TravInfo™ Evaluation

Y. B. Yim, Mark A. Miller, PATH

TravInfo, a regional traveler information system in the San Francisco Bay Area, has the mission of providing the public with accurate, comprehensive, and timely information about traffic conditions and multi-modal travel options. A collaborative partnership among public and private participants, TravInfo is built on an open-architecture concept to make its regional database easily accessible to all parties interested in disseminating traveler information. Conceived in 1992 by individuals from the Bay Area Metropolitan Transportation Commission (MTC), Caltrans, the California Highway Patrol, PATH, and local governments, TravInfo was a Field Operational Test (FOT) from September 1996 to September 1998, with funding from Caltrans and the Federal Highway Administration. PATH recently concluded an evaluation of the FOT using various data sources from field observations, focus group discussions, a series of telephone surveys with travelers and field measurements. The evaluation focused on three areas: institutional, technology, and traveler response.

The TravInfo field test provided strong regional stewardship for an infant program and pioneered a unique, open public-private partnership dedicated to a regional system built on an open architecture. The experience benefited the Bay Area as a whole, both through an improved transportation system and the presence of a new institutional collaboration. The private sector benefited from having a venue in which to test advanced traveler information products.

Institutional Evaluation

The most significant attribute of the TravInfo FOT was its engendering of open public and private party partnerships. Many of TravInfo’s private participants went on to form alliances with one another. The project helped foster constructive relationships among the three principal public participants: the Metropolitan Transportation Commission (MTC), Caltrans District 4 and the California Highway Patrol’s Golden Gate Division. The partners encountered many institutional challenges, among them: different expectations for the project among the partners, delays caused by contracting problems, using an inefficient system while working toward the FOT’s goal, and heavy reliance on Caltrans’ Traffic Operations System, which due to institutional problems was not developed in time for the FOT.

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TravInfo Evaluation
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Technology Evaluation

TravInfo’s operational core, the regional Traveler Information Center (TIC), collects and processes traffic information for dissemination directly to the public through the Traveler Advisory Telephone System (TATS) and to information service providers (ISPs) over TravInfo’s Landline Data Server (LDS). During the field test, three private ISPs deployed traffic web sites in the Bay Area using TravInfo’s data, and a few dozen others retrieved TravInfo data to test a wide range of advanced traveler information products.

The TIC, operated by a private contractor with MTC providing management oversight, disseminates traveler information directly to individuals. Travelers anywhere in the nine-county, eight-area-code Bay Area can get regularly updated traffic and transit information by phone from TATS simply by calling 817-1717, no area code. The center operates 24 hours a day, seven days a week with three weekday and two weekend shifts. During emergencies and special events, additional information is added.

Two information sources are automatically fed into TravInfo: inductive loop sensor data from Caltrans’ Traffic Operations System, and incident data from the Freeway Service Patrol, which aids stranded motorists. Because of these sources’ insufficient geographic coverage and accuracy, the most significant data source during the FOT was incident reports from the California Highway Patrol’s (CHP) Computer-Aided Dispatch (CAD) system. Because operators must manually enter these reports into the TIC’s system, operator response time is critical to how well the center meets its goal of timely, comprehensive, and reliable dissemination of information. Average response times for incident processing from the CHP’s CAD system and entering it into TATS ranged between ten and eleven minutes. Approximately 20 percent of the total number of incoming CAD incidents were entered. Although the timeliness of operators’ responses could not be compared to any reference point, we did determine that the two primary factors influencing response time and number of incidents entered were individual operators’ job performance and workload. Automating the data entry process could both speed response time and increase the number of processed incidents.

TravInfo registered ISPs can also tap into the center’s database through a telnet connection. TravInfo was effective in eliciting participation from ISPs: by the end of the FOT, over fifty ISPs, ranging from Bay Area firms to large international corporations, had registered. Ninety percent were in the private sector. These firms were interested in deploying traveler information through wireless services, in-vehicle navigation devices, web pages and other means. Three of these firms were continuous users throughout the FOT, and about thirty retrieved TravInfo data intermittently.

TravInfo’s centralized regional database offers advantages to public and private partners, because it helps prevent duplication of data collection and expedites data exchanges among public agencies. It also offers an open and level playing field for commercial developers and simplifies the private sector’s access to public data. However, ISPs remained unconvinced of the business opportunities for advanced traveler information services in the current marketplace. TravInfo’s data did not cover a substantial enough portion of the Bay Area’s transportation system for them to actively develop and test their products. Some ISPs believed that personalized traveler information, bundled with other real-time information services, could find a market niche. Many wanted to wait until better data became available before investing. In addition, some providers were also interested in rolling products out nationally, not only those tailored specifically to separate local markets.

