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16. Abstract

This study addresses the feasibility of providing real-time motorist information utilizing computer display terminals at the work place. Dynamic, real-time motorist information at the work place is an integral part of an advanced highway management system. Providing drivers the option to alter departure times and travel routes for commute trips contributes to optimizing the use of the existing transportation network. This optimization translates into decreased urban congestion, driver delay, and fuel consumption. However, few such traffic information systems exist in Texas urban areas. This study addresses their feasibility in Texas so as to maximize the impact on major urban freeway corridors to reduce congestion. Criteria are also needed for implementing such systems in a cost-effective manner as well as providing the real-time information in a format that ensures ease of use and efficient transmittal of pertinent information. The target group includes employment facilities housing drivers who generally travel in major urban freeway corridors in five Texas urban areas: Austin, Dallas, Fort Worth, Houston, and San Antonio.

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APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	2.54	centimeters	cm
ft	feet	0.3048	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	6.452	centimeters squared	cm^2
ft^2	square feet	0.0929	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
mi^2	square miles	2.59	kilometers squared	km^2
ac	acres	0.395	hectares	ha
		MASS (weight)		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.0328	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3

Note: Volumes greater than 1000 L shall be shown in m^3.

		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

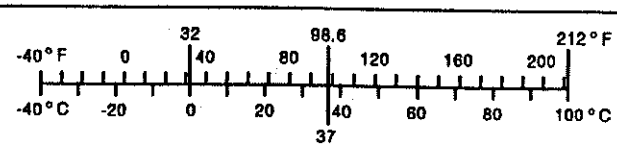
APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
yd	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
yd^2	kilometers squared	0.39	square miles	mi^2
ha	hectares (10,000 m^2)	2.53	acres	ac
		MASS (weight)		
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1000 kg)	1.103	short tons	T
		VOLUME		
mL	millimeters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3

		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

These factors conform to the requirement of FHWA Order 5190.1A

*SI is the symbol for the International System of Measurements



FEASIBILITY OF REAL-TIME MOTORIST INFORMATION SYSTEMS USING COMPUTER DISPLAY TERMINALS IN URBAN AREAS IN TEXAS

Final Report

by

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ABSTRACT

This study addresses the feasibility of providing real-time motorist information utilizing computer terminals at the work place in urban areas in Texas. The target group includes employment facilities housing drivers who generally travel in major urban freeway corridors in five Texas cities: Austin, Dallas, Fort Worth, Houston, and San Antonio.

Real-time motorist information systems have the potential to maximize the impact on major urban freeway corridors to reduce congestion. Criteria are needed for implementing such systems in a cost-effective manner as well as providing the real-time information in a format that ensures ease of use and efficient transmittal of pertinent information.

IMPLEMENTATION STATEMENT

This study addresses the feasibility of providing real-time motorist information utilizing computer terminals at the work place in urban areas in Texas. The target group includes employment facilities housing drivers who generally travel in major urban freeway corridors in five Texas cities: Austin, Dallas, Fort Worth, Houston, and San Antonio.

Real-time motorist information systems have the potential to maximize the impact on major urban freeway corridors to reduce congestion. Criteria are needed for implementing such systems in a cost-effective manner as well as providing the real-time information in a format that ensures ease of use and efficient transmittal of pertinent information.

The equipment and implementation assumptions of this study can be altered to fit the demands of a particular market for a real-time motorist information system. However, the study indicated that the feasibility of a real-time motorist information system requires further research.

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DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and recommendations presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation. Mention of trade or manufacturer's names and commercial products which may appear herein do not constitute endorsement or recommendation for use.

SUMMARY

Dynamic, real-time motorist information utilizing computer terminals at the work place is an integral part of an advanced highway management system. Providing drivers the option to alter departure times and travel routes for commute trips contributes to optimizing the use of the existing transportation network. This optimization translates into decreased urban congestion, driver delay, and fuel consumption. However, few such traffic information systems exist in Texas urban areas. This project addresses the feasibility of providing such a service so as to maximize the impact on major urban freeway corridors to reduce congestion. Criteria are also needed for implementing such systems in a cost-effective manner as well as providing the real-time information in a format that ensures ease of use and efficient transmittal of pertinent information. The target group includes employment facilities housing drivers who generally travel in major urban freeway corridors in urban areas in Texas (Austin, Dallas, Fort Worth, Houston, San Antonio).

The feasibility of a real-time motorist information system requires further research. However, the equipment and implementation assumptions of this study can be altered to fit the demands of the particular markets. Potential time savings estimates based on the study results indicate that each city has the potential to reduce its congestion costs anywhere from $1 million to $60 million per year depending on extent of implementation and on the urban area. Additional benefits as a result of reduced delay, reduced fuel consumption, and decreased emission of noxious fumes can be expected, although the determination of these benefits was beyond the scope of the study. Based on the limitation of the survey sample size, it is difficult to confidently state a specific preferred advanced traffic information system ideal for the work place. However, the survey suggests a design that is non-interactive but flexible enough to display information in both text and graphic formats. Information format guidelines recommend the use of a base map illustrating major traffic arteries in the urban area, text messages describing the information presented by the map, additional information on severe weather conditions and traffic conditions, and the time of the information update. Public relations efforts in conjunction with system implementation are also encouraged in order to maximize utilization potential.

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1. INTRODUCTION

As travel continues to increase on urban freeways, transportation agencies are faced with the task of maximizing the use of the existing transportation network in order to manage roadway congestion. Intelligent Vehicle-Highway Systems (IVHS) are tools currently being developed and implemented to enhance transportation mobility, energy efficiency, and environmental protection. IVHS includes the integration of communications, electronics, and computer systems installed in both the vehicle and on the highways. A major part of IVHS is providing motorists with real-time information regarding roadway and travel conditions, alternate routes, and other information pertinent to urban driving. Common systems currently used to provide real-time information to motorists include radio and television reports and telephone hotlines. A less common but emerging technology is an employer-based computer display service.

1.1 Background

New technologies in computerized communication markets have the potential to allow massive amounts of traffic and mobility information to be assimilated from a variety of sources and then distributed to motorists via computer display terminals in the work place. Theoretically, this service would be provided by commercial traffic advisory services for a monthly fee. The intent of the service is to provide real-time information to drivers before they leave their place of employment so that they may select an alternate route, departure time, or even travel mode if necessary. However, only limited research has been performed to explore the feasibility and usefulness of such technologies.

TTI recently completed a study in Houston, Texas, which evaluated the effectiveness of such a system.[1] The system was a demonstration project in a major activity center in Houston that provided real-time traffic information in the main lobby areas of ten office buildings using computer monitors. The study evaluated the utilization of the system, the reliability of the information provided, and the cost effectiveness of the system. A survey conducted to obtain

feedback concerning system utilization and usefulness showed that 69% of the respondents had used the information system.[1] Of that group, 64% replied that they had found the information useful, while 44% stated that they had changed their travel route based on the information received from the system.[1] However, many employees in the activity center were unaware of the system, denoting a need for public awareness. The lobby location was found to be inconvenient for users, as most preferred to have access to the system in their own office.

In summary, the potential exists for a real-time motorist information system at the work place. However, it is important that employees be made aware of the system and have easy access to it. The objective of this study was to determine the feasibility of such a service to mitigate congestion in major urban freeway corridors. By providing drivers with easy access to information which they can then use to alter departure times and travel routes for commute trips, use of the existing transportation network can be better optimized. This optimization can then translate into decreased urban congestion, driver delay, and fuel consumption.

1.2 Purpose

The purpose of this study was to determine the feasibility of providing urban commuters in major Texas cities with real-time traffic information at the work place using computer display terminals for pre-trip planning purposes. The feasibility study that was subsequently performed by Texas Transportation Institute (TTI) involved the following major tasks: a review of current research in Intelligent Vehicle-Highway System (IVHS) projects, a review of similar systems in operation in the United States, an assessment of alternative technologies, a survey of major employers in selected Texas cities to determine the desirability of such traffic information systems, and an evaluation of the potential cost-effectiveness of such systems. TTI conducted the study with funds provided by the Oil Overcharge Planning and Feasibility Grant Program under the direction of the Texas Department of Transportation (TxDOT) and coordinated by the Southwest Region University Transportation Center (SWUTC) based at Texas A&M University in College Station, Texas.

2. CURRENT RESEARCH AND PRACTICE

Obtaining and evaluating available research material is a key element of real-time motorist information systems using computer display terminals. The study team conducted a literature search to identify similar real-time information systems and available technological alternatives. The reference material was evaluated to determine its applicability to the project. The study team also conducted telephone surveys with key staff of public agencies and private companies involved in IVHS-related projects. Copies of the surveys are provided in Appendix A. The objective of the surveys was to obtain a basic description of the project, the type of information provided to the user, and the technology used in disseminating that information. Summaries of the individual surveys are provided in Appendix B.

The research identified three key issues that need to be addressed. First, similar real-time motorist information systems are in operation in a number of locations in the United States. Although few are concerned with providing the information at the work place, they are working models from which information can be gleaned. Second, several agencies have conducted surveys to determine the desired type of traffic information. These surveys provide information that can be used to develop guidelines for providing traffic information to urban drivers in Texas. Finally, various alternative technologies are available to provide real-time traffic information to motorists at the work place. A comparative evaluation of alternatives was undertaken in this study to determine which technology provides the best potential for utilization. The major points regarding these alternatives are discussed in the following sections.

2.1 Similar Systems and Services

A number of urban areas in the United States are developing traffic management systems to help reduce peak period congestion. As part of this effort, several cities have implemented real-time motorist information systems in various formats providing different types of information. Their application can be used in the development of guidelines for providing real-

time traffic information to urban commuters in Texas. Three such systems sponsored by local and/or state governmental agencies are discussed below. Other systems are highlighted in Appendix B.

2.1.1 Smart Traveler-Boston Area

Located in the Boston area, Smart Traveler is an advanced driver information system that provides real-time, location-specific, on-demand traffic information.[2] This test project, sponsored by the Massachusetts Highway Department and the U.S. Department of Transportation, is designed to gauge public acceptance and potential benefits of a telephone-based traffic information service.[3] The information is disseminated to a number of business clients through a variety of techniques. The objective of the system is to provide up-to-the-minute information regarding construction activities and traffic incidents in order to assist motorists in avoiding delay.

The operation center, run by Smart Route Systems, Inc., collects both "static" (i.e., construction, planned closures) and real-time traffic information from various sources including airplane surveillance, helicopters, television cameras, police and emergency frequency bands, and probe vehicles.[3] This information is assessed by traffic managers using data bases, mapping software, and active data inputs.[3] The result is a comprehensive report which includes such specifics as delay times, alternate routes, and descriptions of conditions.

User businesses obtain the information in a variety of ways including land line or cellular telephone, fax, or computer. The method of obtaining the information determines if it is disseminated in an audiotext or videotext form. The information covers the major radial and circumferential arteries in Boston and is available 24 hours a day. The information is kept current and continuously updated.

Smart Traveler serves businesses with an economic need for traffic information (i.e., delivery services), individual cellular phone users, major employers, developers, hotels, and landlords.[2] Individual users keep informed about current traffic conditions to assist in daily driving. Delivery services use the system to avoid travel delay, and corporations provide the service to their employees as a benefit. Other entities (i.e., building management companies, hotels, developers) use the service as a means of attracting customers.

