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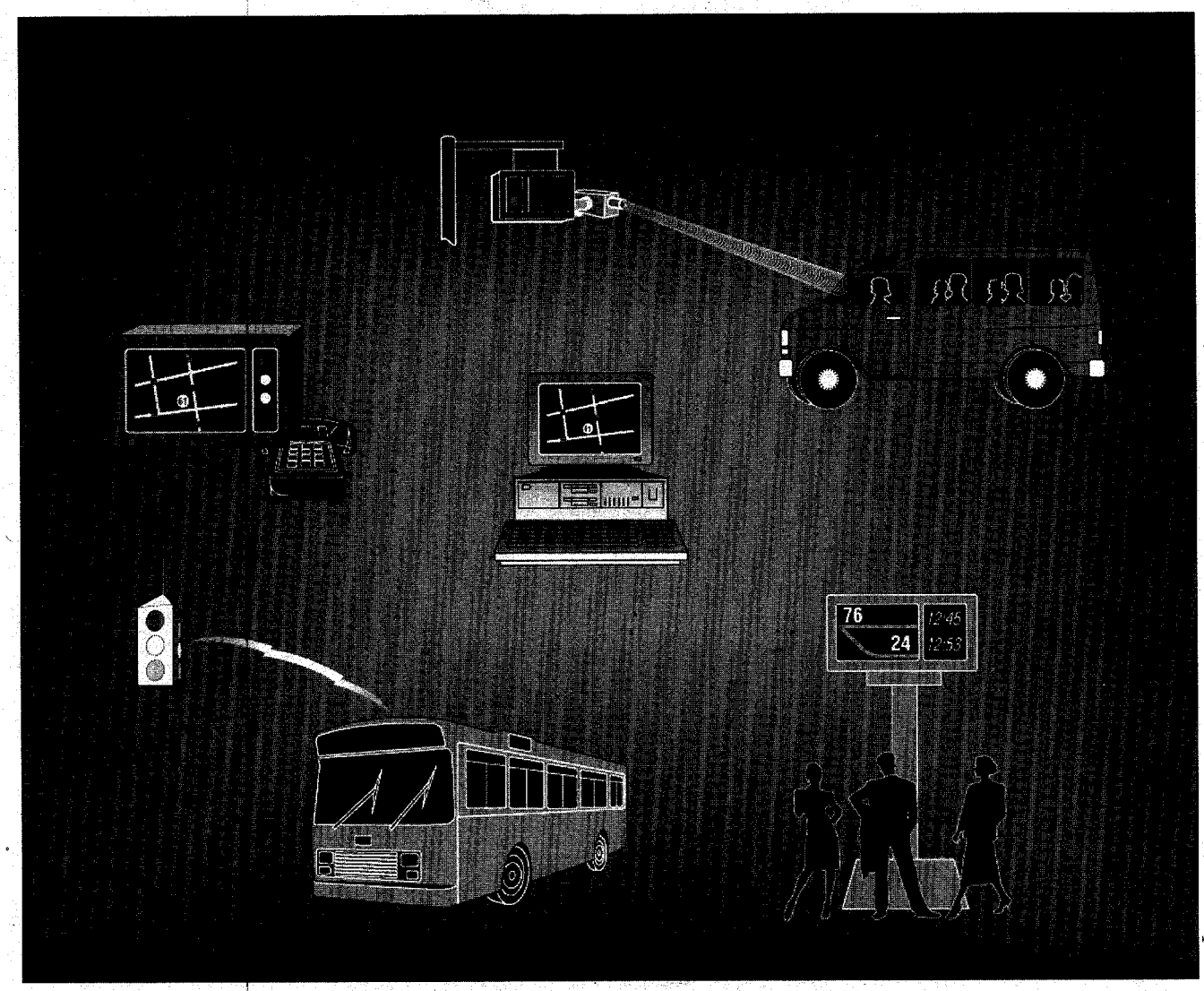
Institutional and 'Policy Issues in Adopting Advanced Public Transportation Systems Technology

September 1995



ADVANCED PUBLIC TRANSPORTATION SYSTEMS PROGRAM
A Component of the Departmental ITS Initiative

Federal Transit Administration

Institutional and Policy Issues in Adopting Advanced Public Transportation Systems Technology

Final Report
September 1995

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INTRODUCTION. ,

This project, Institutional and Policy Issues in Adopting Advanced Public Transportation Systems Technologies, aimed to study critical mass transportation issues associated with the implementation of intelligent transportation systems (ITS) in the northern Virginia area and, more generally, in the entire country.[a] Work included analytic policy studies, education outreach services for transportation policy decision makers at the local and national level; and development of IVHS technology courses. Establishment of a national resource center for IVHS policy research was another objective of the project. The work was supported by Federal Transit Administration grant VA-26-0001. Dr. Roger R. Stough was the Principal Investigator and Dr. Kingsley 'E. Haynes the Co-Principal Investigator.

This report contains six papers describing the major projects carried out under this grant:

-- a kiosk pilot deployment
-- a workshop on APTS evaluation guidelines
-- two conferences on ITS and the environment
-- a conference on metropolitan area deployment of ITS
-- a paper on some policy implications of ISTEA for ITS deployment

A great deal of additional work was also completed under the grant. A full listing of publications and presentations appears at the end of the report. In addition, a number of special projects are described briefly below:

"Transportation and Regional Economic Development" conference, (November 1994, Airlie House, Virginia). This workshop, featuring presentations by such nationally recognized experts on regional development as Charles Sabel, Anthony Downs, and Joel Garreau, addressed the key issues of how transportation systems affect regional productivity and economic development, with particular reference to the newly emerging intelligent transportation systems. Proceedings of this conference are in fiil preparation.

"National IVHS and Air Quality Workshop" Workshop (March 1993, Diamond Bar, California). This conference brought together transportation and environmental planners in an effort to promote improved understanding of each others' perspectives. Considerable effort was devoted to exploring technical issues, such as the different meaning attached to me word "mode" by the two communities.

"During the course of thii project, the phrase "intelligent transportation systems" came to replace the original phrase "intelligent vehicle-highway systems" that had been in use when the Intelligent Vehicle-Highway System Act was passed. As a result, the reports on the early work within this project employs the phrase "intelligent vehicle-highway systems", while "intelligent transportation systems" is used in this introduction and in reports of some of the later activities carried out under this project.

Transportation Research Board presentation on APTS institutional barriers (January 1994, Washington, D.C.). A presentation on institutional issues associated with APTS deployment was made at the 1994 TRB Annual Conference panel, "Advanced Public Transportation Systems Program Highlights", chaired by FTA official Ron Fisher.

"Information Based Uncertainty Management of IVHS Technologies". To help create a framework for evaluating potentially huge IVHS infrastructure investments, this paper by Kingsley Hayne.s and colleagues applies quantitative analytic techniques to infrastructure planning, with particular emphasis on the need to incorporate uncertainty criteria.

"Market factors in transit deployment of ATIS". This study by Brien Benson of market factors affecting ITS deployment argues that a systems architecture must be able to accommodate a variety of localized applications, reflecting our nation's decentralized federal system, and a variety of niche markets, reflecting our entrepreneurial form of capitalism.

IVHS Certificate Feasibility Report (March 1993). This report on the feasibility of issuing certificates of training in IVHS concluded that, while such an approach would not be viable with regard to formal graduate education, it might well be feasible with regard to a "short course" approach to training professionals already engaged in transportation.

Compendium report "IVHS Education and Outreach" (March 1993). This report includes ITS modules suitable to inclusion in college and graduate school courses. Such modules have been incorporated in George Mason University courses on program evaluation, regional policy, and human factors engineering.

Dulles Corridor Evaluation (December 1992). This study of possibilities for IVHS deployment in the Dulles corridor finds the major barrier to ITS deployment to be institutional issues, regarding cooperation between public and private sectors, but among public sector agencies.

Research proposals for the National Transit Institute (March 1993). A series of possible research topics were provided to the new National Transit Institute at Rutgers University.

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Dr. Kingsley Haynes, Director of The Institute of Public Policy and University Professor in Public Policy, serves on the Program staff. He has been Chair of Geography and Public Policy at Boston University, and Chair of the Urban, Regional Analysis and Planning Faculty in the School of Public and Environmental Affairs at Indiana University. Dr. Haynes' research interests include infrastructure policy, environmental policy, and innovative transportation financing.

Dr. Roger Stough, Associate Director of The Institute of Public Policy and Northern Virginia Endowed Chair in Public Policy, is Director of the Transportation Policy Program. He has been Chairman of the Urban, Regional Analysis and Planning Faculty at Indiana University, and advisor on economic development to such foreign governments and universities as South Korea's National Science Council and the National Sun-Yat Sen University (Taiwan). Dr. Stough's research interests include regional economic development and transportation policy, organization change in regional development, and ITS evaluation.

Dr. Thomas **Horan** organized the conference on APTS evaluation, and was a' leader in organizing the conferences on ITS and the environment. Among graduate students supporting the project were Paul Baker and Thomas Hennessey , who worked on the environmental conferences; Yulan Magnolia Hsing, who worked on the regional economic development conference; Timothy Seest, who worked on the kiosk project; and Scott Talkington, who contributed to the paper evaluating the impact of toll rate changes on Golden Gate Bridge traffic. Mary Clark provided administrative support for the overall project.

USING KIOSKS TO PROMOTE TRANSIT:

A PILOT PROJECT IN NORTHERN VIRGINIA

This paper by Brien Benson, Jonathan Gifford, and Timothy Seest, reports on a pilot project by George Mason University to explore the potential of using kiosks to promote increased use of transit, both fixed-route and ride-sharing. The project is being carried out in Northern Virginia, and was initiate< under a research grant by the Federal Transit Administration in 1992 and subsequently extended by the Federal Highway Administration.

INTRODUCTION

Kiosks, both stand-alone and as part of a distributed system, are one important member of the family of emerging information technologies. Kiosks combine the ability to make a multimedia presentation, the analytic capability of a computer, and the capacity to be linked to a central database.

Furthermore, kiosks, if attractively designed and intelligently located, can be miniature "store-fronts", serving as "point-of-purchase" advertisements. Finally, kiosks can improve an organization's cost-effectiveness by substituting relatively cheap capital goods for labor intensive operations.

The most widely recognized kiosk are the ubiquitous automatic teller machines (ATMs), but kiosks are increasingly found in retail sales applications. Department and other retail stores around the U.S. are using multi-media kiosks' to 'display wares that are either available in the store or can be ordered.' (In one Parisian department store, kiosks are used to seli perfume. The customer types in her lifestyle and personality type, and the kiosk computer unit analyzes this input and then recommends a specific perfume.[2])

Kiosks devoted to government services are also spreading. In one interesting experiment, the state of California, in a pilot project conducted in partnership with IBM, has some dozen kiosks, each providing a range of public services, including information about job availability;: welfare benefits information, and the capability for individual motorists to pay off traffic fines.[3]

California is also experimenting with kiosks, named "Auto 'Clerk", that permit motorist to pay traffic fines.[4] And a national U.S. Postal Service experiment with "Postal Buddies" that sold stamps and recorded address changes, while ultimately discontinued, saw deployment in 183 post office lobbies and numerous other locations.[5]

Among examples of kiosks providing tourist and travel information is a street corner kiosk in Boston that provides Yellow Pages guides, with maps, for 'nearby stores and restaurants.[6] A related service is a Worldwide Web site that provides routing information for subway systems in world cities.'

Kiosks have found important. transit applications in Europe, with possible applications in America. Some 2.5 million videotext terminals in France provide an outlet for information on transit services.[8] And use of a German "smart bus" kiosk system has been studied for possible adaptation in both California and Oregon.[9]

THE PILOT PROJECT

The project has been a two-pronged effort. On the one hand, we constructed a single kiosk unit and deployed it on the George Mason campus, with the intention of identifying a range of issues associated with building, installing, and maintaining a single unit in a high-traffic area, such as an office building,' shopping mall, or other activity center. On the one hand, GMU explored a range of institutional issues associated with deploying such a system on a region-wide basis. Our overall objective was to explore the full range 'of issues associated with deploying a multiplicity of units in Northern Virginia.

THE STAND-ALONE GEORGE MASON KIOSK, "MasonRides"

To carry out the first part of our project, we first decided that logical place to deploy a single test unit was on the George Mason campus, where we have the greatest degree of control.

Our first step was to put together a partnership; including GMU Business School professor Stephen Ruth, a kiosk expert; multimedia technology entrepreneur John Redmon of Redmon Group, Inc.; and the GMU Federation of Off Campus Students, which was already managing a paper-based ride-share system for GMU students.

The unit eventually put together, named "MasonRides", is now located in the University's central building, Student Union Building #1. It is portable and reasonably rugged, while being limited to indoor use. It has a printer that dispenses conveniently-sized pieces of paper with the requested transit route-and-schedule information. And it provides the following three basic services:

1. A screen display and print-out of bus-rail transit service from the George Mason campus to some two dozen key Washington-area destinations, and back again. Round trip route-schedule-fare information for the day of the inquiry is provided, adjusted for rush-hour rates,

holidays, and special fares for seniors and the disabled. The database is completely contained within the kiosk itself, and was drawn from WMATA's published schedules.

Destinations are: Downtown East Falls Church, National Airport, Smithsonian Museums, Tyson's Corner, Kennedy Center, Arlington/Seven Corners, Old Town Alexandria, Pentagon City, Georgetown, National Zoo, RFK Stadium, U.S. Capitol, Washington Monument, Dulles Airport, Mount Vernon, Wolftrap Farm Park, and Lincoln Memorial.

Of course, this is a limited selection, but we concluded that it was sufficiently large to attract user attention while at the. same time keeping programming requirements within reasonable limits.

2. Ride-matching capability for students and staff commuting to the GMU campus. This service is designed to facilitate ride-matching on both a continuing and an ad hoc. basis. Ad hoc ride-sharing could be arranged for the next day.

To use the local carpooling feature, a user first selects a region on a map of Northern Virginia. ,The kiosk zooms in on this area, and the user then designates sub-regions for which he would like to view the related postings. The user may then simply note down others who offer or want rides from this sub-region, or he may post his own name, phone number, and the time-of-day and days-of-week he wishes to travel to and from the campus.

