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16. ABSTRACT This report investigates factors affecting ITS implementation as a "mainstream" transportation planning activity. It draws upon a detailed literature review, interviews with fifty-one leaders from a cross-section of jurisdictions and agencies in California, a survey of 228 transportation engineers, planners, and transit staff members, follow-up interviews with 52 of the staff members, and interviews with 20 national transportation leaders with expertise in ITS. The interviews with California leaders revealed widespread familiarity with ITS. However, many of these leaders are irritated by ITS literature, which they view as heavily promotional and full of jargon. Many believe that ITS is being implemented fairly quickly overall and that ITS elements that are not proceeding well suffer from institutional problems or market weaknesses. Respondents do not see a problem in fitting ITS projects into mainstream transportation planning processes, but complain of a lack of good information on ITS benefits and costs. Many are concerned that ITS evaluations have been less than arms-length, and focus too heavily on system benefits rather than traveler benefits. Many believe that the private sector should be left to implement certain ITS applications, but they also think that earmarked funds for ITS applications would speed implementation of other measures. Respondents suggested that the state DOT should lead by example, implementing ready-to-go technologies on its own facilities and within its own agency. Stronger partnerships with local government and other state agencies, developing mutually beneficial, multi-purpose applications, were also recommended. Finally, respondents urged that future ITS work should pay more attention to legal and institutional issues and provide a clearer sense of "next steps."		
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To Develop Effective Strategies for Mainstreaming Intelligent Transportation Systems (ITS)

Final Report

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Report No. CA02-0574

November 2002

Prepared By:

Institute of Transportation Studies
109 McLaughlin Hall
University of California
Berkeley CA 94720

Prepared For:

California Department of Transportation
Division of Research and Innovation, MS-83
1227 O Street
Sacramento, CA 95814

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Mainstreaming Intelligent Transportation Systems

Final Report

to the

California Dept. of Transportation

Authors:

**Elizabeth Deakin
SangHyun Cheon
Jason Ni
Adam Leigland
Sungjin Park
Manish Shirgaokar**

With contributions from

**Patrick Conroy
Jean-Luc Ygnace
Bradley Flamm
Pratyush Bhatia
John Thomas
Songju Kim
Noreen McDonald**

**Institute of Transportation Studies
109 McLaughlin Hall
University of California
Berkeley CA 94720
Tel. 510 642-3585**

**PI: Elizabeth Deakin
Tel. 510 642-4749
edeakin@uclink.berkeley.edu**

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The Principal Investigator, Elizabeth Deakin, is primary author of this report. Graduate students SangHyun Cheon, Jason Ni, Adam Leigland, Sungjin Park, and Manish Shirgaokar participated throughout the project; their work included writing background papers and summaries of ITS applications, as well as work on the development, testing, implementation and analysis of the surveys of local officials. In regular meetings of the project team, these five students also helped draw out the findings, conclusions and recommendations presented in this report.

Graduate students Bradley Flamm, John Thomas, and Songju Kim participated in the literature review during the first year of the study and wrote background papers and other support materials, as did former graduate student Pratyush Bhatia (now a transportation consultant in the Bay Area..) Graduate student Noreen McDonald contributed a background paper as well, as an informal associate of the project.

Patrick Conroy of the California Program on Advanced Highways and Transit and Caltrans offered advice on what applications of ITS technology to review and prepared the background paper comparing European and American experiences with ITS, working with Jean-Luc Ygnace of INRETS (France), who contributed an addendum on the Japanese case.

Linda Howe-Steiger, Director of the ITS Extension, provided the results of a survey of California transportation professionals' course needs, shared participants' comments on the pros and cons of ITS courses available through the National Highway Institute, and offered suggestions on how ITS material might be mainstreamed into existing Extension transportation courses and training programs. UC Berkeley faculty member Alex Skabardonis contributed a course syllabus for teaching graduate engineering students about ITS, and taught the course to a class of about twenty students with funding support from the UC Transportation Center. He also offered useful suggestions about strategies for assisting local engineers.

Discussions with PATH staff members Steve Shladover, Hamed Benouar, and Susan Shaheen provided insights into ITS research, development and demonstration processes, as did comments and suggestions made by Berkeley Professors Pravin Varaiya and Martin Wachs and Davis Professor Daniel Sperling.

The 228 California transportation engineers and planners who completed the survey on intelligent transportation systems and the 122 elected officials, agency executives, and national experts who participated in in-depth interviews on ITS mainstreaming provided the key data for this study. Their assistance was invaluable.

Throughout the study, the project team benefited from the comments and suggestions of the Caltrans project sponsor, Jay Riley, and project manager Katie Benouar. Former project managers Frank Taylor and Lynne March likewise offered useful advice and direction. The team also benefited from comments received on project work products from an advisory board of state, regional and local transportation staff members that met periodically to discuss the project and advise on specific tasks. The assistance provided by Caltrans and their partners is greatly appreciated, as is their patience with contracting delays and University schedules.

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Summary

This report investigates factors affecting ITS implementation as a “mainstream” transportation planning activity. It draws upon a detailed literature review, interviews with fifty-one leaders from a cross-section of jurisdictions and agencies in California, a survey of 228 transportation engineers, planners, and transit staff members, follow-up interviews with 52 of the staff members, and interviews with 20 national transportation leaders with expertise in ITS.

The interviews with California leaders revealed widespread familiarity with ITS. However, many of these leaders are irritated by ITS literature, which they view as heavily promotional and full of jargon. Many believe that ITS is being implemented fairly quickly overall and that ITS elements that are not proceeding well suffer from institutional problems or market weaknesses. Respondents do not see a problem in fitting ITS projects into mainstream transportation planning processes, but complain of a lack of good information on ITS benefits and costs. Many are concerned that ITS evaluations have been less than arms-length, and focus too heavily on system benefits rather than traveler benefits. Many believe that the private sector should be left to implement certain ITS applications, but they also think that earmarked funds for ITS applications would speed implementation of other measures. Respondents suggested that the state DOT should lead by example, implementing ready-to-go technologies on its own facilities and within its own agency. Stronger partnerships with local government and other state agencies, developing mutually beneficial, multi-purpose applications, were also recommended. Finally, respondents urged that future ITS work should pay more attention to legal and institutional issues and provide a clearer sense of “next steps.”

The survey of California transportation staff members found that while recognizing benefits, 83 percent of the respondents felt ITS implementation is slow. They attributed this to a lack of knowledge about ITS among elected officials and the public. Most also expressed concerns about ITS costs. Respondents from small cities were less informed about ITS, had less ITS training, and were less favorably inclined toward ITS than their big-city counterparts. Planners consider transit, bike and pedestrian applications; traffic engineers think of traffic signals and freeway operations. Follow-up interviews with a sub-sample of respondents found strong interest in corridor-long, area-wide, and system-wide ITS applications, traffic signal programs, freeway-arterial coordination, and pedestrian, bike, transit, parking, and traffic calming applications. Respondents advocated folding ITS training into standard continuing education courses, with annual updates at a special symposium or professional meetings. Half thought a catalog of brief

success stories would help them explain ITS benefits to elected officials and citizens. Most agreed that short presentations and articles for elected officials, city managers, and the public would be useful, as would work on institutional and legal issues and multi-jurisdictional, multi-modal demonstration projects.

Interviews with national experts examined organizational, institutional, and procedural considerations in deploying ITS. Interview participants identified lessons learned from the ITS implementation experiences of various states and discussed the role of policy and planning, organizational arrangements and assignments of responsibility that help or hinder ITS implementation. They also discussed whether ITS is best integrated with existing units, planning processes and funding sources or handled as a separate unit and activity. Finally, the participants identified applications, research topics, and training needs that deserve additional attention. Key points include: It is easier to borrow project ideas than organizational ideas because of differences in the states' legal and organizational structures. Decentralized state DOTs have a harder time directing ITS implementation than do centrally controlled DOTs, and must rely more on policy directives backed up with incentives and rewards. Partnerships also are important but necessitate a change in agency culture, including less hierarchical decision-making. Separate ITS units can foster strategic ITS implementation of ITS but may hinder ITS incorporation into conventional plans, programs, and funding streams. Earmarked funding for ITS is appropriate when ideas are accepted but resources are low; signals are an example. Finally, applications need to respond to local government issues more, and training needs to be expanded to cover the general needs of planners as well as the specific technical needs of electronics technicians.

Based on these findings, a series of recommendations are made. Recommendations suggest the development of Caltrans policies and incentives for mainstreaming ITS, a refocusing of applied research to include a wider range of ITS applications, including urban applications and corridor and area-wide applications and their implementation issues, greater application of state of the art planning approaches including consensus building and partnerships, funding for ITS applications that are well accepted but are proceeding slowly because of resource limitations, and the offering of a variety of ITS education and information opportunities, including annual updates on ITS for officials and other non-technical interests. An initial set of technology summaries, presentations and course outlines are provided separately.

Chapter I. Statement of the Problem and Research Approach

A. The Question: Why Aren't Intelligent Transportation Systems Being Implemented Faster?

Intelligent transportation systems (ITS) are the subject of considerable research and development in California and indeed across the US and in other developed countries. Hundreds of millions of dollars have been invested in the invention and development of technologies that can improve traffic operations, increase safety and security, improve transit reliability, lower public and private costs of fare and toll collection, and produce a variety of other social, economic, and environmental benefits. Many of these technologies are now being deployed and are highly cost-effective. (1)

The California Department of Transportation (Caltrans) has been a leader in investing in ITS. Over the past two decades, Caltrans has invested millions of dollars in ITS research and development and has sponsored test programs and demonstration projects on a wide variety of topics, from adaptive traffic control and mobile surveillance to real-time traveler information systems.(2) Like the federal government and many other states, Caltrans is now interested in commercializing ITS advances, when that is feasible, and in “mainstreaming” many ITS elements – that is, planning and implementing ITS not as separate research, development, and demonstrating projects but as routinely considered, important options in planning, designing, and managing transportation systems.

To date, however, ITS implementation has not been routine. Caltrans on its own can implement ITS projects on many of the facilities and services the agency manages, either as separate projects or as part of projects. However, Caltrans cannot fully implement ITS on its own; regional and local government organizations, the business community, and the general public also must participate for intelligent transportation systems to reach their full potential.

Regional agencies play particularly important roles nationwide since the passage of ISTEA and TEA-21, the federal transportation legislation. ISTEA and TEA-21 gave metropolitan planning organizations (MPOs) significant responsibilities for project development and selection across the country. (3) California law, some of it predating ISTEA, gave even greater decision authority to the MPOs, as well as

to county transportation agencies. (4) In addition, under state law and practice, significant responsibility for state projects has been delegated to Caltrans' district offices. Hence project development and programming in California require action by, and in many cases collaboration among, multiple offices and levels of government. Inclusion of ITS technologies and approaches depends, in turn, on staff and decision-makers in all of the involved organizations understanding what ITS can contribute and believing that it is worthwhile.

Several of the MPOs in California have been active in promoting various ITS technologies, and several California cities likewise have been early implementers. (See, e.g., 5, 6, 7, 8, 9.) Overall, however, there is general agreement that ITS implementation has been spotty, both in California and in other states and metropolitan areas. In addition, there are cases where ITS elements have been proposed for certain projects only to be dropped when funding ran short. In other cases ITS elements have not been able to compete effectively against more traditional construction, operations, and maintenance projects and have been given relatively low priority for implementation.

Transportation experts have offered a variety of hypotheses to explain why ITS implementation has not been as fast or easy as its supporters had hoped:

- ITS research and development has been carried out by new technology experts and traffic operations analysts - specialists who are not usually involved in policy development, planning, and programming.
- Many of the public officials and staff members responsible for transportation plans and programs are only vaguely familiar with ITS technologies and what they can do.
- Few regional or local agencies have developed staff positions with specific ITS responsibilities, so few have internal advocates for ITS.
- It's not clear what funds a region or locality could or should use for ITS projects.
- Commonly available planning and evaluation tools do not address ITS very well if at all, so analysts don't know how to incorporate ITS options into their evaluations and don't know how to calculate the value added by ITS.
- There is relatively little information on the costs and benefits of the various ITS options.
- Planners and analysts need training on ITS, but it is not readily available either in university curricula or in continuing education and training courses.
- Current planning regulations, e.g., for air quality plans or CEQA mitigation, do not address ITS or are unclear about how it figures in.

- Prior commitments represented by long range plans and multi-year programs crowd out ITS options.
- The image of ITS that many public officials have is fully automated guideways and vehicles, options that are seen as too far in the future to be worth analyzing as part of ongoing planning efforts.
- Public awareness of near-term ITS options is low.
- Some ITS technologies suggest central control over facilities and services that currently are controlled separately, raising political and institutional issues that have not been resolved.
- Insufficient attention has been paid to consumer conveniences, environmental benefits, and neighborhood enhancements that ITS could provide, e.g., multi-purpose transportation and parking cards, emissions monitoring devices, neighborhood permit parking cards.
- Concerns persist that ITS technologies enhance auto use and in so doing have adverse impacts on transit use, lead to more emissions and energy use, further support sprawl, and harm the central city and older suburbs.

In short, a variety of social, economic, environmental, institutional, and political factors have been implicated in ITS' mixed reception to date. Yet there has been remarkably little work done to confirm or refute these hypotheses, and to overcome barriers to ITS.

