



UPDATE OF ITS BENEFITS – 2000

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16. Abstract This report provides an update to the benefits documented in the synthesis report published in early 1999, Report 1790-2. It summarizes the major documents and other information published through 1999 and early 2000. Topics for these documents include evaluation tools and results, estimates of project and deployment benefits, and extensive listings of issues and discussion papers. An annotated bibliography of recent works is presented. Finally, an extensive list of resources, primarily on the world wide web, is presented. These resources include both official web sites of the U. S. Department of Transportation (USDOT) Joint Program Office and other state web sites, as well as association and educational resources.					
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TABLE OF CONTENTS

	Page
LIST OF FIGURES.....	viii
LIST OF TABLES	ix
INTRODUCTION.....	1
Organization of This Report.....	1
Highlights of 1999 Documentation	1
Benefits of Adaptive Signal Control	2
Benefits of Ramp Metering.....	3
Benefits from Electronic Toll Collection.....	4
Benefits from Incident Management.....	5
ANNOTATED BIBLIOGRAPHY OF DOCUMENTS SINCE REPORT 1790-1	7
Evaluation Methods and Standards.....	7
Evaluation Results and Case Studies	10
ITS Issues and Challenges.....	14
Other Related Topics.....	16
RESOURCES FOR ITS EVALUATION	19
JPO ITS Program Assessment/Evaluation (http://www.its.dot.gov/eval/eval.htm).....	20
JPO ITS Electronic Document Library (http://www.its.dot.gov/welcome.htm).....	20
JPO ITS Benefits Database and Cost Information (http://www.mitretek.org/its/itsbenefits.html).....	20
JPO ITS Deployment Tracking and Inventory (http://itsdeployment.ed.ornl.gov/)	21
ITS Deployment Analysis System (IDAS) (http://www-cta.ornl.gov/cta/research/idas/index.htm).....	21
California Path Bibliographic Database (http://www.nas.edu/trb/about/path1.html)	21
Screening for ITS (SCRITS) Spreadsheet Tool (http://www.ota.fhwa.dot.gov/steam/scrits.htm).....	22
The National Associations Working Group for ITS (http://www.nawgits.com/)	22
ITS Cooperative Deployment Network (ICDN) (http://www.nawgits.com/icdn.html)	22
REFERENCES.....	23

LIST OF FIGURES

Figure	Page
Figure 1. Reduction in Stops Due to Adaptive Control.	2
Figure 2. Percentage Reductions in Travel Time and Delay Due to Adaptive Control.	3
Figure 3. Percent Accident Reduction Due to Ramp Metering.	3
Figure 4. Percent Increase in Speed Due to Ramp Metering.	4
Figure 5. Estimated Annual Operating Cost Savings for Electronic Toll Collection.	4

LIST OF TABLES

Table	Page
1. Summary of Incident Management Data.	5
2. Key Resources for ITS Evaluation.....	19

INTRODUCTION

The purpose of this report is to provide TxDOT with an update on intelligent transportation systems (ITS) benefits information published or made available since the synthesis report, Research Report 1790-1, published in January 1999 (1). Considerable deployment of ITS continues to occur, and the number and quality of evaluations are increasing. Thus the quality of the estimates of benefits of ITS deployment is improving. The vast majority of documents to date are anecdotal accounts of benefits, frequently produced in response to a specific need or request. There is still the apparent temptation to extend or extrapolate results of questionable connection into the ITS realm. However, as the volume of actual ITS evaluations expands, reliable information is beginning to replace less reliable estimates.

ORGANIZATION OF THIS REPORT

This brief update includes the Introduction, which provides some highlights of ITS benefits research and documentation over the past 18 months. Next is a detailed Annotated Bibliography describing products that may be useful to practitioners and researchers alike. The final chapter is a Resource Document for ITS Evaluation. This chapter provides an extensive listing of web-based and other available resources that can aid practitioners in the evaluation of ITS projects.

HIGHLIGHTS OF 1999 DOCUMENTATION

The annual Federal Highway Administration (FHWA) report on ITS benefits (2) continues to be the broadest base of information available. Although some of these data have been criticized, particularly the age of some of the studies, the overall value of the report is very high. The discussion of the data and their meaning provide the reader with a good sense of the data's applicability, reducing the potential for a reader to inappropriately apply the information provided. As a way of introducing the findings in that report and as a means of providing an overview of estimated benefits, key data from that research are included in the following sections.

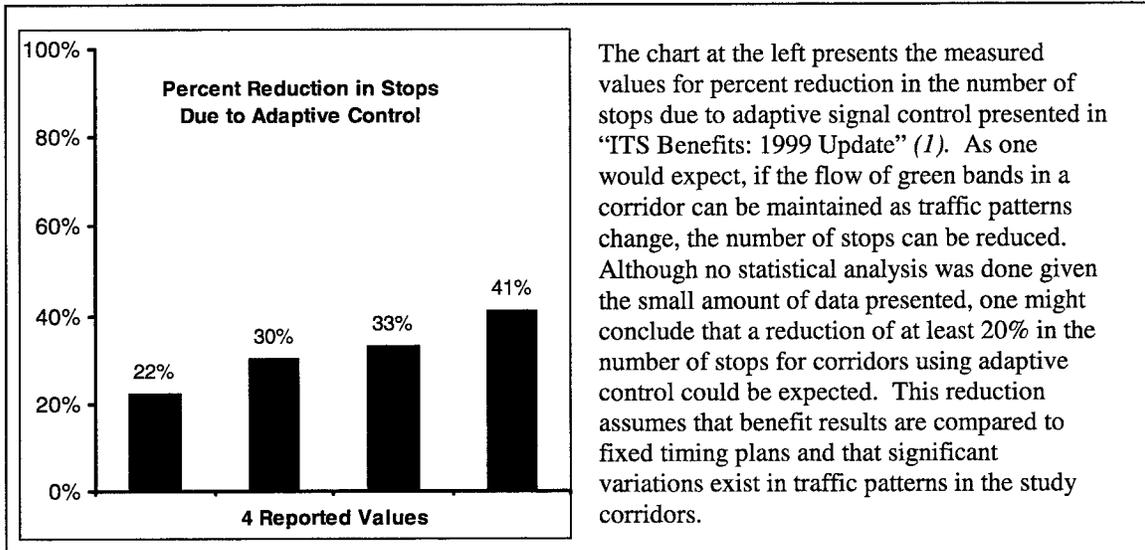
The 1999 update includes multi-study data regarding the benefits of:

- adaptive signal control,
- ramp metering,
- electronic toll collection, and
- incident management.

