U.S. Department
of Transportation

Research and
Special Programs
Administration

IVHS INSTITUTIONAL ISSUES AND CASE STUDIES

DOT-VNTSC-FHWA-94-9
FHWA-SA-94-055

Final Report

ADVANCE CASE STUDY

John A.Volpe National
Transportation Systems Center
Economic Analysis Division
Cambridge, Massachusetts

April 1994

Prepared for

U.S. Department of Transportation
Federal Highway Administration
Office of Traffic Management and ITS Applications

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE April 1994	3. REPORT TYPE & DATES COVERED Final Report June 1993 – January 1994

4. TITLE AND SUBTITLE
IVHS Institutional Issues and Case Studies
ADVANCE Case Study

5. FUNDING NUMBERS

HW452/H4054
Contract
DTRS–57–89–D-00090
Technical Task
Directive RA 3078

6. AUTHOR(S)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Science Applications International Corporation (SAIC)*
1710 Goodridge Drive
McLean, VA 22102

8. PERFORMING ORGANIZATION REPORT

DOT-VNTSC-FHWA-94-9

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
Federal Highway Administration (FHWA)
400 7th St., S.W.
Washington, DC 20590

10. SPONSORING OR MONITORING AGENCY REPORT NUMBER

FHWA-SA-94-055

11. SUPPLEMENTARY NOTES

*Under contract to: U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

12a. DISTRIBUTION/AVAILABILITY

This document is available to the public through the National Technical Information Service, Springfield, VA 22161

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This operational test case study is one of six performed in response to a Volpe National Transportation Systems Center technical task directive (TTD) to Science Applications International Corporation (SAIC) entitled, "IVHS Institutional Issues and Case Studies." ADVANCE, Advantage I-75, HELP/Crescent, TRANSCOM/TRANSMIT, TravTek, and Westchester Commuter Central were the subjects of the six case studies. The case studies were performed to determine (1) institutional issues and legal impediments encountered during the operational test, (2) the point in 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 IVHS 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 1993.

14. SUBJECT TERMS
Intelligent Vehicle Highway Systems (IVHS), Advanced Traveler Information Systems (ATIS), Institutional Issues, Non-technical Impediments, Operational Test, Legal Issues, Lessons Learned, and Transportation

15. NUMBER OF PAGES
48

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

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1710 Goodridge Drive
McLean, Virginia 22102

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Preface

This case study on the ADVANCE operational field test is one of six performed in response to a Volpe National Transportation Systems Center technical task directive (TTD) to Science Applications International Corporation (SAIC) entitled, "IVHS Institutional Issues and Case Studies." Other case studies were performed on the following projects: Advantage I-75; HELP/Crescent; TRANSCOM/TRANSMIT; TRAVTEK and the Westchester Commuter Central. SAIC conducted interviews and case studies of the ADVANCE, HELP/Crescent, TRANSCOM/TRANSMIT, and Westchester Commuter Central projects, and is leading the production of a separate "Analysis and Lessons Learned" report that synthesizes results from all six case studies. Cambridge Systematics, Incorporated (CSI), SAIC's primary subcontractor for this TTD, assisted with interviews of ADVANCE personnel and independently conducted interviews and case studies for the Advantage I-75 and TRAVTEK programs. CSI is also assisting with production of the Analysis and Lessons Learned Report.

"Intelligent Vehicle-Highway Systems" (IVHS) is part of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 that formed the basis for the Department of Transportation's (DOT) initiative to solicit proposals for operational field tests of IVHS products and services. The goals of the DOT IVHS Program are:

1. To improve the safety of surface transportation.

2. To increase the capacity and operational efficiency of the surface transportation system.

3. To enhance personal mobility and the convenience and comfort of the surface transportation system.

4. To reduce the environmental and energy impacts of surface transportation.

5. To enhance the present and future productivity of individuals, organizations, and the economy as a whole.

6. To create an environment in which the development and deployment of IVHS can flourish. (DOT, 1992)

In response to the ISTEA's emphasis upon meeting both the technical and non-technical challenges toward achieving the above goals, the Federal Highway Administration developed the "1992 Intelligent Vehicle Highway Systems Institutional Issues (Non-technical Constraints)

Program." As part of this program, the Volpe Center TTD has initiated the performance of six case studies with the primary purpose of answering four questions:

1. What institutional and legal impediments were encountered establishing partnerships and deploying IVHS services and products during the operational test?

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

3. How were these impediments overcome?

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

The secondary purpose of the case studies is to describe the operational test and document its history.

Information to support the development of the case studies included available documents on each program as well as interview notes and summaries based on an interview protocol especially created for this contract. A detailed description of the standardized procedures and methods followed during the conduct of the interviews is documented within a "Detailed Field Guide," produced as a separate deliverable of this TTD. A list of agencies interviewed is provided as Appendix A, and a bibliography of key references to the project being studied is provided as Appendix B.

Unlike many case studies where projects have been deployed and positive and negative lessons were learned after the total success of the system could be assessed, this case study report is on a project that is still in the development phase. Therefore, interviews represented a snapshot in time during the progress of the project, and issues identified at the time of the interviews may only be temporary.

Interviews for this case study were performed during the summer of 1993 and attempted to provide a balanced presentation of the issues as portrayed by those interviewed. An attempt was made to use corroborating discussions as evidence of the accuracy and/or significance of issues raised. However, as with any report heavily dependent upon interviews, the accuracy and completeness are only as good as the accuracy and completeness of personal accounts told to and recorded by the interviewers. To help ensure accuracy and a balanced view of the issues, the ADVANCE program manager received a draft of the case study report for his project and was given the opportunity to comment. These comments were received and the author has responded to them in this version. Nevertheless, the author takes sole responsibility for the accounts portrayed in the case study reports.

As with any case study or lessons learned report, authors are subject to criticism that their evaluations either seek out the negative aspects with little emphasis on positive lessons, or are incorrect, biased, or lay blame. It is with great sensitivity to these issues that this case study report was written. Postured to identify issues, the authors acknowledge the fact that interviews were oriented toward finding problems; however, some attempt to identify positive lessons was

also made, and so reported. The intent of the authors was to avoid inaccuracies, bias, or blame, and to provide helpful hints to others who are about to embark on similar initiatives.

Separate from this case study, the "Analysis and Lessons Learned Report" will provide conclusions and observations about the institutional issues identified across the six case studies. It will also provide lessons that can be applied to the deployment of IVHS products and services and recommendations regarding: new procedures and programs; the relative magnitude of barriers and respective priorities for their amelioration; and, training requirements for those entering into IVHS programs.

Acknowledgements

Of special note is the expert consultation and review provided to this effort by a specially formed, "Institutional Barriers Advisory Group." This group, chaired by Mr. John Mason of SAIC, consisted of Dr. Christopher J. Hill of Castle Rock Consultants, Mr. Lance Grenzeback of Cambridge Systematics, and Mr. Kenneth Orski of Urban Mobility Corporation. The contributions of this group added greatly to the insight of the interviewers and writers.

The authors would gratefully like to acknowledge the assistance rendered by the ADVANCE field test program manager and the ADVANCE public and private sector partners. Also, special thanks go to all of those who participated in the interview process and contributed such thoughtful insights that can be valued by others facing similar tasks. Finally, many thanks go to Mr. Allan DeBlasio from the Volpe Center for his guidance, understanding, and support.

1.0 SUMMARY

The ADVANCE operational field test began with preliminary studies in the late 1980's. This test involves the building of a system that can give drivers optimal driving routes that avoid traffic congestion conditions. The field test will recruit up to 5000 local drivers who will have a special Motorist Navigation Aid installed in their own cars at no cost to the volunteer. The test, sponsored by the partnership of the Federal Highway Administration (FHWA), the Illinois Department of Transportation (IDOT), the Illinois Universities Transportation Research Consortium (IUTRC), and Motorola, Inc., will last for several years. The system is currently being developed, and deployment with volunteer drivers will begin in about one year.