2.1.2 Freeway Vision-Los Angeles Area

The California Department of Transportation (Caltrans) and the City of Los Angeles are sponsoring a traffic monitoring service, Freeway Vision, which is available on cable television continuously during peak traffic periods.[4] The broadcast consists of a computer graphic map that provides up-to-the-minute traffic conditions on the 750-mile (1200-kilometer) freeway network in the Greater Los Angeles area.

The Freeway Vision map uses a color-coded system to alert viewers of traffic conditions. The color scheme is as follows: green = free flow (speeds > 35 mph [56 kph]), yellow = slowing traffic (speeds between 20 mph [32 kph] and 35 mph [56 kph]), and red = congested traffic (speeds < 20 mph [32 kph]).[4] A flashing red light also notes a possible incident that has caused traffic to stop. The Caltrans Traffic Operations Center obtains the speed and volume data from loop detectors located throughout the freeway system.

Information is aired Monday through Friday from 5:00 a.m. to 8:00 a.m. and from 4:00 p.m. to 6:00 p.m. Operated and managed by the City of Los Angeles' Department of Telecommunications, Freeway Vision reaches over 500,000 homes in the Los Angeles area.[4]

2.1.3 Massachusetts Bay Transportation Authority-Boston

The Massachusetts Bay Transportation Authority (MBTA) has entered into a contract with a private company, MetroVision, to provide up-to-the-minute MBTA service information to commuters and other travelers in its subway and commuter rail stations.[5] The system, provided at no cost by MetroVision, provides the service to passengers on train platforms via color television monitors. In addition to schedule changes, delays, diversions, and other information, the system provides news, weather, financial information, sports, and advertising.[5] The advertising segments provide the revenue necessary to run the system. Similar systems are in operation in Chicago, New York, New Jersey, San Francisco, and Oakland.

The system consists of on-site microcomputers that provide the information to television monitors throughout the MBTA stations.[5] The computers and monitors are interconnected via modem using telephone lines and coaxial cable lines. The system displays information on a local,

regional, or system-wide basis and can be overridden by MBTA personnel when important information such as schedule changes, diversions, and delays must be broadcast. The system can also broadcast one of over 250 pre-programmed emergency messages or operator-generated messages in a matter of seconds.[5]

2.2 Motorists' Desires for Information

It is important to focus on the needs of the motorist when designing a real-time motorist information system, since utilization is directly related to the satisfaction of the user. Thus, the needs of the user must be addressed when developing a format to disseminate traffic information. Several agencies have conducted surveys to ask drivers what information they need and in what format they need it to make decisions about their daily commute. Concerns about accuracy and timeliness were also addressed as confidence in the information relates to utilization and success of the system. The information provided by these surveys can be used to develop a format suitable for giving information to users in Texas.

2.2.1 Los Angeles-Commuter Survey

A research report generated by the Los Angeles County Transportation Commission (LACTC) describes the findings of a commuter information survey conducted by Commuter Transportation Services, Inc., in February 1987.[6] Four hundred (400) individuals were surveyed on the three topics of commute characteristics, factors affecting route change, and improved traffic information.

The survey found that commuters in the Los Angeles area traveled an average of 37.3 minutes to work and 41.9 minutes from work.[6] The average delay for commuters was 18 minutes. A total of 40% of respondents said that they have changed to another freeway or street on their way to work while 72% of respondents knew of an alternate route that they could take to work.[6] A majority of commuters who have changed routes on occasion said they alter their route if traffic is stopping often or is completely stop and go. The factor that most frequently affects route change is radio traffic reports.

The survey indicated that motorists want better information on traffic. Of those surveyed, 94% said they would leave the freeway if more accurate information were available (69% definitely, 19% probably, and 6% maybe).[6] Responses were in favor of continuous radio traffic reporting (68%), and a traffic information telephone number (53%), which could assist the commuter in route selection and route diversion. Only 17% of respondents indicated that existing means of obtaining traffic information were adequate, while 27% of respondents said they want more timely and accurate information. Fifteen percent (15%) wanted more frequent traffic reporting.[6]

2.2.2 Seattle-Graphics Information Survey

Three surveys conducted by the University of Washington were designed to obtain functional requirements for the design of a graphics-based traffic information system.[7] The first survey of 3,893 motorists found that motorists can be divided into four separate commuter groups based on their willingness to alter their behavior based on receiving traffic information. These groups are: (1) route changers, (2) non-changers, (3) route and time changers, and (4) pre-trip changers.[7]

A select group of the initial 3,893 commuters surveyed were then chosen to participate in a second survey which asked questions regarding prototype traffic information screens which provided information in the following formats: time estimates, text messages, pictures of actual traffic, a map of the Seattle area freeways, and bar graphs. According to the survey results, a monitor displaying a picture of heavy traffic combined with estimated travel times to downtown would most influence drivers to alter departure time or to change travel route.[7] A television monitor showing a picture of heavy traffic combined with text descriptions of conditions and bar charts showing parking availability (for potential at-home users) had nearly the same affect on travel route changes. Both displays appeared to have significant influence on mode changes. The following list shows how survey respondents ranked the five forms of traffic information in order of preference: (1) time estimates, (2) text messages, (3) pictures, (4) maps, and (5) bar graphs.[7]

One hundred of the respondents were then surveyed a third time over the telephone regarding motorist information needs. This survey found that commuters tend to perceive a TV-

based traffic information system to be more accurate than any other current information source.[7] It also found that commuters express a strong interest in knowing the timeliness of the displayed information. Most commuters currently perceive traffic information presented over the radio waves as not being accurate, timely, or as geographically specific as it could be.

Commuters who desire the reason for traffic congestion or type of incident want this information to help them decide the severity of the incident so they can generate their own time estimates. Motorists tend to be familiar with typical commute conditions and alternate routes. Therefore, they desire information that lets them decide which driving action to take. They also want to know about unusually severe weather and freeway conditions, rather than typical recurring congestion.

2.2.3 Houston-Activity Center Survey

A survey was conducted in Houston as part of an evaluation of a real-time motorist information system in a major activity center.[1] Respondents were asked what could be done to make the system in place more useful to them on a daily basis. The most important response was that 41% said access to the terminals in their particular office suite or via personal office computer would be ideal.

When asked about improving the format of the information provided, 26% of respondents indicated that alternating a graphic map with the text would be helpful.[1] Sixteen percent (16%) requested the display of alternate route information for congested corridors. Other responses included the use of scrolling text to include information (9%) and access via telephone (8%).[1]

2.3 Alternative Technologies for Disseminating Traffic Information

Several technology alternatives are available to provide real-time traffic information to motorists at the work place. Two types of information are commonly disseminated to motorists: enroute information and pre-trip planning information. Enroute systems provide information to the motorists while they are in their vehicle (i.e., changeable message signs, highway advisory radio). Pre-trip systems provide information to the motorists at home or at the work place prior

to their departure. This section will review alternative systems that could provide real-time information to drivers before they leave their place of employment so that they may select an alternate route, departure time, and even travel mode. The three alternative systems discussed are radio and television reports, telephone hotlines, and employer-based computer display technologies.

2.3.1 Radio and Television Reports

Most commercial radio stations in the larger urban areas provide traffic information during the peak periods. This information is obtained from a variety of sources such as their own air patrols, state agencies, and from commercial traffic reporting services. Several cities and transportation agencies are currently providing a traffic monitoring service that is available on cable television during peak traffic hours.[5] The broadcast consists of a computer graphic map that provides up-to-the minute traffic conditions. Often, the graphic map is color coded. A flashing light or other eye catching icon identifies problem locations. Both radio and television reports provide basic information to the motorist in a familiar and useable format.

Traffic radio reports are easy to obtain enroute since most motorists have radios. However, it may not be as easy to obtain such information at the work place. First, many office buildings may not allow their employees to have radios. Furthermore, there are many types of businesses (such as manufacturing companies or fast food chains) where it is unsafe or impractical to have a radio. Another disadvantage identified is that the motorist has no control over when the information is provided. One must wait until the station decides to broadcast the information. Often, when information is provided by radio, it tends to be general in nature. It is infrequently specific enough to address the motorist's particular travel route.

Since televisions are common in the home, television-based systems are most often used in the morning when motorists are departing from the home to go to work. However, with limited accessibility to televisions in the work place, this system is not often available for the motorist's use prior to leaving the work place.

2.3.2 *Telephone Hotlines*

Another alternative technology for disseminating pre-trip planning traffic information to the motorists is by telephone. This information may be available on a free telephone line where a menu is used for specific information requested.[3] An advantage to such a system is that it is available wherever a motorist has access to a telephone, including the vehicle (if they have a cellular telephone). If the system is menu-driven, the motorist may also be able to obtain specific information about a particular travel route.

One disadvantage about a free telephone service is that since the service is free, it may be difficult to get through to the service. Thus, the motorist cannot always count on getting the information when it is most needed. Typically, such services operate under no federal or state requirements and regulations, and there are no liabilities since the service is free to users.[8] Thus, the accuracy and timeliness of the information may be in question, especially if the traffic service does not regularly confirm information. Another drawback to this system is that when the caller does get through, he or she may not have the opportunity to ask questions.

2.3.3 *Employer-Based Computer Display Technologies*

The third alternative technology available to provide real-time information for pre-trip planning is an employer-based computer display terminal. Most representative of these systems is the private, pay-for-service systems provided by some traffic advisory services. Several commercial traffic advisory services are currently developing traffic information systems for subscription service by corporations, management groups, and companies. The designs being considered by these services for disseminating traffic information via computer display terminals vary according to the format used to provide the information and the addition of non-traffic information (i.e., sports, weather, news). These designs were used to develop the Motorist Information System Survey which will be discussed in more detail in the Market Study section.

An advantage of this technology as a work-based system is that it has the potential for high utilization since employees will have easier access to the information. Also, depending on the sophistication of the system, the information can be tailored to meet the needs of a specific

market (i.e., delivery services, commuters, visitors) and can be available throughout the day. Furthermore, as a commercial system, the information may be more accurate. The advisory service might be more inclined to verify and update the contents of the information more closely to ensure customer satisfaction.

3. MARKET STUDY

A questionnaire survey was used to examine the potential work place applications of real-time information systems via computer terminals. The questionnaire examined whether employers would be interested in providing such a system for their employees and what factors would influence their decision to do so.

3.1 Survey Methodology

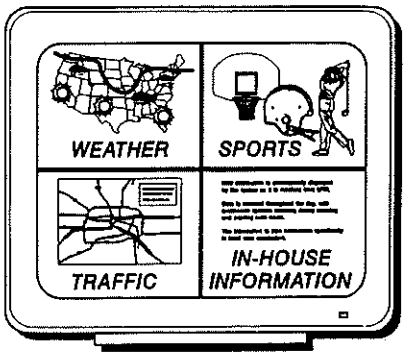
A total of 558 surveys were mailed to randomly selected businesses with 100 or more employees in five large urban cities in Texas. The survey was sent to companies' human resource representatives with a cover letter explaining the technology of an advanced motorist information system and the objectives of the survey. A detailed description of four potential services providing pre-trip planning information to their employees was enclosed (Figure 1). Costs were provided to determine if employers were willing to pay for such a service.

3.2 Topics Investigated

The information sought from the questionnaire included whether or not employers would be interested in providing real-time information to their employees, which system alternative they would prefer, and what would influence their selection of a particular alternative. In addition, the type of business and number of employees was asked for subsequent categorization of responses.