Travelers anywhere in the nine-county, eight-area-code Bay Area can get regularly updated traffic and transit information by phone from TATS simply by calling 817-1717.
Traveler Response Evaluation

Radio was the primary source of traffic and transit information in the Bay Area during the FOT: one-third of households surveyed regularly listen to traffic reports, another third listen when traffic congestion was expected, and the other third never listen. On an average day, approximately 12 percent of the Bay Area traveling population changes travel behavior because of radio and television reports. Most are freeway drivers, and most change their departure time or take an alternate route. Very few switch to public transit, which they consider inconvenient and more time-consuming than driving alone, even with congestion.

During the field test, TravInfo consistently received between 50,000 and 65,000 calls per month (except during two emergencies: a BART–Bay Area Rapid Transit – strike in September 1997, and disastrous floods in February 1998, when call volumes spiked). PATH’s Bay-Area wide household survey, conducted in November 1998, indicated that the vast majority of respondents were not aware of the TravInfo traffic information phone number or web sites, and that very few of those aware had actually tried the service. The ISPs estimated their web site hits at approximately 15,000 a month toward the end of the FOT, without benefit of any ad campaign.

Satisfaction with TravInfo TATS phone service was consistently high; those who used TATS or the web sites rated the information quality as far superior to radio or television, and useful in trip planning, with over 80 percent of respondents repeat users. Most callers liked the easy access to all travel-related information via a single telephone number. Cell phone callers tended to be new TravInfo users. TravInfo led people to substitute TATS or web sites for radio or television reports, and to seek specific information. One-third of phone callers and one-third of web site visitors switched to TravInfo from radio or television reports; most of those who switched were long-distance commuters and high mileage drivers. TravInfo influenced travel behavior far more efficiently than radio or television broadcasts. While 25 percent of radio or television listeners changed their travel behavior, 45 percent of TravInfo callers and 81 percent of web site visitors changed their behavior after getting specific information about their route.

Lessons Learned

TravInfo’s primary successes lay in developing a network of public and private professionals who collaborated on Advanced Traveler Information Systems (ATIS) projects in a variety of settings, and in providing a platform for different organizations to form partnerships. Moreover, these results promise to lead to further developments in innovative traveler information services and products beyond the telephone or web site services.

The major problems that beset the TravInfo FOT were notably similar to those of other Field Operational Tests: setting goals too ambitious to attain within the FOT’s limited time span, underestimating the time required to develop mutual understanding and trust among parties with different expectations and objectives, underestimating the consumer market for commercialization of traveler information products and services, having inadequate information about how to put a consumer value on the information being provided, not defining appropriate roles for the parties involved, and underestimating the importance of having enough time and funds to market the product and convince people to use it.

The project approach was insufficiently flexible to quickly respond to unexpected obstacles; because the partnership was structured around consensus, there were delays in making critical decisions. TravInfo planners relied on the best-case scenario for both system design and implementation, without developing alternative courses of action for worst-case scenarios. Such risk assessment strategies and contingency planning are vital.

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Because of its heavier-than-expected dependence on the manual performance of TIC operators, the operational system is not as efficient as envisioned. TravInfo needs an automated system flexible enough to keep up with rapidly advancing technologies. Added system automation should make a streamlined organizational structure possible, with less need for operator supervision and heavy quality control monitoring.

Public as well as private partners learned that effective marketing was essential. To promote public awareness, a comprehensive and organized marketing plan was needed, with expert guidance for an aggressive, consistent ad campaign with a substantial advertising budget. Information service providers also recognized that an organized marketing campaign for their web sites would have drawn in more users. The high level of user satisfaction with TATS and participating traffic web sites implies that people would use TravInfo’s services if they were aware of and had a chance to try them. The vast majority of traffic information seekers who used TATS and web sites were repeat users. As better marketing improves public awareness of TravInfo, its potential should be more fully realized.

Perhaps the greatest value of the TravInfo field test comes from the experience gained by the partners as testers of open architecture and open partnership concepts. What they have learned about building successful partnerships through better understanding of different viewpoints and improved communication will be invaluable when shared with others developing similar projects.

**Recommendations**
TravInfo’s sustainability beyond the field test is critical to the private partners, since their products rely on the availability of public data that TravInfo supplies. Continued public support after the field test is necessary to encourage organized consumer research crucial to deploying TravInfo through private sector products and services. At the same time, TravInfo’s public partners need to be better informed about the private sector’s consumer research findings to continue their collaboration and supply data usable by private parties.

The first two of our specific recommendations below apply to field tests of other systems and similar projects in other regions; the rest apply to TravInfo as it extends its operation beyond the field test phase.