Better understanding of the issues that ITS raises is a first step toward developing a strategy for "mainstreaming" it. This research has addressed the mainstreaming question by examining the issues ITS raises, reviewing the literature on ITS and its planning and deployment, documenting successful examples of ITS application, and suggesting changes in procedures as well a program of research, education and outreach that could improve the prospects for ITS becoming a mainstream transportation choice.

B. Research Objectives and Tasks

The overarching objective of the work presented here was to identify ways to mainstream ITS. In order to accomplish this, we sought to

- Document the planning processes that have been used for ITS work to date, and to compare those processes with the ones used for more conventional transportation planning activities
- Identify opportunities for, and barriers to, incorporating ITS into the conventional processes for transportation and land use planning.
- Identify opportunities for and barriers to near-term to mid-term implementation of ITS at the state, regional, and local levels.
- Document cases of successful ITS planning and deployment.
- Recommend actions that would help to integrate ITS into ongoing planning processes.

To meet these objectives, a two-part study has been carried out over a 28 month study period (Sept. 2000 - Dec. 2002.) The list of tasks we carried out in each part of the study is presented in Table 1.

Throughout the study we were greatly assisted by Caltrans staff members who reviewed the progress of the work and offered valuable comments and suggestions. Caltrans also formed an advisory committee for the project which met periodically to discuss key findings and next steps. The insights and recommendations of the advisory group also helped to focus and shape the products of the study.

The first phase of the work began with a review of the literature on ITS technologies and applications, paying special attention to information on the conditions that fostered implementation, the planning processes and funding mechanisms used to develop and deploy ITS projects, the various applications' benefits and costs, and the hopes and concerns that they raise among a variety of organizations, public and private.

We examined both the technical literature as reported in transportation journals, working papers, research reports, and a review of the more general news media, including journals and magazines aimed at elected officials, city managers, public works directors, planners, technology enthusiasts, and environmentalists. Principal sources for the technical literature were the Institute of Transportation Studies Library and the UC Program on Advanced Transit and Highways (PATH) publications plus the PATH website, the USDOT website and links provided by those sites. (1) Broader coverage of ITS topics was assessed by

searching key professional organizations' websites and publications and by conducting a general review using a multipurpose search engine.

In carrying out the literature review we had several aims. One aim was to assess the state of the practice for various areas of ITS application, such as freeway management, arterial management, transit operations, traveler information services, etc. We also wanted to identify possible case studies (projects or areas conducting advanced ITS work) and to locate information, if any, on ITS benefits and costs. A second aim was to assess the quantity and characteristics of the information available about ITS, especially for elected officials (who usually have the final say about transportation expenditures, especially at the local and regional levels) and for professionals who are likely to have a role in transportation planning and priority setting but are not the technical staff who design the ITS systems - transportation planners with MPOs, cities and counties, DPW heads, etc. Thus, we not only wanted to understand the content of the publications about ITS but also their frequency, length, level of detail, etc., to gain an understanding of how much (or how little) information key actors and stakeholders are likely to have about ITS technologies.

A third aim was to locate and review evaluations of ITS deployment and impacts. Both the US DOT and other organizations, including the US Congress General Accounting Office, have conducted reviews of ITS deployment in the United States. The European Community likewise has evaluated ITS deployment in its member countries, as have a number of Asian nations. We looked at these reviews of national and international experience both for examples of technology applications and for evaluations of performance and implementation issues.

Since the literature on ITS is vast, with literally tens of thousands of publications, we made no attempt to be comprehensive in our documentation of the literature, but instead focused our efforts on characterizing important applications and on examining key issues affecting ITS mainstreaming and on and topics. We prepared a series of working papers that were used as background materials for later steps in the project. (The papers are available on the web, www.uctc.net/mainstream.)

We then turned our efforts to two key undertakings. One was to explore perspectives on ITS with key decision-makers, staff members, and opinion leaders in California. The second was to document cases of successful ITS planning and implementation in a series of summary papers.

To explore perspectives on ITS, we conducted three separate research efforts. The first was a series of interviews with fifty-one decision-makers, managerial staff, and opinion leaders throughout the State of California. In the interviews, the respondents were asked to discuss their familiarity with ITS in its various forms, what they think about ITS's usefulness in addressing transportation problems, and the pros and cons of ITS applications as they see them. They also were asked for their perspectives on the implementation of ITS technologies, and whether they had particular interest in or problems with them. Respondents were asked for suggestions on what would make implementation more likely or have it occur at a faster rate than at present. Finally, respondents were asked whether they were aware of any examples of ITS implementation that they thought to be particularly noteworthy, either as successes or as failures. Respondents were also given the opportunity to raise additional topics and issues if they so chose.

The second research effort was a survey of transportation engineers and planners working for California cities, counties, and transit operators. The survey examined the respondents' work experience, familiarity with ITS, sources of information on ITS, and perspectives on its implementation. The survey was mailed to 396 transportation planners and engineers in California cities and counties of population over 25,000 and in transit agencies serving these cities and counties; 228 returned completed surveys, for a response rate of 57.6%. We then conducted follow-up interviews with a sub-sample of 52 of the survey respondents to explore their views in more depth and to ask for suggestions on implementation strategies.

The third research effort was a series of in-depth interviews with twenty national experts with extensive experience in managing transportation organizations, intergovernmental cooperation, planning and programming, and project finance. Half of the experts were current or former executives with the federal government or state DOTs. Six others were current or former leaders in important professional organizations, including ITS America, AASHTO, ASCE, and ITE. The remaining four are with university ITS programs or private firms specializing in ITS, although two of these participants also have served in high government posts. The objective of the interviews was to gain insights and gather perspectives on ITS implementation. The interviews examined organizational, institutional, and procedural considerations in deploying ITS. Interview participants identified lessons learned from the ITS implementation experiences of various states and discussed the role of policy and planning, organizational arrangements and assignments of responsibility that help or hinder ITS implementation. They also discussed whether ITS is best integrated with existing units, planning processes and funding sources or handled as a separate unit and activity. Finally, the participants identified applications, research topics, and training needs that deserve additional attention.

All interviews and surveys were conducted in accordance with a detailed protocol. Prospective respondents were sent a letter requesting their participation in the study, explaining its purpose and how the results would be used. The interviews were open-ended, guided by a series of questions prepared as the interview guide. Interviews took place by telephone or in person, at a time selected by the respondent. No interviews were taped, although the interviewer took detailed notes including direct quotations during the interview and also prepared additional notes immediately following each interview. Because there was some potential risk that in the course of an interview, a respondent might make statements about individuals, projects, or agencies that if revealed could be embarrassing, respondents were promised that their identity would not be revealed. Like the interviews, the staff surveys were designed to be anonymous so that respondents would feel comfortable in commenting on such matters as decision-maker's knowledge and understanding of ITS, the reliability and utility of available information on ITS, and relationships with other agencies.

Interviews ran in length from 10 minutes to over two hours, with the typical interview lasting 45 minutes to an hour. The mail out-mail back survey of staff consisted of a three page form containing 10 questions, several with multiple parts. Most questions allowed the respondent to simply check off their responses, but space also was provided for the respondents to express additional views. The pretest showed that completing the survey took about 10 minutes on average.

The findings from the interviews with decision-makers were presented at a conference held in Sacramento and attended by a variety of ITS specialists. (Research papers on all three research efforts were posted on the project website. Recommendations for mainstreaming ITS, presented in the final chapter of this study, are largely derived from these research efforts and the comments received on them.

The second key thrust of the study was to identify and document cases of ITS planning and deployment. As part of the first year of the study, we identified a number of cases for possible further analysis. Some of these cases were identified in the literature review, others were suggested in the interviews, and still others were suggested by Caltrans staff and other reviewers of the working papers. After further discussions with Caltrans staff and analysis of the interviews and surveys, we determined that the greatest need was for brief summaries on the various applications of ITS, written in non-technical language and offering wherever possible information on benefits and limitations as well as examples of deployment experience. Longer case studies, we concluded, would be of less value to those who needed the

information most - local government officials, senior managers, and new hires in both engineering and planning departments of state and local agencies.

During the second year of the study we prepared three dozen such summaries, each 1-3 pages in length. A list of the ITS summaries is presented in Table 2. The summaries cover a wide range of intelligent transportation technologies and applications, with examples for freeways, arterials, local streets, and transitways, parking spaces and facilities, and cars, trucks, transit vehicles, and taxis. Cases illustrate applications for a variety of purposes, including safety, traffic management, traveler assistance, vehicle regulation, transit operations, equipment monitoring, and roadway maintenance. In addition, several of the cases describe policy initiatives and organizational arrangements that have facilitated ITS deployment. Applications for both urban and rural settings are described. Lead agencies for the projects included state DOTs, MPOs, local agencies, transit operators, private companies, and in several cases, partnerships and coalitions.

In addition to these summaries, we prepared additional materials that could be used to help to introduce ITS to government officials, business groups, community organizations, environmental organizations, and other potential stakeholders. These include a PowerPoint presentation providing an overview of ITS technologies, an outline for an introductory one or two day seminar or workshop on ITS applications and implementation strategies, and ways to integrate ITS materials into university curricula and introductory transportation planning and engineering courses offered through the UC Extension.⁽¹⁰⁾ Finally, we prepared presentation materials on the findings and recommendations of this study.

The remaining chapters of this report present the major findings and recommendations of the study.

Table 1.1. Mainstreaming ITS – List of Tasks

YEAR 1

Task 1. Characterize ITS Technologies and Planning Processes

Task 2. Summarize Previous Work on ITS Markets, Market Acceptance, and Market Barriers

Task 3. Design Data Gathering Approach

Task 4. Explore Issues with State Officials

Task 5. Explore Issues with Regional and Local Agencies and Officials and Private Providers

Task 6. Explore Issues with Other Key Actors

Task 7. Identify Cases of Successful ITS Deployment

YEAR 2

Task 1. Work Program Review and Revision

Task 2. Case Studies and Recommended Actions – Incorporation of ITS Into Statewide Policies, Plans and Programs

Task 3. Successful ITS Deployment – State DOT Examples

Task 4. Case Studies and Recommended Actions – Incorporating ITS Into MPO Planning and Programming

Task 5. Case Studies and Recommended Actions – Successful ITS Deployment – Local Examples

Task 6. Case Studies and Recommended Actions – Effective Partnerships with Other Agencies, Interest Groups and the Public in ITS Planning and Deployment

Task 7. Recommendations for Mainstreaming ITS

Task 8. Final Report and Educational Materials

Table 1. 2. List of ITS Summaries

-	Overview of Summaries
1	On-Board Safety Systems
2	Variable Message Signs
3	Highway Advisory Radio
4	511 Traveler Information
5	Road Weather Information Systems
6	Advanced Signal Timing
7	Pedestrian Detection Systems
8	Inductive Loops for Bicycles
9	Ramp Metering
10	Transportation Management Centers
11	Integrated Transportation Management - Traveler Information
12	IMAJINE
13	PeMS
14	Cost-Benefit Analysis
15	Smart Corridors
16	Electronic Toll Collection
17	I-15 HOT Lane and Managed Lane Concept
18	SR-91 Congestion Pricing
19	Roadway Weather Management Systems
20	Smart Snowplowing
21	Smart Cards for Transit
22	Transit Information Systems
23	NextBus
24	Bus Rapid Transit
25	Smart Taxis
26	Car Sharing
27	Smart Cards for Parking
28	Parking Guidance Systems
29	Automatic License Plate Reading
30	Red Light Camera Enforcement
31	Commercial Vehicle Operation
32	CVISN
33	I-95 Coalition
34	European Experience
35	Rural Applications
36	Security Applications

Notes and References for Chapter 1

- (1) For links to a variety of ITS publications and other ITS websites, three valuable websites are <http://www.fhwa.dot.gov> (Federal Highway Administration), <http://www.itsa.org> (ITS America), and <http://path.berkeley.edu> (University of California Program on Advanced Transit and Highways.) Use the search engines at these sites to locate references on particular topics.
- (2) The California PATH website, <http://www.path.berkeley.edu>, provides excellent information on California ITS projects and programs, with links to world-wide resources on ITS.
- (3) Summaries on ISTEA and TEA-21 are available on the USDOT website, www.dot.gov - search for ISTEA and TEA-21 overviews.
- (4) For a review of transportation practice in California see Deakin, Elizabeth. Transportation in California: The Coming Challenges. In Special Edition, California's Future in the Balance, Policy Issues Annual, Pat Brown Institute, Cal State University Los Angeles, and Institute of Governmental Studies, University of California, Berkeley, pp. Nov. 2001.
- (5) Dahms, Lawrence D., Partners join forces to "JUMP Start" San Francisco Bay Area traffic, ITE journal. Vol. 62, no. 12, pp. 22-24, December 1992.
- (6) Yee, Bond M.; and Jack L Fleck, San Francisco red light camera enforcement program. Institute of Transportation Engineers. 67th Annual meeting, Boston, M, 1997. Compendium of technical papers [CD-ROM] 9 p.
- (7) Giuliano, Genevieve, Randolph W. Hall, and Jacqueline M. Golob, Los Angeles Smart Traveler field operational test evaluation, Partners for Advanced Transit and Highways, University of California, Berkeley. Institute of Transportation Studies Report No. UCB-ITS-PRR-95, 41, 1995, various pagings.
- (8) Sullivan, Edward C.: Impacts of implementing the California Route 91 variable toll express lanes. Institute of Transportation Engineers. Meeting (67th : 1997 : Boston, Mass.). Compendium of technical papers [CD-ROM], 12 p.
- (9) Deakin, Elizabeth, Alexander Skabardonis, and Adolf D. May, The Fuel Efficient Traffic Signal Management Program : final report to the California Energy Commission Berkeley : Institute of Transportation Studies, University of California, [1984] vii, 49 p.
- (10) A graduate level course on Intelligent Transportation Systems was developed with funding from the UC Transportation Center in cooperation with faculty in the Civil and Environmental Engineering Program, partly in response to needs identified through this project. The course outline is on the Mainstreaming ITS website, www.uctc.net/mainstream.