The survey consisted of nine closed-ended questions as illustrated in Figure 2. The first question divided out the survey participants into two categories: those that would be interested in such a service and those that would not. Those that replied "Yes", continued the survey, whereas those that replied "No" skipped to Question 5. For those that replied "Yes", Question

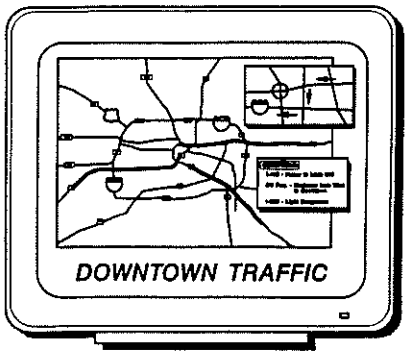
ALTERNATIVE - 1



Complete video information computer monitor; option of either interactive or non-interactive; full color, high resolution system providing real-time traffic and mobility information, weather conditions, headline news, sports, and inhouse updates and information; animated and still graphics, formatted to individual client's needs

Monthly Fee - $1,500.00

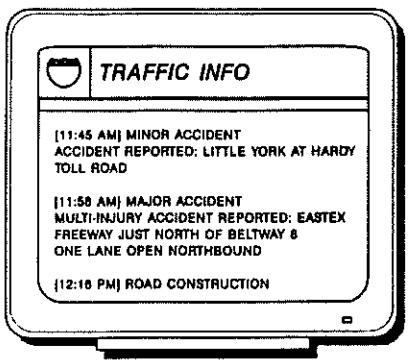
ALTERNATIVE - 2



Full color, high resolution computer, interactive, providing real-time traffic and mobility information in text, color maps and still graphics

Monthly Fee - $1,250.00

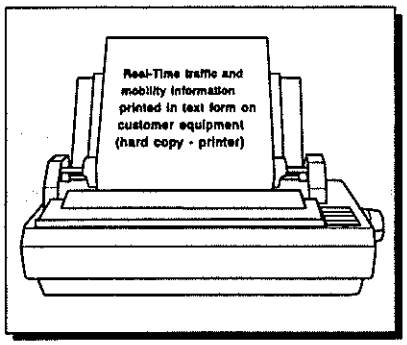
ALTERNATIVE - 3



Full color, high resolution computer monitor, providing real-time traffic and mobility information presented in text and still graphics

Monthly Fee - $1,000.00

ALTERNATIVE - 4



Real-time traffic and mobility information printed in text form on customer equipment (hard copy - printer)

Monthly Fee - $ 500.00

Figure 1. Survey Alternatives

MOTORIST INFORMATION SYSTEM SURVEY

1. **Would you be interested in providing real-time traffic information to your employees?**

___ Yes ___ No

Questions 2-4 relate to those who answered YES to Question 1. If you answered NO to Question 1, please skip to Question 5.

2. **If yes, why? (Select all that apply.)**

___ To Improve Morale of Employees
___ To Encourage Flexible Time for Employees
___ To Provide Potential for Time Savings to Employees
___ To Provide Potential for Cost Savings to Employees
___ Other (briefly describe) _____

3. **After reviewing the alternatives shown on the attached sheet, which alternative do you prefer?**

___ Alternative 1 ___ Alternative 2 ___ Alternative 3 ___ Alternative 4

4. **In selecting this alternative, what factors influenced you? (Select all that apply.)**

___ Type of Information Provided
___ Cost
___ Other (briefly describe) _____

Please skip to Question 7.

5. **Why would you <u>not</u> want to provide this information to your employees? (Select all that apply.)**

___ Type of Business Does Not Warrant Its Use
___ Would Not Be Used by Employees
___ Cost is Too High
___ Other (briefly describe) _____

6. **If you chose cost in Question 5, what would you consider a reasonable price for this service?**

___ Would Not Pay ___ $200 Per Month ___ $400 Per Month
___ $100 Per Month ___ $300 Per Month

7. **Which category best describes your business?**

___ Contract Construction
___ Finance, Insurance, Real Estate
___ Manufacturing
___ Retail
___ Services
___ Transportation, Communications, Utilities
___ Wholesale
___ Other _____

8. **How many full-time employees are in your company?** _____

9. **Which major freeway is located nearest to your office? (Select only one.)**

___ IH 10 ___ IH 610 ___ US 59 ___ Other _____
___ IH 45 ___ US 290 ___ SH 288

10. **On the back of this questionnaire, please provide any additional comments or suggestions.**

Figure 2. Motorist Information System Survey Form

2 asked them to identify their reasons for their affirmative answer. Question 3 then asked the respondents to review the attached alternatives and select the one they would prefer. Since Question 3 asked which alternative they would prefer, Question 4 was used to determine why they chose that alternative. For example, they might have preferred Alternative 4 because of the information it provided, but their business could only afford Alternative 2.

Those respondents that replied "No" in Question 1 were asked in Question 5 why they would not be interested in such a service. If cost was one of their selections, Question 6 was used to determine what they felt was a reasonable price to pay for such a service. Both categories of respondents were then asked to answer Questions 7 through 10. Questions 7 and 8 were used to determine if the type or size of a business would influence the respondents usage of the service, while Question 9 identified the company's location. Question 10 was an open-ended question that asked if the respondents had any additional comments or suggestions.

It should be noted that the surveys were sent to human resource representatives. The intent was to determine if the employer would be interested in providing this service to its employees. The employees' opinions or attitudes toward such a service were not determined.

3.3 Market Selection

Once the survey was developed, a random sample of companies in particular locations in each city had to be selected to receive the survey. The following sections describe the selection process.

3.3.1 Study Corridors

Major radial freeway facilities were selected in each of the cities to be surveyed. The length of each freeway corridor was then chosen from the downtown area to outer areas where commercial areas are located. The outer portions of the corridors which were predominantly residential areas were eliminated. Circumferential freeways and other loops were included, especially through areas with office center developments. Freeway corridors chosen for each survey city are listed in Table 1.

Table 1. Study Corridors and Limits

City	Facility	Corridor Limits	
		From	To
Austin	IH 35	US 290	US 183
	US 183	SH 71	Loop 1
	US 290	IH 35	US 183
	SH 71	Loop 1	US 183
	Loop 1	Loop 360	US 183
Dallas	IH 20	Spur 408	US 175
	IH 30	Loop 12	East IH 635
	IH 35E	IH 20	North IH 635
	IH 45 / US 75	IH 20	North IH 635
	IH 635	IH 35E	US 175
	US 175	IH 635	IH 45 / US 75
	SH 183	Loop 12	IH 35E
	Loop 12	IH 20	IH 35E
	Dallas North Tollway	IH 35E	North IH 635
Fort Worth	IH 20	West IH 820	East IH 820
	IH 30	West IH 820	East IH 820
	IH 35W	IH 20	North 820
	IH 820	West IH 20	East IH 20
	US 287	IH 820	IH 35W
	SH 121	IH 35W	IH 820
Houston	IH 10	West Beltway 8	East Beltway 8
	IH 45	South IH 610	North Beltway 8
	IH 610	West IH 10	West IH 10
	US 59	West Beltway 8	North IH 610
	US 290	North IH 610	West Beltway 8
	SH 288	South IH 610	US 59
San Antonio	IH 10	East IH 410	West IH 410
	IH 35	South IH 410	West IH 410
	IH 37	South IH 410	IH 35
	IH 410	East IH 10	East IH 10
	US 90	IH 35	West IH 410
	US 281	IH 35	North IH 410

3.3.2 Corridor Zip Codes

Zip code maps were obtained for each city for use in identifying companies with addresses in the study corridors. Once the study corridors were chosen, their limits were located on the zip

code maps. The zip codes along the freeway corridors were then selected as potential company locations. A list of each city's corridor zip codes is located in Appendix C.

3.3.3 Company Selection

Members of the study team traveled to Austin, Dallas, Fort Worth, Houston, and San Antonio to visit the appropriate chambers of commerce. The team then obtained business directories which included information on companies within the metropolitan area. These companies were often categorized according to size and nature of business.

Companies not within the specified zip codes along the chosen corridors were eliminated from the pool of potential survey companies. The list was then narrowed to include only companies with 100 employees or more. The study team assumed that larger companies would be more inclined to offer a real-time motorist information system to its employees. Finally, the list of companies for each city was shortened by eliminating certain types of businesses. These types included small retail establishments, restaurants, day care services, school districts, colleges and universities, and government agencies. Most of these employers were removed because most do not have all of their employees located in a central location. The public agencies were eliminated because they typically do not have discretionary funds to use to provide such systems. The remaining business categories were: (1) contract construction; (2) finance, insurance, real estate; (3) manufacturing; (4) retail; (5) services; (6) transportation, communications, utilities; and (7) wholesale.

A goal was established in each city to survey approximately 100 companies from each city. Thus, the survey companies were randomly selected from the remaining list and entered into a database for analysis purposes. A total of 558 survey companies were chosen with the following number for each city: Austin-98, Dallas-127, Fort Worth-98, Houston-115, and San Antonio-120.

3.4 Data Analysis and Findings

A total of 83 (approximately 15%) surveys were completed and returned to the study team. Returned surveys were categorized according to city and were coded into a data file and statistically analyzed. The results of the data analysis are provided in Appendix B.

3.4.1 Survey Company Background

Background information relating to those companies surveyed is provided in Table 2. The categories for each background question are listed, along with the associated response percentage for each category. It can be noted that more surveys were received from Houston with 31%. Service-related businesses made up 32% of the returned surveys, while manufacturing companies made up 28% of those surveys returned.

The surveys were sent to companies which were reported to have 100 employees or more. However, as indicated by the survey responses, 32% of those companies returning surveys had fewer than 100 employees. It is assumed that staff reductions for various reasons, including the economy, caused employee numbers to drop below 100.

3.4.2 Survey Results

Responses to individual survey questions are discussed in the following sections.

Question 1. Would you be interested in providing real-time traffic information to your employees? - Twenty-three percent (23%) of the companies surveyed indicated that they would be interested in providing a traffic information service for their employees, as illustrated by Figure 3.

No significant difference in response rates was found based on company location (by city or corridor). Of those companies responding favorably to an information system, 33% were manufacturing companies and 28% were service-oriented businesses. This response might be related to the fact that more of these types of businesses responded to the survey.

Table 2. Distribution of Survey Responses

Company Information	Response Category	Percent Distribution of Responses
Location of Company	Austin	18%
	Dallas	17%
	Fort Worth	17%
	Houston	31%
	San Antonio	17%
Type of Business	Contract, Construction	9%
	Finance, Insurance, Real Estate	8%
	Manufacturing	28%
	Retail	9%
	Services	32%
	Transportation, Communications, Utilities	8%
	Wholesale	4%
	Other	2%
Number of Full-Time Employees	Less than 100	32%
	100 to 200	27%
	200 to 300	13%
	300 to 400	11%
	Over 400	17%

It is interesting to note that 22% of the companies that expressed a desire for the system had less than 100 employees. This fact may indicate that despite previous assumptions, some small companies may also be interested in providing information to their employees.

Question 2. If yes, Why? - Twenty-three percent (23%) of responding companies went on to answer Question 2. Based on the possible reasons given, 50% of companies responding wanted the system to improve the morale of their employees, and 33% of them wanted to encourage flexible time for employees. The potential for time savings or cost savings for the employees did not receive significant responses. The survey audience may have had some affect on this response as the survey was sent to individuals involved with human resources. These individuals might be more interested in the overall positive impact such a system would have on employee performance and productivity and how the system would benefit the company as a whole.