Project documentation was reviewed in order to understand the project's history, milestones, and accomplishments. Section II of this report describes key aspects of the ADVANCE project. These include the project's history, goals and objectives, and descriptions of the partnership and participants. Specifics regarding the operational field test, such as how ADVANCE works, the use of volunteer local drivers, and methods for funding, are also provided.

Non-technical impediments to the success of ADVANCE were identified in the available literature, but more important, from interviews with a number of key personnel. The interviewees were selected using an approach which identified those participants most often recommended by project staff. Final selection of thirteen interviewees was made to gain a representative sample of interviewees across dimensions such as public vs. private sector, length of involvement in the program, role in the program, etc.

For the most part, the interviewees were the leaders, initiators, and champions of the ADVANCE project. Many had been with the project since its inception and were very knowledgeable about the issues that have been encountered, overcome, or accommodated since the planning phase. Their various roles have included serving as: the program manager; system integrator; system builder; program administrator; executive committee member; and, technical committee member. The interviews followed a structured protocol and the collected data were summarized, integrated, and interpreted. These data are the source of the opinions, perceptions, and views that are reported in Section III of this report.

Because IVHS is such a new concept, and because very few operational field tests have been completed, it is difficult to know what issues will be encountered. There are currently 34 approved IVHS operational field tests and more are yet to be approved. Section IV of this report discusses the potential for institutional impediments in the coming phases of ADVANCE. Those interviewed seemed to be most concerned about liability, market uncertainty, and the unfolding roles of members in this public/private partnership.

Major lessons learned from ADVANCE to date are summarized below:

- Public/private partnerships can be done; some with significant, yet surmountable, difficulties
  - -- Experience will ease the pain
  - -- Apparent insurmountable issues (e.g. FAR) can be overcome in time as long as negotiations continue
  - -- Language/terminologies are different but understandable if defined
- Resource requirements are consistently underestimated
- Expectations are consistently too high

Additional lessons learned as well as recommendations are discussed in Section V.

2.0 PROJECT DESCRIPTION

2.1 Project Background

Early History

The ADVANCE project in Illinois is an Advanced Traveler Information System (ATIS) that evolved from a Motorola initiative to develop an advanced route guidance system. This system would help reduce congestion through a dynamic interaction of instrument-equipped automobiles with a traffic surveillance system. The viability of such a concept was confirmed by airplane fly-over analyses of traffic distributions in the Northwest Chicago, rush traffic corridor. This analysis showed that while there was congestion on certain roads, other roads were considerably less congested. Through discussion of this concept with professionals at the Transportation Research Board, a Chicago Transit Authority official suggested that Motorola, a Chicago-based company, discuss this concept with the Illinois Universities Transportation Research Consortium (IUTRC) in early 1989.

Later in 1989, several members of the IUTRC visited Motorola to listen to their ideas and were enthused about its potential. About the same time, the Illinois Department of Transportation (IDOT) had announced an initiative called "Operation Green Light," a broad based congestion management initiative which included traffic signal timing optimization components. IUTRC, which had an active research program with IDOT, urged Motorola to present their ideas to IDOT. This happened in mid 1989. Although IDOT, already committed to "Operation Green Light," was not initially ready to endorse such an initiative, they decided to participate in a 33-33-33 cost sharing of a feasibility study with IUTRC and Motorola.

In September 1989, IDOT provided $50,000 to IUTRC for the feasibility study. IUTRC and Motorola signed a letter agreement to share costs via in-kind labor expenses. The goal was to complete the feasibility study by March 1990.

The feasibility study started looking at two fundamental issues: (1) How many probe vehicles were needed to do a realistic test? and (2) How large did the network have to be? Motorola quickly identified a 220 square mile area for the test; however, the challenge was to determine where all of the travel time information would be fed and analyzed. The concept of a Traffic Information Center (TIC) was then formulated. Motorola agreed to develop the communications and navigation components, and IUTRC agreed to develop the concept of a TIC.

IDOT's involvement increased when they became concerned that IUTRC and Motorola were proceeding on their subsystem developments without sufficient attention to the needed

interfaces among all parties involved and the TIC. IDOT, therefore, set up regular meetings using an advisory committee to foster communications among all interested parties. Three meetings were held: in the fall of 1989, and in March/April and June of 1990. The feasibility study was ultimately published in July of 1990.

During the feasibility study, federal interest in what was to become ADVANCE was stimulated by developing legislative requirements for IVHS and related operational field tests, plus perceived deficiencies (e.g., small sample of probe vehicles) within the TravTek operational field test. Unlike with the pre-ISTEA, TravTek partnership, in which partners agreed to provide functional capabilities of the system that was to become TravTek, the federal role in ADVANCE required stricter accounting of the use of taxpayer funds and commensurate contributions of the private partners to achieving the functional capabilities desired for ADVANCE. Consequently, the need for signed agreements forced the parties involved to deal with issues which had previously been more implicit than explicit. Such issues, to be expanded upon in the next section, included different ways of doing business in state government, industry, and academia, intellectual property rights, and methods of accounting for the value of contributions by the respective partners. The process of working out an acceptable agreement among the four parties lasted about a year.

Goals and Objectives

Design and development of ADVANCE began in earnest in July 1991 with the signing of the formal IVHS Agreement between the venture partners. The Program Plan was created in late 1991 and early 1992. The overall goals and objectives of the project are to:

- Improve individual travel times by providing real-time information that will allow travelers to adjust mode choice, route choice, departure time, and other travel related behavior
- Provide navigational assistance to travelers
- Enhance existing efforts to provide traffic information to travelers by providing integration with IDOT District One operations
- Investigate to what extent congestion can be reduced through more effective utilization of the existing transportation network
- Evaluate the effectiveness of using vehicles as probes as well as various other IVHS technologies
- Evaluate the behavior and perception of travelers
- Identify and evaluate transition paths and cost to develop and implement an operational IVHS; and
- Help determine future deployment of IVHS.

Design and technical testing of the project began shortly thereafter and continues today. Implementation of the operational field test and evaluation is expected to begin in early 1994 and last until mid 1997.

The ADVANCE Partners

There are four partners associated with ADVANCE: the Federal Highway Administration (FHWA), the Illinois Department of Transportation (IDOT), the Illinois Universities Transportation Research Consortium (IUTRC), and Motorola Corporation.

FHWA provides funding and technical assistance as well as conducts overall program evaluation. This lead administration within the US Department of Transportation is responsible for: developing the overall strategy and the detailed work plan for a comprehensive evaluation; implementing the evaluation in accordance with a detailed work plan; participating in the design of the dynamic route guidance system and in system level reviews and tests; providing technical assistance, in particular during the design and initial implementation stages; and, providing coordination with other IVHS projects. From the federal perspective, the aim of the IVHS is to apply the newest concepts and technology in the areas of communications, navigation and information systems to improve highway safety, provide solutions to traffic congestion problems, and reduce the harm that automobile traffic does to the environment. ADVANCE demonstrates these IVHS concepts in a real-world setting.

IDOT is another government sponsor of ADVANCE. It is responsible for keeping the transportation system in good operational condition, a responsibility that is critical to the economic well-being of the State of Illinois and communities located along its corridors. As the sponsoring state agency of ADVANCE, IDOT provides funding, management, operating and technical assistance to the effort. IDOT is responsible for: providing specialized project management; establishing, operating, and supporting the TIC; establishing and maintaining an interface between the IDOT District One operations center and the ADVANCE TIC; achieving public and local agency support; providing support facilities for the radio frequency communication network control processor and modems; obtaining the necessary radio spectrum to successfully perform the demonstration; and participating in the design of the dynamic route guidance system and in system level reviews and tests. ADVANCE is supported by IDOT to ensure that the state transportation system operates efficiently now and in the future.