- Allow more time for startup tasks and preplanning, including administrative procedures and task-management plans.
- Develop a risk management plan early in the planning process to deal with unforeseen challenges.
- Continue to have the three public agencies responsible for the field test collaboratively (the MTC, Caltrans and the CHP) manage and operate TravInfo, thereby allowing a seamless transition from the field test to system implementation.
- Continue to seek public funding to support TravInfo operations as a public service, while providing support to ISPs for development, testing, and deployment of their products or services.
- Conduct organized consumer research to improve understanding of the Bay Area market, and implement aggressive marketing strategies to increase public awareness of TravInfo and its privately offered products.
- Improve both the quality and the geographic coverage of traffic data, and continue to support research on surveillance technologies and their development.
• Develop a comprehensive outreach program for public and private parties to actively participate in the deployment of a regional advanced traveler information system.

• Encourage debate and discussion of topics of interest to ISPs.

• Improve the TravInfo operating system to the level of efficiency and automation that was originally intended, and investigate the feasibility of redesigning the operator interface.

• Investigate new strategies to improve the quality and timeliness of data dissemination in the TIC. If the system is to be manually operated, further assess operator response time to identify the significance of operator performance and operator workload so that appropriate remedies can be pursued.

Conclusions
The long-term benefits of TravInfo will be more valuable to the partners and the public than its immediate benefits in giving Bay Area travelers accurate, reliable, timely and multi-modal information. New ideas have emerged, new approaches developed, and new partners solicited, all in keeping with TravInfo’s key objective of developing and implementing a regional traveler information system. Traffic system operators have learned how to run their systems better, and ISPs have gained a better understanding of consumers’ purchasing habits and the importance of marketing for their products. Public and private partners have learned the value of making firm commitments to collaborative partnerships.

In sum, the TravInfo Field Operational Test implemented a prototype regional transportation information system to benefit the traveling public and ultimately the Bay Area transportation system. It tested a unique concept of open architecture and collaborative public-private partnership to broadly disseminate traveler information and foster a commercial market for privately offered advanced traveler information services. Despite many challenges, TravInfo has now entered a transitional phase to full deployment as an integral part of the Bay Area transportation infrastructure. The lessons learned from the field test will be of value to the sponsoring agencies and the TravInfo partners, as well as public agencies interested in implementing similar systems.

TravInfo papers published by PATH as part of evaluation.

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- TravInfo Evaluation Plan: Update 1, Youngbin Yim, Asad Khattak, Mark A. Miller, Randolph Hall, Stein Weissenberger, UCB-ITS-PWP-94-3.
- TravInfo Evaluation: Institutional Element Phase 1 Results, Randolph W. Hall, Y.B. Yim, Brian Pfeifle, Stein Weissenberger, UCB-ITS-PWP-95-1. *
- TravInfo Field Operational Test Evaluation Plan, Randolph Hall, Y.B. Yim, Asad Khattak, Mark A. Miller, Stein Weissenberger, UCB-ITS-PWP-95-4. *
- TravInfo Field Operational Test Traveler Information Center (TIC) Study (Technology Evaluation Element) Implementation Plan, Mark A. Miller, Randolph Hall, UCB-ITS-PWP-95-14.
- TravInfo Evaluation: Value Added Reseller (VAR) Study Phase 1 Results, Dimitri Loukakos, Randolph Hall, Stein Weissenberger, Y.B. Yim, UCB-ITS-PWP-96-13. *
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- TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study: System Reliability and Communications Interface (9/96-12/97), Mark A. Miller, Dimitri Loukakos, UCB-ITS-PWP-98-21. *

TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study: Operator Interface Analysis-Phase III, Mark A. Miller, Dimitri Loukakos, UCB-ITS-PWP-98-22. *

- TravInfo Evaluation: The Target Study Phase 1 Results, Ronald Koo, Youngbin Yim, Randolph Hall, UCB-ITS-PWP-98-24. *
- TravInfo Evaluation Traveler Response Element: TravInfo 817-1717 Caller Study Phase 1 Results, Youngbin Yim, Randolph Hall, Ronald Koo, Mark A. Miller, UCB-ITS-PWP-98-25. *
- Testing a Proposed Decision-Oriented Framework to Understand ITS Deployment Issues: An Examination of the TravInfo ATS Project, Mark A. Miller, UCB-ITS-PRR-98-35. *
- TravInfo Field Operational Test Institutional Evaluation Final Results, Youngbin Yim, Elizabeth Deakin, UCB-ITS-PWP-2000-2. *
- TravInfo Field Operational Test Evaluation: Target Study Final Results, Ronald Koo, Youngbin Yim, UCB-ITS-PWP-2000-3.
- User Response to the Telephone Advisory Traveler Information System in the San Francisco Bay Area: Based on TravInfo Caller Survey Wave 1, Jean-Luc Ygnace, Ronald Koo, Youngbin Yim, UCB-ITS-PWP-2000-8.
- Evaluation of TravInfo Field Operational Test: Final Report, Youngbin Yim, Mark A. Miller, UCB-ITS-PWR-2000-7. *

Operations at Regional Traveler Information Centers: The Case of the TravInfo Field Operational Test 9 Final Results, Mark A. Miller, Dimitri Loukakos, To be published.

