Precursor Systems Analyses of Automated Highway Systems

RESOURCE MATERIALS

Institutional and Societal Aspects

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FOREWORD

This report was a product of the Federal Highway Administration's Automated Highway System (AHS) Precursor Systems Analyses (PSA) studies. The AHS Program is part of the larger Department of Transportation (DOT) Intelligent Transportation Systems (ITS) Program and is a multi-year, multi-phase effort to develop the next major upgrade of our nation's vehicle-highway system.

The PSA studies were part of an initial Analysis Phase of the AHS Program and were initiated to identify the high level issues and risks associated with automated highway systems. Fifteen interdisciplinary contractor teams were selected to conduct these studies. The studies were structured around the following 16 activity areas:

(A) Urban and Rural AHS Comparison, (B) Automated Check-In, (C) Automated Check-Out, (D) Lateral and Longitudinal Control Analysis, (E) Malfunction Management and Analysis, (F) Commercial and Transit AHS Analysis, (G) Comparable Systems Analysis, (H) AHS Roadway Deployment Analysis, (I) Impact of AHS on Surrounding Non-AHS Roadways, (J) AHS Entry/Exit Implementation, (K) AHS Roadway Operational Analysis, (L) Vehicle Operational Analysis, (M) Alternative Propulsion Systems Impact, (N) AHS Safety Issues, (O) Institutional and Societal Aspects, and (P) Preliminary Cost/Benefit Factors Analysis.

To provide diverse perspectives, each of these 16 activity areas was studied by at least three of the contractor teams. Also, two of the contractor teams studied all 16 activity areas to provide a synergistic approach to their analyses. The combination of the individual activity studies and additional study topics resulted in a total of 69 studies. Individual reports, such as this one, have been prepared for each of these studies. In addition, each of the eight contractor teams that studied more than one activity area produced a report that summarized all their findings.

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and Development

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EXECUTIVE SUMMARY

In Precursor Systems Analyses (PSA) Activity Area "O", Institutional and Societal Aspects of the Automated Highway System (AHS), many areas were studied including previous research, focus groups, and institutional issues. A representative collection of the current research in the area of institutional issues facing AHS and ITS in general was compiled and reviewed. A primary focus of the research was to identify public reaction to AHS concepts wherever possible, and also refer to those studies and reports that addressed ITS issues as well as AHS.

The institutional issues associated with AHS will pose significant difficulties for commercial vehicle operations (CVO) and the regulators who administer and enforce motor carrier safety and economic standards. The public and private sectors ultimately will share the total cost of an AHS system. How those costs are allocated between industry and the different levels of government, and the effect of the costs on user fee and tax programs are key institutional issues. As the intelligence and instrumentation of the system moves from mostly "in the roadway" to mostly "in the vehicle," costs shift from the public sector (the usual financier of roadways) to the private sector (the usual financier of vehicle purchases).

A variety of strategies are recommended for overcoming the non-technical barriers to the development and implementation of an AHS. These strategies are based largely on the findings from the focus groups, public awareness research and with the planning/development/lmplementation/evaluaion of some of the operational tests of ITS.

- Continue aggressive Federal efforts to enhance the technical reliability of travel demand and air quality modeling to improve the credibility of claims for environmental benefits that would accrue from an AHS for commercial vehicles.

- Prepare information packages to conduct educational briefings for interested public and private parties on the potential benefits of AHS. Use these briefings to build support and understanding among all affected constituents. Tailor materials to meet the needs of the various constituencies (e.g., commercial vehicle drivers).

- As a part of a public acceptance program, the Consortium should conduct a detailed assessment of the range and magnitude of interest and concerns across stakeholder groups. The findings reported in this study are exploratory; a more rigorous and exhaustive inventory of public acceptance issues is needed to firmly establish the baseline upon which AHS activities can build.

- The Consortium should establish a research and development Program to address institutional and public acceptance issues related to AHS.

9 The Program should conduct a detailed assessment of the range and magnitude of interest and concerns across stakeholder groups.

- The Program should assess the influence of new information and/or direct experience on institutional and public acceptance of AHS.

- The Program should develop an outreach strategy that builds upon (the above) public acceptance findings, and in doing so, attends to the interests and concerns of a broad range of stakeholders, from AHS champions to AHS adversaries.

- Demonstrations of system safety are very important to convincing potential users of its safety.

- Success will depend on the ability of the program to involve the private sector so as to ensure market/cost sensitivity.

- AHS needs to be considered in light of other approaches (e.g., congestion pricing) for managing travel demand.

- Planning and evaluation efforts should take into account all of the potential social and environmental impacts.

- There may be a need to rethink the transortation system of the future rather than assume that it will be built on the present interstate system.

- Research and Evaluation studies should focus on a broad range of potential social and environmental impacts.

- There is a need to research in greater detail the potential economic implications of AHS as presently configured.

- Approach the development of AHS for commercial vehicles as a public/private partnership. A major “partnering” program will be required that delegates appropriate and clearly defined roles and responsibilities to the private sector stakeholders is essential.

- Within the public sector partners, identify strong champions and advocates who can devote significant time to the endeavor and who have the clout to secure the necessary high-level commitments of resources.

- Ensure that the public sector (i.e., the state and Federal governments) commit to long-term predictable funding levels and realistic implementation plans and schedules. Wherever possible, implement programs in steps of phases, with established decision points at which to evaluate further activities.

- Establish appropriate goals for commercial vehicle AHS: is it to enhance operational safety, reduce congestion, reduce regulatory inefficiencies, raise revenues, enhance economic competitiveness, improve profitability, or some combination of these goals?

- Emphasize early commercial vehicle AHS projects which have intermodal elements, particularly in enhancing the truck/rail interface, to help dispel the notion that AHS/CVO projects are an alternative rather than a complement to rail freight reinvestment.

- Select initial projects that have the most tangible, quantifiable, and demonstrable benefits to the commercial vehicle industry.

CHAPTER 1: INTRODUCTION

The Automated Highway System (AHS) program component of the Intelligent Transportation Systems (ITS) [formerly known as Intelligent Vehicle Highway System (IVHS)] is a broad national effort to provide the basis for, and transition to, the next major performance upgrade of the U.S. vehicle/highway system, through the use of automated vehicle control technology. The long range goal is to significantly improve the safety and efficiency of the nation's surface transportation system through a national effort that best ensures the early, successful deployment of AHS. As part of the Analysis Phase, the Precursor Systems Analyses (PSA) are being performed to identify issues and risks associated with AI-K.

In Activity Area "O", Institutional and Societal Aspects of AHS, many areas were studied including previous research, focus groups, and institutional issues. The early tasks involved the review of literature and presentations on institutional concerns as they relate to AHS. Later tasks developed focus groups that raised concerns and allowed for "trial ballooning" of potential solutions of such concerns. A representative collection of the current research in the area of institutional issues facing AI-IS and ITS in general was compiled and reviewed. A primary focus of the research was to identify public reaction to AHS concepts wherever possible, and also refer to those studies and reports that addressed ITS issues as well as AHS. A finely tuned Focus Group Survey Instrument, used in focus group sessions representing a broad range of constituencies, allowed the Federal Highway Administration (FHWA) to see firsthand how the institutions and people who have to make AHS a reality really think about the issues.

The institutional issues associated with AHS will pose significant difficulties for commercial vehicle operations (CVO) and the regulators who administer and enforce motor carrier safety and economic standards. The public and private sectors ultimately will share the total cost of an AHS system. How those costs are allocated between industry and the different levels of government, and the effect of the costs on user fee and tax programs are key institutional issues. As the intelligence and instrumentation of the system moves from mostly "in the roadway" to mostly "in the vehicle," costs shift from the public sector (the usual financier of roadways) to the private sector (the usual financier of vehicle purchases).

1.1 DESCRIPTION OF I&S ACTIVITY AREA

The concept of an AHS for the United States is moving forward. Congress has mandated the creation of a test track prototype by 1997. A major factor affecting the ultimate success of this enterprise will be the level of Public Acceptance of AHS. Without some critical level of such acceptance, it is doubtful that the full potential claimed by many for AHS could be realized. It is therefore important that an assessment of the public's acceptance of AHS be undertaken and continued in concert with the program development itself.

Relevant institutional issues fail into three categories: mandate, organization, and resources.

1.2 PURPOSE AND OBJECTIVES

This report will discuss the purposes and objectives of the Institutional and Societal Issues Study of AHS at the precursor level. The societal areas of public acceptance impacts were investigated. Institutional issues as they relate to the public/private arena, with a particular emphasis on issues affecting commercial motor carriers also were investigated.

The objectives were to define institutional issues as they relate to the public/private arena and to evaluate AHS public acceptance for several typical stake holder/user groups.

1.2.1 Purpose

The purpose of the Public Acceptance portion of this study is threefold:

1. Summarize the available information regarding public acceptance of AHS.
2. Develop new information through the use of the focus group methodology applied to a selected set of target groups of relevant populations.
3. Suggest future directions in this process based on the analysis of this information.

The purpose of the second part of this report was to:

1. Develop an analytical framework for categorizing institutional issues.
2. Evaluate the criteria necessary to successfully deploy AHS in both the private and public sectors.

1.2.2 Objectives

This report, as it relates to the issue of Public Acceptance, focuses on the results of work aimed at addressing the following research questions:

- Based on a review of the open literature, what is known regarding the issue of public acceptance of an AHS as presently being developed in the United States?

- What attributes of AHS are likely to affect user acceptance, and how do perceptions vary across different segments of the public?

- What attributes of AHS are likely to affect community acceptance, and how do perceptions vary across different segments of the public?

- What research and policy actions could be taken to ameliorate public concerns and/or enhance acceptance of AHS?

From the institutional issues perspective, the objectives of this report are to identify several analytical frameworks of public, private, and joint public/private sector impacts.

To ensure full coverage of the institutional issues three categories are considered:

- Mandate.
- Organization.
- Resources.

Mandates consist of vision, leadership, and authority. Most efforts that significantly affect the way that business operations are conducted require some kind of mandate from legislation, from executive orders, or from popular demand. With a mandate comes legitimacy and support for action. Impacts of the Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act (ISTEA) on the business sector will shape such mandates.

Issues associated with the “mandate” category reflect the lack of senior executive, political, or administrative support for the implementation of AHS. Mandate issues may arise when there is a strong public demand for a particular change but no executive-level response to implement the change, or when there is an administrative directive but no popular support for an action. They also may occur when there are conflicts among public sector entities on the implementation of a change.

The report objectives include the presentation of key issues relating to the need for defining the mandate for AHS affecting the public sector, the private sector, or both jointly from many perspectives.

The key public sector issues include:

- Multi-jurisdictional regulation.
- Risk management.
- Resistance to change.
- Articulation of benefits.
- Commitment.

In the private sector institutional issues include:

- Market uncertainty.
- Privacy concerns.
- Legal concerns (particularly with respect to liability and insurance).

Joint public/private institutional issues include:

- Safety.
- Economic development.
- Environmental impact.

Another prime objective of this study is to discuss how issues relating to public/private collaborations, coordination, and communication can be achieved among multiple organizations, organizational roles and responsibilities, and administrative requirements.

Finally, an important objective is to identify a plan or approach focusing on the number and skill levels of human resources as well as the availability of financial resources.

CHAPTER 2: SCOPE AND METHODOLOGY

This chapter establishes the research basis for focus groups techniques used in sampling the public acceptance of potential for AHS. Through analysis of the focus group findings, the chapter provides an inventory of major issues that must be addressed by shareholders/stake-holders/users in the Deployment Phase of AHS.

For motor carriers, the primary and secondary research conducted for this analysis are based on the experience of the motor carrier industry with Intelligent Transportation Systems (ITS). The basic analytical framework groups the identified issues into three broad categories of mandate, organization, and resources.

2.1 GENERAL SCOPE AND METHODOLOGY

To ensure coverage of the range of issues across all vehicle types, a combination of primary and secondary research was employed to identify and define the relevant issues. The scope of the literature review was narrowed to focus on the public acceptance of AI-IS as a means of making the searches manageable and within the time and cost constraints of the study. However, the issues that surface regarding public acceptance of AHS cover the range of the institutional and societal issues relating to the deployment of these technologies. As a result, the literature reviewed for this study does, in fact, represent a significant portion of the literature that looks at these more general issues.

The focus group methodology employed in the portion of the study dealing with the public acceptance of AHS was chosen because of the strengths this methodology has when used as an exploratory technique in the early stages of implementing new technologies such as those involved in AHS.

This report discusses the institutional and societal issues associated with the application of AHS to all vehicle types including private passenger cars, public transportation (including buses and mass transit vehicles), and commercial motor carriers. Although some issues will apply across all vehicle types, others will be unique to particular vehicle types, such as commercial motor carriers.

2.2 METHODOLOGY BY VEHICLE TYPE: MOTOR CARRIERS

As a foundation for the identification of institutional and societal aspects of AHS for motor carriers, the motor carrier industry's experience with Intelligent Transportation Systems (ITS) was reviewed. The working assumption was that institutional and societal issues that have arisen during the course of the industry's ITS experience would serve as a basis for projecting the issues likely to arise in conjunction with the implementation of AHS. Analyses of the institutional barriers that have arisen during the planning, design and development, testing, evaluation, and implementation phases of lTS/commercial vehicle operations (lTS/CVO) operational tests were examined as a primary source of information. Drawing on these studies,

studies of institutional barriers associated with the use of ITS for private automobiles, other current literature, and the study team's active participation in a number of ITS/CVO projects, the institutional and societal aspects of AHS were examined from the perspective of the motor carrier industry.

The basic framework used for the analysis groups the issues into three broad categories:

- Mandates. Is there a mandate legislative, administrative, or market demand for the application of AHS to commercial vehicles?

- Organizations. Are the motor carrier industry, its suppliers, and the states that regulate the industry structured so that they are capable of developing and implementing AHS for the trucking industry? Or are responsibilities unclear, jurisdictions overlapping, and priorities conflicting to such a degree that the development and delivery of AHS to the trucking industry will be difficult with or without a mandate?

- Resources. Are there sufficient resources skilled people, equipment and facilities, and funds to realize AHS for motor carriers?

This framework is discussed in greater detail in section 5.1.

2.2.1 **Methodology: Issues of Concern to the Transit/Environmental Constituency**

The project work plan was developed in the context of the wide range of institutional issues facing the development of AHS. From the inception of the project, (i.e. the original proposal submitted) one of the key research elements has been conducting a series of Focus Groups designed to broadly bring out key issues. The Focus Groups were designed to explore the concept of public acceptance of AHS, seen across two dimensions. First, user acceptance of the product as it affects their lives; second, community acceptance of the product in terms of community values. For the traditional transit/environmental constituency, the question of whether one can read the newspaper while driving the vehicle is inherently less critical than the question of the impact of the system on both short term and long term patterns of transportation demand and land use.

Given the concerns of the transit and environmental constituency, the work plan was established to ensure that at least one of the Focus Groups was drawn from a community of transportation professionals already familiar with the institutional implications (including political implications) of various public policies towards transportation. As the work plan developed, this methodological concern resulted in the selection of the ITE Conference workshop. This Focus Group included individuals with significant experience in the direction of public policy in transportation over the past decade, including the creation of ISTEA in 1991. The research method chosen, specifically allowed for a discussion of the personal acceptance of the product,

community acceptance of the regional impacts, and policy implications of the national program. The results of this and the other FOCUS Groups will be discussed in detail in chapter 4.

The work program, then, was designed to illicit a wide range of input concerning the public and professional reaction to AHS concepts. The research method was selected, it is important to note, during a period of extensive legislative and judicial attention to certain transportation planning issues of great concern to the traditional transit and environmental constituencies. The nature of that debate, and that concern, is briefly summarized in section 2.3.3, of this chapter.

2.3 GENERAL ISSUES

Among the many institutional and societal issues surrounding the deployment of AHS, one that appears critical to the success of the program is that of public acceptance. Implementing new technologies, especially when the costs involved wiII likely be passed on to the users of the technologies as well as the communities affected, require that these users and communities perceive that the benefits outweigh these costs. Achieving the necessary level of public acceptance for the success of AHS will be a complex and challenging process and to determine the status of that process at the present time is one of the objectives of this study.

Commercial motor carriers are considered by some to bean ideal target market for early AHS applications, given their relatively small number (compared to private automobiles), their general for-profit orientation, the negative public perception of trucks as contributors to highway problems, and the burdensome nature of motor carrier regulation. Nevertheless, the extensive and unique set of institutional issues associated with the application of AHS to motor carriers severely diminishes the attractiveness of this market.

Recent clean-air and transportation legislation (e.g., CAAA and ISTEA) have heightened the need for transportation programs to adhere to a variety of environmental and related community constraints. Demonstrating AHS'S capacity to operate within these constraints thus represents a key challenge for the program.

2.3.1 Public Acceptance

For the portion of the study that looked at Public Acceptance of AHS, several factors were taken into account regarding the scope of the work performed. First, a broad definition of the term “public” was adopted. It includes not only those groups that would fall under the label of public “end-users” (e.g., commuters, travelers, commercial vehicle operators, etc.), but also other public stakeholder groups that could play a role in decision-making regarding AHS (e.g., metropolitan planning organizations, environmental groups, state Departments of Transportation, etc.). In terms of the literature review, we focused on recent open literature (both general and empirical) that addressed public acceptance issues with respect to transportation and, more specifically, AHS. It was beyond the scope of the study to perform an exhaustive

review of the literature on market research in the AHS area and the individual technologies involved since much of this literature is probably proprietary in nature. Nevertheless, we were able to address this area to some extent, as will be seen in chapter 3. Finally, our development and use of the focus group methodology should be viewed as exploratory in nature, in the sense that it is a demonstration that this approach for gaining information regarding public acceptance of AHS is, in fact, an appropriate tool for such investigation.

Regarding the use of the focus group methodology, it should be noted that group interviews have been used as a technique for collecting information on topics of interest to the interviewers for many years. Marketing research provides an example of where this method has been extensively applied. More recently social science and evaluation researchers have identified and adopted a special class of group interviews, known now as “Focus Groups”, as a valuable tool for use in their own studies. The primary purpose for conducting a focus group in this setting is to collect qualitative data on a set of research or evaluation questions. There are sometimes other objectives, such as building consensus in a group or making group decisions, but typically in social science and evaluation applications, the main objective is to learn from the group through their responses to the questions during the focus sessions. Perhaps a distinguishing characteristic of a focus group from other group interview techniques is the purposeful use of group interaction as a means of generating data for analysis, and this is achieved through the careful probing by the “moderator" as the group considers topics and questions posed to them.

Focus group methods have been particularly useful in the exploratory phase of research in a topic area and therefore are very appropriate for this precursor study of AHS. They can also be insightful for pretesting the method generally and the quality of the instrument in particular. Typically the groups are small (8 to 10 participants) and are formally brought together to discuss and react to a set of questions (in our case these will concern the acceptance of AHS in various configurations). The sessions will be “led” by a moderator whose task it is to keep the discussion “focused” on the theme through the use of the instrument that has been developed for guiding the session.

From the above discussion it is clear that two critical features for the success of the focus group method are the set of questions developed and used to guide the sessions and the selection of the "target“ groups themselves.

The purpose of the Focus Groups that were conducted was to collect data that would provide insights into the answers to the research questions of the study. An underlying goal of the study is to explore ways in which to bring out and forward the thoughts and ideas of a variety of stakeholders in an AHS so that they can be used in the process. Thus, the expected outcome of each Focus Group session was information gleaned from the participants regarding their own thoughts and opinions relative to the major features of an AHS that are important to public acceptance or non-acceptance. The structure of the focus group instrument was designed to permit a balanced discussion of AHS. Specifically, the discussion was divided between features

of an AHS that are perceived as attractive to the group members and features that might be perceived as barriers to acceptance of the system. We also felt it would be useful to have the group members present their thoughts from both the perspective of a user and the perspective of the community in which the system would be deployed.

The instrument itself consists of the set of questions to be used to focus the discussions on the set of issues of interest. It has been developed to be applicable across a wide range of selected stakeholder groups, each one likely to have quite different perspectives. A final instrument is contained in appendix A and described in chapter 4.1.

We opened each focus group session with an orientation section in which we present background information on AHS, what it is, what some of the different technologies are, what various configurations of these technologies might be in different scenarios, what some of the claims are regarding its potential for meeting future transportation needs, what some of the other external issues are that need to be considered, etc. In this way we ensured that when we proceeded to the group discussions, everyone had at least a common understanding of which of their opinions and thoughts we were interested in learning about.

Next we began the discussions regarding those features of AHS that are seen as attractive to the participants and developed a listing of these features. Following this, the group was asked to try to identify **a** small number of these features that would" seem to be most important in promoting acceptance. This was followed with a parallel discussion and listing of those features that are seen as barriers to acceptance. They also identified a subset of major barriers.

During the final portion of the session, we elicited from the group any implications they would draw from their earlier discussions regarding future policies and research requirements in the AHS arena. In this way, we hoped to learn what the group sees as possible next steps needed to enhance public acceptance for AHS.

The following table (table 1) gives an overview of these steps conducted in the sessions.

Table 1. Focus Group Overview

Orientation	
User	Community
Attractive Features	Attractive Features
Most Important Subset	Most Important Subset
Barriers to AHS	Barriers to AHS
Most Important Subset	Most Important Subset
Policy Implications	
AHS Research Needs	

2.3.2 Motor Carrier Industry

The implementation of AHS in the commercial vehicle sector involves many of the same issues as its implementation for motor vehicles in general. The most critical issues for commercial vehicles include:

- Regulation and taxation.
- Risk and safety management.
- Privacy and business confidentiality.
- Market acceptance.
- Environmental impacts of trucks and AHS.
- Economic impacts.

In many ways, the commercial vehicle market may appear to represent an ideal target for initial public sector investments in AHS technologies, particularly if the focus is on vehicles commonly considered to be “heavy trucks.” Compared to the number of other vehicles on the road, these trucks represent a relatively small group: about 25 percent of the 188 million total vehicles on the road in 1990 were trucks, but only about 3.6 million of these trucks weigh more than 4,540 kg (10,000 lbs.) (vehicle Classes 3 through 8).[1]

In addition, because motor carriers are for-profit companies, some believe it would be easier to “sell” them On the idea of an AHS as a “product” which would ultimately enhance their profit margins; this is in keeping with the commercial applications orientation of the entire AHS program. Thus, in theory, demonstration projects and other arrangements could be pursued with more clearly defined and mutually beneficial goals than may be possible for private automobiles.

Commercial vehicles are perceived by some as major contributors to highway maintenance, safety, congestion, noise, and air quality pollution problems. Some believe that the adoption of AHS for motor carriers would reduce these perceived problems, as well as provide a way to increase the efficiency of the expensive, time-consuming, and labor-intensive administration and enforcement of commercial vehicle regulations.

For all these reasons, targeting commercial vehicles for the initial application of AHS may appear to be appropriate. However, the institutional issues associated with this application are extensive. These issues involve a lack of mandate, a complex organizational environment, and constraints on the availability of resources to implement an AHS for trucks.

There appears to be no mandate either -- within the trucking industry or from states and local governments - for the development and implementation of AHS for trucks. Although the rate of truck involvement in fatal accidents has been dropping over the last decade and large trucks constitute less than five percent of peak-period traffic in most cities, the general public perceives trucks as dangerous and major contributors to congestion. In this environment, state and local transportation agencies are very risk averse when it comes to promoting projects that are perceived to favor trucks on the highway at the expense of the automobile driver. Within the trucking industry, there is long-standing support for better roads and bridges, but deregulation of the industry has created sharp price competition within the industry and dramatically reduced profit margins, especially for smaller carriers. Transportation projects, such as AHS, that do not address basic infrastructure repair and replacement needs, and that might result in an increase in the road user taxes paid by the industry, have little support at this time.

The organizational environment of the motor carrier industry and the state agencies that regulate them is particularly complex, especially when compared to private automobiles. Motor carriers are regulated primarily by the states. Unlike automobile owners, truck operators are required to register in each state within which they operate; account for and pay taxes and registration fees on the basis of mileage to be accrued in each state; and conform to size, weight, and safety restrictions that are still largely determined on a state-by-sate and industry-by-industry basis. Moreover, within a given state, there maybe three to eight agencies involved in one or more aspects of motor carrier regulation.

The resulting balkanization of the regulatory environment, multiplied by the corresponding diversity of motor carrier fleets, is a significant barrier today, even to

relatively straightforward projects, such as creating uniform procedures for truck registration. Where there are strong financial incentives for the States, motor carriers, and shippers and receivers to overcome such organizational barriers, transportation projects and legislation have been successfully advanced, However, the benefits of AHS are still so unclear that little awareness -- and even less consensus - exists on the need to organize for AHS.

Deregulation of the interstate motor carrier industry in 1960 triggered a massive restructuring of the industry; the pending deregulation of the intrastate industry (expected in 1995) is likely to provide another jolt to the trucking industry. These changes have created two countervailing pressures on the industry that will shape its perception and use of AHS. The first has been increased competitive pressure within the trucking industry that has reduced profit margins and made motor carriers very cost-sensitive and risk-averse. In this environment, the motor carrier industry will be very conservative in its approach to AHS, especially if they are expected to “ante up” as part of a public/private partnership to develop AHS.

The countervailing trend has been toward increasing sophistication within the motor carrier industry, reflecting its transition from “mom and pop” scale to national and international operations. This change is reflected in the introduction of communication and computer technology to business operations and trucks. Today’s state-of-the-art fleets are among the most sophisticated vehicles on the road. These fleets and their managers will be prepared and able to assess and adopt those aspects of AHS that are of direct benefit to their operations.