IUTRC brings together the research capabilities of four major academic transportation units in Illinois: the University of Illinois at Urbana-Champaign, the Illinois Institute of Technology, the University of Illinois at Chicago, and Northwestern University (Only Northwestern University and the University of Illinois at Chicago are involved in ADVANCE). The consortium is responsible for: designing and implementing the hardware and software for the

TIC; participating in the development and implementation of procedures for monitoring and assessing system performance; participating in the design of the dynamic route guidance system and in system level reviews and tests; and identifying the procedures for recruiting and training private and commercial vehicle operators. The universities benefit from their involvement in ADVANCE by expanding opportunities for their high-tech transportation-related research activities.

Motorola brings important private sector support to the effort. Motorola's technical expertise is key in the deployment of IVHS products and services. The company is responsible for: designing, manufacturing, installing, and maintaining in-vehicle navigation and route guidance systems; providing and maintaining the database for the in-vehicle navigation and route guidance systems; establishing, operating, and maintaining a radio frequency communication system for the transmission of data between the test vehicles and the TIC; and participating in the design of the dynamic route guidance system and in system level reviews and tests. Motorola's involvement creates a valuable market for new IVHS products.

Other Project Participants

ADVANCE's multi-agency cooperative provides additional opportunities for others to participate in the operational test program. As of Fall 1993, the following are included in the list of ADVANCE participants:

AB Volvo Technical Development
Dontech
Etak, Incorporated
Ford Motor Company
General Motors Corporation
Honda R&D North America, Inc.
Illinois State Toll Highway Authority
INRO/University of Montreal (CRT)
Institute of Transportation, Taiwan Republic of China
Mercedez-Benz of North America
National Center for Supercomputing Applications
Navigation Technologies
Nissan Research and Development, Inc.
Pace
Peugeot S.A.
Rational
SAAB
Sun Microsystems, Inc.
Surface Systems, Inc.

Toyota Technical Center, Inc.
Versant Object Technology, (Ligas & Dowell, 1993).

To encourage the involvement of a diverse set of institutions and organizations, four categories for participation were defined. Based on the levels of commitment, the four options for participation are Member, Associate, Sponsor and Contributor. Each of these categories brings with it certain privileges and responsibilities. Included in the privileges is each participant's right to showcase their affiliation with the ADVANCE project in their communications to both external and internal audiences.

A Member of ADVANCE is expected to undertake major responsibility for achievement of the broad objectives of the ADVANCE program, including a substantial contribution of funding and staff resources. Each new member of ADVANCE is invited to participate with voting status on the Steering Committee which has the responsibility to make policy decisions on the continuing development of the ADVANCE program. In addition, all Members will be included in all task force meetings. New Members will be expected to make a contribution of cash, equipment, staff time or services with a value to the program of at least $1 million and to submit a proposal which describes how its participation will be beneficial to ADVANCE.

An Associate of ADVANCE will be invited to attend all task force meetings, providing timely access to information as well as the opportunity to contribute to the design of the program. The rights and responsibilities of Associates will be dependent upon their contribution and expertise. Each applicant at this level will contribute a minimum of $100,000 in cash, equipment or services. If the contribution is in services or equipment, it must be directly beneficial to the program in terms of reducing the costs to other participants or providing a significant improvement to the program. The contribution would not impose significant new costs on ADVANCE.

A Sponsor of the ADVANCE program is required to make a contribution of cash, equipment or services with a value of at least $25,000. Equipment or services, such as automobiles, computer hardware or software, specialized technical services, office space, etc., will be valued in terms of their usefulness to the ADVANCE program. Sponsors will be mentioned in ADVANCE collateral material including the annual report and project information packets as appropriate. Copies of formal ADVANCE publications will be provided to all Sponsors. Formal briefings on ADVANCE will be scheduled semi-annually. Sponsors will be invited to attend these sessions.

A Contributor of the ADVANCE program is required to make a contribution of at least $5,000. This contribution may be in cash, equipment or services. Contributors will be listed in the annual report and will receive the quarterly newsletter.

Risks and Benefits for Project Partners

Involvement in the ADVANCE project posed potential risks as well as benefits to each organization in the partnership. The FHWA's reputation and credibility would suffer if ADVANCE were considered a failure or was badly run. The FHWA also did not want to be perceived as throwing money away, or as causing negative publicity for IVHS projects and programs because of its accountability to the Secretary of Transportation and to Congress. A major potential benefit for the FHWA was the determination of the benefit of ATIS systems in general, and more specifically, the benefits of a probe vehicle-based system for assisting in real-time route diversion around congestion. Other potential benefits included positive media exposure and determining the acceptability of public/private ventures under new accounting procedures.

The IDOT shared many of the same risks as the FHWA. If ADVANCE failed, as a co-funder of the project, the IDOT would have to account to the tax payers of Illinois against potential claims of squandering tax dollars. Because ADVANCE would be conducted in the Chicago area, those in IDOT also risked the wrath of local politicians whose careers could be jeopardized if ADVANCED somehow contributed to rather than relieved traffic congestion. Potential benefits to IDOT included a method for direct relief of congestion in the Chicago area, positive media exposure as a leading IVHS state, and political gain for its backers through tax payer satisfaction regarding congestion and successful teaming with Motorola, a local contributor to the economy.

Risks to Motorola included: the potential for providing ground breaking investments in in-vehicle navigational technologies that other companies could capitalize on; loss of investments in a failing proposition; revelation of its rate structure through accidental mishandling of such information in the Government's cost accounting procedures; production of a system capable of dynamic route guidance with commensurate potential for the Government to withdraw from providing real-time traffic information. Other risks included the system proving to be unsafe. Benefits to Motorola include obtaining a technological leg-up on its competition and commensurate increase in market share of new navigational aid products, reduced break-in costs through piggy-backing onto partner investments in the technology, positive publicity contributing to increases in overall sales.

Risks to the IUTRC were less of a financial nature than the other partners and more along the lines of technological and reputational risk. The technological risk was that the IUTRC had never before developed a data fusion algorithm for the industrial purpose of making real-time route assignments to motorists of the general public. Moreover, a technological failure in this program could affect the ability of IUTRC to attract future transportation project funding, to attract high quality transportation researchers from across the country, and to attract gifted students from wanting to attend universities participating in the IUTRC. On the other hand, the benefits would include a reputation for success that attracted more transportation funding, more high quality researchers, and gifted students attracted to a university system with a demonstrated record of success.

2.2 Operational Field Test Description

The Project

Design and development of ADVANCE began in July 1991 and will continue through September 1994. ADVANCE will proceed to deployment in mid-1994. The project is expected to last up to five years, including the evaluation, and will cost between $40 and $45 million. The public and private sector partners will share in the cost of ADVANCE.

