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ASSESSING THE BENEFITS OF TRAVELER AND TRANSPORTATION INFORMATION SYSTEMS

by

Taryn Kristof
Research Assistant

Mike Lowry
Research Assistant

G. Scott Rutherford
Professor
Department of Civil and Environmental Engineering
University of Washington

Washington State Transportation Center (TRAC)
University of Washington, Box 354802
1107 NE 45th Street, Suite 535
Seattle, Washington 98105-4631

Washington State Department of Transportation Technical Monitor
Pete Briglia, ITS Program Manager
WSDOT Advanced Technology Branch

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16. ABSTRACT

The goal of advanced traveler information systems (ATIS) is to provide travelers with information that will facilitate their decisions concerning route choice, departure time, trip delay or elimination, and mode of transportation. The benefits of ATIS projects can be evaluated through field studies, simulation software, and surveys. An evaluation method called the ITS Deployment Analysis System (IDAS) is suggested for use by the Washington State Department of Transportation (WSDOT). IDAS is a "sketch" planning tool intended for screening and prioritizing all intelligent transportation systems (ITS) projects (not just ATIS projects). The software evaluates a number of benefits. These are determined by changes attributable to the deployment of ITS in vehicle miles traveled (VMT), vehicle hours traveled (VHT), volume-capacity (v/c) ratios, and vehicle speeds throughout a given network.

The IDAS evaluation depends on a number of assumptions that affect the calculations of costs and benefits. The IDAS developers recommend that these assumptions be inspected by local agencies and adjusted to better represent local conditions. The assumptions about the impacts on VMT, VHT, v/c ratios, and vehicle speed are particularly important. Consequently, suggestions are made within this report for adjustments that WSDOT should make to these default values. These values will allow the WSDOT to successfully employ IDAS for ATIS evaluation.

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EXECUTIVE SUMMARY

It is generally believed that advanced traveler information systems (ATIS) are among the most cost-effective investments that a transportation agency can make. The goal of these strategies is to provide travelers with information that will facilitate their decisions concerning route choice, departure time, trip delay or elimination, and mode of transportation. Agencies usually employ a variety of ATIS methods to reach different travelers. Despite the popularity of ATIS projects, there is no reliable and defensible method for evaluating the benefits of such projects. The following report describes current ATIS practices and evaluation methods. An evaluation method called the ITS Deployment Analysis System (IDAS) is suggested for use by the Washington State Department of Transportation (WSDOT).

Every state in the U.S. incorporates some form of ATIS. Across the country cities collect information with varying levels of sophistication, from simple highway patrol reports to complex systems of camera surveillance and electronic traffic sensors. Likewise, the means of disseminating the information varies. The most common dissemination methods are highway advisory radio, variable message signs, and telephone information services. A growing number of cities also provide Web/Internet sites and personal data assistant-type in-vehicle devices for traveler information.

The benefits of ATIS projects can be evaluated through field studies, simulation software, and surveys. Field studies provide reliable, defensible results; however, they are extremely expensive and difficult to execute. The use of simulation software offers a simple, inexpensive alternative to field studies. There are a variety of simulation

methods, yet none produces detailed results, nor do any claim to provide a completely accurate evaluation. Surveys are useful for customer satisfaction but do not provide the quantifiable conclusions necessary for benefit/cost analysis.

The simulation methods are the most practical and the IDAS method, which is endorsed by the U.S. Department of Transportation, is the most promising. IDAS is a "sketch" planning tool intended for screening and prioritizing all intelligent transportation systems (ITS) projects (not just ATIS projects). The software evaluates a number of benefits. These are determined by changes attributable to the deployment of ITS in vehicle miles traveled (VMT), vehicle hours traveled (VHT), volume-capacity (v/c) ratios, and vehicle speeds throughout a given network. Table ES-1 shows the benefits that IDAS evaluates.

Table ES-1. The Benefits Evaluated by IDAS

Benefit	Determined by the change in
In-Vehicle Travel Time	VHT
Out-Vehicle Travel Time	VHT
User Mobility	VHT
Travel Time Reliability	VMT, v/c ratio
Internal Accident Costs (paid by traveler)	VMT, v/c ratio
External Accident Costs (paid by society as a whole)	VMT, v/c ratio
Fuel Costs	VMT, vehicle speed
Vehicle Emissions (HC/ROG, NOx, CO, PM10, CO2, Global Warming)	VMT, vehicle speed
Noise Impact	VMT

The IDAS evaluation depends on a number of assumptions that affect the calculations of the costs and benefits. The IDAS developers recommend that these assumptions be inspected by local agencies and adjusted to better represent local conditions. The assumptions about the impacts on VMT, VHT, v/c ratios, and vehicle speed are particularly important. Consequently, suggestions are made within this report for adjustments WSDOT should make to these default values. These values will allow the WSDOT to successfully employ IDAS for ATIS evaluation.

1. INTRODUCTION

It is generally believed that information-based intelligent transportation systems (ITS) strategies are among the most cost-effective investments that a transportation agency can make. These strategies, also called advanced traveler information systems (ATIS), include highway advisory radio, variable message signs, telephone information services, Web/Internet sites, kiosks with traveler information, personal data assistant-type devices, and in-vehicle devices. Many other technologies are available now or soon will be to assist people with their travel decisions. Despite the ever popular use of ATIS, the Washington State Department of Transportation (WSDOT) does not currently employ a reliable and defensible method for evaluating the benefits of these strategies. Without a means to demonstrate quantifiable benefits, ATIS projects will have difficulty obtaining transportation resources on a competitive basis with more traditional transportation projects, such as highway capacity expansion or safety projects.

The goal of ATIS is to provide travelers with information that will facilitate their decisions concerning route choice, departure time, trip delay or elimination, and mode of transportation. This goal is accomplished in two steps: the collection of data and the dissemination of the data as useful information. The collection of data often requires a complex system of camera surveillance, airborne traffic reporters, highway patrol reporters, traffic queue detection devices, and other electronic traffic sensors. Such a system can be rather expensive. Fortunately, the data serves more than traveler information needs. In fact, data collection systems are usually installed for operations purposes, and traveler information is an added bonus. A number of dissemination methods can be used with an existing system with low marginal costs. Agencies usually employ a variety of methods, since each method is able to reach a different portion of travelers.

The purpose of this project was to find an acceptable way to evaluate the benefits of ATIS projects for the WSDOT. In particular, the project sought a viable means to compare dissemination strategies with each other and with non-ATIS improvements.

The following chapter discusses the state-of-the-art in ATIS. Chapter 3 presents a brief description of current ATIS evaluation methods, all of which, unfortunately, have limitations. One method, called the ITS Deployment Analysis System (IDAS), is recommended and described in Chapter 4. Chapter 5 presents the impact assumptions that IDAS makes for each dissemination method. Chapter 6 provides conclusions and further recommendations concerning the use of IDAS.

2. STATE-OF-THE-ART IN ATIS

The ATIS field has been growing progressively since its first introduction. Currently, all of the states in the U.S. incorporate ATIS in their transportation information networks, and there are many examples of the use of ATIS throughout the world. Below are descriptions of some prominent ATIS programs.

One of the major U.S. investments in ITS was a program labeled the Metropolitan Model Deployment Initiative (MMDI). It was established in 1996 and sponsored by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). Within the program, public and private partnerships existed to provide transportation management systems, including traveler information. Wilbur (1999) gave a good overview of the four sites selected for the MMDI: Seattle, Wash., Phoenix, Ariz., San Antonio, Texas, and the greater New York Metropolitan area (New York City, southwestern Connecticut, and northern and central New Jersey). In Seattle, the MMDI project evaluated the WSDOT's traffic conditions website, shown in Figure 2-1. The site provides a variety of information, such as travel times between different points in the region and a freeway map of traffic flow, labeled with different colors for different levels of congestion.