2.3.3 Issues of Concern to the Transit and Environmental Constituencies

The Institutional and Societal Issues Work Program was designed to identify a variety of issues of concern to the transit and environmental communities. Considerable concern has been expressed in the popular press, (e.g. *The Washington Post* regarding possible conflicts in goals between the environmental community and the IVHS program in general, often with specific reference to the AHS program. Generally these concerns were expressed in two areas; the observed lack of “pay-off” for transit oriented polices and strategies, and the impact of IVHS technologies on travel and land use patterns. The issues of the possible utilization of AHS, and more generally IVHS, technology in support of transit and HOV objectives will not be addressed in this document, as it is the specific subject of a series of studies within the AHS Precursor Studies entitled Commercial and Transit Aspects. The reader is specifically referred to the document prepared by BDM Federal, Inc (October 1994) which suggests that there is a potentially enormous payoff from AHS technology development for a wide variety of transit and HOV applications. This document, rather, focuses on the issue of travel demand and land use impacts as a concern of the traditional transit and environmental constituencies. A brief review of recent published information on this issue can help to set the stage for the discussion in chapter 4 of the activities of the Focus Groups, particularly the one held at the ITE Conference in La Jolla, California.

The issues of secondary impacts arising from improved auto-based technology are part of larger interest in a more global issue generally referred to as Sustainable Transportation. Sustainable Transportation itself can be seen as a subset of the larger policy issue of Sustainable Development. These issues have been explored in a recent article by the World Bank's Richard Barret, whose title is Principal Urban Transport Specialist, and Assistant to the Vice President or Environmentally Sustainable Development. For a definition of Sustainable Development Barret quotes the Bruntland Commission:" Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."(2) At the international level, these concepts were explored in the 1992 Earth Summit in Rio de Janeiro, Brazil resulting in the formation of the United Nations Commission on Sustainable Development, and in 1993, the formation by President Clinton of the President's Council on Sustainable Development. In his presentation to the Transportation Research Board in January of 1994, Secretary Pena commented that ". ..we can meet these challenges by providing 'sustainable transportation' - transportation that meets the needs of this generation without compromising the ability of future generations to meet their needs."(3)

Translating the general goals of global sustainability to the practice of transportation planning will not be easy, but much work has been underway over the past two years. The World Bank's Barret notes that:

> "Environmental issues in the urban transport sector stem mainly from the proliferation and use of private mode vehicles and the failure of Governments to address the real costs that the vehicles place on our society. The impacts are not only pervasive, but are increasing year by year. The question now being asked is whether current urban travel patterns are sustainable in the global regional and local Context. d1)

The American transportation analyst and environmentalist Michael Repogle has commented on the implications of this policy orientation for American transportation planning:

> "The current pattern for transportation planning seeks to maximize circulatory capacity, travel speed, and mobility. The emerging sustainable transportation paradigm seeks to maximize efficiency overall resource utilization. This is achieved by increasing modal diversity, paying more attention to the pattern of transportation and land use, and encouraging use of efficient transportation modes whenever practical, often by encouraging better connectivity between modes.*S)

Fundamental to the sustainability concept is a critical examination of the impact of transportation projects and polices on the creation (or encouragement) of vehicle travel, usually expressed as Vehicles Miles of Travel (VMT.) A key issue is the effect of adding capacity on the generation of additional miles of WT. The issue has generated passionate debate within the professional community -- often without a solid analytical base of data to support that debate. Smith and Schoener have written:

> "A frequent statement advanced by transportation professionals is that highway improvement, by inducing travel, create more congestion than they eliminate. Although few data exist to support this statement it has gained legitimacy by sheer repetition."(G)

In many ways, this debate was brought to a head in September of 1989 when a Federal Judge in California issued a Court Order, based on a law suit filed by environmental groups, ordering the Bay Area Metropolitan Planning Organization (MPO) to refine its procedures for modeling both the short and long term impacts of additional highway capacity. Under the ruling,

> "MTC[1] may not approve any other highway projects that increase existing highway capacity, pending completion of a revised TIP-SIP conformity determination. Capacity-increasing projects are defined to involve the construction of a new highway, increase the number of lanes on an existing highway or permit increased traffic volume on an existing highway."[m]

To deal with this important issue, the FHWA in 1991 sponsored a conference entitled "The Effects of Added Transportation Capacity," and commissioned several key research papers to summarize the state of the practice in the area. Gordon Shunk summarized the key policy question when he wrote:

> "It is clear, however, from recent legal proceedings that business as usual for assessing the effects of roadway improvements on air quality will no longer be acceptable. Future air quality assessments will have to determine whether the potential emissions reductions attributable to improved speeds and reduce idling will exceed the additional emissions reductions generated by induced traffic."(8)

Shunk has defined the four areas of possible increase in trip making as a result of improved highway facilities. He writes that:

> "Transportation analyses should carefully consider the possible occurrence and potential extent of the following effects of added transportation capacity:
>
> Additional trips: New vehicle trips not made previously because of the difficulty or time required for travel area latent demand that may be stimulated by an improved level of service.
>
> Longer Trips when capacity is added, speeds may increase, and a given trip may take less time than it had previously. If this occurs, the time saved may be spent making longer trips, such as to a further destination.
>
> Mode Shift: The possible reduction in travel time due to a capacity improvement may attract people that previously used another mode,

[1] Metropolitan Transportation Commission

> such as transit or ridesharing, because of a change in travel time advantage.
>
> New Development: An increased potential for new development may result if travel times decrease. People willing to travel greater distances may select residential, employment, or other activity locations that previously had required too much travel time to reach. This may generate new development and longer trips."[(s)]

FHWA's Conference Proceedings document provides a wealth of material that help the policy analyst understand the implications of this complicated issue. Before resolving the complicated issues of air pollution generation, which are driven by more factors than VMT alone, data is reviewed that suggest clearly that significant increases in roadway capacity do indeed result in an increase in the amount of travel undertaken. A 1978 study by Smith and Schoener examined trip making patterns in Providence before and after the opening of a major portion of 1-95. They concluded that the data "revealed that the highway did not increase trips, or Vehicle Hours Travelled (VHT) but did increase VMT. This allows the tentative conclusion that travelers increase the VMT until they use up a given amount of travel time...".

This study, and many others, were reviewed in a critical examination by Ryuichi Kitamura, who separated out the phenomenon of additional trip making (often called "induced trips") from four other phenomena: diversion -- trips diverted from a parallel route; transfer -- trips transferred from another mode; and, shift -- trips whose length has increased as a result of the improved roadway. In his study, Kitamura reviewed the adequacy of existing models to deal with this subject, and like Smith and Schoener, did not find evidence that capacity increases were responsible for the addition of new trips; at the same time, he concluded that existing models can deal with diversion, transfer, and shift. He concluded that:

> "There is no empirical indication that added capacity generates a significant volume of induced traffic.
>
> The standard sequential procedure is capable of forecasting diverted, transferred and shifted traffic.[dll)]

As a result of the Bay Area litigation, a court approved modeling procedure was tested. In this "state of the practice" exercise, trip lengths did prove to vary with the capacity assumptions: "Average trip lengths tended to shorten under the no-build alternative and lengthen under the build alternative." In other areas, including trip generation, auto ownership and residential location, "slight differences" were found from the implementation of a relative small amount of new highway capacity.

In the Bay Area work, several scenarios were tested to understand how the inclusion of longer term impacts would impact the conclusions about air quality impacts of significant levels of new transportation capacity. In these studies, longer term effects of land use change were integrated into the air quality modeling process.

Looking at these larger scale changes, (which are appropriate for a discussion of the kind of changes in travel speeds proposed under AHS concepts) Harvey and Deakin report:

> "Capacity increases internal to the developed portion of the region appeared to yield net emissions reductions.
>
> Capacity increases linking fringe areas to the developed portion of the region appeared to yield net emissions increases by increasing auto trips and trip lengths.[d12)]

Thus, the Bay Area litigation research seems to imply that the direction of change depends on several factors, including the propensity of a given investment to either reinforce the shorter distance trip making patterns of existing higher density residential areas, or encourage the development of longer trips associated with lower density suburban and exurban residential areas. This conclusion of Harvey and Deakin is, in essence, consistent with a major review of the relationship of new highway capacity and VMT production. At the conclusion of the study, "The VMT / Urban Highway Supply Relationship" the NCHRP staff wrote "first, the direction of VMT changes because a given highway supply change can vary; second there are many variables that affect both the direction and their magnitude of the VMT changes.[w2] Given that it is impossible to generalize about the overall effects of capacity change, the Harvey/Deakin article makes a major contribution to the field with its focus on the propensity of an investment to either reinforce or undermine the short trip/higher transit lifestyle associated with higher density residential patterns.

The AHS program offers the promise of significant increases of both capacity and speed for the nation's highway system. For some, the possibility of major improvement in personal mobility is highly valued. For others, the possibility that the new technology will lead to increase vehicle travel is an issue of major concern. From the beginning of this project, this analysis of Institutional and Societal Issues in the AHS program has sought out a variety of viewpoints from observations and analyses. This section of the *discussion* of general issues which lay in the background of the Focus Group sessions shows that during the five year period preceding this study the issue of impacts of added transportation capacity went from a subject of academic concern to the subject of major judicial and administrative attention. It is within this context that the results of this research effort should be observed.

[2] NCHRP Comments on "The VMT/Urban Highway Supply Relationship" study.

CHAPTER 3: PUBLIC ACCEPTANCE OF AUTOMATED HIGHWAY SYSTEMS: LITERATURE REVIEW

The analysis of the Public Acceptance literature review provided a summary of the major findings, which were used to update/upgrade our focus group instrument and identify additional needs verified by the Focus Group findings later.

3.1 SOURCES REVIEWED

The analysis of the Public Acceptance literature review provided a summary of the major findings which were used to update our focus group instrument and identify additional research issues. More specifically, the successful implementation of complex systems such as Automated Highway Systems (AHS) will require "acceptance" of the system (e.g., approaches, technologies, procedures, costs, safety, etc.) by a wide range of stakeholders. Operationally, acceptance can classified into one of two subcategories, user acceptance which can be considered to be the willingness of the individual user to pay for and use such technologies, and *community acceptance,* which can be thought of as willingness of the general public to pay for the supporting infrastructure required by AHS.

The objectives of this task were to review the existing literature to assist in identifying and defining these non-technical, but critical issues, as well as to identify any potentially useful methodologies and measures of acceptance that could be applied to assess the degree of public acceptance specifically applicable to the AHS program. In the following review, a broad definition of the term "public" is used to include not only "end users" such as commuters, travelers, and commercial vehicle operators, but also other public groups that will play a role in AHS decisions, such as Metropolitan Planning Organizations (MPOs), state Departments of Transportation (DOTS), and environmental groups.

Given the somewhat complex technical and operational nature of an AHS it is useful to begin any discussion of AHS by defining what it is. A useful definition of the AHS concept has been summarized by Bishop and Alicandri (1993) as:

> "...A system of instrumented vehicles and highways that provide fully automated (i.e., "hands off) operation at better levels of performance (safety, efficiency, comfort) than today; is practical, user-friendly, and financially affordable; is deployable in both urban and rural areas; and preserves the ability of instrumented vehicles to operate on non-instrumented roadways."[(13)]

In order to determine what literature should be included in this review, extensive searches were conducted of the extant general, and technical transportation literature using both manual, and computer based (including the TRIS and PATH databases) search techniques. Search subject areas included: transportation policy and public acceptance; institutional and societal issues related to deployment of transportation

technologies; focus group methodologies, and the results of focus group examinations of AHS, and related, technical acceptance. The latter is particularly important, as the literature reporting on AHS-specific focus group surveys is very thin. As such, the authors drew upon relevant public acceptance literature from associated IVHS and related technologies.

We have grouped the literature into two tiers, general and empirical. Within these two groupings, we have further categorized the literature to reflect the user/community aspects of acceptance. The first tier (general) includes literature that presents relevant information regarding the assessment and analysis of public acceptance related to AHS at a general level of discussion. The second tier focuses specifically on those empirical reports which use actual survey and focus group research. Some highlights of the review are presented in the following sections.

3.2 RESULTS IDENTIFIED

A general literature search on the public acceptance of AHS and Focus groups research structure was conducted. The research results were summarized in this report and used to structure a focus group survey instrument used in the tour focus group encounters detailed in a later chapter of this report.

3.2.1 General Literature on the Acceptance of AHS

Acceptance of Automated Highway Systems, as previously noted, categorically includes a variety of stakeholders who have an interest in the implementation of an AHS system. These can be divided into two categories, the first, includes the individual motorist, transportation professionals, private industry vendors, can be thought of individual users. The second, includes local, state and federal government agencies, and issue advocacy coalitions (e.g., environmental, legal, privacy, etc.), among others, who could more broadly be included in the category of community acceptance. Given the somewhat inter-linked nature of general studies on acceptance, the following section contrasts and compares the literature related to both user and community acceptance issues.

Many of the issues related to AHS implementation affect various stakeholders in different, and sometimes conflicting, manners. While many general IVHS studies (which include AHS) make general note of the importance of public acceptance,[14][15][16][17] and the need to conduct additional empirical studies, very few actually examine the issue at any great length. Some studies, however, discuss acceptance issues as part of a larger focus. (See references 18, 19, 20, 21, 22.)

On the physical side, most AHS research to date indicates a need for developing a faster, more precise, higher quality, and cost-effective infrastructure than is available using existing techniques.[23] Further, they comment that successful deployment of AHS is dependent upon user acceptance of technologies such as Advanced Vehicle Control Systems (AVCS), as well as such IVHS related approaches

as Advanced Traffic Management Systems (ATMS), and Advanced Traveler Information Systems (ATIS).

Turning to a more conceptual focus, the U.S. Department of Transportation (1994) *Nontechnical Constraints and 8arriers to Implementation of Intelligent Vehicle-Highway* Systems[24] discusses issues related to advancing the state of knowledge on IVHS (Intelligent Vehicle Highway Systems), and covers critical issues that should be addressed by the transportation community that are related to pricing and taxation, financing and funding, liability, standards and protocols, intellectual property, user behavior, monopolies, antitrust, legislation, jurisdiction, enforcement, and education.

The Mobility 2000 Report (1990)(=) identifies several categories of issues which could act as potential barriers to development of AHS, from either both user and community acceptance perspectives. These issue areas include: cost/market factors, safety, organizational, legal, political, environmental, and infrastructure associated. Other relevant studies of general interest include: Johnston et. al. (1990), Rockwell (1992), Schofer et. al. (1993), Saxton (1993), and Booz Allen & Hamilton (1993) (See references 26, 27, 28, 29, 30).

For example, Johnston et. al. (1990)31 observe that automated freeways (among other alternatives) have been proposed as a solution to urban traffic congestion, which is particularly of concern to the individual user. The authors describe the staged development of automated urban freeways, and then suggest a series of researchable topics related to the major policy issues of road capacity, air quality and noise, safety and liability cost and equity, privacy and organizational complexity.

3.2.1.1 *Cost Factors/Market Acceptance*

Lute et. al. (1993)* notes that while advanced transportation technologies offer numerous opportunities to enhance the safety and general performance of the nations' transportation systems, the success of IVHS approaches cannot rely solely on the quality of the technology. It is also dependent on the public acceptance (both individual and community) of the changes involved, and the public's willingness to pay for these changes, and make use of these technologies. Further, Page (1994)= notes that different sectors (which could be determined by market segmentation studies) of the public have different needs. For instance the elderly may require special accommodations which might make AHS difficult on one hand (in terms of complexity of use), or beneficial on the other (increased safety as a result of automated assistance in navigation, information, etc.)[34][35]

Although AHS promises significant benefits, it remains to be seen how test systems can be converted into publicly supported systems. Hitchcock (1994)[36] for instance, indicates that economic issues may be the most important for attracting support, but that more basic market research needs to be done to understand the specific perceptions and desires of the individual user. Other reports by the Volpe Center provide a more in-depth assessment of ATIS related market research, which is

generalizable to AHS concems.[37][38][39] Bunwell (1993)[40] comments that the proponents of IVHS need to demonstrate that IVHS technologies have a clear benefit over other approaches if they are going to “sell” the public.

However the literature on the comparative advantage of IVHS technologies over other solutions is still preliminary, and very little effort seems to have been undertaken to determine what the consumer, both the individual driver, “wants.” Lute et. al. (1993),(4’) presents a similar position, noting that IVHS programs will not be successful from any of the stakeholder’s viewpoints (user/community) if the public is not convinced that it meets real needs, and delivers real benefits.

An article on implementation of transportation innovation raises the question ‘Why is highway technology lagging behind technology in other areas of our economy and behind other advanced nations of the world?"[42] Answering his own question, the author indicates that while there are many causes for this, several critical issues deal with a lack of market incentives and opportunities, and a complex set of procedures for adoption that rely on acceptance by various different stakeholders. O'Donnell (1993)(*) provides some basic recommendations for the IVHS program, including that implementing agencies should make better use of operational tests to generate market analyses and that multiple market surveys should be done, in order to better understand markets for these technologies.

3.2.1.2 *Safety*

Safety is frequently cited as a key issue that could possibly impede public acceptance of IVHS technologies. Lasky and Ravani (1993),[44] for example, in a review of AHS literature note that safety related issues are generally cited as the most important issues affecting IVHS (and AHS) deployment. The authors compare implementation of AHS with some of the problems that faced implementation of HOV lanes such as control issues, privacy issues, and “platooning claustrophobia” (reduced following distances). Saxton (1993)(*) observes that the current manual system of highways, is at the limits of its capacity, and any increase in flow can only be safely accommodated by the move to an automated system.

Particularly of interest, with regard to safety, Johnston et. al. (1990)(@) report that the literature indicates that AHS would have to be between 10 and 20 times safer than the current highway system to be acceptable to the general public. Further, the authors argue that these difficult questions should be resolved before public acceptance for the technology can be sought. The authors conclude that policy research on these matters should be carried out before, or at the same time that, the technology is being developed.

Hitchcock (1994),[47] sees several types of potentials for system related accidents in the AHS environment. These can be avoided if the system designers carefully identify the faults that must not occur, and develop complete specifications. The most potentially dangerous situations would be “rogue vehicles”, but this risk could be eliminated through proper infrastructure design. However, as noted in the

Mobility 2000 (1990)(4) report, while careful infrastructure design can alleviate many safety issues, user acceptance and cooperation are vital.

Keller and Jovanis (1990)[49] review various risk perception studies and develop a framework for studies in the IVHS and automated highway areas. The paper concludes with some thoughts about how the experiments might be conducted, and draws from the psychological literature to argue that transportation engineers and decision makers should consider the issue of perceived risk when developing and implementing Intelligent Vehicle-Highway Systems. They note that ultimately, the usage of IVHS technology is actually affected by these perceptions, and the estimation of benefits must be adjusted accordingly.

3.2.1.3 *Environmental Factors*

An increasingly important concern both by individuals as well as by the public institutions, is the environmental effects of AHS. The wide ranging effects of environmental policies may more accurately place environmental factors under the community acceptance category. Arguments have been made on both sides about how “green” AHS is. Lowe (1994)(=) expresses the concern that IVHS, rather than being a “cure-all” for smog, traffic congestion and safety problems may actually exacerbate the problems it is supposed to solve. For instance, increasing the capacity of highways may simply shift the gridlock to secondary streets, assuming that the advanced technologies are, in fact, reliable. This may affects acceptance of AHS from a user stand point in that the AHS may have limited utility, where as from a community standpoint, the adoption of AHS might result in increased congestion across the highway network.

Gordon (1992)(51) also observes that IVHS technology is not a panacea for transportation and environmental problems, adding that while some of the IVHS technologies have a positive environmental value, overall, IVHS is an expensive, and highly complex "fix" to environmental and congestion problems. However, Shladover (1993)[52] and Conroy (1990)[53] see opportunities presented by these new technologies. Conroy comments that influences such as new attention to technological alternatives, the development of the National Transportation Policy, and landmark federal transportation legislation together offer a special opportunity for joint action on transportation, energy and air quality problems. Shladover notes that while trip reduction might be useful for environmental goals, that the mainstream view of IVHS is more oriented toward supply management. Closing these gaps in approaches and perspectives is a major institutional challenge to community acceptance.[54]

3.2.1.4 *Community/Institutional Acceptance*

As has been previously mentioned, institutional issues are in many respects the greatest barriers to successful implementation of AHS. Efforts to bridge gaps between different interests have been made. For example, a comprehensive program of research and development on advanced technologies for the automobile/highway system has emerged in California. In 1987 California began an

outreach effort to establish a multi-state consortium for research, development and demonstration (R, D&D). The following year Caltrans and the Institute of Transportation Studies (ITS) of the University of California at Berkeley sponsored a workshop in California to address some of the institutional and organizational issues involved in a national consortium.

The key issues addressed in the California Department of Transportation reference were:

- Institutional concepts.
- Funding.
- Public-private sector relationship.
- R&D and technical issues.

Shladover et. al. (1992)[55] observe that discussions of most institutional issues associated with IVHS mentions the need to develop public-private partnerships, though the nature of these is rarely defined, either in theory of practice. The authors express the belief that IVHS provides opportunities for cooperative action between the public and private sectors.

Horan and Gifford (1993),[56] in a more general discussion on inter-jurisdictional efforts highlight the managerial and staffing challenges transportation agencies will face when deploying IVHS, and the need for public support to overcome these challenges.

From a community standpoint, it is also of value to understand larger community issues. Booz, Allen & Hamilton (1993)[57] conducted a comprehensive study of the institutional issues involved in implementation of Advanced Traffic Management Systems (ATMS). The study is of value in that some of the institutional issues affecting ATMS deployment have similar impacts on AHS. The study uses a slightly broader than conventional definition of the term “institutional,” noting that the term has so many different uses that one precise definition is inadequate. The report uses as an operational definition the idea that an institution is a social structure that influences individual thought/ action, which could include laws, customs, perceptions, and beliefs, in additional to organizations, per se. The study’s in-depth review of the literature resulted in the generation of a core set of critical issues. These are:

- Expertise (available technical skills).
- Interaction of multiple jurisdictions.
- Organizational structure.
- Procurement processes.
- Funding and budgetary issues.
- Deployment coalitions.
- Marketing.
- Outreach, and acceptance.
- Benefits of the technologies (including safety).
- Environmental concerns.
- Law/regulations.

- Liability.
- Privacy.
- Public-Private Partnerships.
- Flexible Technology Design.

The complex nature of AHS will require a much higher level of coordination across jurisdictions than do current highway transportation approaches. Effective implementation will necessitate the active participation of regional transportation authorities or other planning and management bodies. However, the divergent goals of these different institutions may complicate coordination.[58][59][60]

3.2.2 Review of Survey and Focus Group-Oriented Research

The results of a substantial number of studies indicate that successful implementation of transportation related systems involves not only technical feasibility, but a thorough understanding of user behavior, as well as community concerns as embodied in public acceptance. This section of the literature review concentrates on those studies using empirical (primarily focus group and nominal group) techniques to assess the user and community aspects of public acceptance and behavior with respect to AHS, and summarizes the results of such evaluations as reported in the literature.

In looking at the literature, key issues that arose consistently out of focus groups, or other empirical studies include concerns about cost, safety, and privacy; as well as an expressed interest in travel time and related advantages provided by the systems. Tangential issues involved some concern about complexity and ease of use for these technologies.

3.2.2.1 *Cost/Market Acceptance by Users*

As observed in the general literature section, while many articles note that public acceptance is critical the literature with respect to empirical studies on public acceptance of AHS is still relatively minimal. However, as the results of operational tests of IVHS technologies are beginning to be reported, this situation is beginning to change.

Whitworth (1994)[61] looks at some of the market and development issues involved with implementation of ATIS, including a survey of experts and recommendations for encouraging ATIS development. Findings indicate that there are three potential barriers which stand in the way of market penetration of ATIS into the mass market: the cost of ATIS access, the quality of real time traffic information, and the need to demonstrate significant social benefits to justify further investments.

Turrentine et. al. (1992)[62] studied consumer reactions to automated vehicle control technologies. The underlying premise was that current users of cruise control value the relaxation benefits they gain from its use and would therefore be early adopters of more automated controls. Four focus groups were conducted, two with

avid users of cruise control and two with infrequent users. This hypothesis was not borne out, rather, avid users valued cruise control as a driving aid more than as a means to relax and thus had little interest in more advanced automated controls. Less frequent users, in contrast, were more attracted to the automated controls because of the increased safety benefits they could provide in emergencies, although the users expressed concern about reliance on this automation in inappropriate circumstances. It is hypothesized that:

1. Avid cruise control users are not a special early market.
2. Safety is the primary feature, both negatively and positively, in defining the early market.
3. Convenience is not likely to be a primary feature attracting early adopters of automated vehicle highway systems.

Pietrzyk (1990),[63] and Pietrzyk et. al (1993)[64] report on the experience of the Florida Department of Transportation in analyzing Automatic Vehicle Identification (AVI) technology. The study notes that while AVI is a potentially beneficial service, that potential will not be realized if the market does not accept it. Three types of evaluations were conducted: personal interviews, mail back surveys, and focus groups. Two focus groups were assembled, one representing commercial users, and the other representing private commuters. Commercial representatives indicated that the most important advantages were the abtility to track vehicles, and for accounting purposes. While commuters reacted positively, they were more sensitive to the costs associated with the AVI system. The reports conclude that further study and analysis was necessary for the specific technologies used.

Gourdin and Mclntyre (1992)[65] report on a study conducted in Charlotte, North Carolina that looked at the demand for IVHS across four potential market segments: consumers, commercial vehicle operators, emergency response organizations, and fixed site managers. Results of this study showed that there is a common interest in certain types of IVHS information across all groups. For example, congestion avoidance and alternative route information were cited by respondents in each group as being potentially useful IVHS services.

Serafin et. al., (1991)[66] describe advanced driver information systems that should appear in cars of the early 21st century, and proposes a method for selecting the most beneficial systems. Systems (functions) of interest were cellular phone, navigation/route guidance, roadway hazard warning, traffic information, vehicle monitoring, entertainment, in-car delivery of information, motorist services and in-car offices. Driver wants were based on a focus group study. Driver needs were assessed from the impact of each feature on driver behavior for three representative trip scenarios (work, personal business, and social/recreational). Using these schemes, features of each system were ranked from most to least beneficial. From this and other information, the first five systems listed above were chosen for further study. Features ranked as particularly beneficial provided information about roadway hazards (crash site, construction, railroad crossing), congestion traffic rules, freeway management, path control (e.g., headlight out), and trip planning.