ADVANCE will be conducted in an approximately 300 square mile region in the northwestern suburbs of Chicago, Illinois. The test area is roughly bounded by Illinois Route 59 on the west, Illinois Route 43 on the east, Cuba Road on the north, and Illinois Route 19 on the south. The Chicago suburbs where ADVANCE will be tested are typical of modern suburban developments and have significant traffic congestion problems:

> The geographic context of this demonstration was chosen to meet the following requirements:
>
> - the road network should have numerous alternative routes from origins to destinations;
> - travel demand on the road network should be heavy, resulting in congestion levels at which contemporary traffic signal control systems alone are inadequate;
> - many trips should begin and end within the area during the peak periods, with typical journey times long enough to make route diversion a real option (e.g. 30-40 minutes);
> - the area should be typical of modern suburban developments, with large, widely-dispersed employment sites interspersed with extensive residential areas.
>
> These criteria led to identification of suburban area served primarily by a high quality arterial road network in suburban Cook County, northwest of the city of Chicago. This area is served by a grid arterial highway system overlaid by several northwest-southeast diagonal roads which pose challenging signal control problems. The area, which includes O'Hare International Airport, has experienced substantial employment growth since 1970, in the form of light manufacturing, office center, regional and area shopping centers and sub-regional governmental centers. Office employment expansion continues to stress an already congested road network. Employees in the test region tend to live in low density suburban single-family, town-house and garden apartment developments throughout the Chicago suburbs. (Boyce et al., 1991)

The project will involve up to 5,000 local drivers who will have their own vehicles equipped with sophisticated navigation and route guidance systems. Global positioning satellite receivers

will also be installed in the vehicles to track their exact location within the network. The ADVANCE navigation system develops the driver's best route using information on current traffic conditions and driver input on destination, route preference, and other driver requests (for example, shortest distance, shortest time, or no freeway driving). At appropriate times throughout the trip, the system gives drivers instructions on when and where to turn. Directions are updated as needed to reflect changes in traffic conditions. This "best route" information helps drivers avoid congestion to save time and enhance safety. The on-board navigation system also will contain a directory to help the driver locate restaurants, hotels, stores, or other points of interest in the project area.

Drivers will have their route choices monitored and analyzed, both with and without the navigation systems. The drivers may also be asked to participate in interviews or group discussions to evaluate the performance of the system. When the ADVANCE project is completed, the on-board navigation systems can be removed from the vehicles without damage.

How ADVANCE Works

The ADVANCE in-vehicle navigation and route guidance system will consist of a video screen, a microcomputer, a data communications radio, and a global positioning satellite (GPS) receiver. The system will use the GPS receiver, along with a map of the project area stored in the vehicle, to determine the vehicle's exact location. The driver can enter the address of his or her destination or select it from an area map displayed on the video screen. Drivers can also view a list of services and other points of interest in the area, such as service station, restaurants, or motels. During the trip, route guidance information will be displayed on the video screen in easy to understand visual cues, such as arrows. This information will be supplemented by voice instructions.

Current traffic information will be gathered from and transmitted to the ADVANCE vehicles over a dedicated radio frequency communications system. The primary source of real-time traffic information will be the vehicles themselves, functioning as roving traffic probes automatically reporting unusual traffic conditions. Computers at the Traffic Information Center will combine and process data from vehicle probes, sensors in the roadway, reports from police and other agencies, and, eventually, predictive computer models to determine travel times and other roadway conditions.

Traffic information will be transmitted to the ADVANCE vehicles in the form of updated route guidance instructions. Information from ADVANCE will also be used by the traffic control system operator to improve the flow of traffic for all vehicles in the area.

Funding

Funds from ADVANCE Parties. ADVANCE is expected to operate for approximately six years and cost between $40 and $45 million. It is intended that the total project funding will be split approximately 50% from federal sources, 25% from state sources and the remaining 25% from Motorola, Inc., the Consortium and other private sources. It is intended that overall, the in-vehicle hardware funding will be split 1/3 federal, 1/3 state, and 1/3 Motorola, Inc., and other private sources.

The first phase of the project (the development phase) includes project design, initial deployment, and systems testing of the IVHS technology to be used. It was initially to last 12 to 18 months and was estimated to cost $5.6 million. Funding for this phase meets the intended goal of approximately 50% federal, 25% state and 25% Motorola, Inc., the Consortium and other private sources. (This development phase has grown to a 30 month effort with a budget of $14.2 million.)

Pursuant to 23 USC 307, the federal funds will be committed to ADVANCE through a cooperative agreement between the FHWA and the Illinois Department of Transportation. Expenditure of federal funds will be authorized by work orders issued as addendums to the cooperative agreement.

The commitment of state and private funds used in conjunction with federal funds will be authorized in the same work order authorizing expenditure of federal funds. Other work items that utilize state and private funds committed to ADVANCE, but do not utilize federal funds, will be covered in separate authorizing documents.

Funds from Others. According to the Master Agreement among the ADVANCE partners (the agreement calls partners, "Parties"), the Parties, except FHWA, are allowed to singly and/or collectively, solicit support from private sources to insure that the total program obtains and maintains the funding ratios at the agreed upon levels. When the Parties, except FHWA, solicit support, the private sources are supposed to be informed that their support will go specifically to ADVANCE.

The agreement also allows the Partners, except FHWA, to solicit support toward meeting their responsibilities under the agreement. This support may be in the form of money, equipment, facilities, and services, and will be accounted in dollar value. This dollar value will be applied as cost sharing for the respective Partner or Partners.

Support from outside private sources obtained by the IDOT ADVANCE Program Office can be applied to any element of the program as determined by the Steering Committee. Credit for the value of this outside support will be allocated against cost sharing goals in a fair and equitable manner to those Partners performing the work identified in the selected element.

There is nothing in the Master Agreement that prohibits any partner from conducting research, development, testing or evaluation outside of the assigned area(s) of the agreement. However, if any of the partners pursue such projects (funded either externally or internally by any of the partners) the funding will not be credited as part of ADVANCE funding.

3.0 PAST AND PRESENT INSTITUTIONAL ISSUES

This case study report interprets, "Institutional Issues," as those non-technical impediments to the success of the ultimate deployment of IVHS technologies. The organization of this section presents institutional issues in terms of four broad categories (Organizational; Regulatory; Human Resources; and, Financial), as well as an "Other" category. These categories were derived from an analysis of the report by Haines and DeBlasio (1992) and a series of meetings between interview team leaders and an "Institutional Barriers Advisory Group" (IVHS Institutional Issues and Case Studies Field Guide, June, 1993).

The focus of this section is on identifying past and present issues. For ADVANCE, such issues apply to the planning and design/development phase. This includes bench testing and independent verification and validation activities. The next section (Section IV) synthesizes expert opinions and projections regarding future impediments that might be encountered in the ultimate deployment of ADVANCE-related technologies. These would apply to projections for the actual operational field test implementation, evaluation, and eventual deployment phases.

Of the four major categories of issues, it appears that "Regulatory" contained the most challenging impediments. Essentially, the mismatch between regulatory requirements of the government (federal and to a lesser extent, state) and Motorola IVHS' commercial business practices created a fundamental problem that highlighted and exacerbated other interactive, yet lesser problems with organization, human resources, and finances. The following paragraphs discuss each issue area in turn, from highest to lowest importance.

3.1 REGULATORY/LEGAL

The following, from most important to least, are regulatory issues faced by ADVANCE:

- **Unclear Government Accounting Requirements**
- **Difficulties in Securing Intellectual Property/Proprietary Rights Agreements**
- **Burdensome Administrative Requirements**

Each is discussed in turn below.

Unclear Government Accounting Requirements

Work performed with Federal funding requires the accounting of direct, overhead, and fee expenses incurred by private sector vendors. Because the ADVANCE partnership agreement had requirements for certain percentage sharing of costs for the entire project as well as for hardware to be used in the vehicles, the government procedures require Parties to share their records of these expenses if they were to be considered as cost sharing. **This Federal and state requirement almost caused the termination of the ADVANCE partnership.** Motorola IVHS' commercial business practices did not require the detailed accounting of workers' time in strict accordance with the Federal requirements. More important, Motorola management insisted on total confidentiality regarding product costs.