Figure 2-1. WSDOT Traffic Flow Website

In Phoenix, AzTech was created, an organization with public and private partners to help promote ITS within the area. The ATIS components that AzTech launched include information kiosks displaying traveler information; traffic updates that can be sent to an individual's phone, personal data assistant (PDA), pager, fax, or e-mail for a route he or she specifies; and dynamic or variable message signs (DMS or VMS) that relate incidents or congestion along corridors to drivers. The San Antonio District of the Texas State Department of Transportation developed an ITS project known as TransGuide. It consists of a website that displays travel times and a freeway traffic map, similar to Washington's. In addition, the travel map includes the location of VMSs and whether they are active, as well as locations of major and minor accidents and lane closures. The New York program, known as Trips123 (originally known as iTravel), has had difficulty starting up. Currently, Trips123 is not accessible to the public. It is intended to eventually consist of three parts: a traveler information center that has phone and internet components that make real-time traveler information available 24 hours a day; a transit advisory system that will create transit itineraries for different origins and destinations; and a fee-based personal traveler service that will alert travelers by e-mail, phone, or pager of traffic alerts along a route that they specify (Werner 2002).

Another major ATIS project is SmarTraveler, which is available in multiple cities across the U.S., including Boston, Mass., Palm Beach and Miami, Florida, Camden, N.J., and Philadelphia, Penn.. It is run by a private company that has partnerships with public agencies to obtain traffic information. For each location, highway and freeway real-time traffic information is available on a website. The site also provides information for airports and transit agencies, such as rail or subway conditions and route service changes.

ATIS projects have also been deployed in other parts of the world, such as PROMISE in Europe. PROMISE (Personal Mobile Traveler and Traffic Information Service) is an ATIS in development for use in several European countries, including Finland, Sweden, Great Britain, the Netherlands, France, and Denmark. Information is provided through a mobile device, in some instances two mobile devices. Examples of these devices are pictured in Figure 2-2. The devices can access the Internet for or receive text messages about a variety of information, including trip planning information, travel information, yellow pages, bus stop timetables, maps, and flight delays. However, not all the information is available for the devices in each of the different locations, as the service providers differ among countries.

Figure 2-2. PROMISE ATIS devices: Ericcson MC 12 (left) and Nokia 9000i

There are many other ATIS services in Europe. Rupert *et al.* (2003) reviewed a number of them. In Madrid, Spain, DMSs are used on the M-30 (inner beltway) to display travel times to the next three exits to drivers (City of Madrid 2004). In addition, a website is available that shows a map of real-time traffic in Madrid (http://www.cities.munimadrid.es/mapatraficovi.asp).

Another example is in Munich, Germany, which has an information system called BayernInfo (2003). A website offers real-time information on a map (similar to the WSDOT's map shown in Figure 2-1) and route planning services for travel in the city (http://www.bayerninfo.de). Yet another example is Trafik Stockholm, a transportation management center that also offers a website providing much of the same information as other traffic websites: a congestion map and route planning services (www.trafiken.nu) (Trafik Stockholm 2004).

In addition to the currently operating projects that have been operating for several years, other products are emerging to help travelers receive information. One is TrafficGauge, shown in Figure 2-3, a mobile device that displays the WSDOT traffic flow map on a small screen. Instead of color, it uses solid and blinking lines to identify congested traffic areas on the state's Puget Sound freeway network. The data are provided by the WSDOT and are broadcast every 4 minutes to each of the devices. Drivers can mount the device in their car or take it with them to check on traffic conditions (TrafficGauge 2003).

Figure 2-3. TrafficGauge Mobile Device

With all the technologies being developed, ways to measure the benefits for these technologies are also being developed. The next section describes research conducted to evaluate the benefits of ATIS.

3. ATIS EVALUATION METHODS

To evaluate any form of ITS, goals must be set so that the benefits of the technologies can be measured; the U.S. Department of Transportation (USDOT) defined six goals for ITS technologies (USDOT 2004). The metrics for these goals were also defined and are listed in Table 3-1 according to the ITS goal to which they correspond (Lockheed Martin 1996). Several of these metrics were considered for the purposes of measuring ATIS technologies, and they can be broken down into three categories: field studies, simulation, and surveys. Field studies involve putting drivers with and without ATIS on the roads and determining the differences in travel times between them; simulation studies show the potential benefits that could occur if ATIS were used at a certain location(s); survey studies poll ATIS users to determine what ATIS benefits they perceive, both qualitatively and quantitatively.

Field Studies

Measuring ATIS benefits through field studies is most often done with yoked trails, in which two vehicles (one equipped with ATIS and one not) travel between the same origin-destination (O-D) pair at the same time, each vehicle with a different level or type of information (including none). Some studies have incorporated three vehicles, each with varying degrees of information. The time it takes these vehicles to travel between each O-D pair is then evaluated to determine whether the vehicle with ATIS had a shorter travel time than the other driver(s). Several field studies were conducted in the 1990s, though they are not as popular currently because of their costs.

Table 3-1. USDOT Benefits Metrics

ITS Goal	Related Metric
Increase Transportation System Efficiency and Capacity	Traffic Flows/Volumes/Number of Vehicles Lane Carrying Capacity Volume to Capacity Ratio Vehicle Hours of Delay Queue Lengths Number of Stops Incident-related Capacity Restrictions Average Vehicle Occupancy Use of Transit and HOV modes Intermodal Transfer Time Infrastructure Operating Costs Vehicle Operating Costs
Enhance Mobility	Number of Trips Taken Individual Travel Time Individual Travel Time Variability Congestion and Incident-related Delay Travel Cost Vehicle Miles Traveled Number of trip end opportunities Number of Accidents Number of Security Incidents Exposure to Accidents and Incidents
Improve Safety	Number of Incidents Number of Accidents Number of Injuries Number of Fatalities Time Between Incident and Notification Time Between Notification and Response Time Between Response and Arrival at Scene Time Between Arrival and Clearance Medical Costs Property Damage Insurance Costs
Reduce Energy Consumption and Environmental Costs	NO_X Emissions SO_X Emissions CO Emissions VOC Emissions Liters of Fuel Consumed Vehicle Fuel Efficiency
Increase Economic Productivity	Travel Time Savings Operating Cost Savings Administrative and Regulatory Cost Savings Manpower Savings Vehicle Maintenance and Depreciation Information-Gathering Costs Integration of Transportation Systems
Create an Environment for an ITS Market	ITS Sector Jobs ITS Sector Output ITS Sector Exports

Inman *et al.* (1995) used the TravTek system in Orlando for a study involving three vehicles traveling at the same time (by 2-minute intervals) between the same origins and destinations. To collect travel information, the TravTek system vehicles sent updates every minute back to a transportation management center. The center, in turn, broadcast updated travel times to the vehicles. For the study, one of the test vehicles was equipped with a Navigation Plus configuration, which provided real-time traffic information for route planning. The second vehicle was configured with Navigation, which could plan a route, but not with real-time information. The third vehicle was the control vehicle, in which drivers would plan a route as usual, such as with a map or a list of instructions. The drivers who participated were mostly people unfamiliar with the transportation network who were vacationing in the Orlando area. While an 80 percent time savings in travel planning time (preparation time) was observed for drivers unfamiliar with the area who were traveling to a new, hard-to-find destination, no benefit was observed for individuals who had real-time traffic information. The authors suggested several reasons for this, including drivers' unfamiliarity, the availability of only one limited access road, the short distances between the origin and destination pairs, and the limited number of major alternative arterials.

Simulations

Modeling Tools

Simulation-based evaluations, often using data from travel demand models or archived real-time traffic data, are an alternative to field studies. They demonstrate what would happen if ATIS were implemented in a transportation network and predict the potential benefits. Several methodologies have been created to measure ATIS benefits, including SCRITS, IDAS, PREUVIIN, and HOWLATE.

SCRITS (Screening for ITS) is a spreadsheet analysis tool developed in the mid-1990s by Science Application International Corporation for the FHWA. It was one of the first tools created to measure the benefits of ITS technologies, and it is intended to be used only at a screening level, not for in-depth analysis. The user inputs different variables, such as vehicle miles traveled (VMT), vehicle hours traveled (VHT), and market penetration percentages for different types of ITS, and the software calculates benefits through time saved, accident reduction, emissions, and a number of other variables. This tool was a basis for the development of IDAS.

IDAS is a sketch planning tool created for the FHWA by Cambridge Systematics in the late 1990s to calculate the benefits and costs of implementing an ITS technology within a transportation infrastructure. The software uses output from an existing transportation planning model, then the user can select one or several ITS deployment alternatives to evaluate. IDAS will calculate the benefits and costs of deploying the specified ITS alternatives. The software can analyze over 60 types of ITS strategies, 11 of those related to traveler information. The ATIS benefits are measured with VHT. A survey conducted of 76 metropolitan planning organizations (MPOs) showed that over 50 percent had not heard of IDAS, and of the MPOs that had heard of the software (43 percent), only 24 percent had used the software in a project (Yun and Park 2003).