Drawing from a related IVHS area, Schofer et. al. (1993)[67] examine issues involved in the implementation of ATIS. The authors explore the behavioral issues important to understanding traveler reactions to ATIS, and discuss evaluation strategies, including stated preference methods, and observations of revealed behavior, in laboratory simulations and field tests with various degrees of control and complexity. The paper concludes that market acceptance and driver utilization of ATIS services will determine the success or failure of a particular concept, and at present, there does not appear to be a large market clamoring to overcome congestion with new technology.

3.2.2.2 *User Perceived Safety/Human Factors*

While users indicate a desire for safe vehicles, there appears to be trade-offs involved as far as cost, convenience and safety issues are involved. The literature dealing with safety and human factors concerns is slightly more extensive than that dealing specifically with AHS technology, and is more generally applicable to user acceptance concerns. Other studies dealing with this include Rillings and Lewis (1991),[68] Boyce, Kirson and Schofer(1991)[69] and Inman, et. al (1993).[70]

An early study deals with user acceptance of airbags and other safety related issues.'[71] A telephone survey of a nationally representative sample of 1,213 individuals who drive or ride in cars obtained information about three major areas:

- Automatic safety belts.
- Air bags.
- Mandatory use laws (MUL).

It was found that the public is generally unaware of automatic safety belts and had concerns about the belts breaking down and trapping them in an accident. The majority of the public preferred manual belts to automatic belts. Air bags were preferred by the majority of the public and a third were willing to pay the estimated cost of air bags. While the protection afforded by air bags was recognized, concern was expressed about their reliability.

Drawing from analogous research in acceptance of a previous technological advance (air bags), a General Motors Corporation (1990)@) report documents the progress in auto safety practices in America, measures knowledge of some important safety matters, and points out areas where improvement is needed. By a 51 to 21 percent margin, respondent indicated that they believe air bags provide better protection in an accident than do seat belts. But sizable minorities were concerned about accidental inflation of air bags (38 percent), or that bags can trap people in their cars (35 percent). However, a significant minority of adults (29 percent) say they would pay an additional $500 for a car equipped with air bags. This shows an improvement from an earlier 1978 consumer survey which found only 14.4 percent of motorists favored mandatory installation of airbags.[73]

Brand (1990),[74] describes the results of four focus groups composed of 46 drivers of late model cars equipped with advanced information systems, conducted in Los Angeles and New York. Drivers expressed greatest interest in systems that warn of potential hazards from their vehicles or the road. There were complaints about attention being diverted from driving while operating entertainment systems and cellular phones. The need was identified to integrate cellular phone controls on the dashboard, hands-free dialing, and easier identification of key controls. There is also an interest in navigational systems, and in a system that would provide a head-up display to address safety concerns related to reading directions.

Privacy issues have also been raised as an area of concern and may run into conflict with other institutional issues such as safety. For instance, Fitzpatrick (1991)[75] states that law enforcement is considered an important contributor for maintaining traffic safety. However, limited resources, such as staff and funds, constrain the efforts of police in traffic law enforcement. New technologies such as automated enforcement may offer a partial solution to this problem. Automated enforcement devices are currently being used in the areas of speed enforcement, red-light traffic signal enforcement, and high-occupancy vehicle (HOV) lane enforcement. The author comments on potential legal and privacy issues involved with these technologies, and how lack of public acceptance could be problematic. Regan (1994)[76] further elaborates on the legal ramifications of the privacy issues in IVHS.

Further, ongoing operational field tests such as TravTek in Orlando, Florida, or ADVANCE in Chicago, Illinois, designed to study traveler behavior, are in the implementation phases, and are beginning to yield usable data. Perez et. al. (1993)[77] report that preliminary results of drivers' opinions of TravTek visual and auditory interfaces show that they are positively perceived by the drivers and that the system helps them to navigate. Also, drivers report that TravTek may have helped them drive more safely relative to an non-equipped vehicle.

Another field test conducted University of Michigan Transportation Research Institute (1992)[78] tested various automated speed enforcement devices (ASEDs) The purpose of these projects was to determine impact on speeding and speed related crashes on the ASEDs. In addition, the evaluation was to determine public opinions that may impact legislation enabling the use of these devices for speed limit enforcement. Analyses of the speed data on the enforcement zone roads show that the ASED field test had no effect on travel speeds. Indeed, the program had no true enforcement teeth (warning letters only). Slightly less than half of the licensed drivers in the two pilot counties reported knowing about the ASED pilot program, and less than one-fifth of the drivers surveyed reported actually having seen an ASED in use.

3.2.2.3 *Environmental Factors*

Environmental concerns are an increasingly recurring theme in transportation literature, though primarily as a collateral concern in terms of new system development. The implementation of AHS, interestingly enough seems to provide

both opportunities as well as costs in environmental terms. Very few empirically related studies have a design that specifically deals with environmentally issues.

Green and Brand (1992)[79] present the input from six focus group studies of drivers of late model cars equipped with advanced driver information systems. The purpose of the focus groups was to determine driver attitudes toward existing, high-technology, driver-information systems, and what drivers might want in future cars. In an earlier study conducted using focus group methodology, Nelson et. al. (1992)[80] describe the use of focus-group techniques in analyzing transportation energy-conservation program activities. The work drew upon previous focus-group studies in transportation as well as previous electric vehicle market studies.

3.2.2.4 *Community/institutional Acceptance*

A number of studies have focused more specifically on institutional issues that affect the implementation of IVHS related technologies, reporting the results of surveys or interviews with industry, transportation and institutional representatives. The studies indicate that institutional issues represent, in general, a much greater potential barrier than technical issues, and is tied somewhat to public acceptance issues.

The Booz Alien study features case studies in six metropolitan areas. Major findings suggest that overall, three major institutional impediments exist to implementation of ATMS:

- Lack of awareness and understanding of IVHS and ATMS.
- Organizational cooperation.
- Availability/sources of funding.

In addition, a summation of the literature, noted several additional areas that remain potentially problematic: legal/legislative considerations, and environmental impacts. The conclusions observe that implementation of these systems requires the coordination of various political jurisdictions as well as a mixture of agencies and departments with in these jurisdictions.

In terms of other stakeholders, Turnbull (1991)[84] reports that the Texas Transportation Institute under contract to the Metropolitan Transit Authority of Harris County (Houston) Texas, conducted interviews with representative of agencies and organizations in four cities that implemented rail transit systems:

- Atlanta, Georgia.
- Miami, Florida.
- Portland, Oregon.
- San Diego, California.

The results provide a qualitative assessment of some of the less tangible aspects of rail transit systems, and should provide insight for the practitioner attempting to understand the rail transit decision-making process.

Underwood (1992)[85] uses Delphi technique to generate a forecast on the likely pattern of development for IVHS in North America. The study looks specifically at the range of systems or technologies that are currently recognized as contributing to the development of IVHS, and for each system or technology, it forecasts the likely market penetration for relevant segments of the market. The survey followed the Delphi approach where the respondents are anonymous and where the estimates of market penetration are summarized statistically and fed back to the panel for revision in light of the group estimates. The results of the survey indicate that progress in the development and implementation of IVHS will depend on significant technical and institutional advances over the next 10 years. While the technical problems are fairly well defined, and apparently solvable, the institutional considerations were less certain. The study concludes that the most likely near-term barriers to development/implementation of IVHS were the possible lack of consumer demand for, and acceptance of these new transportation alternatives, and the failure of institutions to support the cooperative development of IVHS.

An overview of the key institutional challenges that could affect the development and deployment of IVHS/ATS technologies in California[86] was developed based on a series of in-depth interviews and review of research related to "nontechnical" constraints both in California and at the national level. The authors outline three core areas that require attention: research collaboration which focuses on public/private partnerships in the development of new technologies; regional management, and stakeholder acceptance. The report also highlights various social science methods that could be utilized in addressing these key institutional constraints. The study concludes by outlining major research implications of the findings, and provides summary recommendations for developing a broad-based, robust program in California aimed at the resolution of these constraints.

3.2.3 **Group Methodology Studies**

Practitioners of modem social science have expressed increasing interest in the use of focus group methodology to collect qualitative data.[87] This is particularly the case in evaluation research, and especially of use when investigating complex behavior and motivations.[88] Duffy (1993)[89] observes that focus groups can be exploratory or confirmatory in nature; but cautions that they may not be particularly beneficial in identifying solutions to problems. However they do produce valuable qualitative data and in contrast with Delphi or nominal group processes (which are designed to produce consensus), focus groups facilitate an open exchange of participant perceptions, opinion, feelings, or reactions.

The following studies provide useful background information in assessing the preceding empirical literature. Especially interesting, Frankel (1987)[90] addresses a subject not infrequently confronted by social researchers: identifying and clarifying a problem and then generating acceptable solutions for the problem. The techniques presented in this article are of use in considering (evaluating) multiple or alternative solutions, in order to generate more robust responses to complex policy and social-environment related problems. Another study by Morris et. al. (1994)(91) attempted to

evaluate the differential gender responses of men and women to traffic safety communication, by combining interviews with experts, and moderated focus group based qualitative research approaches. Other studies of interest that provide relevant methodological insights include Mahler (1987),[92] Gallupe and Cooper (1993),[93] Morgan (1993),[94] Delp et. al. (1977)[95] and Delbecq et. al. (1975).[96]

3.2.4 **Market Research**

As pointed out in chapter 1, an exhaustive survey of the market research that may have been conducted regarding AI-IS is beyond the scope of the present study. However, a series of studies presently being completed by the John A. Volpe National Transportation Systems Center (VNTSC) have particular relevance to the issue of public acceptance of AHS. The Volpe project is one part of FHWA's 1992 Institutional Issues Program entitled - "Public Acceptance and Markets for Various Consumer IVHS Services". The objective was to better understand factors affecting the development and deployment of selected ATISs and in pursuing this objective the Center examined the development of markets for ATIS products and services and reviewed factors affecting public acceptance and user response to existing traffic information services. Since ATIS and AHS can both be viewed as particular 'bundles" of IVHS technologies, a similar study of AHS night be expected to have much in common with the results of the Volpe work to date, and, for this reason, this is seen as an important piece of the literature on public acceptance of IVHS products and services.

Included in the review earned out by the Volpe project were the ongoing and planned operational tests of ATIS products as well as some of the related government and university research in the area of public and user acceptance. Not surprisingly, the consumer-related findings to date from operational tests were limited, mainly because the tests are primarily concerned with the performance of the products and services themselves and also because only a few of the tests are completed and have published or preliminary findings. Also, only a small number of related research efforts underway or completed at universities or tramsportation centers was found. Notwithstanding this, the study concluded that, "taken as a whole, the findings to date from the operational tests and from university and government transportation center research, provide some insight into consumer's response to ATIS products and services. Generalizing broadly, certain consumers, under certain circumstances, report themselves to be willing to purchase or otherwise access traffic and travel information (mostly en-route), to change from their habitual commutation or travel pattern in response to travel information, and, very occasionally, to change modes of transportation". It went on to say that "what is missing regarding consumer response to market demand information from the operational test evaluations is a systematic approach to collecting market research" and that "what is needed is a nationally consistent market research framework that guides operational test teams . . ..in the collection and analysis of market research information".

3.3 SUMMARY

This review of the public acceptance literature has several important implications for the study of AHS public acceptance. The overriding finding is that there is very little empirical information on AHS public acceptance per se, but a range of information of related ITS and other technology acceptance. The implication of this finding is two-fold; first there is a need to initiate research activities to obtain empirical information on the AHS public acceptance (and the focus groups described in chapter 4 are an initial step in this direction). Second, there is a need to develop a conceptual framework for understanding the dimensions of AHS public acceptance, and understanding how this may change over time.

This literature review provides guidelines for understanding possible dimensions for AHS public acceptance. Our review revealed two levels of acceptance as operative within the AHS context. The first level, “user acceptance” pertains to those potential users of the system. The literature we reviewed identified several issues as potentially affecting user acceptance; cost, safety, convenience were each noted several times as key factors in user acceptance. The second level, “community acceptance”, pertains to the acceptance needed among a variety of institutional stakeholders. While some of the items (e.g. cost, safety) have application at this system level as well, the literature also revealed a host of other items that need to be considered: institutional capacity, public/private partnerships, and environmental impacts are all items that can affect community acceptance.

Based on these and related findings, the focus groups were devised to provide preliminary empirical information on acceptance as viewed from these two dimensions. The results, reported in the following chapter, should be viewed as an initial step toward developing a more robust empirical basis to guide the AHS program.

CHAPTER 4: RESULTS OF FOCUS GROUP SESSIONS

This chapter presents the results of the application of the focus group methodology as a means of addressing the research questions of the study regarding the issue of public acceptance of AHS. The survey instrument developed for guiding the focus groups is contained in appendix A. The compositions of each of the four focus groups conducted is discussed in section 4.2. The results for each of the sessions are summarized in section 4.3. Finally, based on an analysis of these results, some policy and research implications are raised in section 4.4.

4.1 SURVEY INSTRUMENT

The purpose and overview of the focus group methodology have been discussed in chapter 2. The resultant more detailed instrument that was used to guide the individual sessions is presented in appendix A.

4.2 FOCUS GROUPS COMPOSITION

Participants for the first focus group were recruited from the list of planned attendees at an Institute of Transportation Engineers (ITE) conference held in La Jolla, California in March 1994 and the session took place on Sunday, March 20, 1994 at the site of the meeting. The composition of the group reflected the technical and transportation backgrounds of the members of the ITE community and had an environmental focus.

The second focus group was held on April 11, 1994 at George Mason University. Participants were graduate students recruited from the school's masters degree program in public administration, and were evenly divided as to gender and age. The participants were professionals with jobs in federal/local government, or with private sector firms.

The last two focus groups were recruited during August and September 1994 by Global Exchange, Inc. a professional services firm specializing in conducting targeted focus groups and consumer research. The groups were held on September 28, 1994 in Bethesda Maryland.

4.3 INDIVIDUAL FOCUS GROUP RESULTS

In the following sections we present the results of each of the individual focus groups conducted, with a narrative description of the sessions themselves.

4.3.1 The ITE Focus Group

The Focus Group moderator opened the session with some introductory remarks regarding the purpose and objectives for holding the discussions. He circulated the agenda and encouraged open participation by everyone. He noted that

the session would first consider possible attractive features of AHS, then consider possible adverse features of AHS, from the user and community perspectives, and, finally consider both research and program implications, based on the group discussions. This was followed by introductions around the table by each of the focus group members.

A representative from the California PATH program gave a brief overiew of the AHS concepts to supplement the written information regarding the program that all the participants had received prior to the meeting. He highlighted what AHS would look like in the year 2010 when the system was to be up and operating, breaking out were it was likely to be in the near term and midterm time periods between then and now. He discussed how the motivation for the program could be found in ISTEA and described some of the present activities that are underway, including the Precursor System Analyses studies and how this focus group is a part of one of these studies. Finally, he talked about the different scenarios that were being considered regarding the actual implementation of the system onto an existing highway and showed one of the Representative System Configuration (RSC) charts of such a scenario and went into some of the details in explaining the chart. He turned the discussion back to the moderator to begin the discussions.

4.3.1.1 *Discussion of Positive Implications of AHS*

The group was called upon to first talk about positive implications they felt might be realized with the implementation of AHS, both from the perspective of a user of the system as well as from the community perspective. They were reminded to consider the time frame to be the year 2010. The first concept raised was that of the safety benefits that might come about through the controls on speed. One participant did indicate that, while he would like a safer system, he didn't like the idea of taking control from the user. This speaker also raised the point that nothing on pricing and management issues had yet been mentioned. A second participant suggested that there would be more vehicles per linear foot of highway and able to go at higher speeds, inserted that the vehicles could be electric to accommodate environmental concerns. These comments caused another participant to raise the question as to what was this system supposed to deliver and what would be the minimum amount of control that would be needed. This participant would prefer, say, to have a black box that could control speed for different road conditions (an advanced cruise control device). Another comment was that a value from the fully operating system would be freedom for the driver to do other things such as reading, etc. and another suggested that the system would improve the reliability of getting somewhere on time.

However, it was pointed out that some positive things for the user may not be positive for the environment. Reading a book in a car should not be a goal of the system. There could be a conflict with spending large amounts of public money on what appears to be a system too much tied to the highway system. This participant felt it was hard to talk about this system in terms of positive and negative implications, pointing to, for example, the possibility that the mix of control and non-control vehicles on the highway could be a real threat to safety. This led to another participant raising

the point about the assumption being that we need to build on the highway system we have and questioned that assumption. This participant still felt that the system holds some hope for improving safety, but had some concern that the aging of our population could lead to some misreading of this safety improvement. A participant suggested that there might be a more “professional” use, i.e. why not put the whole thing on rails! This could provide a rapid transit function with low emissions on a good portion of the trips. Perhaps one should consider an approach where not everything lead to the fully automated system.

The point was made that the AHS sounded good for rural travel, but that in the urban setting it was quite a different thing. Others agreed that while safety improvements seemed possible, efficiency improvements could be counterproductive, encouraging more commuting and resulting in more traffic when you get downtown.

The moderator recapped some of the positive points that had been made. From the perspective of the driver or user, these included increased safety, speed, convenience, and the potential for balancing mobility and environmental goals from the users perspective. From the community perspective, safety, speed control, and increased throughput were also identified as having potential positive implications. There was a sense that the group felt that pricing was very important as a means of keeping the potential increase in capacity from simply being quickly filled up. improved productivity was also surfaced as a possible plus. There remained, however, a sense that AHS cannot go through in the form presented.

4.3.1.2 *Discussion of Adverse Implications of AHS*

Turning next to some of the negative implications, several participants offered examples including impact on low income groups, impact on short trips, the idea that not linking up with pricing is a missed opportunity, costs generally, environmental negative impacts, social disruption, and effects on land use.

The question was posed as to whether this was a publicly acceptable scenario and one response was that it would be better if AHS was developed from the user needs pull as opposed to the technology push that seems to be dominant now. Demand management was seen as also very important, whereas this discussion has all been on the supply side. The need to pursue an environmentally benign approach without negative impacts was raised. One participant asked why the public would even want AHS. Another saw the increase in vehicle miles traveled (VMT) as a show stopper for AHS. Finally, a participant asked how we get there from here. It seems we have to build on the system we have, but how do we do this? Again the need to price the system was raised, but this might be an equity issue to consider.

The moderator asked if there are users who would lose out. One participant responded that some classes or groups of people would not be able to afford the costs likely to be involved. This was followed by someone pointing out that maybe high tech vans should be the focus, in order to ensure HOVs are the winners. Another participant then said that he would like to see the H in IVHS go away. Better

to use all these technologies to deliver goods to the consumer. This prompted the remark that people like the idea of personal transportation and are not likely to give that up easily.

4.3.1.3 *Proposed Recommendations for Next Steps and Research*

The group was next asked to identify some recommendations regarding next steps and/or research areas to be pursued. One participant raised the issue that perhaps we are not looking at the entire system and that it is not just a cars/highway initiative that is needed. The whole area needs to be more goal driven and needs to have an intermodal approach. Another suggested that one should reconsider that AHS be so controlling because this could lead to unintended consequences. The potential for safety/collision avoidance seems to be worth pursuing and the public might buy into that aspect. Again the balance among safety, environment, and congestion needs to be achieved. We must not just look for an increase in throughput. Perhaps we need a paradigm shift. Rethink the transportation system of the future rather than just assume that it will be built on the present interstate system. The various tradeoffs need to be considered.

4.3.1.4 *Final Comments*

Finally each of the participants was given a chance to make a final point regarding AHS and the discussions just held. These comments included the following points:

- AHS as now configured could turn out to be a real threat to IVHS generally.
- Not clear that AHS maximizes the use of the technologies.
- AHS should be redefined taking a goals approach reflecting user needs
- Even the premise about increased safety may be flawed, noting that computers do break down.
- Planning and evaluation efforts should be sure to consider all of the potential social and environmental impacts.
- There are lessons to be learned from other technology push projects that went wrong.
- Need to build in pricing controls and to move away from Single Occupancy Vehicles.
- Concern that as presently perceived, AHS will encourage us to continue all our bad habits.
- The issue of liability maybe another show stopper.

The following table 2 summarizes the results of the focus group discussions:

Table 2 Summary of ITE Focus Group Discussions

DISCUSSION AREAS	USER	COMMUNITY
POSITIVE FEATURES	convenience travel time savings access to services	reduce congestion safety vehicle throughput speed control
ADVERSE FEATURES	low income drivers short trips HOV users costs	environment downtowns pricing initiatives short trips
COMMENTS/ RECOMMENDATIONS	AHS Principals: ATS not AHS Pricing Incorporated Publicly Acceptable Benefit not Technology Driven Balance Supply/Demand Other Comments: Reconsider Interstate Role Could have Positive and Negative Effects on Environment Threat to Environmental Support for IVHS	

4.3.2 GMU Focus Group

The focus group moderator opened the session by explaining the purpose for the research, and procedures to be used in the focus group. He then outlined the general agenda of the session, and provided some background on the AHS program. Following this was a discussion of the evolutionary nature of the AHS program, and how, as it was a fluid concept, the exact nature of the program would change as knowledge about these systems emerged. AHS was placed into the general context of IVHS. The entire AHS research project is part of a three tiered analysis of IVHS, and the present study was part of the first tier - the precursor (exploratory) phase. Following this, the second tier will define system parameters, and the third tier, will include construction of a prototype model. These focus groups are part of the exploratory phase, and center on public (that is, the users) rather than technical acceptance of these types of systems.

4.3.2.1 *Discussion of the Positive Implications of AHS*

The group opened by discussing who the various users of an AHS might be, and what types of benefits might result from adoption of such a system. The first speaker mentioned the rural long distance traveler as a possible type of user that could benefit significantly from AHS. A second member offered that commuters might be a target group, and the idea that they could "turn it on and read a book" while commuting must offer substantial appeal. Other groups mentioned included elderly/senior users, for who AHS might eliminate some of the stress of driving, and provide safety benefits; and commercial/truck operators.

The discussion then shifted to the different ways that the various identified user groups could benefit. For instance, while speed was mentioned as an attribute that would generate travel time savings, safety (especially during bad weather) was raised as a concern. Another benefit suggested might be steady travel (constant speed, rather than constant variations) which could generate general (fuel) savings, as well as reduce fatigue. This led to the comment that AHS might allow the use of larger commercial trailers, which would yield cost savings as well, or more generally, productivity increases.

The group then shifted focus toward a discussion of benefits that might accrue to the community at large, rather than to the individual user, per se. The group mentioned that an important benefit (and one which could benefit both the individual as well as the community) was reduced congestion. Other potential benefits that were offered included: reduced indirect or "support costs" such as for police, fire, rescue, etc., as well as reduced aggregate insurance costs. The ability of a user to travel more safely, and rapidly could lead to the development of communities further away, which suggests that AHS also has potential for driving economic development in outlying areas.

The moderator noted that further examination of AHS could conceivably raise a variety of questions as well as providing solutions. For instance, congestion could be affected either way (more or less) by AHS. The use of such large scale type planning tools as HOV lanes, could be either encouraged or discouraged by the use of AHS. Looking at safety issues, the degree to which AHS differentially affects individuals, children or elderly needs to be determined. Environmental issues such as the potential for increased traffic come into play when looking at AHS. One group member commented that the case might occur where the perceived increased safety and speed of the AHS system might pull more cars on to the highway and increase pollution. Put another way, AHS prove to be a disincentive to ride mass transit. One speaker raised the concern that it was difficult to access some of the actual results of the benefits meaning that there was a high degree of uncertainty present.

The group then generated a list of the most important impacts of AHS or “Hot Buttons”. These included:

1. Reducing congestion.
2. Potential for increased safety.
3. Cost savings.
4. Environmental effects.

4.3.2.2 *Discussion of Adverse implications of AHS*

The group then looked at some of the potential barriers that might exist to implementation of AHS. Considering the case of the individual user, one group member mentioned human factors elements, such as driving practices. Specifically, the observation was made that different individuals have different levels of driving skills, and different abilities to react to changes in the highway environment. Concern was expressed about the potential problems with transitions into and out of the system, which could be anxiety provoking, as well as difficult. Another member observed that while the AHS was a great idea, cost considerations were an important factor to consider. For instance, how expensive would it be to either install AHS technology as new system, or taking an approach that required retrofits. In addition, it was noted, if the costs to the users were too significant, then there would be little use, which would apply to both the individual user as well as the owners of a small business, or fleet of vehicles. Another human factors issue involved the degree of how conducive the technology was to non-technologically oriented users, or “user friendly”, with a focus on what types of interface might be employed. A core concern was that the system be easy to use.

One participant expressed a concern about the potential for catastrophic (system) failure, by speculating about the results of a system “crash”. For instance, what if the control box or electronics was “hit” with electrical lighting, and got knocked out. Another member speculated that without adequate security measures someone might “tap into the system” either for "fun” just to see if it could be done, or for other purposes (i.e. terrorism). Other less serious security problems include methods of preventing system "crashers/violators"; and what level would the enforcement and liability issues be dealt with? One member raised the question that if the system malfunctioned would liability be with the operator of the AHS or the operator/owner of the individual vehicle?

Turning to the area of potential adverse effects to the community, a group member raised the issue of the effect of this type of system on the use of mass transit, such as rail systems and Metro’s. Would high degree of use of the AHS erode the use of mass transit and ultimately weaken ridership to the point that it would be no longer viable. Would this system go in the opposite direction of the goal of “getting people out of their cars”, making HOV obsolete, or discouraging compliance? Thus, promotional issues were considered to be important. Another participant questioned the equitability of AHS, specifically how equitable access to the system

could be assured. Would the situation exist that only the wealthy could afford to use the system while other people sat in lines of traffic?

Looking at the broader picture, one participant wondered about system capability, and jurisdictional questions, and whether it would be possible for a proposed system to be linked/interfaced with systems in other states, invoking the systems architecture/ compatibility issue. One member made an analogy to a worse case type situation with the AHS being equivalent to the VHS vs. Beta competition, where an expensive system might “shut down” upon crossing state lines into another system with a non compatible systems architecture. This raised the question of the role of the locality in governing/regulating or managing the system, which one member referred to as the override problem. Should the locality have any say in the system operations, or would it be like the case of the interstate that just comes through? Further speculation about system access led to the related concern of not only lane changes, but system termination, that is, what happens where the system stops and the regular highways begin?