The following pages display these results.

Benefits of Adaptive Signal Control

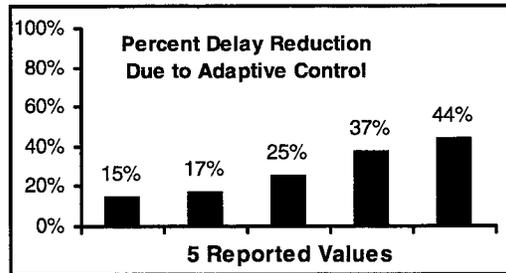
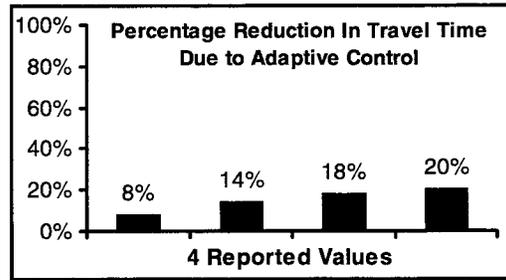
Adaptive signal control is coordinated signals timing adjusted for traffic conditions. The 1999 update includes summaries of studies examining the impact of the deployment of adaptive signal control on reducing total stops, delay and travel time on an arterial. The 1999 update cites four studies; the studies are current, having been conducted between 1994 and 1998. Though the total data samples are relatively small and statistical tests not available, the results show clear patterns of benefits, with stop reductions ranging from 22 percent to 41 percent, travel time reductions ranging from 8 percent to 20 percent, and delay reductions ranging from 22 percent to 44 percent. See Figures 1 and 2.



Source: "ITS Benefits: 1999 Update"(2).

Figure 1. Reduction in Stops Due to Adaptive Control.

The figures at the right present the measured values due to adaptive signal control for the percent reduction in travel time and delay discussed in the 1999 update (2). As expected, the reductions of travel time appear to be far less than reported for delay saved. Furthermore, there is an apparent large range of possible values for each measure. A likely contributing factor to this range is that individual studies may define or measure travel time and delay differently. Travel time may be defined as the time required to complete an entire trip or the time required to traverse a corridor or fraction of the trip. Delay may be defined as stopped time due to signals only or as the time exceeding a predetermined base travel time. Depending on the definitions used, and other operational conditions, estimated values of time saved appear to range between 8 percent and 20 percent. Likewise, reductions in delay due to adaptive control may range between 15 percent and 44 percent.

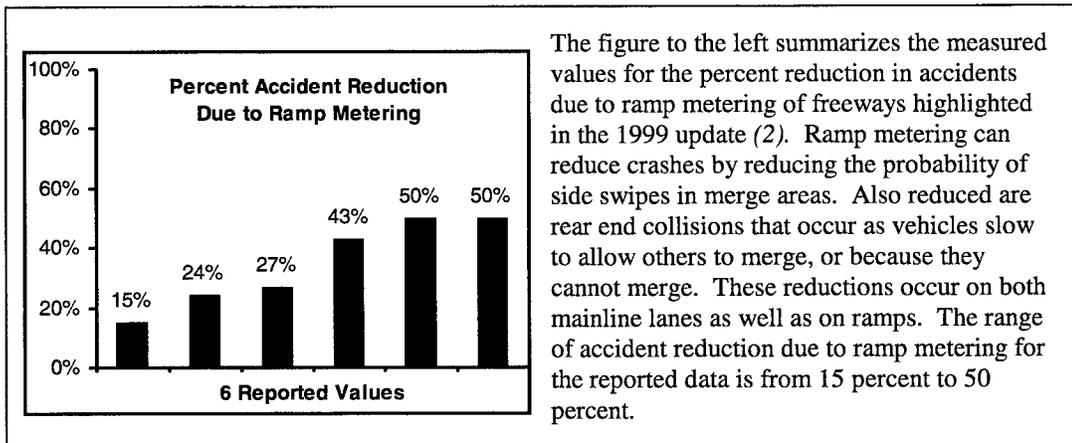


Source: "ITS Benefits: 1999 Update"(2).

Figure 2. Percentage Reductions in Travel Time and Delay Due to Adaptive Control.

Benefits of Ramp Metering

A total of nine studies contribute to the update summary of ramp metering benefits. Benefits estimates from six studies, measured in terms of accident reduction, show a range from 15 percent to 50 percent reduction, but are hindered by some of the studies being more than 20 years old. Nonetheless, the potential for accident reduction is undeniable and substantial as illustrated in Figure 3.