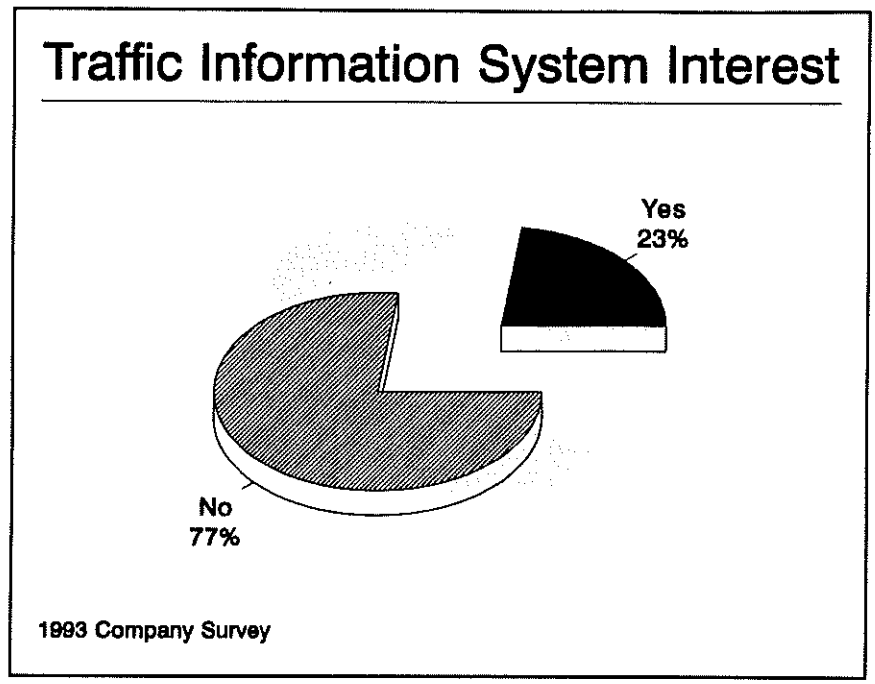


Figure 3. Traffic Information System Interest

Question 3. After reviewing the alternatives shown on the attached sheet, which alternative do you prefer? - Survey respondents were asked which of four alternatives they might prefer. Although a clear preference was not apparent, as indicated in Figure 4, Alternative 3 was chosen by 32% of the companies. Alternative 3 was a basic video-oriented alternative, and it provided all the pertinent traffic information in a text format that was continuously updated. Twenty-six percent (26%) of responding companies chose Alternative 2, which provided the traffic information in both text and graphic formats.

Question 4. In selecting this alternative, what factors influenced you? - When asked the reason for selecting a particular alternative, 72% of the companies indicated that the type of information provided was the deciding factor. Twenty-four percent (24%) chose cost as the factor that influenced their selection.

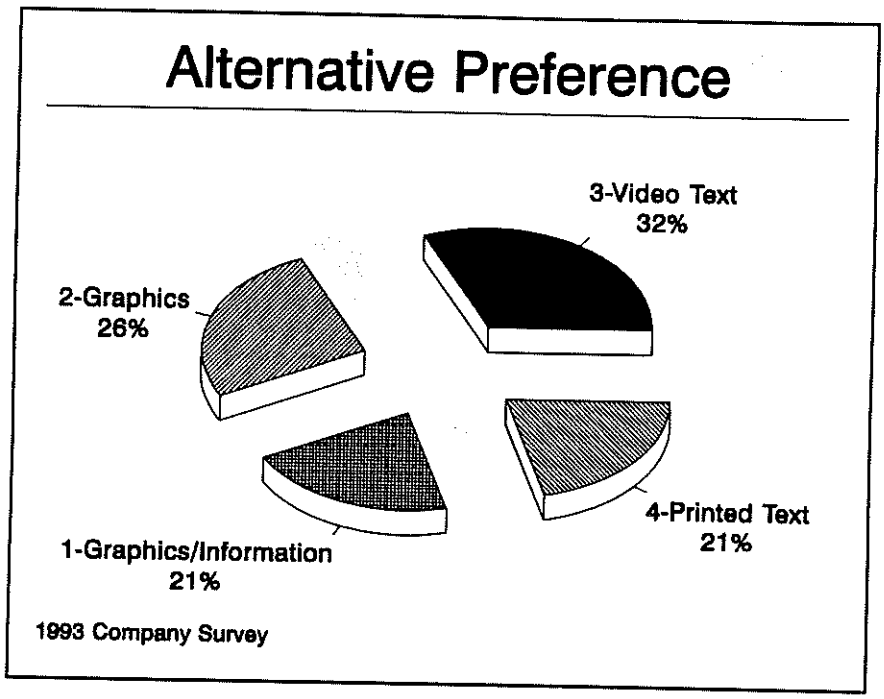


Figure 4. Alternative Preference

Question 5. Why would you not want to provide this information to your employees? Companies that were not interested in a motorist information system were asked to give reasons for their decision. Fifty-four percent (54%) of those surveyed indicated that their type of business did not warrant its use. Thirty percent (30%) said that the cost was prohibitive, and 3% believed that it would not be used by their employees. However, recall that the employees themselves were not surveyed. A poll of the potential users might reveal that they would use the system if it were available, as documented in previous research.

Question 6. If you chose cost in Question 5, what would you consider a reasonable price for this service? - A majority of the companies (67%) that did not want the service said that they would not pay any amount for such a system. A number of responses indicated they can get the same information through other sources which are free, such as the radio. Thus, a video-oriented system offers no advantage to them.

4. BENEFIT/COST ANALYSIS

Based on the response results from the survey, the study team investigated the cost effectiveness of advanced motorist information systems in the work place. The analysis was based on time savings to the driver on a yearly basis.

4.1 Estimated Annual Savings

A stepwise approach was taken to estimate the amount of annual time savings which could be anticipated from a real-time motorist information system at the work place. This process, as illustrated by Table 3 (located in Appendix D), was as follows:

1. Estimate that part of the urban population in the labor force.[9]
2. Estimate the percentage of the labor force working in high-volume freeway corridors.
3. Estimate the size of the labor force working in high-volume freeway corridors.
4. From survey data, estimate the percentage of the labor force working in high-volume freeway corridors who's companies expressed an interest in the system.
5. Estimate the potential market of the labor force by multiplying the percentage of labor force working in high-volume freeway corridors who's companies expressed an interest in the system (#4) with the labor force working in high-volume freeway corridors (#3).

The time savings estimates used several constants in the calculations. Those values held constant for all urban areas and used in the time savings analyses included[10]:

1. Working days per year -- 250 days
2. Average cost of time -- $10.00 per person-hour (1990 value)

Table 3. Potential Market Populations by Urban Area

Urban Area	Employed Labor Force in Urban Area	Percentage of Employed Labor Force in HVC*	Employed Labor Force in HVC*	Percentage of Employed Labor Force in HVC* w/Interested Companies	Potential Market in HVC*
Austin	271,511	44%	119,231	31%	36,794
Dallas	1,012,719	45%	454,011	20%	90,722
Fort Worth	563,579	24%	133,950	31%	41,378
Houston	1,394,710	41%	566,399	7%	38,059
San Antonio	506,801	16%	81,893	11%	8,973

* High-Volume Corridors

Using these constants and the calculated potential market populations, the potential yearly benefits for each city were generated for 5, 10, 15, and 20 minutes savings, assuming 60%, 80%, and 100% of the potential market in a high-volume corridor participate on a daily basis. These percentages were chosen to estimate a range of participation rates. The raw data for these calculations is provided in Appendix D. The results for the 80% participation results are presented in Table 4 as a middle-range savings estimate. These savings estimates are directly related to the numbers of employees represented by responding companies. Thus, they do not necessarily reflect the severity of congestion in each city. The total congestion costs for each urban area for 1990 are presented in Table 5 for comparison purposes.

Table 4. Dollar Savings Per Year, 80% Market Utilization

Time Savings Per Person	Urban Area Savings ($Millions)				
	Austin	Dallas	Fort Worth	Houston	San Antonio
5	$6	$15	$7	$6	$1
10	$12	$30	$14	$13	$3
15	$18	$45	$21	$19	$4
20	$25	$60	$28	$25	$6

By comparing the cost of potential yearly time savings for each urban area to its cost of congestion, each city has the potential to reduce its congestion costs from $1 million to $60 million per year depending on the urban area. These cost savings will increase or decrease depending on the number of employers providing the system to their employees, the actual number of users, and their frequency of use. However, a real-time motorist information system would be expected to benefit employees throughout an entire urban area, not just along high-volume freeway corridors.

Table 5. Total Congestion Costs by Urban Area for 1990[10]

Urban Area	Annual Cost Due to Congestion ($Millions)
Austin	$210
Dallas	$1,120
Fort Worth	$420
Houston	$1,650
San Antonio	$260

4.2 Fuel Consumption/Emissions

The determination of the impact of delay on fuel consumption is beyond the scope of this initial feasibility study. However, it is safe to say that reduction in travel delays in these areas would provide savings in fuel consumption to the individual and the community as a whole. Also, determining increased benefits to employers based on employee productivity is out of the scope of this study.

The impact of decreasing commute time, urban congestion, driver delay, and fuel consumption by utilizing a real-time motorist information system at the work place decreases the overall emission of noxious fumes. This reduction in pollution results in an improvement in air

quality in urban areas, which can be particularly helpful to those designated as non-attainment areas.

4.3 Break-Even Analysis

If a company is willing to pay for a real-time traffic information service, the system must be assumed, for the purpose of economic analysis, to be a worthwhile investment. Based on the monthly cost of the alternative selected by most survey respondents ($1000), a break-even analysis was performed. Potential yearly benefits were generated for 5, 10, 15, and 20 minutes daily time savings as a function of the number of users and their frequency of use per week. The data for the analysis is provided in Appendix D. The number of daily system users needed to offset the cost of providing the service is illustrated in Table 6.

Table 6. System Users Required for Yearly Cost Effectiveness

Time Savings Per Use (Minutes)	Frequency of Use Per Week				
	1	2	3	4	5
5	343	172	115	86	69
10	172	86	58	43	35
15	115	58	39	29	23
20	86	43	29	22	18

The cost effectiveness of a real-time motorist information system can be seen to be dependent upon the amount of time users save and the frequency with which they use the system. Thus, larger companies might have a better opportunity to offset the cost of the system through greater usage. However, the potential for long-range savings generated by decreased congestion, fuel consumption, and driver delay can be experienced by all companies. Furthermore, it is important to note that these benefits can be provided as long as the motorist information system is in place.

5. IMPLEMENTATION GUIDELINES

As part of the feasibility study, the study team developed criteria for the implementation of real-time motorist information systems in the work place in urban areas in Texas. Guidelines for the presentation of the traffic information were also developed for future reference. These implementation guidelines are discussed in the following sections.

5.1 System Implementation Criteria

Based on the limitation of the survey sample size, it is difficult to confidently state a specific preferred advanced traffic information system ideal for the work place. However, the survey suggests a design that is non-interactive but flexible enough to display information in both text and graphic formats. The system could communicate with a central information computer via a designated telephone line using a modem. This alternative is a basic video-oriented one that could provide all the pertinent traffic information in a visual format that can be continuously updated. Accessibility to the system could be adapted to existing in-house computer networks or could be provided with an installed monitor system.