Another aspect of the larger picture had to do with the environmental effects. One member imagined the “visual pollution” resulting from driving into a large city and coming over a hill to see twenty lanes of spread out highway.

4.3.2.3 *Proposed Recommendations for Next Steps and Research*

Finally, a general review was made of the potential benefits and adverse effects that adoption of an AHS might have on both individual users as well as the community. The group was asked to make specific focused recommendations that would be of use to policy makers/designers of an AHS system.

The first recommendation that arose was the need to keep environmental issues in mind. Any system that is adopted should be environmentally “friendly”, that is, it should promote (or at least not discourage) the use of altemative vehicles, and allow for the provision of visually attractive landscapes, and minimize additional pollution.

The next recommendation dealt with cost. Any system should be cost-effective, and attempt to minimize overhead “system costs” to the user/taxpayer. Do we need another expensive “Metro System”?

The safety issue was addressed by noting the linkage between safety and user friendliness. This might reflect of human factors and the design of systems “architecture”. Systems need to have “fail safe” or system redundancies built in to ensure confidence and system reliability.

In terms of public acceptance, the group recommended that the system must be demonstrably better to justify the cost, both in terms of economics as well as time necessary to implement a new system. Designs must pay attention to the needs of the users, and be addressed before the system is implemented. This would suggest

that a well designed educational/promotional effort must be undertaken to familiarize the end user with the advantages of the system.

The group was then directed to focus on the shape or direction research efforts might take in the development of AHS. The first comment offered dealt with what the speaker termed the toy factor," and whether AHS is a reasonably valid proposition or just another "toy" for policy/finfrastructure developers. Has a real need been established for AHS or is it merely a "neat concept"?

Another question dealt with willingness to pay, both as a consumer, and as a taxpayer. Even if the user is willing to use such as system, are they willing to pay the costs for such a complex technology? Related to this was the cost concern. Are the cost savings real? Do they occur over the long run, or are they short term in nature. Are they incentive based in nature, that is, do they seek to shape or transform behavior?

"Willingness to learn" was raised as an issue. WiII the public accept such as system? What is the tolerance/ability of individuals to learn a transportation system which may only be a marginal improvement. What are the various freedom/privacy issues, and how are they to be addressed?

Another member suggested that a question to be explored was "Is there a real need for such a system"? Especially as compared to the needs of other types of transportation related systems. What models will be use to determine how such a system would be developed. Further, who are the players involved in developing and implementing systems. Do they have other interests at heart" or might they have different agendas, for instance are they more interested in "torpedoing the project. (i.e., auto to electronics trade-offs).

Given that public acceptance is critical, what are (or should be) the various incentives for the users for the users to adopt or try the system? For instance might there be market based approaches such as reduced insurance premiums for the use of such a system? Another side of this is who are the "winners and losers?" Who is and isn't going to be able to use this system?

Looking at more technical issues, can the system be upgraded or modified, or is it "locked in" because of complexity of technology or liability, institutional issues? This may be related to determining the goals (design or otherwise) of the AHS system. Should it be optimized to improve commuting flow/use, or is it oriented toward creating a smooth throughput" for distance travelers? How should the system architecture deal with system compatibility issue? Drawing from other analogous or related type tests, experiments, or implementations, we might ask "What lessons can be learned from these?"

4.3.2.4 *Final Comments*

In summary, the conclusion reached indicated that any implementation of AHS should attempt to involve a broad a support base of users as possible, both from a political, as well as economic rational. Further, the aftermarket for such items needs to be considered. Other issues that were raised, which are very important include the legality/ privacy/ equity issues involved in the implementation of AHS. Externalities were raised as an issues, for instance who pays the costs and who benefits. The environmental issue needs to be addressed in terms of externalities such as visual pollution, which while difficult to quantify, is a very real concern. Finally related to equity issues, such as who benefits on a user level, are equity issues that relate to community and economy development concerns. For instance, which roads would be improved, and who decides.

The following table 3 summarizes the results of the focus group discussions:

Table 3. summary of GMU Focus Group Discussions

Discussion AREAS	**USER**	**COMMUNiTY**
Positive FEATURES	Convenience Time Savings Fuel Savings Access for Rural Drivers	Reduced Congestion Lower Costs Lower Insurance Economic Development
ADVERSE FEATURES	Discourage HOV Access for Low income/Ekierly	Decreased Support for Mass Transit Environment Visual Pollution
COMMENTS/ RECOMMENDATIONS	System Egress/Ingress Costs of implementation Catastrophic Failure Education/Promotional Efforts Survey Consumers System Should Stress Safety	

4.3.3 **Third Focus Group**

The third Focus Group was held at marketing research facility in suburban Washington, D.C. After brief introductions, the moderator introduced the agenda and

provided a brief overview of the AHS concepts, and the projected AHS research and deployment agenda for the next several decades. He presented a slide of a representative scenario, and described aspects of various alternative scenarios in some detail. The session then moved into the first section on positive implications of such a system.

4.3.3.1 *Discussion of Positive Implications of AHS*

The first response to the moderators request for users oriented positive aspects of AHS was that the system had to be cost-effective, especially in terms of cost per vehicle. A second participant felt that the system should be successfully implemented, on a system-wide basis. One indicator of this would be, for instance, if the system yielded improved gas mileage, or reduced repair/maintenance costs. Another group member added that the system needed to be user-friendly, and that this was especially important in terms of system response to individual user needs. A variant of this was the expression of interest in the system being "seamless" so that it could be readily navigated from one system to another, or from the system to non-system highways.

A critical issue for the group participants was that of system safety/reliability. AHS would be of great benefit if it reduced accidents, but it was noted that for the system to be effective it would probably have to be "like airbags", that is, it would have to be widespread, or required. Further, the system, would also have to take into account other vehicle users such as truckers and busses. A related concern was that the system had to be secure, in that it could possibly prevent thefts as part of the underlying system control. **Liability** issues were raised with a short discussion occurring about who would have liability for the "AHS unit" in the event of failure, the manufacturer, the system operator or the government (if they were different), or the individual user.

One benefit that seem to be of consistent appeal to the participants was the convenience potential, ". ..it would be great if you could just get in a car and let it go." The possibility of being able to do work during the trip was seen as appealing. Another member said that he would like to be able to take a PC and mobile phone, and use the car as a mobile office. While generally comfortable with the concept of a totally automated system, some of the participants expressed reservations about transitions into or out of the system, or with systems that allowed the mixing of automated and non-automated vehicles.

The issue of system operation, such as mixing vehicles, led to questions being raised about whether the system should be an "ail or none" type of arrangement. One participant expressed the opinion that one public response might be that "the other guy was the problem," and that the system design should take into account different levels and types of drivers or vehicles. This led to the issue of control in general, with at least one member of the group noting that they were a little worried about 'not being in control" of their vehicle. A brief discussion ensued with respect to the balance between mandatory control and driver control.

The moderator asked that the group highlight or determine which of the issues raised should be emphasized as the most important aspect affecting individual user acceptance of AHS. The responses included safety and reliability of the system; ability to maintain a degree of control of the vehicle, and that the system be “user--friendly”, and easy to use.

Next, the participants were asked to focus on desirable system features that would promote acceptance from a community perspective. The first item raised was the idea that an AHS system should alleviate congestion, and yield an overall improvement in traffic, in general, and not just benefit a few. This led to a discussion about equity issues, with at least one group member expressing the concern that a similar condition to HOV not arise--that “everybody pays taxes, but that not everybody gets to use the system.” Further, it had to be inexpensive enough so that everybody could use it, and not exclude groups, such as the elderly who might not be able to afford it.

The discussion then moved to system configuration considerations. Several members expressed the opinion that in order to properly assess the benefits to a community, it would be beneficial to get more concrete details on system design and configuration, such as how it might work Depending on design and level of acceptance, it might lead to insurance cost decreases, especially if safety was improved as a result. The group then expressed a concern that the system might have to be mandatory to work. it was speculated that the system might not work properly if a system configuration mixed automated and nonautomated vehicles. Conversely, a mandatory type system might have difficulties being accepted by the public at large. The examples were raised of seat belts and airbags which required that laws be passed to make them mandatory before they were generally adopted.

This led the group to consider the difference between user and community benefits, and whether the general level of benefits to the community would merit the public costs involved. The group raised questions about who would pay for the system, the public (e.g., local, state and/or federal entities) or the private sector (which could be the individual user and/or manufacturers). It was observed that if a high initial cost was included as part of the vehicle cost, the consumer might be more accepting of the overall system cost.

Additional benefits were perceived to be possible in terms of community development. Several members speculated that such a system might encourage or allow community/economic development to occur more widely. This could be beneficial or not so beneficial (as one member noted).

In terms of what the group deemed the most important elements, the members expressed the sense that while a system had to achieve a balance between safety and speed/efficiency, that the system needed to focus on safety considerations.

4.3.3.2 *Discussion of Adverse implications of AHS*

The moderator asked the group to consider features of AHS that might act as barriers to public acceptance of AHS. From the user perspective, the first point raised was the system could have significantly high costs both the individual and the community. Further, in terms of usage, the group speculated as to whether light or occasional users would benefit from the system, given the costs involved. One member then raised a concern about incremental development costs. He observed, that while the system costs might initially appear reasonable, as the system was implemented costs could spiral out of control. Another concern raised along the cost theme was that of paying for the system. A participant wondered if the system would be paid for by subscription, similar, for instance, to the way that car phones are currently used. And, if this were the case, could the cost be expected to drop, or would it remain the same.

System failure was a concern of group members. This came in several different contexts. How would the system handle catastrophic, system wide failure. Perhaps as important, the group wondered about how the system would handle failure by an individual vehicle unit. Related to these concerns were reliability issues, that is, if the system weren't completely predictable, user acceptance would be low.

When asked to highlight the most important potential barriers to user acceptance the participants listed costs, for the user as well as in terms of infrastructure, and the possibility of system failure as strong candidates.

In terms of barriers from the community perspective, the initial response from the group centered around environmental effects, especially those of noise, and other un-intended impacts to the environment. Other potential barriers that surfaced were the possibility of system overload (too successful), the problem with interconnection to non-system roads, and the possibility that the AHS system might discourage use of the less expensive and useful HOV system.

A discussion occurred, centering around cost issues, and raised questions about what the ultimate cost would be both to the individual and to the community. Further, the system was viewed as being potentially subject to the many problems that occur with adoption of new or innovative technologies. Related to this were concerns expressed that a too rapid adoption could lead to implementation of the "wrong" or outdated technology, or systems that were incompatible with other systems. This is especially the case given the tradeoff between technology driving down cost, and the desire to obtain newer and "better" technologies. The group also considered the possibility of urban sprawl and disruption to the community while the system was being built. This led to a discussion about equity issues, and who might be "losers" or "winners" if AHS systems were adopted.

In general the group indicated that costs, both initial and incremental, and the compatibility issues, either with other systems, or in terms of automated and non-automated vehicles, raised the greatest potential barriers.

4.3.3.3 *Proposed Recommendations for Next Steps and Research*

The moderator next requested suggestions and recommendations for possible policy/research actions which participants felt were generated from the discussions. The first response was that planners should implement an upgradeable technology plan, one that was upwardly compatible as new technologies or improvements were developed. Another recommendation was that as the systems were being tested that consideration be given to efficiency, safety, and overall system benefits.

In terms of public acceptance, the question was raised as to who would use the system, and what market research needs to be done to determine the specific market for AHS. Further, it would help to determine if there is in fact, a sufficient market demand for AHS. Another question that needs examining is what the proper mix of financing and involvement is, including the appropriate levels of private and public input. Lastly, privacy issues were raised, and the concern expressed, that the system not be "used" against the user.

4.3.3.4 *Final Comments*

The moderator then solicited any final comments regarding AHS from the group. These following points were raised:

- Safety features are important, but not if they require a trade-off with speed.
- What are the other investment alternatives (especially for "other people" who are not using the system)?
- Excellent concept, as long it generates improvements.
- AHS looks like a great idea, but it may not be cost-effective.
- There are still many environmental issues to consider.
- What is the "Bull" to benefit ratio?
- Too fuzzy. Safety is important, but how will it be implemented?
- Conceptually great but more studies need to be done.
- Its in the dream stage. More fixes need to be made to existing roads.
- Concerns need to be addressed before they start "digging roads".
- The technology is "here" it just needs to be put together.

Table 4 summarizes the results of the discussions for the third Focus Group soliciting information on public acceptance issues for AHS.

Table 4. summary of Focus Group 3 Discussions

DISCUSSION AREAS	USER	COMMUNITY
POSITIVE FEATURES	User Friendly Safety Reliability Cost/effective Convenience Decrease insurance	Decrease congestion Increase safety Equity Broad based Elderly
ADVERSE FEATURES	High costs Catastrophic failure Privacy concerns Repair costs	High costs Spiraling costs City/suburbs/rural interface
COMMENTS/ RECOMMENDATIONS	The bottom line is costs Need to plan with a view to upgrading as technology expands Testing\Demonstrations are very important Need to develop data on key issues such as safety and congestion Need to identify who wants\needs this system - market issues Need to involve the private sector Be sure it does not become “big brother"	

4.3.4 Fourth **Focus Group**

At the same Maryland market research firm, a fourth Focus Group on AHS public acceptance was held. As in the other sessions, the moderator began with a discussion of the agenda and a brief overview of what AHS concepts were and how it was planned to be developed and deployed over the next several decades. He showed a slide of one of the various scenarios that are being looked at in terms of how the system might be actually implemented on a segment of highway, and

discussed the aspects of such a scenario in some detail. The session then moved into the first section on positive implications of such a system.

4.3.4.1 *Discussion of Positive* Implications *of* AHS

The first response to the moderators request for what might be positive aspects of AHS from the users point of view was that the system had to be safe in terms of no malfunctioning. A second participant felt that the costs had to be reasonable. Another group member added that not only did the costs have to be reasonable, but the benefits had to justify the costs as well. A concern about environmental impacts was raised, but it was agreed that this would come up later when the discussion was on the community perspective. At this point there was some discussion about what the cars would look like and some of their characteristics in terms of energy supply, and this lead to the identification of the need for training and education for the drivers .

The issue of urban versus rural usage for the system was raised by a participant, who pointed out that it would probably be first used on freeways. It had to be hassle-free and convenient, user friendly, and not too controlling. A participant raised the question of why do we want such an automated system, which again brought out a discussion of control aspects and whether it should have a balance between mandatory control and choice for the driver. The issue of choice was considered important by many of the participants.

Security of the system was discussed in some detail. There were concerns raised about the ability of non-AHS equipped vehicles being able to sabotage the whole process. The fact that computers do go down was mentioned. The distance between vehicles in a platoon raised concerns in terms of a driver error, such as forgetting to get off the system or falling asleep in his vehicle.

It was generally agreed that trucks and/or busses should have separate lanes and that some priority should be given to HOV on the car lanes. A participant made the point that a blowout on an eighteen wheeler could be **disastrous,** and asked how the system would deal generally with the issue of the condition of the vehicles using the system.

The moderator at this point asked for some of the more important issues from the above discussions in terms of user perspectives on what the system would have to have to be accepted. The responses included safety, need to get you where you were going sooner, convenient and user-friendly, and security of the system.

Next, the participants were asked to suggest features the system would have to have to gain acceptance from the community perspective. The first item raised was that it would need to be cost-effective, meaning that it must be better than other options that might be available (such has more highways or mass transit). This brought out the idea that it should alleviate congestion. One participant felt that it could lead to cleaner air and less pollution since it would mean less stop-and-go traffic and, therefore, less energy use. It could be a drawing point for a community economically.

There were concerns raised about where the funds would come from for operating and maintenance costs and whether there would be unexpected or hidden costs for the community. Standardization would be important so that the system could be used nationally and not just regionally.

In terms of what would be most important, the participants zeroed in on cost-effectiveness, environmentally positive, and no hidden costs.

4.3.4.2 *Discussion of Adverse Implications of AHS*

The moderator next lead the group into a discussion of the flip side, that is the features of AHS that would likely be barriers to public acceptance of AHS. From the user perspective, the first point raised was the danger posed by possible human error such as pushing the wrong button or suffering a heart attack while on the system. Next, privacy issues were seen as a potential barrier, i.e., the system would likely be keeping all sorts of records and, if a large data base is collected this could lead to unintended privacy infringements.

Costs were cited as a possible threat to acceptance. Again, the issue of other options came up. Also, concerns were raised regarding the availability of the system, that is, would the system be overcrowded and therefore not always available to the driver when wanted for use. Security of the system was also mentioned as being important.

When asked to highlight the most important potential barriers to user acceptance, the participants listed:

- costs.
- Availability.
- Convenience to the driver.
- Infrastructure Issues as candidates.

In terms of barriers from the community perspective, the first one identified was costs, especially costs to taxpayers for something they are unlikely to live to see. Also, unexpected costs are often kept from the public, and maintenance costs are usually underestimated. Next, the group again raised the question of why we are going this route vis a vis other options.

Environmental implications were mentioned as possible barriers to acceptance, in the sense that it could be that this system will, in fact, increase air pollution rather that decrease it. There were also concerns about land use issues, such as urban sprawl and disruption to the community while the system was being built. One participant expressed the view that local communities could lose their identities to the system. The issue of equity was seen as an important potential down-side from the community view.

In terms of what were seen by the group as a few of the most important barriers, costs, environmental impacts, equity, and the quick obsolescence of technology were suggested.

4.3.4.3 *Proposed Recommendations for Next Steps and Research*

The moderator now solicited suggestions for possible policy and research actions which participants felt were indicated from the discussions. A first response was that other options should be looked at. For example, mass transit should be cheaper, but it is underused. The survivability of SOV was questioned. Pricing was mentioned as a way to encourage use of mass transit, i.e., if gas prices went way up, more people would use transit systems.

The issue of the need for the system was raised, as well as the issue of who wants the system. What evidence is there to support the belief that there is a market demand for AHS? The technology may change, and the system talked about today may be much different.

Safety issues need to be further researched. If there are really big safety benefits then these might translate into insurance costs going down. The system, as described would most likely be good for long distances and the cost-effectiveness of this use should be studied.

4.3.4.4 *Final Comments*

Finally each participant was encouraged to make a final point regarding AHS and the discussions of the group. These comments included the following points:

- The price of gasoline should go Up to encourage a shift to mass transit.
- The AHS concept was an absurd idea.
- There is a need to develop economic incentives to make it attractive.
- AHS looks like a great idea, but costs must be kept down.
- There are still many environmental issues to consider.
- Anything that makes life easier would be welcome.
- If the costs, safety, and environmental issues can be resolved, AHS is a very exciting concept.
- Other options and possibilities should be pursued.
- In the short term, increased safety from AHS would be welcome.
- In the long term we need to get away from the automobile.

Table 5 summarizes the results of the discussions from the fourth Focus Group for AHS public acceptance.

4.3.5 Sample Quotes from Focus Group Sessions

The following list of statements made by participants gives a sense of the breadth and scope of the issues that the focus group discussions raised.

4.3.5.1 *User Perspective*

"1 already use my car as an office. If automated highways can help me use it that way, then that's great."

"I'm from New York and I like anything convenient. I like microwaves and fast food. 1 will like automated highways if it makes my life more convenient."

"Saving a few minutes in time would not be a major advantage; saving lives would be, though the system should do both".

"1 would like a safer system, but 1 don't like the idea of taking control from the driver."

"It sounds to me like the system would improve the reliability of getting somewhere on time."

"It has to be hassle-free and convenient, user friendly, and not too controlling."

"What if there is no room to get on and I have spent all the money for the car?"

"1 think that, as presently perceived, AHS will encourage us to continue all our bad habits."

"We need to build in pricing controls and to move away from single occupancy vehicles."

"It sounds like AHS could prove to be a disincentive for riding mass transit."

4.3.5.2 *Community Perspective*

"Positive things for the user may not be positive for the environment. I don't think reading a book in a car should be a goal of the system."

"You definitely have to have separate lanes for trucks and buses"

"1 think this is great but costs must be kept down and it must not be bad for the environment."

"If there really are big safety benefits, wouldn't this mean that insurance costs could go down?"

"If an automated highway system is just going to save a few minutes than it's not worth the costs."

"If costs, safety, and environmental issues can be resolved, this would be exciting"

“It sounds good for rural travel, but in the urban setting it would be quite a different thing”

“You know, computers do go down.”

“Who is going to pay the long term operating and maintenance costs, and what about unexpected costs that always show up?”

“How do we know if this is better than other options like mass transit or even bigger roads?”

“If the system malfunctions, would liability be with the operator of the AHS or the owner of the individual vehicle?”

“This system will likely be keeping all sorts of records and, if a large data base is collected I think it could lead to unintended privacy infringements”

“The AHS concept is an absurd idea”

Table 5. Summary of Focus Group 4 Discussions

DISCUSSION AREAS	USER	COMMUNITY
POSITIVE FEATURES	Safety (failsafe) Reasonable costs User-friendly Convenience Decrease congestion	Cleaner air Uses less energy Economic benefits Less congestion Cost-effective
ADVERSE FEATURES	Dangerous Human failure Privacy issues costs Loss of control	High infrastructure costs Environmental Increased traffic Equity of costs Regional Cooperation
COMMENTS/ RECOMMENDATIONS	**Need** to look at other technology altematives. Costs and environmental issues will have to be resolved. Need to encourage more intermodal usage. In the long term we need to get away from high SOV. Standardization needs to be built in. Congestion pricing should be used to encourage demand management. Need to study the economic implications, especially as compared to other investments.	

4.4 POLICY AND RESEARCH IMPLICATIONS

As pointed out earlier, the purpose for conducting these focus groups was to collect data that could provide insights into the answers to several of the research questions of the study. Specifically, the questions were:

- What attributes of AHS are likely to affect user acceptance, and how do perceptions vary across different segments of the public?
- What attributes of AHS are likely to affect community acceptance, and how do perceptions vary across different segments of the public?
- What research and policy actions could be taken to ameliorate public concerns and/or enhance public acceptance of AHS?

The focus group sessions were designed to lead the discussions through each of these questions. Based on the results, as described above, each of the individual sessions were successful in developing information relating to the questions. They each identified lists of features that they saw as likely to affect public acceptance of AHS and even suggest which ones were major. They were also able to surface these features from the different pespectives of the user and community, which confirmed our belief that this is an important distinction and one that should be given attention in future work. Finally, each group was able to identify both policy and research activities for consideration.

In each focus group, the full range of issues and concerns that have been raised in the literature and other **sources were surfaced,** although the emphases on specific issues varied considerably across the groups. Thus, while in one group the issues regarding potential environmental implications were discussed in great detail, other groups noted these issues, but devoted much less time to them. Issues raised did, as expected, differed when viewed from the user or community acceptance point of view. Regarding the former, for example, several possible advantages were raised such as safety and convenience, but so were corresponding concerns such as about catastrophic failure. Regarding the latter, while participants thought the system could be deployed in a way that would encourage multi-modal transportation use, there were concerns about possible effects on urban sprawl, etc. An overriding concern among all the groups was the cost of such a system as compared to the benefits it could provide to a user or a community.

In terms of a methodology, the focus groups demonstrated their value as a mechanism for soliciting public acceptance issues regarding AHS. They revealed a variety of issues that could form the basis for more sustained follow-up research, such as survey research. One disadvantage of the focus group methodology in this instance was the limitation for dealing with such an abstract concept like AHS. Perhaps the use of actual simulators in conjunction with the conduct of a focus group session would provide a useful mechanism for eliciting public reaction to more tangible

aspects of AHS. Finally, there are program implications for how to best incorporate public opinion research within the context of a technology driven program.

Table 6 provides an overview of the various issues that were raised in the focus groups, along with whether the issue was viewed as a positive attribute (+) that would enhance acceptance of AHS, or whether the issue was viewed as a barrier (-) to such acceptance,

Table 6. Examples of Positive Attributes and Barriers to AHS From Focus Group Sessions

AHS FEATURE	USERS	COMMUNITY
Reduce Congestion	+	+
Safety	+ ,-	+ , -
costs		
Increase in Vehicle Use	+	-
Air Quality	+ , -	+ ,-
Convenience	+	
Equity		

LEGEND:
+(positive) = potential for enhancing public acceptance
- (barrier) = potential for constraining public acceptance

The table reveals several interesting, and we feel, important points. First, some of the features identified are viewed as both potential positive enhancers and barriers to the deployment of AHS. And, this dual nature of the feature can surface both from the user and/or the community perspective. A good example of this phenomenon is the feature of safety. While both user and community perspectives saw increased safety as an important and, in fact, likely crucial factor in promoting public acceptance of AHS, at the same time, the potential of what was perceived as a possible 'catastrophic failure" of such a high-tech system was also identified as a major concern. A second finding is that some features emerge as being viewed as positive from one perspective and as a barrier from the other. The potential for an increase in the availability for vehicle use, for example, was seen as a plus from the users perspective, while seen as a minus for many from the community perspective, leading as it might to a reemergence of congestion and environmental problems.

In some instances there is common agreement on the nature of the feature from both perspectives, and, this can be in either category. For example, costs clearly surfaced as a potential barrier to public acceptance of AHS both from the users point of view as well as the community. This is not surprising, since there are different

costs involved. As a user, most participants felt that the in-car equipment costs would fall directly on them. However, from the community perspective, there were concerns for the added costs likely to accrue from the deployment of the system itself, things like infrastructure costs passed onto the taxpayers as a whole. What this does highlight, however, is the importance of the user/community distinction, because it points that an AHS system “sold” to the community may very well “not” be deployed if it does not have sufficient tangible benefits for the users as well.

Some features were only raised form one or the other perspective. Convenience was seen as a potential plus from the users view, but did not surface when the discussions were from the community perspective. Likewise, Equity of an AHS system was raised when the community perspective was being focused on, not when the focus was on the users.

The issue of environmental quality was raised by all groups, though the importance given to it varied. In one focus group, which included several environmental professionals, the issue of environmental quality was the overriding concern. The opinions of this group were decidedly mixed. Some saw potential environmental gains through the appropriate application of AHS; others viewed AHS as a definite threat to environmental goals. In the other groups a more general concem was expressed about how any transportation improvements (such as AHS) would need to be consistent with environmental concerns.