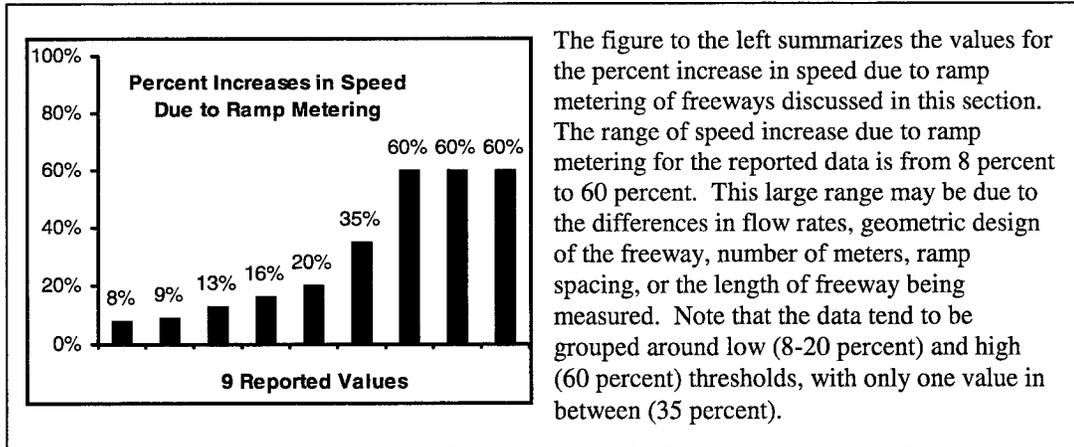


The figure to the left summarizes the measured values for the percent reduction in accidents due to ramp metering of freeways highlighted in the 1999 update (2). Ramp metering can reduce crashes by reducing the probability of side swipes in merge areas. Also reduced are rear end collisions that occur as vehicles slow to allow others to merge, or because they cannot merge. These reductions occur on both mainline lanes as well as on ramps. The range of accident reduction due to ramp metering for the reported data is from 15 percent to 50 percent.

Source: "ITS Benefits: 1999 Update"(2)

Figure 3. Percent Accident Reduction Due to Ramp Metering.

Researchers use those studies, plus three more, to estimate the impact of ramp metering on average speeds on a freeway. Benefits range from 8 percent to 60 percent, suggesting substantial improvement in speeds, as shown in Figure 4. The wide variation in extant operating conditions largely accounts for the wide range in benefit estimates.

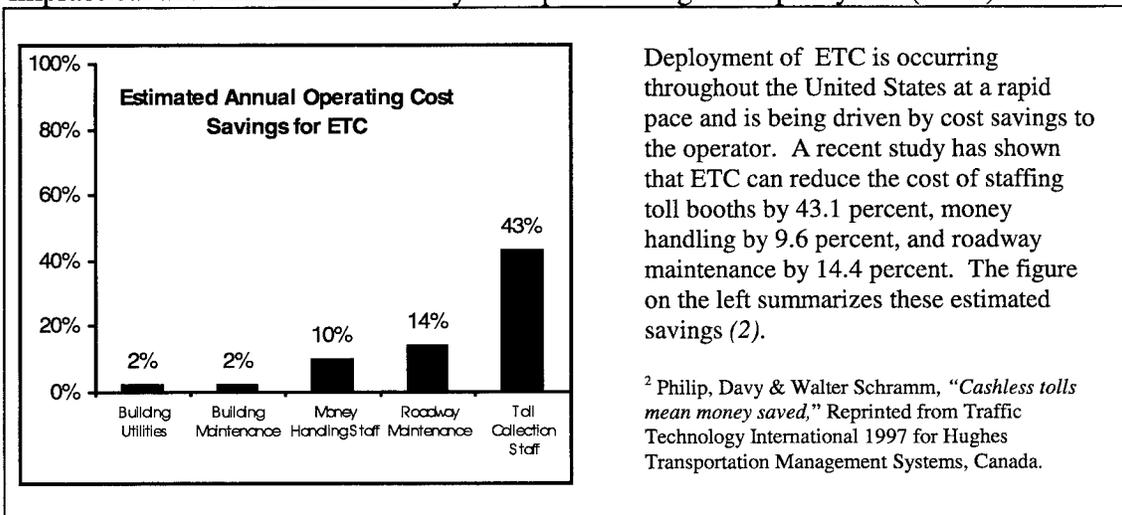


Source: "ITS Benefits: 1999 Update"(2)

Figure 4. Percent Increase in Speed Due to Ramp Metering.

Benefits from Electronic Toll Collection

Electronic toll collection (ETC) is a technology of growing interest to public agencies as more and more applications are developed. The 1999 update cited one source that identified five key areas where ETC has benefits, three of which appear to be significant. In addition, ETC enables activities that would otherwise be impossible, such as adding tolling to existing lanes, like high occupancy vehicle (HOV) lanes. Without the ability to add high-speed, mainline tolling, other techniques such as toll booths would be wholly impractical and eliminate the ability to implement high occupancy toll (HOT) lanes.



Source: "ITS Benefits: 1999 Update"(2)

Figure 5. Estimated Annual Operating Cost Savings for Electronic Toll Collection.

Benefits from Incident Management

Among the areas of greatest interest to practitioners is the potential benefit of deploying ITS to aid in all facets of incident management. As seen below, many locations have attempted to document the benefits that are accruing. However, as is the case with many ITS evaluations, the measures used are tailored to local needs and are frequently inconsistent from one evaluation to another. Thus it is difficult to draw transferable conclusions about the probable benefits in potential deployment.

Table 1. Summary of Incident Management Data.

Location	Reduced Incident Clearance Time	Reduced Response Time	Accident Reduction	Secondary Accident Reduction	Reduced Accident Rates	Cost Savings/yr. (\$ millions)	Delay Savings (hrs/yr.)
Brooklyn, NY	66.0%						
Philadelphia, PA			40.0%				
San Antonio, TX		20.0%	35.0%	30.0%	41.0%	1.65	255,500
Japan				50.0%			
Houston, TX						8.40	572,095
Denver, CO						0.95	95,000
Atlanta, GA							2,000,000
Minnesota						1.40	

This table summarizes the data presented in the 1999 update (2). Incident management programs have shown the potential to reduce both the number of accidents and the time required to detect and clear incidents. These programs show a significant savings in the cost of congestion and have been shown to be cost effective. In addition, the public response to these programs has been positive.