3. Ride-matching for intercity travel, throughout the "Lower 48" states. This capability has been designed for the University's student population, which has great demand for rides home or to vacation destinations during breaks in classes. Obviously this service would be of little interest off a college, campus, but we thought this would be an excellenttest of developing "niche" markets peculiar to specific situations.

The kiosk's carpooling services, both local and long-distance, raise the issue of confidentiality, since participants are asked to place their name and phone number in a publicly-accessible database. This "electronic bulletin board'! poses the danger of crank calls. Indeed, under the previous, paper-based system, the Federation of Off-Campus Students served as "broker" between ride providers and acceptors, thereby providing a buffer against crank calls.

However, we decided to use the electronic bulletin board concept -- largely because it would, be much simpler to manage. In addition,- it was not clear that the added complexity of going through the Federation of Off-Campus Students to obtain information produced any significant degree of added security, since requests for information were essentially never denied, and the Federation had not experienced a problem with crank calls.

FINDINGS OF "MasonRides" PROJECT

cost

The development costs of the MasonRides prototype were approximately $25,000, including $10,000 for hardware, $1,000 for the unit housing, and the remainder for software and programming. Total time from initial planning to deployment was three months.

Software development time required approximately 120 hours from a senior programmer and 300 hours from a junior programmer. The most difficult 'prog ramming task was designing an efficient algorithm for selecting an optimal route from the Metro Guide database; this algorithm was the main factor in determining system response time. Making all of the hardware components work together provided some minor challenges, but did not begin to rival the difficulty of debugging and optimizing the programming.

Usage

Amount of usage was fairly high. On a campus with 16,000 students and 3,000 staff, during the test period of three months -- October through December of 1994 -- the kiosk's main menu screen was accessed about 4500 times. Metro Guide was accessed about 1,000 times, local carpooling 1300 times, and long distance carpooling also 1300 times.

It would seem that the long-distance carpooling was substantially more popular than local carpooling. Only 15 people posted their name and phone number for local carpools, but 100 did so for long distance carpools. And an informal telephone survey of system users which we conducted in February, 1995, found several people who had given long distance rides, but none who gave or received local rides.

A problem confronting the ride-share service, and particularly local carpooling, was paucity of people in the database. A number of respondents to our phone survey noted this problem, and the recommendation was made by several that better advertising of the kiosk -- for example, in the local student newspaper *Broadside* and the local newsletter for staff members, Mason Gazette -- could lead to more names in the database. Another popular suggestion was putting the system on-line, so that. people could use it from their homes.

One of the objectives of our project was to test whether a kiosk with both transit, and ride-share services would encourage people to explore' both options as alternatives to single-occupant-vehicle travel. In fact, we seem to have succeeded somewhat in this objective. By our estimate, the same person accessed both the carp001 and metro guide some 300 times, or about *7%* of total accesses. (We assumed that an access of both services within 8 minutes of each other was done by the same person.)

Ease of use

A critical issue we faced was making the kiosk easy to use, since we wanted to attract first-time users and wanted the unit to appeal to all travelers, not just those who are "computer literate".

The principal design question with both the Carp001 Guide and Metro Guide was" how to construct a user-friendly touch-screen. When faced with a trade-off between adding more screens to the system or putting numerous choices. on one screen, we generally opted for more screens, since it is less tedious for users to move quickly through multiple screens than to be forced to study a particular screen for some period of time.

In spite of these guidelines, we were forced to construct a handful of fairly complicated screens. The most difficult was the weekly schedule screen, on which the user must indicate, for each day of the week, his preferred arrival time and departure time.

In the event, our approach seemed justified. All users we contacted in our informal telephone survey stated that the system is easy to use. Of course, such a survey has serious limitations. Users of the kiosk were probably self-selecting -- that is, only those people feeling comfortable with it would use it. Furthermore, one might expect people on a college campus to be somewhat more computer literate than the overall population.

Finally, it is possible that those surveyed, even if they, did have trouble using the machine, may not have wished to admit this. Nonetheless, so promptly and so universally did those surveyed say the machine was fairly easy to use that it seems fair to conclude that our overall approach in this regard was correct.

Portability and ruggedness

The unit proved to be both rugged and portable. We transported it from campus to two different conferences, some ten miles distant in Tyson's Corner, outside Washington, D.C., and one in Richmond, some 100 miles from George Mason. In both cases, we were able to put the unit up and running in its new site within a few minutes, and the unit seemed none the worse for its transport. (Interestingly, at both conferences people inquired about whether our kiosk could be installed in an office building, suggesting that we had succeeded in developing a concept applicable outside the college community.)

ISSUES IN REGION-WIDE DEPLOYMENT.

In the second part of our project, we explored the feasibility of putting together a consortium of relevant organizations that would be needed' to deploy the unit throughout Northern Virginia.

The fixed-route capability was to be developed in conjunction with the Washington Area Metropolitan Transit Authority (WMATA) and the region's suburban transit operators, while the ride-share capability would be developed with the Washington Area Council of Governments (WashCog), which currently manages the region's ride-matching program. In order to secure financing for the proposed project, we explored the possibility of "electronic yellow page" advertising with Bell Atlantic and with selected local tourism bureaus.

It soon became evident that formidable institutional barriers would need to be overcome if such a project were to be successful, notwithstanding strong and positive leadership by the Northern Virginia Transportation Commission in bringing together the interested parties.[10]

WMATA had some particular concerns with the project, and spent several months studying the question of what should be its role. Finally, in June, 1993, it promulgated a document, "Policy and Guidelines of the Use of ARTS Data Bases and/or Facilities", laying out a charge of $75,000 for one-time requests for its database ($25,000 for the transit database and $50,000 for the geographic database), plus $2,000 for each update, in the event that the database was used to generate revenue, a condition that was inevitable in our project, which was designed to be self-financing."

WMATA did agree to provide the database free of charge to the Federal Transit Administration, which would be permitted to "authorize use of the ARTS data bases by other agencies or organizations for government purposes". Whether or not profit-motivated sale of kiosk advertising space, by, for example.; Bell Atlantic, would constitute "government purposes" would almost certainly be left to the lawyers to decide. In effect, then, WMATA had expressed willingness to support our project, but not as part of a "public-private partnership".

WashCog, while not presenting the same kinds of barriers, was in the midst of a proposal to the state of Virginia's Transportation Efficiency Improvement Fund for funds to upgrade its ride-matching software. Under the upgrade, commuters wanting to share rides could be matched not just on the basis of the immediate neighborhood around their homes, but also along their whole commute corridor. This was certainly a worthy effort, and the upgrade of the existing software was long overdue, but WashCog preferred to condition its participation in George Mason's project on completion of the upgrade, which at best would take months to complete.

A third major institutional barrier was encountered in efforts to secure kiosk advertising. As noted, George Mason approached both local tourist and trade associations and Bell Atlantic about possible participation. The local associations evinced no interest, and, while Bell Atlantic was quite open an communicative, it advised that it was not interested in the project -- for the following reasons. [12]

First, publicly located kiosks, of any type, confront serious problems of vandalism, misuse of equipment, and deterioration that make maintenance extremely difficult. Second, kiosks are expensive -- costing $1525,000 for a laser disc system, and $8-15,000 for a CDI (compact disc: interactive) system. Third, and more specific to our proposal, our travel

information would likely be presented in videotex form, and that this would not create a sufficiently visually sophisticated environment for typical electronic yellow page ads.

And fourth, Bell Atlantic noted that Americans have very high expectations for new technologies, such as electronic yellow pages, and expect them to work immediately, and to have vast amounts of information. Thus, an electronic database such as we propose in a kiosk would create instantaneously high expectations, and failure to meet these would cost us considerable loss of credibility from the outset.

CONCLUSIONS

This two-pronged research project aimed to explore the organizational, fiicial, and technical issues associated with a single-unit kiosk, and the institutional issues associated with a region-wide, multi-modal kiosk transportation information system. While this study was limited in its scope, and we should therefore be careful about generalized conclusions, our experiences can be summarized as follows.

First, our pilot kiosk on a university campus showed that, despite a series of practical difficulties, it is feasible to install and manage a kiosk in a high-traffic area without extraordinary expense or effort, and that it can experience a reasonable amount of usage. Such a unit could fairly readily be installed in various other activity centers, such as office buildings or shopping centers.

On the other hand, patience, flexibility, and tenacity will be required to bring together the team required for a full scale deployment in Northern Virginia. Such a deployment would, of course, present a range of technical and organizational problems well beyond those tested in the first phase of this project.

For example, we would expect that the transit advisories would be based not on a localized database residing in the kiosk, but, rather, by putting the kiosks on-line with WMATA's central database. This will require a very considerable upgrade in the software being used.

Similarly, to succeed in an environment of office buildings and shopping centers, the ride-match capability would need to include the advanced software now being refined by WashCog, rather than the rather simple software developed for campus use based on FOCS's paper system.

Finally, one rather prosaic matter will need to be addressed. While the current unit is reasonably portable, it is quite heavy, and normally requires a skilled technician to re-start it in its new location. In more general applications, the unit should be lighter (but still theft-proof), and, if moved around, should be able to start up without expert assistance.

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9. ***German "Smart-Bus" Systems: Potential for Application in Portland, Oregon,*** Washington D.C. : U.S. Federal Transit Administration, January 1993; and ***California Smart Traveler System,*** Washington, D.C. : U.S Federal Transit Administration, February 1992, pages 14 ff.

10. A September 11, 1992, conference convened by the Northern Virginia Transportation Commission at its Ballston, Virginia, headquarters was the principal effort at securing cooperation.

11. Document provided to author in June 29, 1993, transmittal by WMATA Assistant General Manager for Public Service Gwendolyn A. Mitchell.

12. Author interview with Bell Atlantic official Kenneth Clark, November 12, 1993, Bethesda, Maryland.

EVALUATING APTS:

CONFERENCE PROCEEDINGS

This conference, planned and directed by Thomas Horan (then at George Mason University) and held at the Herndon, Virginia, Center for Innovative Technology on June 17, 1993, drew some hundred participants from around the country, representing a broad range of transit and transportation concerns.

INTRODUCTION

A central element of the APTS program is the development of operational test evaluations that produce valid, timely, and relevant information for program managers and policy decision-makers. Recently, a national workshop was held to provide feedback and recommendations on the APTS evaluation process, and in particular, on the role of federal evaluation guidance in the planning and conduct of local APTS evaluations. The conference was sponsored by the Federal Transit Administration, George Mason University, and IVHS AMERICA, and drew upon the expertise of 60 experts from around the country. This paper presents key findings and recommendations generated by workshop participants 'regarding current and future APTS evaluations.

OVERVIEW OF AI'TS EVALUATION

A major aim of the APTS Program is to promote application of advanced navigation, information, and communication technologies to public transportation. These include smart travel technology, smart vehicle technology and smart intermodal systems. ***Smart Traveler*** technology provides real-time transportation information to travelers through computer, communication and navigation applications. ***Smart Vehicle*** technology allows improved fleet planning, scheduling and operations of transit vehicles, and ***Smart Intermodal Systems*** provide inter-modal linkages between APTS and other IVHS technologies. APTS technologies do not exist in isolation--often these technologies are integrally imbedded in a service function. Thus APTS operational test evaluations are faced with the challenge of distinguishing between service evaluation and technology evaluation.

An APTS operational test typically consists of one (or more) technological applications introduced on either an individual or sequential basis. The test periods are anticipated to range from 3 to 4 years, with the evaluation phase expected to last approximately 1 year.

The operational tests and evaluations under the APTS Program are designed to allow for real world testing in a variety of locations.

These will involve joint ventures with state and local governments, and when appropriate may include universities and private vendors. The APTS program serves as a bridge between the actual performance of the technology at a given site, and potential applications in other locales. The quality of the evaluation process directly affects the results, and ultimately, the applicability of the findings to other areas.

A key objective of the APTS evaluation guidelines[b] (developed by the Volpe National Transportation Systems Center) is to develop a uniform and consistent set of procedures and approaches for the evaluation of APTS technologies. The evaluation guidelines provide a common framework and approach for all aspects of the evaluation process, and also suggest a content and format for progress reports.

The evaluation process for an APTS operational test is envisioned to have four stages: the evaluation frame of reference, evaluation planning, evaluation implementation, and potential evaluation spin-offs. The guidelines indicate that the second and third stages -- planning and implementation -- are to be thought of as the active phases of the evaluation process, with the first and fourth stages the "input and output" segments. In order for the information to be of value, the guidelines stress the need for evaluations to be conducted in a consistent, carefully, structured manner. The evaluation process can be thought of as the link between the operational test and technology transfer aspects of the APTS Program.

CHALLENGE!3 FOR APTS EVALUATIONS

The conference contained a mix of presentations and discussions on the role of evaluation in APTS. The following sections highlight the challenges raised during these presentations, as well as during afternoon breakout groups.

Overall, the general consensus of the participants was that the APTS guidelines are a valuable set of working methodologies and procedures. The APTS evaluation guidelines cover a number of critical elements, and provide a reasonable level of detail for use by APTS evaluators. Participants focused on the role of 'the guidelines within the larger evaluation process, and how the guidelines should either be refined or augmented to represent the range of challenges inherent in the evaluation process.

The greatest concern with the guidelines was that they lacked specificity on certain key issues. These include linkages to overall APTS objectives such as mode-change, air quality goals, balancing the needs of the various stakeholders, use of a consistent measurement of system operational costs, and improved reporting of test results. Attendees were generally in

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[b] U.S. DOT. ***Draft Evaluation Guidelines for the Advanced Public Transportation Systems Operational Tests. Prepared*** by Volpe National Transportation Systems Center, U.S. DOT, Washington D.C.: 1993.

agreement that the guidelines should -- where possible -- help provide insight into changes in travel patterns and mode choices determined through the evaluation, and what impact these changes might have on the overall traffic and air quality. This could involve measurement of household and employment travel through travel activity surveys.