Study results indicated that no significant difference was found in the market potential for an advanced motorist information system based on company location or type. Thus, all of the five urban areas surveyed might be inclined to use the system, and all types of companies might be considered a potential market. However, it is logical to assume that service-oriented businesses such as delivery services might be more inclined to use such a system, since its benefits would be directly reflected in its daily operation. In addition, the size of a company should not necessarily limit it from being considered a potential market for the system.

In summary, since a relatively small percentage of companies surveyed (23%) indicated an interest in providing a real-time motorist information system to their employees. The feasibility of such a system requires further research. However, the equipment and

implementation assumptions of this survey can be altered to respond to cost limitations, restrictions, or demands of particular markets.

5.2 Information Format Guidelines

Several information formats were presented to the respondents for providing traffic information to users. Based on survey responses and research on similar systems, several guidelines are recommended for presenting the traffic information in a clear and concise format that encourages utilization.

The real-time traffic information can be displayed in several formats to accommodate the preferences of different users. One recommendation is to incorporate a base map illustrating the major traffic arteries in the urban area. This map might be color coded to indicate travel speeds and conditions (i.e., green for free flow, yellow for moderate congestion, red for heavy congestion), as well as using markers to denote the location of key traffic-related conditions such as incidents, construction, and signal malfunctions.

Text messages describing the information presented by the map are also recommended. These messages can give a more detailed explanation of the conditions or incidents and can also recommend alternate routes. Travel times might also be included in these messages to indicate the level of congestion. Since drivers are generally aware of the travel times under normal peak period conditions, they can use the travel times to decide for themselves if the conditions are severe enough to divert to an alternative travel route.

Since severe weather conditions have an affect on roadway travel, the display of these conditions is also suggested. These messages can enable drivers to change travel routes and departure times if necessary to avoid hazardous traveling conditions.

A primary recommendation is to place the time of the information update on the screen. Various research reports have indicated that commuters do not always believe traffic information to be accurate and timely. By presenting the time of the update on the screen, the user is immediately aware of the timeliness of the report and can have confidence that the information provided is as accurate as possible.

6. FINDINGS & RECOMMENDATIONS

Advanced traffic information systems are unique in that they can provide real-time traffic information to a substantial driver population on a large scale, at the work place, rather than in the vehicle or at home. They would allow the commuter to make choices concerning his or her trip before leaving the office. By providing drivers with this pre-trip planning option, the existing transportation network could also be more efficiently utilized. This improved utilization could translate into decreased urban congestion, driver delay, and fuel consumption which reduce the overall cost of congestion on the entire urban area.

As indicted by the survey results, some employers are not willing to pay for an advanced information system that provides traffic information. Although the information provided might be cost beneficial, convincing employers to consider making an out-of-pocket payment may be difficult. If such an advanced system is to be utilized, it might need to be provided at a lower cost to the provider or the commuter. An alternative to fully charging the user or employer for the information is to subsidize the cost of the system with advertising dollars. More research is needed to fully determine the best method of disseminating and funding motorist information to the commuter using this technology.

Public awareness is an important contributor to system success. If the system is to be cost-effective, potential users need to know of its existence and the information it provides to the commuter. Public relations efforts should be included with system implementation to increase public awareness and utilization. Bulletins or newsletters could be distributed on a regular basis to inform users of any changes or upgrades in the system and to provide any general information on the system that might be of particular interest. The newsletter could also provide a forum for soliciting public opinion regarding the system.

The recommendations previously mentioned in association with the implementation of the system and the format of the information are directed toward maximizing utilization. Without utilization, the system cannot achieve its purpose of providing accurate and timely traffic information to users. The timeliness and accuracy of the information are crucial to establishing

credibility and maintaining the confidence of the users. Without the confidence that the information is correct, the utilization cannot be maintained and the benefits cannot be reached.

The guidelines for providing traffic information to commuters at the work place in an effective and useful manner can be expanded to include other venues (i.e., homes, airports, bus stations, transit facilities). This expansion only broadens the target audience and increases the impact on urban congestion. Furthermore, it could be implemented into broader IVHS programs as technology permits.

The results of this study can be implemented in any major urbanized area in the state, particularly those planning a comprehensive advanced traffic management system of which this system could be a part. The criteria and guidelines for establishing real-time motorist information systems at the work place can be used to provide traffic information to commuters in other urban areas which experience congested major urban freeway corridors.

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APPENDICES

Appendix A: Data Collection Forms

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Similar Systems

Surveyor: _____

Entity: _____ **Public/Private:** _____

_____

_____

Contact: _____ **Telephone No.:** _____

Title: _____ **Fax No.** _____

1. **Describe the advanced motorist information system in operation at the current time?**

_____

_____

_____

_____

2. **From where is the information obtained?** _____

_____

_____

3. **What agencies/organizations are involved in this process?** _____

_____

_____

_____

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Similar Systems

4. **In what manner is the information delivered to users?** _____

5. **What type of hardware do you use?** _____

6. **What type of software do you use?** _____

7. **What type of network do you use?** _____

8. **What communication medium do you use between main system and users?** _____

9. **How do you monitor the accuracy/timeliness of the information used?** _____

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Similar Systems

10. **Who uses the system?** _____

_____

_____

11. **Have any research reports been written that we could use as background information?**

_____

_____

_____

Thank you for your cooperation.

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Traffic Advisory Services

Surveyor: _____

Entity: _____ **Public/Private:** _____

Address: _____

_____

_____

Contact: _____ **Telephone No.:** _____

Title: _____

1. **What is your method of obtaining information?** _____

_____

_____

_____

2. **Is the information on a computer network?** _____

_____

_____

3. **Who are your clients?** _____

_____

_____

_____

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Traffic Advisory Services

4. **How many clients do you serve?** _____

5. **What is the cost of the service to the clients?** _____

6. **How do you transmit the information to clients?** _____

7. **What type of hardware do you use?** _____

8. **What type of software do you use?** _____

9. **Are there any federal/state requirements/regulations under which you must operate?**

Date _____

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Telephone Survey - Traffic Advisory Services

10. **Are there any liabilities associated with your service?** _____

_____

_____

_____

11. **How do you monitor the accuracy/timeliness of the information?** _____

_____

_____

Thank you for your cooperation.

TEXAS TRANSPORTATION INSTITUTE

SYSTEM IMPLEMENTATION AND EVALUATION PROGRAM
701 N. Post Oak, Suite 430
Houston, Texas 77024

Houston
(713) 686-2971
850-1390 (TexAn)

May 25, 1993

Dear Business Executive:

Tired of getting caught in traffic jams? Frustrated by roadway construction? Wouldn't it help to know what the traffic on freeways and roadways is like before leaving work? Well, the Texas Department of Transportation (TxDOT) wants to help drivers do just that.

A study is being performed for TxDOT by the Texas Transportation Institute, part of the Texas A&M University System, to examine the potential uses and applications of Advanced Motorist Information Systems in the work place. An Advanced Motorist Information System provides real-time information about traffic and travel conditions on the freeways and arterial roadways. Examples of the type of information available with these systems include: updates of current traffic conditions, status on road construction and lane closures, location of disabled vehicles, intersections where traffic signals are malfunctioning, and other problems on freeways and roadways. In addition, the systems can also provide current weather, sports, and news information, as well as custom in-house bulletin board information. These systems can aid employees in making decisions on travel routes and departure times to avoid congestion and minimize their travel time home from work.

The information is displayed in the office using one of the four possible alternatives shown on the following page. It is continuously updated when new reports are received. The benefits of such systems include decreased roadway congestion, decreased driver delay and costs, as well as a decrease in fuel consumption and air pollution.

Survey forms are being sent to randomly selected businesses in the Austin, Dallas, Fort Worth, Houston, and San Antonio areas. Please take a few moments to review the four alternative systems illustrated on the following page, fill out the enclosed survey, and return the survey in the enclosed postage-paid envelope. All information you provide will remain strictly confidential. The data will be used for statistical purposes only. Your timely return and cooperation in this survey effort is greatly appreciated.

Sincerely,

Beverly A. Thompson
Assistant Research Scientist

Enclosures

MOTORIST INFORMATION SYSTEM SURVEY

1. **Would you be interested in providing real-time traffic information to your employees?**

   ___ Yes ___ No

****

Questions 2-4 relate to those who answered YES to Question 1. If you answered NO to Question 1, please skip to Question 5.

2. **If yes, why? (Select all that apply.)**

   ___ To Improve Morale of Employees
   ___ To Encourage Flexible Time for Employees
   ___ To Provide Potential for Time Savings to Employees
   ___ To Provide Potential for Cost Savings to Employees
   ___ Other (briefly describe) _____

3. **After reviewing the alternatives shown on the attached sheet, which alternative do you prefer?**

   ___ Alternative 1 ___ Alternative 2 ___ Alternative 3 ___ Alternative 4

4. **In selecting this alternative, what factors influenced you? (Select all that apply.)**

   ___ Type of Information Provided
   ___ Cost
   ___ Other (briefly describe) _____

Please skip to Question 7.

****

5. **Why would you <u>not</u> want to provide this information to your employees? (Select all that apply.)**

   ___ Type of Business Does Not Warrant Its Use
   ___ Would Not Be Used by Employees
   ___ Cost is Too High
   ___ Other (briefly describe) _____

6. **If you chose cost in Question 5, what would you consider a reasonable price for this service?**

   ___ Would Not Pay ___ $200 Per Month ___ $400 Per Month
   ___ $100 Per Month ___ $300 Per Month

7. **Which category best describes your business?**

   ___ Contract Construction
   ___ Finance, Insurance, Real Estate
   ___ Manufacturing
   ___ Retail
   ___ Services
   ___ Transportation, Communications, Utilities
   ___ Wholesale
   ___ Other _____

8. **How many full-time employees are in your company?** _____

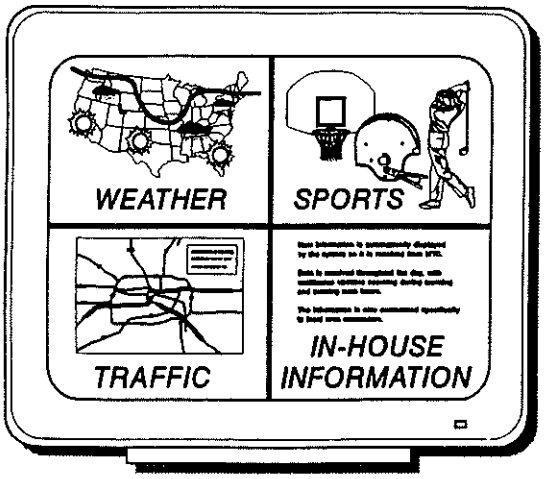
9. **Which major freeway is located nearest to your office? (Select only one.)**

   ___ IH 10 ___ IH 610 ___ US 59 ___ Other _____
   ___ IH 45 ___ US 290 ___ SH 288

10. **On the back of this questionnaire, please provide any additional comments or suggestions.**

Thank you for your time and participation.