The groups had little difficulty in identifying a wide range of potential actions that could be taken to enhance public acceptance of AHS or address some of the public concerns seen as barriers. A number of these policy actions surfaced in more than one of the group discussions. The groups were also able to articulate a number of areas and issues where further research appeared to be required before certain decisions should be made. Table 7 summarizes some of the areas cited by the different focus groups.

Table 7. Summary of Suggestions for Future Research and Policy Activities

• Demonstrations of system safety are very important to convincing potential users of its safety.
• Marketing studies should be undertaken to determine who needs/wants this system.
• Success will depend on the ability of the program to involve the private sector so as to ensure market/cost sensitivity.
• AHS should be structured taking more of a goals approach reflecting both user and community needs.
• AHS needs to be considered in light of other approaches (e.g., congestion pricing) for managing travel demand.
• Policy makers need to review all other alternatives and possibilities in reaching decisions.
• Planning and evaluation efforts should take into account all of the potential social and environmental impacts.
• Lessons learned from other technology push projects that went wrong should be identified and utilized.
• Policies must be implemented that will address the many privacy issues that the system is likely to generate.
• There may be a need to rethink the transportation system of the future rather than assume that it will be built on the present interstate system.
• Research and Evaluation studies should focus on a broad range of potential social and environmental impacts.
• Need to collect and analyze data on many of the key issues such as safety and congestion implications.
• Need to research in greater detail the potential economic implications of AHS as presently configured.

In summary, the focus groups we conducted were able to provide considerable input data for answering the research questions. While limited to only four groups for this study, it nonetheless appears to confirm that the focus group methodology is useful for generating important data relevant to the public acceptance issues surrounding the potential for successful deployment of AHS.

Several conclusions can be drawn from the findings discussed above. First , the focus groups demonstrated that public acceptance has both user and community

elements that need to be considered in the design and deployment of AHS. User elements are key for any consumer element of acceptance. Community elements are important for general taxpayer acceptance as well as interest group acceptance. Second, many issues surfaced and many suggestions were made for future policy and research activities, and these need to be considered seriously. Third, the focus group methodology is an appropriate one to add to those methods already known for identifying important issues regarding public acceptance for developing technologies such as those in AHS. Also, the instrument developed for this study has proved useful in generating the information desired. These lead to the following recommendations :

- The Consortium should establish a research and development Program to address institutional and public acceptance issues related to AHS.

The overall recommendation of the study is to develop a multi-faceted research and development Program to deal with the variety of institutional and public acceptance issues that will affect the deployment of AHS. While the technical aspects of AHS are daunting, acceptance of these technologies is vital if the program is to be successful. Therefore, the Consortium needs to initiate a series of research and outreach activities aimed at addressing key interests and concerns of various institutional and public stakeholder groups. Based on the findings of the public/institutional acceptance focus groups and the Itierature review, we recommend that this Program include - at a minimum -- the following components:

- The Program should conduct a detailed assessment of the range and magnitude of interest and concerns across stakeholder groups.

The focus groups we conducted provide a preliminary assessment of the types of issues that are of major interest and concerns to some stakeholders. In particular, they demonstrated the benefits--such as safety and convenience--that potential early adopters may perceive as possible through AHS. They also demonstrated the pervasive cost and environmental concerns associated with the system. However, these findings are exploratory; a more rigorous and exhaustive inventory of public acceptance issues is needed to firmly establish the baseline upon which AHS activities can build. This baseline should include an understanding of both the potential early users of AHS, as well as the concerns of key constituencies (e.g., environmental groups).

- The Program should assess the influence of new information and/or direct experience on institutional and public acceptance of AHS.

Both the literature and focus groups revealed some low level of awareness of AHS. As such, the aforementioned baseline will provide an indication of the initial reactions of stakeholders to the prospects of AHS. It will, therefore, be important to know how these opinions are affected by new information, such as will be developed by the Consortium. There are a variety of research and outreach methods that can be used to gain this understanding. From the research perspective, in addition to further

use of focus groups, there are at least two other techniques that should be useful to this end: deliberative polling and the use of simulators. Deliberative polling involves the sampling of citizen representatives and immersing them in a substantive area while polling their reactions. Use of simulators, a more common technique in transportation, involves simulating an AHS experience, and then querying participant reactions to this experience. These and related research methods could provided a more in depth understanding as to the extent to which initial reactions are confirmed or modified by subsequent experiences.

- The Program should develop an outreach strategy that builds upon (the above) public acceptance findings, and in doing so, attends to the interests and concerns of a broad range of stakeholders, from AHS champions to AHS adversaries.

The conduct of public and institutional assessment research should inform the design of an AHS outreach strategy. This strategy should be sensitive to the original concerns of stakeholders, while at the same time understanding the core concerns that may arise among informed stakeholders. Moreover, it should target strategies for both champions and adversaries alike. However, one important impact of the research should be on the structure of the program itself; that is, key concerns should not just be dealt with via a public relations approach, but addressed in the technical program as well. For example, the concerns about costs and environmental quality that were raised in the course of this review, should be the subject of intensive analysis, so that information about these areas can be communicated in a credible manner.

Incorporating public acceptance research will help ensure that AHS development will take into account the features considered important from a user and community perspective. Nonetheless, the challenge of doing this is considerable, given the strong technology-dnven orientation of the AHS program. Special mechanisms will therefore be needed (through the AHS Consortium or U.S. DOT) to ensure that public opinion and related social science/institutional research is appropriately managed and interfaced with the technical development aspects of AHS.

CHAPTER 5: ANALYTICAL FRAMEWORK FOR INSTITUTIONAL ISSUES

5.1 OVERVIEW AND DEFINITIONS

Institutional barriers are often narrowly defined as statutory or administrative constraints; for example, a statutory requirement (in some states) that vehicles be weighed on static scales (instead of using weigh-in-motion devices, which measure dynamic axle loads) for weight enforcements; or requirements that vehicles signal before making lane changes. Using this narrow definition makes it difficult to identify and understand the full range of non-technical barriers to implementing change, particularly change based on new technology. To ensure full coverage of the issues that might affect the implementation of AHS for commercial vehicles, three broad categories of institutional issues will be considered: mandate, organization, and resources.

5.1.1 Mandate

Mandates consist of vision, leadership, and authority. Most efforts that significantly affect the way that business operations are conducted require some kind of mandate -- from legislation, executive orders, or popular demand. With a mandate comes legitimacy and support for action.

Institutional barriers in the “mandate” category reflect the lack of senior executive, political, or administrative support for the implementation of AHS. Mandate difficulties may arise when there is a strong public demand for a particular change but no executive-level response to implement the change, or when there is an administrative directive but no popular support for an action. They also may occur when there are conflicts among public sector entities on the implementation of a change. Lack of a mandate may reflect not only opposition based on the full understanding of a particular change, but also a lack of education about the meaning of a change or **lack** of involvement in how the change will be implemented.

5.1.2 Organization

Without a mandate, there are no guidelines for the public or private sectors to organize efficiently to meet the goals and objectives that will fulfill that mandate. Even with a mandate, there may be challenges to ensuring that organizations are appropriately structured, organized, and administered so that the mandate is fulfilled. “Organization” issues reflect problems with how public and private sector organizations are structured to implement a particular change. These issues include problems associated with jurisdictional overlaps; unclear responsibilities; conflicting operating and administrative policies, as well as priorities; and cultural differences. These are critical issues for the implementation of AHS, which will require close cooperation and coordination between the public and private sectors.

5.1.3 Resources

If organizational priorities are confused or organizational structures are unclear, resources cannot be allocated efficiently in either the public or the private sectors. Sufficient resources (primarily money and people, although equipment and facilities may also be of concern) must be provided if technology-based change is to be successfully implemented. In the current environment, where the public sector appears to be chronically underfunded, agencies and programs must compete for scarce resources. This is particularly problematic when the benefits of proposed programs, such as AHS, are difficult to define and measure.

5.2 MANDATE **ISSUES**

This section presents the key issues relating to the lack of a mandate for AHS affecting the public sector, the private sector, or both.

5.2.1 Public Sector

Key public sector mandate issues include multi-jurisdictional regulation, risk management, resistance to change, articulation of benefits, and commitment.

5.2.1.1 *Regulatory Concerns: Multi-jurisdictional*

Problems associated with multi-jurisdictional regulation are particularly acute with respect to commercial vehicles. Unlike private automobiles, for which there is a high degree of consistent regulation and reciprocity among the states, the regulation of commercial vehicles remains a fiercely-guarded state prerogative. Inspection protocols, vehicle dimension regulations, taxation, and regulatory procedures vary widely across the states. Because the administration and enforcement of commercial vehicle regulation is perceived as critical to both public safety and revenue generation, states are particularly reluctant to cede their independent control of these areas. Achieving a mandate among multiple states, or an agreement to accept Federal priorities in these areas, will be no easy task.

In addition, within each state, multiple organizations usually are involved with commercial vehicle regulatory administration and enforcement. These may include:

- Tax, commerce, corporation, and public utilities commissions.
- Departments of transportation, revenue, highways, vehicle regulation, public safety, agriculture, and consumer services.
- Other independent agencies.

To complicate matters further, multiple divisions maybe involved within each department. Every single one of these organizations may perceive that it has a unique mandate which must be protected, and will scrutinize any proposed AHS for possible negative effects on its business operations. Achieving consensus on the desirability of a particular AHS format will be a considerable task within an individual

state; the complexities only increase when multiple states are involved, and may present a substantial barrier to undertaking an AHS initiative.

The intrastate problems are complicated by the fact that few states have established ongoing, broad-based forums for the many parties involved with motor carriers to raise, discuss, or resolve motor carrier-related regulatory issues. Some states have begun to form motor carrier working groups, with representation from the agencies responsible for administering various motor carrier regulatory functions. In other states, multi-state forums have been initiated as a result of the first phase of Federally funded institutional issues studies for the implementation of ITS for commercial vehicles. However, these groups are still in the early stages of learning to work together, and AHS represents a quantum leap of complexity over ITS, particularly with respect to its potential effects on motor carrier regulatory enforcement.

The public sector multi-jurisdictional problem also extends beyond the state level. Federal officials, from the Federal Highway Administration (including its division, regional, and Federal offices), National Highway Traffic Safety Ministration, and Interstate Commerce Commission all have a stake in motor carrier operations. Finally, local and county officials who are involved in the administration and management of traffic flows also will be affected by the implementation of an AHS. Realizing a consensus mandate for AHS among these officials may be difficult, given their different organizational priorities.

5.2.1.2 *Risk Management*

It is generally accepted that there is a public mandate to increase highway safety. However, public agencies are notoriously risk averse, particularly on issues related to public safety where successes tend to be incremental and noted only by researchers over time, but failures can be immediate and dramatic. Trucks are perceived by much of the traveling public as major contributors to highway safety problems. AHS technologies which substitute mechanical and electronic control for driver control will be subject to a high degree of scrutiny and skepticism, despite the public's concerns about commercial vehicle driver safety. This will cause public agencies to proceed very cautiously and incrementally.

5.2.1.3 *Resistance to Change*

The motor carrier regulatory administration and enforcement environment is very complex, and many past efforts to change the system have failed. Institutional resistance and conservatism on the part of public agencies, as well as motor earners may substantially impede the ability to implement an AHS, as well as to develop a consensus mandate for its implementation. For the motor carrier enforcement community, the shift to an AHS is likely to mean a substantial change in the way they do business. The process and protocol for conducting roadside weight and safety inspections, for example, would require significant overhaul in terms of both statutory requirements and operating procedures. Resistance to the use of technology to improve the enforcement of motor vehicle regulations is already being encountered as

states and regions work to develop technology-based ITS programs; this resistance is likely to continue, and to grow, at the prospect to moving to an AHS.

5.2.1.4 *Articulation of Benefits*

The private sector will not warmly embrace the idea of participation in a publicly-mandated AHS unless the public sector can articulate the direct and indirect benefits of the AHS for commercial vehicles in a detailed, convincing fashion. Currently, the commercial vehicle operators are not demanding the implementation of an AHS; in fact, many are strongly resisting even the implementation of ITS programs for commercial vehicles. This resistance is substantial among carriers of all sizes, but is strongest among the smaller carriers (under 20 trucks) which make up the majority of the nation's fleets.[g] This experience suggests that it will take more than a simple listing of the potential benefits of a partial or total AHS deployment, which may include reduced congestion, smoother traffic flow, and improved incident response, to convince the private sector that the implementation of an AHS will improve their profitability by reducing costs and increasing productivity. This is particularly the case if private sector investment is required to make vehicles compatible with an AHS.

5.2.1.5 *Commitment*

A long-term public commitment to (and mandate for) AHS, particularly with respect to ensuring the availability of public monies, is necessary before commercial vehicle operators will be willing to make investments of time and money in configuring their vehicles or making other operational changes to accommodate the needs of an AHS. Experience with ITS operational tests and institutional issues studies suggests that motor carriers are particulatrly concerned about having technology standards established by the Federal government; no one wants to invest in equipment that may become obsolete or is not uniform on a national level. Given the ferocious competition for public resources, the inherent instability of public management (with respect to political change and turnover), and the perception that the implementation of an AHS will be a costly, long-term effort, finding ways to assure this level of commitment may be difficult.

5.2.2 **Private Sector**

In this section, the key private sector issues under the mandate category are identified. They include market uncertainty, privacy concerns, and legal concerns, particularly with respect to liability and insurance.

5.2.2.1 *Market Uncertainty*

Market uncertainty arises from questions about who will be willing to bear the costs associated with the implementation and operation of an AHS. The uncertain long-term market for AHS technologies, and the degree of public sector commitment to achieving full implementation, will be a concern to the motor carrier industry, which like the technology industry, will be asked to participate on the basis of the potential

profits that the industry can realize. In the case of motor carriers, this issue is further complicated by the more ambiguous nature of the profit potential. A vehicle or component manufacturer can clearly envision profits from the sale of its product should a sufficient market develop. Motor carriers will realize the secondary benefits of reduced operating costs and increased productivity derived from the primary AHS benefits such as reduced congestion and increased safety. These "indirect" benefits will lead to a more efficient and profitable industry, but a healthy dose of skepticism is likely to abound and will contribute to the lack of a mandate from the carriers for AHS.

5.2.2.2 *Privacy Concerns*

Privacy will be a major issue for commercial vehicle operations on an AHS. In addition to the private motorists' concern with the potentially intrusive nature of AHS technologies on civil liberties, the motor earners worry about the protection of proprietary corporate financial and other data, such as the number of vehicles operating on a particular route. This concern, which has arisen during the planning and development of the Advantage 1-75 operational test relates both to the potential for information to be shared inappropriately with competitors, and also the fear that this whole effort is really intended to allow government to more effectively regulate and tax the industry. For example, some industry officials fear that these technologies could encourage the spread of weight-distance taxation, which they oppose.[w]

AHS projects increase the amount of information available to the public sector about the comings and goings of individual trucks. The personal and professional behavior of commercial vehicle drivers may be even more carefully scrutinized than it is today, potentially infringing on privacy and possibly resulting in increased enforcement capabilities (e.g., of vehicle speed). The individual truck driver may be uncomfortable (or downright suspicious) with changing what is familiar. In addition, drivers may not always benefit from increased efficiency, particularly if it results in lost jobs.

5.2.2.3 *Legal Concerns: Liability/Insurance*

Many of the insurance and liability issues which bedevil any potential application of AHS will be of particular concern to commercial vehicles, especially given the high potential damage caused by a large truck careening out of controi on an automated highway. Efforts to secure insurance industry financial participation (notably unsuccessful to date) may prove particularly critical in commercial vehicle applications.[m]

5.2.3 **Public/Private Issues**

Key public/private issues related to AHS include safety, economic development and environmental impact.

5.2.3.1 Safety

In order for the public to accept new automated systems, the level of safety must be much higher (by a factor of 10 or 20) than comparable manual systems. This will be particularly true for the public to accept the automated operation of commercial vehicles, given widespread public concern about their operational safety. Early experience with HOV lanes may represent an appropriate precursor model, especially with regard to such issues as the transition of vehicles in and out of lanes, mixed vehicle operation, and the level of physical separation from other traffic required (e.g., in the case of contraflow lanes).

One of the first issues which will require resolution is the types of trucks that should be allowed in automated operation under particular roadway characteristics. Another critical issue is the potential of the system architecture to distinguish and respond accordingly to trucks of differing sizes and configurations. For example, should at least initial implementation be limited to single unit vehicles? This is a particularly critical issue as trucks continue to evolve into larger, multi-unit, higher technology vehicles. Certain behavioral characteristics of trucks must be taken into account to a greater degree than automobiles, including protection from rollover, hydroplaning, rearward amplification, and off-tracking.

The costs to the industry of implementing acceptable safety standards in their vehicles may be quite significant. These could include enhanced maintenance levels, greater system redundancy and back up, and higher reliability standards.([101])

The transitions between manual and automated operation for commercial vehicles will be a major concern of the traveling public. Given the suspicions about motor carrier driver safety and fatigue which already exist, the establishment of convincing checkout mechanisms is critical to ensuring that the driver is physically capable of resuming manual operation.

The selected roadway infrastructure (or Representative System Configuration) will also play an important role in achieving a private sector mandate for commercial vehicle AHS applications. Clearly, completely separate automated roadways would have the greatest safety acceptance, but also the highest environmental impacts. More likely, most automated operation will occur in some combination of mixed (i.e., automated and non-automated) traffic on existing facilities and special “HOV-like” lanes. How the transitions between manual and automated operation are handled for vehicles on these facilities will have a major impact on public perceptions of safety. Again, the longer the transition and greater the physical separation, the higher degree of perceived safety but also of infrastructure costs and impacts. A related infrastructure question is whether commercial vehicles will be mixed in traffic with private automobiles; the less the degree of separation of the two types of vehicles, the more private sector concern there is likely to be related to the safe operations of commercial vehicles under AHS.

5.2.3.2 *Economic Development*

Trucking activity centers (including warehouses and terminal facilities for groups of carriers) often are located near major highways. Shifting to AHS for commercial vehicles on selected portions of the nation's highway system could have significant implications for economic development, both in terms of relocating established facilities and in making location decisions for new facilities. The size of the impact on the probable "winners" and "losers" will affect the degree to which they will actively support, or oppose, the implementation of a particular AHS.

5.2.3.3 *Environmental Impact*

The greatest potential environmental benefit to be achieved by the AHS is improved air quality resulting from smoother freeway flow and less congestion. With respect to commercial vehicles, the benefit is not as clear-cut. In general, congested facilities produce greater pollutant levels per vehicle than free-flowing facilities. The complication arises from the potential for AHS to increase the throughput of roadways and thereby attract latent demand.[102] If highways function more efficiently, commercial vehicle traffic may increase, and all traffic may move faster. The ability to increase the speed at which commercial vehicles operate may be viewed as promoting more commercial vehicle operations; many advocacy groups aim to reduce those operations, and even to promote the transfer of some cargo from trucks to rail.

With respect to air pollution, emissions of oxides of nitrogen (NOx) are the most serious truck-related problem. For gasoline-powered vehicles, NOx emissions rise steadily with speed. For diesel vehicles, these emissions drop off until an average speed of about 64.4 km/hr [40 miles per hour (mph)] is reached; they then rise slowly until about 60.5 km/hr (50 mph), after which the NOx emissions increase sharply. Suggestions that air quality improvements may result by raising the speed at which commercial vehicles are operating (and reducing the time spent idling in congestion) are likely to be met with a high degree of skepticism and disbelief by the environmental community. This will make it politically difficult for public agencies to pursue such initiatives.

Therefore, from an environmental point of view, appositions likely to any actions which would increase both highway throughput and the proportion of freight shipped by truck. This is likely to be exacerbated by the many advocacy groups which favor the diversion of large quantity, long-distance freight shipments to rail. Thus, AHS could emerge as a competitor to reinvestment in the rail freight system, at least in the perceptions of some segments of the public; others are convinced that rail already is an AHS for trucks," particularly for long-haul markets.

In other environmental areas the negative impacts might be perceived even more strongly than the potential benefits. Engine and tire noise is a major environmental impact of commercial vehicle operations. Although a smoother traffic flow may reduce noise in some cases particularly where stop-and-go traffic can be minimized on inclines, ambient noise levels do increase with rates of speed due to

engine and tire noise. Highway noise impacts can be significantly mitigated by construction of noise barriers which in turn are often perceived as having negative visual impacts.

Rates of fuel consumption will improve through the reduction of highly congested operations until trucks reach a certain speed, at which point fuel economies start to decrease. In addition, mandates of the Clean Air Act Amendments (CAAA) and the National Energy Policy Act (NEPA) for the increased use of clean and alternative fueled vehicles focus on commercial vehicle fleets. Thus, planning for the development of AHS-compatible vehicles must take into account the likelihood of significant implementation of several different types of non-gasoline powered vehicles over the coming decades. It is not even clear at this point which one or several fuel altematives will emerge as competitive winners over time.

Commercial vehicles place greater loads and stress on bridges and pavements than do automobiles. AHS design concepts must take into account the likelihood that commercial vehicles may account for a disproportionate share of AHS traffic compared to general purpose facilities, particularly under an evolutionary approach focused on large fleets. This may make it difficult to design sleek and unobtrusive AHS physical infrastructure components, which is a major concern because the visual and land use implications of AHS are being potentially underestimated.

On the one hand, a driving force for AHS is its potential to reduce the construction of new highway infrastructure to meet the growth in travel demand. However, AHS will itself require new infrastructure. As mentioned above, the amount of infrastructure which AHS ends up requiring may involve tradeoffs between perceived safety concerns and the economic and environmental costs of construction. The more the public demands segregation of AHS facilities, particularly those oriented toward commercial vehicle operation, the greater will be the requirements for transition lanes, physical barriers, and dedicated exit/entrance ramps and flyovers; ultimately free-standing facilities could be required. At that point, all of the environmental constraints which presently impede highway construction will come into play and AHS will be perceived as a competitor to transit, rail, and land use and travel demand management strategies.

A potential strategy for avoiding this conundrum is the conversion of existing facilities to AHS operation with a minimum of physical modification. However, this raises the aforementioned safety perception problem, as well as the HOV experience. These past episodes suggest a higher degree of public acceptance for new facilities and a combined lower degree of acceptance where the operation of an existing facility is changed and a service degradation is experienced.

A final environmental issue which is receiving increasing prominence in transportation environmental impact statements (EISs) is the health impact of electromagnetic fields. Some configurations of AHS may employ hardware that is associated with the generation of significant electromagnetic fields. Advocacy groups promoting this issue tend to be highway and truck opponents who are likely to seize

on this issue as another reason for opposing AHS projects in the commercial vehicle sector.

5.3 ORGANIZATION/MANAGEMENT ISSUES

This section discusses how issues relating to public/private collaborations, coordination and communication among multiple organizations, organizational roles and responsibilities; and administrative requirements will affect the successful implementation of an AHS.

5.3.1 Public/Private **Collaborations**

For public/private collaborations, a significant challenge is posed by the need to develop an appropriate structure for a collaboration involving the many public sector organizations associated with the administration and enforcement of motor carrier regulation. Also, there is a significant potential for cultural conflicts within and between the public and private sectors.

5.3.1.1 *Structure*

Organizational and management issues represent some of the most difficult and pervasive concerns in both the planning and implementation of AHS for commercial vehicles. This is because the development and management of AHS for commercial vehicle operations must involve both the public and the private sectors at many levels of government across jurisdictional boundaries.

As discussed above, the number of public sector entities that must be involved in the design, implementation, and operation of an AHS is significant, particularly when considering the implementation of AHS on a national scale. As the design of ITS programs for CVO has progressed, the necessity of involving all stakeholders, both public and private, in the development of high technology efforts has been clearly demonstrated. This involvement must begin early and be as wide-ranging as possible. Private sector participants in ITS/CVO operational tests have included the following:

- Individual motor carriers.
- Associations of for-hire and private carriers.
- Vehicle manufacturers.
- Technology vendors.
- Private consultants.
- Universities.
- Systems integrators.

Considering the number of public sector participants, a significant organizational challenge arises in the development of an appropriate structure for any collaboration involving all of the affected parties.

These structural problems extend to commercial vehicle-related entities within a particular state. Motor carriers and state regulatory agencies have multiple points of contact in most states. To obtain the credentials required for legal operation in most states, motor carriers must go to an average of five state agencies. For roadside inspections (weight and safety), most states have two agencies with separate responsibilities for enforcement. A few states have a third agency with enforcement responsibilities for operating authority and other credentials. These regulatory agencies often have little in common and little or no experience working together. Their management, administration, accounting, and operations are separate and sometimes contradictory. ITS/CVO operational tests such as the HELP/Crescent Project have demonstrated the difficulties of trying to bring together disparate agencies such as law enforcement, the department of motor vehicles, tax and revenue collection agencies, and other departments without any overriding coordination. Gaining the involvement of all the appropriate agencies, and having each assign appropriate leadership with decision-making powers have proven to be a challenge. Without coordination within each state, coordination among states became extremely difficutt. Similar problems maybe anticipated for a commercial vehicle-oriented AHS.(1~)

5.3.1.2 *Cultures*

The commercial vehicle industry is not monolithic; in some ways, the various segments of the industry and its stakeholders are more different than alike with respect to interests, goals, and ways of doing business. These differences will create cultural conflicts when industry stakeholders try to work together in the development of a high technology system such as an AHS. Cultural differences among partners may create an environment of poor communication and conflicting interests, which must be overcome. These problems may be the most pronounced in the earlier stages of the project when the partners know least about each other and are just beginning a process of compromise. Operational tests for ITS/CVO have shown that cultural differences often result in significant up-front delays and therefore increased project costs.(lu) This may be significant if the early focus of AHS is commercial vehicle applications.

The potential for cultural conflicts is evident within the public sector, within the private sector, and particularly between the public and the private sectors. The impediments created by these conflicts are likely to arise when building the public/private partnerships necessary for the successful implementation of AHS for commercial vehicles.

