Institutional Issues Test

Prepared for:
Minnesota Guidestar Program
Minnesota Department of Transportation

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1. Executive Summary

Genesis was an Advanced Traveler Information System (ATIS) that used personal paging devices to distribute timely travel information intended to be of assistance to Minnesota travelers.

The primary objectives of the Genesis project were to:

- Influence individual travel decisions
- Determine the technical feasibility of personal paging to deliver traffic information
- Assist in the development of the Twin Cities integrated transportation system.

The Genesis Operational Test was a six month test designed to deploy, test, and evaluate the Genesis system. Two personal communications devices were tested: the Motorola Advisor alphanumeric pager and the Apple Newton 110 with Motorola Newscard pager card. There were three types of messages:

- Congestion (i.e., slow, heavy, stop-and-go)
- Incident (i.e., accidents, disabled vehicles, lane closure)
- Planned Event (e.g., stadium events, construction).

Purpose of Test. The purpose of the Genesis Institutional Issues Test was to:

- Document methods used to promote institutional cooperation
- Document institutional issues and lessons learned
- Assess partner goals and perceptions of project success
- Identify future applications for and improvements PCD technology

A secondary purpose was to document the history of the Genesis project.

Methods. The methods used to conduct the Genesis institutional issues evaluation primarily consisted of questionnaires and semi-structured interviews. Eleven (11) partner representatives were selected by Mn/DOT management to provide questionnaire comments and to participate in the semi-structured interviews.

A Volpe (1994) institutional issues report for Mn/DOT’s Genesis and Travlink projects provided a baseline of understanding regarding existing and potential issues that could impact the Genesis deployment. Issues identified by Volpe were classified into the following categories:

- New business relationships
- Contracting and auditing
• Organizational coordination
• Funding
• Human resources
• Intellectual property and royalty rights
• User perception and acceptance
• Project evaluation
• Implementation and deployment
• Standards and regulations

Genesis Partner representatives were presented with a questionnaire that contained the Volpe-identified list of existing and potential Genesis institutional issues and asked to score which issues actually affected deployment of the Genesis system. New issues, if any, were also solicited. Completion of the questionnaire usually took approximately 15 minutes and immediately preceded the semi-structured interviews.

Semi-structured interviews took approximately two hours to complete and were conducted by the Genesis Evaluation Principal Investigator. Genesis Partner representatives were primarily asked to identify up to five institutional issues that affected deployment of the Genesis system and to describe any lessons learned. They were also asked to provide answers to series of background, organizational perspective and future solutions questions as identified in the Appendix.

Results

Methods Used to Promote Institutional Cooperation. Four activities were primarily identified as having served to promote institutional cooperation among Genesis partners:

• Guidestar committee structure
• Genesis Working Committee
• Shared equipment
• Shared personnel

Institutional Issues and Lessons Learned. Genesis partner representatives identified multiple examples of occurrences which affected deployment of the Genesis system. These issues were concentrated in four areas:
Lessons learned addressed a number of possible solutions to problems encountered in the above areas. Among the Genesis lessons learned were:

- Funding limitations can negatively impact the scope and level of functionality of an operational test.
- Operations personnel within Mn/DOT need to view ITS activities as part of their normal functions and not as add-on activities.
- Metro and Guidestar divisions of Mn/DOT need to work more effectively together.
- Federal funds for ITS projects need to be released as quickly as possible.
- Partners need to make customer satisfaction a high priority in the project.
- Feasibility of implementing new technology (e.g., PDA) needs to be determined during the early phase of the project.
- Integration of related projects needs to be made a high priority.
- Better technical support is needed from development contractor.
- Development process needs to be clearly specified.
2. Introduction

Intelligent Transportation Systems (ITS) is part of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 that formed the basis for the Department of Transportation (DOT) initiative to solicit proposals for the operational field tests of ITS products and services. The goals of the DOT ITS 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 ITS can flourish.

Operational tests present the opportunities to develop, deploy, and evaluate a specific implementation of ITS. Operational tests also represent a significant step in accelerating the deployment of ITS in North America. They generally entail the support and involvement of Federal, State, and Local Governments in partnership with industry and academia. Resources from public and private organizations are brought to bear to conceive, design, develop, and deploy an ITS that meets the DOT goals.

The conduct of an operational test results in early feedback from the public regarding the viability and perceived usefulness of a specific ITS implementation. Data are also provided to determine the potential benefits associated with full-scale deployment of ITS technologies. Also, lessons learned are derived with respect to the institutional and legal barriers that might affect future operational tests or full-scale deployments.

2.1 Project Genesis

Genesis was an Advanced Traveler Information System (ATIS) that used personal paging devices to distribute timely travel information intended to be of assistance to Minnesota travelers. Genesis was one of the principle elements of the Minnesota Guidestar program’s integrated
transportation system. Genesis provided the Minneapolis/St. Paul area travelers with current traffic incident data.

The primary objectives of the Genesis project were to:

- Influence individual travel decisions
- Determine the technical feasibility of personal paging to deliver traffic information
- Assist in the development of the Twin Cities integrated transportation system.

Secondary objectives of the Genesis project were to:

- Expand traffic monitoring capabilities
- Integrate traffic and transit information databases
- Determine appropriate information for dissemination and advice
- Manage the expanded traffic operations database.

2.2 Background

The following sections provide a brief overview of the Genesis System, the Genesis Operational Test, and the operational test evaluation that included this User Perception Test.

2.2.1 Genesis System Description

The Genesis System was an ATIS. The system provided traffic information to travelers using wireless radio to transmit messages to personal communications devices. Two personal communications devices were tested: the Motorola Advisor alphanumeric pager and the Apple Newton 110 with Motorola Newscard pager card.

Genesis was sponsored by the Minnesota Department of Transportation (Mn/DOT) as part of the broader Guidestar program. Guidestar is responsible for implementing Minnesota’s Intelligent Transportation Systems (ITS) program. The goals of the Guidestar ITS program are to:

- Enhance mobility and reduce congestion
- Improve safety
- Reduce environmental impacts
- Promote new institutional relationships
- Develop public-private partnerships
- Promote a key role for academia
• Promote and strengthen ITS research and education
• Develop innovative applications of academic research
• Promote public acceptance
• Maintain ITS leadership.

The Genesis system concept, depicted in Figure 1, was composed of four subsystems:

• Data Collection Subsystem (DCS)
• Traveler Information Processing Subsystem (TIPS)
• Communications Subsystem (CS)
• Personal Communication Device (PCD) Subsystem.

**DCS.** The DCS consisted of two workstations located in Mn/DOT’s Traffic Management Center (TMC). Operators used the DCS to enter traffic incident and event messages into the Genesis system.

There were three types of messages:

• Congestion (i.e., slow, heavy, stop-and-go)
• Incident (i.e., accidents, disabled vehicles, lane closure)
• Planned Event (e.g., stadium events, construction).

![Figure 1. Genesis System Overview.](image-url)
The messages conformed to International Traveler Information Interchange Standards. These standards specify an *event* description, a *location* identification, the traffic *backup extent*, and an *expected duration* estimation. Genesis messages conformed to this standard, except that it did not provide a duration. Typical messages broadcast during September 1995 are shown in Table 1.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
<th>Event Description</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/01/95</td>
<td>12:48</td>
<td>S:I-35W N</td>
<td>N roadway reduced to one lane. Slow traffic</td>
<td>CR 42</td>
<td>HWY 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/01/95</td>
<td>17:43</td>
<td>S:I-35W S</td>
<td>S road construction. left lane closed</td>
<td>46TH ST</td>
<td>DIAMOND LAKE RD (09/01)</td>
</tr>
<tr>
<td>09/05/95</td>
<td>16:46</td>
<td>N:I-35E N</td>
<td>N heavy traffic</td>
<td>PENNSYLVANIA AVE</td>
<td>LARRENTEUR AVE</td>
</tr>
<tr>
<td>09/01/95</td>
<td>06:17</td>
<td>S:I-35W S</td>
<td>S disabled vehicle</td>
<td>I-94 (W JCT)</td>
<td>31ST ST</td>
</tr>
<tr>
<td>09/01/95</td>
<td>06:32</td>
<td>S:I-494 S</td>
<td>S stop and go traffic</td>
<td>CARLSON PKWY</td>
<td>HWY 7</td>
</tr>
<tr>
<td>09/01/95</td>
<td>08:01</td>
<td>N:I-35W S</td>
<td>N accident</td>
<td>UNIVERSITY AVE</td>
<td>HWY 55</td>
</tr>
</tbody>
</table>

The TMC was Mn/DOT’s Minneapolis-based, Traffic Management Center. It monitored traffic primarily through video display from closed-circuit cameras along controlled-access highways in the Twin Cities area. In addition, it collected loop detector information and controlled ramp meters. Besides providing traffic information through Genesis, the TMC disseminated traffic information to Minneapolis/St. Paul travelers via radio broadcasts and changeable message signs. Radio broadcasts were transmitted over 88.5 FM (KBEM).

**TIPS.** TIPS gathered, formatted, and addressed messages entered via the DCS. TIPS determined which portion of the Genesis coverage area, North or South, should receive the information, and transferred the information to the CS for broadcast to the user devices. Figure 2 depicts the boundaries of the two coverage areas. Traffic incident information was provided for limited access roadways within the coverage areas. TIPS also stored Genesis messages in a relational database.
CS. The CS received messages from TIPS and transmitted them via telephone modem to a local communications provider that broadcast the messages.

Pager. The Motorola Advisor pager, pictured in Figure 3, has a liquid-crystal display capable of displaying 20 alphanumeric characters on each of 4 lines. In addition to an on/off switch, the pagers had four cursor buttons, arranged in a diamond shape, for moving a cursor on the display, a button to read selected messages, and a button to access other pager functions. The Advisor measures 3.38 by 2.32 by 0.78 inches, and weighs 4.11 ounces.

The main menu screen of the pagers displayed two lines of triangle characters that represented messages. Each triangle symbol could represent a message, or messages, of up to 230 characters. The triangles were only displayed when messages were present. Triangles on the first line represented personal pages. Triangles on the second line represented group page messages. Non-Genesis group page messages included services such as news, weather, sports, and stock quotes. Up to four triangles could be displayed for Genesis traffic information messages; two for the North area and two for the South.