Those interviewed from Motorola stated that their unwillingness to apply the FAR was a major contributor to ensuing problems in resolving the partnership agreement. FHWA concludes, however, that the FAR did not apply to the ADVANCE project. ADVANCE is governed by the Federal regulation known as the "Common Rule" (OMB Circular A-102, "Uniform Administrative Guidelines for Grants and Cooperative Agreements to States and Local Governments" which is codified at 49 C.F.R. Part 18). More specifically, 49 CFR Section 18.22 states that the cost principles contained in FAR Part 31 or uniform cost accounting standards that comply with cost principles acceptable to the Federal agency are to be used to determine allowable costs on contracts with for-profit organizations.

Although there are certain regulations that must be abided and accounting information that is required for any use of Federal funds, the Common Rule provides flexibility in determining how to determine the appropriate value (cost) of products and services that are subject to Federal funding. In so doing, it does refer to the FAR as a source of cost principles. The ADVANCE Project partners worked together to reach a process that was agreeable to all parties and would satisfy the regulations that do apply to ADVANCE. However, these applicable regulations are not the FAR per se, and it is inappropriate to infer that the FAR apply to IVHS operational tests in general.

Because Motorola was unwilling to apply Federal accounting practices, and because commercial practices were so foreign to the Federal and state governments, negotiations lasted

many months to clarify the concerns and identify an acceptable solution. At the time interviews were being conducted for this case study, this issue was not yet fully resolved. However, it appears that the use of a third party auditor will be the agreed upon solution. This resolution was developed by a problem resolution working group involving administrative, audit, financial, and legal representatives from all involved Parties. During this time, work performed by Motorola for the partnership, and intended by the partners to be reimbursed to Motorola, was not being reimbursed. Motorola was continuing work without a payment mechanism in place.

Difficulties in Securing Intellectual Property/Proprietary Rights Agreement

This issue stems from the stereotypical view that results of any endeavor that uses Federal funding will fall in the public domain. The universities' partner representatives, however, wanted to ensure that they could publish/copyright their products, and Motorola's representatives wanted to ensure that their partnership investments would not jeopardize the proprietary status of their hardware and software products. More specifically, Motorola was concerned that the competition could capitalize on Motorola's front end investment by having access to ADVANCE documentation on Motorola-developed hardware and software. Although FHWA continues to have an interest in ensuring the results of the ADVANCE project are publicly available so that others might learn from this investment, negotiations among the partners ultimately resulted in mutually acceptable wording that was included in the Master Agreement. Although an issue that did require time to negotiate, none of those interviewed saw this as a serious problem. Many felt that the ADVANCE agreement could be readily used by other partnerships as a starting template for addressing this particular issue.

Burdensome Administrative Requirements

Classified by most as an annoyance, the universities and Motorola complained of government emphasis on free and open competition for obtaining components necessary for the development of ADVANCE. Paperwork to justify a product as the best for the money seemed unrewarding and denying professionals the time to do more meaningful work. The same was held true for monthly progress reports regarding areas where everyone knew from meetings, for example, that no progress had been achieved. No resolution to this impediment was reported by those interviewed. The government interviewees felt that their concerns for documenting progress for public record seemed quite appropriate. One interviewee suggested that detailed minutes from such meetings with appropriate sign-offs by each Party might be deemed an acceptable replacement for progress reports.

3.2 Organizational Issues and Findings

There were three interactive issue areas within this category that constituted the majority of impediments to progress with the planning and, more so, development of ADVANCE: Cultural Differences in Public/Private Partnerships; Insufficient Inter-organizational Communications Channels; and Insufficient Intra-organizational Communications Channels.

Cultural Differences in Public/Private Partnerships

A fundamental impediment to the smooth accomplishment of a partnership agreement for ADVANCE was the stark difference in the ways the partners did business. Such differences are due in large part to the differences in measures of success for the types of partners, i.e., commercial industry, Federal government, state government, and universities. Motorola's biggest indicator of success is profitability, with price and quality of its products being a key determinant. In the case of ADVANCE, FHWA's indicators of success are the same as those for IVHS, i.e., reducing congestion, improving driving safety, etc., on a nationwide level. IDOT shares the same goals as FHWA, but their interests, of course, are focused on the problems of the State of Illinois, and with ADVANCE, the city of Chicago and its surrounding suburbs. The universities, even though IUTRC is a combination of public and private universities, pride themselves on advancement of science and engineering and other academic areas of excellence. They pride themselves on the reputation of their professors and the quality of the students they attract and matriculate.

In light of the relative measures of success of the various public and private Parties involved with ADVANCE, **the organizational part of Motorola involved with ADVANCE was not organized in a way that was conducive to participate in a cost reimbursement government contract.** For example, time cards were not kept for work performed on ADVANCE. Moreover, no accounting system or organization was geared to satisfy Federal accounting requirements because, until ADVANCE, Motorola IVHS had no experience with cost reimbursement contracts.

The size and role of government as the steward of taxpayers' money accounts requires special considerations to ensure the safeguarding of the taxpayers' interests. Consequently, **the government, unlike Motorola, is required to establish a set of procedures to ensure that contracts receive full and open competition**. Only under special circumstances does the government award sole source contracts. The FAR requirements have led to government organizations being built to perform such functions; no parallel organizations exist within commercial business.

At the university level, involvement with **ADVANCE meant they were placed in the unusual position of being systems builders** who needed to procure special purpose computer equipment. Some at the universities complained that government procedures for ensuring competition were counterproductive to cost and schedule goals of the program and a full documentation of the merits of four proposed systems providers was time consuming.

Insufficient Inter-organizational Communications Channels

Misunderstandings and other cross-organization impediments did occur, especially for the following reasons:

- **Unclear definition of "evaluation"**
- **Uncertainty regarding cost sharing goals and how they would be measured**
- **Negative stereotypes of cultural differences**

Each area is discussed in turn.

Unclear definition of "evaluation." Some of the non-Federal interviewees stated that although FHWA wanted to evaluate ADVANCE, the interviewees were really thinking in terms of "demonstration." "Universities wanted to evaluate the technologies and driver responses to them; however, FHWA wanted to evaluate a fielded system and not let the developers evaluate it." It appears that **there is much confusion regarding terms that are close in meaning, but are meant to be very different things to different people.** These terms include: "research," "test," "evaluation," and "demonstration."

"Research" implies that gaining a better understanding of IVHS systems is the end goal of the activity. The term "test" implies that an IVHS system is being measured against a profile of specific performance standards, such that the test will give the system measurable grades compared to pre-set standards. In this way, the relative proximity of each grade can be evaluated against the passing grade standard. The term, "evaluation," is much more forgiving in that it implies more global standards for success, and scrutiny with regard to projecting what the system's performance would be like if it were placed under novel, hypothetical circumstances. The term "demonstration" implies a lack of concern for exacting testing or evaluation, except for a passing grade if the system generally works or does not work. Results of interviews with those from the universities, the state, the Federal, and the private sector partners revealed that each of these different terms was portrayed by at least one interviewee as what was meant to be conducted in the process of evaluating the ADVANCE project.

This confusion among the partners led to hard feelings and the omission of important evaluation considerations in the early planning of the system development. Many interviewees identified the impact of this omission as contributing to increased program cost, longer operational field test schedule, and missed opportunities to consider evaluation data collection in the system design and development process. It is possible, for example, that with little if any cost or schedule impact, the system design could have been modified either to improve the system performance based on more explicitly stated evaluation criteria, or to improve the evaluation process by including the addition of "data ports" or other "hooks and strings" into the system design that could have assisted earlier on with a more quantitative evaluation.