Also, several participants thought that evaluation of operational tests should take operational and maintenance costs into account, as well as initial start-up-costs. A final area that drew substantial amount of comment related to the reporting of results. The groups expressed the opinion that results of operational tests need to be reported in a variety of manners and formatted to be accessible to a wider audience than just the technical transportation community. While many of the issues raised by attendees where directed at the guidelines, it was noted that some of these challenges were applicable to the evaluation process in general, rather than specifically to the guidelines. The following paragraphs highlight the specific challenges inherent in the evaluation process.

Focus of the Guidelines

Prioritizing *the Objectives:* Considering the four sets of objectives proposed by the FTA, one of the key challenges facing development of useful guidelines is to prioritize the objectives. The guidelines should foster a clear definition of the scope and overall focus of the evaluation process. This includes delineation of who the evaluation is intended for, who the participants are, and what the specific underlying assumptions in the process are. The participants felt that this was an essential factor in conducting a focused evaluation.

Further, the objectives need to fit in with the overall objectives of the FTA, the APTS program, and the objectives of the transit agency, the MPO, or the region. The guidelines should, however, allow the evaluation process to be more specific to a given operational test and demonstration project. Too often, in evaluation processes, the tendency is to gloss over objectives and then realize (after the fact) that adequate measures of effectiveness cannot be developed without those objectives. A key element of focus for determining objectives is to take into account the priorities of stakeholders for the APTS project.

Target Audiences: Defining the target audience is a second related challenge. This can be summarized as the need to consider the information requirements of evaluation customers. This needs to be determined both on the front end (during evaluation design), and at the back end (during reporting and dissemination of results). There was a strong consensus that the evaluation process needs to address the larger world of users such as regional planners, politicians, or administrators. The guidelines seem to focus on the internal world within transit management, and need additional emphasis to the world outside.

Linkage to Broader Goals

Linkage to Other Legislation: The complexity of transportation related issues are such that the evaluation process needs to consider how the possibly competing requirements of other federal legislation such as ADA, CAAA, or the labor and privatization goals of the FTA act, could affect operational tests. For example, the evaluation process could more explicitly recognize its relationship to national environmental efforts. These issues should be considered as part of the evaluation design, and not just "patched on" at the. back end of the process.

Context: Participants also expressed interest in the role of the APTS evaluation process relative to development of other technical efforts such as in the IVHS systems architecture. That is, the evaluation process needs to consider how the measures of effectiveness used in APTS evaluations will fit into the larger picture of the IVHS architecture and requirements. Additionally, the participants expressed the viewpoint that the results of the operational tests should get disseminated and reviewed both on a national scale for national comparisons, as well as be modified to address the focus of local/regional issues that might differ from the larger context.

Local vs. National Goals

The third major challenge that faces the evaluation process is the need to address the competing demands of national and local stakeholders. The needs or concerns of nationally focused groups may be quite different from those of the local groups. Examples that were generated by the participants include the contrasts between a local group's focus (on such elements as consumer response, efficacy, cost, and public perception), and the more global focus of a national perspective (such as, on lessons learned, -applicability across different environments, and investment choices facing the national program).

This leads to the question of how the guidelines allow the evaluation process to address this rather divergent set of demands. One recommendation was that a new flow diagram or flow figure be developed that focuses more on the local evaluation effort, and the local stakeholders, possibly tying in with the idea of a local evaluation committee or group, again to focus more on how it fits into the local process. Without an allowance for regional differences, the evaluations run the risk of producing "one size fits all" evaluations.

Need to Address Non-technical Issues

Terminology: Several participants expressed concern that overly complex terminology could have the effect of separating transportation (technical) professionals from other evaluators. The guidelines need to be structured and should specify -that descriptions of a particular evaluative technique used be as clear and non-technical as possible. Much of the evaluative process, as currently practiced, has a scientific or technical orientation. While this may be appropriate for certain types of public works -oriented projects, it may be less appropriate for transit or IVHS in general. The key difference is that APTS is trying to affect consumer. choice, or in a broader sense, consumer behavior. Transit has a customer orientation that may be

missing from the standard evaluation process. Thus, in this case, the evaluations need to have an increased emphasis on "soft" or non-technical issues to be truly 'effective.

Costs: The issue was raised that the APTS evaluations need to consider costs in a broader context rather than just confining the review to cost associated solely with a given operational test. The focus of the evaluation must be to look beyond the start up costs associated with a particular product, and to take into account, the long term operational and maintenance expenses. Without considering the larger frame of reference, the evaluation could potentially produce a misleading set of numbers "downstream" to decision makers worried about the life cycle costs of a particular product or improvement. The challenge for the guidelines is to determine whether the parameters used to define the cost segment should take into consideration the long-term operational costs as well as initial implementation costs.

Static vs. Dynamic Evaluations

Dynamic Evaluations: The participants in the workshop repeatedly emphasized that the APTS context is not a static environment and, consequently, the evaluations need to address the issue of evolving hardware and software. There was substantial discussion on the trade-offs between a "snapshot assessment" yielding a report at the end (summative), versus an on-going "real-time" evaluation that uses, feedback from the evaluation to continually affect the product under evaluation (formative).

As the current process does allow for some elements of formative evaluation, this introduces the associated need to ensure the production of adequate summative information. This is significant given the timetable of the operational tests, and the possibility that improvements will be made to the product or technology in evaluative "mid-stream. " This raises a follow-on question of whether or not the objective of the exercise is to freeze the test in time, providing stability to the test information, or whether the ultimate objective, in fact, is to ensure that the product of the evaluation is as usable as possible.

The group reached the conclusion that the APTS evaluations should be of a responsive, dynamic nature, with a continual feedback from, the evaluator to the project. A major concern expressed was that the situation be avoided where once the evaluators had "conclusively proved" that the project didn't work, the evaluators would be unwilling to consider changes to the project that might render the evaluation wrong. Rather, the guidelines ought to encourage a cooperative learning environment where the evaluators learn from project developments, and the project sponsors and implementors, in turn, learn from the evaluators.

Timeliness: A related issue was a concern that the guidelines encourage timeliness in the implementation of evaluations. The rapid development of transportation technology, and more generally, of advancements in hardware and software systems, require that operational tests and reporting of results be done quickly and accurately in order to be of use to other communities. Stretching out test evaluations could result in the situation of producing detailed

results on outdated technologies. The dynamic iterative process discussed above may well be a key factor in making evaluations more time sensitive.

Participants in the Evaluation Process

Objectivity: Workshop participants also agreed that a major issue to be addressed when implementing the evaluations was the need to balance the interests of the sponsor with the need for objectivity. Given the partnership context of many of the operational tests, it may not be possible to generate an "arms length evaluation, " and still have a successful project. The process needs to insure that there is some degree of participation by the vendor or suppliers. The challenge in this case is to insure the active participation of these parties, without compromising the autonomy and credibility of the report. Several participants noted that the process needs to recognize that the vendor or supplier ought to be considered or at least acknowledged as a player at the table as this process goes forward.

Role: The issue of role was also raised in the discussion on participation in the evaluation process. The guidelines contain a chart that details the various roles present in the process. These are fairly strictly defined--evaluators of the test, reviewers of work, or monitors of the process. The participants noted a variety of other roles that should be considered including, for example, that of dissemination, outreach, or promotion of the technology. The role of the local evaluation team for APTS projects was discussed. One purpose could be to explicitly define roles for all participants at the beginning of the project, so the exact position espoused by a given participant is clear.

Cultural Resistance to Change: Finally, the participants noted that APTS evaluations need to take into account such institutional issues as cultural resistance to change. The guidelines should allow some consideration for a natural reluctance to high technology change on the part of either managers or professionals as well as in the community at large.

Determining the Focus of the Reports

Audience: The results of the evaluations need to be reported in such a way that they can be fine-tuned for specific audiences. The objective might be to avoid a situation where the process generates nicely packaged evaluations that indicate a particular "widget" worked, but does not include data concerning such issues as whether the application is of any real interest to users.

Format/Utility: In terms of output, there was concern expressed that APTS evaluation guidelines on report content may be a bit too narrow. It might be a more effective approach to allow or encourage the production of different reports, or to adjust outreach efforts to the very different users of the results. The guidelines should encourage the reporting to address a'variety of concerns, i.e., "what did they do at this project, " or "this project is similar, in that it uses the same technology but 'a different environment". The guidelines should specify how the information can be made useful or relevant to a variety of different markets, large urban, small

urban, or rural. The repackaging and preparation of the results for specific audiences need to be addressed at some point in the design process, rather than as an afterthought.

Outreach/Educational Efforts

The final challenge builds on reporting of the results. The guidelines need to address the output (report) of the evaluations, as well as the manner in, which they are disseminated (outreach). Any outreach effort needs to achieve a broad based dissemination through all organizations that are stakeholders in the process. This includes professional organizations, trade organizations, and as feasible, dissemination through other alternatives such as electronic bulletin boards or "clearing houses. " This extends to the federal government's new electronic "gateway" to other bulletin boards produced government-wide. The suggestion here would be to encourage the use of media beyond purely the printed word to publish results.

The end result of the evaluation process should be a report (or alternatively, a collage of reports) that is usable and understandable to multiple audiences. Decision-makers are not going to plow through a great deal of technical information, and are more likely to be interested in knowing the various ways that a project contributes to the community.

Conversely, another set of reports might be produced for the technical/transportation specialists who have a different set of considerations in mind. In summation, there needs to be consideration given to the range of users and decision makers who are going to receive the report.

CONCLUSIONS

Therefore,, the guidelines should be seen as being derived from a set of policy goals, such as improving the environment or increasing customer satisfaction. There should also be recognition of the need to address a variety of factors that are key to evaluating operational tests, and that require more understanding and insight than can be reasonably provided by the evaluation document. Additional guidance could take the form of evaluation issue papers or issue analyses. Finally, it was noted that while many of the observations had implications for APTS guidance, to a large extent they reflected challenges inherent to the evaluation process itself.

ITS AND THE ENVIRONMENT:

CONFERENCE PROCEEDINGS

This conference, chaired by Thomas Horan (then at George Mason University) and held June 1994 in Ballston, Virginia, was the third and final conference in a series devoted to ITS and environmental issues. Participants included leaders in the environmental community, senior U.S. DOT officials, and representatives of private corporations and firms. The official report is in final preparation; presented below is the list of recommendations from the break-out workshops of the conference.

Environmental and ITS communities must establish and articulate their respective visions of the intelligent transportation systems (ITS) future.

Broaden mission statements to include environmental goals.

Establish and add performance measures.

Ensure that ITS missions include transportation and environment issues in setting goals and action strategies.

Review these goals and strategies often.

MPOs should include a vision for the whole region, sustaining bottom-up participation in the process, where appropriate.

Adjust the ITS mission to more accurately reflect society's environmental goals and objectives.

Account for both existing and emerging information technologies.

Work toward agreement on the early implementation of measure that maximize environmental benefits, while minimizing negatives.

Have local government fund a local deployment plan and build from it.

Fund several local efforts to see how NEPA might interact with attempts to deploy ITS technologies.

Provide Early Deployment Program grants directly to MPOs.

Develop M'S evaluation methodologies that permit comparison of diverse technologies. This requires that the federal government take the following actions.

Provide guidance for evaluations of IVHS implementation for early deployment that will be accepted.

Undertake long-range planning that considers alternative scenarios based on investment studies that are called for under the four ISTEA management information systems.

Mandate the adoption of ISTEA legislation at the state level.

Improve research and data regarding benefits and costs associated with ITS so as to allow improved public policy decision-making,

Establish cost effectiveness protocols for determining cost effectiveness.

State DOTs should organize and make available "lessons learned" at the State and MPO level to all States and MPOs.

U.S. DOT should provide funding for "Centers of Excellence" to conduct research on institutional issues pertaining to transportation and the environment.

Identify and explore the usefulness of various analytical techniques to understand views and preferences of public and other stakeholder groups.

Encourage U.S. DOT to continue improvements in modeling and data collection, developing complex modeling techniques that include economic, societal, racial, and ethnic groups and link land use, transportation and ITS.

Make a better effort to understand what the user wants out of the transportation system.

Establish more and better forums to share information on available analytical tools, i.e.an electronic BBS that describes available models.

Multi-modalism and inter-modalism should be part of intelligent transportation systems.

Make more effective use of currently available resources and capabilities.

Tie together U.S. DOT field personnel and IVHS America regional and student chapters in a more effective outreach effort.

Provide, in cooperation with state governments, unified guidance on training and technical assistance.

Expand direct federal assistance to include community-based organizations, in addition to MPOs.

U.S. DOT should fund local efforts to examine ways effective bundling of technology applications to maximize both environmental and overall transportation benefits.

Broaden ITS coalitions and develop institutional linkages.

Seek ways for diverse groups to communicate.

Attend to active planning with public involvement as a necessary condition for institutional change.

Specify and pursue strategies for institutional "culture change" that influence the norms, understandings, and expectations of institutional actors consistent with shared transportation and environmental goals.

Pursue policy actions that recognize substantial geographic variation in LTS institutions and require different institutional policy approaches in different places and at various organizational levels.

Create task groups that include the environmental community.

Seek to create. a demand for systems that are sensitive to transportation a&environmental needs through the use of marketing strategies that encourage institutional change.

Make contracting procedures more flexible to encourage the consideration of local contractors.

An educational initiative is required.

Establish a common language for the environmental and transportation communities.

Target local community involvement through dissemination of technical information and guidance for MPO and other local/regional staffs in environmental and planning areas.

Add user participation at the front end in the way we now have evaluation at the end of a particular project.

Convert ITS into language that has meaning to the citizen using the transportation system and the **MPOs.**

Have **IVHS** America encourage local level participation in **IVHS** America through incentives for membership.

Federal funds should be directed to local 'entities to encourage this broader participation

Alternative fuel vehicles work needs to be integrated or coordinated with ITS work.