Chapter II. Findings

A. The Literature on ITS

A key finding from the literature review was that the vast majority of publications on intelligent transportation systems are either highly technical or highly promotional. Some articles focus on the details of how electronic components of intelligent transportation systems are manufactured, how software for ITS works, etc. (1) While technical specialists who develop new systems undoubtedly benefit from these articles, they are far too detailed to be useful to policy-makers and planners.

Many other articles on intelligent transportation systems are written by enthusiasts who make large claims for ITS - that intelligent transportation systems will resolve congestion problems, make transportation systems safe, make travel carefree, etc. (2) Such articles often describe ITS applications in clear language but provide very little information on costs of deployment or any "downside" that the technology applications might have. (3) The articles are intended, in many cases, to create a "vision" of ITS that is attractive and compelling. (4) Unfortunately, to an outside reader the claims for ITS seem unsubstantiated and unconvincing.(5)

Relatively few articles described how implementation occurred - who was involved, how the projects were paid for, or what they accomplished in terms of travel time savings, cost reductions, environmental improvements, or other valued results. The articles and reports that did provide this information often were for projects implemented as "demonstration projects" or "early deployment initiatives". In fact, the US DOT's Early Deployment reports (6) are one of the best sources for details on ITS project implementation. Nearly 100 such deployment plans have been completed to date; most document such activities as identifying "stakeholders" (e.g., the state DOT, the MPO, local government traffic engineers, freight operators) and agreements reached about the needed "architecture" (functions to be performed) for various ITS applications such as ramp metering and arterial signal coordination.(7) Far from being mainstreamed, however, these projects were supported by special funding, organized by research and development divisions of government agencies or private companies, and carried out by specialized staff. Most of the plans leave to the future the integration of recommended high-priority activities into the state or MPO plans and programs. Thus, while the findings on the performance of the ITS technologies and applications were usable, institutional, procedural, and funding approaches provide little guidance for mainstreaming efforts.

Some exceptions do exist. A series of studies conducted over the past several years by the US DOT's Volpe National Transportation Systems Center (8) presents detailed case studies of mainstreaming efforts in selected US metropolitan areas. These studies provide background on the region and its organizations, describe ITS applications, and examine regional strategies for both deploying ITS and mainstreaming it as part of the region's planning and implementation process. For California readers, the case study of the Los Angeles Region (9) is especially germane.

While the ITS literature is large, very little has been written about ITS in conventional transportation documents or on transportation websites. For example, federal and state planning and programming requirements, California General Plan guidelines, and environmental review guidelines are almost entirely silent about ITS technologies and their application. Indeed, far from being mainstreamed, ITS applications have been treated as a separate topic needing separate planning documents to develop deployment plans.

One conclusion we drew from the literature review, then, was that more work needed to be done on the "soft side" of ITS, to address an array of difficult questions about the performance of ITS projects in practice, and on the difficult questions of policy, planning, and priority-setting, finance and costs for ITS, as well as organizational behavior, interagency relations, and the roles played by expertise and leadership. As we noted in Chapter 1, our methodology for better understanding these issues involved in-depth interviews with California leaders, a survey and follow-up interviews with California transportation staff members, and interviews with national experts in ITS and transportation planning. Here, we report our findings.

B. Interviews with Leaders in California

Interviews were conducted with elected officials, senior staff in charge of engineering and planning operations in cities and counties, MPO executives and senior managers, and interest group leaders. Table 2.1 describes the sample frame and completed interview sample. Findings from the semi-structured interviews cover their knowledge of ITS options, their views on its fit with the regular or conventional planning process, perspectives on ITS's impacts, and other issues the respondents deemed important. (11)

Information about Intelligent Transportation Systems

The interviews began with a discussion of the respondent's understanding of Intelligent Transportation Systems. Contrary to initial hypotheses that many would be only vaguely familiar with ITS, all the respondents said that they were either reasonably familiar with these new programs and technologies ("as familiar as I am with standard transportation programs and technologies", as one elected official put it) or were very familiar with them. The programs and technologies that came to mind first when thinking of ITS differed by the agency and title of the respondent. Elected officials mentioned automated highways, smart cards for tolls and transit payments, and advanced traffic management systems. Planners mentioned advanced traffic signal equipment, bus rapid transit, toll tags and smart cards. Engineers and regional agency staff were more comprehensive, typically listing seven or eight categories of ITS using nomenclature and abbreviations from the ITS National Architecture. (7)

All of the local engineers and state and regional agency staff had learned of ITS as part of their professional programs; some had also studied ITS as part of their graduate education. (University education in ITS was reported primarily by individuals under 40, although four middle-aged respondents said they had first learned of these technologies in the 1970s and saw the current programs as "the latest round" of work on new technologies.) In contrast, local planners had most commonly learned about ITS from their engineering or regional agency counterparts, by participating in project reviews for local and regional agencies, where proposals for ITS occasionally came up, or through publications, especially Transportation Research Board papers.

Elected officials, in contrast, said they had learned about ITS mostly from news media (news articles, professional press) and to a lesser extent, from presentations or memos from staff. They all felt that if they wanted more information they would be able to get it from either their own staff or regional agency staff. One pointed out that the elected officials who serve on transportation agency boards get briefings and information packets that get them up to speed on transportation options, although he also said that these packets tend to lack details on markets and costs.

Based on their knowledge of the options, almost all of the respondents listed private sector freight operations, using logistics, global positioning systems, and telecommunications for real-time dispatching and tracking as the most important short-term application of ITS. Advanced traffic signal systems timing and intersection controls were the second most commonly mentioned as an important short-term application of new technologies. The majority also listed automated toll collection, smart cards for transit,

consumer route-finding systems (on the Internet, built into some vehicles, or for hand-held computers), and GPS and other systems for tracking buses and adjusting schedules.

State and regional staffers and local engineers also mentioned traffic operations centers, ramp metering, weigh in motion, and automated commercial vehicle safety checks, and but no one else did.

For long-term applications, most respondents believed there would be substantial improvements in the technologies that they mentioned for short-term application. For example, 35 of the respondents felt that advanced signal systems would become ubiquitous and would be better integrated with transit operations. Another 31 of the respondents expressed the hope that eventually multi-purpose smart cards would be available. Several expressed frustration at how long it was taking for smart cards to be implemented in the US, noting that they were ahead of the US in several countries overseas. As one elected official put it, “It’s a shame that we are getting different technologies for tolls and for transit. Of course, it took ten years to get either of them going here, which itself is shameful. It probably would have taken twice as long if they had tried to make the same thing work for tolls and transit. Eventually, though, I think the public is going to demand that they have a single smart card that can pay for parking, tolls, and transit. Why not?”

Fifteen of the respondents mentioned fully automated guideways and vehicles as the options that they believed ITS experts expected to see in the future, though several also noted that federal funding for these programs had been cut. Most of the respondents were skeptical about these strategies, commenting that they did not personally think these options would be around for a very long time, except perhaps in limited applications like airport transit systems. Four questioned whether automated guideways would really work, saying that they had not heard a clear explanation of how the added traffic carried on such facilities would be accommodated getting on or off locally owned streets and arterials.

Asked how informed they thought the public was concerning ITS, respondents were divided. Most elected officials thought the public had pretty good awareness of available and upcoming options, including toll tags, smart cards, GPS route-finding systems, traffic advisories available on computer, commercial vehicle operations management, and so forth. Planners and interest groups representatives also agreed that many members of the public were interested in technology and wanted to try such things as smart cards. State and regional officials, in contrast, felt that citizens were not very knowledgeable about ITS. Pressed for examples, several mentioned a lack of public interest in traffic management systems as their reason for believing the public is ill informed about ITS.

A number of the respondents, and in particular elected officials, interest group representatives, and planners, commented on the quality of the information available on ITS. They characterized most of the available information as “too technical” and “way too long”. Many also thought the literature was too promotional. As one planner put it, “they list a large number of benefits but it is hard to find cost information, or any sense of “compared to what”?” Twenty of the respondents specifically commented on the lack of believable, dispassionate evaluation of the ITS options.

While most of the respondents felt that they had a reasonably good understanding of ITS, most also complained about the use of jargon to describe the options. As one elected official put it, “The technical people continually use initials to describe their work. They don’t seem to understand that when they do this with a general audience, it is anesthetizing. They should be instructed to speak and write in plain English. These are not difficult concepts, and they shoot themselves in the foot by continually using these abbreviations.” A regional agency official commented, “The term “architecture” is proving to be a mistake. We are finding that people outside the group discussing it think we are talking about building things, structures. It should have been called guidelines or framework, not as glorious sounding, but more informative.” An interest group representative said, “It’s alphabet soup. It doesn’t communicate.”

Ten of the respondents, including six elected officials, felt that there was particularly poor information about public investment strategies for ITS - either what needed to be done in the public sector or what it would cost.

Fit with Planning and Funding Processes

Initial hypotheses suggested that a poor fit with existing planning and funding processes might explain slow ITS implementation. The interviews provided mixed support for these hypotheses. About half the respondents challenged the basic premise of slow implementation, arguing that many ITS applications have taken off in the market and are well on their way to being the norm, or were already widely implemented in California or elsewhere. The others felt that implementation was hampered mostly by a lack of clear priorities for ITS investment and by a lack of funding dedicated to ITS.

Respondents who argued that ITS was, in fact, being implemented quickly pointed to the widespread use of information technologies in freight applications, consumer adoption of GPS devices and computer-based route information, automated toll collection, advanced traffic signal systems, transit smart cards,

transit priority systems, and transit monitoring systems. They agreed, however, that institutional conflicts had gotten in the way in some cases. “California has put a lot of money into technology and system development, but we haven’t been particularly skilled at handling the institutional issues. We were slow to get automated toll collection, way behind New York and the New England states. Labor issues and contracting problems seem to get in our way. We have spent years on an integrated fare collection system in the Bay Area but have not really faced up to the underlying problem, which is how to allocate costs and revenues, and that is a problem because underlying that is insufficient revenues for transit.”

Respondents who argued that ITS was not being implemented very quickly commented primarily on traffic operations centers and traffic management systems. Most of these respondents were state and local officials with responsibility for highways, and auto and trucking interest group representatives. Their diagnoses of the problem were not, however, identical.

State officials felt that the problem was largely that metropolitan regions did not give these ITS projects priority. With few exceptions, they felt that MPOs, both the elected officials on the board and staff members, lacked interest in the ITS options and were more comfortable with and interested in traditional capital projects. Two exceptions specifically noted were the Bay Area, where MTC had designated staff and funding for ITS, and the San Joaquin Valley, where an inter-jurisdictional traffic management center had been put together.

Local government officials, in contrast, thought the problem depended on the application. For traffic signal systems, they felt the issue was simply one of funding. Five of the respondents pointed to the state’s Fuel Efficient Traffic Signal Timing Program (FETSIM) of the 1980s as a good example of what can be done if a program is established and funded. Under the FETSIM program, almost all of the signal systems in the state were timed with modern methods, and traffic engineers and their consultants were trained in state of the art signal timing and learned about advanced signal equipment. Many used that knowledge even after the program ended. (9) These respondents felt that a new signal program would be welcomed. For ramp meters and traffic operations centers, the locals saw the problem as institutional and political rather than technical or financial. “Sure, we know how to do it, we can show that it would help. We already have a lot of ramp meters working. Where we don’t have them are in places where the locals don’t trust the state not to divert too much traffic to local streets. And a lot of times they have bad experiences to point to that make them not trust the state. That’s also why some locals are not so enthusiastic about a joint traffic operations center. It’s a question of control, and trust.”

Asked whether a lack of planning and evaluation tools was a barrier, the respondents who had an opinion unanimously disagreed. (Twelve of the respondents did not feel sufficiently knowledgeable about available methods to comment on this topic.) The respondents felt that there were plenty of methods that could be used to evaluate ITS options, and what was missing was not planning tools but basic information on costs and benefits. “If we had information that our policy board would accept, we could put it into our evaluations”, said one regional agency official in a comment typical of those made on this topic. “We don’t really need any more analysis methods, and we certainly don’t need any requirements to use them.”

Ten of the respondents commented that rather than invest in new analysis tools, they would prefer demonstration projects. Said one, “Elected officials are more easily convinced by a project that works than by a technical report or a modeling run. Show them what can be done and they are willing to listen and give it a try if it makes sense.” Others added that case studies that had carefully documented benefits, costs, public reaction, etc. were very helpful, especially when written for a non-technical audience.