*Available online at:
http://www.path.berkeley.edu/Publications/PATH/index.html
Deploying Electronic Toll Systems
David Levinson, University of Minnesota; Elva Chang, David Gillen, UC Berkeley

Converting conventional toll plazas to electronic toll collection is seemingly inevitable: electronic toll collection (ETC) systems enable bridge, tunnel, and turnpike operators to save on staffing costs while reducing delay for travelers, leaving everyone better off. The greater the ETC market share, and the sooner that share is achieved, the more overall welfare is improved. However, new technologies such as ETC are not adopted instantaneously. Agencies need to familiarize themselves with the technology, while distrust, inconvenience, up-front costs, and procrastination cause many users to defer expending time or resources to set up ETC accounts and buy transponders.

It is clear that toll agency policy—opening ETC lanes faster or slower—can drive user adoption of ETC. A toll agency can affect commuters’ choice either by returning some of the cost savings as a discount for ETC users, to optimize the use of the lanes, or by increasing congestion in the manual lanes, by reducing their number as they are converted to ETC. An agency’s choice to convert a given number of lanes in one year will inevitably shape user preferences in the next, factors that an accurate model must take into account.

Our research examines the question of how quickly lanes at a toll plaza should be converted from manual toll collection to ETC, and what discount for using ETC would be socially optimal. We have identified a process that may guide the speed of this conversion, where public toll agencies striving to improve the general welfare are constrained both by limits in their ability to forecast accurately and by political acceptance.

Our study extends the benefit-cost model presented by Jianling Li and her colleagues in Intellimotion 7.3 (1998). While Professor Li’s research started with basic assumptions about what percentage of traffic volume would be ETC users vs. manual tollbooth users, and about how that share of volume would change with time, we are internalizing the estimation of ETC vs. manual share within the model. This enables us to understand how pricing and the number of toll lanes affect the shares using the old and new technologies.

**Model**

In our model, the travel time, ideal lane configuration, optimal discount, and payment choice decision are all interdependent. Our objective is to explain the share of each payment mechanism in any given year. The choice between manual and electronic payment depends on the out-of-pocket cost and time spent at the toll plaza associated with each method, and on the one-time fixed cost associated with electronic toll collection. We posit that individuals using manual payment reevaluate their payment mechanism each time there is a change in circumstances (in this case annual growth and a change in the lane configuration, and discount policy), assumed to be once per year.

The “fixed cost” of acquiring transponders is implicitly a predisposition against switching from manual to ETC. However, this disposition may not remain constant over time. In year one, some fraction of the population switches to ETC. These early users can be assumed to have a more favorable than average disposition towards ETC, and those who don’t adopt it in the first year a less favorable disposition towards it. This is illustrated in Figure 1.

In following years, as more people switch to ETC, the average predisposition against switching among those who haven’t already adopted it rises even more. This rising predisposition against new technology may be offset by several factors that explain why the more people who have transponders, and the longer the system is deployed, the more willing nonusers will be to obtain it. First, confidence increases: nonusers may come to trust others’ judgment that the system is reliable, doesn’t overcharge, doesn’t violate their privacy, and is easy to use. Second, more learning takes place, e.g.,

![Figure 1. Effect of Disposition on Choice](image-url)
a nonuser will be more likely to take a ride in a vehicle with the technology. Third, the opportunities to choose the technology accumulate: every day a potential user has some probability of signing up. Finally, as more and more toll plazas (and other applications) adopt the ETC system, the technology becomes ever more useful. (Transponders are even being used at parking garages, gas stations, and fast food drive-through windows.) This background effect may be the strongest drive toward increasing the adoption rate. However, it is impossible to know from the available data how this predisposition against electronic toll collection changes over time. We suspect that the reluctance to switch to ETC will decrease over time, but we are not sure how quickly. We assume that it goes to zero over twenty years, but we test the sensitivity of that assumption.

Our model assumes that an individual who has chosen electronic payment does not switch back to manual transactions. However, ETC users who change commutes away from a particular toll plaza (because they change jobs, homes, or both) may be replaced by new manual users, who are then offered the choice of ETC. The fraction of those who stay with the same commute from year to year is dubbed the “survival rate.” This value is taken to be 84 percent, based on our previous work evaluating the survival of commutes between the same home and workplace. All replacements for non-survivors are placed in the pool of users who may choose their payment each year.