Figure 2. Genesis Coverage Area.
Figure 3. The Motorola Advisor Pager.

When a message was being received, an icon resembling the back of an envelope was displayed on the screen. During the time that the envelope icon was displayed, the user could not review messages or use the cursor to navigate between mail slot. Thus when a series of traffic messages were sent, users might have to wait 20 seconds or more before they were able to review or access messages.

**PDA.** The Apple Newton MessagePad 110, pictured in Figure 4 is a general purpose hand-held computer that comes with applications for maintaining personal information such as appointments, phone numbers, and reminders. Instead of a keyboard interface, the Newton has a touch sensitive surface over a reflective (no back light) liquid crystal display with 320 pixel vertically and 240 pixels horizontally. The user controls the Newton using a stylus to select icons on the screen. The MessagePad can recognize both cursive or printed handwriting, and can accept hand drawn graphics. The MessagePad 110 is 8 by 4 by 1.25 inches (height, width, depth), and weighs 1.28 pounds.
Equipped with the Motorola Newscard, pictured in Figure 5, the MessagePad can display alphanumeric pages. The Newscard uses a PC card interface to connect to the MessagePad. The Newscard base measures 2.1 by 3.4 by .196 inches (height, width, depth). The extension measures by 2.1 by 1.1 by .6 inches. Weight with battery is 2.2 ounces. When the card was installed, only the extension, shown towards the top of Figure 5, protrudes from the MessagePad.

When turned on, the Newscard stored all messages internally. To review messages the user had to download the messages from the Newscard to the PDA using a MessagePad application provided by Loral Federal Systems. The application provided three mail slots: one each for North
and South area traffic information, and one for personal pages. The newscard could hold hundreds of messages. Generally 8 traffic messages could be viewed on the Newton screen at once, with the most current message displayed at the bottom of the screen. Downloading messages from the Newscard to the Newton caused older messages already in the Newton to be deleted, although there was a function that allowed users to save messages they did not want deleted. When the Newscard was full, as would be the case if a long time had elapsed since the previous download, a download of messages could take up to 25 minutes. The download could be lengthy because of the number of messages the Newscard could hold, and because the Newton application that downloaded the messages categorized each message and determined which messages updated which other messages.

A number of challenges were faced in deployment of the PDAs. These challenges resulted in deployment late in the operational test, and caused the developers to consider canceling altogether the PDA field test. Hardware incompatibilities and software challenges to overcome differences in the way the pagers and Newscard/PDA combination handle messages resulted in design compromises that had been not foreseen. The potential for lengthy downloads, and display of most recent messages last were among the less that desirable compromises that were made to meet field test schedule.

After information was downloaded three rectangular buttons were displayed: N, S and P for North traffic, South traffic, and Personal pages. By selecting any of the three buttons, the user could scroll through messages one at a time.

### 2.2.2 Genesis Operational Test

The Genesis Operational Test was a six month test designed to deploy, test, and evaluate the Genesis system.

### 2.2.3 Genesis Evaluation

Genesis was an operational test of new ITS technologies. As a federally supported program, and in the interest of providing information to the transportation community, the Genesis project included a significant amount of evaluation. By evaluating the Operational Test, Minnesota Guidestar sought to determine the benefits of the program and the feasibility of continuing and
expanding the project. It was also anticipated that evaluation results might be beneficial to other agencies that are contemplating ATIS programs.

The Genesis evaluation consisted of five individual tests. Each of the tests was to evaluate one or more of the objectives. The Genesis evaluation tests, summarized in Table 2, were organized according to the nature of the data used to evaluate objectives.

<table>
<thead>
<tr>
<th>Test</th>
<th>Goal Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Issues</td>
<td>Document the Genesis partnership arrangement.</td>
</tr>
<tr>
<td>Modeling</td>
<td>Use a traffic network model to extrapolate from available Pilot Operational Test data what the effects would be of widespread deployment of the Genesis pager technology.</td>
</tr>
<tr>
<td>System Effectiveness</td>
<td>Evaluate Genesis pager benefits to users.</td>
</tr>
<tr>
<td>User Perception</td>
<td>Evaluate the Genesis system from user responses to questionnaires.</td>
</tr>
<tr>
<td>Human Factors</td>
<td>Evaluate (1) the effects of Genesis pagers on driving safety, and (2) the Genesis user interface.</td>
</tr>
</tbody>
</table>

2.3 *Purpose of the Institutional Issues Test*

The purpose of the *Genesis Institutional Issues Test* was to evaluate the deployment of the Genesis System as measured by responses of representatives to questionnaire and semi-structural interviews. Table 3 summarizes the objectives and approach of the *Genesis Institutional Issues Test*. 
Table 3. Methods Used to Address the Objectives of the *Genesis Institutional Issues Test*. 

<table>
<thead>
<tr>
<th>Objective</th>
<th>Hypothesis</th>
<th>Measure of Effectiveness</th>
<th>Measure(s) of Performance</th>
<th>Data Source</th>
<th>Method of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document the methods used to encourage institutional cooperation during the conduct of the Genesis operational test</td>
<td>Genesis methodology led to effective institutional cooperation.</td>
<td>Partner relationships may be documented. Project was on schedule and under budget.</td>
<td>Perceptions of system development and deployment adequacy. Perceptions of operational test completeness.</td>
<td>Partner interviews. Strategic/Program plans. System documentation. Meeting minutes.</td>
<td>Description.</td>
</tr>
<tr>
<td>Document Partner goals for the Genesis operational test and perceptions of project success.</td>
<td>Participation in Genesis Partnership results project success</td>
<td>Identified: • Goals • Perceptions of project success</td>
<td>Attribution statements.</td>
<td>Partner interviews.</td>
<td>Description.</td>
</tr>
<tr>
<td>Identify future applications for and improvements to the Genesis PCD technology that became evident to the Genesis Partners as a result of the operational test.</td>
<td>Genesis results may be effectively applied to future ITS PCD efforts.</td>
<td>Identified: • Applications • Improvements</td>
<td>Documented suggestions.</td>
<td>Partner interviews.</td>
<td>Description. Quotation.</td>
</tr>
</tbody>
</table>

**2.4 Objectives**

The objectives of the *Genesis Institutional Issues Test* were to:
3. Methods

3.1 Overview

Data collection for the Genesis Institutional Issues Test evaluation was conducted during November and December, 1995. Predominant data-collection procedures consisted of checklists and semi-structured interviews. The data sources for the Genesis Institutional Issues Test evaluation are shown in Table 4. Specific data-collection methods for each objective are described in the following sections.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document methods used to promote institutional cooperation</td>
<td>Partner verbal reports, program plans, system documentation and meeting minutes</td>
</tr>
<tr>
<td>Document institutional issues and lessons learned</td>
<td>Volpe Center (1994) checklist and Partner interviews</td>
</tr>
<tr>
<td>Assess Partner goals and perceptions of project success</td>
<td>Partner interviews</td>
</tr>
<tr>
<td>Identify future applications for and improvements to PCD technology</td>
<td>Partner interviews</td>
</tr>
</tbody>
</table>

3.2 Method for Documenting Methods Used to Promote Institutional Cooperation

Genesis institutional cooperation was documented by obtaining verbal reports from Genesis partner representatives, reviewing ITS strategic and program plans, reviewing Genesis system documentation, and reading Genesis meeting minutes. The primary sources of information in each of these categories are listed below.
3.2.1 Genesis Partner Representatives
Ray Starr, as Mn/DOT Genesis program manager, served as the primary source of Genesis information. He provided historical, technical and organizational information regarding the Genesis project. In addition, Gary Hallgren, Mn/DOT Trilogy program manager, and Marilyn Remer, Mn/DOT Travlink program manager, provided related-project and systems-integration information. Finally, Melanie Braun, Guidestar Assistant Marketing Director, provided general information on Guidestar activities that provided a context for understanding Genesis.

3.2.2 ITS Strategic and Program Plans
U. S. DOT, FHWA and Guidestar ITS strategic and program plans that provided a background for understanding Genesis were:

U. S. Department of Transportation (December, 1992), ITS [formerly called Intelligent Vehicle Highway Systems] Strategic Plan.


Minnesota Department of Transportation (June, 1994), Minnesota Guidestar Strategic Plan.

3.2.3 Genesis System Documentation
Various pieces of Genesis system documentation provided specifics about system development, deployment and operation:


3.2.4 Genesis Meeting Minutes
Genesis operational test activities were documented by two sets of Genesis meeting minutes: technical team, and working committee. The Genesis technical team was composed of
representatives of public, private and non-profit entities concerned with defining the Genesis operational concept; defining the Genesis partnership agreement; and providing the initial system design work. This group met over a seventeen-month period from December, 1991 to May, 1993.

The Genesis working committee was comprised of representatives of the FHWA, Genesis public- and private-sector partners, partner subcontractors and the independent evaluator. This group met from September, 1995 to March, 1996 to review and discuss the status of the project’s development, deployment, testing and evaluation status.

3.3 Method for Documenting Institutional Issues and Lessons Learned
Documentation of Genesis institutional issues and lessons learned was accomplished through the use of semi-structured interviews in which a checklist was used to ensure all topics of interest were covered. Genesis partner representatives were asked to complete the checklist in advance of interview sessions. Specifics of checklist and semi-structured interview data collection procedures are discussed in the following sections.

3.3.1 Volpe Center Checklist
The checklist, or Genesis Institutional Issues Survey, was constructed from a document produced by the Volpe Center in 1994. This paper, entitled Review of the Travlink and Genesis Operational Tests, identified 44 “existing” (i.e., currently present) and 18 “possible” (i.e., could potentially occur in the future) institutional issues that applied to both the Genesis and Travlink operational tests as they were being developed by Mn/DOT at the time. The institutional issues identified in the Volpe Center document were listed and topically grouped in the Genesis Institutional Issues Survey in the same fashion that they were identified in the Volpe Center document. The checklist was then distributed to each of the partner representatives to be interviewed. Usually, completion of the Genesis Institutional Issues Survey required 10-15 minutes and occurred just prior to the conduct of the interview session.