At the same time, many of the respondents noted that there was not enough transportation funding to go around, and even projects with considerable popular support and strong technical merit had to wait for funding. Prior commitments represented by long-range plans and multi-year programs took precedence, and crowd out ITS options. Local officials and interest group members added that projects like traffic calming and sidewalk installation and repair had plenty of public support but couldn’t compete with large regional projects; it took federal legislation to make funding available for these measures, and even then they have a hard time competing unless the MPO has set aside funds for them. In this context, 15 of the respondents advocated earmarking funds for ITS, but a larger number (28) commented that giving ITS special precedence seemed unfair, especially after so many years of heavy funding. “ITS has gotten a lot of research and development money over the last 10 or 15 years,” one respondent said.. “It’s time to start showing what all that money was good for. If these are good ideas, they should be able to compete on their own, and not need further special treatment.”

Several respondents argued that Caltrans should be spending the money under its control for ITS if it believes these are high priority investments. “Lead by example”, one respondent put it. Another put it, “Caltrans has been funding the research. If it has produced good products, Caltrans should get on with it and implement them.” Variable message signs, weather advisories, automated tolls, mainline flow metering as well as ramp metering, freeway patrol services tied to detector and camera data, telecommuting and teleconferencing for employees were some of the measures that respondents mentioned as items that Caltrans could implement on its own.

Twenty-six of the respondents felt that it was not so much funding availability per se that was limiting ITS implementation, but rather the lack of a clear picture of what would be gotten for the money. Several respondents used traveler information systems as an example. “We already have [radio traffic advisories]”, one respondent argued. “They tell you what has been reported, whether it is one person who phoned in or several, they check the information with the CHP [California Highway Patrol] and Caltrans and tell you what they have to say...That is pretty good. People already can get a cheap add-on for their [hand-held computer] that will give them alternate routes, if they don’t know them already, and believe me, commuters figure out every alternate route in the first two weeks on the job. If we are going to keep spending public money on traveler information, somebody is going to have to make it clear what the government is going to give you that we don’t already have from the private sector.” Another respondent, voicing similar sentiments, added, “It is not just that we could make it better. You have to show that the added expenditures make sense at the margin, that it will be enough better that I should be willing to pay for it.” Several expressed concerns that evaluations were being performed by ITS advocates; as one put it, “People who spend their days promoting new systems are not the right people to be evaluating them”

Speaking of funding and priorities, 20 of the 51 respondents suggested that at least some ITS technologies should now be left to the private sector to further develop and market. One respondent put it this way: “There are a lot of projects that have positive benefit-cost ratios. The issue is how these beneficial projects stack up against each other. And when we are looking at a field where the private sector is already active, providing us with a range of products, free to pretty expensive, I want to see some evidence that a public expenditure will produce a worthwhile added benefit. Another respondent said, “I don’t want to just fund some ITS project just because there is a Not Invented Here attitude among the ITS staff. If the public sector has done a lot of work but now the private sector has moved in and taken off with an idea, great. Declare it a victory and move on to something else.”

Impacts of ITS

A third set of hypotheses considered ITS impacts as potential barriers to implementation. The interview respondents largely supported these hypotheses.

Most respondents agreed that the ITS technologies that suggest central control over facilities and services that currently are managed by separately raise political and institutional issues that have not been addressed adequately. As noted earlier, several respondents felt that disinterest in automated guideways

and slow implementation of traffic operations centers and ramp meters partially reflected this concern. Along the same lines, most respondents felt that there was lingering concern that ITS programs for highways could encourage more auto use and in so doing have adverse impacts on transit use, lead to more emissions and energy use, further support sprawl, and harm the central city and older suburbs. To some extent, transit ITS projects such as Bus Rapid Transit are dispelling this concern, providing an example of how ITS can help transit, inner cities, and older suburbs.

However, most respondents felt that the biggest issues concerning ITS impacts had to do with user-side benefits and costs. All of the elected officials, all of the planners, all of the interest group representatives, all of the regional agency officials, and about half of the local engineers and state agency representatives thought that far too little attention had been paid to the consumer conveniences, environmental benefits, and neighborhood enhancements that ITS could provide.

“Why aren’t we giving the consumer multi-purpose transportation and parking cards? Why aren’t we even trying a demonstration project that allows a toll tag to pay for parking in major facilities?” asked one respondent. “I can only conclude that the interest in toll tags is mostly to make the facility operate better, not really to help the consumer out.... If we cared about the consumer we would get moving.”

Coordination with other state programs also could be improved, as several respondents noted. One suggested linking traffic and environmental data: “...we could add remote sensing equipment [emissions monitoring devices] and combine that with vehicle identification, speed and flow measurements, and so on, and greatly improve our air programs. But there is a lot of turf here and hardly any of the ITS [work] builds this sort of environmental linkages.”

Several local respondents suggested ways that ITS technologies could be more useful to local governments:

- “We should have a demonstration program for a single transportation pass that pays for transit and parking and maybe taxis, too.”
- “It would be great if we had smart cards that also could serve as neighborhood permit parking cards so that we could read them electronically just by driving by the vehicles. We could enforce these programs more easily.”

- “There should be some way to use all this new technology to automate origin-destination surveys.”
- “I can’t get a straight answer on how many commute trips never use the freeway system at all, and for those that do, how many miles they spend on freeways versus arterials versus local streets. Couldn’t all these detectorized freeways produce that information?”
- “Couldn’t we use these new technologies to catch speeders and other bad drivers? Couldn’t part of the ITS research program be to figure out how to do that institutionally if it is legal issues that are in the way?”

These respondents suggested that ITS projects would be implemented faster “if it were a two way street – the state should be interested in what would help us out, not just ask us to help them manage their freeways better.”

Other Issues

Respondents were asked whether there were other issues that they would like to raise. Two issues were suggested by a number of respondents.

First, over half of the respondents commented that there was a need for more work on the institutional and legal aspects of ITS proposals. “There is a lot of good technical work but we are continually getting hung up on institutional conflicts,” as one respondent put it. “Legal issues, like how to develop an enforceable agreement on ramp metering and arterial signal timing that protects local interests, could use attention”, another added.

Second, twenty respondents suggested the need for both state and local strategies for ITS. One elected official’s comments summarize the overall sense of frustration with existing programs and the need for direction: “I don’t get any sense of priorities from the materials I see,” said the official. “Some sense of the relative importance of the various strategies is needed.”

C. Survey and Interviews with Transportation Staff in California

The mail out-mail back survey of traffic engineers and transportation planners in public agencies provided staff perspectives of ITS, including their views on benefits and costs and on possible barriers to implementation. Follow-up interviews explored these issues in greater detail with a smaller number of the respondents.

Staff Familiarity with ITS and Views of Key Opportunities

Survey results show that most transportation staff members in California rate themselves reasonably familiar (68%) or very familiar (20%) with ITS technologies. Most (87%) learned about ITS on the job or from conferences and workshops (55%). Relatively few regularly read about ITS in journals and newsletters (22%) or from professional development or extension courses (20%). Departmental directors were far less likely to be highly familiar with ITS than their more specialized staff.

A large majority of traffic engineers (95%) and a substantial majority of planners and transit staffers (65%) see traffic operations improvements, especially advanced traffic signal timing, as the chief near-term opportunity for implementing ITS; 74% of the respondents overall listed this as the key short term application. Traveler information systems, especially dial-up and dial-in traffic advisory sites and real-time transit information systems, were a close second (62% overall) for all respondents.

For the longer term, capacity- and efficiency-enhancing applications such as advanced incident response systems, weather warning systems, integrated arterial-freeway management, and bus rapid transit with priority treatment on freeways and arterials were seen as the most significant probable applications of intelligent transportation technologies (rated important by 72% of respondents.) Engineers and planners had similar responses, though planners were more likely than the engineers to comment on applications for transit, parking management, and safety. A few, all transit staff members or planners, also mentioned that smart card applications could be important, especially if multiple applications were put on one card.

Perceived Benefits and Costs

Most respondents of the staff survey - 77 percent - listed increased capacity and increased operating efficiency as the key benefits of ITS. Sixty-three percent also saw better information for travelers as a major benefit. Respondents who reported a high level of familiarity with ITS identified improved data,

greater safety, better system administration, more rigorous and effective law enforcement, and resulting cost reductions as additional benefits. Overall, however, fewer than half the respondents thought these items were major benefits of ITS.

High costs were seen as the major downside of ITS applications. Two-thirds of the respondents identified initial costs of deployment as the major barrier to more widespread implementation. Just under half of the respondents noted further concerns about the costs of operation and maintenance. Engineers and transit operators were especially concerned about these ongoing costs, and on the need for staff with technical skills to manage, maintain and repair the new equipment used in ITS applications. As one put it, "We have a need for electronics technicians, and that is new for us." Several mentioned that they had difficulty keeping loop detectors operating correctly.

Previous studies (and some of the comments from California leaders) have raised concerns about ITS's impacts on the environment, community values, and urban form, but almost none of the staff who responded to this survey thought these matters were at issue with ITS projects. In fact, the respondents saw few significant effects, positive or negative.

Barriers to Implementation

Most of the respondents felt that progress was being made in incorporating ITS technologies into transportation programs and projects, but 83 percent also felt implementation had been slow and spotty. Over 70% attributed this, foremost, to the lack of knowledge about ITS among elected officials and the general public. In the staff view, this lack of knowledge was the reason that there was very little advocacy for ITS projects.

Both of these comments are in sharp contrast to the findings from the interviews of transportation leaders carried out in the preceding study (1). Staff feel that elected officials don't know much about ITS; the officials believe that they are reasonably knowledgeable. Staff attribute inaction to a lack of knowledge about ITS; elected officials point to a lack of attention to institutional issues, markets, and cost-effectiveness issues.

Respondents were fairly evenly divided on whether more information about ITS applications would be helpful. Just over half the respondents thought that success stories would help build public understanding and support. A number of respondents added comments to the effect that a simple web search would turn

up plenty of easy to read, brief examples of ITS implementation. In addition, about a third of the respondents felt that the real successes would depend on corridor and system wide implementations; the more knowledgeable the respondents on ITS matters, the more likely they were to say that corridor examples are what's needed.

Interestingly, staff concerns about ITS projects' potential community and environmental impacts, sprawl effects, etc. were highest among those who consider themselves the most knowledgeable about ITS (40% listing this as a concern vs. 25% overall.) Similarly, those most familiar with ITS were far more concerned that ITS experts are too technical and ineffective at advocating their projects than were their less knowledgeable counterparts (50% of those very familiar with ITS vs. 12 percent of those less familiar.)

Finally, very few of the respondents felt that significant barriers were posed by a lack of analysis tools or a lack of impact information for ITS projects or project elements.

Leaders in the Field?

Although most of the staff responding to the survey felt they were quite knowledgeable about ITS technologies, very few identified any states, regions, or localities that they felt were leaders in ITS implementation. Less than 20% of all surveys identified leaders in response to the survey's open-ended questions. For those who did respond, the states identified as leaders were New York, for its multi-application smart cards and electronic toll collection systems; Minnesota, for ramp metering and arterial management deployments; and California, for longstanding freeway ramp metering and advanced signal timing programs. The regions and localities identified as leaders included Houston, for traveler information systems; San Diego, for High Occupancy Vehicle-Toll (HOT) lanes and variable pricing; and Los Angeles, for Bus Rapid Transit.

Variation in Responses

We carried out analyses to determine whether responses varied systematically with the respondent's (self-evaluated) level of experience, profession /job title, years on the job, city population size, or location in the state. We found that familiarity with ITS was associated with more positive views toward ITS's capabilities. To some extent, however, this may be due to the fact that among the more knowledgeable

respondents were a number of individuals, mostly from large organizations, who were hired specifically to handle ITS applications.

We also found that respondents from small cities (50,000) were less informed about ITS technologies and applications, less likely to have had formal training on ITS, and less favorably inclined toward ITS than their counterparts in larger cities. Planners were more likely to consider transit, bikes and pedestrians and traffic engineers were more likely to consider traffic signals and freeway operations when discussing ITS. Respondents located in the Bay Area, South Coast and San Diego areas felt better informed about ITS than other respondents.

Findings from Interviews with Staff

Follow-up interviews both elaborated on some of the findings of the survey and revealed new information, especially on ways that ITS implementation might be advanced.

First, many of the interview participants commented that corridor-wide, area-wide, and system-wide ITS implementation was needed, rather than piecemeal projects. Asked for suggestions on strategies that would encourage implementation, many traffic engineers responded that they would welcome a state program to upgrade and retime signal systems using the latest technologies and software, possibly also reviewing how the introduction of new equipment could enhance system performance. Traffic engineers also were interested in learning more about the efficacy of freeway-arterial coordination capabilities.

Similar to the comments made by elected officials, several of the staffers who participated in these interviews said that Caltrans could best advance ITS by implementing it consistently on Caltrans facilities. About half of those interviewed thought that a case book of success stories would help them explain ITS benefits to their elected officials and citizen committees. However, nearly half felt that this sort of material was already available from the Federal Highway Administration and others. Planners wanted information on how to integrate ITS into pedestrian, bike, transit, parking, and traffic calming applications. They were especially interested in how detectors, signal timing plans, etc. could be used to increase pedestrian and bike safety and to facilitate bus movements.