Each year, our model assumes that the toll agency chooses an optimal combination of the number of ETC lanes and discount policy to maximize the overall social welfare, constrained so that the net benefit of the toll agency is positive and delay in the ETC lanes is less than in the manual lanes. This lane configuration and discount policy are in equilibrium with the ETC market share estimated from the payment choice model.

Results

Our model uses historical traffic and financial data at the Carquiñez Bridge to illustrate this procedure of determining an appropriate pace of ETC deployment and discount policy. Twelve lanes go through the toll plaza, one of which has been a dedicated ETC lane since August 1997. Two lanes are also open for mixed ETC/manual toll collection. Since vehicles equipped with ETC suffer delay in mixed-use lanes, the gains from mixed payment lanes are expected to be marginal and are thus neglected in our model. We assume that all vehicles equipped with transponders use the ETC dedicated lane.

Table 1 shows optimal discount policy and pace of ETC deployment for the base case assumptions. The overall net present value is about 61 million dollars. In year 20, the model projects that ETC market share will reach 91 percent and there will be 9 ETC lanes.

The results of the basic model depend greatly on assumptions, so we have also examined several variables through sensitivity analysis, among them

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Traffic</th>
<th>ETC Share</th>
<th>ETC Lanes</th>
<th>Discount</th>
<th>Annual NPV</th>
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</thead>
<tbody>
<tr>
<td>96/97</td>
<td>19,064,849</td>
<td>0.00 %</td>
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<td>-$2,223,592</td>
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<td>97/98</td>
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<td>01/02</td>
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<td>23,447,360</td>
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<td>-0.20</td>
<td>$2,122,575</td>
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<td>$2,492,436</td>
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<td>74.03 %</td>
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<td>11/12</td>
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<td>-0.28</td>
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<tr>
<td>12/13</td>
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<td>Sum</td>
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Table 1. Results from Base Case Simulation

One lane of the Carquiñez Bridge toll plaza is dedicated to ETC.
On six continents, groups involved in developing Intelligent Transportation Systems (ITS) products and services are faced with the challenge of how to go from a long-range global vision to an evaluation of particular local markets in the near term. To the extent that ITS market growth will depend on ITS supply, one may well assume that specific products and services can and will be deployed geographically according to the differential strength of local players involved in the worldwide ITS arena. One can hypothesize that the presence of ITS industry representatives in ITS organizations might be a good indicator of the strength of ITS supply. The results presented here are based on analysis of the characteristics of the registered members of the three major global ITS organizations: ITS America in the US, ERTICO (Intelligent Transportation System–Europe) in Europe, and VERTIS (Vehicle, Road and Traffic Intelligence Society) in Japan. Although the various organizations have very different requirements for membership and dues structures, we can assume that firms belonging to two or more ITS organizations have a strong stake in ITS.

As of November 1998, there were 978 members registered with at least one of these three organizations. The members represent various market sectors, and these sectors’ representation in each organization highlights the state of ITS trends and potential markets in each continent. One must mention that companies offering (or developing) ITS products or services do not necessarily join an ITS organization. Nevertheless, there are growing institutional incentives (e.g., networking advantages) to joining an ITS organization while being in a process of the development or deployment of a product, a service, a policy or even a standard in the ITS arena. ITS America membership is the largest among the three ITS organizations considered, as shown in Figure 1. The participants’ profile shows that the most important sectors represented by ITS members worldwide are (in decreasing order of numeric importance): electronic industry (25 percent), universities (26 percent), consulting firms (12 percent), DOTs (12 percent), and other (50 percent).

The material in this article, originally delivered as a UC Berkeley Institute of Transportation Studies seminar, may also be found in Les systèmes de transport intelligent: un enjeu stratégique mondial (Jean-Luc Ygnace and Etienne de Banville, Paris: La Documentation Française, 1999) an in-depth analysis of major trends in ITS worldwide. Dr. Ygnace is from time to time a visiting PATH researcher.
Each ITS organization has a significantly different membership profile. ITS America members are much more often involved in services, consulting, Departments of Transportation, and universities. ERTICO members more often represent the electronic industry, Departments of Transportation, and the automobile industry.

Vertis, the Japanese ITS organization, shows an interesting balance; as in Europe, a great majority of members are from the electronic industry; as in the US, there is an important number of consulting companies and universities.

ITS America, ERTICO, and VERTIS each have a majority of “domestic” members but each one is open to foreign participation. A limited number of companies have a multi-continental ITS membership, the result of the globalization of the ITS industry. Table 2 lists the “global” players who participate in more than one continental ITS organization.