Existing and possible Genesis institutional issues identified in the Volpe Center (1994) report were grouped into ten categories:

1. New Business Relationships—how to establish and conduct ITS business relationships
2. Contracting and Auditing—how to establish public-private ITS partnerships
3. Organizational Coordination—intra- and inter-agency coordination within Mn/DOT required for successful deployment of ITS programs
4. Funding—what it takes to obtain public and private funding for ITS projects
5. Human Resources—how to attract qualified staff to work in ITS and develop appropriate work habits
6. Intellectual Property and Royalty Rights—how to sort out proprietary and ownership rights for ITS partnerships
7. User Perception and Acceptance—how end users of ITS services perceive the usefulness of the product
8. Project Evaluation—how to determine ITS benefits
9. Implementation and Deployment—how to develop economies-of-scale to implement ITS programs most efficiently
10. Standards and Regulation—how to develop appropriate standards and regulations for ITS without restricting development and deployment

3.3.2 Semi-Structured Interviews
The semi-structured interviews were conducted over a five-week period with interviewees who were selected by Ray Starr, Genesis Program Manager. Interviews were generally conducted in the office of the Genesis partner representative, with one interview conducted over the telephone. A written record of interviewee responses was kept and meetings were not tape recorded. Interviewees were identified in advance through consultation with the Genesis program manager.

The primary focus of the Genesis institutional issues interviews was to document important Genesis problem areas and any lessons learned that may be derived from them. To do this, each interviewee was asked to discuss the 3-5 most significant, or important, institutional issues that impacted the deployment of the Genesis system and conduct of the operational test.

Conduct of Genesis institutional issues interviews was guided by use of a protocol. This protocol consisted of 19 questions divided into four areas:

- Partner-Representative Background
- Organizational Perspective
- Identification of Institutional Issues and Lessons Learned
- Future Solutions
4. Results

4.1 Brief History of the Genesis Project

4.1.1 Genesis Partnership Agreement

Project Genesis took shape in 1991. Initially, the idea for Genesis was developed by Mn/DOT and a radio equipment manufacturer. The first meeting of interested parties was held in December, 1991, with Mn/DOT, a radio equipment manufacturer, University of Minnesota--Center for Transportation Studies (CTS), and the FHWA in attendance.

The *Genesis Concept Definition and Preliminary System Design* was prepared in 1993. This document was prepared by BRW, Inc., Battelle Memorian Institute, JHK & Associates, and Barrientos and Associates, and specified a five-phase Genesis project. The phases were:

- Pilot pager test in Minneapolis
- Pager test in Minneapolis
- PDA test in Minneapolis
- Pager test in St. Paul
- PDA test in St. Paul

By March 1994, a series of Genesis detailed system design documents were completed by IBM [now Lockheed Martin Federal Systems (LMFS)] and BRW, Battelle Memorial Institute, JHK & Associates. In addition to providing details about the Genesis system design, these document added a third Genesis PCD, the notebook computer, and information about the Genesis operational test and evaluation plans. A summary of this information is provided in *Genesis: A Summary of the Detailed System Design* (March, 1994).

At the same time that Genesis was taking shape, other Mn/DOT ITS systems were also being configured. These included Trilogy and Travlink, two other ATIS projects. Travlink focused on providing transit riders with up-to-the-minute bus information, while Trilogy was concerned with providing in-vehicle traveler information. Throughout, Minnesota Guidestar program served to coordinate ITS development. The Metro division of Mn/DOT, one of eight operating field divisions, managed the Trilogy project.

In August 1994, LMFS was selected to be the private partner for Genesis. As part of its team, LFS retained JHK, MinnComm Paging, Inc. and BRW as subcontractors. JHK was responsible for the development of DCS, MinnComm was the communications service provider and BRW
served as local liaison for the project and staffed the Genesis HELP desk during the conduct of the operational test. The Genesis public partners throughout the project, of course, were Mn/DOT and the FHWA.

4.1.2 Genesis Operational Test

The Genesis operational test was conducted in the Twin Cities area of Minneapolis and St. Paul from July 25, 1995 through January 24, 1996. According to the FHWA document, *Generic ITS Operational Test Guidelines* (1993), an ITS operational test is a “joint public/private venture, conducted in the real world under live transportation conditions…” that “serve[s] as [a] transition between research and development (R&D) and the full-scale deployment of [ITS] technologies.” In the grand scheme of the ITS initiative, Genesis was one of the first ITS operational tests to be completed in the United States.

Genesis operational test participants were 492 individuals divided into pager (449) and PDA user (43) categories. These individuals were recruited from the public at large and from those who indicated that they drove a lot on the Genesis travel network, either for commuting to/from work/school or for work-related travel. The use of pagers for receiving traffic information was evaluated throughout the six-month operational test, while PDAs were only evaluated during the final two months of the test.

Staging of the Genesis operational test took almost four-years to occur. The draft Mn/DOT Request For Proposal (RFP) was released in August, 1991 which specified, in actuality, a smart-vehicle probe system rather than an ATIS. The live test for Genesis started in July, 1995. Fielding of the Genesis operational test involved a number of significant events, including approximately five “delay” periods that could be identified. Figure 6 provides a summary of the significant events in the conduct of the Genesis operational test.

The first phase of the Genesis operational test was originally scheduled to occur from April through September, 1993. Due to various problems, however, the actual test did not start until over two years later. The Genesis operational test delays and the primary reason for them were:

- 1992 —Project definition
- Summer, 1993—Search for partners
- Spring/Summer, 1994—Development-contract negotiation
- Spring, 1995—System development
Each of the above are discussed in the following sections.

System-Definition Delay

Genesis project definition problems occurred during the first year of the project when the technical team failed to bring closure on the scope of the system to be developed. Resolving of
broad-scale issues did not occur, however, until the *Genesis Concept and Preliminary System Design* document was produced in March, 1993 at the urging of the FHWA.

**Search-for-Partners Delay**

Due in part to the determination that Genesis would best be hosted on a communications system that currently provided services (e.g., paging) to customers, rather than on a new Mn/DOT-owned system, the radio equipment manufacturer discontinued its involvement in the project in the Spring of 1993. This occurrence resulted in an expanded search by Mn/DOT for new private-sector partners to assist with detailed system design. Negotiations with potential partners requires time, however, so Genesis was delayed again. Ultimately, after discussions occurred with a number of companies, IBM Federal Systems, BRW, Inc., and JHK and Associates were selected to assist with Genesis detailed system design.

**Development-Contract Negotiation Delay**

After the Genesis detailed system design was completed in early 1994, Mn/DOT entered contract negotiations for developing the Genesis system with Loral Federal Systems Company [formerly IBM Federal Systems Company]. These activities represented a second-round of contract negotiations for all parties involved, but this time the negotiations were protracted due to the level of specificity required. Issues for Mn/DOT were the level of private-sector in-kind contributions, state auditing requirements, and state non-indemnification requirements, while LFS was primarily concerned with negotiating software rights and the appropriate contract vehicle (i.e., firm-fixed fee).

**System Development Delay**

After the Genesis development contract was signed, unexpected problems were encountered that resulted in additional delays to fielding of Genesis. These primarily involved the resolution of problems that were encountered due to a lack of specification regarding the nature of the Genesis system. For example, integration with the Trilogy project required that the algorithms used to calculate Genesis links or way-points be changed to accommodate the method used to calculate Trilogy nodes, with the result being that the size of the Genesis network was expanded. Also, further Mn/DOT database specification resulted in a Database Management System (DBMS)
switch from DB2 to Oracle. Finally, an expansion in the amount of traffic incidents that should be handled by Genesis resulted in unexpected processing difficulties for DCS processors.

**PDA-Development Delay**

Original specifications stipulated that Genesis traffic messages were to be provided as personal pages to users. When it was discovered in December of 1994 that a mail-slot architecture was used for the Motorola Advisor pagers, this architecture was specified for the Genesis PDA. Unfortunately, the Motorola Newscard only provided one mail slot and software patches written for the Apple Newton to provide an emulation of the multiple pager mail-slots proved difficult to code and implement.

4.2 Methods Used to Promote Institutional Cooperation

Four activities are highlighted as methods used to promote institutional cooperation for the Genesis project. Identification of these methods occurred primarily through review of documentation and discussion with partner representatives, in particular the Genesis Project Manager. Descriptions of these activities are contained in the following sections:

- Guidestar Committees
- Genesis Working Committee
- Shared Equipment
- Shared Personnel

4.2.1 Guidestar Committees

The organization of Mn/DOT for implementing ITS projects is shown in Figure 7. The organization of the Minnesota Guidestar Program is further illustrated in Figure 8. This organizational structure promotes Genesis institutional cooperation because the Guidestar charter provides for a set of hierarchical committees to manage and coordinate all ITS activities, including the Genesis project, to ensure the overall success of Guidestar’s objectives in this area.

The planning and program management committee meets as appropriate to make recommendations to the Guidestar Steering Committee regarding the selection of projects and the allocation of ITS funds received from the FHWA and provided by the state. These funds may be
encumbered for use by any organization within Mn/DOT—which is to manage one of the selected projects.

The executive committee is composed of senior managers and chief administrative officers of the various transportation-related state and local agencies. Its purpose is to ensure that the Guidestar program stays focused on its goals and objectives, supports the program’s overall success, and makes appropriate strategic policy decisions. It meets four times a year.

The steering committee of Guidestar is responsible for directing Guidestar’s day-to-day management activities, developing and maintaining the program’s strategic plan, specifying project funding requirements, and for assisting with the coordination of specific projects, such as Genesis. This committee is comprised of representatives from federal, state and local government agencies and meets twice a month.

Guidestar working committees are responsible to the Guidestar steering committee for the coordination, implementation and management of individual project areas, such as transit or rural ITS.

Figure 7. Mn/DOT Organization.
Figure 8. Guidestar Committees.

4.2.2 Genesis Working Committee

Organization of the Genesis working committee is shown in Figure 9. This committee is important because it provided a forum for cooperation among the affected institutional organizations.

Mn/DOT served as the Genesis project manager and received funding and input from the FHWA while it simultaneously received in-kind contributions from and paid LFS to be the primary developer of the project, the latter of which LFS accomplished with the assistance of three subcontractors. All three organizations—FHWA, Mn/DOT and LFS—were the “partners” in the Genesis operational test.

Two other organizations, SAIC and UMHFRL, were the “independent evaluators” of the Genesis project. These organizations worked for Mn/DOT and received their tasking directly from Mn/DOT. They had an independent relationship between each other, but retained an overall responsibility to each other to provide a fair and impartial, yet coordinated, evaluation of the Genesis system.