Both planners and engineers commented that multi-jurisdictional, multimodal efforts of the sort they envisioned would require significant efforts to build relationships and trust among diverse agencies and interests. They felt that unless there were funds for putting together the institutional arrangements, these

larger scale but larger benefit projects were likely to go undone. Special programs to give planning grants for multi-jurisdictional, multimodal projects were recommended by several of the staffers interviewed.

Planners and engineers also advocated integrating ITS training into standard continuing education courses, although most felt that an annual update could be offered as a special symposium or as part of other professional meetings. Several commented that it was difficult to attend short courses that lasted longer than a day or required overnight travel, suggesting a need for course offerings in a number of locations across the state rather than only in the major cities. Many suggested that it would be helpful to inform decision-makers about ITS advances; they recommended that short presentations and articles could be placed in publications read by elected officials, city managers, and the public.

Additional recommendations on ways to speed the implementation of ITS included:

- An urban applications demonstration program combining bus rapid transit concepts (touchless transit passes, transit priority at signals, comfortable buses) with low emissions vehicles (natural gas or electric buses, electric hybrid station cars) and pedestrian and bicycle improvements (pedestrian detection systems at signals near major stations, bike signals on bike routes) and other pedestrian and bike improvements (tree planting, sidewalk widening, bike parking, etc.)
- Smart parking demonstration programs that combine smart parking at meters and garages with smart parking location information systems telling motorists where to find available spaces
- Demonstration projects showing how to use detector data to determine intersection traffic counts, level of service, vehicle classifications / traffic mix, and origin-destination or through vs. local traffic analyses.
- Demonstration projects on how to use GPS equipped "probe vehicles" and GPS person-packs to collect travel survey data.
- Training on the use of remote data collection devices and methods.
- Demonstration projects on the use of ITS technologies to enforce traffic rules at the local and regional level - ticketing using license plate photos, truck tire safety enforcement through remote sensing, etc.

- An introductory one day short course that would explain both what new technologies were available for transportation improvements and what they cost to implement.
- Smart card demonstrations for resident permit and other reserved or restricted parking.
- Planning guidance for local governments on how to deploy ITS to do the tasks they want to do better.
- Model agreements that could be used by localities wishing to jointly manage arterials that pass through several jurisdictions.
- Model memoranda of understanding that could be used for local agencies and transit operators to agree on joint management of bus priority treatments (signal timing, signal equipment, location of bus stops, etc.)

D. Interviews with National Experts

The third set of interviews was with twenty national experts on ITS and transportation organizations and management. This group commented on institutional issues.

Learning from Other States

Asked what California could learn from the experiences of the various states, most of the national experts recommended caution, because the states' legal frameworks, transportation organization structures, and assignments of responsibility differ greatly, as do the nature and the magnitude of their transportation problems. In particular, California's decentralized transportation planning and decision-making structure was seen as a reason that California cannot implement ITS "top down" but must build partnerships among agencies. As one interview participant commented:

"California will not be able to use the approaches of state Dots that control most of the highways and arterials, like Virginia or Maryland. In those states the DOT can coordinate actions on the whole system. Under California law, the MPOs and local governments are in charge of decision-

making for most of the urban facilities. Caltrans doesn't have the control and has to be a partner at the table."

Another respondent put it this way:

"Some states set policy on operations centrally by controlling funds and permitted designs. California is not one of them. This gives [California agencies] considerable flexibility and is one of the reasons that innovations come from California since local agencies can try things out on their own. It does make it harder to get things done from the top. You have to be persuasive and build partnerships."

Several of the participants also commented that when a state DOT has strong district offices, as Caltrans does, headquarters views of the importance of ITS may not be shared by district leadership. A view expressed by most is well captured by this comment from a former state DOT executive:

"Decentralization to districts makes it harder to come up with a coherent plan for mainstreaming ITS. Each district has its own priorities and constituents and there usually isn't a constituency for operations of any sort."

Another put it:

"In states where district offices have considerable authority, it can be hard for headquarters to steer [priorities], especially when the districts have been delegated the lead for operations and maintenance.... Most [districts] will put their money in snow removal and fixing pavements first and foremost, and they don't have enough money for that, so ITS is pretty low on the list."

In addition, several of the participants felt that ITS leadership was confined to a comparatively small number of states. The reasoning was that, to date, ITS has been used by state DOTs primarily as a strategy for improving system operations and level of service. However, not all states have major operations and level of service concerns. As one interview participant said,

"For many states, that [level of service, congestion] is not a serious or widespread problem and where it is a problem, there usually are a strong constituency and the resources for adding new

lanes or new facilities. The comparison group has to be other urbanized states with severe congestion and difficulties adding capacity - a much smaller group."

Finally, nearly all of the participants commented that California itself had produced many of the project-level innovations and much of the leadership for ITS:

'California was early to adopt ramp metering, advanced signal systems, bus rapid transit, and a whole host of other innovations. Most states are trying to do what California already treats as mainstream. The state may have been a bit slower with ETC (electronic toll collection) but has largely caught up now. It is still a bit behind on smart cards but that is more of a local issue than a state issue, given the way things are organized out there.'

The interview participants also noted that a considerable amount of ITS research was emanating from California.

The Role of Policy

All of the national experts felt that state policy could play an important role in fostering ITS. Policy could be expressed in legislation or could come from Headquarters directives backed up by incentives and rewards.

One participant pointed out that Japan has made a commitment at the legislative level to becoming an IT leader and is funding projects accordingly. In the US, however, only Maryland has a legislatively approved ITS plan.

Most of those interviewed did not think that legislation was necessary, however; policy direction from top DOT leadership was seen as a key way to promote ITS. One felt that most states would benefit from clear state DOT headquarters policies on ITS, putting it as follows:

"ITS would proceed a lot faster if there were state DOT policies making it a priority and rewarding districts and units that show they understand [ITS technology] and can use it effectively. "

While several of the interview participants noted that ITS deployment has progressed well when there has been a champion for it, they also felt that passively waiting for a champion to appear is not a workable strategy. They argued that champions appear when staff members are assigned that role, or when policies make it advantageous for staff to champion an idea or approach. As one participant said:

Some areas have had champions for ITS [who] have done wonders, but [you shouldn't] wait for a champion to appear. You need to get it done by setting policy and creating awards. In fact that is likely to create champions."

Organizational Issues

Interview respondents had differing opinions about whether ITS should be handled as a separate program with its own line item or integrated into ongoing activities. One commented,

"There is a split among the states on whether ITS should be a separate program. {A separate program]isn't mainstreaming it, but it does give it the attention and expertise it may need for the next few years, or maybe decades, until it is part of standard education and practice."

Another offered the following example in arguing that a separate ITS unit is needed:

"Where traffic engineering and signals are part of maintenance, there isn't much attention to ITS. Most of the budget goes to snow removal (if it snows, that is) and to pavements, and the budget is based on what [these items] cost in previous years.... Some states are reorganizing to make operations and management a separate division, which gives it more importance."

Others believe that a better approach is to establish state mandates for ITS, along with performance measures and rewards for accomplishment, then integrate responsibility for using the best technologies into all divisions. A view held by about half of the interviewed is well expressed by this statement from a former federal official:

"Having an Office of Intelligent Transportation Systems is important during the research and development phases. When applications are ready for implementation it is important to have policies and funding to get them into the regular planning and programming processes. Otherwise they will forever be somebody else's responsibility."

Partnering

For multi-jurisdictional and multi-modal applications, partnerships are usually necessary - for example, traffic management applications of ITS often require several neighboring cities to cooperate and coordinate their activities, and transit applications typically require transit operators, local governments, the metropolitan transportation agency (MPO), and the state DOT to cooperate. Several of the interview participants commented that MPOs are good organizations to facilitate these partnerships, since most potential partners already are part of the MPO or work with the MPO on projects and funding.

Partnerships are not always easy to establish, however. The interview participants had several comments on the benefits and difficulties involved; this one is typical:

"The benefits of partnerships are working together to solve mutual problems. The limitations are that it takes a huge amount of time to get to a decision and even then it is not certain that the decision will hold, if the group is ad hoc. Even formal MOUs can be broken if the new mayor or [other key decision-maker] wants to go a different direction."

Several interview participants also expressed concern about the state DOT staff members' ability to negotiate as a partner. The following comment reflects a view expressed by many:

"State highway departments are often very hierarchical and don't let the people who are in charge of operations make commitments for the agency. They [state DOTs] are not used to making decisions in a short timeframe, which may be necessary for other partners to be able to make their commitments in turn, especially if there is money involved.... This will have to change somehow if the state wants timely results [on ITS implementation.] It also hurts credibility when the people at the table can't get a response from their higher-ups for weeks on end."

Others noted that partnerships with local organizations had similar problems in determining who could make a binding commitment. A former state DOT official offered this comment:

"Local traffic engineers are a possible constituency for ITS and they could be partners in deciding what to do. But they aren't the ultimate decision-makers. They usually report to a DPW director who reports to a city manager or chief of staff who reports to a mayor or council. Agreements to

coordinate operations of arterials owned by cities and highways owned by the state will fall apart if the real decision-makers see the results as hurting businesses or irritating voters.... the traffic engineer may be ready to take off the parking [from city-owned arterials] during peak periods, but the council probably won't be."

Despite these difficulties, all twenty of the national experts we interviewed saw partnerships as likely to become easier as states and localities gain experience with this mode of decision-making.

Planning for ITS

State and metropolitan plans were seen by the majority of the national experts we interviewed as an important way to express policy on ITS, provide direction on ITS to disparate units and organizations, and begin to set priorities. Several of the national experts expressed concern about the development of separate ITS plans, however. As the following quotes from four of the participants indicate, their concerns ranged from fears that a separate plan would not be integrated into the conventional planning documents to which mainstream funding is tied, to a concern that a separate ITS plan would further delay the integration of operations planning into conventional long range planning and programming, to a concern that ITS advocates would lead the planning effort and not pay attention to costs and benefits:

- "Several states do have ITS plans - MD, FL, WS - and MPOs do also, but in most cases the ITS plans are separate when they need to be integrated into the conventional statewide plan, STIP, metropolitan plan, and so forth."
- "Operations has to be planned [as part of the system] if it is going to have system effects. Operations should be part of the long range plan, and using ITS to improve operations should be there too.... A separate plan just delays this."
- "We need to do strategic plans for transportation and incorporate ITS into them, not go looking for ways to use ITS willy nilly."
- "The technology people never saw an ITS concept they didn't like. They aren't the people to do strategic planning for transportation. Let them convince the planners that their ideas deserve to be part of the plans and programs, and then it will happen."

Two of those interviewed commented on the value of including ITS in state and regional plans as a way to help persuade staff of its importance and to give supporters of ITS some "ammunition" to have the ITS projects, or project elements, forwarded and funded. They both saw this as a way to encourage the development of champions for ITS in state, regional, and local agencies:

- "Exhortations [in planning documents] for using new technologies to improve system performance won't pay the bills but they will give champions a basis for justifying attention to new technologies."
- "It gives the champions of ITS some backup if they can point to the plan and show that ITS is adopted policy."

Several of the national experts who participated in our interviews had doubts about the utility of plans as a mechanism for encouraging ITS implementation, however. They thought demonstration projects would lead, gradually, to imitation, and this gradual imitation and adoption in turn would lead to ITS being implemented where it made most sense. Plans, in this view, tended either to be all or nothing - to say that ITS should be included in all projects, whether it makes sense for them or not , or else tended to leave loopholes that provide little guidance - for example, mandating ITS implementation " where appropriate."

Evaluation Issues

A key reason cited for including ITS in the state and regional plans is that it can be considered as an alternative and compared to other ways of making improvements - major capital investments, travel system management, and so on. All of the interviewees felt that ITS applications needed to be carefully evaluated with their lifecycle costs considered, and that it would be a mistake to assume that new technologies will be cost-effective for every possible project. As one put it,

"ITS isn't the answer for all operations problems. You need performance standards and you need to consider total costs including realistic maintenance costs. It doesn't make sense to detectorize a road and then let 30% of the detectors be dead or malfunctioning at any time [because of a lack of maintenance funds.] It doesn't make sense at current costs to instrument the entire interstate system because much of it doesn't have problems we could solve with instrumentation."

Some, however, were skeptical about the utility of detailed cost-benefit analyses. One interview participant commented:

"It is just about impossible to admit that some of these ideas aren't that useful. For example, roadside phones: We finally did these after most people had cell phones."

That participant went on to say that the benefit-cost analysis had shown that the phones had a high benefit-cost ratio, but made unrealistic assumptions about the phones' utility to the public.

Several of those interviewed also commented that it was not just evaluation as part of project decision-making, but evaluation of implemented projects, that was needed, expressing concerns about traveler information in particular:

"Worthless information undermines the value of variable message signs, e.g., signs that say "construction next five miles" placed at start of construction zone where you can see the construction yourself. The same holds for travel information systems that give bad information - tell you there will be delays due to construction and when you get there, having left half an hour early, you see that they aren't working that day."