Source: "ITS Benefits: 1999 Update" (2)

ANNOTATED BIBLIOGRAPHY OF DOCUMENTS SINCE REPORT 1790-1

EVALUATION METHODS AND STANDARDS

Gillen, David, Jianling Li, Joy Dahlgren, and Elva Chang. *Assessing the Benefits and Costs of ITS Projects: Volume 1 Methodology*. Report No. UCB-ITS-PRR-99-9. California PATH Program, Institute of Transportation Studies, University of California, Berkeley, March 1999.

This document develops a framework for evaluating ITS. The report addresses one of the central issues — are ITS projects distinctly different from other more conventional transportation projects, and thus the traditional decision methods such as benefit-cost analysis cannot be used. The answer is mixed. The decision models used in the past are still relevant; however, these models have been applied in an environment in which there was a well-developed database. The models identified, selected, assembled, and evaluated data to make judgments as to whether the proposed projects were good or less good public investments. With ITS, there is not the history of data on either the cost or benefit (demand) side. Therefore, ITS projects are much more model oriented than data collection oriented. In effect, the data or information to be used in the decision models applied to ITS project evaluation must be generated through the use of models, including simulation models.

A number of conclusions can be drawn from this study. First, the evaluation framework provides basic guidelines for conducting a benefit-cost analysis. The lists of ITS benefits and costs are useful in helping evaluators identify the specific benefits and costs of a specific ITS project. While the cost estimation is relatively easy, the benefit estimations are difficult tasks. They require sophisticated assumptions and modeling techniques to provide inputs for the estimations. Different assumptions and modeling techniques will result in different inputs for calculation of benefits. They can alter the outcomes of the evaluation. This variation implies that ITS project evaluators should be fully aware of these limitations. Great effort should be placed in making and disclosing the assumptions for estimations of benefits and costs. There is an urgent need for collecting data from ITS deployments and developing models that can be used to accurately predict demands and benefits of ITS applications.

Gillen, David, Jianling Li, Joy Dahlgren, and Elva Chang. *Assessing the Benefits and Costs of ITS Projects: Volume 2 An Application to Electronic Toll Collection*. Report No. UCB-ITS-PRR-99-10. California PATH Program, Institute of Transportation Studies, University of California, Berkeley, March 1999.

The report describes the evaluation of the benefits and costs of ETC. The findings of this study suggest that, overall, the ETC project will meet most of its

objectives. It will provide a higher level of service quality to toll patrons, improve the quantity and quality of data collection, increase traffic flow on toll bridges, and reduce vehicle emissions and fuel consumption. However, the environmental benefit of the ETC project may be small. In addition, saving in toll collection may not offset the initial capital investment if the demand for ETC usage is limited and the cost of transponders is high. Hence, promoting ETC while reducing cost is essential for cost recovery and benefit enlargement.

Guidelines for the Evaluation of Operational Tests and Deployment Projects for Intelligent Transportation Systems (ITS). *Federal Register*. Vol. 64, No. 181, September 20, 1999, pp. 50854-50861.

The Transportation Equity Act for the 21st Century (TEA-21) states that the secretary of transportation shall issue guidelines and requirements for the evaluation of operational tests and deployment projects for ITS. This document sets forth TEA-21 guidelines that are required to include provisions to ensure objectivity and independence of evaluators so as to avoid real or apparent conflicts of interest on the outcome of project evaluations. The guidelines are further required to establish evaluation funding levels based on the size and scope of each test or project to ensure adequate project or operational test evaluations. Should it be deemed necessary to establish any requirements for the evaluation of operational tests and/or deployment projects, these requirements would be established pursuant to rulemaking to be issued in the future.

The objective of the TEA-21 evaluation guidelines is to fulfill the requirements imposed on the secretary in the referenced section by accomplishing the following:

- defining the different categories of projects carried out under subtitle C;
- defining, in general terms, different types of evaluations to be conducted by projects in the categories defined;
- establishing criteria to guide the selection of evaluations to be performed;
- defining, in general terms, procedures for ensuring objectivity and independence of evaluating organizations;
- defining the funding mechanism to provide project evaluation resources;
- providing a general description of the procedures (and requirements) that project partnerships can expect when participating in the types of evaluations defined; and
- providing access through a web site address to detailed evaluation procedures to include examples of specific evaluation plans, test plans, and reports.

ITS Evaluation Resource Guide. ITS Joint Program Office, Federal Highway Administration, Washington, DC, n.d.

TEA-21 prescribes that the secretary of transportation shall issue guidelines and requirements for the evaluation of operational tests and deployment projects for ITS. The document fulfilling this mandate is titled *Guidelines for the Evaluation of Operational Tests and Deployment Projects for ITS*, with short title, *TEA-21 ITS Evaluation Guidelines*. The *TEA-21 ITS Evaluation Guidelines* also describes a recommended, proven, six-step process for conducting evaluations. One of the purposes of this ITS Evaluation Resource Guide is to expand and elaborate on the recommended evaluation procedures outlined in the *TEA-21 ITS Evaluation Guidelines*.

This document is divided into the following sections:

- a primer that presents the federal philosophy on ITS evaluation, as well as a definition of “independence” as it relates to an independent evaluator;
- a detailed description of the recommended six-step process for ITS evaluation, including background information how to collect data in support of key performance measures of ITS goals;
- examples of each type of document required by the six-step evaluation process:
 - an evaluation strategy,
 - an evaluation plan,
 - one or more test plans, and
 - a final report; and,
- bibliographical references that describe certain evaluation techniques in more detail.

McGurrin, Michael, and Karl Wunderlich. Running at Capacity: Are the Capacity Impacts of ITS Believable - Or Is It Simply a Question of Definition? *Traffic Technology International*, April/May 1999, pp. 40-44.