Genesis participants were connected primarily through the Genesis working committee. This was the coordinating body of Genesis. The Genesis working committee met about every six weeks.
and monitored the development and deployment of Genesis, the conduct of the independent evaluation, and the coordination between Genesis and other ITS projects and Mn/DOT operations. The Genesis working committee was also responsible for addressing any problems that may arise during the development and deployment of Genesis, and for providing suggested solutions to the Genesis project manager for consideration.

**Figure 9. Genesis Working Committee Structure.**

### 4.2.3 Shared Equipment

The Genesis project promoted institutional cooperation by sharing equipment resources with other ITS projects whenever possible. In particular, both the Genesis and Trilogy projects used the same DCS workstation to compose traffic messages for its users to reduce space requirements within the TMC and provide for more efficient data dissemination.

Common use of the DCS workstation for Trilogy and Genesis required considerable coordination between project management. In particular, software algorithms for determining incident locations were discovered to be different for the two projects. This occurrence stipulated in the Spring of 1995 that members of the two development teams work closely together to determine how incident locations needed to be differentially formatted so as to best facilitate message transmission for each project.
One result of Genesis/Trilogy coordination regarding equipment usage was a better understanding of the information-processing requirements of the two projects. This knowledge will be helpful in the future as Guidestar moves toward a broader-scale, traffic-information dissemination project for full-scale deployment. Another outcome of Genesis/Trilogy equipment coordination was a better understanding of the integration testing requirements of each system. Finally, this coordination required the managers of the two projects to communicate with each other regarding the development status of each other’s projects, an activity which helped both to better understand the overall context in which to place his project.

4.2.4 Shared Personnel
The Genesis project promoted institutional cooperation by sharing personnel resources. In particular, the project agreed to share the expenses of a System Administrator and DCS Operators with the Trilogy project to save money by coordinating spending. Specifically, Genesis paid for the Genesis/Trilogy System Administrator, while Trilogy paid for the DCS Operators.

One outcome of Genesis and Trilogy sharing personnel resources was saved expenses. Another was improved technical understanding of how each other’s projects operated which contributed to more effective coordination when problems in either project developed needed to be resolved. A third outcome was improved communication between the two project managers.

4.3 Institutional Issues and Lessons Learned
The documentation of Genesis institutional issues and lessons learned was the main focus of the *Genesis Institutional Issues Test* evaluation. A checklist and semi-structured interviews were used to determine the existence of institutional issues, while semi-structured interviews were used to derive Genesis lessons learned.

4.3.1 Genesis Institutional Issues
Genesis institutional issues were identified by asking partner representatives to engage in two activities:

- Score existing and potential Genesis institutional issues that were identified in the Volpe Center (1994) report for their actual impact upon Genesis. The list of these institutional issues included those applicable to both Travlink and Genesis since the integration of both of these systems was done together.
• Discuss the three to five most important Genesis institutional issues, either previously identified by Volpe Center (1994), or new.

The results of these two activities are discussed in the following sections:

• Reassessment of Volpe Center Identified Institutional Issues
• Discussion of Most Important Institutional Issues

Reassessment of Volpe Center Identified Institutional Issues

Genesis and Travlink institutional issues that were previously identified by Volpe Center (1994) can be divided into existing and possible categories. Existing institutional issues were those that were deemed by Volpe Center as currently impacting either the Genesis or Travlink operational tests, while possible issues were those that could possibly impact the two operational tests.

Genesis partner representatives were asked to score these two sets of issues as part of the Genesis Institutional Issues Test in order to relate the current evaluation to this previous work and to stimulate awareness of the types of issues that could be discussed in the discussion portion of the semi-structured interview.

A list of twenty (20) Volpe-identified (1994) institutional issues that were rated by Genesis partner representatives as having the highest impact on the conduct of the Genesis operational test are shown in Table 5. These findings indicate that the Volpe funding and organizational coordination categories were rated as having the most impact upon the Genesis operational test, with five issues in each of those categories having been scored by Genesis partner representatives as playing a significant role. In particular, three of the funding category issues were in the top-five out of the twenty (20) issues. Additionally, the implementation and deployment category provided three topics and the new business relationships category provided two.

Discussion of Most Important Institutional Issues

In addition to ranking the Volpe Center Identified Institutional Issues, Genesis partner representatives were asked to describe the three to five most important, or significant, institutional issues, in general, that impacted the Genesis operational test. This was done by asking the six questions in the Genesis Institutional Issues Interview Protocol that addressed the parameters surrounding each institutional issue and taking written notes that reflected as accurately as possible each respondent’s answer.
### Table 5. Top Twenty Ranking of Volpe Center-Identified Genesis Institutional Issues.

<table>
<thead>
<tr>
<th>ISSUE</th>
<th>TOPICAL CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Funds have not been committed for implementation of products and services after the test is complete.</td>
<td>FUNDING (Possible)</td>
</tr>
<tr>
<td>2. Funding limitations can negatively impact the scope and level of functionality of an operational test.</td>
<td>FUNDING (Existing)</td>
</tr>
<tr>
<td>3. ITS success may be limited because the infrastructure required for deployment of ITS technologies and services is not in place.</td>
<td>IMPLEMENTATION AND DEPLOYMENT (Possible)</td>
</tr>
<tr>
<td>4. Two divisions within Mn/DOT were pursuing ITS activities simultaneously.</td>
<td>ORGANIZATIONAL COORDINATION (Existing)</td>
</tr>
<tr>
<td>5. Funding for ITS operational tests is limited and not guaranteed.</td>
<td>STANDARDS AND REGULATIONS (Existing)</td>
</tr>
<tr>
<td>6. The ITS program lacks standards.</td>
<td>NEW BUSINESS RELATIONSHIPS (Existing)</td>
</tr>
<tr>
<td>7. Public-private partnerships require management styles and organizational structures not found in traditional government-contractor relationships.</td>
<td>ORGANIZATIONAL COORDINATION (Existing)</td>
</tr>
<tr>
<td>7 (8). Operations personnel within Mn/DOT view ITS activities as add-on functions.</td>
<td>PROJECT EVALUATION (Existing)</td>
</tr>
<tr>
<td>7 (9). Judging the success of ITS operational tests is difficult because benefits are hard to quantify.</td>
<td>IMPLEMENTATION AND DEPLOYMENT (Possible)</td>
</tr>
<tr>
<td>7 (10). The ability to update technology as projects proceed is especially difficult.</td>
<td>NEW BUSINESS RELATIONSHIPS (Possible)</td>
</tr>
<tr>
<td>11. Projects with multiple partners are difficult to manage.</td>
<td>IMPLEMENTATION AND DEPLOYMENT (Existing)</td>
</tr>
<tr>
<td>12. Implementation of operational tests on a small-scale complicates standardization.</td>
<td>HUMAN RESOURCES (Existing)</td>
</tr>
<tr>
<td>13. Participation in operational tests places a strain on the staffs of the public-sector partners.</td>
<td>USER PERCEPTION AND ACCEPTANCE (Possible)</td>
</tr>
<tr>
<td>13 (14). Public perception diminishes the ability of government agencies to take risks.</td>
<td>INTELLECTUAL PROPERTY AND ROYALTY RIGHTS (Existing)</td>
</tr>
<tr>
<td>15. Private partners were unwilling to share proprietary information.</td>
<td>ORGANIZATIONAL COORDINATION (Existing)</td>
</tr>
<tr>
<td>16. Coordination and communication between the Federal Transit Administration and other partners needs improvement.</td>
<td>ORGANIZATIONAL COORDINATION (Existing)</td>
</tr>
<tr>
<td>16 (17). Transit agencies and Mn/DOT have different priorities.</td>
<td>ORGANIZATIONAL COORDINATION (Existing)</td>
</tr>
<tr>
<td>16 (18). Changes in Mn/DOT executives could affect the ITS program.</td>
<td>ORGANIZATIONAL COORDINATION (Possible)</td>
</tr>
<tr>
<td>16. (19). Federal funds for [ITS] projects are not released as quickly as expected.</td>
<td>FUNDING (Existing)</td>
</tr>
<tr>
<td>16 (20). Partners may not make a commitment if continued and adequate funding of the project is not guaranteed.</td>
<td>FUNDING (Possible)</td>
</tr>
</tbody>
</table>
A Genesis institutional issue was one that either negatively affected the development of the Genesis system or implementation of the operational test, or had the potential to negatively affect the test if it were not controlled. Interviewees were instructed that the issues they discussed could be taken from the Volpe Center (1994) list or, if they wished, newly identified. Finally, each Genesis institutional issue was discussed in the order in which it was presented by the interviewees.

Table 6 shows the 27 issues that the eleven (11) Institutional Issues Test interviewees stated as being the most important Genesis institutional issues. Type shows whether the issue was an existing or possible institutional issue previously identified by the Volpe Center (1994), or whether the issue was newly identified by the interviewees. Number shows how many of the interviewees identified this same topic as being important. Ranking of Volpe issues in this table may differ from that in Table 5 because these are ranked by the number of interviewees who wanted to discuss the issue in the context of all issues, while Table 5 was ranked on importance of Volpe issues only.

Twenty-seven Genesis institutional issues were discussed by partner representatives. Twelve, or 44%, of the 27 issues discussed were identified as being one of the existing or possible Genesis institutional issues identified by the Volpe Center (1994). Fifteen, or 56%, were newly identified issues. Thus, of the 62 (44 existing, 18 possible) issues previously identified by Volpe Center (1994), only 19% (8 existing, 4 possible) were selected to be discussed by the Genesis partner representatives.

The first thing noticeable about the list of most important Genesis institutional issues is that the majority (i.e., 15) were newly identified. This means that development and deployment of the Genesis system and conduct of the corresponding operational test resulted in making apparent a number of institutional issues that were previously un-identified. Perhaps this is to be expected due to the extent of the experience acquired since the Volpe Center (1994) interviews.