Uncertainty regarding cost sharing goals and how they would be measured. Initially, the Mobile Navigation Assistant (MNA) was estimated to cost $4K per unit, and the cost for it was to be split 1/3-1/3-1/3, versus the 50%-25%-25% split for the entire ADVANCE program. Some understood that the last 1/3 was to be paid by Motorola; however, Motorola disagreed, and, in fact, no such provision existed in the Master Agreement. The effect of this misunderstanding was that this could reduce the number of vehicles equipped with MNAs and might impact the evaluation. Currently, there is a goal of 5000 units; however, the actual number needed appears to be in a range of 3000 and 5000 units. No final determination has been made.

Negative stereotypes of cultural differences. Webster (1982) defines a stereotype as, "a fixed or conventional notion or conception as of a person, group, idea, etc., held by a number of people, and allowing for no individuality, critical judgement, etc." One of the partner's leaders indicated that the entire concept of partnerships between industry and government in the United States is not a conventional notion; it is an innovation. Like all innovations, such partnerships, if successful, must overcome those old ways of thinking and doing that have impeded progress. Part of overcoming old ways is to have trust that organizations can change their ways to meet the new challenges of IVHS public-private partnerships. An impediment, therefore, is the degree to which organizations can't ignore stereotypes and overcome their lack of trust that others can change their ways.

Among the first and more frequently mentioned impediments to progress were cultural differences among the partners. The measures of success discussed in this section under, "Public/Private Partnerships," translate into stereotypical ways of thinking about the partners. There are many examples of this that were evident in interviews. Those in government and industry often felt that because universities typically perform basic research contributing to the overall basis of scientific knowledge, they are out of touch with the realities of producing technologies that work as expected, according to schedule and within the budget.

Some in universities felt that the government's lack of understanding of technology creates annoying hurdles to progress through unrealistic sole source justifications for acquiring one-of-a-kind equipment and software; use of consultant contractors as "middle men" provide yet one more layer of management and resultant inefficiencies; and desire for quick results causes premature implementations of unproven technologies.

Many in industry stated that those in government do not understand that time is money. Many of those in government felt that those in industry are only out to make a profit and do not have the genuine interests of the American public in mind.

The perceptions described in the previous paragraphs have been reinforced to some degree by the experiences of many of those involved with ADVANCE and have been an impediment to progress. On the other hand, one leading interviewee noted that the opposite of these stereotypes has also been witnessed. The lack of communication across organizations, therefore, appears to have contributed to the lack of understanding why certain negative stereotypes might exist, how they can be overcome, and how positive attributes of the partners can be capitalized upon.

Insufficient Intra-Organizational Communications Channels

Problems in communications between ADVANCE partner organizations highlighted the fact that there were similar problems with communications internal to the partner organizations. The biggest problem here stems from differences among organizations' normal business practices compared to new business practices required by the creation of the IVHS operational field test program. Current ways of organization to achieve efficiency and success had to be changed to meet IVHS requirements. Although one division of Motorola, located primarily in Phoenix, is used to doing business with the government, the division of Motorola in Schaumburg, IL, the ADVANCE Partner, is not. Therefore, **until ADVANCE, Motorola IVHS had no need to communicate with experts in Federal accounting practices**. In addition, because there are multiple divisions of Motorola that were not as motivated to participate in a joint public/private venture, reduced pricing of ADVANCE components was a significant effort. These difficulties created delays in the ADVANCE schedule because internal coordination was needed in an area where there was no precedent for such communications.

Delays like those experienced in Motorola were similarly experienced within organizations of the government. **Both the state and Federal governments did not involve their accounting specialists in early meetings associated with formulating the ADVANCE agreement.** When it became evident that Federal accounting provisions were a major problem for Motorola, a broad based initiative across government office boundaries had to take place to put communications back on track.

Other Organizational Issues

There were three impediments to the success of ADVANCE that were identified but were more of annoyance factors than true impediments. In order of more to less important, they are:

- **Overdependence on Unproven Technology**
- **Resistance to Change**
- **Acceptance of Management and Leadership**

Overdependence on Unproven Technology. At least one person interviewed expressed the concern that the success of ADVANCE was over-reliant upon technologies that had yet to be demonstrated. Specifically, the ability to test the concept of dynamic route guidance depended upon the development of sophisticated software data fusion. This process will fuse information from probe vehicles, inductive loops, video systems, and voice input, and render recommendations of faster routes around congestion. The impact of the uncertain proficiency of the technology is causing certain partners to develop contingency plans in case the technology fails. This issue was reported as an emotional issue that has not been resolved. A recommended remedial strategy was to identify high-risk technologies early in the process and identify fall-back plans should the technologies not materialize within schedule.

Resistance to Change. During the early planning phase of ADVANCE, one of IDOT's personnel who worked in Chicago's traffic management center, where a traffic management system was in place for 30 years, was less than positive about the ADVANCE concept. This person perceived that the ADVANCE Project was an encroachment upon the state's responsibility to collect and use data pertaining to traffic congestion. This issue required ADVANCE leadership, particularly within IDOT, to involve such personnel more actively and accommodate their concerns in the technical approach for ADVANCE. With this approach of ensuring that all stakeholders were represented in decision making, resistance stopped.

Acceptance of Management and Leadership. During the formation of the ADVANCE partnership, FHWA needed to be convinced that the other parties had appropriate management and leadership in place. It is clear that many interviewees believed leadership and upper management support were positive aspects of ADVANCE. Such leadership enabled those in ADVANCE to overcome the regulatory issues (See Section III, B) that almost ended the ADVANCE initiative.

3.3 Financial

Two financial impediments surfaced from the interviews of ADVANCE partner participants:

- **Uncertainties in Costing and Accounting**
- **Difficulties in Identifying Liabilities and Obtaining Insurance**

Although the first was by far the most troublesome and is still not fully resolved, none of the partners' representatives gave the impression that either problem represented an insurmountable problem. Each is discussed in turn:

Uncertainties in Costing and Accounting

Highly related to problems with Federal accounting requirements is the method by which hardware contributions are assigned a dollar value, and what part of that value is partner-owned, and what part is proprietary to a single partner. The goal for ADVANCE was to have 5000 cars equipped with ADVANCE-specific hardware. Fundamental unit pricing questions include: Which unit will be considered the "first" unit? If it is agreed that pre-production units are needed, who pays for the cost of these, and how are they valued? If Motorola decides to market an item that resembles or uses technologies contributing to the development of the ADVANCE system, can they charge their pre-marketing investments as a credit against ADVANCE cost sharing goals? How will the Partners know what costs from Motorola to omit from credit to ADVANCE contributions? At the time of the case study interviews, it was not clear that these issues had been completely resolved; however, it was believed that if the third party auditing was acceptable to all partners, this issue could be resolved through mediation by the partner-selected auditor.

Another complicating factor was the way in which universities do their business. Although universities do not work for fee, there are book keeping problems that make comparisons between universities' and other partners' contributions difficult. For example, professors who work on a project are not required to keep time cards. Instead, **professors' work obligations are monitored by universities in terms of how many courses they teach.** A recently completed audit of 1992 IUTRC records indicated compliance with accepted government practice.

Difficulties in Identifying Liabilities and Obtaining Insurance

Who will insure vehicles for collision and liability? Who will insure liability on the project against things such as faulty wiring, wrong way directions? Because the devise is attached to the inside of the vehicle, could a person sue because of compromised safety due to the screen? Such safety and liability concerns created management concerns among the ADVANCE partners. These concerns delayed the ability of partners' personnel to use the vehicles and caused some annoyance in finalizing the partner agreement. After opening discussions with six insurance companies, insurance was obtained for the partners, and it was decided that participants from the general public would have to take the insurance consequences, if any. All partners acknowledged the need to provide participants from the general public a consent statement that identified possible risks associated with volunteer participation. It should be noted that there was little interest by the insurance industry in providing quotes for ADVANCE. Also, each of the Parties is self-insured. The major concern was liability of others driving ADVANCE vehicles.