TRANSPORTATION, INF'ORMATION TECHNOLOGY AND PUBLIC POLICY:

CONFERENCE PROCEEDINGS

This conference, organized by Jonathan Gifford, Thomas Horan (then at George Mason University), and Daniel Sperling (University of California, Davis) and held April 1992 at the Asilomar Conference Center in Monterey California, was the first national IVHS conference to include the perspectives of prominent environmentalists. Representatives from Rails to Trails, the Union of Concerned' Scientists, the California Energy Commission, and the California Air Resources Board, presented environmental perspectives on IVHS, prompting spirited discussion of impacts of IVHS on clean air.

INT'RODUCTION

The recent advent of advanced communications and control technologies in road transport, known variously as intelligent vehicle-highway systems (IVHS) in the U.S. and as road transport informatics (RTI) or advanced transport telematics (ATT) in Europe, has created considerable enthusiasm in the transportation community (the term IVHS will be used hereinafter). These technologies have the potential to reduce highway congestion and delay, reduce air pollution, and improve the quality and timeliness of travel-related information for both single- and multiple-occupant vehicles and transit.

Until recently, most analysis focused on technical capabilities and the technical challenges associated with the design and widespread implementation of IVHS. Attention has now begun to shift to the policy issues implicit in the continued development and implementation of these technologies. [1] Indeed, increased attention to these issues is a logical extension of the success of these technical efforts. These policy and implementation issues encompass a wide range, including legal liability, the respective roles of public and private institutions, intergovernmental relations, international competitiveness, standardization, environmental impacts and land use and urban form.

These concerns inspired the idea of a workshop on IVHS policy issues. The initial concept included all policy areas, but it quickly became apparent that a sharper focus would be necessary to ensure constructive debate. The workshop therefore focused on institutional issues

and the environment and was conceived to be the first of a possible series of IVHS policy forums.

The workshop, entitled "IVHS Policy: A Workshop on Institutional and Environmental Issues," was organized by The Institute of Public Policy at George Mason University and the Institute of Transportation Studies at the University of California, Davis." The specific objectives of the workshop were: (1) to stimulate debate and initiate an exchange of views between those within and outside the IVHS community; (2) to identify the core institutional and environmental policy areas that deserve further attention; and (3) to identify what actions need to be taken at the policy, research, testing and other levels to ensure adequate attention to these core policy areas. The workshop program appears as an appendix to this introduction.

In order to inform discussion, the organizers commissioned several original white papers and collected other relevant papers. These papers are presented in this volume.

WORKSHOP FINDINGS

A Vision for IVHS. The papers, presentations and discussions at Asilomar identified several core environmental and institutional issues. The first is the need for a compelling vision to guide IVHS investments and ventures. In the absence of a unified vision of IVHS, it may be impossible to create-much less maintain-the necessary political support to bring an alternative future into being. A unifying vision for IVHS could galvanize the political support for the development of a dramatically different kind of transportation system. Not to have a vision risks IVHS being nothing more than a "haphazard assortment of gadgets."

The standard vision of highway applications of IVHS, moreover, may not be particularly inspiring to the environmental community, which may be more responsive to goals related to the quality of urban 'or metropolitan life. It is not that IVHS is inherently hostile to the environment. Rather, its potential to enable environmental enhancements has not been a central focus of the visions that have been developed to date.

The development of a shared vision suggests the need for outreach and education to involve those in the associated policy domains and user groups, including the environmental and planning communities. Central to the success of such efforts is keeping all' parties 'informed about IVHS developments, involving a broad range of interests in policy and program development and responding to issues and concerns raised by the' different groups.

One mechanism for such outreach would be a forum of IVHS policy experts and analysts for discussing research activities, assessing current and future policy needs and encouraging interdisciplinary approaches. This forum could include a continuation of the workshop held at Asilomar, perhaps 'recurring on an annual basis, with each focusing on a particular policy theme.

Public and Private Roles

The second key issue relates to the respective needs of public and private enterprises in the development of IVHS systems. Should IVHS bedevised in an integrated manner to achieve the synergistic goals of an integrated system-a top-down approach-or as "loosely coupled" systems that can be more responsive to market preferences and opportunities? An argument for the top-down approach is that system-level technological changes that incorporate, for example, advanced vehicle control systems (AVCS) may not come about in the absence of a broad-scale system architecture. Thus, a failure to develop a system architecture may be essentially an abdication of the potential of IVHS to effect system-level changes. Moreover, immediate market interests may not necessarily encompass the public goals of IVHS (such as reduced congestion or improved air quality) and an integrated system may better support the public interest in these areas.

One the other hand, a top-down "big technology" approach may be inappropriate to the nature of IVHS technology and to the institutions involved. System designers may be "out of sync" with broader market forces that favor the development of specialized, niche-oriented technology, as evidenced by the trend throughout the communications industry. Perhaps IVHS technologies should be decoupled from an overall transportation vision to focus the technology as a mechanism to achieve other goals, such as using automated vehicle" identification to develop market-based approaches to improved air quality.

It is essential to examine the institutional implications of alternative IVHS system architectures. Appropriate directions For IVHS development should depend in part on the policy implications of various levels of coupling for IVHS technologies, from a tightly coupled universal architecture to a loosely coupled set of individual applications.

Education and Training

A third key issue is' the challenge to IVHS technical professionals posed by IVHS environmental and institutional issues. The appropriate application of IVHS requires careful attention to environmental implications and resource and institutional constraints, as well as an understanding of technical feasibility. As with any complex socio-technical system, the ability to manage IVHS projects successfully requires transportation managers and professionals who are flexible, who understand rapidly IVHS technology and -who are sensitive to the changing roles of governmentand private institutions in infrastructure supply, operation and management. They need a "dual competency" in the technology being developed and the institutional and market context.

These concerns have serious implications for education and training. Educational programs should train professionals to understand alternative systems of values and technology, with programs geared to all levels. of higher education (undergraduate, graduate and continuing education).

Truth and Uncertainty

The most significant policy challenge is the need 'and the difficulty of fashioning a successful technical program that is responsive to the full range of transportation constituencies. As IVHS moves from the technical sphere into implementation and dissemination, attention is shifting from what is technically feasible to what is socially desirable. The application of IVHS technology becomes subject to varying and competing notions of appropriate public policy and invariably involves evaluating tradeoffs between mobility, accessibility, environmental quality, energy dependence and economic productivity.

Ideally, policy and investment will be informed by scientific fact and by a recognition of uncertainty about the relationships between transportation, institutions and the environment. But values can color one's assessment of objective fact, and can also powerfully color one's assessment of uncertainty. The treatment of uncertainty plays an especially important role in explaining opinion regarding the environmental impacts of a technology.

A key challenge to the IVHS community is to untangle fact from value judgement. If the interested parties are able to identify a body of fact on which they can agree, then progress on IVHS implementation will be more orderly. Which IVHS technologies, for example, can contribute to the mobility and air quality goals of metropolitan dwellers? Those that do will be most attractive. Much more knowledge is required about the full costs and benefits, direct and indirect, of transportation investments, including IVHS. This will involve identifying fully the externalities associated with all modes of travel, including the automobile and transit. It will also require careful analysis of various approaches to internalizing the costs of travel, including the environmental costs of IVHS.

It is also important to identify key areas of uncertainty, responding to the broad range of policy domains affected by IVHS and the body of scientific knowledge. Values and perspectives exert a powerful influence on the interpretation and specification of uncertainty. They also affect perceptions about what constitutes conservative treatment of uncertainty and where the benefit of doubt should reside. Research is needed on ways to recognize, assess and address the inherent uncertainties associated with IVHS technologies, especially in the assessment of environmental gains and/or tradeoffs from alternative IVHS configurations.

IVHS field operational tests are key opportunities to obtain data that could inform several of the issues under discussion. While these tests often have a technological orientation, it may be appropriate to develop a more diversified research approach that would include non-technical elements.

Recent Developments in IVHS Institutional and Environmental Policy

Since the Asilomar workshop, IVHS AMERICA's Committee on Institutional Issues (chaired by G. Sadler Bridges) has moved to advance discussion of institutional and policy issues through the creation of working groups in several areas, including policy issues, investment

capital issues, environmental issues and educational issues. The full committee convened a series of meetings during the summer of 1992 to develop a research agenda on institutional issues for consideration by the U.S. Department of Transportation.[3] Similar work within IVHS AMERICA's Benefits, Evaluation and Costs Committee (chaired by Donald E. Orne) has also raised institutional and environmental policy issues.[4] In addition, the Federal Highway Administration and the Federal Transit Administration have both put forward research agendas that incorporate IVHS institutional and environmental issues, including several major research procurements that are currently in process.

These activities reinforce many of the themes raised at the Asilomar and other conferences. There has been a strong emphasis on public and private. roles, interjurisdictional issues, privacy, economic development, productivity and competitiveness, the relationship between metropolitan planning and IVHS and contracting and procurement.

Concluding Remarks

In closing, we note that improved understanding of IVHS institutional and environmental issues serves the public interest by allowing debate that is informed by a wider range of values and interests, although it may not benefit every interested party. The occasional reluctance to explore seriously and fully these institutional and environmental issues is articulated well in the quite different context of acid rain research:

> [T]o the doctrinaire "true believer," scientific research is a potential threat. To the politician who has championed a cause, future research findings might be very embarrassing. To the federal agency with embedded programs, external review and a diversion of funds challenge the stability of its staff and institutions. . . . There are only a few groups deeply interested in the success of a . . . research program: the scientific community (professionally motivated), the affected production sector (economically motivated), and the few intellectual leaders genuinely concerned with the habitability of the world in the next century.[5]

The institutional and environmental policy issues raised by the dissemination of IVHS technologies may threaten the conventional wisdom, operating assumptions and interests of some stakeholders. For example, some see mobility enhancement as a positive outcome, while others see it, as negative, leading to more energy use, pollution and urban sprawl.

Yet IVHS technologies can facilitate environment-enhancing actions. Automatic vehicle identification (AVI) coupled with time-of-day congestion pricing might allow substantially better use of existing facilities and reduce tailpipe emissions related to peak-hour congestion. Emission monitoring and/or pricing might allow policy makers to target the worst polluters. Advanced traffic management and information systems (ATMS and ATIS) may smooth flows and reduce emissions, Advanced public transportation systems (APTS) could substantially improve the accessibility of information for those. seeking alternatives to the single occupant vehicle.

The most central policy challenge for the IVHS community is how to encourage consensus where possible and how to resolve conflict where consensus is impossible. Complete consensus on every issue is a laudable but unachievable goal. There will be conflict. But an open, broad-based, inclusive process that incorporates a wide range of values and interests, including planners, environmental interest groups, various units of government, private firms and end users, will facilitate consensus where it is possible. The Asilomar workshop sought to open the debate to new parties and interests. The papers in this volume, while sometimes advocating controversial views, seek to advance that debate further.

SUMMARIES OF CONFERENCE PAPERS

"Intelligent Vehicle/Highway Systems: An Environmental Perspective". *Deborah Gordon"*

Since roads are used essentially free of charge, the true cost of maintaining our highway system is about $95 billion and the social costs are an additional $285 billion, while total user taxes generate only $35 billion. This paper evaluates the environmental impact of each of several IVHS scenarios. Negative impacts of IVHS are: 1) increased travel, i.e. VMT, 2) increase in travel on currently underutilized arterials, most collectors and even local streets, with subsequent increases in pollution and negative impacts on the equality of life, and, 3) absorption of public and private resources to the extent that other technologies and innovative solutions will be grossly underfunded. Advantages are that certain IVHS technologies could buy time to develop better policies and technologies. The author sees Advanced Driver Information Systems (ADIS) and Automated Vehicle Control Systems (AVCS) as negative developments, but Advanced Traveler Information and Services (ATIS), Automatic Vehicle Information (AVI), Automatic Vehicle Location (AVL) and Weight-in-Motion/Automatic Vehicle Classification (WIM/AVC) as positive.

"Air Quality Impacts of IVHS: An Initial Review". *Daniel Sperling, Randall Guensler, Dorriah L. Page and Simon P. Washington*[d]

Advanced transportation technologies, ranging from the provision of real-time traffic flow information to fully automated in-vehicle control systems, are promoted as a means of not only reducing congestion, but also to make vehicle travel ". . . more energy efficient and environmentally benign."[6] In this paper, we explore the air quality implications of deploying advanced technologies, hereafter referred to as Intelligent Vehicle Highway System (IVHS) technologies.

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"All of the Institute of Transportation Studies, University of California, Davis, Davis, California.

"Exploring the Transportation-Environment Nexus: The Role of IVHS in Reducing Urban Air Pollution Caused by Congestion and Super-Emitting Vehicles". ***Lamont* C. *Hempel*[e]**

Transportation programs that offer multiple side benefits for environmental quality, energy security, and land use improvement are likely to become increasingly important in America's future. This paper focuses on the. potential role of IVHS development in helping to capture such benefits for the protection of urban air quality. Because traffic, congestion and gross polluting vehicles account for a large and growing share of mobile source emissions, special attention is given to opportunities and strategies for integrating IVHS technology with environmental measures that reduce pollution from these two sources. Three strategies are presented: (1) expansion of electronic road pricing to abate congestion-related emissions, (2) use of remote sensing technologies to monitor on-road emissions, and (3) development of electric vehicles to lessen dependency on the internal combustion engine. Each strategy' is briefly explored with an eye to possible linkages between transportation, air quality management, and IVHS technology.

"IVHS and Transportation Demand Management Meeting the Challenges Tog&h-er?", ***Jan K. Baird***

The author hypothesizes that increasing capacity with IVHS will fail to meet the objectives of reduced congestion, cleaner air and reduced fuel consumption. However, if IVHS is tied to an intensive transport&ion demand management (TDM) program it may be successfully applied. The author identified several counter-TDM policies of public agencies, such as, most local planning agencies have increased the minimum number of parking spaces required for office and retail buildings, have discouraged telecommuting and have fought compressed work weeks. The author concludes that the nation must invest in TDM research and long term implementation.

"Advanced Public Transportation Systems (APTS): Multimodal and Alternative Market Applications of IVHS". ***Robert W. Behnke*[g]**

Intelligent Vehicle Highway Systems (IVHS) technologies can be used to develop new types of public transportation services and to integrate these new services with conventional transit, paratransit and ridesharing modes to form multimodal, advanced public transportation systems (APTS). Preliminary market research studies indicate that APTS can reduce traffic congestion, gasoline consumption, air pollution and mobility problems at a low cost to taxpayers.