Nine Genesis institutional issues were discussed by two or more partner representatives. A synopsis of the comments made for each of these issues is provided in the following sections.
<table>
<thead>
<tr>
<th>ISSUE</th>
<th>TYPE</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW BUSINESS RELATIONSHIPS</strong></td>
<td>--None--</td>
<td>--</td>
</tr>
<tr>
<td><strong>CONTRACTING AND AUDITING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Viability of Genesis partners needs to be determined in advance</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>2. Strategic negotiation process for ITS projects is difficult</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>3. Current contracting procedures are not suited to the requirements of ITS projects</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td>4. Developing memoranda of understanding with partners has been difficult</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td>5. Projects with multiple partners are difficult to manage</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td><strong>ORGANIZATIONAL COORDINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Metro and Guidestar divisions of Mn/DOT need to work more effectively together</td>
<td>New</td>
<td>3</td>
</tr>
<tr>
<td>2. A gap in expectations for ITS projects exists between regional and national FHWA offices</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>3. Operations personnel with Mn/DOT view ITS activities as add-on functions</td>
<td>Existing</td>
<td>4</td>
</tr>
<tr>
<td>4. Changes in Mn/DOT executives could affect the ITS program</td>
<td>Possible</td>
<td>1</td>
</tr>
<tr>
<td><strong>FUNDING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Genesis funding was excessive for amount of demonstrated return</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>2. Federal funds for ITS projects are not released as quickly as possible</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td>3. Funding limitations can negatively impact the scope and level of functionality of an operational test</td>
<td>Existing</td>
<td>5</td>
</tr>
<tr>
<td>4. Funds have not been committed for implementation of products and services after the test is complete</td>
<td>Possible</td>
<td>2</td>
</tr>
<tr>
<td><strong>HUMAN RESOURCES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Staffing continuity is not a big concern among partners</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td><strong>INTELLECTUAL PROPERTY AND ROYALTY RIGHTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Software rights and ownership not clear</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td><strong>USER PERCEPTION AND ACCEPTANCE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pager turn-on problems for existing users affected acceptability</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>2. Partners may forget to make customer satisfaction a high priority</td>
<td>Possible</td>
<td>2</td>
</tr>
<tr>
<td><strong>PROJECT EVALUATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Judging the success of ITS operational tests is difficult because benefits are hard to quantify</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td><strong>IMPLEMENTATION AND DEPLOYMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Software changes caused development delays</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>2. Feasibility of PDA operation should have been determined in advance</td>
<td>New</td>
<td>2</td>
</tr>
<tr>
<td>3. Performance requirements not specified</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>4. Integration of related projects not a high priority</td>
<td>New</td>
<td>2</td>
</tr>
<tr>
<td>5. Sustainability of Genesis is questionable</td>
<td>New</td>
<td>1</td>
</tr>
<tr>
<td>6. Better technical support needed from development contractor</td>
<td>New</td>
<td>2</td>
</tr>
<tr>
<td>7. Development process not clearly specified</td>
<td>New</td>
<td>2</td>
</tr>
<tr>
<td>8. Implementation of operational tests on a small-scale complicates standardization</td>
<td>Existing</td>
<td>1</td>
</tr>
<tr>
<td>9. ITS success may be limited because the infrastructure required for deployment of ITS technologies and services is not in place</td>
<td>Possible</td>
<td>1</td>
</tr>
<tr>
<td><strong>STANDARDS AND REGULATION</strong></td>
<td>--None--</td>
<td>--</td>
</tr>
</tbody>
</table>

FUNDING LIMITATIONS CAN NEGATIVELY IMPACT THE SCOPE AND LEVEL OF FUNCTIONALITY OF AN OPERATIONAL TEST [Category: FUNDING]
Five Genesis partner representatives indicated that funding limitations impacted the scope and functionality of the Genesis operational test. In particular, planned Genesis phases 2 and 3, that would have added an interactive (i.e., two-way) communications capability, were dropped when the expected amount of FHWA funding for Guidestar ITS programs was not forthcoming. This caused the Guidestar executive committee to cancel phases 2 and 3 of the Genesis operational test and change the conceptual scope of the Genesis operational test in mid-stream. Phase 1 of the test now included 50 one-way PDAs along with 400 pagers. In addition, cancellation of phases 2 and 3 hindered deployment of phase 1 by requiring software-development resources to be used for the PDA and causing emphasis in phase 1 to be switched from a pilot test to that of a full-blown evaluation. Finally, it was feared that the rushed PDA development process may have backfired in that user perceptions of the (incomplete) PDA functionality might not have been as positive as it might have been if a fully-functional PDA had been fielded.

Reasons given for causing this problem were that: (1) the FHWA was “micro-managing” the project and withdrew funding because of what the FHWA perceived to be technological limitations (e.g., PDA usability, travel-time algorithms) of the phase 2 and 3 technologies, (2) the FHWA did not want to fund the additional sensors that were proposed for phases 2 and 3, and (3) that competing program objectives within Mn/DOT’s Guidestar division drew funding away from Genesis.

OPERATIONS PERSONNEL WITHIN MN/DOT VIEW ITS ACTIVITIES AS ADD-ON FUNCTIONS [Category: ORGANIZATIONAL COORDINATION]

Four Genesis partner representatives remarked that it appeared Mn/DOT personnel working at the Traffic Management Center (TMC) viewed Genesis as excess, or extra, workload rather than view it as part of their service mission. The impact of this view, it was said, caused delays during integration testing, affected staff morale in that workers for the Genesis private and public partners felt that they were causing extra workload for TMC operations personnel and were not appreciated for doing so, and affected the perceptions of Genesis’ usefulness among TMC workers.

The reasons given for causing this problem were that: (1) a better “buy in” from TMC personnel, especially management, should have been obtained from the start; (2) TMC management was
more interested in supporting another project (i.e., Trilogy) over Genesis; (3) there was inadequate planning for the obvious integration problems that would have to be addressed among Genesis, Trilogy and Travlink; and (4) there was no study of the impact that Genesis would have upon the daily operations of the TMC.

**METRO AND GUIDESTAR DIVISIONS OF MN/DOT NEED TO WORK MORE EFFECTIVELY TOGETHER [Category: ORGANIZATIONAL COORDINATION]**

Three Genesis partner representatives suggested that Mn/DOT’s Metro and Guidestar divisions needed to learn how to work more effectively together in deploying ITS projects. The primary concern in this area was communication; in particular, different lines of reporting authority affecting key project personnel made it difficult for everyone to work together as a team. In addition, perceptions of Mn/DOT’s Guidestar division as being an “ivory tower” research division appeared to influence responsiveness on Metro’s part. Finally, different perspectives regarding Genesis’ development process (e.g., should separate or integrated workstations be built) were not adequately understood or appreciated by either party until delays in the development process appeared.

The reported causes of Metro’s and Guidestar’s difficulties in working together were many: (1) organizational (e.g., Genesis and Trilogy were in different reporting hierarchies), (2) technical (e.g., which project, Genesis or Trilogy, was going to drive the technological scheme for disseminating traffic information?), (3) Guidestar and Metro personnel working the project were separated (i.e., they worked in different rooms), (4) different perceptions of problems among affected personnel (e.g., the priority of user interface issues with the DCS workstation versus database query problems), and (5) different responses to crises among personnel (e.g., overreaction to system crashes and other problems).

**FUNDS HAVE NOT BEEN COMMITTED FOR IMPLEMENTATION OF PRODUCTS AND SERVICES AFTER THE TEST IS COMPLETE [Category: FUNDING]**

Two Genesis partner representatives indicated that they were very concerned about the ITS funding situation beyond the current operational tests around the country. That is, if funding stops or slows precipitously, the ITS momentum might grind to a halt. Related to this issue, these two individuals were concerned about whether there will be sufficient funds to pay for operators,
software maintenance/improvement personnel, and support personnel beyond the end of the test; if not, then there is even less of a chance that ITS will become institutionalized within Mn/DOT’s operations sector.

There were two primary causes for the above problem. First, the current Federal political climate calling for a balanced budget makes it hard for the FHWA to commit to long-term operating budgets for ITS projects anywhere in the country, let alone Mn/DOT’s projects. Secondly, it was suggested that because the Guidestar office did not select an overall systems integrator from the start, Mn/DOT effectively hamstrung its ITS program by allowing each program to fend for itself in the operations-budget area. Although Guidestar’s current Polaris project is now seeking a unified architecture for all of Mn/DOT’s ITS programs, it remains to be seen whether an integrated system would have been a better initial sell to Mn/DOT’s operating divisions and, thus, more effective in garnering additional ITS funds.

PARTNERS MAY FORGET TO MAKE CUSTOMER SATISFACTION A HIGH PRIORITY

Two Genesis partner representatives, both from the public sector, indicated that they believed that private partner personnel put a low priority on customer satisfaction. In particular, both were concerned about the usability and performance of the DCS software that was placed in the TMC, and the lack of responsiveness that was exhibited in solving some of the system problems. In particular, slow query or system response times affected the operator’s capability to put timely messages out to users, and attempts to update Genesis software often caused system crashes that affected other projects (e.g., Trilogy), sometimes for days. In addition, complaints about the usability of the DCS user interface were common, and often it was difficult to get a timely response to fixing the problems. The upshot, for one partner representative, was that these performance problems with DCS affected the institutional relationships among the two primary Mn/DOT organizations involved, Guidestar and Operations.

Reasons provided for these problems were that: (1) TMC operations personnel, or the users of DCS, were not consulted from the beginning regarding the adequacy of the user interface; (2) DCS software was unstable (i.e., not fully tested) before it was installed in the TMC; (3) troubleshooting methods for solving DCS problems were cumbersome and slow due to the fact
that too many people were involved in the problem-solving chain; and (4) the distant locations of some of the critical technical people required to solve DCS problems sometimes resulted in troubleshooting requests going unmet.

FEASIBILITY OF PDA OPERATION SHOULD HAVE BEEN DETERMINED IN ADVANCE
[Category: IMPLEMENTATION AND DEPLOYMENT]

Two Genesis partner representatives, both from the private sector, were critical of the decision to proceed with PDA deployment during the Genesis operational test because of what they felt was an inadequate technical understanding of the feasibility of combining the Apple Newton with the Motorola Newscard. Basically, as it turned out, interface problems between the two devices slowed development and resulted in a system that was not well accepted by users, primarily due to some basic incompatibilities between the two devices.

The reason given for this problem was that Mn/DOT was too aggressive in trying to use new technology, especially without having done feasibility studies regarding the compatibility of the Apple Newton with the Motorola Newscard in advance. Compounding this situation, one interviewee indicated, was Mn/DOT’s decision to push for full deployment of the PDAs in the Genesis operational test after it was determined that phases 2 and 3 of the project were canceled.