Japanese firms make up 63 percent of the global ITS players, companies that belong to at least two continental ITS organizations. The European ITS industry makes up 22 percent of this population, although ERTICO members represent only seven percent of the total membership of the three main ITS organizations. American firms comprise only 15 percent, quite a small figure when compared to their numeric importance when it comes to ITS America membership.

Table 2. Global players: ITS firms belonging to two or more ITS organizations

<table>
<thead>
<tr>
<th>ITS America</th>
<th>VERTIS</th>
<th>ERTICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch</td>
<td>Bosch</td>
<td>Bosch</td>
</tr>
<tr>
<td>Navtech</td>
<td>Navtech</td>
<td>Navtech</td>
</tr>
<tr>
<td>Matsushita/</td>
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An Updated List of Recent PATH Sponsored Research Publications

PATH publications (which include research reports, working papers, technical memoranda, and technical notes) can be obtained from:

Institute of Transportation Studies
Publications Office
University of California
109 McLaughlin Hall
Berkeley, CA 94720-1720
510-642-3558,
FAX: 510-642-1246
http://www.its.berkeley.edu/publications.html

A searchable database of PATH publications is available via the PATH World Wide Web site at: http://www.path.berkeley.edu

A Vehicle to Roadside Communications Architecture for ITS Applications, Tetiana Lo, Pravin Varaiya
March 2000, 205 pp., $30
UCB-ITS-PRR-2000-3*

An Investigation in the Use of Inductive Loop Signatures for Vehicle Classification, Carlos Sun
March 2000, 138 pp., $20
UCB-ITS-PRR-2000-4*

Dynamic Origin/Destination Estimation Using True Section Densities, Carlos Sun, Himanshu Porwal
March 2000, 148 pp., $20
UCB-ITS-PRR-2000-5*

SmartAHS and SHIFT Enhancements, Persistence and Query Interpretation, James Misener
March 2000, 88 pp., $15
UCB-ITS-PRR-2000-6*

Evaluation of TravInfo Field Operational Test: Final Report, Youngbin Yim, Mark A. Miller
May 2000, 81 pp., $15
UCB-ITS-PRR-2000-7*

Advanced Braking Methods for Longitudinal Control of Commercial Heavy Vehicles, Lasse Moklegaard, Anna G. Stefanopoulou
May 2000, 50 pp., $10
UCB-ITS-PRR-2000-8*

Feasibility of A Gyroscope-free Inertial Navigation System for Tracking Rigid Body Motion, Chin-Woo Tan, Kirill Mostov, Pravin Varaiya
May 2000, 35 pp., $10
UCB-ITS-PRR-2000-9*

Carlink–A Smart Carsharing System Field Test Report, Susan Shaheen, John Wright, David Dick, Linda Novick
May 2000, 200 pp., $25
UCB-ITS-PRR-2000-10*

Deploying Electronic Tolls, David Levinson, Elva Chang
May 2000, 29 pp., $10
UCB-ITS-PRR-2000-11*

TravInfo Field Operational Test Institutional Evaluation Final Results, Youngbin Yim, Elizabeth Deakin
February 2000, 58 pp., $15
UCB-ITS-PWP-2000-2*

TravInfo Field Operational Test Evaluation: Target Study Final Results, Ronald Koo, Youngbin Yim
March 2000, 16 pp., $5
UCB-ITS-PWP-2000-3*

Database Environment for Fast Real-time Simulation of Urban Traffic Networks with ATMIS, R. Jayakrishnan, Phillip Sheu, Taehyung Wang, MinHua Xu
March 2000, 52 pp., $15
UCB-ITS-PWP-2000-4*

TravInfo Field Operational Test Evaluation: Information Service Providers Customer Survey, Youngbin Yim
May 2000, 23 pp., $5
UCB-ITS-PWP-2000-5*

Experimental Studies on High Speed Vehicle Steering Control with Magnetic Marker Referencing System, Han-Shue Tan, Bénédicte Bougler
May 2000, 76 pp., $15
UCB-ITS-PWP-2000-6*

Institutional Aspects of Bus Rapid Transit–A Macroscopic Examination, Mark A. Miller, Stephen M. Buckley
July 2000, 31 p., $10
UCB-ITS-PWP-2000-7*

User Response to the Telephone Advisory Traveler Information System in the San Francisco Bay Area: Based on TravInfo Caller Survey Wave 1, Jean-Luc Ygnace, Ronald Koo, Youngbin Yim
July 2000, 38 pp., $10
UCB-ITS-PWP-2000-8

TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study: Operator Response Time Analysis, Mark A. Miller, Dimitri Loukakos
August 2000, 34 pp., $10
UCB-ITS-PWP-2000-9

A Field Survey of Site Visits to Passenger Intermodal Transfer Facilities in California, Chris Mitchell, Mark A. Miller
August 2000, 32 pp., $10
Tech Note 2000-1*

*Available online at:
http://www.path.berkeley.edu/Publications/PATH/index.html
US companies with headquarters in North America represent 82.7 percent of ITS America membership, those headquartered in Japan 6.2 percent of this population, and European groups 5.3 percent, as shown in Table 3.