1. **Within the Public Sector.** Individual states must be focused on addressing local concerns, first and foremost, as this is their political mandate. However, as noted above, multiple public sector entities are involved with motor carrier regulatory administration and enforcement in each state. These agencies have internal conflicts over goals and priorities, and often are at odds over issues of “turf.” Differences in their mandates as well as their ways of doing business make it difficult for

them work together. Failure to find common ground and shared interests will create conflicts of interest within each state, as well as among states, and make it difficult to work together to create the kind of shared vision that is essential for implementation of AHS.

2. Within the Private Sector. The cultural diversity among the private sector stakeholders (e.g., motor carrier operators, technology vendors, industry associations, permit services, etc.) in the motor carrier industry creates the potential for significant cultural conflicts. Even within the motor carrier industry itself, various segments are likely to have very different perspectives on the desirable components of an AHS for commercial vehicles, as well as on the allocation of costs and benefits. Differences in the ways these various types of organizations do business may be fertile ground for cultural differences.

   For example, there are likely to be cultural differences between larger and smaller motor carriers; the more profitable and the relatively less profitable carriers; private and for-hire carriers; unionized and non-union carriers; and employees, independent owner-operators, and owner-operators who contract to carriers. Some carriers put a higher priority than others on being in full compliance with all tax and regulatory requirements; their attitudes towards technologies and systems which may make enforcement more uniform, such as AHS, may be very different than those of carriers who “cut corners.” In addition, labor/management relations have always been volatile. The potential for labor/management conflict over AHS implementation is high, given that a major selling point for the industry may be the potential for changing driver work rules (i.e., permitting longer consecutive hours of operation), more closely monitoring driver activities, and reducing labor needs.

   Differences in the values of these organizations, combined with variations in operating procedures, communications patterns, and priorities create an environment in which efforts will have to be made to accommodate the various cultures in the development and implementation of an AHS.

3. **Between the Public** and **Private Sectors.** Because the public sector is the taxer and the regulator of the commercial vehicle industry, and because government taxation and regulatory policies frequently are perceived as negatively affecting the industry’s efficiency and profitability, the motor carrier industry’s often adversarial relationship with government is based on a fundamental lack of trust. Consequently, the concept of entering into a partnership with these very government bodies is likely to be met with a high degree of wariness within the industry, as has been the case with the development of ITS/CVO programs. The industry’s fear of increased taxation (especially with respect to weight-distance taxes) is a particular flash point when it comes to high technology programs such as an AHS. Thus, a considerable effort will be required

from the outset just to break down these barriers of suspicion, and to convince industry leaders that the government seeks to be their partner and helper.

A fundamental impediment to an effective public/private partnership may be differences among the partners in ways of doing business; these differences may be driven by different measures of success for various types of partners.[lm] The motor carrier industry may approach an AHS project very differently than the public sector because neither the immediate nor the long-term benefits to the industry may be quantifiable. Private industry, including motor carriers, focuses on profits, productivity, and return on investment. Public sector goals are often more esoteric and less clearly definable, including advancing the public interest through increased safety, reduced congestion, and reducing negative environmental impacts of vehicle traffic, as well as political motivations. Public interests also include enhancing regulatory efficiency, which may not necessarily be viewed positively by the industry since it could entail more stringent and effective regulation.

5.3.2 Coordination and Communications

Many different public and private sector organizations will be involved in the development and implementation of an AHS. Decisions about the information to be shared among the partners, and how this information is to be communicated, will be critical to the success of the effort. Information sharing patterns also will determine the degree of coordination that is possible among the participating organizations. Coordination and communication problems are related inextricably to the complexity of structural and cultural differences.

Coordination and communication among the many state regulatory agencies whose cultures and operational and administrative policies have little in common can be difficult. In the HELP/Crescent ITS/CVO operational test, collaboration and communication problems among agencies with different administrative and operational policies made the project very difficult, particularly during the earliest developmental phases. Communication among many agencies with different administrative and accounting systems may require extensive and duplicative paperwork and bureaucracy, making coordination difficult.

Communication may be particularly challenging if a project agenda has not been clearly defined and agencies are working toward divergent goals. In addition, if communication policies or protocols differ among state agencies, some may be better informed than others and better able to participate in decision-making, while others may perceive that information is being withheld.

Another important issue which may pose a barrier to intrastate communication is concern over turf. Cooperation between agencies toward a new and common goal, particularly one such as AHS which strives to increase efficiency, many change or

diminish an agency's current roles and responsibilities. Agencies may be quite resistant to sharing information if it is perceived as potentially diminishing their importance or resulting in reduced labor requirements.

The lack of uniformity in how the motor carrier industry interfaces with each state poses a significant coordination problem in the development of AHS for commercial vehicles. As discussed, regulatory administration and enforcement for motor carriers vary widely among the states, and there are many reasons why states are wed to their own regulations. An AHS directed toward the motor carrier industry inevitably must struggle with the inconsistencies of state regulation, because increasing the efficiency of goods movement across jurisdictional boundaries is a primary goal. Without greater uniformity in commercial vehicle regulation and enforcement across the states, coordination of a the uniform implementation of AHS on a national scale will be problematic.

The Advantage I-75 lTS/CVO operational test provides a good example of how variations in state regulations may cause major coordination problems in the implementation of a high technology commercial vehicle program. The goal of the project is to increase transport efficiency through automated clearance of transponder-equipped trucks, thereby decreasing the number of required enforcement station stops. The project experienced delays due to extensive debate over how to accommodate the right of each state to enforce its own laws while finding sufficient common ground for the project to proceed.(IW

Assuming that the development of an AHS would go through an operational test phase, as has been the case for ITS for commercial vehicles, effective coordination and management of stakeholder involvement is crucial. With the many stakeholders who must be involved, the designation of management steering committees and technical subcommittees is essential, especially for operational tests. However, given the number of players, the size of even a representative management body can easily become unwieldy, as making decisions and building consensus becomes difficult when too many parties are at the table. This was the experience of the Advantage 1-75 project, which found itself bogged down by not limiting the number of participants in the meetings of its Policy Committee, which provides overall management and guidance to the project.

Another communication problem that surfaced in the Advantage 1-75 project concerned an action that significantly affected the progress of the project but was not communicated to the satisfaction of its partners. The Governor of Kentucky, who at the time was the Chair of the National Governors' Association Transportation Committee persuaded the governors of all six participating states to sign a letter of support for the project. This occurred during the planning phase, when it was considered that such a demonstration of top-level support for the project would help to convince reluctant state **officals** to cooperate with the project and, therefore, improve its chances of success. However, this letter did not originate with the Policy Committee; this committee was notified only after the fact. The carrier participants, in particular, were upset that they were not kept informed of this important activity. In

response to their concerns, the project staff developed a communications document known as the MACS FAX as a timely means of communicating information to all project parties.

5.3.3 Organizational Roles and Responsibilities

In any effort involving multiple participants, the roles and responsibilities of each participant must be clearly defined -- they must be both appropriately distributed and well articulated. This may sound straightforward, but in the excitement associated with developing ground-breaking, high technology programs, it is easy for confusion to arise over the delegation of authority. To complicate matters, the optimal division of responsibility at the planning phase of a project may no longer be appropriate as the project moves through the stages of development, testing and implementation, and into full deployment. In some of the ITS operational tests, formal partnership agreements have been developed which spell out (in varying degrees of clarity) the roles and responsibilities of each partner. Despite the best intentions of all partners, this may not eliminate the confusion that inevitably arises over the evolution of a program.

The division of responsibility among partners becomes a particularly sticky problem if cost-sharing arrangements become involved. In the Advantage 1-75 program, for example, the Federal government is paying for most of the effort, but each of the six participating states (Michigan, Ohio, Kentucky, Tennessee, Georgia, and Florida) was required to put up a contribution of its own money based on the number of participating weigh stations. For some of the states, it was difficult to secure the funds because of executive skepticism about the program. To break this logjam, as discussed above, a letter of support drafted by the Governor of Kentucky was signed by the governors of the six states. Once the letter was signed, the state representatives had more leverage to secure the required monies.

In the earliest stages of developing ITS programs for commercial vehicles, the public sector (primarily the FHWA) has taken the lead role both in terms of financing and technology development. However, states and university organizations have taken on project management, staff support, and evaluation roles. For example, in the case of Advantage 1-75, the state of Kentucky was designated as the lead state for contracting purposes, the University of Kentucky Transportation Center was designated as staff to the project, and Iowa State University has been selected to conduct an evaluation. The motor carrier industry has had little motivation to play any kind of financial role, but its participation has been critcal in shaping a program that will generate benefits sufficient to ensure carrier enrollment.

The role and responsibilities of the FHWA changed over the course of the two ITS/CVO operational tests. As the Advantage 1-75 project developed, the headquarters office of the FHWA increased its involvement in the project. The most significant impact of this involvement was the effective upgrading of the level of the technology that the project would employ. Originally, the project intended to use widely available, off-the-shelf technology in order to achieve rapid implementation;

technology-related research and development was not part of the plan. However, through the FHWA's influence on the request for proposal that was developed for the technology procurement, the project emphasis shifted toward technology development.[IOn] In the case of HELP/Crescent, the FHWA's involvement led to the expansion of the demonstration from an assessment of technology applications to a broader “system” evaluation .[108] Thus, the FHWA headquarters played a role that had not been envisioned at the project’s inception, and the course of the project has been changed.

In the HELP/Crescent operational test, problems arose between the public and private sectors based on a lack of early involvement by private sector stakeholders. Early disputes between the states and the trucking industry severely hampered this project. These disputes and distrust constrained early carrier recruitment efforts and may constrain full deployment because carriers are still not convinced of the benefits of participation. These issues may stem from early perceptions that carriers were not going to have any significant input in developing the program in which they were expected to participate. Only after gaining leadership roles and participation on committees did the industry become significantly involved with the project.

5.3.4 **Administrative Requirements**

Establishing public/private partnerships to develop operational tests invariably creates administrative headaches, particularly for the private sector participants. When Federal monies are involved, strict accounting standards must be met for labor costs and all other expenses. In at least one ITS operational test, the combination of the administrative burden plus fears regarding the sharing of proprietary cost information nearly caused the termination of a partnership agreement. Time-consuming negotiations involving administrative, audit, financial, and legal representatives were required to clarify the concerns of the private sector partner and identify possible solutions, such as the use of a third-party auditor. Other paperwork associated with Federally funded projects, such as the preparation of written progress reports, was resented as an annoyance and viewed as taking away professionals’ time from more meaningful work.([IIO])

5.4 **RESOURCES ISSUES**

Resource concerns focus on the number and skill levels of human resources, as well as the availability of financial resources.

5.4.1 Human Resources

Problems of securing a sufficient number of staff with the appropriate skills to develop, implement, operate, and maintain an AHS will arise in both the public and private sectors.

5.4.1.1 *Public Sector*

In an environment where public sector personnel already are over-burdened, securing a sufficient number of appropriately trained staff to participate in a new or experimental project (such as the development and implementation of AHS) will be difficult. The complexity of the problem increases for commercial vehicles because of the numerous agencies, levels of government, and jurisdictions that must be involved. In addition, even with staff dedicated to an AHS project, demands will be made on the time of other public sector staff, who may not have the time to spare (or the inclination to spare it). For example, ITS/CVO operational tests such as the HELP/Crescent project found that agency staff who were not paid to participate in the project could not be counted on for ready response to unexpected project problems, thereby delaying decisions and causing significant frustrations.[III]

The problem is not just getting the right number of staff; it is also getting staff with the appropriate technical expertise in both the development and implementation phases. There may be a fundamental lack of appropriate technical expertise to create, operate and maintain a new technology. As has been the case with ITS, concerns arise over whether staff currently responsible for administering and maintaining the roadways (with their traditionally strong traffic and civil engineering backgrounds) have the right skills to run a high technology, heavily electronic configuration of an AHS. Because AHS technologies are so new, there may be few people who have the necessary skills. If significantly different skills or levels of expertise are required, it may be difficult to use existing staff, and training either existing or new personnel is expensive.

Resource problems are complicated by the multi-jurisdictional nature of these projects. For example, if a maintenance problem occurs in one state, that state may have neither the technical expertise to fix the problem nor the immediate authority across agencies or jurisdictional boundaries to mandate the problem be resolved.

5.4.1.2 *Private Sector*

In the private sector, human resources problems relating to AHS are likely to be the most troublesome in the implementation phase for the commercial vehicle industry. Similar to the problems found in the public sector, there maybe lack of appropriate technical expertise for the operation and maintenance of new technologies. For example, drivers may need a more sophisticated set of skills to deal with automated vehicles, and vehicle maintenance personnel may require training in the maintenance of on-vehicle system components. On the other hand, some innovations in vehicle technology and operation, such as the introduction of cruise control for private automobiles, have not created these problems.

5.4.2 **Financial Resources**

The uncertainties surrounding the measurements of potential costs and benefits associated with AHS affect the ability of both the public and private sectors to commit

financial resources, as will the overall scarcity of resources available for investing in new technologies.

5.4.2.1 *Public Sector*

The commitment of financial resources to an AHS/CVO project is characterized by many uncertainties for both the public and the private sectors. ideally, a comprehensive beneft/cost analysis would be performed to demonstrate the value of an AHS investment. Such an analysis is complicated because the systems that would need to be evaluated are either still evolving or do not currently exist. Consequently, the costs of operation and maintenance are uncertain, and the financial and other benefits of the utilization of new technologies are unproven. Complicating the process, many of the cost outlays will be required up-front, long before the benefits may begin to accrue.

Should AHS follow the operational testing path of ITS, it quickly will become apparent that a long-term Federal commitment to providing the resources for the planning, development, and implementation of an AHS is essential. Operational testing of lTS/CVO projects has been financed primarily through the Federal government, with some financial participation by state and local partners (as well as some private sector partners). Uncertainties regarding the long-term Federal commitment to providing these resources has undermined the willingness of other public entities to commit their own resources to these projects. From the perspective of the public sector, investing in such a risky undertaking -- when benefits are uncertain and long-term, and costs are initially high -- may be politically unwise and financially infeasible, particularly at the state and iocal levels.

Also, during the implementation phase, additional public funds may be required to implement any administrative, procedural, or policy changes that may result from an AHS. Securing these funds may be difficult.

5.4.2.2 *Private Sector*

While the uncertainty of benefit and cost estimates maybe risky to the public sector, it serves as an enormous disincentive for the commitment of resources by the commercial vehicle industry. A clear demonstration of a positive bottom-line impact is required to secure the willing financial participation of motor carriers in an AHS. The uncertainty of continued public sector investment is also of great concern to the industry. Investment in expensive new machinery to compliment uncertain, new public sector technologies would be foolish. For example, carriers already are frustrated by what they perceive to be “foot-dragging” on the part of the Federal government regarding setting standards for ITS/CVO technologies, and are reluctant to invest in ITS technologies that may be incompatible or become outdated.

The motor carrier industry also maybe wary of establishing a financial partnership with the public sector, with which relations historically have been strained. This may not hold true for other private sector entities, such as technology suppliers;

these parties have been willing participants in ITS/CVO tests, and are likely to be enthusiastic over an opportunity to play a role in the development of AHS.

Another important financial issue for the private sector is the timing of investment in new technologies such as AHS. Carriers are likely to prefer that a single standard be set for national operation as quickly as possible, enabling those carriers that operate with any significant geographic scope to minimize their required technology investment and to begin reaping the benefits. However, the development of new technologies is a costly undertaking, and many types of technologies may be developed and tested prior to the setting of any national standard. In addition, suppliers may have a vested interest in promoting a proliferation of technologies, and even of AHS configurations; to some extent, this has been the experience of ITS.

CHAPTER 6: RECOMMENDED STRATEGIES FOR OVERCOMING INSTITUTIONAL ISSUES

A variety of strategies are recommended for overcoming the non-technical barriers to the development and implementation of an AHS. These strategies are based largely on the experience with the planning, development, implementation, and evaluation of operational tests of ITS for commercial vehicles.

- Approach the development of AHS for commercial vehicles as a public/private partnership. A major 'partnering" program will be required to overcome the organizational and institutional problems among the public sector agencies as well as between the public agencies and the private sector motor carrier interests. All of the diverse elements of the industry, including labor, should be involved in this effort from the outset. Delegating appropriate and clearly defined roles and responsibilities to the private sector stakeholders is essential.

- Select initial projects that have the most tangible, quantifiable, and demonstrable benefits to the commercial vehicle industry.

- Within the public sector partners, identify strong champions and advocates who can devote significant time to the endeavor and who have the clout to secure the necessary high-level commitments of resources.

- Demonstrate a strong commitment to improving the safety of commercial vehicle operations and protecting proprietary data.

- Minimize construction of new physical infrastructure without compromising both the provision of a high degree of actual and perceived safety of operation and the maintenance of historic service levels on pre-existing facilities.

- Ensure that the public sector (i.e., the state and Federal governments) commit to long-term predictable funding levels and realistic implementation plans and schedules. Wherever possible, implement programs in steps of phases, with established decision points at which to evaluate further activities.

- Establish appropriate goals for commercial vehicle AHS: is it to enhance operational safety, reduce congestion, reduce regulatory inefficiencies, raise revenues, enhance economic competitiveness, improve profitability, or some combination of these goals? To the extent that improving

regulatory efficiency and revenue collections are goals, they could compromise the willingness of the industry to participate and reduce the chances of achieving safety and congestion goals. Make at least the early projects explicitly revenue-neutral in their impacts on the industry, to develop a reasonable level of trust and establish the credibility of the long-term benefits to the industry.

Continue aggressive Federal efforts to enhance the technical reliability of travel demand and air quality modeling to improve the credibility of claims for environmental benefits that would accrue from an AHS for commercial vehicles.

Emphasize early commercial vehicle AHS projects which have intermodal elements, particularly in enhancing the truck/rail interface, to help dispel the notion that AHS/CVO projects are an alternative rather than a complement to rail freight reinvestment.

- Install strong leadership and a dedicated full-time project manager for every AHS project for all project stages from planning and development through implementation. Designate a lead state and a lead agency for all operational tests. All parties must be committed to the project and assign representation to it with decision-making authority. Clearly define the project's agenda, pnorities, and partnering responsibilities.

- Identify and accommodate cultural differences among the partners. Seek flexibility in approaching problem solving and be willing to change ways of doing business.

- Establish a clearly defined protocol for information flow among the partners. Maintain regular, open communications. Ensure sufficient outreach also to parts of the community who may not be directly involved in program development.

- Establish an effective partnership management structure, which is critical to bringing AHS development efforts to a successful conclusion. The need to give each stakeholder **a** voice and to coordinate the activities of multiple partners must be balanced by efforts to ensure effective decision-making protocols.

- Review the current procedures for the administration of projects involving Federal funds, as well as funds from other public and private sources. Determine whether the statutory accounting and administrative requirements can be accommodated through procedures that are less burdensome, particularly for the private sector patties.

- Develop a privacy policy incorporating the Fair Information Principles developed during the 1970s: ensure that only relevant personal information is collected; inform individuals about what is being collected and how it will be used; make records available for inspection and review by the affected individuals; limit the availability of the information to those with a legitimate need to know; do not disclose information to a third party without due process; and establish appropriate security measures.

- Prepare information packages to conduct educational briefings for interested public and private parties on the potential benefits of AHS. Use these briefings to build support and understanding among ail affected constituents. Tailor materials to meet the needs of the various constituencies (e.g., commercial vehicle drivers).

- The Consoryium should establish a research and development Program to address institutional and public acceptance issues related to AHS. While the technical aspects of AHS are daunting, acceptance of these technologies is vital if the program is to be successful. Therefore, the Consortium needs to initiate a series of research and outreach activities aimed at addressing key interests and concerns of various institutional and public stakeholder groups.

- As a part of this public acceptance program, the Consortium should conduct a detailed assessment of the range and magnitude of interest and concerns across stakeholder groups. The findings reported in this study are exploratory; a more rigorous and exhaustive inventory of public acceptance issues is needed to firmly establish the baseline upon which AHS activities can build. This baseline should include an understanding of both the potential early users of AHS, as well as the concerns of key constituencies (e.g., environmental groups).

- As part of this public acceptance program, the consortium should assess the influence of new information and/or direct experience on institutional and public acceptance of AHS. The aforementioned baseline will provide an indication of the initial reactions of stakeholders to the prospects of AHS. It will, therefore, be important to know how these opinions are affected by new information, such as will be developed by the Consortium. There are a variety of research and outreach methods that can be used to gain this understanding, including focus groups, simulation, and deliberative polling.

- The AHS Program should develop an outreach strategy that builds upon (the above) public acceptance findings, and in doing so, attends to the interests and concerns of a broad range of stakeholders, from AHS champions to AHS adversaries. However, one important impact of the research should be on the structure of the program itself; that is, key

concerns should not just be dealt with via a public relations approach, but addressed in the technical program as well. For example, the concerns about costs and environmental quality that were raised in the course of this review, should be the subject of intensive analysis, so that information about these areas can be communicated in a credible manner.

AGENDA

I. INTRODUCTION

-- Focus Group Background
-- PARTICIPANT Introductions
-- Overview of AHS

II. POSITIVE IMPLICATIONS OF AHS

-- Listing of Positive Attributes for Users
-- Listing of Positive Attributes for Communities
-- Focused Discussion on Key User and Community Attributes

III. ADVERSE IMPLICATIONS OF AHS

-- Listing of Possible Barriers for Users
-- Listing of Possible Barriers for Communities
-- Focused Discussion on Key User and Community Barriers

IV. RECOMMENDATIONS AND COMMENTS

-- Policy Implications for AHS
-- Research Recommendations for AHS Program
-- General Comments on AHS

APPENDIX A (cont'd)

1. Introduction

Welcome to tonight's focus group on Automated Highway Systems. We appreciate that you have volunteered your time to provide input on this growing program in surface transportation. My name is Tom Horan. I am a Senior Fellow at George Mason University, and I will be the moderator tonight.

Agenda

Let me first provide an overview of tonight's agenda and then we will go around the room with introductions; the following chart provides a general outline of tonight's discussion.

We will first explore the possible advantages of an automated highway system from both the individual user and community perspective. **We** will then explore the inverse of this-that is, possible adverse implications of AHS, again from both the user and community perspectives.

Finally, we will consider possible policy and research recommendations that would aim toward ensuring the achievement of positive attributes and minimizing the achievement of adverse and negative attributes.

Logistics and Ground Rules

The session is two hours long; with approximately 20 minutes for each topic.

The session is being recorded; not for attributable quotes, but for our analysis.

Everyone is expected to participate; There are no right or wrong answers--we need thoughts and opinions-- feel free to offer tentative or far out ideas because we are at an early stage of development. Do not feel that you have to provide an overall judgment on AHS at this time; rather we are trying--in an exploratory fashion, to develop structured input for use by those who are actively investigating AHS concepts.

We have tried to make the things we are going to discuss easy to understand, but don't be reluctant to ask questions. The topic of the focus group is public acceptance of AHS; we will provide a technical overview but we are primary interested in your input on the public acceptance aspects of the concept.

APPENDIX A (cont'd)

Participant Introductions

Before getting into specifics, let's go around the table and introduce ourselves and provide a sentence or two about our background and/or interests.

IVHS/AHS Background Information

The Intelligent Vehicle/Highway System (IVHS) program currently being developed with considerable federal support is seen as a major thrust in transportation for the next several decades. It is expected to provide for the accelerated use of advanced technology aimed at achieving a variety of societal and user benefits, such as improved safety, improved mobility, improved environmental impacts, and improved productivity.

A major component of IVHS is the Automated Highway System (AHS), which will be the focus of our session tonight. The AHS program is premised on the view that the fully automated control of vehicles operating on dedicated lanes in high priority oorridors holds promise for substantially improving the performance of our transportation system. For example, proponents of AHS claim it offers the potential for decreasing congestion, improving safety, increasing mobility, decreasing air pollution, etc. This "high performance" highway system is seen as possibly the next major evolutionary stage in surface transportation in this country. Evolution from manual to full automated control may transition through stages of control assistance, partial control, and eventual full control. This scenario is presented in the following graphic (see attached RSC #6).

II. LISTING AND DISCUSSION OF ATTRACTIVE FEATURES OF AHS

Let's begin by considering the kinds of benefits that you think an automated highway system would have to provide in order to be attractive to users and communities. That is, what kinds of attributes would the system need to have to be viewed as attractive. Let's first have an open discussion to generate a range of possible benefits, and then while narrow it to a smaller subset.

User Listing What do you think are possible attractive features of an AHS from the perspective of a user of the system? For the various benefits, also consider what types of users would most likely realize these benefits?

Probe on:

mobility and access. - Under what conditions would increased mobility or access be an attractive feature of AHS?

APPENDIX A (cont'd)

transportation options. - How could AHS be used to increase the attractiveness of HOV or other choices---such as electric vehicles--on the transportation system?

safety. - What kind of safety gains would be attractive to the user?

convenience. - To what extent could travel under AHS be more convenient?

productivity. - In what ways would AHS be considered as a productivity enhancer for users?

Based on these kinds of attributes, are there certain user groups that may have the most to potentially gain through AHS (possible different users: commuters [SOV, HOV, inter-urban travelers, rural travelers, special populations [young, old, commercial travelers, etc.)?

Community Listing. What do you think could be the most attractive features of AHS from the perspective of the community in which the system is to operate? That is, what kinds of impacts do you think an automated highway would need to have to be considered attractive from a community point of view? Also, think of the institutional stakeholders within the community that would be most supportive of these system benefits.

Probe on:

system performance. - Under what conditions would AHS be considered a positive contributor to a region's overall system performance?

transportation options. - How could AHS be used to increase the attractiveness of HOV or other choices---such as electric vehicles--on the transportation system?

environmental impacts. - Under what conditions would AHS be viewed as making positive contributions to a community of regions overall environmental quality?

urban form. - Under what conditions could an automated highway have attractive implications on urban form; for example, improving neighborhood quality?

productivity. - In what ways would AHS be considered as a productivity enhancer for users?

APPENDIX A (cont'd)

Focus Attribute(s) Let's try to narrow the list of potentially attractive features to one or two "hot button" issues,

User Focus. For the features identified as potentially attractive to users of the system:

Which one or two benefits seem to be most important in terms of public acceptance of an AHS?

What conditions would maximize the achievement of this attribute?

What types of users would most gain by an AHS designed around this attribute? What types of users would not gain or would lose?