INTEGRATION OF RELATED PROJECTS NOT A HIGH PRIORITY [Category: IMPLEMENTATION AND DEPLOYMENT]

Two Genesis partner representatives indicated that Genesis integration testing should have proceeded more smoothly. In particular, one thought that the development schedules for the different projects that needed to be integrated with Genesis (i.e., Travlink and Trilogy) were not synchronized with Genesis’ development schedule. This caused delays for the other projects because their people either needed to assist with integration testing on the Genesis’ schedule, or were required to solve problems that occurred due to the integration of Genesis with their system. In addition, the other partner representative felt that the testing procedures for updates to the system during integration testing were inadequate. For example, the Genesis system crashed at least twice due to software updates that were supposed to occur with little or no system impact. This caused problems for Genesis’ users (e.g., public), it was stated, in addition to making life
difficult for system operators. The reason speculated to be the cause of this problem was inadequate testing of software patches by the developer.

The reasons provided for this problem were: (1) inadequate project scheduling; (2) poor communications among some of the participants; (3) development delays which caused delays for other projects; (4) changes in system requirements; and (5) incomplete, or unclear, software update and integration testing procedures. One major reason for the software update problems, it was argued, was that new software patches were inadequately tested by the developer before they were sent to Mn/DOT to be installed in the TMC. Further, this problem was exacerbated because the developer was not able to test on a “live” system like the one operating in the TMC. This caused the developer to miss, or simply not understand, many of the problems encountered by the Genesis system administrative staff.

BETTER TECHNICAL SUPPORT IS NEEDED FROM DEVELOPMENT CONTRACTOR
[Category: IMPLEMENTATION AND DEPLOYMENT]

Two Genesis partner representatives, one private and one public, agreed that better technical support for Genesis was needed from the development contractor. Basically, the problem appeared to be delays in getting technical assistance for system problems (e.g., crashes, performance degradation) that occurred during some software upgrades, during peak operating conditions, or during evening operations. Because the people available for solving these problems were often unavailable because of difficulties in reaching them (e.g., responsible person, time-zone differences), it was felt that recovery time from these problems was severely delayed. For example, a crash which occurred one evening would not get solved until the middle of the next day, after an opportunity to serve the public during an AM rush hour had passed. As a result, these delays in service caused much anxiety among TMC operations and Genesis system administrator personnel, and hindered working relations among the partners by causing the public sector partner to balk at installing upgrades due to fear of lack of technical support.

The reasons provided for this difficulty were: (1) contractor personnel responsible for solving problems were hard to reach because they were subcontractors and protocol required that prime contractor personnel needed to be included in discussions of all problems; (2) contractor personnel were often unavailable because of time-zone differences or extended communications
channels; (3) a technical-support “hot-line” was not provided; and (4) corporate decision-making processes were often slow because of the need to determine whether the company was responsible for correcting a technical-support request or whether the request was beyond scope of the contract and required additional funding to solve.

DEVELOPMENT PROCESS NOT CLEARLY SPECIFIED [Category: IMPLEMENTATION AND DEPLOYMENT]

Two Genesis partner representatives, one each from the private and public sectors, indicated that the Genesis development process was unclear. In particular, it was felt that Mn/DOT's entry into the ITS computer-systems development was handicapped by a lack of previous management experience in this area. This included such things as knowing what types of engineering was best needed to solve specific problems, how to write system requirements, how validation testing was conducted, how equipment procurements were best handled, and how the evaluation process fit into the whole picture. In essence, it was suggested that it was unclear whether Genesis was a research and development contract, which would make provisions for handling system requirements changes, or a development contract which simply specified that the system needed to be built to documented specifications. For example, Mn/DOT's request to change Genesis’s database software from DBII to Oracle severely impacted development, as did numerous requests to change the DCS user interface. Evidently, an underlying distinction that appeared to be missing was what was the difference between a software repair and a software enhancement or upgrade. This lack of understanding, unfortunately, was deemed the primary cause of Genesis’ system development delays and operational problems.

The reasons, or causes, provided for the lack of clarity regarding Genesis’ development process were primarily attributed to Mn/DOT. This included: (1) a lack of previous system development experience; and (2) a basic misunderstanding about the-- sometimes severe-- impacts of changing system requirements once development has started. Nonetheless, both interviewees felt that a lot was learned during Genesis’ implementation that should enable the development of future projects to proceed more smoothly.
4.3.2 Genesis Lessons Learned

Lessons learned for each of the top-ten most important Genesis institutional issues identified by the Genesis Institutional Issues Test evaluation are presented in the following sections.

Funding Limitations Can Negatively Impact The Scope and Level Of Functionality Of An Operational Test

- Adequate feasibility scoping of ITS projects is needed.
- There is a need to continually “sell” an ITS project until all funding is received.
- There is a need to get as much funding for a project in advance as possible.
- There is a need to educate more people on the overall development process for a project.

Operations Personnel Within Mn/DOT View ITS Activities As Add-On Functions

- Commitment, or buy-in, for the project should have been obtained from the TMC’s management and operations personnel from the start.
- Better planning, especially for the overall systems architecture and integration testing (the latter of which occurs on-site), should have been conducted in advance of the project.
- TMC operations personnel should have been consulted throughout the systems development process for their inputs rather than when problems (e.g., excessive time required for integration testing) occurred.

Metro And Guidestar Divisions Of Mn/DOT Need To Work More Effectively Together

- Shared vision of project needed.
- Better communications channels needed:
  --Who determines extent of problem?
  --Who calls who when a problem occurs?
  --Who makes the final decision regarding system-integration problems?
- Schedule coordination needed.
- Shared commitment needed.

Federal Funds For [ITS] Projects Are Not Released As Quickly As Possible

- State agencies can’t assume FHWA funding will always be there and, as a result, state directors of ITS projects should probably seek increased monetary contributions from their private partners.
- Expectations regarding the results of ITS projects should probably be reduced; development schedules should be more realistic, and more careful review of projects is probably needed.

Funds Have Not Been Committed For Implementation Of Products And Services After The Test Is Complete

- Private sector should be expected to pick up more of the cost of building traveler information systems.
• Mn/DOT should hire one company to do the overall system architecture instead of developing multiple projects independently, with multiple companies.

Partners May Forget To Make Customer Satisfaction A High Priority

• Operations personnel, especially those expected to use and maintain an ITS system, should be involved from the start regarding the usability of the system.
• ITS software specifications should include quality statements (e.g., availability requirements, query response times) to avoid a broad class of usability problems (e.g., downed systems, slow query response times) that can hamper operations.

Feasibility Of PDA Operation Should Have Been Determined In Advance

• Feasibility of combining new technology needs to be determined in advance of a project, e.g., PDA and pager card compatibility.
• Analyses which more clearly specified the operational requirements of Genesis should have been conducted before the system requirements were written.

Integration Of Related Projects Not A High Priority

• Integration-testing schedules for different ITS systems should be coordinated.
• Integration testing procedures should minimize impact upon more mature system.
• Live-trial integration-testing procedures should be written to facilitate field personnel effectiveness.
• Development contractor needs to thoroughly test all integration testing procedures before they are delivered to the customer.

Better Technical Support Is Needed From Development Contractor

• Lines of communication with who’s best to solve particular types of problems are needed.
• All-hours technical support “hot line” is needed.
• Technical support requirements (e.g., after-hours support) needs to be better specified in ITS contracts.
• Need to better understand each partners organizational culture so that the “process” of getting to the proper sources of information is recognized.

Development Process Not Clearly Specified

• Project’s development process should be documented and understood by all participants before development is initiated.
• One contractor should be given the job of overseeing complete ITS system design and development instead of just being given one small part to build.
• Perhaps all operational tests should be viewed as research and development efforts and funded accordingly (i.e., money should be set aside for system changes/upgrades that are discovered during the construction of the system).

4.4 Partner Goals and Perceptions of Project Success

All partner representatives were asked to provide their organization’s goals for participating in the Genesis operational test. A summary of their responses, provided in no particular order, is provided in Table 7.
All Genesis partner representatives were asked to list the perceived benefits and risks of participating in the Genesis operational test for their organization. A summary of their responses is provided in Table 8.

Genesis partner representatives were also asked to provide their perceptions regarding whether Genesis was a successful project. Their responses are provided in Table 9.

4.5 Future Applications for and Improvements to PCD Technology

All Genesis partner representatives were asked for their inputs regarding future applications for and improvements to the Genesis PCD technology. Their responses are provided in the following sections.

4.5.1 Future Applications for Genesis PCD Technology

Genesis-partner-representative suggestions regarding future applications for Genesis PCD technology are provided below:

- PCD acceptance critical—FHWA will get cold feet otherwise.
- Some type of device, developed in the consumer market area, needs to be developed—should not be driven by ITS, however.
- Wonderful idea, but not sure what people are going to do with it—pagers will be here for awhile, however.
- Alternative modes (e.g., internet) for distributing traffic information are necessary.
- Phase 2 and 3 applications (e.g., driver profile, two-way communications) were good ideas, but they appeared to get ahead of technology.
- Mn/DOT needs to make traffic information available on a wider scale—private sector will then develop/determine delivery system.
- Sees hope for in-vehicle and in-home applications.
- Genesis needs to be expanded by gaining more service providers.
- Transit information needs to be added.
- Graphic, map-based, interface would be an improvement.
- Two way capabilities would be nice, but may be too expensive.
- PCD acceptability by public needs to be improved.
- Latter phases of Genesis (e.g., driver profile, two-way communications) would be good—depends upon PCD technology improvement.
- Real time, comparative traffic information is needed.
- Different ways to disseminate traffic information are needed.
- Automated route planning is needed.
- PDA usage needs to be improved, perhaps by adding route planning capabilities.
- Route-planning capability based upon travel-time information is needed.
- Fax and telephone servers for distributing information are needed.
- Filtering information by route should be attempted.