A user-friendly public Advanced Traveler Information System (ATIS) is a critical component of a well-designed APTS. By pressing one or two buttons on a touch-tone telephone,

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personal computer (PC), videotex terminal or other input/output device, a user should be able to quickly find the "best" way to get between two points by public transportation.

A well-designed multimodal ATIS should also be able to quickly tell drivers of public transportation vehicles, delivery trucks and other public or private vehicles the "best" routes to take to get between two points, based on the latest information about accidents, construction projects, traffic delays, etc. Integrating ATIS with other information services (e.g., home-shopping, telebanking, electronic mail, video games, interactive training programs) could reduce the need for some trips and reduce costs to information service providers, users and taxpayers.

Implementing APTS, ATIS and other IVHS applications will require transformational leaders who have the "ability to creatively destroy and remake their organizations". These leaders must develop and communicate a new vision and get others to commit themselves to it. Those who have studied the strategic transformation of different types of organizations have found some common characteristics. Awareness of these common characteristics. should be useful to those who propose to use IVHS technologies to transform highway and public transportation organizations.

"Approaches to the Economic Evaluation of IVHS Technology". Richard R. Mudge, Ph.D.[h] ***and Cynthia S. Griffin, Ph.D.***[i]

The authors explain that the direct benefits, (user time savings, reduced fuel consumption, reduced accidents, etc.), identified in the economic analyses' 'of traditional transportation improvements are only part of 'the benefits that will most likely accrue from IVHS investments. In addition, there are benefits to the general economy such as productivity gains, better access to labor, materials and markets, savings in logistics (warehouse, distribution centers, inventory, etc.), and lastly there are social benefits such as reduced anxiety, increased convenience and the like. The authors then explain the complexities in identifying and quantifying these non-direct benefits, and outline a research program that would investigate these complex benefits issues.

"Intelligent Vehicle Highway Systems: Private-Sector Investment Capital and Regulatory Issues". ***George V. Robertson, CFA and Mark A. Roberts, CPA***[j]

The most significant issue in the development and deployment of Intelligent Vehicle Highway Systems (IVHS) in the United States is how they are to be financed and who will ultimately pay. The histories of other industries seem to indicate that economic issues (not technological, political or social issues) are often the most important factors in the development of new markets. Consequently, we believe that many bold initiatives in the past have failed mainly because of economic factors. If so, the issue of who pays for IVHS is of critical importance. We believe that the private and public capitals markets and private-sector

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investment initiatives are the most efficient and desirable ways to pay for and deploy IVHS. This report, while-not being necessarily conclusive, will raise what we believe are some .of the key factors that must be addressed if policymakers are to foster vigorous private-sector investment, as well as, those issues policymakers should confront in shaping a regulatory structure and environment to attract investment capital.

"Command vs. Spontaneous Coordination in the Development of- Standards: The Case of Intelligent Vehicle Highway Systems". ***Michael* I. *Krauss*[k]**

In the face of this widely-advocated government intervention, this paper strikes a dissenting note. Its central contention is that the case for government-imposed standards has not been made, even in WI-IS-like situations where government intervention is already pervasive, and that the "public good" of standards can be, and has been, provided by markets spontaneously, and that there is simply no reason to believe that governments can do the job any better than does the market.

"The Influence of Human Factors and Public/Consumer Issues on IVHS Programs". ***Laura Luce, Hal Richard, Wesley S. C. Lum*[l]**

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

"State and *Local* Institutional *Issues* in IVHS". ***Dr. Christopher J. Hill"***

The development and implementation of the intelligent vehicle-highway system (IVHS) presents challenges to all levels of government, as well as private sector participants. However, the greatest of these must be considered to lie with state and local agencies. Ultimately, it is these two groups that will take much of the responsibility 'for system deployment and for satisfying the traveling public as to the value of IVHS.

This paper reviews some of the key issues that state and local government agencies are currently addressing in the course of planuing for or deploying IVHS technologies. The paper draws principally on two case studies in which the author is participating: Minnesota Guidestar, a statewide M-IS initiative; and ENTERPRISE, a multi-state IVHS coordinating initiative. It concludes by discussing organizational arrangements adopted in these two programs aimed at

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addressing the issues described. It is recognized that these two studies represent only a limited perspective on state and local institutional issues in IVHS. However, the two initiatives are both recent efforts and have been extremely successful in addressing organizational issues. For that reason, it is believed that they can serve as useful models for other start-up IVHS programs.

"Evaluating IVHS: Key Issues in Institutional and Environmental Assessments of IVHS Technologies". *Thomas A. Horan, Ph.D."*

Interest in the application of advanced technologies to the nation's transportation infrastructure has mushroomed over the past five years. In particular, the potential gains from applying advanced communication technologies to the nation's highway and transit systems has engendered considerable support across a spectrum of agencies and industries. These intelligent vehicle-highway systems (IVHS) involve a host of technological configurations and capabilities ranging from centralized traffic control centers, to traveler information systems, to fully automated freeways. Recent federal and state legislation has given a tremendous boost to research and development of IVHS, with well in excess of $100 million being spent annually on various IVHS tests and research projects.

The eventual cost of deploying IVHS could be quite high, perhaps in the hundreds of billions of dollars.[7] A program of this size would approach the scale of infrastructure investment made by the interstate system during the last three decades. Not surprisingly, the prospect of this massive technological infusion into the transportation infrastructure heightens concern that the deployed systems will be both efficient and effective in achieving their transportation goals and that the various transportation-related institutions will rise to meet the requirements of such a technologically demanding system. For this reason, discussions and debates are occurring as to how IVHS could best be structured to maximize its improvements to the surface transportation system and how new institutional arrangements might facilitate the cost-effective implementation of IVHS technologies.

The purpose of this paper is to contribute to this discussion by presenting a range of evaluation issues surrounding IVHS and then focusing-in on two: institutional and environmental implications of IVHS. The paper first discusses recent federal legislation and related reports that set an overall policy context for IVHS research activities and then analyzes specific institutional and environmental features of IVHS and how they could be incorporated into field tests and other evaluations.

"IVHS Institutional and Environmental Issues: Lessons from Other Technologies". *Aviva Brecher and Gary Ritter*[o]

The Volpe National Transportation Systems Center, an element the U.S. Department of Transportation (US. DOT) Research and Special Programs Administration (RSPA), has been

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involved in advanced transportation systems research and development for over two decades. As part of the resurgence of national interest in advanced transportation systems, the RSPA Volpe Center is revisiting previously unresolved challenges in applying advanced technologies to surface transportation. It recently conducted a series of seminars to heighten awareness within the transportation community regarding emerging technology-based opportunities, -challenges and constraints. This paper reflects upon efforts to achieve transportation system innovations outside the realm of Intelligent Vehicle Highway Systems (IVHS) in an attempt to identify relevant "lessons learned" for IVHS, while acknowledging, of course, that approaches tailored to IVHS will be required.

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METROPOLITAN AREA DEPLOYMENT OF IVHS:

CONFERENCE PROCEEDINGS

This conference, organized by Brien Benson and held December I992 in Alexandria, Virginia, was the first major IVHS conference to bring together national& recognized IVHS experts to focus on issues associated with metropolitan area deployment of IVHS. Following presentations by national experts, local transportation officials and private sector representatives broke into working groups to discuss issues of IVHS deployment in Northern Virginia and elsewhere in the Washington, D.C. area. The following paper is in two parts:' a background statement on traffic issues, in Northern Virginia, and a summary of the findings of the I992 conference in Alexandria.

THE TRAFFIC PROBLEM IN NORTHERN VIRGINIA

Traffic congestion is a major issue in Northern Virginia. The last two supervisorial elections in Fairfax County swung on this issue. Numerous public opinion polls show it to be the area's number one concern. And in at least one blue-ribbon workshop on the region's future, sponsored by George Mason University in 1992, business and political leaders agreed that transportation should be the top priority in coming years'.

The region's congestion is due primarily to the surge of economic growth during the 1980s, when, typically for fast growth areas, population and travel expanded for quicker than infrastructure. Between 1980 and 1990, population in the area grew 32%, while registered vehicles increased by 50%, and vehicle miles traveled soared 68 % , according the U.S. Census Bureau figures. Also according to the Census Bureau, Northern Virginians spend some 32 hours every year sitting at a dead-stop in traffic?.

Economic and demographic trends have been exacerbated by two critical facts of the region's road network. First, the lack of a strong overall grid pattern of roads complicates the job of travelers trapped in congested arteries seeking out alternative routes. And second, in a region that sends tens of thousands of commuters daily into the District, the Potomac River's bridges constitute major bottlenecks.

Efforts to address traffic flow problems are complicated by the different perspectives of different governmental jurisdictions. Arlington County, for example,, has adhered closely to its overall strategy of promoting developing along the MetroRail route. Alexandria has remained sensitive about through traffic that threatens its residential character. And fast-growing Fairfax County has been focusing on how build the infrastructure needed by rapidly increasing numbers of vehicles. Finally, the "Dillon-rule"-based control by the state over local transportation priorities has, in cases, led to frustration of local efforts to meet local transportation needs.

Transportation Reform in Virginia

The first recognition at the state level of. the unique traffic problems associated with growing suburban areas such as Northern Virginia was taken by Gerald L. Baliles, Virginia's Governor from 1986-1990, who tried to make transportation policy more accommodating to public concerns. As explained in?

> The Baliles transportation initiative was based upon the premise that the elites who have traditionally made highway policy in Virginia do not make "good" policy if their policy decisions do not accommodate the desires of the majority of the state' citizens. Concomitantly, the initiative represented the proposition that allowing pluralism, in both citizen input in to the administrative decision-making process and in the legislative decision-making process, is normatively superiority to transportation policy-making by engineering elites. As a result, the Baliles transportation initiative rejected the traditional traffic engineering consensus that governed Virginia highway policy-making before the 1980s and attempted to replace it with majority/pluralist policy-making regime.

Baliles appointed Ray D. Pethtel as Highway Commissioner, the first such appointee since George Coleman, who held the office in the early 1920s, who was not a civil engineer.[4] Pethtel has implemented this policy of citizen involvement in the transportation planning process. As explained by the Bowman study:[5]

> Many of Pethtel's efforts were directed at making the Department's engineers more sensitivity to the environment of highway policy: the concerns of citizens, local governments, the legislature, and special. interests, such as truckers:. By decentralizing control of many functions to the District Engineers, Pethtel sought to move the Department closer to its clients and constituents. By increasing the channels of communication within the Department and with the public, he sought to make the Department's decision-makers aware of citizen's demands for roads. Pethtel's administrative initiatives demonstrated that, unlike his engineer predecessors, who emphasized well-engineered highways that fit into the inter-city road scheme, he was more concerned with process of highway de&ion-making itself.

Under Commission Pethtel VDOT has certainly made efforts to deploy IVHS in Northern Virginia to help address the region's traffic concerns. A VDOT Transportation Management Systems center. in Arlington maintains control over freeway on-ramp meters and electronic variable message signs (VMSs) along the interstate highways of Northern Virginia. And VDOT is currently. negotiating for the placement of an electronic toll collection system along the Dulles tollroad, which leads from the Beltway in Northern Virginia along a major commercial and residential corridor out to the Dulles International Airport.

While impressive efforts, all of these initiatives have confronted significant institutional barriers. The usefulness of freeway on-ramp meters remains unclear, partly because compromises in signal timing were necessary to secure the agreement of all affected communities.

The VMSs, to judge by widespread anecdotal evidence, often contain inaccurate information. Congressman Frank Wolf was probably speaking for the region when he said at a March 1993 Congressional hearing on IVHS in Washington, D.C., "These electronic traffic information signs don't do me any good; they are almost always wrong. "[6] It is not clear whether additional resources -- more traffic sensors embedded in highways, more closed circuit televisions, additional staff -- would substantially improve the performance. of the VMSs. At the same Congressional forum, Congressman Wolf expressed his frustration with VDOT's inability to speed the procurement of the Dulles tollroad electronic toll collection system, again undoubtedly reflecting the attitudes of his constituents.

Northern Virginia has undertaken two additional efforts at IVHS deployment, both of which have confronted severe institutional barriers. One effort, in which this writer is involved, involves a multi-jurisdictional test of an information kiosk containing both an instantaneous ride-matching system and an interactive information system incorporating route and fare information for all transit operators in the region. The Washington Metropolitan Area Transportation Authority (WMATA) has been somewhat cool. towards this effort, viewing both ride-sharing and suburban transit operations as competitive.

The second effort, the Dulles Area Transportation Information System (DATIS) organized a team of-local jurisdictions, VDOT, and a private sector vendor (MetroTraffic) for the purpose of presenting for an FHWA pilot deployment, grant a proposal for a public-private IVHS system along the Dulles corridor. Unfortunately, the application was denied, and the informal explanation given was that the group did not, seem. to have a "champion" willing to drive forward the deployment effort.

In all of these efforts at IVHS deployment, institutional issues played a major role, and in only one of the five cases -- that of VMSs --'were technical hardware or software issues of any real significance. There is in Northern Virginia a striking ambiguity that confronts those wishing to deploy IVHS.

On the one hand, Northern Virginia should be a favorable environment for application of IVHS technologies. Traffic congestion is the preeminent political issue. in the area. The population has an extremely high educational level, which is generally considered a factor favorable for public acceptance of IVHS. 'And a substantial proportion of national policy-makers concerned with IVHS commute from their homes in Northern Virginia to offices in Washington, D.C. ; they might be expected to want to test out IVHS in their own "back yard".

On the other hand, serious jurisdictional issues stand in the way of IVHS deployment. Northern Virginia is split into welter of separate counties and cities with divergent transportation priorities. Northern Virginia as a region has rather strained relations with the rest of the state of Virginia. And the overall federal area comprised of Northern Virginia, suburban Maryland, and the District of Columbia has traditionally not been particularly successful in establishing or carrying out region-wide programs.