3.4 Human Resources

Two areas of deficiency in human resources were noted. From more to least important, they are:

- **Insufficient Resources/Part-Time Management**
- **Lack of In-house Technical Expertise**

Each is discussed in turn.

Insufficient Resources/Part-Time Management

The partners agreed that the State of Illinois would serve as the lead partner for program management of ADVANCE. However, particularly in the early phase of ADVANCE, no state employee had ADVANCE program management as a full time job, and there was a short time after the initial state champion was not readily available that there was positioning among the partners vying for power. This **lack of continuity may have been a factor in assigning technical responsibilities among the partners.**

The new full-time program manager was brought on board a month after the agreement was signed (August). The selection of a system integration consultant was made in September and a contract was executed in December 1991. An Administrative and Contract Manager was brought on in March 1992 along with secretarial staff.

Almost everyone agreed that full time staffing was essential to the survival and continued success of the ADVANCE program. Most also agreed that **having an independent systems integrator authorized to resolve conflicts among partners was a welcome and beneficial move.** Most agreed earlier staffing would have assisted. The time frame for hiring the consultant and adding staff, although normal for government, was not consistent with the practice in private industry.

Lack of In-house Technical Expertise

One university-originated complaint was that FHWA and the state have moved in a direction where there is not a lot of technical expertise present among the respective staffs. When universities produce a piece of work, both groups want to evaluate it, yet they are incapable of doing it themselves. Therefore, people's livelihoods (e.g. technical consultants) depend on this inefficient system. Consequently, it appears as though there is a lot of redundant work. Government interests indicated a concern that the system operate as a whole, hence they thought that it is important that the systems integrator fully understand all Parties' efforts. They acknowledged that oversight over all agencies might be uncomfortable but still necessary.

3.5 Other

This category provides for issues that do not easily fit into the preceding categories. There were two of these such issues:

- **Concerns Over Lack of Public Acceptance Due to Perceived Threats to Privacy**
- **Concerns Over Lack of Local Township Acceptance Due to Possible Increases in Local Congestion**

These are discussed in turn.

Concerns Over Lack of Public Acceptance Due to Perceived Threats to Privacy

Because the ADVANCE system operation, evaluation, and associated research require that drivers be tracked over time, there was and continues to be some concern that drivers would

protest that "big brother" would be invading their privacy, especially if ADVANCE wants to track drivers over several years. There was and continues to be the special concern that commercial vehicle operators (e.g., truckers) would be very concerned regarding employers knowing where they are. This issue affects the design of the in-vehicle units and how the system is operated. It also will affect the design and use of the help center which tracks the make and model of the car and the drivers' identifications. The impact of this issue on recruitment is unknown; however, none of the partners thought that recruitment would be an insurmountable problem.

The partners resolved that for the purposes of the operational tests, all participants from the general public must be made aware of the fact that ADVANCE will be tracking their locations. Partners also agreed that they would attempt to use a system that separates the data base of names of participants from the data bases that contain information regarding how individuals used the system and other pertinent measures that could help evaluators determine the overall success of ADVANCE in meeting its goals.

Concerns Over Lack of Local Township Acceptance Due to Possible Increases in Local Congestion

A major concern expressed by one of the interviewees was that, if there were enough ADVANCE participants recruited for the system to work as intended, ADVANCE would divert traffic to arterials in local communities and residents might complain that ADVANCE was clogging their streets. In fact, the feasibility study for ADVANCE suggested that indeed, there were instances when some arterials were being underutilized. It is in such instances that a system like ADVANCE might very well increase traffic on these streets as a way of alleviating total system congestion. There was the definite concern that public resentment of ADVANCE might lead to the halting of the ADVANCE operational field test.

Although the potential for this problem was identified early, there are differences in perceptions of at least two interviewees regarding the level of action taken to address this concern. One interviewee reported that the partners recruited participation from someone who could represent the interests of the local suburbs; however, this person's participation was short lived, and the partners never tried to revitalize this initiative. Another interviewee reported that contacts with all municipalities are in place, newsletters are sent to all, and presentations have been made to local government groups.

It is clear that the concern is real and shared. It is also possible that both accounts of preventive activities are correct, and that one precedes the other in time. That is, although initial attempts at generating involvement by local communities failed, more recent activities were unbeknownst to the other interviewee.

4.0 ISSUES PROJECTED FOR FUTURE PROGRAM PHASES

At the time of these ADVANCE case study interviews, ADVANCE had completed the planning phase, and was well into design, development, and development testing. The implementation phase, whereby people recruited from the general public would be driving the vehicles, was planned to start in a year. Consequently, interviewees were asked to reflect on their experiences to date, and project what non-technical impediments might be waiting for each phase of the future: implementation of the field test; evaluation; and commercial deployment. Such impediments could be continuations of existing impediments, or new impediments.

4.1 Implementation of Operational Field Test

The most pressing issues projected for this phase of ADVANCE were concerns over the sufficiency of the program's budget and concerns over liability costs. Concerns over cost jumped dramatically, from hardly being encountered at all to definitely hindering progress. Concerns over liability also jumped from a slight irritant to hindering progress. This is understandable since the number of ADVANCE users would grow from less than 50 to a target of 5000.

Severity of organizational concerns generally dropped, especially those over intra-agency communications. However, concerns associated with public/private partnerships and inter-agency communications still persisted, ranging from being an irritant to moderately hindering progress. Administrative reporting and cost sharing concerns dropped considerably from the preceding phase, but were still projected to be a slight irritant.

Although people indicated that proprietary rights and sufficiency of staff and staffing expertise were problems experienced by ADVANCE in the present, they did not think these would be encountered at all in this or any of the remaining phases.

4.2 Evaluation

The most significant issue pertaining to the evaluation phase was the difference in business practices between public and private sectors. With reference to this issue in Section 3, each partner uses a different metric for success and has different aspects of the system for which its

organization is particularly interested. Motorola is interested most in the performance of the vehicle units, IUTRC is interested most in the effectiveness of the TIC for data fusion and dissemination. The state and Federal partners are interested in the system as a whole and whether the taxpayers will be suitably served by ADVANCE. The common denominator of interest, however, appears to be concerns over recruitment success and peoples' willingness to pay for an ADVANCE-like system.

Closely following these concerns were concerns over administration requirements of the evaluation. Of equal concern were inter-agency communications, and the definition of goals, roles, and responsibilities for the Parties.

A valid concern of those at FHWA appears to be the insufficient attention paid to evaluation by the ADVANCE partners in the early stages. If the purposes of an IVHS operational field test are to be satisfied by ADVANCE, an evaluation plan should have begun development at the end of the feasibility study and when the decision was made to go forward with ADVANCE. No data collection specifications appeared yet to be in place, and those at Motorola did acknowledge that hardware requirements for the evaluation were not completely defined.

The Evaluation Sub-Committee has been in place for the past year under the lead of an FHWA consultant. It is reported that progress is being made in many areas.

4.3 Commercial Deployment

The highest rated non-technical impediments to the success of ADVANCE rated for the commercial deployment phase were:

- **Incompatible Standards and Protocols**
- **Market Uncertainty**
- **Uncertain Public/Private Partnership Roles**

Significantly below these were inter-agency communications, liability, and environmental concerns. These are discussed in turn.