ERTICO, like ITS America, is open to foreign participation, and the foreign presence is similar, about 13 percent, compared to about 17 percent foreign membership in ITS America. US groups represent the majority of foreign participation in ERTICO. Figure 3 shows ERTICO members by country in which their headquarters are located.

VERTIS is open to non-Japanese firms, but foreign membership is small: one Korean, one European, and three American members at the time of our study. There is, after all, no reason for the Japanese ITS industry to be different from the rest of the Japanese economy, where (although things are changing) it is still difficult for foreign industry groups to do business.

Conclusion
It is important to mention that the “Intelligence” in ITS is information technology, an industry that leads the trend toward globalization. The participation of many economic and industrial sectors in various ITS organizations on a global basis is a good indicator of the ITS industry’s ability to function as an innovative “network,” an important sign of the industry’s ability to deliver products and services on a large scale.
PATH Presentations

Recent and Upcoming Presentations of PATH Sponsored Research

SAE International Congress and Exhibition, Society of Automotive Engineers, Detroit, Michigan, March 6-8, 2000.
• C.A. MacCarley, B. Hemme, L. Klein, “Evaluation of Infrared and Millimeter-Wave Imaging Technologies Applied to Traffic Management”.

• Mark A. Miller, “The Human Influence on the Operation of TravInfo’s Traveler Information Center for the Delivery of ATIS Services”.

Daimler Chrysler, Stuttgart, Germany, March 6, 2000.
• Daniel Sperling, “New Mobility Strategies”.

• Mark A. Miller, “The Human Influence on the Operation of TravInfo’s Traveler Information Center for the Delivery of ATIS Services”.

Youngbin Yim, “Customer Response to ATIS in TravInfo”.
• Bongsob Song, Delphine Delorme, “Human Driver Model for SmartAHS Based on Cognitive and Control Approach”.
• Pravin Varaiya (presented by Pat Conroy), “California’s Performance Monitoring System (PeMS)”.


• E. M. El Koursi, Ching-Yao Chan, Wei-Bin Zhang, “Preliminary Safety Analysis of Frontal Collision Avoidance Systems”.

Daimler Chrysler, Stuttgart, Germany, March 6, 2000.
• Daniel Sperling, “New Mobility Strategies”.

• T. E. Cohn, “Visual Fields when Perimetric Targets Appear to Move”.


• James Marca, Craig Rindt, Michael McNally, “A GPS-based In-vehicle Data Collection System: A Comparison with Conventional Loop Data”.

• Daniel Sperling, “New Mobility for our Cities: Smart Car Sharing, Communication, and New Propulsion Technologies”.


• Xia-Yun, J.K. Hedrick, “Integral filters from a New Viewpoint and Their Application in Nonlinear Control”.


• Seri Oh, Carlos Sun, and Stephen G. Ritchie, “An Intelligent Loop-Based Traffic Surveillance System”.

Intralley motion
PATH researchers Y. B. Yim and Mark Miller’s final report on the field operational test of TravInfo was the 20,000th record entered into the PATH Database, maintained at UC Berkeley’s Institute of Transportation Studies Harmer Davis Transportation Library. The report, and the entry, set a milestone in efforts toward disseminating information not only to researchers and academicians working on Intelligent Transportation Systems, but also to travelers in the San Francisco Bay Area.

In 1988, when the PATH Database was created, Internet databases and real-time information for travelers were ideas whose time had not yet come. Researchers in the fledgling field of Intelligent Vehicle Highway Systems had access only to a DOS-based database with 300 records and very limited search capabilities. Travelers could only tune in to a local radio station and hope to catch a report about traffic affecting them. Today, the PATH Database is a Windows-based, Internet accessible resource, growing by 300 records a month. Funded by Caltrans and hosted by the Transportation Research Board, the PATH Database is widely considered to be the world’s most comprehensive source of bibliographic information on Intelligent Transportation Systems. Researchers can use a subject thesaurus that works in conjunction with the Transportation Research Thesaurus to access information from monographs, technical reports, conference proceedings, journals, newspaper articles, and ITS-related web sites. Search results include standard bibliographic information, abstracts, and URLs.

As demand for real-time traffic information and for safe and efficient transportation continue to grow, transportation researchers’ needs for access to bibliographic information will grow with it. With this goal in mind, PATH librarians remain committed in their efforts to support the transportation research community.