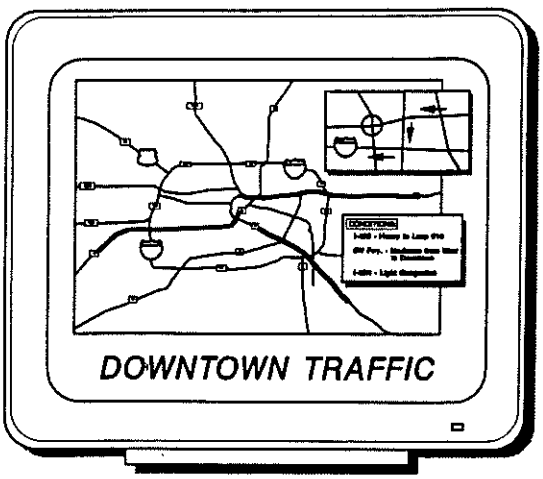
ALTERNATIVE - 1



ɔmplete video information computer monitor; option of her interactive or non-interactive; full color, high resolution stem providing real-time traffic and mobility information, eather conditions, headline news, sports, and inhouse dates and information; animated and still graphics, rmatted to individual client's needs

Monthly Fee - $1,500.00

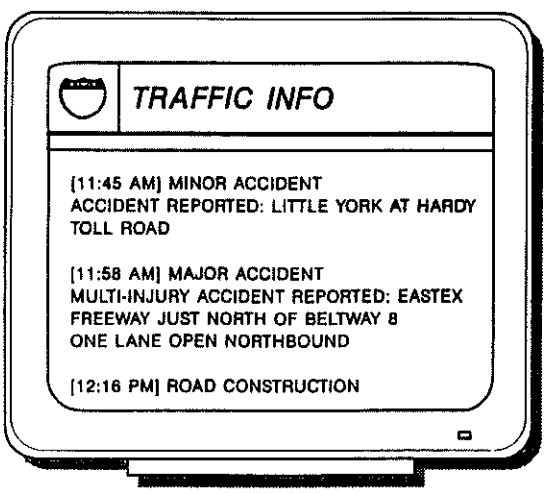
ALTERNATIVE - 2



Full color, high resolution computer, interactive, providing real-time traffic and mobility information in text, color maps and still graphics

Monthly Fee - $1,250.00

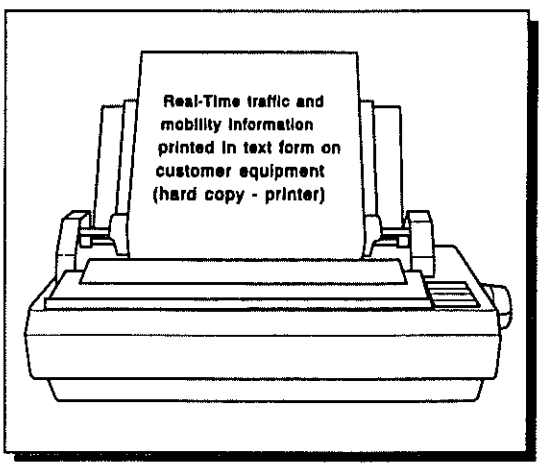
ALTERNATIVE - 3



ll color, high resolution computer monitor, providing real-ne traffic and mobility information presented in text and l graphics

Monthly Fee - $1,000.00

ALTERNATIVE - 4



Real-time traffic and mobility information printed in text form on customer equipment (hard copy - printer)

Monthly Fee - $ 500.00

Appendix B: Survey Response Data

Date: 28 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location: Ford Freeway - Detroit, Michigan

Entity: Michigan DOT

Project: DIRECT

Public/Private: Public/Private

Contact: Dr. Rajendra

Surveyor: Dennis Smalley

Summary:

DIRECT is a public/private partnership test project that stands for Driver Information Radio Experimenting with Communication Technologies. It is a national IVHS project designed to test alternative driver-information systems. It is being funded by the Federal Highway Administration, the Michigan Department of Transportation, and several automobile and electronic component manufacturers.

Providing drivers with real-time information about the highway environment along with diversion advice has been identified as a key component of an incident management system. The DIRECT project focuses on how to present information to the driver in such a manner that it is most effective. The following voice-message delivery systems will be evaluated over the course of the project in order to address this issue: (1) low-power highway advisory radio (LPHAR) with flashing signs; (2) automatic highway advisory radio (AHAR); (3) broadcast voice/data channel (BVDC); and (4) cellular call-in (CCI). Each of the aforementioned systems varies according to initial cost to the driver and the method of disseminating information.

The DIRECT project is being conducted along the Ford Freeway (I-94) in Detroit. Each of the message delivery systems operates independently of the others. Thirty test vehicles are equipped with the appropriate receivers for each of the transmission methods.

Date: 28 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

The Transportation Advisory Center (TAC) receives information from a variety of outside sources (Michigan Emergency Patrol, WJR and WWJ radio traffic-copters, Michigan State Police communications) as well as internally from video data and surveillance data (16 cameras at 6 video sites, 4 inductive loop sites, and 1 weather-pavement condition monitoring sensor system). The information is formulated by technicians and then reviewed and approved by the operator. It is then disseminated through the Infrastructure Communications Subsystem (ICS) to the remote sites where it is broadcast to the drivers.

The ICS has hardware necessary to transmit roadside surveillance and status data to the TAC as well as providing TAC-generated advisory messages to the test vehicles. Communication between all facets of the system takes place through various mediums including fiber optic cable, coaxial cable, and radio frequency transmissions that might include digital trunking, spread spectrum, or microwave.

Four voice-based message-delivery mechanisms will be evaluated with respect to the following items: (1) cost to the driver, (2) the need for new standards, (3) the degree of driver control over the dissemination of the information, and (4) the utilization of existing technologies.

Date: 29 September 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location: Chicago, Illinois

Entity: Illinois DOT

Project: ADVANCE

Public/Private: Public & Private

Contact: Joe Ligas

Surveyor: Beverly A. Thompson

Additional Source: *ADVANCE: Advanced Driver and Vehicle Advisory Navigation Concept.* Publication No. FHWA-AD-91-006. Washington, DC: Federal Highway Administration, U.S. Department of Transportation, 1991.

Summary:

ADVANCE is a public-private partnership project sponsored by the Illinois Department of Transportation currently in the organization stages. Full operation is expected by Fall of 1993. The system will consist of an in-vehicle navigation system, and the network will consist of 5000 private vehicle probes covering an area of approximately 300 square miles. These probes will provide more reports and more information to help provide reliable traffic information to users. ADVANCE plans to have 20 probes operating by the end of the 1992 calendar year with full operation of all 5000 probes by Fall 1993.

The traffic information will be obtained from the 5000 probe vehicles, closed-loop traffic signal systems within the project area (probably only one corridor), one route in the expressway surveillance system, and possibly from the AVI system to be implemented by the tollway authority. Further information will be obtained from state and local police agencies, the area's emergency service accessible to users by dialing *999, and area traffic advisory services. It is important to note that the closed-loop traffic signal systems will probably require additional detectors since they are inherently designed to give only presence information and not real-time information. The following agencies are or will be involved in the project in both design and research capacities as well as information capacities: Illinois Department of Transportation,

Date: 29 September 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Motorola, Federal Highway Administration, Illinois University Transportation Research Center Consortium consisting currently of the University of Illinois at Chicago and Northwestern University, state and local police agencies, area emergency service, and local traffic advisory services.

Primarily, there will be 5000 private vehicle users that will act as probes for the system. A secondary market may be the general public, but research and analysis of the primary system is necessary before a final decision can be made on this phase. The information will be provided to primary users through an in-vehicle navigation system. A secondary method to provide information to the general public has yet to be determined. An evaluation of the primary system is necessary before proceeding with expanding the user base. The hardware for the in-vehicle navigation system will be designed and manufactured by Motorola. The design of the software for the in-vehicle navigation system will be the responsibility of Motorola. The software for use at the Traffic Information Center will be designed by the University of Illinois at Chicago. The traffic information will be provided to the users through a high-speed data radio.

Date: 12 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location: Chesapeake Bay Area - Maryland and Washington, DC

Entity: Maryland Department of Transportation State Highway Administration

Project: CHART
Chesapeake Highway Advisories Routing Traffic

Public/Private: Public

Contact: Stephen R. Kuciemba

Surveyor: Dennis Smalley

Additional Source: Kassoff, Hal. "Maryland's CHART Program: A New Model for Advanced Traffic Management Systems." In *ITE Journal*, Vol. 62, No. 3. Washington, DC: Institute of Transportation Engineers, March 1992.

Summary:

Chesapeake Highway Advisories Routing Traffic (CHART) is a program aimed at responding to non-recurring congestion along interstate and primary highway systems in the Chesapeake Bay area (Maryland and Washington). Its focus is to broadcast information to advise, warn, or provide alternate route information to motorists in order to reduce the impacts of incidents. Its three tasks are: (1) to engage in congestion monitoring and detection; (2) to provide motorist information and guidance; and (3) to implement incident response and service. The project covers an area of 400 miles of freeway and 400 miles of major arterial roadways.

Information is obtained from various sources including Maryland State Police, the State Highway Administration (SHA) Traffic Operations Center (TOC) field personnel in Emergency Traffic Patrol Vehicles or mobile CHART communications vehicles, SHA monitoring stations, various media sources, cellular phone calls, other Maryland Department of Transportation agencies, local governments, as well as future IVHS projects, such as the Video Imaging Detection Systems, planned for the area. The following agencies are involved in the process: Maryland State Police, Maryland DOT State Highway Administration, Maryland Transportation Authority, political subdivision agencies, Federal Highway Administration, adjacent states, utility companies, and public media.

Date: 12 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Motorists, highway users, the general public, and the media are those that use the information provided by the program. Information is delivered to them through the use of Variable Message Signs (VMS), Travelers Advisory Radios (TAR), and through the media. Fiber optics are used to communicate between TOCs and the VMS, and radio signals are used to deliver information via TAR. SHA and MSP personnel continually control the TAR and VMS systems from the TOCs to provide accurate information. They also use information from MSP radios, CB radios, cellular phone calls, as well as Emergency Repair Units equipped with cellular phones. Eventually, automatic surveillance via CCTV will be used to ensure accuracy and timeliness of information.

Date: 20 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location/Entity: Oakland Co., Michigan

Project: Fast-Trac IVHS Program

Public/Private: Public

Contact: James C. Barbaresso

Surveyor: Dennis Smalley

Additional Source: Barbaresso, James. "Overview of the Fast-Trac IVHS Program." Beverly Hill, MI: Road Commission for Oakland County, August 1992.

Summary:

Fast-Trac is an IVHS program that stands for Faster and Safer Travel through Traffic Routing and Advanced Controls and is sponsored by the Road Commission for Oakland County, Michigan. It consists of an integrated system using an advanced traffic management system using the Sydney Coordinated Adaptive Traffic System (SCATS), Autoscope advanced traffic sensors, and an advanced traveler information system using the Siemens Ali-Scout real-time traffic routing system. Its strategy is to optimize the traffic signal system while using real-time information to provide route guidance information to drivers.

SCATS obtains information from local signal controllers. Other information regarding construction and incidents is obtained from Michigan State Police, emergency services, public transportation, the Michigan Department of Transportation, the Metropolitan Transportation Center, and GIS video surveillance. The following agencies are involved: Michigan Department of Transportation Metropolitan Transportation Center, Federal Highway Administration, Michigan State Police, emergency services, and GIS.

