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-94-07 1
DOT-VNTSC-FHWA-94-18
NTIS Number: PB 94-203296

*ITS Institutional and Legal Issues Program - Review **of** the **SmarTraveler** Operational Test*
FHWA-JPO-95-002
DOT-VNTSC-FHWA-94-24
NTIS Number: (not assigned yet)