You can reach the PATH database at http://www4.nationalacademies.org/trb/tris.nsf/web/path
the survival rate (shown in Figure 2). The higher the survival rate, the more people who have chosen ETC payment will continue to use the system in the coming year. When the survival rate is low, the operator has to provide greater incentives (time and money differential) to achieve the market share equivalent to that of high survival rates. An interesting and unexpected behavior emerges for low survival rates (here below 40 percent). The interplay of the overall welfare optimization and two constraints (the operator having non-negative revenue and the ETC lanes always being faster than the manual lanes) leads to what we might consider a complex phase change. If the toll agency chooses to allocate more ETC lanes (11) to enlarge the travel time difference between the two payment choices, this strategy brings about a higher market share in year 20 and a somewhat higher overall net present value (NPV).

In the original model, we assumed that the ETC specific constant hits zero in year 20 by decreasing at a constant rate. We also investigated different rates. We believe that the magnitude of this constant is associated with the market share of ETC users (or nonusers). To do this, we set the constant equal to its base year value multiplied by the ETC market share raised to a power. The power term indicates whether there is positive feedback for ETC (users beget more users) or negative feedback (the more ETC users the greater the predisposition against adopting ETC). Figure 3 shows how net benefits change for different power terms.

What is the real value of the power term? Employing the best available data for the Carquinez Bridge, we estimate the power term to equal -1.636, less than -1. The overall NPV for this scenario is negative. While this may appear to be an unpleasant result, maybe the reluctance to adopt ETC really is that strong. A single dedicated ETC lane is not a signal for most drivers to switch. This implies that if the toll agency wants to proceed with ETC, it must actively work to change people’s preferences. Because the major effort has been on ensuring technical functioning of the Carquinez ETC system rather than on marketing, relatively little effort has been made to sell ETC to potential customers. We anticipate this will change.

In the original model, the capacity is decided by optimizing overall NPV in a given year, independent of its consequences for future years. From our simulations, we observed that a greater number of ETC lanes usually results in higher overall NPV over the entire period. Is it possible to trade a suboptimal NPV in the present year for a higher long-term NPV? Clearly, the best approach to solve this problem would be to optimize for all twenty years simultaneously.

Constrained by computation time, we tried several heuristic alternatives. Overall, social welfare increases when two ETC lanes are installed in the first year. Similarly, when more ETC lanes are added in subsequent years, the higher the overall NPV over the entire twenty-year period. Finally, we optimized the number of ETC lanes in two-, three-, and four-year bundles. The longer time span we take into account, the better overall results we attain compared to the short-term optimization rules.

**Conclusions**

Longer term decision-making will result in higher overall welfare than short-term decisions, though the penalty for short-term analysis (as high as 50 percent) depends on other assumptions. Many of the gains can be achieved by simply looking two years out.

The single most important factor in the model that dictates whether ETC will fail or flourish is commuters’ reluctance to join the ETC network,
whether because of transponder cost, the inconvenience of opening an account, simple inertia, or other factors. If these barriers to entry diminish, the system will take off. If the barriers don’t fall, fewer and fewer of those predisposed against ETC will adopt it each successive year. We are left with the question of determining whether people will be won over by increasing familiarity with the technology’s advantages, or whether their reluctance to make the leap is deeper. A more concerted marketing strategy to reduce the barriers to entry could easily shift preferences. Alternative technologies, such as Automatic Vehicle Identification, used on Highway 407 in Toronto, would eliminate the barrier to entry of transponder acquisition. Further deployment of electronic tolls, as recently done on the Golden Gate bridge and as scheduled by Caltrans for all other Bay Area bridges by years’ end, should also make ETC more advantageous.

Acknowledgments

Research on this project was funded by the Caltrans Division New Technology and Research Program under MOU 357.

References


Jeff Morales, recently appointed Caltrans Director, visited PATH’s Richmond Field Station headquarters July 17, along with the Intelligent Transportation Society of America Coordinating Council, meeting that day in Berkeley. Accompanied by Caltrans New Technology and Research Program manager Roy Bushey and Caltrans District 2 Director Thom Niesen, Mr. Morales checked out a set of demonstrations of recent PATH research. He “drove” the snowplow guidance system simulator, rode in a platoon car performing an automated merge maneuver and precision docking, inspected the SamTrans Forward Collision Warning System bus and the automated Freightliner truck, and saw demonstrations of the Freeway Performance Measurement System (PeMS), Paramics traffic simulation, and CarLink carsharing programs.

According to PATH Deputy Director Steve Shladover, “He was so impressed with what we showed him that he has scheduled a visit here with all twelve Caltrans District Directors in the Fall, so that they can all see what we are doing. This could be a real encouragement to implementation of projects based on our research results. It will mean more work, but certainly with a high payoff. Good work begets more work.”