**Table 7. Reasons for Participating in Genesis Operational Test.**

<table>
<thead>
<tr>
<th>PRIVATE PARTNERS</th>
<th>PUBLIC PARTNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop market-driven solution for traffic problems in the Twin Cities</td>
<td>Provide traffic information so people can make better decisions</td>
</tr>
<tr>
<td>Build and grow ITS business</td>
<td>Opportunity to integrate different ATIS programs</td>
</tr>
<tr>
<td>Develop a replicable ITS technology</td>
<td>Provide timely traffic information to the general public</td>
</tr>
<tr>
<td>Establish or strengthen relationship with Guidestar partners</td>
<td>Offer options to drivers</td>
</tr>
<tr>
<td>Exposure in ITS area</td>
<td>Improve traffic flow</td>
</tr>
<tr>
<td>See traffic information become available to general public</td>
<td>Test ATIS concept</td>
</tr>
<tr>
<td>Develop incident data-collection subsystem and data interfaces to enhance the technology</td>
<td>Interested in two-way communications technology</td>
</tr>
<tr>
<td></td>
<td>Provide an opportunity to measure travel times—never done before</td>
</tr>
<tr>
<td></td>
<td>Test different delivery methods</td>
</tr>
<tr>
<td></td>
<td>Provide a significant ATIS for users</td>
</tr>
<tr>
<td></td>
<td>Equipment will become core of future incident-dissemination system</td>
</tr>
<tr>
<td></td>
<td>Test the value of using PCDs for providing traffic information</td>
</tr>
<tr>
<td></td>
<td>Learn about technology issues in ITS area</td>
</tr>
</tbody>
</table>
Table 8. Perceived Benefits and Risks of Participating in Genesis Operational Test.

<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>RISKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private-Partner Responses</td>
<td>Technical risks</td>
</tr>
<tr>
<td>Exposure to ITS technologies</td>
<td>Requirements changes from Mn/DOT</td>
</tr>
<tr>
<td>Reference—can say we’ve done this</td>
<td>Performance challenges</td>
</tr>
<tr>
<td>Experience working with state contracts</td>
<td>User acceptance—not sure whether people will want to pay for traffic information</td>
</tr>
<tr>
<td>Technology integration</td>
<td>Program failure</td>
</tr>
<tr>
<td>Chance to put a useful product in front of users</td>
<td>Negative image if project a failure</td>
</tr>
<tr>
<td>Establish relationship with Mn/DOT</td>
<td>Being a sub-contractor</td>
</tr>
<tr>
<td>Develop ITS workbase</td>
<td>Requirements/enhancement risk</td>
</tr>
<tr>
<td>Establish relationships with Guidestar partners</td>
<td></td>
</tr>
<tr>
<td>Increased pager sales/rental</td>
<td>Cost overrun</td>
</tr>
<tr>
<td>Exposure</td>
<td></td>
</tr>
<tr>
<td>Learn about technology</td>
<td></td>
</tr>
<tr>
<td>Consolidate database technology</td>
<td></td>
</tr>
<tr>
<td>Work with Mn/DOT on ITS project</td>
<td></td>
</tr>
<tr>
<td>Project exposed to a larger audience</td>
<td></td>
</tr>
<tr>
<td>Sharing of traffic information</td>
<td></td>
</tr>
<tr>
<td>Experience of working with other operational tests during integration</td>
<td></td>
</tr>
<tr>
<td>Fusing data and data distribution</td>
<td></td>
</tr>
<tr>
<td>Partnership with MinnComm</td>
<td></td>
</tr>
<tr>
<td>Good for public</td>
<td></td>
</tr>
<tr>
<td>Good project for learning about DBMS issues</td>
<td></td>
</tr>
<tr>
<td>Work with TMC</td>
<td></td>
</tr>
<tr>
<td>Good user product</td>
<td></td>
</tr>
<tr>
<td>Experience dealing with private sector</td>
<td></td>
</tr>
<tr>
<td>Software development/specification experience</td>
<td></td>
</tr>
<tr>
<td>Real ITS project with success potential</td>
<td></td>
</tr>
<tr>
<td>Learn about technology</td>
<td></td>
</tr>
</tbody>
</table>
Table 9. Perceived Genesis Success.

<table>
<thead>
<tr>
<th>PRIVATE PARTNERS</th>
<th>PUBLIC PARTNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lukewarm at this point—interface with Trilogy was difficult and we’re still learning about pagers/wireless communications systems.</td>
<td>Can’t determine—current problems (e.g., Trilogy interface) make me very frustrated at this point. I guess I’ll have to wait until I see the evaluation results.</td>
</tr>
<tr>
<td>Yes, we’ve helped facilitate Guidestar’s impact in the TMC and have shown the value of ITS technology. There appears to be genuine interest in this program.</td>
<td>Yes, the project provides traffic information to users and helps them make informed decisions.</td>
</tr>
<tr>
<td>Yes, because it shows the public what ITS is all about and because we’ve learned a lot about TIPS/DCS integration.</td>
<td>No, because the Genesis system as it currently exists won’t be retained. This primarily has to do with the fact that the system is unstable and the Trilogy interface doesn’t work right.</td>
</tr>
<tr>
<td>Yes, because I think this project has a lot of benefits for the public.</td>
<td>Yes, because the system is providing useful traffic information to people.</td>
</tr>
<tr>
<td>Too early to tell-- will depend upon whether system is retained or applied to future uses.</td>
<td>Partial success—we’ve had some successes (e.g., good user product, system development experience), but we’ve also learned some lessons (e.g., need for integrated system architecture, negative impact upon TMC).</td>
</tr>
<tr>
<td></td>
<td>Too early to tell, but we’ve learned a lot about contracts, software development and project management.</td>
</tr>
</tbody>
</table>

4.5.2 Improvements to Genesis PCD Technology

Genesis-partner-representatives suggestions for improvements to Genesis PCD technology are provided below:

- Need to focus more on the type of information that is being disseminated-- not the technology itself.
- Need user inputs along the way, not just engineering perspective.
- Genesis is more timely and accurate than current commercial activities (e.g., radio, TV)-- needs to stay this way to get wide acceptance.
- Real-time systems are needed that are unobtrusive-- Genesis PCDs may be too obtrusive.
- Need to integrate with CMS system.
- Message formatting needs to be improved.
- Motorola’s “mail-slot” idea is good-- needs to be expanded to PDA.
• GPS-driven map display for PDA.
• Pager readability needs to be improved.
• Information should be distributed by road, not zone.
• Map displays on PDAs are needed.
• Scrolling of information needs to be controlled better.
• Too many messages being sent.
• Message usefulness needs to be improved.
5. Discussion

The major findings of the *Genesis Institutional Issues Test* evaluation are highlighted by identifying (1) the most significant existing/possible issues that were identified by the Volpe Center (1994) and (2) newly-identified issues that actually impacted the conduct of the Genesis operational test. This discussion is provided in the following sections:

- Significant Volpe Center-Identified Issues
- Significant New Issues

5.1 Significant Volpe Center-Identified Issues

The most significant Genesis institutional issues can be derived by looking at the overlap between top twenty issues identified in the Genesis Institutional Issues Survey and those the Genesis partner representatives wished to discuss during the evaluation interviews. Eight (8) topics were included in both lists. Of these topics, two subject categories -- funding and organizational coordination-- contained two or more topics that were identified in both lists. These topics are discussed below.

5.1.1 Funding

Three topics were identified as significant *funding* issues:

- Funding limitations can negatively impact the scope and level of functionality of an operational test.
- Funds have not been committed for implementation of products and services after the test is complete.
- Federal funds for [ITS] projects are not released as quickly as possible.

The major concerns expressed were that the lack of expected FHWA funding for phases 2 and 3 of Genesis (1) severely impacted the evaluation of the Genesis operational test, and (2) impaired the ability of Mn/DOT to deploy Genesis after the operational test was complete. In particular, concern was expressed regarding how well Genesis PCD functionality (both pager and PDA) would be evaluated since the functionality that was provided did not benefit from additional refinement from feedback and technological advancement that would have occurred if the original, phased deployment schedule for Genesis was kept. In addition, the lack of committed funds (both federal and state) beyond the end of the operational test led some to question the long-term commitment that is being provided to the ITS area. Regardless of these concerns, however, the Genesis operational test was conducted pretty much on schedule, with feedback that...
was fairly encouraging regarding the need to continue the dissemination of traffic information to Twin Cities area travelers.

5.1.2 Organizational Coordination
Two (2) topics were identified as significant organizational coordination issues:

- Operations personnel within Mn/DOT view ITS activities as add-on functions.
- Changes in Mn/DOT executives could affect the ITS program.

The first of these topics is particularly significant because it was the second most frequently discussed Genesis institutional issue and indicates that Mn/DOT could do a better job coordinating the development and deployment of ITS projects. For example, it was widely held was that Mn/DOT personnel working in the TMC viewed their activities related to Genesis as extra, or beyond, their current job responsibilities. Given the fact that other ITS projects (e.g., Trilogy, Travlink) were also conducted through the TMC, this points to the need for a more thorough analysis of the operational impacts of ITS, especially upon operations personnel.

Regarding potential changes in Mn/DOT executives, the concern expressed here was that interest within the department for ITS applications might wane if those individuals who advocated for Minnesota’s current entry into this field would ever leave. Although an earlier example of such an occurrence resulted in the formation of the CTS at the University of Minnesota, this fear appears to be aimed at keeping a critical mass of ITS technological expertise in residence within Mn/DOT.

5.2 Significant New Issues
Of the 15 issues newly identified by the Genesis partner representatives, the majority, or seven, of these issues were related to implementation and deployment. This makes sense since these issues were not obvious or anticipated before the start of the test. They became apparent, however, once the development process was initiated. Two other categories, contracting and auditing, and organizational coordination, also had newly identified issues. The significance of the new issues identified for each of these areas is discussed below.

5.2.1 Implementation and Deployment
The seven topics newly identified as implementation and deployment issues were:

- Feasibility of PDA operations should have been determined in advance.
Institutional Issues Test

- Integration of related projects not a high priority.
- Better technical support needed from development contractor.
- Development process not clearly specified.
- Software changes caused development delays.
- Performance requirements not specified.
- Sustainability of Genesis is questionable.

These topics addressed the need to clearly delineate the general system development process for ITS projects. In particular, the importance of: (1) doing proper operations and feasibility analyses with all proposed equipment; (2) planning integration-testing efforts that minimize impacts upon the development schedules of other projects; (3) receiving timely technical support during live-trial operations; and (4) clearly identifying the system development process for all involved parties was highlighted. Regarding the latter, in particular, procedures clearly delineating the difference between software-trouble reports (i.e., problems that must be fixed to meet contractual obligations) and software-enhancement reports (i.e., software changes outside the scope of the current contract and, perhaps, requiring additional funding) were needed for Genesis.