Currently, 60 public transit vehicles are equipped with the system. The traveler information is provided through a navigational display in the vehicle as well as through voice messages. SCATS uses computers from the Digital Equipment Corporation, and includes individual computers, regional computers, and a management computer, all connected via voice-grade phone line. Autoscope uses its own detectors. The Ali-Scout system uses a central computer with route guidance information, roadside infra-red beacons, and on-board navigation

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

systems with computers. Each system uses its own software, and the traffic signals are connected to the SCATS computers via voice-grade phone lines. The Ali-Scout system is connected through an infra-red communication system. Infra-red communication lines connect the vehicle on-board navigation systems to the roadside beacons and the Ali-Scout system. Information provided through Michigan Department of Transportation and the Michigan State Patrol is used to monitor the timeliness of information.

Date: 23 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems
Task 1.2 - Technological Alternative Study

Survey - Similar Systems

Location: Twin City Metropolitan Area - Minneapolis and St. Paul, Minnesota

Entity: Minnesota DOT

Project: Minnesota Guidestar

Public/Private: Public

Contact: Mike Sobolewski

Surveyor: Dennis Smalley

Additional Source: Castle Rock Consultants. *The Minnesota Guidestar Program: Final Report.* St. Paul, MI: Castle Rock Consultants, May 1992.

Summary:

Minnesota Guidestar is a statewide intelligent vehicle system, sponsored by the Minnesota Department of Transportation (MnDOT), currently focused on the Twin City Metropolitan Area (Minneapolis and St. Paul). It includes a combination of the following components: Advanced Traffic Management Systems, Advanced Traveler Information Systems, Advanced Public Transportation Systems, Commercial Vehicle Operations, and Advanced Vehicle Control Systems. Its focus is to provide information to help reduce congestion and enhance mobility, to improve safety, and to reduce environmental impacts of transportation.

Information will be obtained from various sources including ramp meters, closed circuit television systems, call boxes, area-wide surveillance and detection systems, freeway surveillance and ramp control, fiber-optic communication, Autoscope machine vision cameras, traffic signal inductive loops, automatic traffic recorders, police in-vehicle terminals, radar monitors, and smart car probe monitors. Involved agencies include Minnesota Department of Transportation, State Highway Patrol, and the local transportation and police agencies.

A variety of systems and methods for providing information to travelers will exist including FM radio, highway advisory radio, in-vehicle systems, cable television traffic channel, teletext traffic information services, videotext information systems, portable digital personal

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems
Task 1.2 - Technological Alternative Study

Survey - Similar Systems

communication devices, high data rate sideband information systems, 2-way digital cellular radio, and digital audio broadcasting. The hardware used varies according to the system concerned. The software used, like the hardware, varies according to the system concerned. Various communications networks will be used including fiber optics, conventional radio, spread-spectrum radio, satellite communication, hard-wired connectors, leased telephone lines, and dial-up telephone lines. Various mediums will be used to communicate between the main system and the users including telephone lines, cellular communication signals, radio signals, and television signals. The information will be real-time based on the continuous flow of information from the aforementioned sources. Citizens as well as commercial businesses will use the system.

Date: 13 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location: Santa Monica Freeway - Los Angeles Area

Entity: Caltrans

Project: Pathfinder Project

Public/Private: Public/Public

Contact: Goro Endo

Surveyor: Beverly A. Thompson

Summary:

Pathfinder is a public/private project sponsored by California Department of Transportation (Caltrans). It is an experimental project which involves testing of an in-vehicle motorist information and road navigation system. Its objectives are to provide information on accidents, congestion, highway construction, and alternate routes to motorists via in-vehicle systems. The project is taking place within the "Smart Corridor", a 13-mile stretch of the Santa Monica Freeway in southern California which includes the freeway, service roads, and five parallel arterials roads. Twenty-five (25) vehicles are currently equipped with the system.

The traffic information provided to the users is culminated from various sources which include: (1) Caltrans Semi Automated Traffic Management System (SATMS) which provides congestion data from the freeway; (2) LADOT Automated Traffic Surveillance and Control System (ATSAC) which provides data from arterial streets; (3) incident data obtained from police agencies; (4) Caltrans construction and maintenance reports; and (5) the Pathfinder equipped vehicles. The following agencies and/or organizations are involved in the information process: Caltrans, Federal Highway Administration, California Highway Patrol, Los Angeles Police Department, service patrols, and the motorist call boxes.

At present, 25 commuters use the system in the Pathfinder equipped vehicles. The potential market for the system includes commuters, drivers that will participate in an origin-destination study associated with Pathfinder, and commercial companies. The information is provided to the users in three manners which include congestion symbols on the in-vehicle display screen, text messages on the display screen, and digitally recorded voice messages. The

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

in-vehicle system consists of: (1) an ETAK Travelpilot display, processor, compact disc player, and sensors; (2) the Pathfinder vehicle processor system which uses an Ampro single board microcomputer with a synthesizer/digitizer board; and (3) a communications system which includes a DataRadio Modem Datalink Controller, a Motorola radio and an antenna. The Central System consists of the Pathfinder workstation, the ETAK workstation, a packet radio communications system, and communications links to external computer systems. The in-vehicle system uses the ETAK system of map matching navigation system and Pathfinder software. Others are assumed to be software specifically developed for the project by participating corporations or agencies based on Structured Query Language interface. The Pathfinder workstation communicates with the individual Pathfinder vehicles using packet radio transmitting at 4800 bps on 419.975 MHz using a Data-Radio Corporation MDLC modem and a Motorial MCX-1000 30 watt mobile radio. Accuracy and timeliness of information is accomplished by monitoring incident, construction, and maintenance data provided by involved agencies, by information provided to the central control system by the two-way radio communications with the vehicles, and by monitoring communications errors with the vehicles by a central control operator.

Date: 12 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems

Survey - Similar Systems

Location: New York Metropolitan Area

Entity: TRANSCOM

Public/Private: Public

Contact: Tom Batz

Surveyor: Beverly A. Thompson

Additional Source: *The Utility of Real-Time Traffic Information in Trucking Operations.* TRANSCOM. Alexandria, VA: ATA Foundation, 1991.

Summary:

TRANSCOM is a congestion management program demonstration project aimed at providing real-time traffic incident information to seventeen trucking companies in the New York metropolitan area. Its objectives are to (1) identify trucking companies' needs regarding operations; (2) determine benefits from use of real-time traffic incident information; (3) identify additional information sources for interagency network; and (4) examine feasibility of marketing to truckers in the region.

The traffic information is obtained from various public transportation and traffic information agencies in the New York-New Jersey region. Other agencies include over 100 highway police, transit agencies, traffic reporting services, and local police departments. The following agencies are members of TRANSCOM: Metropolitan Transportation Authority, NJ Transit, New Jersey Department of Transportation, New Jersey Highway Authority, New Jersey State Police, New Jersey Turnpike Authority, New York City Department of Transportation, New York State Department of Transportation, New York State Police, New York State Thruway Authority, Palisades Interstate Park Commission, Port Authority of New York and New Jersey, Port Authority Trans-Hudson Corporation, and Triborough Bridge and Tunnel Authority.

Various companies participated in the demonstration project. The information was transmitted from TRANSCOM to the individual agencies by means of an alpha-numeric pager system. The pager can receive a message of up to 70 characters, and the message remains in the

pager and is also transferred to hard copy form through a connected printer. Weekly Traffic and Transit Advisory reports and updates were sent via facsimile machine (2-3 per week).

The information between TRANSCOM and the individual agencies is transmitted via alpha-numeric pager and facsimile machine. Information is disseminated from agencies (trucking companies) to individual drivers through two-way communication systems or is used to determine dispatching, loading, or routing changes. TRANSCOM maintains the accuracy of the information through continuous communication with participating agencies.

Date: 14 December 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems
Task 1.2 - Technological Alternative Study
Task 1.3 - Potential Market Study

Survey - Traffic Advisory Services

Location: Chicago, Illinois

Entity: Shadow Broadcast Services

Public/Private: Private

Contact: Jay Trotsky

Surveyors: Beverly Thompson, Nada Trout

Summary:

Shadow Broadcast Services, Inc. based in Chicago provides a traffic information service to customers in various cities in the United States. Traffic information is obtained with air units (airplane and helicopter), mobile units (cellular phone), and will eventually have fixed cameras to monitor key locations throughout the area. Information is also obtained from state and local agencies on lane closures, maintenance, and incidents.

The exact number of clients is unknown, although the numbers reach into the thousands in some areas such as New York. The cost of the service to the client depends on the type of service provided. The information is transmitted to clients through monitors in building lobbies and garages and through radio reports. Shadow can provide the service for peak periods of the day or on a 24-hour basis. For example, they have some projects where traffic reports are made over a low power station in parking garages during peak periods only (similar to Highway Advisory Radio, HAR). The software to run the system is developed in-house, and the information is monitored through a cross-reference system every fifteen minutes.

Date: 14 December 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems
Task 1.2 - Technological Alternative Study
Task 1.3 - Potential Market Study

Survey - Traffic Advisory Services

Location: Baltimore, Maryland

Entity: Metro Traffic Control

Public/Private: Private

Contact: Kelly Makant

Surveyor: Beverly Thompson, Nada Trout

Summary:

Metro Traffic Control, Inc. is a traffic advisory service company based in Baltimore that has a range of traffic information services available to customers in various cities in the United States. Information for the service is obtained using aircraft, mobile units, fixed based observers, police, and public and private agencies. It is also part of the TRAVSTAR project which is an IVHS Advanced Traveler Information System in New Jersey. TRAVSTAR will gather and disseminate real-time traffic and mobility information to individual commuters on a specified commuter corridor in New Jersey. The information will be gathered from Metro Traffic Control, Inc. and various automated methods including speed detection through infrared, induction loop, and toll tags.

The type of client varies and includes truck drivers, businesses and industries, cellular telephone subscribers, corporations, property management groups, automobile clubs, and car rental agencies. The cost of the service to the client varies according to the type of service desired. The information is provided to the client in a variety of computer-based formats and transmitted over telephone lines.

Date: 22 October 1992

TTI PROJECT #30100: FEASIBILITY OF REAL-TIME SYSTEMS
Task 1.1 - Review of Similar Systems
Task 1.2 - Technological Alternative Study
Task 1.3 - Potential Market Study

Survey - Traffic Advisory Services

Location: San Francisco Area

Entity: Fastline (Formerly InfoAccess, Inc.)

Public/Private: Private

Contact: Steve Wollenberg

Surveyor: Nada Trout

Summary:

Fastline, Inc. is a company out of San Francisco that provides traffic information to the public via telephone line. Information is obtained from airport (airplane and helicopter) units that gather traffic information for them as well as for TV and radio stations. There is also a computer aid dispatch system that includes information from Caltrans (information on lane closures, maintenance, incidents, etc.), cellular phones, call boxes, and air quality.

Fastline clients include the general public, all local transit facilities, and ride share organizations. Information on parking for special events is provided as well as air quality information on the severity of the ozone pollution. When pollution is severe, employer trip reduction is required and alternate travel arrangements are encouraged. The exact number of clients is unknown since the service is available at no cost through a free phone line.

The traffic information is transmitted using a telephone line with an available menu. The system uses a PC compatible program with a digitally stored voice and the software is developed in-house. They operate under no federal or state requirements and regulations, and there are no liabilities since the service is free to users.

The service doesn't monitor the accuracy of the information. They have considered it but do not have a good base on it. They conduct their own surveys on misinformation and effectiveness.