The authors discuss the concepts of throughput and capacity as ITS measures of effectiveness. The paper describes how the commonly accepted definition of capacity is changing as technology is applied in the transportation system. The authors encourage transportation analysts to consider that “normal” traffic conditions are in fact quite variable and that transportation analyses should consider this variability in defining capacity. The paper concludes by suggesting that analysis tools be updated to reflect these changes in definition and practice.

Science Applications International Corporation. User’s Manual for SCRITS, SCReening Analysis for ITS. Federal Highway Administration, Washington, DC, January 1999.

SCRITS (SCReening for ITS) is a spreadsheet analysis tool for estimating the user benefits of ITS. It is intended as a sketch-level or screening-level analysis

tool for allowing practitioners to obtain an initial indication of the possible benefits of various ITS applications. SCRITS was developed in response to the need for simplified estimates in the early stages of ITS-related planning, in the context of either a focused ITS analysis, a corridor/subarea transportation study, or regional planning analysis.

SCRITS does not include an evaluation of every possible ITS application. Rather, it identifies 16 applications for inclusion in the spreadsheet. These applications were selected based on a prioritization of analysis needs and an assessment of information available to use as the basis for analysis. In some cases, the tool requires input that may be best generated by another analysis procedure that is not contained in this tool. The manual provides references to other types of tools that relate to SCRITS, where appropriate.

Tarnoff, Philip J. Perceived Benefits: Making the Case for Credible ITS Evaluation. *Traffic Technology International*, February/March 1999, pp. 38-41.

The author discusses issues and details related to ITS evaluation in the context of bridging the apparent gap between traveler perceptions and ITS benefits documented by evaluation studies. The author suggests several factors as the possible cause for this benefits discrepancy: motivation, measures of effectiveness, and actual data collection procedures. The author describes ways to improve ITS evaluations and to bridge the gap between traveler perception and reported benefits.

EVALUATION RESULTS AND CASE STUDIES

Alexiadis, V., M. Carter, A. DeBlasio, V. Inman, B. Perez, C. St-Onge, and M. Van Aerde. *Metropolitan Model Deployment Initiative National Evaluation Strategy*. Report No. FHWA-JPO-99-041. Federal Highway Administration, Washington, DC, November 1998.

This document describes the strategy used to evaluate the ITS Joint Program Office's Metropolitan Model Deployment Initiative (MMDI). The MMDI is an aggressive deployment of ITS at four urban sites: New York/New Jersey/Connecticut, Phoenix, San Antonio, and Seattle. These sites were chosen because of their high level of pre-existing ITS and the promise of evaluating the integration of these legacy ITS components together with new ITS components.

The evaluation strategy itself consists, first, of classifying all MMDI projects as one of nine ITS components or their integration. These nine ITS components are:

- traffic signal control,
- freeway management,
- incident management,
- electronic toll collection,

- emergency management,
- transit management,
- electronic fare payment,
- railroad grade crossing, and
- traveler information systems.

One section of the document is devoted to defining these components as well as integration, and also shows what projects within MMDI fall into each category. The MMDI projects and their integration are then evaluated through six different study areas. These study areas are safety, energy and emissions, operational efficiency, benefit-cost, customer satisfaction, and institutional benefits. A further section of the report is devoted to the presentation of the approach to be used in each study area. The importance of the evaluation of integration is stressed throughout the strategy.

Kang, Seungmin and David Gillen. *Assessing the Benefits and Costs of Intelligent Transportation Systems: Ramp Meters*. Report No. UCB-ITS-PRR-99-19. California PATH Program, Institute of Transportation Studies, University of California, Berkeley, July 1999.

This study undertakes an evaluation of the benefits and costs of ramp metering. The primary purpose is to provide empirical information on the value of the introduction and use of this form of ITS technology. The analysis examines three cases. The study simulated the impact of ramp metering on traffic behavior based on a cell transmission model and an assumed travel demand on the freeway as well as the ramp. The average travel pattern obtained from the I-880 freeway database is the basis for the temporal travel demand change. The study assumes isolated, single traffic responsive ramp metering. Researchers identify and quantify the benefits and costs based on established assumptions, and finally analyze the economic value of ramp metering. Benefits of ramp metering are derived based on travel time value and fuel consumption and by savings in travel delay. In this study, it turns out that there is a net increase in vehicle emissions as a result of ramp metering.

The costs of ramp metering are site dependent and a function of planned-metering technology. Since this study is not for any specific site, costs are estimated for three cases obtained from conversation with traffic engineers at Caltrans District 4 or literature. Under the original assumptions regarding fuel economy, time value, and travel demand on the freeway and the ramp, investing in ramp metering generates a net present value (NPV) of \$10.44 million. For all three cost scenarios, implementing ramp metering turns out to be worthwhile. The benefit-cost ratios exceed 1 in all cases.

Levinson, David, David Gillen, and Elva Chang. *Assessing the Benefits and Costs of Intelligent Transportation Systems: The Value of Advanced Traveler Information*

Systems. Report No. UCB-ITS-PRR-99-20. California PATH Program, Institute of Transportation Studies, University of California, Berkeley, July 1999.

Recent literature has extensively discussed the social costs of highway travel. Over the next few years, driver behavior should become more informed with the advent and deployment of in-vehicle navigation systems. Information technology will provide the driver the minimum travel time between his or her current location and final destination, updated to consider real-time recurring and non-recurring congestion. This paper considers the effects of those systems, which not only reduce the drivers' travel time and vehicle operating costs, but also have positive or negative external travel time effects for other commuters and environmental effects for society at large. Furthermore, over the long term, such systems may reduce the need to construct additional highway infrastructure or may induce additional demand.