PRUEVIIN (Process for Regional Understanding and Evaluation of Integrated ITS Networks) is a framework to be used with travel demand models and simulation software to measure the costs and benefits of ITS projects. It was created in the late

1990s by Mitretek Systems for the USDOT. The framework uses some of the metrics listed in Table 3-1 for measuring benefits and costs, including travel time variability, the probability of a severely delayed trip, and the number of stops per vehicle-km traveled. It is to be applied to a regional model and sub-area (smaller) simulation model. The impacts of ITS technologies are generated at the sub-area level, then expanded to the region. This is done with several alternatives, which can be specified by the user. A case study was conducted in the Seattle region to demonstrate the PRUEVIIN framework. Several alternatives were chosen as changes to the baseline (do nothing) alternative, including single occupancy vehicle (SOV) modifications, high occupancy vehicle (HOV) modifications, SOV plus ITS, and HOV plus ITS. The alternatives with ITS tested a number of technologies, including several ATIS. These technologies consisted of VMSs, information kiosks, and highway advisory radio (HAR) in the study area. When the SOV and the SOV plus ITS alternatives were compared, the latter resulted in an average delay reduction of 2.2 minutes per traveler per day, as well as an increase in annual AM peak period throughput from 168,338 veh/day for the SOV to 185,565 veh/day for the SOV plus ITS alternative.

A recent simulation method called HOWLATE (Heuristic Online Web-Linked Arrival Time Estimator) was created by Mitretek Systems. Wunderlich *et al.* (2001) explained the process in a report of a Washington, D.C., case study. The model uses simulated yoked pairs traveling between specified origin and destination (O-D) pairs, one of which has ATIS and one that does not. The simulation extracts traffic data every 5 minutes from an Internet service provider that records link travel times on various roadways. The first step of the simulation is to establish the routes and departure times for the ATIS traveler and the non-ATIS traveler. Once the routes and departure times have been chosen, the second step consists of using the archived data to construct actual travel and arrival times in traffic conditions during the date and time used for simulation. While many yoked-pair studies have drivers depart at the same place and time, HOWLATE focuses on the destination and target arrival time of the yoked pairs.

The HOWLATE method focuses on measuring travel time reliability. The first case study found that the ATIS user had the smallest monthly average for late schedule delay (the amount of time after the target arrival time that the driver arrived at the destination), at 2 minutes a month. The conservative non-user (habitually has early start times to avoid late arrival) had an average late schedule delay of 6 minutes a month, and the aggressive non-user (habitually has late start times) had 24 minutes a month. A more recent case study for Washington, D.C., compared the benefits of radio broadcast advisories and formal, route-specific ATIS. This study concluded that ATIS users had 13 percent greater on-time reliability than radio listeners for the AM peak period and 5 percent greater on-time reliability for the PM peak period. This was most likely due to the sporadic and inconsistent information provided by radio broadcasts (Vasudevan 2005).

A few researchers have developed abstract theoretical models to assess ATIS benefits. Wahle et al. (2002) formulated a hypothetical two-route network for ATIS users and non-ATIS users. The ATIS users chose their route on the basis of travel time predictions relayed back to them from vehicles exiting the network (a floating car travel time prediction). Non-ATIS users chose their route on the basis of probabilities. Travel time savings were not achieved for the ATIS users. The study also showed that volumes, speeds, and travel times exhibit an oscillating effect as a result of ATIS use. Levinson (2003) conducted a similar study using economic theory for route choice. In this study, however, travel time savings were achieved for both ATIS users and non-ATIS users. Levinson (2003) preceded his work with a review of eleven other studies (all theoretical simulations) that demonstrated travel time savings.

At the 85th Transportation Research Board (TRB) meeting, Balakrishna et al. (2005) presented the framework for a simulation-based laboratory for ATIS evaluation. The lab integrates a microscopic simulation package, MITSIMLab, with a dynamic network assignment model, DynaMIT, to simulate the effects of route guidance. Initial tests of the system focused on the phenomenon of overreaction, the shift of congestion to other routes as a result of ATIS information. Balakrishna et al. suggested that overreaction can be reduced through improved travel time prediction methods and more frequent updates.

Puget Sound Example

A simple simulation was executed to evaluate travel time benefits from the WSDOT Traffic Information website. The WSDOT site presents travel time predictions for selected commutes in the region. The predictions, which are updated every 5 minutes, are based on the historical travel times for the particular time of day and real-time loop detector data collected along the commute. The simulation modeled three commuters traveling from Bellevue to Seattle during the evening rush hour. The commuters used either I-90 or SR 520 to complete the commute (see Figure 2-1). The travel times of the three commuters were compared to determine travel time savings.

The three commuters were as follows:

- Commuter A (Non-ATIS user): Leaves work at 5:15 pm every day. Takes the I-90 route because it has a historically shorter travel time.
- Commuter B (ATIS user, route change only): Checks the WSDOT website every day at 5:00 PM and leaves at 5:15 PM using the route with the shortest predicted travel time as displayed at 5:00 PM.
- Commuter C (ATIS user, change/delay): Checks the WSDOT website every day at 5:00 PM. If the predicted travel time of both routes is above a pre-defined threshold (120 percent of normal), then the commuter waits until 5:30 PM, checks the website again, and leaves at 5:45 PM using the route with the shortest travel time as displayed at 5:30 PM. If at 5:00 PM the travel time of one of the routes is not above the threshold, then the commuter uses that route, leaving at 5:15 PM.

The actual travel times for the three commuters were determined *a posteriori* by using archived loop detector data (Avery et al. 2003). The decisions made by the ATIS users were based on the predicted travel times posted on the WSDOT site. Data from 2003 were used for the simulation. Weekends and days with data errors were removed, leaving 244 days of analysis for the Bellevue to Seattle evening commute.

The simulation revealed that ATIS influenced commuter B to choose a different route 80 times (33 percent). Of those 80 trips, 43 resulted in shorter travel times. Consequently, commuter B benefited from ATIS use in 17.7 percent of the evening commutes examined. For the 80 times in which ATIS influenced route choice, the mean travel time for commuter B was 1.25 minutes shorter than for commuter A (one-sided paired t-test, std. dev = 4.39, 95 percent confidence: p-value = 0.007).

Commuter C altered travel plans because of ATIS 86 times (35 percent). Delayed departure occurred 36 times. In comparison to commuter A, ATIS usage resulted in a shorter travel time for commuter C in 46 trips (18.9 percent), with an average travel time savings of 1.35 minutes (one-sided paired t-test, std. dev = 4.41, 95 percent confidence: p-value = 0.003). Interestingly, in quite a few instances (15 percent of 244 trips), ATIS use resulted in longer travel times (although the difference was less then 5 minutes in all cases).

Although the simulation revealed valuable information about travel time savings from ATIS use, the methodology had a number of limitations. Note that the study deliberately only considered the Bellevue to Seattle evening commute. This simplification excluded the mode choice and trip elimination decisions faced by morning commuters and non-commuters throughout the day. Furthermore, the Bellevue to Seattle commute presents only two viable route alternatives because it entails crossing Lake Washington on either I-90 or SR 520. Consequently, it would be difficult to apply this methodology to ATIS users who make mode choices, trip elimination choices, and a variety of route choices. To understand the full meaning of the results from this simulation, further investigation would be needed to understand who uses the website and how it is used. This simulation illustrated the complexities of ATIS evaluation.

Surveys

Surveys involve polling the public about a particular technology, including whether they know it exists, what they perceive it does for them, and how much they do or would be willing to pay for a certain technology. Surveys are typically broken into two sub-categories, user perception and willingness-to-pay (WTP). The perception study is a more qualitative approach, while the WTP study measures quantitative results.

User Perception

While perception is a difficult thing to measure, a number of studies have conducted surveys in which participants responded that ATIS helped them save time, reduce stress, or arrive on time. One such study, conducted in the late 1990s for SmarTraveler in Boston and reported by Ullman *et al.* (2000), surveyed 2,000 users of the system. The study found that 68 percent of users experienced reduced frustration from using the service; 63 percent stated they were able to avoid traffic problems; 59 percent stated they saved travel time; and 51 percent stated that the service aided them in arriving on time.