Community Focus. For the features identified as potentially attractive to communities implementing these systems:

Which one or two benefits seems most important in terms of public acceptance of an AHS?

What conditions would maximize the achievement of this attribute?

What types of stakeholders would be natural proponents of an AHS system designed around this attribute? What types of stakeholders would be natural opponents: (possible stakeholders: MPOS DOTS, Chambers of Commerce, neighborhood groups, local governments, etc.)?

III. LISTING AND RANKING BARRIERS TO ACCEPTANCE

Next, we want to go through the same exercise but this time we are looking for those features you think would represent barriers to the system being accepted by the public. That is, what are the potentially unattractive features of AHS that would act as a barrier to the successful deployment of this system? Again, we would like you to consider your responses both from the perspective of a **user** and that of the **community.**

User Listing: What features of an AHS do you think would present barriers to the acceptance of such a system from the perspective of potential users?

Probe on:

perception of safety. - Under what conditions could the "perceived" safety of AHS be a deterrent to public acceptance?

APPENDIX A (cont'd)

cost. - Under what conditions could the cost of AHS be considered as a deterrent to public acceptance?

personal autonomy. - To what extent could lack of autonomy and choice on the transportation system act as a barrier to user acceptance?

privacy. - Could perceived lack of privacy be a barrier to AHS acceptance?

Based on these kinds of barriers, are there certain user groups that may have the most trouble accepting AHS (possible different users: commuters [SOV, HOV, inter-urban travelers, rural travelers, special populations [young, old], commercial travelers, etc.)?

Community Listing. What features of an AHS do members of the group feel would present barriers to acceptance from the community perspective?

Probe on:

costs. - Under what conditions would the potential costs of owning and operating an AHS be a barrier to community acceptance of AHS?

environmental effects. - Under what conditions would the environmental implications of AHS be a barrier to community acceptance?

equity of access. - Could equity of assess be a barrier to acceptance?

urban form. - Could AHS effects on neighborhood quality and urban form be a barrier?
What types of stakeholders would be natural proponents of an AHS system designed around this attribute?

What types of stakeholders would be natural opponents: (possible stakeholders: MPOS DOTS, Chambers of Commerce, neighborhood groups, local governments, etc.)?

Focus Attribute(s~ Once again, let us try to narrow the list of potentially attractive features to on one or two "hot button" issues:

User Focus. For the features identified as potential unattractive to users of the system:

Which one or two disbenefits or risks seem to be most important in terms of public acceptance of an AHS?

APPENDIX A (cont'd)

What conditions would maximize the possibility of this risk/disbenefit occurring?

How would different users be affected by an AHS which contained this attribute?

Community Focus. For the features identified in potentially unattractive to communities implementing these systems:

Which one or two disbenefits or risks seem most important in terms of public acceptance of an AHS?

What conditions would maximize the possibility of this disbenefit/risk occurring?

What types of stakeholders would be most affected by an AHS system which contained this risk/attribute? (possible stakeholders: MPOS DOTS, Chambers of Commerce, neighborhood groups, local governments, etc.)?

IV. SUMMARY COMMENTS AND RECOMMENDATIONS

Having considered both the possible attractive features to AHS and the possible unattractive features of AHS, the fourth and final part of the discussion is to consider possible implications or recommendations that follow from these observations.

Policy Implications Based on the discussions above, what conclusions or implications would the group draw in terms of future policy regarding AHS implementation?

Research Recommendations. What conclusions or recommendations would the group draw in terms of future research requirements in the AHS arena?

Other Comments. Are there any other implications or observations that you would like to make with regard to public acceptance issues for AHS?

Conclusion

We want to thank you all for being very responsive throughout the session. We intend to use these results in our report to the U.S. Department of Transportation. The intent of this study is to highlight key issues to be considered by a new national initiative (the AHS consortium), and we will transmit our results for such use. If there are any matters you would like to raise at this time before we adjourn, please feel free to do so. Again, thanks for your participation.

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85. Underwood, Steven. 1992. "Delphi Forecast and Analysis of Intelligent Vehicle Highway Systems through 1991 ." University of Michigan Transportation Research institute.

86. Horan, Thomas A. and Jonathan L. Gifford. 1993. "New Dimensions In Infrastructure Evaluation: The Case of Non-Technical Issues in IVHS." Policy Studies Jrnl 21 (2) 347-356.

87. Knodel, John. 1993. "The Design and Analysis of Focus Group Studies." In: Morgan, David L (cd.) Successful *Focus Groups: Advancing the State of the Art.* Newbury Park, CA: Sage Publications.

88. Morgan, David L (cd.). 1993. Successful ***Focus Groups:*** *Advancing the State of the Art.* Newbury Park, CA: Sage Publications.

89. Duffy, **Barbara Poitas. 1993. "Focus** Groups: An Important Research Technique for Internal Evaluation Units." *Evacuation Practice* 14(2),1 33-139.

90. Frankel, Stanley. 1987. "NGT + MDS: An Adaptation of the Nominal Group Technique for Ill Structured Problems." *Jrn/ of App/ied Behaviora/ Science. vol.* 23 (4) 543-51.

91. Morns, S.W., J. Lynch, J. Swinehart and K. Lanza. 1994. *Responses of Men and Women to Traffic Safety Messages: A Qualitative Report* Washington D. C.: NHTSA DOT Report Number DOT HS 808091.

92. Mahler, Julianne G. 1987. "structured Decision Making in Public Organizations." Public Ministration Review July-August, pp. 336-342.

93. Gallupe and Cooper (1 993)

94. Morgan, David L (cd.). 1993. *Successful* Focus *Groups: Advancing the State of the Art.* Newbury Park, CA: Sage Publications.

APPENDIX B (cont'd)

95. Delp. Peter, Ame These, Juzar Motiwalla, and Neelakantan Seshadri. 1977. System Tools for Project Planning. Program of Advanced Studies in Institution Building and Technical Assistance Methodology. Bloomington, IN: Indiana University.

96. Delbecq et. al. (1975)

97. United States Department of Commerce, Department of the Census, 1987 Truck Inventory and Use Survey, Washington, D.C., 1990.

98. SAIC, "IVHS Institutional Issues and Case Studies: Advantage 1-75 Case Study," Contract DTRS-57-89-D-00090, Technical Task Directive RA 3078, December 7, 1994, p.17.

99. Kent Syverud, "Legal Constraints to the Research, Development, and Deployment of ITS Technology in the United States," March 1993.

100. Thomas A. Horan, Paul M.A. Baker, and Richard Barnes, "Public Acceptance of Automated Highway Systems", January 1994.

101. Thomas A. Horan, Paul M.A. Baker, and Richard Barnes, "Public Acceptance of Automated Highway Systems", January 1994.

102. Roy Bushey, comments at ITS America Conference on AHS, Session 10, April 1994.

103. SAIC, "IVHS Institutional Issues and Case Studies: HELP/Crescent Case Study," Contract DTRS-57-89-D-00090, Technical Task Directive RA 3078, December 7, 1993, p.13.

104. SAIC, 'IVHS Institutional Issues and Case Studies: Analysis and Lessons Learned," Contract DTRS-57-89-D-00090, Technical Task Directive RA 3078, March 17, 1994, pp.2-7.

105. SAIC, "IVHS Institutional Issues and Case Studies: Analysis and Lessons l-earned," Contract DTRS-57-89-D-00090, Technical Task Directive RA 3078, March 17, 1994, pp.2-7.

106. SAIC, "Advantage 1-75 Case Study," pp. 16-17.

107. SAIC, "Advantage 1-75 Case Study," pp. 16-17.

108. SAIC, "HELP/Crescent Case Study," p. 6.

109. SAIC, "HELP/Crescent Case Study," p. 6.

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110. SAIC, "IVHS Institutional Issues and Case Studies: ADVANCE Case Study," Contract DTRS-57-89-D-OO090, Technical Task Directive RA 3078, March 17, 1994, pp. 14-15.

111. SAIC, "HELP/Crescent Case Study," pp. 12, 15.

112. "IVHS and Privacy Issues Addressed," in The Urban Transportation Monitor, Vol. 8, No. 17, September 16, 1994, pp. 1-2.

APPENDIX CI. ANNOTATED BIBLIOGRAPHY: GENERAL PUBLIC ACCEPTANCE STUDIES

Bedford, G. M. 1992 "IVHS And The Mobility Of Older Americans." In: Surface Transportation and the Information Age. Proceedings of the IVHS America 1992 Annual Meeting, Vol. L Washington D.C.: IVHS America.

The major characteristics of transportation affecting the mobility of older people are: (1) availability; (2) accessibility in its broadest sense; and (3) fit to lifestyle. In this context, this brief overview is a combination of institutional memory, an outline of current conditions, **and** future outlook. This paper presents a summary of the scope of the work of the Institutional Issues Committee and what role of the committee is within IVHS America, and summarizes some of the current work of the committee.

Booz Allen & Hamilton. 1993. *Institutional Impediments to Metro* Traffic *Management Coordination: Task 5- Final Report Volpe* National Transportation Systems Center.

This report contains a comprehensive review of the literature describing a related IVHS technology, Advanced Traffic Management Systems (ATMS), and details many of the institutional issues involved in implementation of ATMS. The core set of critcal issues include: expertise (technical skills), multiple jurisdictions, organizational structure, procurement, funding, deployment coalitions, marketing and outreach, benefits, environment, law/regulations, liability, privacy, public-private partnerships, and flexible technology design. The conclusions observe that implementation of ATMS requires the coordination of various political jurisdictions as well as a mixture of agencies and departments with in these jurisdictions. The report also contains the results of a survey of institutional representatives in six metropolitan areas, as well as pointing the way for further studies to be done on institutional related problems.

Burwell, David G. 1993. "IS Anybody Listening to the Customer?" IVHS *REVIEW Summer* 1993 (17-28).

The author comments that the proponents IVHS need to demonstrate that IVHS technologies have a clear benefit over other approaches if they are going to "sell" them to the public. However the literature on the comparative advantage of IVHS technologies over other solutions is extremely thin, and very little effort seems to be undertaken to determine what the consumer, both the individual driver, or public agencies "want." More *studies need* to be conducted to determine the marketably and acceptance of IVHS technologies.

California Department of Transportation. 1988. "Berkeley Workshop: Multi-State/private Sector Cons. For R, D & D On Advanced Technology For The Highway, Berkeley, CA March 24-2S, 1988."

Over the past several years a program of research and development on advanced technologies for the automobile/highway system has emerged in California. In 1987 California began an outreach effort to establish a Multi-state

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consortium for research, development and demonstration (R, D&D). A two-day workshop on automatic control technologies, hosted by the Federal Highway Administration at the Turner Fairbanks Research Center on November 12-13, 1987, addressed a number of technical issues related to the exploitation of advanced control technologies for relief of congestion. At that time the California Department of Transportation (Caltrans) and the Institute of Transportation Studies (ITS) of the University of California at Berkeley, offered to sponsor a follow-on workshop in California to address some of the institutional and organizational issues involved in a national consortium. The results of the Berkeley Workshop are summarized in this report. The Workshop was organized in alternating plenary sessions and discussion groups. Four groups were set up to examine the following topics: (1) Institutional Concepts; (2) Funding; (3) Public-Private Sector Relationship; and (4) R&D and Technical Issues.

Carlson, E.D. 1993. "Federal Actions To Deliver The IVHS Program." Institute of Transportation Engineers Journai Vol.: 53, Issue Number: 2, Pp. 25-30.
A status report is presented of the major activities that the Federal Highway Administration and other Department of Transportation agencies are undertaking to deliver the intelligent vehicle highway system (IVHS) program. The IVHS research and development program is designed to explore issues critical to IVHS implementation and to provide needed insight into new technologies and applications. Several broad categories of research will be pursued that relate to the following: research tools and knowledge base; environment for IVHS applications; defining opportunities for IVHS applications; developing IVHS applications. The implementation of a comprehensive set of operational test projects to address IVHS technological and institutional issues are discussed. IVHS Corridors program is discussed, as well as IVHS system architecture. Comments are also made on DOT'S automated highway system (AHS) program.

Ciszewski, Stanley J. 1991. "Smart tolls for smart highways." in: international Bridge, Tunnel and Turnpike Association. Proceedings of the annual meeting 59th (1991). Pp. 159-171.
This article describes the various "back office" activities, such as accounting, administrative and marketing, which are crucial to the successful implementation of electronic toll and traffic management (ETTM) systems.

APPENDIX CI (cont'd)

Colk, Henk van der. 1969. "PROSPECT, the cognitive impulse to traffic safety and transportation psychology." Road Safety in Europe (Conference: 1966: Gothenburg, Sweden). Proceedings of Road Safety in Europe in Gothenburg, Sweden, 12-14 October 1966 Vol. 2.1969. Linkoping, Sweden: Statens vag-och trafikinstitut. pp. 96-112
Reports on the Dutch research program PROSPECT (PROgram of Scientific Projects on the Effects of Communication and control techniques on Traffic behavior) whose key issues include: (1) cognitive aspects of traffic behavior, (2) arousal and performance in traffic, (3) public acceptance of new technologies, (4) driver education, and (5) expert systems and travel mode choice.

Conroy, Patrick J. 1990. "Transportation's Technology Future: Prospects for Energy and Air Quality Benefits." TR NEWS June, pp.32-37.
New attention to technological alternatives, the development of the National Transportation Policy, and land federal transportation legislation together offer a special opportunity for joint action on transportation, energy and air quality problems. The first step is to recognize the opportunity being presented.

Covil, JL; Martin, PC; and E.J. Regan, Ill. 1991. "New Highway Uses for AVI Systems" Joumal *of Transportation Engineering. Vol: 117 (6) 697-7Q3.*
An overview is presented of road pricing and congestion-pricing application status of several AVI (Automatic Vehicle Identification) projects: San Francisco International Airport toll revenue collection; Heavy-vehicle electronic license plate (HELP) study; Hong Kong electronic road pricing project; Singapore congestion pricing project; and toll industry initiatives. It is noted that present technology is sufficiently advanced to effectively collect user fees (tolls) and to administer congestion pricing strategies. Public acceptance of new road pricing approaches appears to be the major factor impeding implementation of AVI-based systems. It is pointed out that AVI system development and implementation efforts are more fragmented than desired, and increased efforts to coordinate development and implementation efforts are needed.

Darwin, Richard J. 1992. IVHS Deployment and Public/Private Sector Issues, The Purely Private Model: White Paper." In: Public and Private Sector Roles in IVHS Deployment; Seminar, Rockville, MD. U.S. DOT, FHWA:
This white paper is written in response to a request by the Federal Highway Administration (FHWA) to investigate possible business organization approaches that could be used by the private sector in their deployment of Intelligent Vehicle/Highway Systems (IVHS). More specifically, a better understanding of private *sector* participation in the development and marketing of Advanced Traffic Management Systems (ATMS) and Advanced Traveler Information Systems (ATIS) is of particular interest to the FHWA. ATMS and ATIS are two of the five components that make-up the family of IVHS.

APPENDIX CI (cont'd)

Davies, P; Ayland, N; Hill, C; Rutherford, S; Hallenbeck M; Ulberg, C. 1991. "Assessment Of Advanced Technologies For Relieving Urban Traffic Congestion." NCHRP Report Issue Number: 340, 103pp. (TRB)

This report presents the results of a study to assess the application of advanced technologies in relieving urban traffic congestion. Technologies have been reviewed in the areas of traveler information systems, traffic control systems and automatic vehicle control systems. Both qualitative and quantitative assessments of a broad range of technologies were undertaken in order to select the three most promising technologies available for short-term implementation. These technologies comprise the radio data system for traffic information broadcasting, externally-linked route guidance, and adaptive traffic control. Detailed benefit-cost analyses were performed on these technologies, together with a review of the funding sources, jurisdictional and institutional issues, and consumer and user reactions to the systems. The study included a review of current moves toward a national intelligent vehicle/highway systems (IVHS) program. An outline of the projects and activities to be included in an IVHS program has been prepared, along with a preliminary time schedule. These activities have been grouped into advanced traveler information systems (ATIS), advanced traffic management systems (ATMS), fleet management and control systems (FMCS), and automatic vehicle control systems (AVCS). The report concludes by recommending the urgent need for a national program for developing, demonstrating and implementing advanced transportation technologies.

Fitzpatrick K. 1991. Review of Automated Enforcement. Texas Department of Transportation: Transportation Planning Division.

Law enforcement is considered an important contributor for maintaining traffic safety. However, limited resources, such as staff and funds, constrain the efforts of police in traffic law enforcement. New technologies such as automated enforcement may offer a partial solution to this problem. Information on automated enforcement devices currently being used in the areas of speed enforcement, red-light traffic signal enforcement, and high-occupancy vehicle (HOV) lane enforcement is provided in the report through summaries and discussions of current technology, experiences in the use of automated enforcement devices, legal issues, and public acceptance of automated enforcement. Examples of experiences include the use of portable billboard speed displays in Richardson, Texas, and Glendale, Arizona, as well as the use of automated speed enforcement devices in Arlington, Texas; Galveston County and LaMarque, Texas; Paradise Valley, Arizona; Pasadena California; and Peoria, Arizona. Legal issues associated with automated enforcement include photographing of the driver, mailing the citation to the owner of the photographed vehicle, and requiring the owner of the vehicle to identify the driver at the time of the offense.

APPENDIX Cl (cont'd)

Gordon, Deborah. 1992. "Intelligent Vehicle/Highway Systems: An Environmental Perspective." In: Gifford, J.L., T.A. Horan, and D. Sperling (eds.). *"Transportation, information Technology, and* Public *Poilcy.* Fairfax, VA: George Mason University,; and Davis, CA: University of California Davis, Institute of Transportation Studies.
The author observes that IVHS technology is not a panacea for transportation and environmental problems. Simply developing systems that allow more automobiles on the highways mere postpones the problem of how modify behavior to reduce automobile use, or shift demand to other modes of transportation. While some of the IVHS technologies are of some value to the environment, overall IVHS is an expensive, and highly complex "fix" to environmental and congestion problems.

Goulias, KG; and Mason, JM, Jr. 1993. "Planning The Resolution Of IVHS Issues Via A Staged Development Approach" ITE *Journal Vol: 63 (2):33-40.*
This paper discusses issues related to advancing the state of knowledge on IVHS (Intelligent Vehicle Highway Systems), and covers critical issues that should be addressed by the transportation community that are related to pricing and taxation, financing and funding, liability, standards and protocols, intellectual property, user behavior, monopolies/antitmst, legislation, jurisdiction, enforcement, and education. Examples are described of pubilc/private/university partnerships in IVHS research and development and deployment, and the role of each partner is bnefly outilned. The optimal timing of barrier removal is then illustrated by comparing possible partner roles over time and by providing a staged development plan for IVHS deployment.

Hitchcock A. 1994. "IVHS Safety: Specifications and Hazard Analysis of a System with Vehicle Borne intelligence." Paper presented at Transportation Research Board, 73rd Annual Meeting, Washington D.C.
HitchCock sees three opportunities for system related accidents in the AHS environment. These can be avoided if the systems designers carefully identify the faults that must not occur, and develop complete specifications. The most potentially dangerous situations would be "rogue vehicles", but this risk could be eliminated through proper infrastructure design.

Horan, T. A. and J. L. Gifford. l993. "New Dimensions In Infrastructure Evaluation: The Case of Non-Teohnical Issues in intelligent Vehicle-Highway Systems." Policy Studies Jrnl 21 (2) 347-356.
In the contemporary policymaking environment, non-technical criteria are often of great importance in determining the success or failure of a particular infrastructure enterprise. This paper examines the importance of these criteria through a case study of the implementation of a major highway investment program in advance communication and control technologies (IVHS).

APPENDIX Cl (cont'd)

Inman, V.W.; Fleischman, R. N.; Dingus T.A.; and Lee, C.H. 1993. *Contribution Of Controlled Field Experiments To 7he Evaluation Of TravTek.* Washington D.C. IVHS AMERICA.
TravTek is a joint public and private sector operational field test of an advanced traveler information and traffic management system. This paper describes the design of three experiments and presents preliminary results from one of them. The three experiments focus on: (1) the effect of altemative navigation guidance displays on safety related aspects of driver behavior; (2) the contribution of up-to-date traffic information to trip time savings and navigation efficiency; and (3) the effect of altemative display configurations on driver performance and navigation. All three experiments focus on human factors issues.

Johnston, Robert A, M.A. DeLuchi, D. Sperling and P.P. Craig. 1990. Automating Urban Freeways: Policy Research Agenda *Joumal of Transportation Engineering* 118(4)442-480.
Automated freeways have been proposed as a solution to urban traffic congestion. The authors describe the staged development of automated urban freeways and then suggest a series of research topics related to the major policy issues of mad capacity, air quality and noise, safety and liability, cost and equity, privacy, and organizational complexity. These difficult questions should be resolved before public acceptance for the technology can be sought. The authors conclude that policy research on these matters should be carried out before, or at the same time as, the technology is being developed.

Kanafani, Adib. 1987. Towards a Technology Assessment of Highway Navigation and Route Guidance. Berkeley, CA. Institute of Transportation Studies, University of California 14 pages.
Report produced by Institute of Transportation Studies Program on Advanced Technology for the Highway (Calif.). There are now a wide variety of route guidance systems available, both automated and non-automated. There are navigation aids, route guidance, and route control. The technology has reached an advanced stage and is on the market in some forms. Needed is an assessment of driver response and network behavior to evaluate the technical requirements and limitation. A thorough economic analysis needs to be undertaken to clarify cost effectiveness implications. Policy analyses are needed to look at the issues of liability and public acceptance.

Kantowitz, B.H., C.A. Becker, and S.T. Barlow. 1993. "Assessing Driver Acceptance of IVHS Components." In proceedings of the Human Factors and Ergonomics Society 37 Annual Meeting, Seattle, 1993.
Abstract to follow.

APPENDIX Cl (cont'd)

Keating-Edh, B. 1984. Airbags Are 7hey Help Or Hidrance? Washington; NJ: Consumers' Research Incorporated. Consumers' Research Vol: 67 (4): 34-35

A 1978 consumer survey found only 14.496 of motorists favored mandatory installation of airbags. The public was also unaware that airbags increase the cost of a new car by $200; to be completely effective, seat belts would need to be worn in conjunction with airbags; and the system would not be reusable after initial deployment. It was found that evidence of deaths in airbag equipped cars had been suppressed. Airbags may not always deploy and manual belts, where worn, are more effective and far less costly. The reasons why insurance companies appear to be the main proponents of a mandated passive restraint rule are also considered.

Keller, John and Paul P. Jovanis. 1990. Taming The Silicon *Steed: Assessing Public perceptions Of Risk Associated With Intelligent Vehicles And Automated Hlghways Davis; CA:* University of California, Davis; Institute of Transportation Studies

The paper begins with a sketch of the emerging technologies of intelligent vehicles and automated highways. Risk perception studies are then reviewed and a framework is developed for studies in the IVHS and automated highway areas. The paper concludes with some thoughts about how the experiments might be conducted, and draws from the psychological literature to argue that transportation engineers and decision makers should consider the issue of perceived risk when developing and implementing Intelligent Vehicle-Highway Systems. It is important to understand that there are well-developed methods to study societal perception of risk. These methods appear to be readily adaptable to the testing of IVHS risk perception. The suggested set of surveys is intended to assess the public perceptions of the technological risk of intelligent vehicles and automated highways, which can influence the public acceptance of these technologies and their consequent market. Ultimately, the usage of IVHS technology is actually affected by these perceptions, and the estimation of benefits must be adjusted accordingly.

Lappin, Jane E. Suzanne M. Sloan, and Robert F. Church. 1994. A *Market Analysis of the Commercial Traffic /information Business* Cambridge, MA: EG & G Dynatrend and John Volpe National Transportation Systems Center.

This paper explores the kind of traffic information available to consumers, how consumers respond to these offerings and what market potential exists for the further development of this market. Study of this market yields insights into consumer response to ATIS as well as provides useful information to policy makers considering any future role for government in this arena.

APPENDIX CI (cont'd)

Lasky, Ty A. And Bahrain Ravani. 1993. A Review of Research Related to Automated Highway Systems (AHS). Interim Report. California AHMCT Program, University of Califomia Davis.
The authors note that while there are a number of good general review of IVHS, there appears to be no reviews that have focused on issues related to AHS. This literature review was designed to bridge that gap, and focuses on vehicle control, and associated areas including general AHS research, safety and fault tolerance, sensors and vehicle types, system architectures, and human factors.

Lowe, **Marcy D. 1993. "Road to Nowhere." World *Watch* (May/June)27-34.**
The author expresses the concern that IVHS, rather than being a cure for smog, traffic congestion and safety problems may actually exacerbate the problems it is supposed to solve. For instance increasing the capacity of highways may simply shift the gridlock to secondary streets, assuming that the advanced technologies are, in fact, reliable. The author proposes that instead it would be more rational to consider other approaches such as congestion pricing, and to encourage a shift to public transit.

Loux, S; Hersey, J; Greenfield L; and E. Sundberg. 1936. National *Understanding And Acceptanoe Of Occupant Protection Systems Final Report.* Washington D.C.: National Highway Traffic Safety Administration; Report Number: HS-807 025.
A telephone survey of a nationally representative sample of 1,213 individuals who drive or ride in cars was conducted in January-February 1986, which obtained information about 3 major areas: automatic safety belts, air bags, and mandatory use laws (MUL). It was found that the public is generally unaware of automatic safety belts and had concerns about the belts breaking down and trapping them in an accident. A substantial minority said they would unbuckle automatic belts, but a smaller number reported they would permanently disconnect them. The majority of the public preferred manual belts to automatic belts. Air bags were preferred by the majority of the public and a third were willing to pay the estimated cost of air bags. While the protection afforded by air bags was recognized, concem was expressed about their reliability. MULs were supported by the majority of the public, and people in states with MULs in effect reported significantly higher safety belt use; Those in states without MULS would use belts more often if a MUL were enacted. Perceived strict enforcement and the inclusion of a fine in the MUL were related to reported increased belt use in states where MULS were in effect.