A bundle of costs, which include the expected travel time, monetary cost, quality of the trip, and reliability (e.g., the probability of being late) comprise the travelers' full cost per trip. Individuals will be willing to endure a higher expected travel time on trips with lower variance or higher reliability. Two effects will cause the total number of trips to rise. First, there is movement along the demand curve as the expected travel time (price of travel) is reduced. Second, as the quality of trips increase due to improved reliability, there is a greater willingness to make a trip at a given cost (travel time), implying a shift of the demand curve. After reviewing the literature on information and travel behavior and on the value of time, this paper explores complex topics from a theoretical economic perspective and then simulates stylized cases.

Perez, William, and Bruce Wetherby. *Seattle Wide-Area Information for Travelers (SWIFT): Evaluation Summary*. Washington State Department of Transportation, Seattle, Washington, January 1999.

This report summarizes the results of the SWIFT evaluation in Seattle, which was aimed at providing pre-trip and en-route traveler information. The goal of the SWIFT field operational test (FOT) was to evaluate the following:

- consumer acceptance, willingness to pay, and potential impact on the transportation system;
- effectiveness of the high-speed data system transmission network;
- performance of the system architecture;
- institutional issues that affected the operational test; and
- deployment costs — estimate how much money it would take to deploy and maintain a SWIFT-like system.

In conclusion, the SWIFT FOT evaluation indicated that the project was a highly successful ITS test that demonstrated the efficiency of using a high speed data system (HSDS), or file maintenance (FM) sub-carrier, to disseminate incident,

bus and speed/congestion information via three different end-user devices: pager watch, portable computer, and in-vehicle navigation device. Almost 700 Seattle-area commuters, many with route- or mode-choice options, participated in the FOT and provided user-acceptance evaluations showing that the system was perceived to be useful for avoiding traffic incidents, traffic congestion, and for making transit-related decisions. Other evaluation components examined the operational features of the communications and architectural systems, and showed that the system was operational over 90 percent of the time and performed as expected. The SWIFT FOT evaluation identified various institutional issues that affected the project which were minimal in their perceived impact and determined that the financial bases for future deployment of such advanced traveler information system (ATIS) projects were good. Finally, the test results yielded recommendations for the deployment of future traveler information systems.

Proper, Allen T. *ITS Benefits: 1999 Update*. Report No. FHWA-OP-99-012. Federal Highway Administration, Washington, DC, May 1999.

This report continues the emphasis on documenting evaluation results of ITS user services and the benefits these services provide to the surface transportation system. The organization of this report differs from that of the previous ITS benefits reports. Referenced data are classified into a structure that reflects individual ITS program areas. These program areas include the metropolitan and rural infrastructure, ITS for commercial vehicle operations (ITS/CVO), and intelligent vehicle user services. Data within the report reflect empirical results from field operations of deployed systems, supplemented with benefits information based upon modeling studies and statistical studies.

This report is intended to be a reference report. It highlights benefits identified by other authors and refers the reader to information sources. The interested reader is encouraged to obtain source documents to appreciate the assumptions and constraints placed upon interpretation of results. It is the intent of the ITS Joint Program Office to update this report periodically.

Volpe National Transportation Systems Center, *Successful Approaches to Deploying a Metropolitan ITS*, USDOT, March 1999.

This report analyzes the four model deployment initiative (MDI) sites of Phoenix, San Antonio, Seattle, and New York/New Jersey. It identifies nine approaches, which facilitated successful deployment in these areas. Those approaches are the following:

- develop a regional perspective,
- make ITS visible,
- understand the nuances of partnering,
- plan for long-term operations and management,
- develop a regional management structure,

- facilitate ITS within your organization,
- identify appropriate procurement mechanisms,
- address intellectual property rights issues early, and
- develop written policies.

Tables of questions for deploying agencies are provided to test compliance in each of the nine areas. Cost-benefit tables for each are also presented, with most costs associated with additional staff time.

ITS ISSUES AND CHALLENGES

General Accounting Office, *Challenges to Widespread Deployment of ITS*, USDOT, February 1997.

ISTEA legislation has changed the short-term focus of the ITS program from research and operational tests to the deployment of systems. A change in focus calls for the need to assess the current challenges to deployment. This paper addresses those challenges, which include the lack of architecture and standards, the need for federal support, the lack of proper staffing, the lack of general awareness, and the need for more and better quantitative data.

Joint Programs Office, *Implementation of the National Intelligent Transportation Systems Program*, Report to Congress, 1997.

The report, which is the fifth and final of a series, focuses on addressing implementation issues of the new, near-term focus on intelligent infrastructure and intelligent vehicles. Challenges to deployment as well as funding issues are discussed.

L.S. Gallegos and Associates, *Innovative Contracting Practices for ITS*, USDOT, April 1997.

This report addresses the issue that low bid contracting techniques often lack the flexibility to handle such emerging technologies as ITS. The following 10 contracting issues are examined:

- types of contracts,
- methods of awards,
- combined or coordinated procurement,
- pricing and cost sharing,
- allowability of costs,
- cost accounting standards and principals,
- auditing,
- intellectual property,

- organizational conflicts of interest, and
- liability.

US Department of Transportation, *Non-technical Constraints and Barriers to the Implementation of ITS*, 1997 (Update of 1994 report).

The report concludes that there are not any major barriers to ITS deployment but focuses on the areas where issues are present. Issues discussed include:

- staffing and education,
- design and performance standards,
- liability,
- intellectual property,
- privacy,
- anti-trust,
- public/private partnerships,
- institutional and multi-jurisdictional impediments,
- government procurement regulations, and
- environmental impacts.

In addition to the discussion, recommendations for action are given to various agencies (such as state DOTs and metropolitan planning organizations [MPOs]).

The Urban Institute, *Overcoming Barriers to ITS – Lessons From Other Technologies*, November 6, 1995.