Incompatible Standards and Protocols

Standards and protocols were not considered by most to be a problem for any of the ADVANCE phases except deployment. In the deployment phase, however, the median projection was that the demand for, or absence of, a national architecture would hinder the progress of deploying a system like ADVANCE in the commercial market place. This is not surprising since all Parties agreed that ADVANCE itself and the success of the operational field test would help to determine the shape of the national IVHS architecture. All Parties also agreed that there was always the possibility that the new IVHS architecture could render all or

part of ADVANCE components as useless. That is, if the architecture does not accommodate the existing functionality of ADVANCE, the future of ADVANCE components could end or be significantly altered.

Market Uncertainty

The ultimate measure of success of ADVANCE and IVHS is whether people will purchase such systems or subscribe to such services. It is not surprising then, that those associated with ADVANCE would indicate that market uncertainty could hinder the success of ADVANCE in the commercial deployment phase. It is also not surprising that it is only in this commercial deployment phase that market uncertainty appeared as a noticeable concern of those interviewed. In fact, those recruited to participate in the ADVANCE operational field test will receive the installation of the vehicle unit free of charge (the unit will be removed after the study is over). ADVANCE has spent considerable resources through IUTRC development of a recruiting plan and will be testing its usefulness in 1994.

Uncertain Public/Private Partnership Roles

This category was understandably one of the most consistently high-rated areas of concern across all ADVANCE project phases. The concerns, however, are not the same in each phase. For the deployment phase, questions like the following were asked of the interviewees: Who will run the Traffic Information Center (TIC), i.e., will it be privatized? How will revenues be shared by the partners? Is it possible to contract traffic management activities? Since ADVANCE has recognized a new role for universities, as co-builders of ADVANCE, will universities also have a new role in commercialization of ADVANCE? The answer to some of these questions were more consistent than to others. For example, most agreed that IUTRC's role was somewhat provocative as it currently stands, and no one projected an even more aggressive role for IUTRC's future. In fact, many questioned the wisdom of placing IUTRC in such a critical role in the first place. With regard to the selling of traffic information, there was less conformity. Some thought the TIC should be run by the state and that TIC-provided information should be made available to all potential users according to present policy regarding IDOT traffic information. Others were sympathetic to selling information to subscribers.

Other Deployment Issues

Like "public/private partnerships," the topic of inter-agency communications was a consistent concern across all phases, but to a markedly lesser degree after the design and development phase. Liability also remained a concern, but its importance also dropped markedly from the Implementation to Deployment phases. The degree to which interviewees thought that environmental concerns (e.g., the potential for ADVANCE to increase automobile usage/emissions) impeded the achievement of ADVANCE goals was of little concern in the Planning phase. And, for all but the Deployment phase, environmental concerns were only

considered to be slightly encountered. Although environmental opinions markedly jumped for the Deployment phase, interviewees viewed such issues only a little more than being encountered, and still not severe enough to be considered as irritants.

5.0 LESSONS LEARNED

This section completes the ADVANCE case study report with a summary of findings and recommendations. Because ADVANCE has not entered into data collection, all of those interviewed agreed that it was too soon to tell if the formal objectives of ADVANCE have been met. It is clear that Federal regulatory requirements, particularly associated with the FAR, are the roots of many of the significant, non-technical institutional issues associated with ADVANCE. Despite these problems, many thought that the fact that the ADVANCE partnership was still moving ahead toward solutions to inter-agency differences and ineffective government regulations was an intermediate measure of success.

5.1 Findings

Public/private partnerships can be done, but with significant, yet surmountable, difficulties. Experience will ease the pain; however, apparently insurmountable issues (e.g. Government accounting requirements) can be overcome in time as long as negotiations continue. Aside from certain Government accounting requirements that need to be changed to accommodate the effectiveness of public/private partnerships, a major impediment is the different language and terminologies used by public and private Parties. Over time, however, the terms became understandable as the Parties took the time to teach each other. As was learned in the teaching process, it became apparent to ADVANCE management that resource requirements are consistently underestimated, and that expectations are consistently too high.

Good leadership is essential. The program suffered when the original champion of the concept and study was not available to provide full time management. For a program like ADVANCE, good leadership must be full-time leadership. The partners also agreed that it was absolutely essential to have talented leadership with an acceptable personality to all the partners. Although personality is such a subjective trait, it became clear that not having the right person for the job could ultimately halt the program. Respected characteristics of a leader included integrity, having an open mind and even temperament, decisiveness, and assertiveness to keep the project on track. Such personality traits overcame the concerns that such a person might bring biases from the donating partner's organization.

Sufficient human resources must be assigned in the beginning. The ADVANCE program suffered some delays in the initial implementation of the project. It is essential to have a core staff within the program office. This was ultimately accomplished by the state with a combination of state personnel and a partner-hired system integrator, but this was not in place until the project was underway. Although some Parties complained about the lack of the technical expertise of the system integrator in certain areas, most agreed that as an

outside consultant, the system integrator forced a welcomed sense of objectivity to dealing with all partners. Indeed, a major step was for partners to give the integrator full authority to make day-to-day decisions as long as partner vetoes could be invoked. As the program matured and the realization of the need to recruit sponsors as well as driver participants occurred, ADVANCE management saw the need to hire professional help with the public information aspects of the program. Although the use of a public information agent was promising, the agent had not been on board long enough for lessons learned to be generated from ADVANCE.

Caution should be exercised in the degree of agency-wide coordination before an IVHS partnership agreement is in hand. This point was highlighted by ambivalence of some and disagreement between some of those who experienced the early negotiations among partners. Some indicated that things would have gone a lot smoother regarding issues associated with Government accounting requirements if only the right people (e.g., legal and contracting experts) had been brought into discussions sooner. Others, however, cautioned that if such people were involved in the beginning, the program might never have been launched. That is, the number and magnitude of organizational differences and non-technical impediments might have been so great that upper management would have decided not to back the initiative.

5.2 Recommendations Based on Interviews

Based on the findings presented above, the following recommendations are offered:

- Involve a system integrator at the beginning of the project
- Capitalize on broad experience base of FHWA early on in the project
- Allow for a significant front end education process among partners whose contract and administration backgrounds do not include working with the Federal accounting requirements
- Don't propose an IVHS operational field test unless you can commit full-time positions dedicated to the effort
- Work to change Government accounting procedures to accommodate public/private partnerships
- Each organization should designate a single focal point to represent them to the IVHS partnership
  - -- Organizational leaders must take the time to communicate internally with IVHS-related offices not involved in usual business routine
- Provide a guide to partnerships on getting started
  - -- Define common terms in operational language (e.g. "work order")
- Don't spend all of the project time concentrating on technical issues
  - -- Cultural differences require significant investments in non-technical issues (e.g. public relations; pricing strategies; contract procedures and negotiations)

- Retain universities in consultant, not management leadership roles
- Hold 5 to 7 day retreats to ensure all partners can concentrate on hammering out essential program goals, roles, responsibilities, procedures, and common understanding of terms, schedules, and milestones

The above recommendations are based primarily from observations obtained in the interview process of those within the ADVANCE program. The final report of this IVHS Institutional Issues and Case Studies technical task directive will provide a more thorough coverage of the broader range of lessons learned and recommendations based not only upon the interviews of personnel involved with ADVANCE, Advantage I-75, HELP/Crescent, TRANSCOM/TRANSMIT, TravTek, and the Westchester Commuter Central, but also upon the literature and experiences of the members of the Institutional Issues Advisory Group formed for this effort.

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APPENDIX A

AGENCIES INTERVIEWED

ADVANCE Program Office

Federal Highway Administration
- Headquarters
- Region Offices
- Division Offices

Illinois Department of Transportation

Illinois University Transportation Research Consortium

Motorola

Parsons DeLeuw

APPENDIX B

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