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Lute, Laura, Hal Richard, and Wesley S.C. Lure. 1992. "The Influence of Human Factors and Public/Consumer Issues on IVHS Programs.'" in Gifford, J. L., T.A. Horan, and D. Sperling (ads.). *"Transportation,* Information *Techno/ogy, and Public Policy* Fairfax, VA: George Mason University,; and Davis, CA: University of California Davis, Institute of Transportation Studies.

This paper notes the influence of human factors, consumer perception, as and consumer demands on the various IVHS program elements. It provides discussions of advanced transportation technology research with Caltrans to illustrate the kind of user considerations and societal concerns that must be factored into capture and keep popular support while maintaining overall program direction in line with the ultimate IVHS goals.

Marans, RW. 1991. "User Acceptance Of intelligent Vehicle- Highway Systems (IVHS): Directions for Future Research." In: The *Intelligent Vehicle Highway Society of America. First Annual Meting.* Washington; DC: IVHS America.

Following a review of the potential non-economic consequences of deploying an Intelligent Vehicle Highway System, the paper discusses the need for a systematic program of research dealing with the behavioral aspects of the new technology. A research agenda covering components of behavioral research is then outlined, and recommendations are made for specific studies that need to be undertaken as part of that agenda

Marans, Robert W. and Cyrus Yoakum 1991. "Assessing The Acceptability Of IVHS: Some **Preliminary Results in: Vehicle** Navigation **And */nformation Systems Vol: 2657-668.* Warrendale; PA: Society Of Automotive Engineers.**

Abstract to follow.

Mobility 2000. 1990. Final Report *of the Working Group on Advanced Vehicle Control Systems (AVCSJ* Dallas TX: Mobility *2000* AVCS Working Group.

This report provides a working plan for the implementation of AVCS, including critical planning and system development considerations, a program plan for development and deployment of AVCS, benefits expected to derive from the program, institutional and other issues that might serve as barriers to implementation, and conclusions and recommendations for proceedng. The report urges undertaking a intensive, systematic program for deploying AVCS which will have significant safety and congestion reduction benefits.

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Morris, S.W., J. Lynch, J. Swinehart and K. Lanza. 1994. Responses of Men *and Women to Traffic Safety Messages: A Qualitative Report* Washington D.C.: NHTSA DOT Report Number DOT HS 606091.

The objective of this project was to obtain a greater understanding about receptivity to traffic safety communications in order to develop effective media campaigns targeted at women. The project conducted a review of the literature on gender differences in response to traffic safety and health messages, and conducted interviews with men and women to evaluate their responses to selected traffic safety public service announcements (PSAS). The report obseved that the focus groups were valuable in assessing the differential reactions of men and women to different PSAS, and perceptions of views to public generated campaigns.

O'Donnell, John. 1993. "Examination of Public Acceptance of IVHS Products and Services." Paper presented at Transportation Research Board, 72rd Annual Meeting, Washington D.C.

The author notes in a study conducted to better understand public acceptance, that IVHS promises significant benefits, but what remains to be seen is how test systems can be converted in to publicly supported systems. He indicated that economic issues may be the most important for attracting support and that more basic market research needs to be done to understand these issues. He provided some basic recommendations for the IVHS program: 1) implementing agencies should make better use of the operational tests to generate market analyses; 2) multiple market surveys should be done; and be open to unfavorable responses; 3) a better understanding needs to developed for the process of implementing new products; 4) the market potential for services such as ATIS should be examined to determine whether they can be enhanced by bundling them together.

Orski, CK 1976. "Issues In New Transportation Systems And Technology" Transportation Research Board Special Report No. 170 (16-19) Transportatlon Reasarch Board.

This paper emphasizes that transportation system performance requirements should be defined in terms of level of service as perceived by the users instead of engineering characteristics. Although the management professionals in research and development have been aware of user needs. The problem is that because the research and development team define the service objectives to be attained, these level-of-service parameters go hand-in-hand with the engineering performance targets. It would be preferable to have service needs identified at the local level, where community desires can be accurately expressed. It is important that the initial testing of innovative transportation technologies could be achieved with substitute, lower cost technologies (e.g. an express bus being used to simulate the service characteristics and dual- mode behavior of automated guideway systems). It is also pointed out that the current

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trend to design vast, comprehensive transportation systems in order to draw a region together need not be the most effective solution. A better approach would be a phased, incremental implementation of a new system in which confidence and public acceptance could grow. Although new transportation systems are the promise of the future, they need to be implemented with restraint.

Pietrzyk, M; Jeffers, P; Polk, A. 1993. *Tampa Bay Arae /ntegrated* Transportation *Information system. Fins/ Report.* Tallahassee; FL: University of South Florida; Center for Urban Transportation Research, and Florida Department of Transportation.

This report is a compilation of three previous technical memoranda, a summary of focus group interview sessions, and feedback from project Advisory Committee members. The first technical memorandum analyzed different methods of gathering real-time traffic information. The second memorandum evaluated methods of disseminating that information to a variety of audiences: local traffic operations, fleet operators, broadcast media and commuters. The third technical memorandum cataloged existing traffic control centers and other traffic information resources in the Tampa Bay area. In addition, the report described other traffic control centers and traffic management projects in North America, as possible models for the recommended system. Finally, this report contains the recommendations for the components necessary for implementation of a regional, real-time traffic information center in the Tampa Bay area: determination of geographic coverage, staffing, physical location, hours of operation, system architecture, and organizational structure.

Roberts, Mark A. 1902. "IVHS Strategies" Alex. Brown& Sons. in: Surface transportation and the information age : Proceedings of the IVHS America 1992 Annual Meeting, Newport Beach, CA, May 17-20, 1992. Vol. 1. Washington, D.C.: IVHS America, pp.304-306.

In this paper, the author discusses some of the key factors of attracting private sector investment capital and the applications to Intelligent Vehicle Highway Systems (IVHS). The author identifies three key factors in particular: stable regulatory environment, highly defined potential market segments, and the ability to secure sustained competitive advantage. The author also discusses the role of government policy in defining potential market segments.

Saxton, Lyle. 1993. "Automated Control--Cornerstone of Future Highway Systems." IVHS REVIEW Summer 1993 (1-16).

The author comments that the future of surface transportation is primarily connected with a personal vehicle, highway mode of movement. Further improvement in the efficiency and capacity of the highway network will require the development and implementation of automated highway systems. Successful implementation of AHS requires awareness of the need for

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increased cooperation between public and private sector interests, and the recognition and acceptance of the importance of these systems by broad societal forces beyond the transportation community.

Serafin, C; Williams, M; Paelke G; and P. Green. 1991. *Functions And Features Of Future Driver Information Systems Ann* Arbor; Ml: Univ. of Michigan Transp Research Inst; FHWA.

This report describes advanced driver information systems that should appear in cars of the early 21 st century, and proposes a method for selecting the most beneficial systems. Systems (functions of interest were cellular phone, navigation/route guidance, roadway hazard warning, traffic information, vehicle monitoring, entertainment, in-car delivery of information, motorist services, and in-car offices. For each system, an evaluation was conducted weighing the following criteria: the reduction of accidents (59.3%), benefits to traffic operations (39.4%), and driver wants (0.5%) and needs (0.8%). The accident scores were based on the impact of features on causal factors of accidents (e.g., inattention, excessive speed, etc.). Benefits to traffic operations were estimated from changes in mode choice (e.g., use of public transportation), route choice, and traffic flow (e.g., eliminating peak congestion). Driver wants were based on a focus group study. Driver needs were assessed from the impact of each feature on driver behavior for three representative trip scenarios (work, personal business, and social/recreational). Using these schemes, features of each system were ranked from most to least beneficial. From this and other information, the first five systems listed above were chosen for further study. Features ranked as particularity beneficial provided information about roadway hazards (crash site, construction, railroad crossing), congestion traffic rules, freeway management, path control (e.g., headlight out), and trip planning. Information elements (specific units of information) were identified for these features and prioritized.

Shiadover, Steven E., Michael Dearing, Paul Bouchard, and Roy Bushey. 1992. "Public-Private partnerships for Evolutionary Development of AVCS in the PATH Program." in: Surface Transportation and the information Age. Proceedings of the IVHS America 1992 Annual Meeting, Vol. i. Washington D.C.: iVHS America. pp. 341-6.

Discussions of most institutional issues asspociated with IVHS mentions the need to develop public-private partnership, though the nature of these is rarely defined, either in theory of practice. The authors express the belief that IVHS provides opportunities for cooperative action between the public and private sectors. CALTRANS and PATH experiences have demonstrated that public-pnvate relationships can be made to work in the U.S. The paper explains how these partnerships work, so that lessons learned might be helpful in developing other such partnerships.

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'Silkunas, Steven. 1993. "Customer Satisfaction: The Next Frontier." Transp. ***Research Record 1393 (176-41)*** This article provides an introduction and overview to the concept of customer satisfaction, it's measurements, and outline for implementation, generated from business research literature. The author proposes an agenda for public transportation based on customer-driven expectations and requirements. In order to meet these criteria, such tools as a focus on quality, market research, and measurements are evaluated with a special emphasis on transportation.

Society of Automotive Engineers (SAE). 1990. "Automated Highway/intelligent Vehicle Systems: Technology And Socioeconomic Aspects" Warrendale; PA: SAE. SAE/SP-90/833: 128 pp.
This publication is a collection of 12 papers presented at three Intelligent Vehicle Highway Systems (IVHS) sessions during the 1990 SAE Future Transportation Technology Conference and Display. The first six papers deal with technological aspects of the IVHS. They cover a variety of technical subjects including an innovative vehicle concept, vehicle control and communication systems, and complete vehicle/highway operation systems. The last six papers are on the socioeconomic aspects of IVHS, an area where the institutional issues are noted as at least as challenging as the technical issues.

Transportation Research Institute. 1992 Field Test Of Automated Speed ***Enforcement In Michigan: Effects On Speed And Public Opinion.*** **Ann Arbor: University of Michigan Transp. Research Institute.**
The National Highway Traffic Safety Administration (NHSTA) selected the states of Michigan, New Jersey, and Washington to field test various automated speed enforcement devices (ASEDS) The purpose of these projects was to determine impact on speeding and speed related crashes on the ASEDS. In addition, the evaluation was to determine public opinions that may impact legislation enabling the use of these devices for speed limit enforcement. Analyses of the speed data on the enforcement zone roads show that the ASED field test had no effect on travel speeds. Indeed, the program had no true enforcement teeth (warning letters only). Slightly less than half of the licensed drivers in the two pilot counties reported knowing about the ASED pilot program, and less than one-fifth of the drivers surveyed reported actually having seen an ASED in use.

Van Vuren, Tom; and Malcolm B. Smart. 1990. "Route Guidance and Road Pricing - Problems, Practicalities and Possibilities." ***Transport Review, vol.1O*** **no.3. July-September 1990. pp. 269-283**
The authors discuss the basic principles and applications of route guidance and road pricing. They make a case for public operation and public acceptance of both systems. The importance of environmental issues in network definition and the compensation strategy is emphasized. In conclusion, the authors

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indicate that the combined introduction of mute guidance and road pricing might lead to a synergy, with maximum profits to the system as a whole.

Waested, K. 1992. "Electronic City Access and Road Pricing: Political and Technical Aspects. Part A, The Oslo Toll Ring System." in Vehic/e *Navigation and information systems Conference* (3rd:1992: *Oslo, Norway). NY:* IEEE. pp 347-354.
This paper describes automatic toll payment systems in Norway. Issues include the toll ring layout, prices, design of toll stations, privacy, traffic volumes, and driver's responses.

WhitWorth, Paul. 1994. *Market* Issues *in The Deve/opment Of in- Vehicle Advanced Traveler information Systems* (ATIS). Washington, D.C.: J.D. Power and Associates and Transportation Research Board.
This paper presents market and development issues of Advanced Traveler Information Systems (ATIS). issues addressed include: early markets for ATIS, the government's role in ATS development, evaluation of users response, market penetration, and willingness to pay. The paper presents the results of a survey of experts, the conclusions of the research, and recommendations on how to encourage ATIS development. Findings indicate that there are three potential barriers which stand in the way of market penetration of ATiS into the mass market: the cost of ATIS access, the quality of real time traffic information, and the need to demonstrate significant social benefits to justify further investments.

Whitworth, Paul. 1993. *Public Acceptance and User Response to Advanced Traveler Information systems (ATlS) #aducts and Services: The Role of Operational Tests in Understanding User Response to ATIS* Cambridge, MA: Massachusetts Institute of Technology and John Volpe National Transportation Systems Center.
Abstract to follow.

Whitworth, Paul. 1993. Advanced Traveler Information *systems: Technology, Market Development User Response and the Govermnent's Role SM* Thesis, Cambridge MA: Maasachusetts institute of Technology.
Bibliographic entry only.

WhitWorth, Paul, Suzanne M. Sloan, and Jane E. Lappin. 1994. ATIS *Market Research: A survey of Operational T-and University and Government Reseach.* Cambridge, MA: EG & G Dynatrend and John Volpe *Narional* Transportation Systems Center.
Abstract to follow.

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Willis, OK. 1990. "IVHS Technologies: Promising Palliative Or Popular Poppycock?" *Transportation* Quarterly *Vol: 44 (1):73-84.*

This article assesses the potential benefits of intelligent vehicle/highway systems (IVHS) technologies. These technologies include improvements in traffic management, driver information, and vehicle control techniques made possible by recent advances in microprocessing and telecommunications. They are of interest because they offer promise as means to (1) reduce urban traffic congestion, *(2)* improve highway safety, and (3) increase highway transportation productivity. It is concluded that certain IVHS technologies, especially advanced traffic management systems, have demonstrated utility to help alleviate urban traffic congestion. Advanced driver information systems are far less well-developed approaches to dealing with traffic congestion. They require further field testing and refinement. To the extent that traffic congestion is eased by the use of IVHS technologies, congestion-related traffic accidents will also be reduced, thereby improving highway safety. Whether much larger improvements in highway safety can be made from the adoption of various crash avoidance technologies is unclear, as much laboratory and field testing remains to be done on these technologies. Highway transportation productivity is being improved through the adoption of IVHS technologies. Acceptance of automatic vehicle identification, location, and communications technologies is spreading rapidly among several types of commercial vehicle operators, because these public- and private-sector fleets can either save or make more money using them.

Wilshire, RL. 1990. "Intelligent Vehicle/Highway Systems-a Feeling of Deja Vu. Institute of Transportation Engineers." In: ITE Journal Vol. 60 No. 11. ITE :

The author draws parallels between the emerging Intelligent Vehicle/ Highway Systems (IVHS) technologies and the pioneering computer- application technologies that were developed and implemented in the 1960s and 1970s, and recognizes that IVHS applications hold a far greater potential for widespread implementation. Many of the issues are still the same, but this time there is a true convergence of technology, attitude, and public acceptance, creating a groundswell of opinion driving the need for action. It is not just a slick repackaging of old techniques in a glossy new wrapper. These differences are the result of four principal factors.

Wolfe, Bob and Mark Anderson. 1991. "Minnesota Department of Transportation in the Marketplace." *Transportation Research Record 1-(26$272)*

The authors describe Minnesota DOT's approach to providing goods and services. Drawing upon an expanded notion of marketing, that goes beyond sales into product development, market analysis, education, etc.,. The authors note that MDOT must be more sensitive to the consume in that it must compete in the marketplace for government goods and services, and in the overall

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marketplace at large. It stresses customer involvement and is attempting to apply modem marketing techniques to all of its operations.

Ygnace, Y. L. 1990. "From worldwide production to local use : the challenge of in-vehicle navigation and route guidance emerging technologies." Program on Advanced Technology for the Highway (Calif.). in: Royal Institute of Navigation (Great Britain). Conference (1990 : Warwick, England). NAV 90: land navigation and information systems. paper no. 14. London, UK: Royal Institute of Navigation, London. 8pp.
This paper focuses on the development of navigation and route guidance technologies with emphasis on existing systems, industrial strategies, market approach and human factors considerations by considering the different situations in the U. S., Europe, and Japan. The article analyzes the conditions under which one reasonably could assume a wide spread of these technologies with social and individual benefits.

APPENDIX Cl (cont'd)

EMPIRICAL STUDIES

Brand, JE. 1990. "Attitudes toward advanced automotive display systems: feedback from driver. Focus group discussions. Final report." Brand Consulting Group University of Michigan Transp Research Institute. Washington D.C.: Federal Highway Administration.

Forty-six drivers of late model cars equipped with advanced information systems participated in four focus groups conducted in Los Angeles and New York. The sessions provided insights into drivers' perceptions of the value of these systems, including strengths, weaknesses, and potential improvements for future systems. Drivers expressed greatest interest in systems that warn of potential hazards from their vehicles or the road. These systems must provide information in a timely manner to allow appropriate corrective actions. There were complaints about attention being diverted from driving while operating entertainment systems and cellular phones. The need was identified to integrate cellular phone controls on the dashboad, hands-free dialing, and easier identification of key controls. There is also an interest in navigational systems. Interest was expressed for a system that provides a head-up display to address safety concerns related to reading directions.

Bonsall, P. and M. Joint. 1991. "Evidence on drivers' reaction to in-vehicle route guidance advice.'* University of Leeds Institute for Transport Studies. in: *International Symposium on Automotive Technology & Automation (24th : 1991:* Florence, Italy). 24th ISATA International Symposium on Automotive Technology and Automation, Florence, Italy, 2024 May 1991. Croyden, UK: Automotive Automation Limited, Croyden, England. Pp. 391-401.

Presents results of two projects yieldng information on drivers' reactions to in-vehicle route guidance advice. The first project involved users of the LISB route guidance system, and the second focused on the DRIVE project CARGOES which provided information on drivers' compliance with advice of different qualities. This paper presents the evidence on driver response from these two sources and highlights some implications that this has for the design, evaluation, simulation and marketing of route guidance systems.

Frankel, Stanley. 1987. "NGT + MDS: An Adaptation of the Nominal Group Technique for Ill Structured Problems." Jrnl of Applied Behavioral Science. vol. 23 (4) 543-51.)

This study addresses a subject not infrequently confronted by social researchers: identifying and clarifying a problem and then generating acceptable solutions for the problem. The techniques presented in this article assist in considering multiple or alternative solutions, in order to generate more robust responses to complex policy and social-environment related problems.

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Gourdin, Kent N.; and Patricia E. McIntyre. 1992. "Demand for IVHS in Charlotte, North Carolina: a marketing study." *Transportation Quarterly. Vol. 46 (2).* April 1992. Pp 205-217

A study was recently conducted in Charlotte, North Carolina that looked at the demand for IVHS across four potential market segments: consumers, commercial vehicle operators, emergency response organizations, and fixed site managers. Results of this study showed that there is interest in IVHS across a potentially broad customer base in Charlotte. There is also a common interest in certain types of IVHS information across all groups. For example, congestion and altemative route information were cited by respondents in each group as being potentially useful IVHS services. Lastly, it is clear that there is much still to be learned regarding the market demand for IVHS services.

Green, Paul; and Jonathan Brand. 1992. "Future in-car information systems : input from focus groups." Warrendale, PA: Society of Automotive Engineers.

Presents the input from six focus group studies of drivers of late model cars equipped with advanced driver-information systems. The purpose of the focus groups was to determine driver attitudes toward existing, high-technology, driver-information systems and what drivers might want in future cars.

Jacobson, Leslie N. 1992 "Marketing ATMS and measuring the benefits." WA (State) Dept. of Transportation. in: Surface transportation and the Information Age: Proceedings of the IVHS America 1992 Annual Meeting, Newport Beach, Califomia, May 17-20, 1992. Vol. 2.1992. Washington, D.C.: IVHS America Pp. 645-649

This paper describes the importance of Advanced Traffic Management Systems (ATMS) marketing and some actions needed for an effective marketing program.

Kanafani, Adib, Asad Khattak, and Joy Dahlgren. 1994. "A Planning Methodology for Urban Transportation Systems" Paper presented at Transportation Research Board, 73 Annual Meeting, Washington D.C.

These authors describe a new computer based framework for performing transportation planning, referred to as PLANiTS. A computerized knowledge base containing information about possible strategies and their effects, and a model base, are used to identify potentially effective strategies. PLANiTS provides computer support for group processes such as brainstorming, deliberation, and consensus seeking.

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Kansan, Ammar Y. 1993. "The Economic Effects of Implementing Electronic Toll Collection and Traffic Management Systems" In: Transportation Research Board 72nd Annual Meeting, Washington, D.C. TRB :
The transportation community is devoting considerable attention and resources to Electronic Toll Collection and Traffic (ETTM), a technology that could have a dramatic impact on both the users and operators of toll facilities, as well as non-users and the environment. However, the public acceptance of such systems will have a direct impact on the decision to install ETTM and on the ultimate success of such systems. The purpose of this paper is to identify and discuss the short and long term economical effects resulting from the implementation of ETTM systems. In addition, this paper describes, for illustrative purposes only, a small pilot study that attempted to determine the initial demand for ETTM in the Boston, MA area. This work is believed to constitute the first step in establishing a more comprehensive ETTM economic and financial analysis methodologies.

Morgan, David L (ad.). 1983. Successful *Focus Groups: Advancing the State of the* Art Newbury Park, CA: Sage Publications.
A very useful collection of articles targeted at encouraging the use of group oriented methodologies as primary data collection tools.

Nelson, David O.; Melanie S. Payne, and **Timothy J. Tardiff. 1882. "Assessing Consumer Market Potential for Electric Vehicles: Focus-Group Report." Transportation Research Record No. 8821982 Pp. 13-18.**
A demonstration of focus-group techniques in analyzing transportation energy-conservation program activities is described. The Electric Vehicle Commercialization Project of the Electric and Hybrid Vehicle Program of the U.S. Department of Energy was the test case for the demonstration. This application builds on previous focus-group studies in transportation as well as previous electric vehicle market studies. The focus-group meetings were structured around a discussion guide that covered topics such as adjustments to down- sizing, perceptions of future energy shortages, and, most importantly, reactions to electric vehicles likely to be available in the short to medium range. The results of the focus groups are consistent with previous quantitative studies of electric vehicle market potential, in that the market for vehicles likely to be available in the near term appears to be very limited. The major impediments to market penetration are limited range, long battery recharge period, and high costs.

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Perez, William A., Rebecca Fleischman, Gary Golembiewski, and Deborah Dennard. 1993. "TravTek Field Study Results to Date." in: Surface Transportation: Mobility, Technology and Society: Proceedings of the IVHS America 1993 Annual Meeting. Washington, D.C.: IVHS America, pp. 667-73.

The authors report that preliminary results of a subset of data for the Rental User Evaluations with emphasis on information display systems. Drivers' opinions of TravTek visual and auditory interfaces show that the ATIS components are positively perceived by the drivers and that the system helps them to navigate. Also, drivers report that TravTek may have helped them drive more safely relative to an non-equipped vehicle.

Pietrzyk, Michael C. 1990. "Analysis of Automatic Vehicle identification Technology And its Potential Application On The Florida Turnpike: Technical Memorandum 2." Center for Urban Transportation Research and The Florida Department of Transportation.

The project is comprised of three distinct but related phases. Phase I consisted of a review of the state of the art in automatic vehicle identification (AVI) technology including a surey of vendors and operators of AVI systems to determine available technologies, system operating characteristics, and examples of applications nationwide. Phase ii consists of survey research regarding attitudes and characteristics of existing AVI users as well as current Florida Turnpike patrons. This phase includes five survey research efforts including surveys of existing AVI user, summary of other AVI-related surveys, and Florida Turnpike patron interviews, mail-back surveys, and focus groups. The results of Phase II and Phase iii efforts are summarized in this technical memorandum.

Schofer, Joseph L., Asad Khattak and Frank S. Koppelman. 1993. "Behavioral Issues in the Design and Evaluation of Advanced Traveler Information Systems." Transportation Research Vol. 1C (2) 107-117.

Decisions about implementing ATIS should be based on the individual and social benefits expected from such technologies, which will strongly be dependent on the way travelers respond to new information sources. The paper explores the behavioral issues important to understanding traveler reactions to ATIS, it discusses evaluation strategies, included stated preference methods, and observations of revealed behavior in laboratory simulations and field tests with various degrees of control and complexity. The paper concludes that market acceptance and driver utilization of ATIS services will determine the success of failure of a particular concept , and at present, there does not appear to be a large market clamoring to overcome congestion with new technology. ATIS must be sole based on the benefits it offers, it ease of use and the cost of acquisition and operations to be borne by users.

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Turpentine, T; Sperling, D; Hungerford, D. 1991. "Consumer acceptance of adaptive cruise control and collision avoidance systems." In: Transportation Research Record N1318 pp 118-121. TRB.
Consumer reactions to automated vehicle control technologies were studied. The motivating hypothesis was that current users of cruise control value the relaxation benefits they gain from its use and would therefore be early adopters of more automated controls. Four focus groups were conducted, two with avid users of cruise control and two with infrequent users. The hypothesis was not borne out: avid users valued cruise control as a driving aid more than as a means to relax and thus had little interest in more advanced automated controls. Less frequent users, in contrast, were more attracted to the automated controls because of the increased safety benefits they could provide in emergencies, although the users expressed concern about reliance on this automation in inappropriate circumstances. It is hypothesized that (a) avid cruise control users are not a special early market; (b) safety is the primary feature, both negatively and positively, in defining the early market; and (c) convenience is not likely to be a primary feature attracting early adopters of automated Vehicle Highway Systems.

Underwood, Steven. 1992 "Delphi Forecast and Analysis of Intelligent Vehicle Highway Systems through 1991." University of Michigan Transportation Research Institute:
This report presents the results from a survey of experts on the likely pattern of development for IVHS in North America. it looks specifically at the range of systems or technologies that are currently recognized as contributing to the development of IVHS, and for each system or technology, it forecasts the likely market penetration for relevant segments of the market. The survey addresses the full range of lVHS. The survey also assesses the expected capitalized cost, including installation and subscription fees, to the vehicle owner. The respondents to the survey were from North America, Europe and Japan and are recognized experts in the systems or markets that they addressed. They were asked to limit their forecasts to those systems that they felt qualified to evaluate. The survey followed the Delphi approach where the respondents anonymous and where the estimates of market penetration are summarized statistically and fed back to the panel for revision in light of the group estimates. This most recent market forecast should provide improved estimates of market penetration due to the development described above.

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