CONFERENCE ON NORTHERN VIRGINIA DEPLOYMENT OF IVHS

In the face of these considerations, a conference to explore the possible applications of IVHS in Northern Virginia was held in December 1992 in Alexandria, under the direction of the IVHS Program at George Mason's Institute of Public Policy, and co-sponsored by the Northern Virginia Transportation Commission, the Northern Virginia Planning District Commission, the Virginia Department of Transportation, the Federal Transit Administration (FTA), and the Federal Highway Administration (FHWA).[7]

Speakers included the Administrator of FTA, the Deputy Administrator of FHWA, Los Angeles transportation chief Ed Rowe, leaders in the application of IVHS from New York, Boston, and consultants from around the nation. The conference was attended by some 100 people, roughly equally divided between private and public sector leaders, including both elected and appointed officials from federal, state, and local government.

This was the first conference in the country to bring together nationally-recognized IVHS experts to discuss issues surrounding deployment of IVHS in a specific region. Most IVHS conferences and workshops deal with policy or technical issues at 'a national level.

The afternoon of the one-day conference was devoted to workshops, which focused on three topics: general discussions of IVHS, under the title, "Using IVHS to Control Congestion"; transit and ride-sharing; and the Dulles corridor. Following are the key recommendations from each working group.

Using IVHS to Control congestion

Recommendations fell into the following categories:

Trafficoperations

-- Increase substantially the number of adaptive traffic signals, on both surface streets and freeway on-ramps.

-- Speed, incident clearances, for example, by assigning more roving emergency tow vehicles to the area.

-- Add remote Transportation Management System centers, linked the main Arlington center through high-capacity fiber optic lines.

Traffic information

-- Petter integrate the collection, analysis and communication of traffic information from throughout the region. For example, improve communications between VDOT's Arlington TMS and MetroTraffic Control's Bethesda studio. There is a need to develop better techniques for validating information collected through traffic sensing, systems. Television monitoring of incidents is often useful, but in some cases it is not possible to verify the incident except on sight.

-- Display on variable message signs estimates of estimated incident clearance times.

-- Promote multi-agency use of the area's VMS system, permitting incremental addition of VMSs by different jurisdictions.

Planning and coordination

-- Promote coordination throughout Northern Virginia,. including Loudoun and Prince William Counties, of long-range planning,, emergency contingency planning, and development of traffic information sources. Such coordination should occur through regular inter-agency meetings at both the policy and technical level.

The Los Angeles Smart Corridor and New York/New Jersey TRANSCOM are worth studying as possible models, and particularly the TRANSCOM model might be adaptable to the Washington area. It was noted that both TRANSCOM and Smart Corridor developed in a "bottom-up", rather than "top-down" fashion.

-- Develop pre-planned alternative routes in case of major incidents. This is a particularly important task in view of the area's lack of grid road network, which would offer more obvious alternative routes.

Analysis

-- Develop algorithms for region-wide traffic patterns. Localized traffic algorithms already are well-developed; the difficulty lies in region-wide forecasting.

Education

-- Conduct active outreach program explaining IVHS to the community, tapping into the high level of education throughout the region. VDOT's TMS could broaden dissemination of traffic information through Virginia's Channel 8 and use of the radio, particularly during the morning rush period.

Public transit and ridesharing

-- Use Smartcards to provide regional, intermodal transit passes.

-- Link transit and ride-share databases and information systems to provide "one-stop shopping". Support the plan to integrate the, Metropolitan Washington Council of Government's ridesharing system with WMATA's transit route-and-fare database. Establish kiosks for automated transit information and same-day ridematching.

As possible demonstration sites for new kiosks or other audiotex/videotex technologies, consider outlying jurisdictions with no current transit service, whose residents may wish to drive or ride-share to the new Virginia Railway Express commuter rail system.

-- Use "instant ride-matching" lines (known as "slugs") at the Springfield shopping center, where passengers seeking rides join drivers unknown to them to qualify for HOV lanes, as a control group for experiments in the safety and social acceptance of MIS-provided ridesharing techniques (such as "parataxi").

-- Use IVHS to help enforce the area's many diamond HOV lanes.

-- Transit operators should use M-IS to share information about delays with each other and travelers.

-- Use ongoing efforts at the National Capital Area's Transportation Planning Board to share regionwide transit simulation models for microcomputers. Test the effects on air quality and congestion of various IVHS/APTS proposed applications.

-- An aggressive education campaign should be initiated for public officials, staff and citizens, including school children who should take field trips to learn about the technology and become comfortable with transit and ridesharing options before single-occupant vehicle habits are formed.

Dulles corridor

-- Once electronic toll collection is installed, consider congestion pricing along tollroad, i.e., higher charges during rush hour. Purpose would be to ease congestion, while using the added revenue from congestion pricing to provide subsidies for other programs such as HOV or transit.

-- HOV Support Program.. The success of any congestion pricing program would be dependent upon an adequate supporting network of services. While some of these are in place (such as the Virginia Railway express), others would need to be developed over time (such as express bus and -- ultimately -- rail along the corridor). Related application of advanced public transit system (APTS) technologies would facilitate use of existing and new transit services.

-- Integrated Information System. The overall aim should be to develop an integrated information system that provides commuters with timely information. Congestion pricing can be viewed as information about the cost of commuting. Other information -- such as real time traffic and HOV information -- is also needed by the commuters. The IVHS system should integrate these for the corridor, so that the commuter can make an informed choice.

-- Institutional Support. The recent problems with HOV lane introduction in the corridor underscores the need to proceed in a coordinated fashion. A multi-agency (public/private) team should be established early on to guide IVHS implementation. This group should bring together all of involved parties to establish a consensus on short-term and long-term actions.

Conclusions

Three central themes emerge from these recommendations.

First, there was a clear orientation to incremental improvements in transportation technologies, as opposed to some of the more "high tech" types of IVHS. This reflects the pragmatic nature of the conference participants, virtually all of whom are practitioners, either public or private sector, in the transportation field.

Second, there was vast attention given to the need for inter-jurisdictional planning and cooperation, reflecting both the opportunities, and the challenges, of such cooperation.

And third, a recurring theme in all workgroups was the need for public involvement and understanding. There have been numerous reminders in recent Northern Virginia history of how transportation initiatives, however well-intended, have foundered for lack of public acceptance.

To the degree that IVHS can accommodate these issues, there was a widespread sense that the emerging information technologies could, indeed, offer some hope for relief from congestion in Northern Virginia.

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IMPLEMENTING ISTEA: ISSUES AND EARLY FIELD DATA

This paper by Jonathan Gifford, William Mallett, and Scott Talkington examines how ISTEA can best be implemented in metropolitan areas like Washington, D.C. The paper cautions that, while interest groups are often more concerned with influencing capital than operating expenditures, the effect of capital budget changes will often not be felt for years to come.

ABSTRACT

This paper examines implementation issues associated with the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). In particular, it discusses whether ISTEA is more a truly revolutionary change in policy, or a continuation of the status quo. The article considers these issues in the context of a legislation battle that did not produce clear winners and losers, where both sides appear to have achieved what was important to enable a test of their own hypotheses, and where each has an interpretation of what the ('spirit" or the intention of ISTEA is, and how it ought to play out.

The result, is an "experiment" testing the viability of two world views. One view sees a public policy largely at odds with the real public sentiment on transportation, where the will of the people has been distorted by federal intervention to favor SOVs and urban sprawl. Given an alternative, this view predicts the public will opt for different behavior and lifestyle changes. The other view sees public policy as largely consonant with abiding public preferences, behaviors and land use patterns that are unlikely to change quickly as a result of the flexibility and local focus introduced by ISTEA.

The complexity is compounded by the new role of Metropolitan Planning Organizations, especially with regard to requirements for public participation and clean air. Finally; since the expression of public preference is related both to the outcome of the policy experiment and to the ongoing legitimacy of the institutions (including MPOs) charged with its implementation, this participatory framework is critical, to understanding the future direction of transportation policy.

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is one of the most widely heralded pieces of transportation legislation since the 1950s. Is it truly a revolutionary change in transportation policy? Does ISTEA, together with recent clean air legislation, remake transportation planning, programming and financing, as well as the

intergovernmental system through with they operate? Or is it merely a modest shift from the previous trajectory?

The analysis of such broad scale questions about the impact of transportation policy are not easy to assess systematically. Nobel economics laureate Robert Fogel, in his assessment of the impact of railroads, for example, underscores the difficulty of assessing even so dramatic a change as that. He. concludes that the conventional wisdom that railroads were instrumental to 19th century American growth was simply not well founded. Uncertainty about an *ex post* assessment of a technology of that scale gives pause to an assessment of the significance of ISTEA and the Clean Air Act Amendments of 1990. Clearly, we will have to wait and see.

These new laws incorporate air quality as an important priority in transportation policy, place states under deadlines to achieve clean air goals, give states and localities greater flexibility in the use of federal transportation funds, and, alter the authority and responsibilities of metropolitan planning organizations. The impact of these changes, realized through implementation, will provide evidence for or against the viability of two very different outlooks on the world. One emphasizes mobility and social choice while the other regards environmental quality and sustainability as the overriding consideration in transportation policy.

Whether ISTEA effects actual changes in the decision-making process, in investments, and ultimately in the design of the infrastructure system, must now be determined through implementation. But implementation may also determine how these two world views are themselves transformed, and how this transformation of perception could affect the evaluation process. The consistent message of Fogel's historicism is that objectivity during a profound period of change is uncommon. This makes careful review of the progress of this socio-cultural experiment a critical element of the transportation policy debate.

ISTEA raises implementation issues that range from recasting intergovernmental relations to altering individual travel behavior. The scope of these issues, together with the uncertainty of new and untried legislation, make a comprehensive review of implementation a formidable undertaking. In addition, full evaluation now of a policy passed in late 1991 would be premature, and might sell short those responsible for implementation. The goals of this paper are more modest: to identify some key problems, and to suggest how they might be categorized and monitored.

We draw from three sources of information and insight. First, policy implementation has been a topic of significant research and analysis for at least twenty years. The literature provides guidance on what types of issues are likely to give rise to implementation problems Second, the legislative history of ISTEA helps to identify the key actors, institutions and issues, as well as the strategies and agendas that they characterize. Our third source of insight is the early evidence on implementation from the Washington, D.C., national capital metropolitan region. Based on these sources, we identify key issues and discuss what sources can inform an ongoing assessment of ISTEA implementation.

After the introduction, this paper is organized in sixsections. The first presents a brief overview of the major provisions of ISTEA. The second reviews the literature on implementation to identify classes of issues that may give rise to problems "ISTEAing" transportation planning and programming. The third section reviews the legislative history of ISTEA and identifies implementation issues related to advocacy politics. We then review early experience with implementing ISTEA in the Washington, D.C., metropolitan region, followed by a synthesis of insights from the implementation literature, legislative history, and field experience to identify key concerns that warrant continued observation through 1996. Concluding remarks follow.

MAJOR PROVISIONS OF ISTEA

ISTEA provides greater flexibility to state, local and regional planning entities, but also places them. under new obligations requiring openness to public dialogue and input. As a departure from transportation policies of the post World War II era (which focused on developing the interstate highway system) ISTEA provides greater flexibility for funding transportation modes that include not only. highways, but also car- and van-pools, transit, commuter rail and municipal bikeways. Yet, the bill does not mandate much reallocation of spending. Of the $151 billion authorized for transportation under ISTEA, $110 billion can be spent by state and local governments on any transportation mode. Of the remaining $41 billion, $17 billion is allocated to maintaining (but not expanding) the existing interstate highway system and $16 billion' to maintaining the nation's bridges. Only $8 billion is earmarked specifically for expansion of interstate-type highways.

ISTEA also requires states to develop and implement six management systems in cooperation with metropolitan planning organizations (MPOs): pavement on federal-aid highways; bridges on and off federal-aid highways; highway safety; traffic congestion; public transportation facilities and equipment; and intermodal transportation facilities and systems. To aid in the development of congestion management ISTEA allocates $6 billion to the Congestion Mitigation and Air Quality (CMAQ) improvement program.

While a broader range of choices for local and state planning and decision making units does not preclude continuation of past spending patterns, the provisions of a complementary piece of legislation make this course more difficult. The Clean Air Act Amendments of 1990 (CAAA) require that transportation and capital investment plans conform to state clean air plans[2]. These provisions complement and magnify the requirements of CAAA, for example mandating congestion management for non-attainment areas.

One of the strongest arguments of environmentalists in successful support of CAAA was that automobile -emissions are the greatest threat to air quality because vehicle trips are rising at three to four times the rate: of population growth. This rate of automobile use is, furthermore, offsetting the benefits of reduced emissions through automobile and fuel modifications. Consequently, CAAA mandates reducing the number- of trips as an important element of protecting air quality.

According to CAAA, new highways can only be built as part of a plan to improve air quality. Significantly, these new restrictions come with enforcement authority. In cases of noncompliance federal money can be withheld. Moreover, CAAA allows parties of interest to block funding and construction by suing decision making units. For example, Natural Resources Defense Council might sue a metropolitan planning organization or state department of transportation if state and local plans fail to meet new restrictions. Environmental interest groups have expressed their intention to use this new advocacy power[3].

ISTEA triples the money earmarked for spending in metropolitan areas. In return, the bill requires that local governments participate in more rigorous transportation planning with state transportation agencies, considering air quality and energy use as well as social and economic impacts. ISTEA strengthens the role of metropolitan planning organizations in conducting planning and programming[4]. These measures include giving MPOs in major metropolitan areas significant control over federal funds; hence, states must also work with MPOs or risk forfeiting these funds. Such reciprocity provisions may nullify some of the parochial conflicts that originate from the composition of MPOs, which are often made up of officials from local jurisdictions that are recipients of federal funds.