Yim (2000) conducted a study on the TravInfo system in San Francisco, which provides traveler information to privately run traffic websites. A survey was conducted of website users for the three websites that used TravInfo data at the time of the study. The findings of this study are interesting: of the participants who learned about congestion, 80 percent of them changed their travel behavior. Of those who changed travel behavior, over half (58.8 percent) stated that it helped them save travel time, with an average travel time savings of about 20 minutes. However, only 9.6 percent of all participants stated that the website information helped them save time, and even fewer (5.6 percent) said that the information reduced stress and/or anxiety.

In the final report for the Seattle MMDI, Jensen *et al.* (2000) reported on a survey that was conducted for the WSDOT website. A survey popped up for users of the website, who could then decide whether to participate. Of the users who participated, 93 percent stated that using traffic information on the WSDOT website helped them save time. In addition, roughly one-third of the respondents stated that they used the website to help them stay clear of unsafe driving conditions, and nearly three-quarters agreed that use of the site helped them reduce the amount of stress associated with traveling in the greater Seattle area.

User perception surveys produce results that cannot be easily generalized, nor do they allow a quantifiable evaluation of benefits. At the most recent annual TRB meeting, Lee et al. (2005) presented a fuzzy logic methodology for evaluating perception surveys. The approach seeks to account for the variability and complexity of human perception. Lee successfully formulated fuzzy concepts that could be applied to a survey concerning driver perception of VMSs; however, the authors admitted that the technique needs further investigation. In general, user perception surveys tend to reveal driver satisfaction. However, quantifying perceived time savings is an extremely difficult task. Jung et al. (2003) pointed out that while users may perceive a high time savings, the actual time savings may be minimal.

Willingness-To-Pay

These studies focus on a driver's willingness-to-pay (WTP) for traveler information. It can also be referred to as stated preference, in which people being surveyed state what they believe they would do given the situation presented in a particular question. Different studies have yielded different results.

Polydoropoulou *et al.* (1997) reported on two studies done for SmarTraveler in Boston; one study focused on SmarTraveler users, the other on non-users introduced to SmarTraveler. The service was free at the time of the study, and participants were asked their willingness to pay for the service under two different pricing scenarios: a per-call service charge and a monthly service charge. The survey arrived at mixed but fairly positive results. Of the non-users, 32 percent said they would make 1 to 4 calls per week at a rate of $0.10 a call; 20 percent would make the same number of calls at $0.25 per call; and 24 percent would call at a rate of $0.50 per call. The perceived usage dropped off severely at a higher number of calls per week: only 6 percent said they would make 10 or more calls a week at a rate of $0.10 per call. The users had higher percentages, with 42 percent stating they would call 1 to 4 times weekly at a charge of $0.10 per call. As the service charge rose, the percentages dipped somewhat: 36 percent said they would call with a $0.25 per call charge, 28 percent would call with a $0.35 per call charge, and 21 percent would call with a $0.50 per call charge. The percentage of people who believed they would make 10 or more calls per week at $0.10 was actually less than non-users, at 5 percent.

For a monthly charge, 40 percent of non-users said they were very unlikely to use SmarTraveler with a monthly service charge of $2.50. However, 24 percent said they were somewhat likely to use the service with a monthly charge of $2.50, and 17 percent said they were very likely. At a service charge of $15.00 per month 80 percent said they were very unlikely to use SmarTraveler, with only 7 percent saying they were somewhat or very likely to use the service. Users were slightly more willing to pay. At a rate of $2.50 per month, 20 percent were somewhat likely to use the service, and 23 percent were very likely. At a rate of $15.00 per month, a huge 93 percent said they were very unlikely to use the service, which is 13 percent more than non-users.

Ojala *et al*. (January 1999) put together results from studies of the European PROMISE ATIS. Five test sites were reported on: Finland, France, the Netherlands, Sweden, and The United Kingdom, with different amounts of traveler information being provided within the different countries. The results showed that despite these varying levels of service, customers were still willing to pay for the service. The amounts varied, however. In Finland the average amount participants were willing to pay monthly was 5.00 (~$6.14 U.S.). In France the average amount was lower, at 2.50 a month (~$3.07 U.S.). The Netherlands had a higher rate, but most participants preferred a different payment plan, with a monthly average rate of 11.20 (~$13.76 U.S.) plus a pay-per-use fee of 0.18 (~$0.22 U.S.). The average monthly fee Swedish participants were willing to pay was 7.60 (~$9.34 U.S.), and in the U.K., 68 percent would pay a maximum of 7.50 per month (~$9.21 U.S.).

A study conducted by Khattak *et al.* (2000) in the San Francisco area looked at the free Traveler Advisory Telephone System. The average number of calls a typical user placed to the system was 4.8 times a month, with 30 percent of the population being cell phone users who were charged for using a cell phone. On the basis of participants' stated preference, if customized service was available at $0.25 per call, average use of the service would increase to 7.09 times per month, a rise of over two calls per month per user from the existing system. However, if the charge were increased to $0.50 or $0.75, average use would decrease to 4.36 times per month or 1.75 times per month, respectively.

While WTP studies do offer insight into how much people potentially value the system, often what a person thinks he will do and what he actually does are two different things. This makes it hard to measure benefit through WTP research.

Thus far many different approaches for measuring benefit of ATIS have been reviewed: field studies, simulation studies, and surveys, including user perception and willingness-to-pay. Though all of these methods provide a means for measuring ATIS technologies, some have become outdated (like SCRITS), others are costly (like the yoked-pair field studies), and still others are difficult to expand to additional metropolitan areas (like HOWLATE). For these reasons, IDAS was explored in greater detail and chosen as the best methodology for evaluating ATIS technologies.

4. IDAS

None of the current ATIS evaluation methods can provide a detailed evaluation; however, for a preliminary evaluation, IDAS is the most effective. The developers of IDAS remind the user that the program is a "sketch" planning tool and, therefore, intended for screening and prioritizing ITS alternatives. This chapter lists some of the reasons that IDAS is preferred over the other methodologies. This is followed by a description of the IDAS methodology and a brief summary of a few recent applications.

Advantages

For sketch planning, IDAS is preferred for a variety of reasons. The key reasons are described below.

- *Sponsored by USDOT* – IDAS was developed at the request of the FHWA. Consequently, research and development is assured to continue. In fact, Cambridge Systematics has been awarded an Indefinite Quantity Contract to provide continued maintenance for the software. The definitions and concepts found in IDAS conform to the National ITS Architecture, and the output meets the requirements of the U.S. DOT's ITS Evaluation Guidelines and other federal requirements, such as those of the Environmental Protection Agency.
- *Progressive software* – The IDAS program will continue to advance through the release of updated versions, and the methodologies are sure to be improved according to the latest research. The development of IDAS is supported by the ITS Benefits and Costs Database, which is maintained by the ITS Joint Program Office.

- *Inexpensive software* – The latest version of IDAS can be purchased from McTrans Software Center at the University of Florida for $795.
- *User friendly* – IDAS runs in a Windows environment with click and drag capabilities. The various application modules are straightforward and easily managed. An FHWA-sponsored course is available through the National Highway Institute.
- *Uses data that are readily available* – The input for IDAS are travel demand data (including a link-node network), ITS deployment data, and a set of assumptions for the evaluation. (Default values are given for all the assumptions, but the software developers recommend the use of values based on local conditions. The next chapter presents the assumptions associated with the ATIS components.)
- *Compatible with the leading travel demand forecasting models* – IDAS operates as a post-processor to a travel demand forecasting model. It is readily compatible with TRANPLAN, EMME/2, MINUTP, and others packages.
- *Evaluates other ITS components* – IDAS can analyze the benefits of 69 ITS treatments, 11 of which are information-based components. It can also analyze a user-defined "generic" component.
- *Best alternative* – The other evaluation methods have a number of costly disadvantages. Field studies are extremely difficult and expensive, surveys do not produce reliable, useful results beyond evaluating customer satisfaction, and other methods of simulation are not as effective as IDAS. Other programs designed for ITS evaluation are either outdated, such as SCRITS, or difficult to execute for certain cities, such as HOWLATE.