One interview participant had doubts about the ability of transportation agencies to do good evaluations, and expressed concern about what he saw as an unrealistic belief in the power of marketing:

"We are really bad at [consumer] surveys and market studies. We confuse market studies and marketing, and act like marketing can overcome lack of interest in products that don't really do much."

Overall, the interview participants thought that better benefit-cost work was necessary, but recognized that evaluations of proposed projects of any sort can be too rosy or can otherwise miss the mark.

Funding and Prioritizing

Interview participants had a wide range of views about the need for earmarked funding vs. mainstreaming funding of ITS projects, as illustrated by the following quotations from the interviews:

-- questioning earmarking:

- "We are already mainstreaming ITS. Traveler information, ramp metering, signal coordination, transit AVL, are all mainstream. They are pretty standard. We have paid for them with regular project funds.'
- "We talk about mainstreaming but focus on keeping ITS a separate program with separate funding. ITS upgrades and approaches should be eligible projects period. If they can't compete effectively they must not be competitive."
- "ITS is an option, not a fix-all. In some cases low cost capital improvements or the old TSM/TDM sorts of projects are effective and cheaper. A problem with earmarking money is that then you want to spend it regardless."

-- favoring earmarking:

- "If resources for ITS are low and uncertain, and the benefits in an area are low or uncertain, there is very little chance of action. If benefits are high but resources are low, that makes the case for earmarked funds."
- "You need special grants for things like signal timing where there isn't a big capital budget to hide them in."
- "Earmarked implementation funding or special programs would get things mainstreamed in a hurry, especially for signal upgrades and extras like transit priority options and pedestrian [safety improvements]."
- "VDOT has about \$60 million for ITS out of a total construction budget of \$1.2 billion. That is a higher percentage than most states give to operations - typically 3-4 percent on systems operations and management. That is a big part of why they are a leader in the field."

Others suggested available funds be redirected:

- "Funding should be focused more on demonstration and deployment than on R&D now. There are a lot of things ready to go and we should get going with them. That isn't to say that we don't need to do R&D - we do - but we need to get going on implementation."
- "Divvying up maintenance and operations funds on a geographic or lane miles basis is common but not effective as a way to manage resources. [State DOTs] ought to be looking at use as well as mileage. There is no incentive to invest in a costly but ultimately cost saving technology if you can't get any more money for the upfront costs."

Finally, one of those interviewed was most concerned about what would come out of the next federal transportation bill and how that would affect ITS:

"ITS can be funded with STP or CMAQ funds, or we could shift the ITS program that Congress has funded to focus more on implementation of technologies that are ready now. But what happens to these programs in reauthorization will be important."

Ideas for ITS Applications

Several of the national experts suggested planning and implementation topics that in their view would benefit from further research. One topic suggested by 11 of the 20 experts interviewed was how to move from project-level, opportunistic ITS implementation to a more systematic, strategic implementation:

"More applications that show how to apply ITS on a corridor-wide or area-wide level would be good. System wide applications would be even better."

One of the participants commented that the practice of calling each separately funded action a "project" made it hard to be strategic and systematic. He argued that often,

"...the individual pieces don't do much on their own; they need a series of additional "projects" to make a difference. Calling {each funded activity} a "project" is not useful in communicating what is [needed because] the benefits of the individual steps just aren't very significant.... We need to

think of the pieces as steps in larger projects that aim for important results. This may require the creation of a different terminology in programming."

Others suggested that local governments could gain a great deal from the systematic application of ITS:

"We could do a lot more for local governments. Local permit parking cards should be smart cards with the resident name and address, license numbers and so forth on the card. {We could} use signal technology for the benefit of pedestrians [and] bicycles. We could build support for investments in better signal equipment and signal timing if we would use these investments for a lot of purposes rather than just for cars."

Research Needs

Several research needs were suggested:

- "We aren't being very sophisticated about how to use the data produced by ITS technologies. That would be a good research project. Figure out the most effective uses of detector data and AVL data, and what additional steps could be taken to make the data more useful. For example if we detectorized off-ramps we could do more on [origin-destination] patterns."
- "Work zone traffic management is typically done as part of each construction project. That is an area where ITS technologies might be able to help out if there were more guidance and some good examples of what can be done. It is a big ticket item for a lot of projects so a key question is whether ITS will lower costs. Safety improvements also would be a key issue."
- "Is Segway [new aid-to-walking device] worthwhile or a problem?"

Two of the experts also suggested that integrating environmental monitoring more explicitly into ITS would be a good idea and would expand support for the program.

Training

Asked about training needs, most interview participants responded that many training courses are already available from FHWA and professional organizations. The bigger problem, in their experience, is that staff members are not able to attend because of workload or lack of funding. Several suggested that courses should be brought into each district or made available on the internet, echoing comments made by California staff members.

There also was a concern that some of the available training is too abstract to help engineers and planners begin to implement ITS. The national experts identified the ITS Architecture courses as an example: they are useful as an introduction for those who are going into system engineering but are too general to actually support system design and too detailed for planners and engineers who mainly want to know what options are available and what the general cost range is. One interview participant reported a comment he heard from his staff: "OK, we have an architecture, but what do we do now?"

On technical training, two experts made the following comments:

- "Some people need to be trained about how to repair the new technologies - detectors, signals, and so forth - and some people need to be trained on how not to damage or mess up the new technologies when they are doing their usual construction and maintenance. These are two different issues... usually the first group are electronics technicians, the second are the pavers and so on.'
- "Junior colleges and technical schools could train people to maintain signal equipment, variable message signs, and sensor systems. Or we could just contract for services with the suppliers or with third party providers, and that might be the better approach because they are in the business of keeping these things going 24-7 and know their own systems."

Several of the participants suggested the development of a brief, half day or one day introduction to ITS for planners and engineers who haven't been exposed to it, to get them up to speed. They also suggested that ITS examples should be integrated into the regular introductory training courses for engineers and planners.

Finally, the interview participants agreed that a short introduction to ITS for city managers and council members would be useful. This could be used by staff or could be presented at meetings of city managers, city officials, etc. As one interview participant put it:

"They don't need the technical details, just functions that ITS can perform, with examples and some good discussion of what it takes to do it right and what it accomplishes."

Other Comments

Asked for any other comments they might have, several of the national experts we interviewed offered suggestions for California:

- "Caltrans can show [leadership]... by making the facilities it does operate showcases for new technologies and by creating programs that provide funding for good [ITS] programs and projects."
- "More could be done on real streets and highways and transit systems."
- "...Just take the work that [has been done nationally] and get going."

E. Summary of Findings

Key findings from the interviews of elected officials, senior managers, and interest group leaders are as follows:

- Contrary to our initial expectations, the vast majority of elected officials and senior staff feel reasonably familiar with ITS. However, they are irritated by ITS literature, which they view as heavily promotional and/or technical, and full of jargon.
- Also contrary to expectations, there is considerable sentiment among California leaders that ITS is being implemented fairly quickly, and that the ITS elements that are not proceeding quickly suffer from institutional problems or lack markets.

- California leaders do not see a problem in fitting ITS projects into the planning process; rather, they see a lack of good information on benefits and costs of various options. Further, in the most common view, benefits of various ITS proposals not only must be weighed against costs, but the proposals also must be weighed against alternative projects and other currently available approaches to the same issue.
- Elected officials, in particular, are concerned that ITS evaluations have been less than arms-length and that too few demonstration projects and case examples have been carried out by dispassionate evaluators. They are distrustful of technology and program evaluations carried out by their own proponents.
- California leaders characterize available ITS literature and evaluations as focused on why the system would operate better with ITS, not why travelers would want the new systems and services. They feel there is not enough user (customer) orientation in ITS programs.
- Many elected officials believe that government should recognize that the private sector has assumed the leadership in some ITS applications and that government efforts should move on to focus on topics where the value added by government involvement will be greatest.
- Many elected officials and senior staff would support special programs for ITS applications, providing funding for planning and implementation, training staff and consultants, and building longer term capacity for using ITS technologies. Some, however, feel that ITS has already had heavy support and should compete on its own.
- Many California leaders believe that government, and the state DOT in particular, should lead by example, implementing ready-to-go technologies on its own facilities and within its own agency. Many more demonstration projects also would be useful, in the respondents' view.
- Many argue for stronger partnerships with local government and other state agencies, looking for ways that ITS technologies could be mutually beneficial and multi-purpose.

- Finally, California leasers urged that future ITS work should pay more attention to legal and institutional issues and to implementation strategies, to provide a clearer sense of priorities and “next steps.”

From the surveys and interviews with California transportation engineers and planners with local government and transit agencies:

- Staff see traffic operations improvements and better traveler information systems as the primary short-term applications of ITS. In the longer term, these staff members anticipate capacity- and efficiency-enhancing applications of new technologies.
- While recognizing ITS benefits, the vast majority of staff respondents felt ITS implementation had been slow. In contrast to the state leaders, the staff attributed this to a lack of knowledge about ITS, and a resulting lack of advocacy for it, among elected officials and the public. Most also expressed concerns about ITS equipment purchase, installation, operations, and maintenance costs.
- California staffers have a strong interest in corridor-long, area-wide, and system-wide incorporation of new technologies into transportation systems and see this as the way to get big payoffs from ITS.
- Many traffic engineers would welcome a state program to upgrade and retime signal systems using the latest technologies and software, introducing some new equipment and adding freeway-arterial coordination capabilities.
- Planners want support for integrating ITS into pedestrian, bike, transit, parking, and traffic calming applications.
- Both planners and engineers advocated folding ITS training into standard continuing education courses, although most felt that an annual update could be offered as a special symposium or as part of other professional meetings.
- Planners and engineers can identify a variety of additional demonstration projects and offerings that, in their view, would greatly help speed the implementation and mainstreaming of ITS. Some

of this work should focus on legal and institutional arrangements for multi-jurisdictional and multi-agency projects. Much of it would involve applications of a number of technologies together to produce multimodal improvements.

From the experts:

- State to state differences in state DOT organization and authority make it difficult to directly "borrow" ideas on best state practices from an institutional perspective. With attention to context, we can, however, learn from and borrow project experiences - how technologies perform, consumer responses, etc.
- States like California that have decentralized and delegated considerable authority over transportation to district or local units have a harder time directing the implementation of new ideas like ITS than do state DOTs that have retained central control of the road system and the decision-making.
- Policy directives can play an important role in getting ITS into the mainstream, especially when they are backed up with incentives and rewards (e.g., more funding, promotions.) The directives can come from legislation or from Headquarters leadership.
- Partnering among several agencies is the key way that many ITS applications will be implemented, particularly in states like California that have decentralized transportation decision-making. Effective partnering will require some changes in agency culture, so that people attending partnership meetings are able to speak for the agency or get a decision on issues by the next meeting.
- Separate ITS units can help an agency develop plans and programs for strategic implementation of ITS but the drawback is that ITS may not get incorporated into conventional plans, as it must be if it is to receive funding from conventional sources, if ITS deployment is treated as a separate function. If there is a separate unit, there needs to be policy, processes, and incentives for integrating the top ITS concepts into the regional plans.
- Some ITS applications are already mainstream, especially in California - ramp metering, signal timing, etc. Funding is probably the bigger issue.

- Special funding for ITS is appropriate when ideas are accepted but resources are low. Signal timing, signal systems upgrades, etc. appear to fall into this category.
- Training for ITS should be broadened to include introductory overviews for new hires, planners, etc. Technical courses on how to install and repair the technologies used in ITS applications may be suitable for junior colleges.

In short, the survey and interviews provided a wealth of insights into the problems that ITS proposals may face, as well as a wealth of suggestions for mainstreaming ITS.

Table 2.1, Interview Sample

	Elected officials	Local govt. planner-managers	Local govt. engineer-managers	Regional agency managers	State agency managers	Interest group leaders	total
initial sample	12	12	13	10	10	10	67
- interviewed	9	10	9	7	6	10	51

Notes and References for Chapter II

- (1) See, e.g., the ITS architecture and standards discussions.
- (2) The U.S Congress General Accounting Office commented on this in GAO, Widespread Challenges to Widespread Deployment of Intelligent Transportation Systems, Washington, DC, GAO-RD-97-74, April 1997, 28 p.
- (3) Benefit-cost information is, however, available at the following US DOT website:
<http://www.benefitcost.its.dot.gov/ITS/benecost.nsf>
- (4) ITS visions statements can be found on a variety of ITS websites.
- (5) As one commentator put it, "Intelligent transportation systems (ITS) have the potential to revolutionize surface transportation, but listening to all the claims of some ITS proponents, one could begin to believe that ITS will solve all our transportation problems - and maybe the common cold too." McHale, Gene, at <http://www.tfsrc.gov/pubrds/mayjun00/idas.htm>
- (6) See early deployment examples on the FHWA website.
- (7) United States Federal Highway Administration, Intelligent transportation system architecture and standards, Federal Register, Vol. 66, No. 5, FHWA docket no. FHWA-99-5899, 23 CFR parts 655 and 940, pp 1335-1454, Jan. 8,2001.
- (8) See the series of reports on Mainstreaming ITS in Metropolitan Areas prepared by staff of the Volpe National Transportation Systems Center, Cambridge, MA (search fhwa.dot.gov for Mainstream Metro Areas)
- (9) The Los Angeles area plan shows significant efforts at combining ITS into conventional planning processes. See Deysher, Elizabeth et al., Mainstreaming ITS Within the Transportation Planning Process: Review of the Los Angeles, CA, Metropolitan Area, Volpe National Transportation Systems Center, Cambridge, MA, Feb. 2000.
- (10) For example, a text search of a pdf of the California Office of Planning and Research's General Plan Guidelines found no mention of intelligent transportation systems. www.opr.ca.gov
- (11) Deakin, Elizabeth, Mainstreaming Intelligent Transportation Systems: I. Findings from a Survey of California Leaders. University of California, Berkeley, July 2002. Also available at www.uctc.net/mainstream
- (12) Deakin, Elizabeth, Alexander Skabardonis, and Adolf D. May. The Fuel Efficient Traffic Signal Management Program: final report to the California Energy Commission Berkeley : Institute of Transportation Studies, University of California, [1984] vii, 49 p
- (13) Deakin, Elizabeth et al. Mainstreaming Intelligent Transportation Systems: II. Findings from a Survey of California Transportation Engineers and Planners. . University of California, Berkeley, October 2002. www.uctc.net/mainstream
- (14) Deakin, Elizabeth, Mainstreaming Intelligent Transportation Systems: III. Interviews with National Experts. University of California, Berkeley, November 2002. www.uctc.net/mainstream

Chapter III. Conclusions and Recommendations

A. Why Intelligent Transportation Systems Aren't Being Implemented Faster

The findings from the interviews reveal a variety of reasons why intelligent transportation systems aren't being implemented faster and "mainstreamed" in California. But not all of the hypotheses we considered were confirmed.