ISTEA contains several provisions aimed at enhancing the role of the private sector in the design, and operation of transportation services. This includes relaxing restrictions on toll roads, as well as provision for up to five congestion pricing demonstration projects. Additionally, the act provides $660 million for testing intelligent vehicle-highway systems (MIS). These technologies, ranging from computerized traffic control centers. to fully automated freeways, are envisioned as having significant private sector involvement. One such approach could employ "bundling innovative public/private partnerships" to provide IVHS information functions that assist traffic diversion from congested areas[5]. Indeed, the strategic plan developed by IVHS America suggests that 80% of the costs for IVHS will be in the form of private sector products and service@,

The measure also introduces a variety of new participants to the transportation planning process through requirements for public participation as well as "enhancement" provisions that expand the number of stakeholders and provide $2.8 billion for scenic and historic preservation, and environmental and landscape improvements. As a result, a broader range of interest groups (e.g., preservationists, designers, etc.) now have a stake in the regional and state transportation project decision-making process.

Finally, ISTEA is largely silent on some issues that powerfully affect transportation and clean air. Most notably, although it requires MPOs to consider the effect of transportation decisions on land use, ISTEA includes no direct constraints on use and development, which are traditionally the purview of local government. Any changes in land use regulation will therefore only be developed from the "bottom up, " that is, by local officials, in order to comply with the air quality requirements of CAAA.

JMPLEMENTATION LITERATURE

The scope and magnitude of the changes stipulated in ISTEA suggest a broad range of implementation issues. One source for identifying which, of these is central to the assessment of success is the literature on policy implementation. Since the seminal work of Pressman and Wildavsky implementation has become one of the central foci of policy analysis'. A sizable literature is now available to serve the development of implementation studies Generally this documents and explains why policies are typically not carried out as intended, 'and why major changes are usually made (Louise White, personal interview, Aug. 4, 1993).

Academic inquiry into implementation evolved in three phases. The first generation sought to anchor the field of study identifying policy implementation as an important problem and demonstrating specific cases where execution mattered. The second focused'on broadening the significance of execution to a range of policy fields, through a series of case studies. The current generation is concerned with developing an effective theory of implementation and identifying principles that apply to most policy domains, thus attempting to secure an element of synergetic advantage for the field of implementation studies*.

A brief review of the implementation literature suggests several insights useful in identifying key implementation issues for ISTEA. First, it is essential. to recognize the activation of public programs as a complex political process. The actors and institutions that are engaged are not minions of rigidly organized hierarchies. Thus, it is appropriate to ask what provisions have been made to ensure willing cooperation between and within these agencies. To the extent ISTEA diminishes the power, prestige or personal satisfaction of actors charged with its implementation, those sufficiently "disenchanted" may seek to resist or subvert it [9].

A second and related insight concerns the practical reliance on the intergovernmental system. Federal officials often lack effective leverage over state and local bureaucracies, and moreover, lack knowledge about incentives and bureaucratic goals that guide those officials. Some believe that in the case of ISTEA federal agencies simply cannot, have much impact in terms of policy guidelines[10].

A third insight is that implementation problems often arise in just those areas where the policy formulation process has generated the greatest controversy. In a sense, "the mishaps of program administration are actually rooted in the policy-making process"'!. In the case. of ISTEA, policy formulation gave rise to several sharp differences, as we shall see in the next section. These controversial areas should clearly be considered possible key implementation subjects.

Finally, effective implementation is sometimes displaced by the desire of Congress and the Executive to achieve short-term tangible "deliverables" that influence the allocation of inputs. Cashflow, rather than intelligent planning, is often the most important implementation issue for actors at all levels. A desire to get the money flowing may undermine efforts to effect some of the more fundamental changes in comprehensive planning.

LEGISLATIVE HISTORY OF ISTEA

Many consider ISTEA a revolutionary reorientation of transportation policy from automobiles and highway building to a multi-modal, environmentally sensitive strategy. Some of the distinctive provisions of ISTEA were neither designed nor supported by the coalition of highway interests, which has traditionally dominated highway policy. Bather, they originated from a relatively small coalition of environmentalists and urban planners. If highway interests suffered a planned strategic defeat at the hands of the environmentalists and urban planners, as some have already suggested, this may lead to future implementation problems.

ISTEA's legislative history, however, may also be interpreted as an interplay of interests, Wherein two coalitions ultimately obtained much of what they thought essential to establish conditions that would help prove the validity of their particular world view. Each world view, in turn, reflects a strongly held conviction regarding what kind of transportation system the public really wants. In the following historical discussion we refer to these two principle groups as the mainstream coalition and the reform coalition. The terms are used for notational convenience, and are intended as neutral modes of reference.

By the mid-1980s, the Interstate Highway System was largely complete. The 1991 reauthorization offered an opportunity to reassess and redefii federal transportation policy, providing a new focus for the next twenty to thirty years. In recognition of the significance of this opportunity the mainstream coalition began, in the mid-1980s, to develop. a new more inclusive rationale for transportation policy through a process of extensive consultations and hearings.

These meetings, known as "Transportation 2020, " formulated a post-Interstate highway policy based on two concepts: a newly identified system of "highways of national significance," or a national highway system (NHS), and the devolution of authority to the state and local level. Meanwhile, a parallel effort moved forward under the auspices of a, strategic plan commissioned by the Department of Transportation under Secretary Samuel Skinner. This strategic plan also emphasized the importance of highways of national significance.

Early in the 1990s, a coalition of environmental and urban planning groups began to formulate a transportation initiative to complement, and indeed to help implement, new clean air amendments passed in 1990 (the CAAA). The coalition of groups that had recently succeeded with the passage of the CAAA reorganized as the Surface Transportation Policy Project (STPP). The core belief of the STPP, in sharp contrast to the mainstream coalition, was that existing incentives for single occupancy vehicle use and new construction designed to accommodate its growth was not in the public interest.

The view that the public's true preference was for more livable and environmentally sustainable communities seemed justified by the success of recycling programs and by a new environmental ethic. These beliefs accorded with the ideas of the Senate Committee on Environmental and Public Works (which had jurisdiction over the CAAA), and especially with

those of the subcommittee chair Daniel P. Moynihan (D-NY). Thus began collaboration on a Senate transportation bill that matured as ISTEA.

In assessing implementation prospects, 'it is important to understand the extent to which the final legislation constituted a planned "victory" by the'reform coalition, au accidental victory by the reform coalition, or in fact, no victory at all. While there may be a certain appeal to victory; stealth and defeat, our interest in these issues is that parties who lose in policy formulation may well be actively engaged in 'achieving their objectives through subverting or influencing implementation.

Did ISTEA really represent a victory of the reform coalition rather than compromise? Some accounts maintain that the success of the reform coalition was partly attributable to a "stealth strategy" that avoided cross-coalition debate by maintaining low visibility in the policy formulation stage. Meanwhile, much of the debate within the mainstream coalition was absorbed with the nature and extent of congressional participation and with oversight of the designation of routes in the National Highway System. Thus, the low visibility of the details within the reform dialogue in the Senate served to avert the full mobilization of opposition and allowed a concentrated focus on reform priorities for transportation legislation.

The stealth hypothesis rests upon the assumption that the reform coalition consciously concealed their activities. Yet obscurity might have been circumstantial rather than deliberate, since neither coalition had much incentive to engage in the specialized dialogue of the other. Hence, an involuntary lack of communication about differences might have averted an impasse. A mainlegislative concern of the highway interests was apportionment, or who got the money for major programs. The notion of providing more flexibility to local constituencies, which resonated well with the "public involvement" concerns of the reform coalition, also supported a desire for devolution of authority that had long been sought by the mainstream.

Flexibility of funding (to include non-highway projects) was a principle that had no natural enemies, and thus no ready-made opposition. There was little apparent political incentive to distinguish this principle from the related concept of devolving authority to local decision-making units, such as MPOs. The result was a law that placed more emphasis on local decision-making, but had many prescriptive planning requirements related to environmental and public participation. Ironically, given the complexity of the program, only those career professionals with an intimate knowledge of how programs are administered are in a position to have any idea who really won or lost (Steve Lockwood, personal interview, November 23, 1993).

Another useful interpretation is the "whole orange" scenario of conflict resolution; whereby two parties contesting for possession of an orange' have different purposes in mind. The first wants to consume the flesh, the second to use the rind in a recipe. Since the underlying interests are quite different it is possible for both to win full possession of the orange, or at least that whole portion of it that serves their interest". If both sides got primarily what they wanted from the legislative process, in what sense was anyone the loser?' A' "winner" may eventually be determined if one of their competing visions ultimately prevails. Hence, the

evaluation of implementation is even more important than if the legislative contest had created clear winners and losers.

In terms of the literature on implementation, however, it seems advisable to at least consider the implication of the "stealth strategy" hypothesis: the conjecture that victory was due, at least in part, to the suppression (through strategic "restraint") of open debate and confrontation. The perception that the environmental community won its, case primarily by maneuver and strategy, rather than on the substantive merits of its position, might provoke the opposition to reverse its losses. So far, however, there is very little evidence to suggest that either side significantly disgruntled by the outcome.

Finally, there may be important divisions within the federal transportation community that could affect its overall performance. Consensus within that community was based on appropriations, and therefore the inability of appropriations to meet authorization levels without a bigger reservoir of money (which is. what mostexpect from ISTEA) could magnify a sense of rivalry between transit and highway interests (Joel Markowitz,' personal interview, July 21, 1993). Consequently, no matter which hypothesis one 'accepts as an explanation for the legislative history--stealth strategy or circumstantial scenario--the need to monitor and evaluate the consequences of ISTEA is imperative.

THE NATIONAL CAPITAL METROPOLITAN REGION

The authors have collected preliminary evidence on implementation experience in the National Capital Metropolitan Region. The selection of this area was based on the fact that, since it is one of thirteen multi-state metropolitan regions, it is useful for exploring a range of jurisdictional issues likely to emerge under ISTEA. Its proximity also makes it a convenient case study area for the authors. One should bear in mind, however, that the National Capital Region is not a typical metropolitan area precisely because it is multi-jurisdictional and'also because its economy is so closely tied to government. Additional research is necessary to balance the conclusions drawn from what some consider a highly nonrepresentative situation.

Sources of information include public records and interviews with officials who have responsibility for- formulating, planning and implementing transportation policy. This group includes professionals within organizations charged with coordination and integration of the policy process across the twenty counties and municipalities, within three state jurisdictions. In addition, we interviewed principles from most of the environmental and community interest groups who have been actively involved in the implementation process.

Overview

Transportation planning, programmin g and financing occurs through the actions of a complex web of federal, state and local governments, private actors and interest groups. This web is especially complex in multi-state jurisdictions, like the National Capital Metropolitan Region. Each state has its own department of transportation (Virginia [VDOT], Maryland

[MDOT], and the District of Columbia [DCDOT]). The cities and counties of the region vary widely in income distribution, geographic size and population density. There are also a host of quasi-governmental organizations, some with public, and some with private affiliations.

All three "state" entities are required to submit two State Improvement Plans (SIPs) in order to comply with the CAAA. The first, due' 'November 15, 1993, must reduce levels of volatile organic compounds by '15% by 1996. The second, due in 1994; must reduce levels by 20% by 1999; These, in turn, must be coordinated with transportation-improvement plans (TIPs) for the metropolitan regions.

The National Capital Transportation Planning Board (TPB) is the designated metropolitan planning organization for the area, contracting for staffmg with the Washington Area Council of Governments. Its meetings are open to the public. The TPB is divided into two advisory committees, 'the' Technical Advisory Committee and the Citizen's' Advisory Committee, 'and it is responsible for formulating the' area's transportation improvement plan (TIP), the primary document for regional transportation planning.

The technical committee recommends projects to be funded under the 10% set aside for "safety" projects, whereas the citizen committee performs a similar function with respect to the 10% "enhancement" set aside. Endorsement under these set asides by VDOT (as well, as DCDOT and MDOT) requires prior approval from the TPB as part of its TIP. Because of this connection between the responsibility for forming the TIP and requirements for public involvement, as well as the high priority 'conferred on the TIP by ISTEA, this review focuses primarily on issues raised by the TPB.

Besides the state and regional structure, the subregion of northern Virginia has a Transportation Coordinating Council that meets quarterly to address subregional issues (Roderick Burfield, personal interview, August 4, 1993). The TCC is'chaired by the Northern Virginia representative of the Commonwealth Transportation Board and is comprised of local government representatives. The TCC advises TPB and VDOT on Northern Virginia issues.

In Maryland a similarly designated "advisory" committee, the Technical Committee, is comprised of the heads of four state agencies: Transportation, Historical Preservation, State Highway, and Mass Transit (Mary Keller, personal interview, August 4, 1993). The District of Columbia has no similar "specialized" entity because it is a unitary jurisdiction without the need to coordinate with a larger state government. Its subregional interests are looked after by the DC. Department of Public Works.

Responses to ISTEA

One of the earliest responses to ISTEA's requirements for public involvement was the formation of the Citizen Advisory Committee to the TPB. In addition, the TPB immediately opened its meetings to all interested parties, allowing an opportunity to make a three-minute statement during a twenty minute period'at the beginning of each meeting. However some feel

that this involvement occurred too late in the process to provide meaningful input on complex issues, and that public involvement must start well in advance of the meetings where decisions are made. Merely inviting the public to attend when the agenda has already been set and the plans fully conceptualized is insufficient.

Early evidence and interviews suggest that public interest groups have begun to participate in meetings of the Citizen Advisory Committee (CAC). Active groups include. the American Automobile Association, DC Roadbuilders, the American Trucking Associations, the Greater Washington Board of Trade, DC wards three and five, the Chesapeake Bay Foundation, the Sierra Club and the Washington Area Bicyclists Association. The CAC now sees itself as an advisory body, with a regional focus and with a mandate to influence both long range and short range planning and to inform the public on transportation issues. The committee sponsors a series of Citizen Forums to help meet these objectives. Meeting times for TPB hearings were recently shifted from the lunch hour to 5:00 PM, in order to facilitate a more diverse attendance[13].

One area that has been influenced by public involvement has been an increased emphasis on new bicycle projects, placing strategic bike paths that connect projected metrorail sites with high activity areas like the University of Maryland. Prince George County, Maryland, has seen most of this activity so far, but Arlington County, Virginia, also has an active bicycle path program.