Evaluation Methodology

The IDAS evaluation follows the flowchart shown in Figure 4-1. The evaluation begins with input that is the output of a travel demand model, most importantly link-node and origin-destination demand data. IDAS uses this information to calculate standard transportation measures for the base case or "control alternative." These measures include VMT, VHT, volume-capacity (v/c) ratios, and vehicle speeds. The same measures are calculated for the proposed plan or "ITS alternative" with consideration of the impact from the ITS deployment. The difference in the two calculations represents the change in the network as a result of the ITS components. In turn, these changes are used to calculate the benefits (and the costs) associated with the proposed plan (Cambridge Systematics 2004).

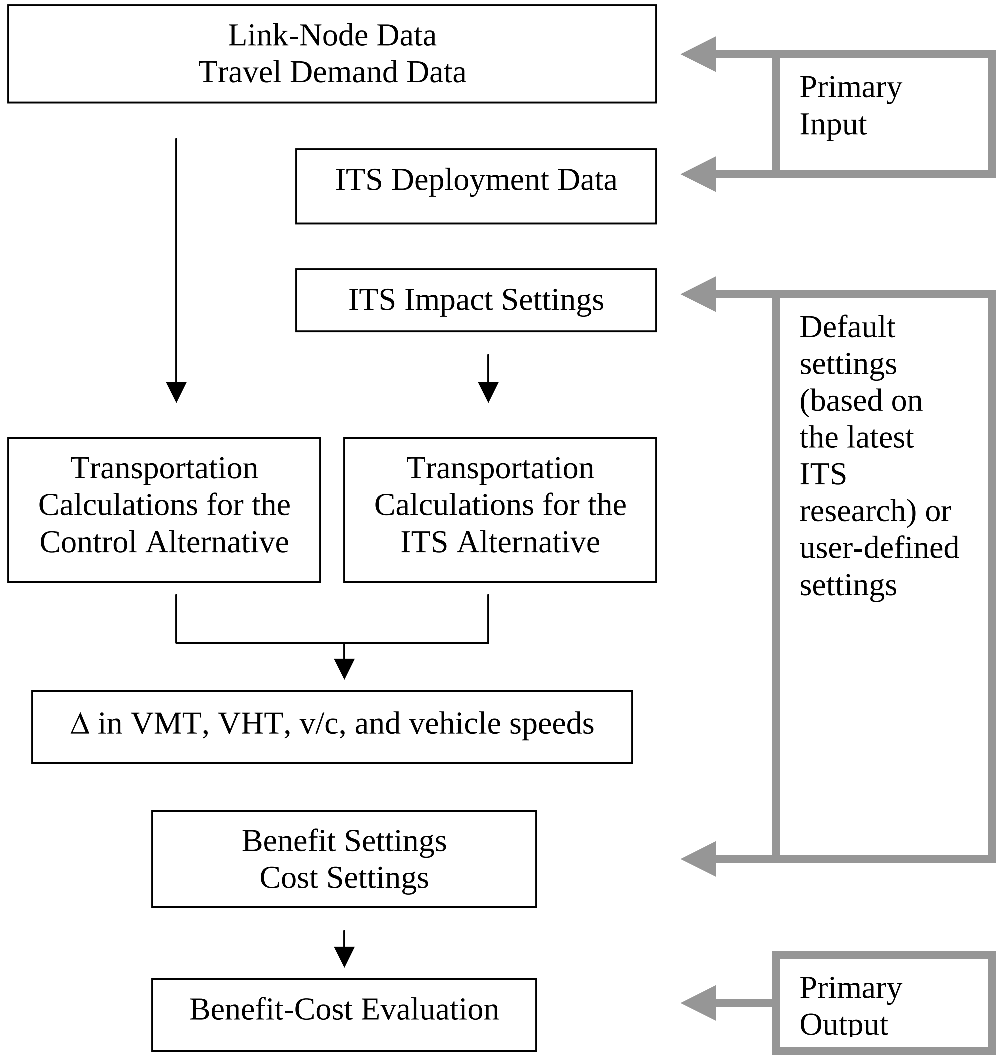

Figure 4-1. Flowchart for IDAS Benefit Evaluation

Table 4-1 shows the benefits that are evaluated by IDAS and the influence that each traffic measure has on the evaluation. Note that the benefits have been categorized in accordance with the U.S. DOT's recommended ITS goals (see Chapter 3).

Table 4-1. The Benefits Evaluated by IDAS

ITS Goal	Benefit	Determined by the change in
Efficiency and Capacity	In-Vehicle Travel Time Out-Vehicle Travel Time	VHT VHT
Mobility	User Mobility Travel Time Reliability	VHT VMT, v/c ratio
Safety	Internal Accident Costs (paid by traveler) External Accident Costs (paid by society as a whole)	VMT, v/c ratio VMT, v/c ratio
Energy and Environmental Costs	Fuel Costs Vehicle Emissions (HC/ROG, NOx, CO, PM10, CO2, Global Warming) Noise Impact	VMT, vehicle speed VMT, vehicle speed VMT

The ITS impact settings, benefit settings, and the cost settings shown in Figure 4.1 are the most critical components of the IDAS methodology. These settings are primarily rates. For example, the calculations made for the deployment of HAR can be summarized as follows:

Impact: Reduction in VHT per HAR-equipped corridor

Benefit: Increase in $ saved by the traveler and society per reduction in VHT

Cost: Increase in $ spent by the agency per HAR unit employed

All of the settings have default values based on the latest ITS research (the impact default values for the 11 ATIS components are presented in Chapter 5). The IDAS developers strongly recommend that these "national" default values be used only if local values are not available. The software includes an "ITS Benefits Library," which contains the research that was used to determine the default values. The developers encourage the analyst to use the library as a reference in developing local settings.

In addition to the default values, IDAS makes three significant assumptions concerning ATIS components:

1. ATIS components are most beneficial during non-recurring congestion.
2. The impact that ATIS components have on route diversion, temporal diversion, and mode shift are insignificant in comparison to the impact on time savings.
3. The decrease in VMT that ATIS causes on preferred routes (freeways) is offset by increased VMT on alternative routes (arterials).

Consequently, IDAS does not evaluate ATIS in the same way that it evaluates other ITS components. Most of the other ITS components influence traffic assignment, but ATIS components do not. In other words, the traffic assignment for a network with ATIS components is identical to the control alternative's traffic assignment. IDAS simply reduces the calculated VHT according to the ATIS deployment. This "time saving" benefit is considered three times more valuable than the VHT reduction achieved by other components because the avoided delay is unexpected and thus more "expensive." IDAS reports this benefit under the category User Mobility, but it has been suggested that this benefit is better understood as a measure of travel time reliability (Heither and Thomas 2003).

The IDAS evaluation recognizes the complexities associated with "pre-trip" components and components that offer route guidance. Pre-trip components, as opposed to "en-route" components, provide information before the trip. This makes them potentially more powerful because they can influence route selection, departure time, trip elimination, and mode choice. Components with route guidance capabilities, although they are en-route devices, are equally powerful because they can influence route selection. The irony of ATIS is that drivers are often diverted to the same route, in turn causing congestion on the new route. This is a phenomenon called the "hunting effect." IDAS compensates for the hunting effect by reducing the potential savings in delay as the market penetration increases (see the default values presented in Chapter 5 for the pre-trip components and components with route guidance).

Case Studies

The development of IDAS has followed a "rapid prototyping" schedule that has included seven case studies. The first three case studies were "beta testers" for an early version of IDAS. These early studies were conducted by the MPOs of Chicago, Tucson, and San Francisco (McHale 2000). The MPOs provided valuable insight, which prompted the FHWA to sponsor four more case studies. Three of the latter four case studies involved projects with ATIS components. The lessons learned from these three case studies are presented below (Cambridge Systematics 2003).

Case Study 1

Ohio-Kentucky-Indiana Regional Council of Governments' Evaluation of ARTIMIS and ITS Program Plan. January 2002

ARTIMIS, the Advanced Regional Traffic Interactive Management Information System, in the Cincinnati, Ohio, region is considered a pioneer in ITS. ARTIMIS covers parts of Ohio, Kentucky, and Indiana and is managed by the MPO covering the region, called OKI. The system comprises a variety of ITS components, including four ATIS components: HAR, a telephone service, a Web service, and DMSs. OKI and its partner agencies used IDAS to evaluate the benefits associated with ARTIMIS. The evaluation determined that the ATIS components of ARTIMIS saved travelers 360 hours per day during the AM peak period and 500 hours per day during the PM peak period.