The study supported the hypothesis that ITS research and development has been carried out by new technology experts and traffic operations analysts - specialists who are not usually involved in policy development, planning, and programming - and that their expertise doesn't usually extend to the deft handling of planning, evaluation, and programming issues. While a technological focus is clearly needed when new technologies are being developed and when standards and protocols are being established, different expertise is called for in planning and evaluation. Missteps have sometimes occurred when deployment efforts have been narrowly focused on technological issues and systems performance, with insufficient attention to the human side of implementation. Where technology specialists have worked in partnership with planners and decision-makers, ITS projects often do get implemented as part of "mainstream" efforts to improve transportation operations and services.

We hypothesized that a lack of information about ITS was one of the reasons that public officials senior staff, and other opinion leaders did not pursue ITS applications more energetically - that they just did not know enough about the technologies and what they could accomplish. We found that to the contrary, almost all of the public officials and senior staff felt reasonably familiar with a variety of intelligent transportation systems. They had learned about the technologies from their own experience, from reading, and from staff. Furthermore, they expect their staff members to routinely keep them informed about new opportunities or issues - but are irritated and put off by heavily promotional presentations or technical, jargon-filled reports.

Interestingly, the staff survey found that staff members are less confident in their leadership's understanding of ITS, with most agreeing that public officials and managers are only vaguely familiar with ITS technologies and what they can do. But neither the leaders themselves nor the agency staff members thought that there were widespread misunderstandings about ITS. Almost no one, for example, thought that intelligent transportation systems meant fully automated highways or other technologies that

wouldn't be available until far into the future. The leader group understood intelligent transportation systems to include a variety of safety and information equipment on vehicles, the use of electronic payment and data transfer technologies, vehicle location and tracking systems, public service traveler information, accident detection, notification, and removal services, and the like. Traffic engineers thought of ramp metering and advanced signal timing, as well as information technologies for operators and travelers. Planners added urban applications such as bus rapid transit, multi-purpose smart cards, use of detectors and signal systems to improve pedestrian and bike safety and ease, and smart parking technologies.

The difference in perspectives on how much leaders understand about ITS is probably due to the leaders being comfortable and satisfied with a general idea of what various technology applications can do, while staff note that their leaders are not particularly conversant with the details. The fact that leadership expects staff to keep them informed and to do so using common English terms is important; the message that elected officials and senior managers are annoyed by jargon and overly technical language should be taken to heart. Much of the ITS literature (and even some of the public information documents and websites) put a great deal of emphasis on teaching readers a long list of acronyms and typologies and explaining what technology components are in an application material that may be useful for technical staff but counterproductive when placed before senior decision-makers. (1)

California elected officials and managers also provided an alternative set of reasons why ITS applications may not be proceeding faster. They commented that much of what they heard and saw about intelligent transportation systems was focused on why the system would perform better, not on why travelers would want the application. They feel there is not enough user (customer) orientation in ITS programs.

The recent experience with ramp metering in Minnesota - and similar experiences in California years earlier - provide an example of system vs. customer orientation. (2) Delays at ramps are intended to keep the facility flowing, but long delays - as much as four minutes in some of the initial Minneapolis-St. Paul applications - were unacceptable to travelers, and traffic backups or diversions to local streets caused conflicts with local government to erupt. Keeping the freeway flowing had to be balanced with public sentiments about acceptable delays, multiple uses of local streets and arterials, and opposition to allowing suburbanites already on the freeway to travel fast by delaying inner suburban and urban residents. Minnesota learned that a better understanding of traffic patterns, trip lengths, and acceptable delays was a necessary component of effective ramp metering, and that the desire to optimize flows had to be balanced with other community values.

Elected officials in California are certainly concerned about the full range of community values, not simply traffic matters, and part of their irritation over the overblown language sometimes used with ITS has to do with their concern for a balanced view of transportation in the context of broader efforts for economic improvement, environmental protection and enhancement, and social justice.

California public officials also expressed considerable skepticism about how well ITS has performed. Here too this may be a reaction to the promotional tone of some of the literature. The promotion seems, in this instance, to have backfired, leading the officials to be skeptical about the validity of the claims and the general reliability of information produced by ITS proponents.

In fact, the leaders group expressed concerns that ITS evaluations have been less than arms-length and that there are too few demonstration projects and case examples carried out by dispassionate evaluators. The credibility of evaluations would be increased by having them carried out by organizations and units who do not have a direct stake in the outcome.

Many public officials also were critical of the quality of the benefit-cost information provided. They do not want to simply be told that the benefit cost ratio is, e.g., 7:1; they want to know what the benefits are and what the costs are, who captures the benefits and who bears the costs. They need to know how investments in ITS stack up against other ways they could invest transportation dollars. They also want to know whether government dollars need to be invested or whether private entrepreneurs can provide the services. Some believe, for example, that the private sector is well equipped to introduce certain ITS applications and is doing so; these officials commented that the public sector should not keep spending money on the development of its own versions of the services. (Traveler information was the example most frequently mentioned.)

The views of California leaders on these points contrast with the views of their staff members. Most staff members see ITS as producing very positive results, and the more experience the staff had with ITS, the more favorable their views of it. Staff members do agree that there is relatively little solid information on benefits and costs, but are less troubled by this than are elected officials. Some staff members think better case examples and better planning and analysis tools would help advance ITS applications, but many others think there is plenty of information, easily obtainable from the web. On this point it is also worthwhile to recall the comments made by the national leaders we interviewed. Several were skeptical about the ability to get good data on benefits and costs from demonstration projects and

field tests, and some argued that integration of new technology options into the regular planning process would be the main way to get benefits, costs, and tradeoffs realistically considered. (3)

Funding was seen by almost everyone as a significant barrier to faster ITS implementation, although reasoning differed among the groups of study respondents. Most of those we interviewed or surveyed felt that prior commitments of transportation funds made it hard to deploy new ITS projects on a fast track. Most felt that ITS applications were compatible with existing policies and planning processes, and recognized that under TEA-21 federal dollars could be used for many ITS projects. However, they also saw those funds as oversubscribed. Staff attributed a lack of priority to ITS to low public awareness of its benefits; elected officials and other leaders thought that many ITS projects were already being given high priority, and that ITS proposals that weren't being implemented must be flawed - not sufficiently useful to attract support or marred by negative aspects that were unacceptable.

There was no clear agreement on whether additional funds should be set aside to help speed ITS deployment. Most staff thought special programs to fund ITS deployment would be a good idea, but elected officials were divided, with some supporting earmarked funds and others objecting that ITS had already received millions in earmarks and good ITS projects should be able to compete on their own. National experts suggested that earmarks made sense for projects and programs for which acceptance was high but fiscal capacity for implementation was weak, e.g., local government and transit applications.

On the topic of environmental impacts, relatively few leaders, staff members, or national experts saw this as a major issue for ITS - although comments to the effect that some ITS proposals raised doubts about environmental impact or promotion of auto dependence does suggest that some projects are failing on community and environmental grounds. Local government officials and staff also saw opportunities for ITS application that were not being pursued, especially for urban applications such as multi-purpose smart cards and measures that help manage parking and facilitate transit, bikes, and walking. Almost no one saw ITS as a traffic impact mitigation strategy or a way to reduce environmental impact.

Finally, staff did see a need for ongoing training on ITS, especially for new staff, but few saw a lack of staff training as a major barrier to ITS deployment or mainstreaming. Both decision-makers and staff felt that non-technical information on ITS applications and their pros and cons would be useful; again, however, staff felt the need for "success stories" whereas decision-makers were mainly concerned that the information be unbiased and balanced.

B. Are Intelligent Transportation Systems Already Mainstream?

An interesting finding of the study is that many California leaders and national experts believe that many intelligent transportation system applications are already mainstream. California elected officials and other leaders commented that ITS is being implemented fairly quickly overall (especially considering funding shortfalls.). National leaders suggested that freeway monitoring, ramp metering, traffic signal timing, automatic vehicle location for transit, and many traveler information systems are already mainstream technologies, especially in California. (4) Like the California leaders group, they see funding shortfalls as a major impediment to faster deployment of these ITS applications.

This view contrasts sharply with the views of staff members, 83% of whom agreed that ITS implementation has been slow and spotty. One reason for the difference in views between staff members and others appears to be that staff members think that the main benefits of ITS will come from area-wide, corridor, and system-wide applications. Staff members also think that such wider applications are needed to make significant improvements in transportation capacity and efficiency. Both California leaders and national experts seem more comfortable with project-level gains, at least for many applications such as traffic signal upgrades and bus information (where applications can be done for particular groups of signals or for key routes only and still produce important benefits.) As some of the national experts commented, spotty coverage is the normal way for technology implementation to begin; a few early innovators are followed by more widespread adoption, first gradual then faster, as others see the benefits of a practice or technology and that practice or technology becomes an accepted way of doing things. In fact, some of the national experts cautioned that attempts to promote system-wide or area-wide applications might not be cost-effective, putting advanced technologies in locations where they are not really needed - a perspective not articulated by any of the staff members who responded to our survey or participated in interviews.

Thinking of some ITS applications as mainstream, or ready to go, led to consideration of whether strategies for faster deployment could be developed. Several of the elected officials and national experts interviewed in this study suggested that if faster progress was desired, Caltrans should lead by example, implementing ready-to-go technologies on its own facilities and within its own agency. The national experts noted that policy direction and incentives from Headquarters could provide important incentives for decentralized district offices to give higher priority to ITS applications. Plans identifying "missing links" also could serve as the basis for leadership initiatives, especially if tied to performance measures

and indicators to help evaluate the cost-effectiveness of individual investment opportunities. Among the ITS applications that could be advanced as ready to go and could be implemented on Caltrans facilities are ramp metering, advanced signal timing, variable message signs, and fog and other weather warning systems.

Stronger partnerships with transit operators and local governments were identified as ways to further the implementation of ready-to-go technologies such as transit automated vehicle location and information systems, advanced signal systems, smart cards, and parking, pedestrian, and bicycle technology applications. Respondents suggested that one way to advance such partnerships would be to develop a model memorandum of understanding (MOU) delineating respective roles and responsibilities, which agencies could use as a starting point to develop their own MOU. An alternative would be to develop a catalog of successful MOUs.

A second and somewhat more controversial way to further local government and transit operator deployment of ITS would be to help fund their projects. (We noted earlier that some California officials are reluctant to see earmarks for ITS projects, while others see earmarks as a necessity if faster ITS implementation is to occur.) In this case we agree with the national experts who argued that earmarks are appropriate when ideas are accepted but resources are low, as is usually the case for transit operators and local governments.

Finally, some ITS applications are not ready for mainstreaming yet, either because the bugs are not yet worked out of the application or because the benefits and costs are still uncertain. Research should be an ongoing function, to invent new applications and to improve current ones. Demonstration projects are appropriate for the ITS technologies and applications that are not yet in widespread use. Integrated urban applications and coordinated freeway-arterial management are two topics where a demonstration project grant program might lead to both testing of concepts and on-the-ground applications.

C. Sorting Out Barriers to Further Implementation

In reviewing the findings from the interviews and survey, it is clear that there are several key barriers to the mainstreaming and the faster implementation of intelligent transportation systems: 1) funding, 2) the need to form partnerships, 3) the need to resolve potential or real conflicts over operations and impacts, and 4) the need for more field tests, demonstration projects, and evaluations for some ITS applications.

Each of these barriers can be overcome, but it is necessary to sort out which barriers apply to which applications in order to develop appropriate responses. (We do not consider a lack of market demand for an ITS application or the failure of a technology or service to be cost-effective to be a barrier; instead, these conditions are good reasons not to move ahead with an ITS project or program.)