Some of the planning for these projects, however, predates ISTEA. A Regional Bicycle Plan was developed by the Bicycle Technical Subcommittee of the TPB in 1989 and published in 1991, the year ISTEA was passed. Bicycle interests sought $60M in new projects over a five-year period. The TPB suggested a much more conservative twenty-year distribution of funds (Ellen Jones, personal interview, August 11, 1993). In order to make their priorities known the Washington Area Bicyclists Association (WABA) arranges special bike tours for members of the community, pointing out hazardous conditions, repair priorities, and new construction possibilities. At these and other events they distribute literature and explain the intricacies of the ISTEA legislation. Most of the members of local planning commissions attend the bike tours, and many of the interest group% detailed recommendations have been implemented to improve safety and accessibility.

Although these projects are not large or expensive by comparison with highway projects they are significant in the sense that they facilitate the kind of lifestyle changes sought by the STPP coalition. WABA is quick to point out, however, that much of the region remains unaware of the funding potential that exists, and that Prince George and Arlington Counties are exceptions to the general condition of knowledge and public participation (Ellen Jones, personal interview, August 8, 1993). The DC Department of Public Works has proposed the addition of a Metropolitan Branch Trail, but advocates claim that it is seriously under-funded and that DC officials remain unaware of the potential that exists within the new legislation to improve alternative transportation.

The evaluation of projects has emerged as a potential issue of contention. Asmentioned previously, in addition to projects funded as technical improvements others may be funded as enhancements. Reconstruction of the' 1905 vintage Union Tram Station in Alexandria is an example of a proposal made under the enhancement provision. Thesubmission of this project was made on August 1, 1993, after the deadline for grant applications had been postponed several months. VDOT needed extra time to make preparations for evaluating proposals and establishing a process to make endorsements

As a result Virginia has just begun to solicit new project proposals. Little, if any, evaluation is conducted on enhancement proposals at this time because of the lack of technical expertise to make assessments, and because the number of proposals has been so small that there is little need to prioritize (Mary Keller, personal interview, August 4, 1993). The 'TPB has plans to prioritize projects or project categories in the future (Gerald Miller; personal interview, August 8, 1993).

Some groups are concerned about the inertia of projects once they are included in the TIP. The Chesapeake Bay Foundation submitted formal comments on the content of the TIP, requesting that' it include language to the effect that projects may be dropped[14]. The comments of the Washington Metropolitan Area Transit Authority (WMATA) focused on similar concerns: the delegation of the Governor's transportation authority to state DOTs '(seen as contributing to business-as-usual), and the ability of the statewide transportation plan to address long term issues (Federal Highway Administration, Office of the General Counsel, Docket Division). Underscoring these issues the Metropolitan Washington Council of Governments recently released a report prepared by Price Waterhouse, that indicates a 20% shortfall in funding for the Long Range Plan[15].

In addition to such procedural and technical issues is a political dynamic. Participants at a recent workshop raised the possibility of a new MPO for the Virginia part of the region if cooperation with Maryland and DC. became troublesome. There were also indications that MDOT would rather work through the counties 'than through the designated MPO (the Transportation Planning Board). The issue concerned whether or not discretionary money could cross state lines, and since the TPB is a tri-state entity Maryland and Virginia were concerned that they might end up subsidizing improvements in D.C. The issue was resolved by an agreement, formalized as a bylaw, that the flexibility of funding stops at the state line. This, of course, does not resolve all of the economic 'rivalries between the states that have been intensified by linkage to the CAAA requirements.

The Washington Metropolitan Region; plus three rural counties (Stafford in Virginia, and Charles and Calvert in Maryland) 'make up the' Metropolitan Washington Statistical Area (MWSA); which 'has been designated by the EPA as the jurisdiction of the Metropolitan Washington Air Quality Committee for the purpose of formulating plans to reduce smog 15 % by 1996, and 20% by 1999 (see Appendix 2). These'-plans "must be coordinated as part of the SIPs. Fairfax County (Virginia) recently vetoed the 15% reduction plan, which was due November 15, 1993, over the issue of an Employee Commute Option (ECO) that would require

businesses with 100 or more employees to reduce SOV commuter trips. by 20%, which Virginia jurisdictions considered an excessive burden on business[16].

Maryland's interests place. it in conflict with Virginia over the ECO. Maryland counties are in a better position to cope with the ECO requirements than Virginia, because of greater access to mass transit and higher density land use patterns in that state. In addition, the adoption of the ECO in Baltimore is mandatory, because it has a more serious air quality problem, and that city is concerned about migration of its larger businesses to the Washington area to avoid compliance. Thus, if the Washington area as a whole rejects the ECO this creates an internal conflict in Maryland that the state would prefer to avoid by keeping its own playing field level. The ECO requirements highlight both inter- and infra-state competitive conflicts that will be very difficult to resolve. The smog reduction plan for the MWSA was finally passed without the controversial ECO measures (and still awaits doubtful approval by the EPA), but the much tougher 1999 plan is due next year, and the issue will undoubtedly resurface[17].

KEY ORGANIZATIONAL ISSUES IN IMPLEMENTING ISTEA

The foregoing analysis suggests that both political and technical aspects of implementation will be critical for ISTEA. This is true for institutions as different elements of the intergovernmental system, particularly states and MPOs, vie for advantage. It is also true for interest groups as different constituencies, either established or emergent, organize their positions on ISTEA. The jurisdictional and interest group issues that are played out in the political arena are related to a set of serious constraints on organizational resources, for both the MPOs and the states.

After two decades of declining budgets the now restricted capacities of the MPOs are being asked to perform at a higher operational level than at any time in their history. The gap between expectations and the resources to fulfill them is at an historic maximum; and ISTEA fails to address this capacity problem directly since it funds MPOs as a percentage of the total funding. With the requirements for comprehensive air quality planning, etc., technical planning is now more complex than ever.

The political challenge is less obvious. MPOs have acquired the responsibility for dividing up funds for surface transportation projects under the STP program, administered by the Federal Highway Administration. These are non-mode-specific projects, divided within the five-year TIP, that are "fiscally constrained" to *available* funds (not proposed taxes) and cannot assume increases based on authorizations (which are only upper limits rather than guarantees of funding). Someone must therefore prioritize projects within these constraints, and the challenge *becomes* political in the sense that the parties to the MPO each have to get enough out of the settlement to support it. The constraint on the political distribution of benefits is similar to that imposed on a legislative body that must make hard funding decisions. But the MPOs have neither the resources nor the legitimacy of "real governmental bodies."

Partly for this reason, as Maryland has demonstrated, some states would prefer to work directly through chartered local entities like the counties, assuming the responsibility for regional planning themselves. Finally, if one believes the MPOs arc essential to the implementation of ISTEA, both the technical and the political challenges are critical to the future; since the MPOs can be emasculated by either'*. In addition; MPOs now have some authority over programs that used to be under the discretion of the state DOT s, creating possible bureaucratic tension and requiring accommodation between 'the states and MPOs.

State DOTs likewise have two technical and political challenges. Some will have to build from scratch. Only five or six states have significant planning capacity. Oregon is probably the leader, having had an integrated long range transportation' plan since the 1970s[19].

Second, the need for DOTs to build partnerships with other agencies. such as those responsible for air and water quality can magnify the implications of a lack of planning capacity. Many practitioners see the governor is the pivotal actor both as primary authority to resolve conflicts arising between bureaucratic jurisdictions, and in the use of his authority to help build the capacity for joint planning. It has been the executive, in states withenvironmental and economic. development planning experience, that has provided coordinating authority (Bruce McDowell, personal interview, July 21, 1993).

Perhaps what is occurring is a bureaucratic "cultural shift." Because it is difficult to overcome inertia from an institutionalized mission -(which has been internalized by individuals through a long process of cultural identification) change may only result from interest group pressure, unless the executive becomes more directly involvedin managing institutional change. In some states governors have delegated their authority under ISTEA to their DOTs rather than confront the problems of defining this complex new mission, a step' that advocacy groups such as STPP, may challenge. The tension between institutional" inertia, the mutual dependence of major organizational units (especially the MPOs and the states), 'and the expectations created by ground breaking legislation, is a theme in most of the practitioner comments encountered in the study. One side regards change with apprehension, the other regards inertia with frustration. What sort of accommodation will work?

The Larger Community

Beyond the direct technical and political challenges for organizations at the state and local levels are problems involving the huger community. ISTEA 'promotes private sector involvement in new areas such as demand management and IVHS. In addition to this encouragement of 'private participation, the act requires early and significant public participation in decision making[20]. At this stage public participation is primarily important, from the perspective' of the provisions, because 'failure to adequately address the regulations would render the MPO's product 'invalid (J.S. Hassell, Jr, -personal interview, July 21; 1993). Again, these challenges require a high degree of political expertise that may not be available to MPOs.

MONITORING AND EVALUATION

Continued monitoring of ISTEA in the Washingtonarea should focus on three substantive domains: investments, on-street changes, and public involvement.

Investments: The continued tension between various institutions and interest groups over discretionary funds in support of the environmental or highway coalitions will.continue to be important. Nearly all of the interviewees identified the allocation of flexible. funds as a significant factor to be monitored. They are concerned with whether the funds are being spent on special projects, construction or system management. Evaluation should be informed by the degree that flexible funds get used, what projects get.considered, and how quickly. they become obligated. Since there is an obligation limit on highways and transit we also need to measure the share that gets obligated specifically to innovative programs, even though the definition of this category is subjective.

In the short term, evaluation has to be concerned with whether investments that affect modal infrastructure have- shifted as a result of ISTEA. The conventional argument is that categorical grants skewed investment toward highways and it will be important during the early years to determine if the supposed shift in priorities has modified the pattern (Joel Markowitz, personal interview, July 21, 1993). Whether the allocations reflect an integration between land use, transportation and air quality is a question that directly addresses the world view of the reform coalition.

On-Street Changes: Some feel that the starting place for evaluation ought to be the priorities established by Congress; that is, the criteria governing the intermodal and Interstate systems, congestion demand issues, and the physical capacities of facilities. This set of criteria is more closely related to the world view of the mainstream coalition.

Public Involvement: The problem with this set of criteria is that there is no consensus about what it means. Most respondents, however, see education as a critical overall factor, so it would make sense to monitor the accuracy and credibility of information provided to the public in terms of the other two categories mentioned. In other words, how well is the public being informed about project funding, planning and physical changes to the transportation infrastructure?

In addition, not only is the law a little. ahead of the average citizen, but the uncertainty connected with its regulatory environment places formidable constraints on implementation. Initially therefore, it seems a good idea to review comments on the. rule-making process at the Federal Highway Administration in the form of letters, exceptions, and so forth. This should give an indication of who has become disillusioned with ,the bill' and provide hints as to whether resources are being committed to active opposition. The deadline for comments on the first phase of the process, involving the. planning regulations, took place during mid-summer of 1993, and on the conformity regulations and compliance with CAAA, in October[21].

CONCLUSIONS

According to our findings there are four major factors that will affect implementation:

1. The politics of the states and their local subregions, including rural vs urban and inter-urban and interstate rivalries over funding and economic 'development;

2. The extent to which interest groups are able to coalesce at the regional level and overcome parochial interests;

3. The politics of intergovernmental relations between MPOs and the states, including issues related to bureaucratic culture and accommodation; and

4. The quality and quantity of expertise (both political and technical) available to the various actors, including interest groups.

The literature on implementation highlights the role played by the various actors throughout the policy. process, from policy formulation and design to implementation, emphasizes the importance of status, suggesting that parties who feel left out of the design phase may re-emphasize their perspective by attempting to move implementation toward their view of balance. Yet the emphasis on status, while instructive, maybe somewhat thin. Why, is status important in the first place? The legislative history suggests that, on the whole, neither faction was left out. Hence, status may not be the overriding issue, at least in terms of a concerted effort to right some perceived imbalance.

It may be useful to view ISTEA implementation as a socio-cultural experiment of the validity of two competing world views. On the one hand is the reform coalition, which views the current state of travel and land use as the result of bias and manipulations of public policy to favor auto-centric "hypermobility." Public policy, according to this view, has been significantly displaced from public base preferences. A milder. rendition of this view is that public preferences have shifted, while public policy has not shifted, or not yet, or not enough. According to this view, the public need only be provided a real alternative to precipitate a shift in behavior. The legislative provisions essential to this view are: MPO authority, public participation, linkages to air quality regulation and funding of enhancements.

On the other hand is the mainstream coalition, which views the current' arrangement as largely consistent with the public's base preferences. They are willing to accept greater authority for the MPO because they feel it will change little. This faith is realistic in the sense that it rests on years of administrative 'experience, and 'on a tacit understanding of administrative processes. These processes, in 'turn; rest on deep-seated convictions about the legitimacy of institutions that even' transcend statutory provisions. Such deep-seated convictions are related to established ways of doing things; to electoral accountability and also to a pragmatic assessment of the unwillingness of the public to suffer high opportunity costs associated with direct participation in a process of change[22].

The analogy of a socio-cultural test implies a single objective standard of evaluation, which may be misleading. It is unlikely, for instance, that both groups will use the same criteria to judge the viability of an integrated regional community. The reformers value "livability" and environmental sustainability. The mainstream values mobility and choice. Where these values are inconsistent one ought to expect conflict, and possibly fragmentation. The expectation that a definitive experimental result or a future "fusion of horizons" will resolve the significant value differences is, especially for planners and engineers steeped by education and temperament in pragmatic virtuosity, probably an acutely idealistic presumption.

Finally, since the expression of public preference is related both to the outcome of this socio-cultural experiment and to the legitimacy of the institutions charged with its implementation, it might be well to ask the public what it thinks of the situation[23]. To what degree do people feel that transportation planning and coordination ought be the responsibility of a national, state, local or inter-jurisdictional regional authority?

One recent study found that although public confidence has been going down, the decline was much more precipitous for federal and state than for local government%. what this indicates is that confidence in local authority *relative* to federal and state authority has been increasing for at least twenty years, providing a partial explanation for the consensus on devolution of governmental responsibility. A similar study of a cross-jurisdictional level of authority between state and local may be instructive. It might provide a new reference point for, the development of an effective theory of implementation, in a world that increasingly manifests a tendency toward public participation in the policy process within a regional frame of reference.

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