This is a summary of the proceedings of the symposium held by the Urban Institute. It includes a discussion of issues related to advanced traffic management systems (ATMS)/ATIS such as franchise agreements and data issues. Lists of participants as well as presentation slides are provided.

Volpe National Transportation Systems Center, *Analysis of USDOT-sponsored Reports on Nontechnical Issues*, USDOT, December 1995.

This report reviews older documents that predate actual deployment and often reflects only the author's opinion. The non-technical issues are placed into nine general categories, namely:

- awareness,
- coordination,
- government,
- intellectual property rights,
- liability,
- organizational,
- planning,

- privacy, and
- resources.

To address these issues, the paper recommends action for the USDOT and categorizes those actions into the following seven areas:

- general ITS information,
- public/private partnerships,
- government operations,
- intellectual property rights,
- liability,
- privacy, and
- standards.

Excellent tables are provided which summarize the issues and actions.

Volpe National Transportation Systems Center, *Discussions of Crosscutting Issues*, USDOT, July 1996.

This document analyzes the metropolitan areas of Boston, Denver, Miami, Milwaukee, Phoenix, Pittsburgh, and St. Louis by interviewing those organizations involved in ITS including state DOTs, transit authorities, MPOs, city and county officials, and law enforcement agencies. The analysts developed white papers that discuss the following issues:

- motivation,
- ITS planning,
- ITS deployment,
- public sector interaction,
- training and education,
- benefits,
- transit, and
- air quality.

Additionally, possible solutions are suggested to overcome each issue. The report provides summaries of the seven metropolitan areas.

OTHER RELATED TOPICS

Texas Department of Transportation, *Intellectual Property Rights Policy*, December 22, 1997.

This report is the Texas Department of Transportation's legal document that outlines procedures to be used regarding software development and many other intellectual property issues.

US Department of Transportation, *Intelligent Transportation Systems in the Transportation Equity Act for the 21st Century (TEA-21)*, 1999.

This short pamphlet by Christine Johnson of ITS Joint Program Office (JPO) discusses TEA-21 in general, gives funding tables, standards' timelines, and other policy-oriented information.

RESOURCES FOR ITS EVALUATION

Numerous resources exist for the evaluation of ITS programs and services, several of which have been used to support the research activities conducted thus far on this "ITS Benefits and Evaluation" project. Many of the resources are provided by or originate from the ITS Joint Program Office of the FHWA. Other ITS evaluation resources have been developed by state DOTs or their affiliated research agencies. Several of the most useful resources are summarized in Table 2 and the following paragraphs, with the intent to publicize these resources as widely as possible to interested TxDOT staff.

Table 2. Key Resources for ITS Evaluation

Title	Description
JPO ITS Program Assessment/Evaluation Page (http://www.its.dot.gov/eval/eval.htm)	Contains evaluation guidelines, evaluation resource guide, in-depth case studies, and documentation of evaluation activities.
JPO ITS Electronic Document Library (http://www.its.dot.gov/welcome.htm)	Contains a fairly complete inventory of USDOT-sponsored ITS documents since 1997, as well as numerous other ITS documents prior to 1997.
JPO ITS Benefits Database and Cost Information (http://www.mitretek.org/its/itsbenefits.html)	Contains extensive information on the benefits and costs of ITS components.
JPO ITS Deployment Tracking and Inventory (http://itsdeployment.ed.ornl.gov/)	Describes the state of deployment of metropolitan ITS and Commercial Vehicle Information System and Networks (CVISN) infrastructure in the nation's largest metropolitan areas.
ITS Deployment Analysis System (IDAS) (http://www-cta.ornl.gov/cta/research/idas/index.htm)	Contains information on IDAS, a sketch planning tool that will assist MPOs and DOTs in assessing the benefits and costs of ITS and other transportation alternatives.
California Path Bibliographic Database http://www.nas.edu/trb/about/path1.html	Database of ITS journal articles, conference reports, and other published documents.
Screening for ITS (SCRITS) Spreadsheet Tool (http://www.ota.fhwa.dot.gov/steam/scrits.htm)	SCRITS is a sketch-level or screening-level analysis tool to allow practitioners to obtain an initial indication of the possible benefits of various ITS applications.
The National Associations Working Group for ITS (http://www.nawgits.com/)	Contains a listing of national associations in the transportation, planning, and technology fields with an interest in ITS planning and implementation. Includes web sites of those organizations. Also includes a link to the ICDN, listed below.
ITS Cooperative Deployment Network (ICDN) (http://www.nawgits.com/icdn.html)	Contains extensive resources including ITS information repositories; a calendar of ITS-related conferences, meetings, and seminars; discussion forums; and an ITS newsletter.

JPO ITS PROGRAM ASSESSMENT/EVALUATION
([HTTP://WWW.ITS.DOT.GOV/EVAL/EVAL.HTM](http://www.its.dot.gov/eval/eval.htm))

The Program Assessment/Evaluation web page contains a variety of information related to ITS evaluation, including the following:

- guidelines for the evaluation of ITS operational tests and deployment projects as required by the TEA-21;
- ITS evaluation resource guide that can be used by practitioners in developing ITS evaluation plans and conducting ITS evaluations; and
- documentation and in-depth studies of numerous topics related to ITS evaluation (e.g., simulation, benefits and costs, user acceptance, and institutional issues).