Lack of funding seems to be the major impediment to local government signal upgrades and advanced timing plans, an ITS application with proven benefits. Without a grant program, signal equipment will gradually improve as aging equipment fails and replacements are purchased or as signal upgrades are needed as part of some other investment. Speeding up signal improvements will take money - most likely in the form of a state or regional program providing grants to local agencies, since only a handful of cities, mostly the largest ones plus a few affluent, fast-growing suburbs, have a track record of undertaking major signal upgrades on their own.

Advice on strategies to make the most of available signal equipment and funding would be useful, and could be offered as part of a grant program or in a training course on signal systems. (For example, one strategy is to always install new equipment along key routes, swapping signal heads and controllers as needed to develop an advanced signal subsystem.) Also, without intervention, timing plans will likely continue to be updated using simple methods. Training in advanced methods would be valuable to local staff members who are interested in using more sophisticated approaches.

Funding also appears to be a limiting factor in Caltrans' own implementation of ITS technologies. The agency's budgets for maintenance and operations cannot fund all the desired projects proposed by staff or affected interests. Here is where a well designed ITS strategic plan could help, by identifying applications that are cost-effective, setting priorities, and developing strategies for implementing the high-priority ITS projects and programs by incorporating them into the standard state and regional plans, programs, and projects.

Partnerships are needed to implement traffic management strategies that cross multiple jurisdictions, coordinate freeway and arterial operations, or add transit priority options to local streets and ramp meters. The metropolitan planning organization in each region may be able to help organize, staff, and provide legal and technical assistance to these partnerships, including assistance with conflict resolution and consensus building.. Caltrans District office personnel should be partners to many of these multi-jurisdictional and multi-agency partnerships and assigned staff should have authorization and incentives to make commitments toward mutually beneficial solutions. The MPO and Caltrans should also try to

offer financial support for partnership planning studies and for deployment. In some areas the Congestion Management Agency could substitute for the MPO as the convenor, and some CMAs also may be able to help with funding and staff support.

Conflicts do arise over ITS deployments, both among partnering agencies and for seemingly straightforward applications when the incidence of costs and benefits differs among the affected interests. For example, increasing capacity and reducing traffic delay along a congested urban arterial is a desirable transportation objective, but that objective could raise real or apparent conflicts with residents and business managers who fear negative consequences from a heavier traffic load (e.g., more noise, more difficulty crossing the street at unsignalized intersections, more difficulty riding a bike on the street, parking along the street, etc.) In such cases there is no substitute for a well designed planning process with substantive public involvement, thorough environmental assessment, and the use of design elements and operating strategies that limit or mitigate adverse effects. The Minnesota ramp metering experience discussed earlier is an example where an operations-focused ITS application was viewed as benefiting some and harming others; Minnesota's response to the ensuing controversy was a participatory process of review leading to a compromise set of adjustments that reduced conflicts

While many ITS applications are ready to go if funding can be found, partnerships established, and/or conflicts resolved, some ITS applications are still in need of research, testing, demonstration and evaluation. Lane centering and vehicle docking technologies, for example, are still under development; states are still examining the efficacy of automated deicing applicator systems and working out some bugs in the equipment; tests are just now being conducted on the efficacy of various types of security monitors, seals, and tracking technologies for freight containers. Demonstration and evaluation is needed, as well, for many urban ITS options. For example, the impediments to smart parking and parking location systems in downtown areas appear to include both a simple lack of information about the possibilities, and questions about the costs of these systems, whether travelers make use of them, and whether resulting savings due to more efficient use of available supply offsets the cost of the information system. Familiarity with this ITS application surely could be increased by a combination of technology briefs, case studies, and outreach activities, but the questions about costs and benefits will require carefully evaluated, well publicized demonstration projects in different types of urban settings.

Finally, in some applications of ITS, the issues center on case specifics, e.g., whether the use of a fog detection and warning system is cost-effective given the number of foggy hours and the amount of traffic along a particular stretch of highway, or whether bus priority treatment will in fact increase operating

speeds on a particular transit line. In such cases careful evaluation is what's needed, not a push to use new technology regardless of costs and benefits. If the benefits are insufficient to justify the ITS application, the costs are too high, or both, the wise transportation agency will look to other solutions.

In summary, overcoming barriers to ITS necessitates a series of steps, including strategic planning, partnership building, conflict resolution, and research, testing, demonstration, and evaluation. Caltrans should take comfort in the fact that, from a national perspective, the state is seen as a leader in ITS implementation and as having helped to make a number of ITS applications mainstream, especially in the area of traffic operations and management. The evidence supports this view that many ITS applications are already mainstream; ITS projects are being implemented throughout the state and Caltrans, MPOs, transit operators, and local agencies are all engaged in ITS deployment. Specific deployment levels for various ITS applications do vary from area to area, but that in large part reflects the nature of the transportation problems and opportunities in different localities. Future efforts to promote mainstreaming of ITS can build on this strong record of accomplishments.

D. Recommendations for Mainstreaming ITS

We present recommendations that, in our judgment, would help remove barriers to ITS or otherwise help “mainstream” it further in California. The recommendations are based on the findings presented in the preceding chapter as well as additional discussions with educators and marketing specialists at the University of California. The recommendations suggest ways to increase deployment of ITS as well as to integrate it more effectively into key planning processes.

They also suggest ways to overcome problems and concerns uncovered in the course of our research. Recommendations are grouped by topic; major topics are shown in Table 3.1.

Develop State Policies and Programs for Mainstreaming ITS

- Caltrans Headquarters should continue to monitor ITS deployment throughout the state and should prepare an annual update on accomplishments in each metropolitan area and Caltrans district.
- Caltrans should use policy directives from Headquarters to encourage Caltrans District staff to include ITS as part of their projects and programs.

- Building upon deployment plans and service plans in the various regions, Caltrans should work with the MPOs and local agencies to specify ITS programs and projects to be incorporated into state and regional surface transportation plans and programs of projects.
- Caltrans should develop ways of recognizing and rewarding innovations and accomplishments in the deployment of intelligent transportation systems. Individual, district, and partner agency accomplishments could be rewarded in a program modeled after FHWA's Environmental Excellence Awards, for example.
- Caltrans should conduct regional and district studies to identify "missing links" in ITS applications - for example, key freeway links that are not yet equipped with detectors or other monitoring technologies, areas where ramp metering or coordinated freeway-arterial projects should be a high priority. Strategic plans for ITS implementation could bridge existing deployment studies and conventional surface transportation plans and programs.
- Caltrans should continue to support training on ITS applications for Caltrans district offices and other public agencies, and should make training courses available in each district and on the web whenever possible to reduce travel and scheduling barriers.(5)

Focus Basic Research on ITS on New Technologies, Broaden Applied Research to Include A Wider Range of Strategies and Implementation Issues

- Caltrans should continue basic research and development on new technologies for highways and transit. More emphasis should be given to multimodal and multi-jurisdictional applications, including applications that address urban transportation problems on local streets and arterials, traffic mitigation, etc..
- Caltrans should continue to test new ITS technologies in California applications, partnering with other states or with regional agencies when opportunities arise.
- Studies should be conducted to examine demand for ITS technologies and consider the alternatives available to travelers, including conventional options as well as private sector options, in deciding where to expend research, development, demonstration, and deployment dollars looking at near-term applications.
- Caltrans should conduct more research on markets, consumer acceptance, and public acceptance of ITS in real-world deployments.
- Caltrans should establish a number of smart corridors that allow the testing of multi-jurisdictional, multi-modal applications of ITS and focus research, demonstrations, and evaluations on these smart corridors.

Apply and Evaluate State-of-the-Art Planning Methods and Processes for Mainstreaming ITS

- Caltrans should support strategic planning for further ITS deployment and mainstreaming, in cooperation with MPOs.
- Caltrans should revise planning guidelines to advise the consideration of ITS both as an alternative and as an ingredient in transportation project development.
- Caltrans should provide training in available methods for evaluating the costs and benefits of ITS applications.
- Caltrans should continue to support the development of advanced methods for ITS planning and analysis, as well as sketch planning approaches and databases on ITS project performance.
- Caltrans should work with local and regional agencies to develop partnerships for ITS implementation. A first step might be to review deployment plans and ITS plans to identify high priority projects where partnerships are needed.
- Caltrans should work with MPOs and local agencies to demonstrate the use of approaches for resolving institutional conflicts in a mutually beneficial manner, and should apply dispute resolution techniques and partnership approaches in addressing ITS planning and implementation, documenting the processes and evaluate their performance.

Support and Partner with Regional and Local Programs for ITS

- Recognizing that many local governments and transit agencies lack the funding to implement ITS projects, Caltrans should consider establishing a grant program to support local government and transit operator ITS applications. Such a program could be funded and managed in partnership with MPOs or could be a separate Caltrans grant program. The program could fund ITS applications such as traffic signal timing and upgrades, bike and pedestrian detectors, smart parking, traveler information, bus rapid transit, etc.
- Caltrans should help support projects that show how ITS technologies and applications can be used for air quality improvement and for project mitigation required under CEQA. For example, ITS technologies could make smart paratransit and smart transit attractive, and traffic signal retiming along affected arterials could be used to reduce traffic impacts of new development.

Use Demonstration Projects to Test Approaches that are Not Yet Mainstreamed

- Caltrans should use demonstration projects to implement and showcase ITS technologies that are being used in other areas (including overseas applications) but are not yet common in California. Demonstration projects might include urban applications such as smart parking meters and payment cards, parking location systems, multi-purpose smart cards, pedestrian and bike detection and priority systems, etc.
- Caltrans should use demonstration projects to show how corridor-long and area-wide applications of key technologies can improve transportation system performance. For example, establish a number of smart corridors and demonstrate the full range of modal applications along these corridors, in partnership with regional and local agencies.

Provide Funding When the Lack of It Impedes ITS Deployment.

- Caltrans should use available Caltrans funds to fund ITS programs and projects that are particularly beneficial and ready to go, such as traffic signal timing and transit management and information systems.
- Caltrans should consider earmarking funds for a discretionary grant program for ready-to-go ITS applications that have not yet been widely implemented in California due to a lack of funding.

Offer a Variety of ITS Education and Information Opportunities

- Caltrans should continue to support training on the use of software for signal timing, freeway management, etc., and as well as on planning and analysis tools that specifically address ITS options, such as the IDAS benefit-cost tool.
- Caltrans should help make training courses and seminars on ITS available in rural areas, in each Caltrans district, and on the web, when possible.

- Caltrans should encourage efforts to integrate ITS materials into ongoing University Extension courses, including introductory courses on planning and traffic engineering, courses on traffic calming and traffic mitigation, etc.
- Caltrans should support the development of an annual workshop and briefing package that will introduce non-experts to ITS, especially the strategies and measures that are ready for implementation.
- Caltrans should seek out opportunities for key staff to make presentations on the state of the art in intelligent transportation systems, for elected officials, city managers, and other top leaders.

Table 3.1. Recommendation Topics (Several Recommendations For Each Topic - See Text)

- 1) Develop state policies and programs for mainstreaming ITS.
- 2) Focus basic research on ITS on new technologies; broaden applied research to include a wider range of strategies and implementation issues.
- 3) Apply and Evaluate state-of-the-art planning methods and processes for mainstreaming ITS
- 4) Support and partner with regional and local programs for ITS.
- 5) Use demonstration projects to test approaches that are not yet mainstreamed.
- 6) Provide funding when the lack of it impedes ITS deployment.
- 7) Offer a variety of ITS education and information opportunities.

Notes and References for Chapter III

- (1) ITS Architecture and Standards websites and reports are an example in point, providing more technical information than most senior-level decision-makers need or want.
- (2) The summary presented here is based on conversations with University of Minnesota researchers as well as the study, Twin Cities Ramp Meter Evaluation Final Report prepared for Minnesota Department of Transportation by Cambridge Systematics, Inc., April 2001, also available at http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@cx01!.pdf
- (3) Several respondents mentioned that the ITS architecture and standards efforts as necessary to make sure various deployments will be state of the art and interoperable, but did little to foster mainstreaming of ITS technologies and "market packages" into the conventional planning processes in the regions. A few commented that deployment plans were a step closer to mainstreaming but often still fall short on linkages to conventional transportation plans and programs.
- (4) ITS deployment plans and Oak Ridge National Laboratory's survey of the 78 largest metropolitan areas' ITS accomplishments are both good sources of benchmarking information. See <http://ops.fhwa.dot.gov/travel/traffic/> and click on metropolitan deployment for a quick link to the Oak Ridge studies. Reports for Bakersfield, Fresno, Los Angeles, Sacramento, San Diego, and the San Francisco Bay Area are included and can be compared to other metro areas or to nationwide averages for a number of highway, arterial, and transit ITS deployments.
- (5) Caltrans support for ITS training courses could include funding the development of new courses through ITS Extension of the California Transportation Centers, working with California universities to encourage ITS training as part of undergraduate and graduate level transportation courses, subsidizing offerings of the National Highway Institute or arranging for free courses to be offered, etc. For a review of courses needs identified by California traffic and transportation staff, see Howe-Steiger, Linda. Report on the Training, Technical Assistance, Information Services and Technology Transfer Needs of Public Agency Transportation Professionals in California, Prepared by the Technology Transfer Program of the Institute of Transportation Studies at the University of California, Berkeley, May 2002.