The lessons learned from the evaluation were enumerated by the IDAS developers as follows (Case Study 1, Cambridge Systematics 2003):

1. OKI did not have the staff resources available to prepare the travel demand model data in the format necessary for direct import into IDAS. However, the Tranplan files and OKI model documentation provided were well organized and thorough. The model data were easily converted [by a private consulting firm] into IDAS format through the use of TP+ and Viper, making the import into IDAS relatively seamless.
2. Impact values from local sources better represented conditions in the Cincinnati region than national default values available within IDAS.
3. Matching the ITS components [definitions and usage] in ARTIMIS with the components available in IDAS required careful consideration before use of IDAS, particularly the use of the components and possible synergies.
4. Agency review and approval of modifiable IDAS defaults, particularly impact values and benefits values (value of time, incident costs), is critical for confidence in and comfort with the results.

Case Study 2

Michigan Department of Transportation; Evaluation of the Temporary ITS for the Reconstruction of I-496 in Lansing, Michigan. April 2002

During the summer of 2001, the Michigan Department of Transportation (MDOT) completed a major repair/rebuild project on I-496 through downtown Lansing, Michigan.

The project required full closure of the Interstate for phase one and closure of one lane in each direction for phase two. The closures resulted in major changes in commuting patterns. To mitigate this disruption, the MDOT employed a variety of ITS components, including three ATIS components: a telephone service, a Web service, and DMSs. IDAS was used to evaluate the benefits associated with these mitigation efforts. IDAS demonstrated that the use of ITS greatly benefited the project. However, the benefits associated with the ATIS components were masked by the adverse conditions induced by the lane closures.

The lessons learned from the MDOTs experience with IDAS were enumerated by the IDAS developers as follows (Case Study 2, Cambridge Systematics 2003):

1. The availability of a regional travel demand model already updated for the base year of travel was very important to the success and credibility of the analysis.
2. Impact values from local sources better represented conditions in the Lansing region than the national default values available within IDAS. The default values are not necessarily reflective of smaller to mid-sized urban areas. As more information on ITS deployment in these areas is collected, it needs to be disseminated as widely as possible.
3. It is important to account for all cost components and elements of the program. This project started as an evaluation of the temporary mitigation efforts, but in the early stages of the project it became clear that arterial system improvements and a public relations campaign were critical to the success of the project, and they were incorporated into the analysis.

4. IDAS has demonstrated value in the evaluation of ITS alternatives for mitigation of major construction projects.
5. Adequate time must be provided to accommodate review by different departments. Even a relatively small evaluation project such as this one may require review by a number of different agencies and departments within those agencies. This review is needed so that the assumptions are accepted and that the deployments and operational strategies in place are reflected accurately in IDAS.

Case Study 3

Mid-America Regional Council's Enhanced Congestion Management System. July 2002

In 1999, the Mid-America Regional Council (MARC) began a project to reduce congestion and enhance mobility in the Kansas City, Missouri, region. The project, called Enhanced Congestion Management System (ECMS), involved a number of transportation improvements, including HAR, a telephone service, a Web service, and DMSs. IDAS was used to evaluate the benefits associated with the ECMS. The ECMS was also evaluated through the use of a regional travel demand model in conjunction with a transportation demand management model. The IDAS evaluation estimated annual benefits from the ATIS components to be $4,669,313.

The lesson learned from the use of IDAS, as presented by the IDAS developers, was as follows (Case Study 4, Cambridge Systematics 2003):

1. The strategies selected for evaluation in IDAS should take into consideration other ongoing activities in the analysis area. Future analyses will need to

assess the IDAS default impact values and adjust them as necessary to better reflect local conditions and ITS or operational components already functioning in the study area.

5. THE IDAS IMPACT SETTINGS

The accuracy of IDAS is dependent upon the calibration of the impact settings. This chapter presents recommendations for impact values to be used by WSDOT. The recommendations are based on ATIS studies that have been conducted in Washington and elsewhere. A few of the studies are listed in Appendix 1 with brief descriptions of the results.

Highway Advisory Radio

The WSDOT operates 55 highway advisory radio (HAR) transmitters, of which six are portable trailer units. The HAR system provides situational traveler information, so the majority of the transmitters are located in urban areas (for commuter congestion and non-recurring traffic), on mountain passes (for weather conditions), and near construction sites. The Federal Communication Commission (FCC) restricts transmission to .93 miles, but some receivers can pick up the signals for up to 3 miles. All of the traveler information provided by the service is disseminated by other ATIS components as well. Operation and maintenance costs, which do not include the cost to acquire the traveler information, are about $2,000 per year per transmitter. Purchase and installation costs are about $50,000 per transmitter (Pennington 2004).

The WSDOT should adjust the IDAS impact settings for HAR evaluation, as shown in Table 5-1. The percentage of time that beneficial information is transmitted should be adjusted according to the frequency of incidents on the route in question. For example, if the HAR is intended to service a mountain pass, then historical weather conditions and incident frequency data should be used to adjust this value. Studies conducted in Seattle and in Detroit, Michigan, have suggested that a high percentage of travelers use radio reports for traveler information (75 percent and 89 percent, respectively). However, the survey respondents most likely were referring to private radio broadcasts (PSRC 2004, Reed 2000). A study conducted for the Cincinnati, Ohio, region supported the 5 percent default value for HAR usage (Krista 2001). Often the intention of HAR is simply to inform drivers of severe conditions without expectations of time savings, especially if there are no alternative routes for the drivers. Therefore, the percentage of listeners who save time should be between 0 percent and 20 percent, depending on the intention of the broadcast. If the intention is to simply inform drivers, then an additional benefit should be added. This can be added as an annual monetary benefit. A different study for Detroit, Michigan, using simulation techniques produced results that support the 4-minute time savings default value (Shah and Wunderlich 2001).

Table 5-1. Highway Advisory Radio Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of time HAR provides beneficial information	10%	route specific
Percentage of vehicles that use HAR	5%	2%-7%
Percentage of listeners that save time	25%	0%-20%
Average travel time saved per traveler	4 minutes	4 minutes

Freeway Dynamic Message Sign

The WSDOT operates 145 permanent freeway dynamic message signs (DMS), also called variable and changeable message signs (VMS and CMS). All of the traveler information provided by the DMSs is disseminated by other ATIS components as well. Purchase and installation costs are about $75,000 to $125,000 per sign (Pennington 2004).

The impact settings should be adjusted by the WSDOT as shown in Table 5-2. Once again, the percentage of time that beneficial information is transmitted should be adjusted according to the frequency of incidents on the route in question. Field observations made in Nebraska and Japan showed a 4 percent increase in route diversion (McCoy and Pesti 2000, Atush *et al*. 1998). Since this is an appropriate indicator of usage, the default value for vehicles using the DMSs should be reduced from 28 percent to 4 percent. However, in addition to diversion decisions, drivers use DMSs for general cognizance of traffic conditions and to slow their speeds in the case of incidents or construction. Consequently, it is recommended that a 2 percent reduction in accidents be included with the impacts (Shah and Wunderlich 2001). The field studies in Japan illustrate that the average time saved should be adjusted for each corridor depending upon the potential for finding an alternative route. Corridors that offer many alternative routes should have time savings of up to 20 minutes. On the other hand, corridors with only a few alternative routes should have time savings of no more than 5 minutes (Atush *et al*. 1998).

Table 5-2. Freeway Dynamic Message Sign Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of time DMS provides beneficial information	10%	route specific
Percentage of vehicles that save time	28%	4%
Average travel time saved per traveler	11 minutes	5-20 minutes

Transit Dynamic Message Sign

WSDOT does not operate transit DMSs. For IDAS evaluation of transit DMS deployment the impact settings should be adjusted according to Table 5-3. The percentage of travelers who use transit DMSs is a measure of traveler familiarity with the route. This value should be lowered to 40 percent to reflect the number of travelers seeking transit information. If the DMS deployment is for a new route, the percentage should be increased. A study conducted at Acadia National Park in Maine showed that a high percentage of the tourists who used DMSs saved time (Daigle and Zimmerman 2003). Consequently, this value should be increased to at least 50 percent. There is insufficient research to support changes to the time savings value. However, a survey of transit users in Wisconsin revealed the need to add an additional benefit that accounts for customer satisfaction. In the survey 80 percent of the respondents ranked real time information as the most important indicator of bus performance (Peng *et al*. 2001).