JPO ITS ELECTRONIC DOCUMENT LIBRARY
([HTTP://WWW.ITS.DOT.GOV/WELCOME.HTM](http://www.its.dot.gov/welcome.htm))

The Electronic Document Library (EDL) contains a largely complete inventory of USDOT-sponsored ITS documents since 1997, as well as numerous other ITS documents prior to 1997. Examples of documents in the EDL that are useful to ITS evaluation:

- *ITS evaluation plans and results* - examples include "Evaluation Plan: The I-40 Traveler and Tourist Information Systems Field Operational Test" (EDL Document No. 6084) and "Seattle Wide-Area Information System for Travelers: Evaluation Summary" (EDL Document No. 9204);
- *syntheses of reported ITS benefit information* - examples include "ITS Benefits: 1999 Update" (EDL Document No. 8323) and "Working Paper: Estimating the Potential Safety Benefits of Intelligent Transportation Systems" (EDL Document No. 8883); and
- case studies of various issues related to ITS deployment and evaluation - examples include "Incorporating ITS into Corridor Planning: Seattle Case Study - Full Report" (EDL Document No. 11303) and "Analysis of ITS Operational Tests: Findings and Recommendations" (EDL Document No. 700).

JPO ITS BENEFITS DATABASE AND COST INFORMATION
([HTTP://WWW.MITRETEK.ORG/ITS/ITSBENEFITS.HTML](http://www.mitretek.org/its/itsbenefits.html))

This JPO web site contains extensive information on the benefits and costs of ITS components. Mitretek gathers ITS benefit and cost information from ITS deployments nationwide and disseminates the information through this web site and periodic benefit synthesis reports. The database also contains information on the source or original documentation of the benefits and costs information.

**JPO ITS DEPLOYMENT TRACKING AND INVENTORY
([HTTP://ITSDEPLOYMENT.ED.ORNL.GOV/](http://ITSDEPLOYMENT.ED.ORNL.GOV/))**

The Deployment Tracking web site describes the state of deployment of metropolitan ITS (as well as commercial vehicle information systems and network, or CVISN) infrastructure in the nation's largest metropolitan areas. The deployment tracking information is being collected to monitor progress toward ITS deployment goals as set by the secretary of transportation in *Operation Timesaver*. The most recent information contained in this deployment inventory is dated September 1997, but the JPO is in the process of updating inventories for 1999.

ITS deployment inventory information is provided for five metropolitan areas in Texas: Austin, Dallas/Fort Worth, El Paso, Houston/Galveston, and San Antonio. The deployment inventory includes information on the following ITS infrastructure components: freeway management, incident management, traffic signal control, electronic toll collection, electronic fare payment, transit management, highway- rail intersections, emergency management, and regional multi-modal traveler information.

**ITS DEPLOYMENT ANALYSIS SYSTEM (IDAS)
([HTTP://WWW-CTA.ORNL.GOV/CTA/RESEARCH/IDAS/INDEX.HTM](http://WWW-CTA.ORNL.GOV/CTA/RESEARCH/IDAS/INDEX.HTM))**

IDAS is a sketch planning tool that is being developed to assist MPOs and DOTs in assessing the benefits and costs of ITS and other transportation alternatives. Capabilities of the IDAS software include:

- represent transportation infrastructure improvements, including ITS, within transportation planning networks;
- work with existing planning modeling and analysis results to analyze the impacts of transportation infrastructure improvement alternatives;
- provide life-cycle cost estimates; and
- compare the results of alternative ITS deployment scenarios, both as alternatives to and/or enhancements of traditional highway and transit infrastructure investment options.

IDAS and other similar ITS sketch planning software (see SCRITS below) are seen by many as the tools to help mainstream ITS into the transportation planning process.

**CALIFORNIA PATH BIBLIOGRAPHIC DATABASE
([HTTP://WWW.NAS.EDU/TRB/ABOUT/PATH1.HTML](http://WWW.NAS.EDU/TRB/ABOUT/PATH1.HTML))**

The PATH web site is an extensive database of ITS journal articles, conference reports, and other published documents. A link to the TRIS database is included, along with an "ITS Thesaurus" of terms that can be used to refine a database search.

**SCREENING FOR ITS (SCRITS) SPREADSHEET TOOL
([HTTP://WWW.OTA.FHWA.DOT.GOV/STEAM/SCRITS.HTM](http://www.ota.fhwa.dot.gov/steam/scrits.htm))**

SCRITS is a spreadsheet analysis tool for estimating the user benefits of ITS. It is intended as a sketch-level or screening-level analysis tool to allow practitioners to obtain an initial indication of the possible benefits of various ITS applications. SCRITS was developed for simplified estimates in the early stages of ITS planning, and users with need for greater accuracy are encouraged to use IDAS. The SCRITS spreadsheet allows users to estimate benefits for numerous ITS components, including detection and surveillance, traveler information, ramp metering, and traffic signal control. The spreadsheet contains default values for many inputs, which can be changed to reflect local deployments or conditions.

**THE NATIONAL ASSOCIATIONS WORKING GROUP FOR ITS
([HTTP://WWW.NAWGITS.COM/](http://www.nawgits.com/))**

This web site contains a listing of national associations in the transportation, planning, and technology fields with an interest in ITS planning and implementation. Represented organizations include AASHTO, APTA, CTA, FTA, ITE, FHWA, TRB, and other transportation, safety, and planning groups. The site includes web sites of those organizations, and also a link to the ITS Cooperative Deployment Network (ICDN), listed below.

**ITS COOPERATIVE DEPLOYMENT NETWORK (ICDN)
([HTTP://WWW.NAWGITS.COM/ICDN.HTML](http://www.nawgits.com/icdn.html))**

This web site contains extensive resources including ITS information repositories; a calendar of ITS-related conferences, meetings, and seminars; and ITS discussion forums. The ICDN on-line newsletter is also provided on this site, containing ITS news, "lessons learned," standards, trends, and resources.

REFERENCES

1. Turner, Shawn, W. R. Stockton, Scott James, Troy Rother, and C. Michael Walton. *ITS Benefits: Review of Evaluation Methods and Reported Benefits*. TTI Research Report 1790-1, Texas Department of Transportation, October 1998.
2. Mitretek Transportation Systems. *Intelligent Transportation Systems Benefits: 1999 Update*, United States Department of Transportation, May 1999