Other Genesis implementation and deployment issues raised included: (5) the need to minimize software changes (i.e., requirements) during development because of the possibility that unforeseen impacts (e.g., time, money) may be encountered; (6) the need to clearly specify performance requirements (e.g., system availability) in ITS software requirements; and (7) the need to design a sustainable (i.e., usable) system architecture that will provide greater returns for the money spent. All three of these issues imply the need for improved requirement tracking efforts within Mn/DOT. If system requirements could be easily identified, for instance, confusion over what needed to be built would be reduced.

5.2.2 Contracting and Auditing

Two topics were newly identified as contracting and auditing issues:

- Viability of Genesis partners needs to be determined in advance.
- Strategic negotiation process for ITS projects is difficult.

These issues identified the need to determine-- in advance-- the financial viability of all partners and companies providing hardware and software to an ITS project. For example, a supplier of one of the early PDAs proposed for Genesis became insolvent. Consequently, this caused problems for the development contractor because a new, compatible PDA needed to be found.
very quickly. As a result, the operational impacts of this new device were not fully understood before the beginning of the Genesis operational test.

Another contracting and auditing issue that was deemed significant was the need to provide some structure to the strategic negotiation process for ITS projects. It was felt, for example, that the free-form negotiations that initially took place between the public- and private-sector Genesis partners could have proceeded more smoothly if both parties had a better understanding of each other’s contracting history, contracting preferences, and what each party wanted to derive from the Genesis contract. Factors to be considered here are the different contracting requirements/perspectives of federal and state contracts, the fact that ITS partners may not share a common framework for negotiation, and the parameters surrounding the new and special contracting requirements imposed by the ITS partnership agreements promoted by the FHWA.

5.2.3 Organizational Coordination

Two topics were newly identified as organizational coordination issues:

- Metro and Guidestar divisions of Mn/DOT need to work more effectively together.
- A gap in expectations for ITS projects exists between regional and national FHWA offices.

The need to better coordinate the installation, testing, and updating procedures for any future ITS software placed in the TMC was highlighted. In addition, the need to better coordinate ITS expectations between national and regional FHWA personnel was also discussed. An example cited in this regard was the differing perspectives forwarded by FHWA personnel regarding the significance of Genesis’ phases 2 and 3 and the need, in particular, to fund these latter phases.
6. Summary and Conclusions

A summary of the major findings and the conclusions derived from the *Genesis Institutional Issues Test* are presented in the following sections.

6.1 Summary

As was stated in the Introduction, the goals of the Genesis project were to:

- Determine technical feasibility.
- Influence individual travel decisions.
- Complement and integrate with other ITS projects.

The results of the Genesis Evaluation have shown that the above goals have been met. PCDs were shown to be viable for providing travelers with up-to-date traffic information. Users of the Genesis PCDs responded to the information provided and altered route choices. Finally, Genesis was integrated with other ITS projects (e.g., Travlink, Trilogy) under the Guidestar program.

The Genesis operational test was completed, as scheduled, on January 24, 1996. System development impacts upon Genesis included (1) a three-month delay in the start of the operational test; (2) initiation problems for existing pager users; and (3) delayed deployment of the PDA. Other problems included: (4) coordination of integration testing; and (5) adequate and timely receipt of technical support for system updates after the Genesis operational was initiated.

The three (3) categories of institutional issues that had the most impact upon the conduct of the Genesis operational test were:

- Funding
- Newly-Identified Implementation and Deployment Concerns
- Organizational Coordination

Cutbacks in funding were felt to be the major problem for Genesis because they resulted in a reduced scope of services. In particular, a poorer user interface for both users and system operators occurred because improvements to these systems were supposed to be identified in the first phase of Genesis and implemented before the start of phases 2 and 3. In addition, functions that were planned for Genesis phases 2 and 3 (e.g., the providing of route-specific information, two-way communications capabilities) and that had the potential of significantly improving user satisfaction were not implemented. Finally, the lack of continuation funds served to provide a damper on the purported significance of the Genesis operational test.
Newly-identified implementation and deployment issues were considered to have significant impacts upon the Genesis operational test because they served to hinder the deployment of this system. Among the issues identified here were the needs to conduct feasibility analyses in advance of system development, make system integration a high priority, provide timely technical support, clearly delineate an overall development process, minimize software changes, delineate system performance requirements, and build a sustainable system.

Organizational coordination was one of the top three Genesis institutional because it highlighted the need for improved coordination between Mn/DOT operating units. In short, the concerns expressed here primarily appear to simply be one of communication-- better communication regarding the planned ITS activities of the Guidestar program of Mn/DOT is needed because these projects may have very real impacts upon the activities of other offices (e.g., Operations) within Mn/DOT. In addition, coordination of integration testing activities of the various ITS projects that were being fielded in the TMC could have been better planned.
7. Conclusions

Overall, the results of the *Genesis Institutional Issues Test* emphasized:

- The importance of proper financial planning for ITS projects to ensure that project goals are realized.
- The significance of understanding the myriad of factors involved with system development and deployment, especially as they relate to integration testing.
- The need to communicate the operational impacts of newly-fielded ITS systems upon the activities of other operating units.
8. References

DOT (December, 1992). *ITS [formerly called Intelligent Vehicle Highway System, or IVHS] Strategic Plan*.

BRW, Inc.; Battelle Memorial Institute; JHK and Associates; and Barrientos and Associates (March, 1993). *Genesis Concept Definition and Preliminary System Design*.


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Volpe Center (June, 1994). *Review of the Travlink and Genesis Operational Tests*.
APPENDIX

Interview Questions
Partner-Representative Background

1. What is your position?

Partner representatives were asked to provide their job titles and description of their job responsibilities in order to secure an understanding of their organization perspectives regarding the Genesis project.

2. What is your experience/history with the Genesis project?

Partner representatives were asked to provide their background and history with the Genesis project in order to obtain their perspective regarding the development and deployment of the project.

3. What stage was Genesis in when you first became involved?

   - Plan
   - Design/Develop
   - Implement/Test
   - Evaluate
   - Commercial Deployment

Genesis partner representatives were asked to provide this information to supplement the information requested in the previous question.

Organizational Perspective

4. In your own words, what are your organization’s project goals?

Partner representatives were asked to list their organization’s Genesis goals in order to determine the degree of overlap with those provided by the other partner representatives.

5. What were the benefits and risks of participating in this operational test for your organization?

Partner representatives were also asked to provide the perceived benefits and risks of Genesis participation in order to gauge their commitment to the project.

6. Who would you say were the initiators of the project?
This question was asked in order to gain a perspective on what organizations were most responsible for starting Genesis.

7. Who would you consider to be the champions of the project, i.e., who is really pushing for it to succeed?

This question was asked in order to determine what individual(s) were primarily pushing for Genesis to succeed.

8. What do you consider to be the most important measures of success of this project, i.e., how will you know that it has succeeded or met its goals?

Partner representatives were asked to provide their estimates of what it would take for Genesis to be considered a success, or a project that has met its goals and obligations.

9. In your opinion, is the program a success? If so, what are its positive contributions?

Partner representatives were asked to relate whether, considering the factors discussed by the previous question, they thought that the Genesis project was successful.

Identification of Institutional Issues and Lessons Learned

10. What were the three (3) to five (5) most important institutional and legal impediments that project participants encountered while establishing the Genesis partnership and while deploying its services and products? These issues may or may not have been previously identified by the Volpe Center (1994) as either existing or potential institutional issues. Please list in order of priority.

This question was considered to be the primary question asked by the Genesis Institutional Issues Test evaluation. The objective here was to get the partner representative to list, in order of priority, the institutional issues, or problems, that most affected the development, deployment and conduct of the Genesis operational test. The evaluator wrote these issues down and determined the parameters surrounding these issues before the Genesis partner representatives were asked to elaborate on each issue. Most partner representatives had little difficulty in providing the topics to be included on this list and responding to the following questions for each issue that they identified.
10-1. Was this issue previously identified by Volpe Center (1994) as either an existing or potential Genesis institutional issue?

____Yes
____No

This question was asked in order to determine the degree of overlap with the set of Genesis institutional issues previously identified by Volpe Center (1994).

10-2. What, specifically, is the issue?

Partner representatives were asked to state as succinctly as possible the nature of the problems or issues they identified. These issues were addressed in the order that they were originally identified by Question 10.

10-3. When in the project life-cycle did this issue occur?

____Plan ____Design/Develop ____Implement/Test ____Evaluate ____Commercial Deployment

This question was asked in order to determine the point in the Genesis program where the problem was first encountered.

10-4. How did this issue affect the overall project?

Partner representatives were asked to describe in as much detail as they felt appropriate how the issues they identified in Question 10 affected the overall project.

10-5. What were the major causes of this issue and how were they overcome?

Partner representatives were asked to identify the cause(s) of each issue identified in Question 10 in order to determine the reason(s) these issues were encountered. As part of this identification process, each partner representative was also asked to state whether these problems were overcome.

Future Solutions

16. What overall lessons were learned in dealing with this issue that can be applied to other deployments of ITS products and services?
After identifying each Genesis institutional issues and the reason(s) for its occurrence, each Genesis partner representative was asked to provide the lessons that could be learned from the situation. To increase the potential significance of these answers, each interviewee was asked to provide the lessons learned in a fashion that could assist other ITS professionals to avoid these types of problems with their projects.

17. *Knowing what you know now, if you were assigned to be the project manager in charge of all resources, how would you have done the project manager’s job differently if you had to do it from the beginning?*

The purpose of this question was to obtain a succinct summary statement from each partner representative as to what were the most important management issues that should have been addressed in the Genesis project and, by extrapolation, to other ITS projects.

18. *What do you feel are some of the future applications of Genesis PCD Technology?*

Each partner representative was asked to provide some suggestions regarding how he/she felt the Genesis technology could be extended to solve related types of ITS problems.

19. *What do you feel are some of the improvements that could be made to Genesis PCD Technology?*

Each partner representative was asked to provide some suggestions for how Genesis, as it was implemented, could be improved.