Table 5-3. Transit Dynamic Message Sign Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of travelers that use transit DMS	50%	40%
Percentage of DMS users that save time	20%	50%
Average travel time saved per traveler	2 minutes	2 minutes

Telephone-Based ATIS

In July of 2000 the FCC, by recommendation of the U.S. DOT, designated 511 as the national traveler information telephone number. Within three years WSDOT was operating a statewide 511 service (prior to this a seven-digit number and a toll-free number were available). The WSDOT service is funded by gas taxes, and therefore free to the user. All of the traveler information provided by the service is disseminated by other ATIS components as well. Operation and maintenance costs, which do not include the cost to acquire the traveler information, are about $300,000 per year for the entire system. The service receives 4.6 million calls per year (WSDOT 2004, Jacobson 2004).

Benefit evaluation for telephone-based ATIS conducted by the WSDOT should use the recommended values found in Table 5-4. The 2002 Puget Sound Transportation Panel (PSTP) survey revealed that 12 percent of the respondents used telephone-based ATIS (PSRC 2004). The high volume of calls reported by TravelerInfo supports this finding (WSDOT 2004). Therefore, the usage setting should be adjusted to 10 percent. The IDAS developers assumed that time savings decrease as market penetration increases because of the "hunting effect" (see Chapter 4). Research has supported this assumption; however, most studies suggest that time savings typically would not drop to zero, even for 100 percent penetration (Levinson *et al.* 1999). Therefore, the time savings for 60 percent of the users should be increased to 5 percent.

Table 5-4. Telephone-Based ATIS Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of travelers that use service	0.5%	10%
Percentage of time saved by 10% of the users	15%	15%
Percentage of time saved by 60% of the users	0%	5%

Web/Internet-Based ATIS

The WSDOT runs a website that displays CCTV images of state roads and freeways, a real-time congestion map, incident information, and trip travel times. The 2002 PSTP survey suggested that 6 percent of travelers were using the Internet for traveler information (PSRC 2004). WSDOT's most recent quarterly evaluation reported a 15 percent average increase in Web page use from 2003 to 2004 (MacDonald 2004). Although this does not translate to traveler usage, it can be assumed that usage is on the rise. The percentages found in Table 5-5 better reflect this information. Time savings should be reduced as shown in the table for a more conservative evaluation.

Table 5-5. Web/Internet-Based ATIS Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
In 2000, percentage of travelers with devices	0.5%	3%
In 2005, percentage of travelers with devices,	5%	8%
In 2010, percentage of travelers with devices	10%	13%
In 2015, percentage of travelers with devices	20%	20%
In 2020, percentage of travelers with devices	30%	30%
Percentage of time saved by 10% of the users	20%	15%
Percentage of time saved by 40% of the users	10%	10%
Percentage of time saved by 60% of the users	0%	5%

Kiosk with Multimodal Traveler Information

WSDOT does not manage kiosks with multimodal information. WSDOT operates 42 rest areas with kiosks offering highway information. All of the kiosks provide "static" information, such as maps and long-term road construction warnings. One kiosk, at the Indian John rest area on I-90, has dynamic traveler information, such as road closures, traffic congestion, and other non-recurring traffic conditions (Hager 2004).

There is no research to support any adjustment to the default values. However, for a conservative evaluation WSDOT should use the values shown in Table 5-6.

Table 5-6. Kiosk with Multimodal Traveler Information Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of travelers that use Kiosks	0.05%	0.05%
Percentage of Kiosk users that save time	40%	30%
Average travel time saved per traveler	3 minutes	2 minutes

Kiosk with Transit-Only Traveler Information

The WSDOT does not operate kiosks with transit-only information. There is no research to support any adjustment to the default values. For a conservative evaluation, WSDOT should use the values shown in Table 5-7.

Table 5-7. Kiosk with Transit-Only Information Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
Percentage of travelers that use Kiosks	5%	1%
Percentage of Kiosk users that save time	20%	15%
Average travel time saved per traveler	2 minutes	2 minutes

Handheld/In-Vehicle Devices with Traveler Information

Washington residents can use a number of handheld systems for traveler information. The most common system is TrafficGauge (see Chapter 2). There is no evidence that market penetration for TrafficGauge or any other handheld/in-vehicle device will be as high as the IDAS default values suggest. For a conservative evaluation the values should be reduced as shown in Table 5-8. However, those with the device tend to use them (Trombly and Wetherby 1998). Therefore, the percentage of time activated should be increased to 65 percent. The travel time savings should be reduced for a more conservative evaluation (Wunderlich *et al.* 2001, Levinson *et al.* 1999, Carter *et al*. 2000).

Table 5-8. Handheld/In-Vehicle Devices with Traveler Information Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
In 2000, percentage of travelers with devices	0.5%	0.5%
In 2005, percentage of travelers with devices,	5%	1%
In 2010, percentage of travelers with devices	10%	5%
In 2015, percentage of travelers with devices	20%	10%
In 2020, percentage of travelers with devices	30%	15%
Percentage of time the device is activated	50%	65%
Percentage of time saved by 10% of the users	20%	15%
Percentage of time saved by 40% of the users	10%	10%
Percentage of time saved by 60% of the users	0%	5%

Handheld/In-Vehicle Devices with Route Guidance

Devices that relay traveler information and route guidance have been available to the public for the past five years. Systems such as General Motors' OnStar™ are available already installed in a vehicle and provide a variety of information. The WSDOT performed a study using Delco's in-vehicle navigation device in four different cars but offers no such device currently.

Route guidance seems to be growing in popularity at a fairly quick pace. Nonetheless, for a conservative evaluation the market penetration values should be reduced as shown in Table 5-9. Once again, those with devices tend to use them (Trombly and Wetherby 1998). Therefore, the percentage of time activated should be increased to 85 percent. The travel time savings should be reduced for a more conservative evaluation (Wunderlich *et al.* 2001, Levinson *et al.* 1999, Carter *et al.* 2000).

Table 5-9. Handheld/In-Vehicle Devices with Route Guidance Impact Settings

Impact Setting	IDAS Default Value	Recommended WSDOT Value
In 2000, percentage of travelers with devices	0.5%	0.5%
In 2005, percentage of travelers with devices,	5%	3%
In 2010, percentage of travelers with devices	10%	7%
In 2015, percentage of travelers with devices	20%	12%
In 2020, percentage of travelers with devices	30%	17%
Percentage of time the device is activated	50%	85%
Percentage of time saved by 10% of the users	25%	15%
Percentage of time saved by 40% of the users	12.5%	10%
Percentage of time saved by 60% of the users	0%	5%

6. CONCLUSIONS

Across the country traditional transportation improvements are unable to satisfy current travel demands. Research has shown that ATIS strategies can appease today's information-hungry traveler and provide substantial benefit to the transportation system. Unfortunately, a reliable and defensible method for evaluating their benefits of these new projects is lacking. This project reviewed the current methodologies that attempt to evaluate ATIS deployment. As a result, the IDAS methodology is presented as the recommended evaluation method for sketch planning of ATIS implementation.

IDAS is the best evaluation methodology for a number of reasons. Foremost, IDAS is sponsored and endorsed by the USDOT. Consequently, it is in tune with current federal recommendations and is sure to progress hand in hand with the advancing ITS field. Second, IDAS is designed to evaluate a variety of ITS components. This is beneficial because ATIS projects are progressively being viewed as a standard component of large, comprehensive projects.

The current IDAS methodology makes a number of assumptions about ATIS that threaten the accuracy and dependability of the evaluation. As explained in Chapter 4, is the method also assumes that ATIS components do not change the traffic assignment in a way that would affect the calculation of benefits. However, ATIS research suggests that this assumption is incorrect. Fortunately, the IDAS user has the potential to change this assumption through user-defined benefits. Moreover, the inaccuracy maybe considered unimportant because IDAS is intended as a sketch planning tool for comparing and prioritizing ITS components. The IDAS developers have stated that efforts are under way to settle this issue before the release of the next version.

IDAS offers the best methodology for benefit evaluation; however, it should be used with caution. The three case studies introduced in Chapter 4 unanimously concluded that obtaining local values for the impact settings is essential for successful execution. In Chapter 5 a number of adjustments to the default values are recommended. These recommendations will allow the WSDOT to successfully employ IDAS for ATIS evaluation.

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APPENDIX: ATIS Research

Highway Advisory Radio

Study	Methodology	Other ATIS	Results
Detroit, Michigan (Shah and Wunderlich 2001)	Simulation	DMS, Internet	• Average vehicle speed increased by 5.4 mph • The average time saved was 4.6 minutes • Commuter delay decreased by 22%
Detroit, Michigan (Reed 2000)	Survey	None	• 89% of travelers use radio • 86% of users believe radio is beneficial at most half of the time • 14% of users believe radio is beneficial seldom or never
Seattle, Washington (PSRC 2004)	Survey	TV, Telephone, and Internet	• 75% of respondents stated they use radio for traveler information
Cincinnati, Ohio (Krista 2001)	Survey	Radio, TV, Telephone, Internet, and DMS	• 4% of travelers preferred HAR for travel information over radio, TV, telephone, internet, and DMS sources
Honolulu, Hawaii (Prevedouros 1999)	Simulation	DMS	• Delay time was reduced by 40% • Traffic diversion increased by 25%
Spokane, Washington (Cluett 2004)	Survey	Internet and Telephone	• 56% of CVOs surveyed said they used HAR, of which 38% found the service “somewhat useful,” 51% found it “useful,” and 13% found it “very useful” • About 1/3 of the CVOs said they would change routes due to the information, but few were able to find viable alternatives

Freeway Dynamic Message Signs

Study	Methodology	Other ATIS	Results
Greenwood, Nebraska (McCoy and Pesti 2000)	Field Observations and Survey	None	• The DMS increased traffic diversion by 4% • 57% of passing vehicles saw the sign • 71% of the users that were told to use an alternative route found the sign beneficial • 77% of the users that were told to use caution found the sign beneficial
Osaka-Kobe, Japan (Atush et al. 1998)	Field Observations	None	• The DMS increased traffic diversion by 3.7% • At one location, the average time saved was 9.8 minutes during congestion • At another location, the average time saved was 38 minutes during incident congestion
Cincinnati, Ohio (Krista 2001)	Survey	Radio, TV, Telephone, Internet, and DMS	• 11% of travelers preferred DMS for travel information over radio, TV, telephone, internet, and HAR sources
Honolulu, Hawaii (Prevedouros 1999)	Simulation	HAR	• Delay time was reduced by 40% • Traffic diversion increased by 25%
Detroit, Michigan (Shah and Wunderlich 2001)	Simulation	HAR, Internet	• Average vehicle speed increased by 5.4 mph • The average time saved was 4.6 minutes • Commuter delay decreased by 22%
San Antonio, Texas (Carter et al. 2000)	Simulation	Kiosk, Internet, In-Vehicle Device	• 5.7% decrease in delay, 2.8% decrease in crashes, 1.2% decrease in fuel consumption annually

Transit Dynamic Message Sign

Study	Methodology	Other ATIS	Results
Acadia National Park, Maine (Daigle and Zimmerman 2003)	Survey	Telephone and Internet	• 90% of visitors who used real-time transit departure signs, 84% of visitors who experienced automated on-board next-stop message announcements reported these services made it easier to get around • 44% of transit users said the ATIS helped make the decision to use transit
Wisconsin (Peng et al. 2001)	Survey	None	• 79.4% of respondents rank real-time information as the most important factor contributing to bus riders' perception of bus performance

Telephone-Based ATIS

Study	Methodology	Other ATIS	Results
Cincinnati, Ohio (Clemons et al. 1999)	Survey	None	• 99% of those surveyed said they benefited from the phone service • 65% of users were willing to pay for the then free service • 81% said they had recommended the service to someone else
Seattle, Washington (PSRC 2004)	Survey	TV, Radio, and Internet	• 12% of respondents use telephone for traveler information
Cincinnati, Ohio (Krista 2001)	Survey	Radio, TV, HAR, Internet, and DMS	• 4% of travelers preferred telephone services for travel information over radio, TV, HAR, internet, and DMS sources
San Fransico, California (Yim and Miller 2000)	Survey	TV, Internet	• 9% of households were aware of the telephone service • Less than 1% of travelers used the service

Web/Internet-Based ATIS

Study	Methodology	Other ATIS	Results
Detroit, Michigan (Shah and Wunderlich 2001)	Simulation	DMS, HAR	• Average vehicle speed increased by 5.4 mph • The average time saved was 4.6 minutes • Commuter delay decreased by 22%
Cincinnati, Ohio (Krista 2001)	Survey	Radio, TV, HAR, Telephone, and DMS	• 2% of travelers preferred internet services for travel information over radio, TV, HAR, telephone, and DMS sources
San Fransico, California (Yim and Miller 2000)	Survey	TV, Telephone	• 81% of users changed their travel behavior because of the internet service
Pittsburgh and Philadelphia, Pennsylvania (Fekpe and Collins 2002)	Survey	None	• Of the Pittsburg population, 3.6% have used the service, 28% have heard of the service and at least 50% are looking for relief from congestion • Of the Pittsburg Web-users (separate survey), 67% changed their travel route, 47% changed their time of travel, and 6% changed their mode of transportation • Of the Philadelphia population, 6% have used the service, 23% have heard of the service • Of the Philadelphia users (separate survey), 86% changed their travel route, 66% changed their time of travel, and 8% changed their mode of transportation
Spokane, Washington (Cluett 2004)	Survey	HAR and Telephone	• 46% of post-deployment operators for CVOs indicated they used the internet • 94% of travelers surveyed agree the web site makes them better prepared for their trips and 56% agree that the service helps them avoid travel delays

Seattle, Washington (Pierce and Lappin 2002)	Survey	Radio reports, TV reports	• 3.2% of respondents consult traveler information • Radio most common source of information (56%), then pre-trip radio (22%), TV news (13%), traffic websites (6%), transit websites (6%) • 37% change in travel behavior (1.1% of total trips) – of the trips, 13% change departure time, 11% make small route changes, 9% took whole different route, 2% added, delayed, or cancelled trip, 1% change mode • Obtaining information rarely leads to change in travel modes • Route changes more common than departure time changes
San Antonio, Texas (Carter et al. 2000)	Simulation	VMS, Kiosk, In-Vehicle Device	• Small number of users = no overall system impacts. • 5.4% reduction in delay, 0.5% reduction in crash rate, and 1.8% reduction in fuel consumption
Netherlands (Van der Horst and Ettema 2005)	Survey	Any information source	• 90% of the pre-trip ATIS users seeking car travel time information used car • 75% of the pre-trip ATIS users seeking car cost information used car • 55% of the pre-trip ATIS users seeking public transportation information used public transportation (the other 45% used car or bike)

Kiosk with Multimodal Traveler Information

Study	Methodology	Other ATIS	Results
Los Angeles, California (Giuliano et al. 1997)	Field Observation	None	• Most frequent request, 83%, was for freeway maps • 85% of respondents said they would use the kiosk again • 88% of respondents said they were inform a friend about the kiosk
San Antonio, Texas (Carter et al. 2000)	Simulation	Internet, VMS, In-Vehicle Device	• Devices had functional problems, determined they were unlikely to be used by travelers • Further research abandoned

Kiosk with Transit-only Traveler Information

Study	Methodology	Other ATIS	Results
Acadia National Park, Maine (Daigle and Zimmerman 2003)	Survey	Telephone and Internet	• 90% of visitors who used real-time transit departure signs reported the service made it easier to get around • 44% of transit users said the ATIS helped make the decision to use transit

PDA/In-vehicle with Traveler Information

Study	Methodology	Other ATIS	Results
Seattle, Washington (Trombly and Wetherby 1998)	Survey	None	• Because of their device (2 devices in study), up to 80% of users changed their commute route, up to 50% of users changed their commute time, up to 10% changed their mode

PDA/In-vehicle with Route Guidance

Study	Methodology	Other ATIS	Results
Seattle, Washington (Trombly and Wetherby 1998)	Survey	None	• Because of their device, 63% of users changed their commute route, and 12% of users changed their commute time
Orlando, Florida (Inman et al. 1995)	Field Observation	None	• 80% time savings in trip planning • No observed benefit for real-time traffic information
San Antonio, Texas (Carter et al. 2000)	Simulation	Internet, Kiosk, VMS	• No system impact from In-Vehicle Navigation Units • 8.1% reduction in delay, 4.6% reduction in crash rate, and 3% reduction in fuel consumption over a year.

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