Q1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	18	23.1	18	23.1
No	60	76.9	78	100.0

Frequency Missing = 5

Q2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Morale	21	50.0	21	50.0
Flexible	14	33.3	35	83.3
Other	5	11.9	40	95.2
Time Savings	2	4.8	42	100.0

Q3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Alt 1	4	21.1	4	21.1
Alt 2	5	26.3	9	47.4
Alt 3	6	31.6	15	78.9
Alt 4	4	21.1	19	100.0

Frequency Missing = 64

Q4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Type of Info	18	72.0	18	72.0
Cost	6	24.0	24	96.0
Other	1	4.0	25	100.0

Q5	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Type of Bus.	67	54.0	67	54.0
Cost is High	37	29.8	104	83.9
Other	16	12.9	120	96.8
Would not be	4	3.2	124	100.0

Q6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Would not pay	32	66.7	32	66.7
100 per month	9	18.8	41	85.4
200 per month	4	8.3	45	93.7
300 per month	2	4.2	47	97.9
400 per month	1	2.1	48	100.0

Frequency Missing = 35

Q7	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Contract const	7	9.3	7	9.3
Finance	6	8.0	13	17.3
Manufacturing	21	28.0	34	45.3
Retail	7	9.3	41	54.7
Services	24	32.0	65	86.7
Transportation	6	8.0	71	94.7
Wholesale	3	4.0	74	98.7
Other	1	1.3	75	100.0

Frequency Missing = 8

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	9	10.8	9	10.8
20	1	1.2	10	12.0
40	1	1.2	11	13.3
47	1	1.2	12	14.5
49	1	1.2	13	15.7
50	2	2.4	15	18.1
70	1	1.2	16	19.3
75	1	1.2	17	20.5
80	2	2.4	19	22.9
90	1	1.2	20	24.1
95	1	1.2	21	25.3
98	1	1.2	22	26.5
100	5	6.0	27	32.5
120	3	3.6	30	36.1
125	1	1.2	31	37.3
140	1	1.2	32	38.6
150	2	2.4	34	41.0
165	3	3.6	37	44.6
167	1	1.2	38	45.8
168	1	1.2	39	47.0
170	1	1.2	40	48.2
175	1	1.2	41	49.4
200	8	9.6	49	59.0
215	1	1.2	50	60.2
230	1	1.2	51	61.4
240	1	1.2	52	62.7
250	2	2.4	54	65.1
263	1	1.2	55	66.3
300	4	4.8	59	71.1
325	1	1.2	60	72.3
345	1	1.2	61	73.5
350	2	2.4	63	75.9
353	1	1.2	64	77.1
374	1	1.2	65	78.3
375	1	1.2	66	79.5
400	3	3.6	69	83.1
439	1	1.2	70	84.3
530	1	1.2	71	85.5
550	1	1.2	72	86.7
600	1	1.2	73	88.0
606	1	1.2	74	89.2
650	1	1.2	75	90.4
800	3	3.6	78	94.0
850	1	1.2	79	95.2
1,100	1	1.2	80	96.4
2,000	1	1.2	81	97.6
2,500	1	1.2	82	98.8
7,500	1	1.2	83	100.0

CITY=A

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	6.7	1	6.7
47	1	6.7	2	13.3
120	1	6.7	3	20.0
140	1	6.7	4	26.7
150	1	6.7	5	33.3
175	1	6.7	6	40.0
200	2	13.3	8	53.3
240	1	6.7	9	60.0
250	1	6.7	10	66.7
345	1	6.7	11	73.3
400	1	6.7	12	80.0
600	1	6.7	13	86.7
650	1	6.7	14	93.3
2,500	1	6.7	15	100.0

CITY=D

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
80	1	7.1	1	7.1
120	1	7.1	2	14.3
150	1	7.1	3	21.4
200	4	28.6	7	50.0
230	1	7.1	8	57.1
300	1	7.1	9	64.3
350	1	7.1	10	71.4
400	1	7.1	11	78.6
530	1	7.1	12	85.7
800	1	7.1	13	92.9
7,500	1	7.1	14	100.0

CITY=F

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	3	21.4	3	21.4
50	1	7.1	4	28.6
80	1	7.1	5	35.7
90	1	7.1	6	42.9
95	1	7.1	7	50.0
100	2	14.3	9	64.3
125	1	7.1	10	71.4
200	1	7.1	11	78.6
250	1	7.1	12	85.7
375	1	7.1	13	92.9
850	1	7.1	14	100.0

CITY=H

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	4	15.4	4	15.4
75	1	3.8	5	19.2
98	1	3.8	6	23.1
100	1	3.8	7	26.9
165	1	3.8	8	30.8
167	1	3.8	9	34.6
170	1	3.8	10	38.5
200	1	3.8	11	42.3
215	1	3.8	12	46.2
263	1	3.8	13	50.0
300	3	11.5	16	61.5
325	1	3.8	17	65.4
350	1	3.8	18	69.2
353	1	3.8	19	73.1
374	1	3.8	20	76.9
400	1	3.8	21	80.8
550	1	3.8	22	84.6
606	1	3.8	23	88.5
800	1	3.8	24	92.3
1,100	1	3.8	25	96.2
2,000	1	3.8	26	100.0

CITY=S

Q8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	7.1	1	7.1
20	1	7.1	2	14.3
40	1	7.1	3	21.4
49	1	7.1	4	28.6
50	1	7.1	5	35.7
70	1	7.1	6	42.9
100	2	14.3	8	57.1
120	1	7.1	9	64.3
165	2	14.3	11	78.6
168	1	7.1	12	85.7
439	1	7.1	13	92.9
800	1	7.1	14	100.0

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IH 35	6	42.9	6	42.9
US 183	3	21.4	9	64.3
Loop 1	5	35.7	14	100.0

Frequency Missing = 1

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IH 20	1	7.7	1	7.7
IH 30	1	7.7	2	15.4
IH 35E	5	38.5	7	53.8
IH 45/US 75	1	7.7	8	61.5
IH 635	2	15.4	10	76.9
SH 183	2	15.4	12	92.3
Dallas NT	1	7.7	13	100.0

Frequency Missing = 1

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IH 20	2	16.7	2	16.7
IH 30	3	25.0	5	41.7
IH 35W	2	16.7	7	58.3
IH 820	3	25.0	10	83.3
US 287	1	8.3	11	91.7
SH 121	1	8.3	12	100.0

Frequency Missing = 2

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IH 10	5	21.7	5	21.7
IH 45	6	26.1	11	47.8
IH 610	5	21.7	16	69.6
US 290	3	13.0	19	82.6
US 59	1	4.3	20	87.0
SH 288	2	8.7	22	95.7
Other	1	4.3	23	100.0

Frequency Missing = 3

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IH 10	4	30.8	4	30.8
IH 35	2	15.4	6	46.2
IH 37	1	7.7	7	53.8
IH 410	5	38.5	12	92.3
US 281	1	7.7	13	100.0

Frequency Missing = 1

Appendix C: Corridor Zip Codes

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
IH 35	78701 78702 78704 78705 78722 78723 78741 78744 78745 78751 78752 78753	US 183	78702 78721 78723 78724 78725 78741 78742 78743 78744 78752 78753 78754 78757 78758 78759	Loop 1	78703 78727 78731 78735 78739 78746 78749 78756 78757 78758 78759
SH 71	78704 78735 78736 78741 78742 78743 78744 78745	US 290	78723 78724 78751 78752 78754		

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
IH 20	75116 75134 75180 75217 75232 75236 75237 75239 75241 75253	IH 30	75149 75150 75201 75202 75203 75207 75208 75210 75211 75212 75215 75223 75226 75227 75228	IH 35E	75062 75134 75201 75202 75203 75207 75208 75216 75219 75220 75224 75229 75232 75234 75235 75241 75247
IH 45/US 75	75201 75204 75205 75206 75215 75216 75225 75226 75230 75231 75239 75240 75241 75243 75251	IH 635	75041 75043 75149 75150 75180 75217 75218 75228 75229 75230 75234 75238 75240 75243 75244 75251 75253	US 175	75180 75215 75217 75253

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
SH 183	75061 75062 75247	Loop 12	75039 75060 75061 75062 75211 75212 75220 75236	Dallas North Tollway	75205 75209 75219 75220 75225 75229 75230 75235 75240 75244

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
IH 20	76109 76115 76119 76126 76132 76133 76134 76140	IH 30	76102 76103 76104 76107 76108 76110 76111 76112 76116 76120 76127	IH 35W	76102 76104 76106 76110 76111 76115 76134 76131 76137
IH 820	76053 76106 76108 76112 76114 76116 76117 76118 76119 76120 76126 76131 76135 76137 76148 76179 76180	US 287	76102 76103 76104 76105 76119	SH 121	76053 76102 76111 76117 76118 76180

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
IH 45	77002 77004 77006 77009 77010 77017 77019 77022 77023 77037 77038 77060 77067 77076 77087 77088	IH 610	77008 77009 77012 77013 77017 77018 77021 77022 77024 77025 77026 77027 77028 77029 77035 77051 77053 77054 77055 77056 77081 77087 77092 77096 77401	US 59	77002 77004 77005 77006 77010 77020 77021 77026 77027 77031 77032 77036 77056 77057 77074 77081 77095 77098 77099
IH 10	77002 77007 77008 77009 77013 77015 77020 77024 77029 77043 77055 77079	US 290	77008 77040 77041 77065 77092 77095	SH 288	77004 77021 77030 77045 77051 77054

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Corridor	Zip Codes	Corridor	Zip Codes	Corridor	Zip Codes
IH 10	78201 78204 78205 78207 78210 78212 78213 78219 78220 78225 78229	IH 35	78073 78108 78202 78203 78204 78205 78208 78210 78211 78214 78215 78217 78218 78219 78221 78224 78225 78234 78239	IH 410	78073 78201 78209 78211 78213 78214 78216 78217 78218 78219 78220 78221 78222 78223 78224 78227 78228 78229 78230 78234 78235 78236 78238 78239 78242 78245 78252
US 90	78204 78207 78225 78226 78227 78236 78237 78241	US 281	78209 78212 78215 78216	IH 37	78210 78223 78235

Note: Zip code groups identify the survey area along the indicated major highway corridor.

Appendix D: Benefit Cost Analysis Data

1990 Population Characteristics

Population Characteristic	Austin	Dallas	Fort Worth	Houston	San Antonio
1 - Urban Area Population (a)	510000	1990000	1200000	2880000	1170000
2 - City Population (b)	465622	1006877	447619	1630553	935933
3 - Employed City Labor Force (b)	247885	512404	210224	789635	405412
4 - % of City Population in Employed Labor Force Calculation: (#3 / #2) * 100	53%	51%	47%	48%	43%
5 - Urban Area Population in Labor Force Calculation: (#4 * #1)	271511	1012719	563579	1394710	506801
6 - Sample of Employed Labor Force (c)	201448	526541	253929	693473	349066
7 - Sample of Employed Labor Force in HVC (c) HVC - High Volume Freeway Corridors	88464	236053	60353	281623	56405
8 - % of Sample Employed Labor Force in HVC Calculation: (#7 / #6) * 100	44%	45%	24%	41%	16%
9 - Urban Area Employed Labor Force in HVC Calculation: (#8 * #6)	119231.4	454011.1	133950	566399	81893
10 - Employed Represented by Responding Companies (d)	6157	11260	3043	10611	2446
11 - Employed Represented by Affirmative Responses (d)	1900	2250	940	713	268
12 - % of Employed in Potential Market in HVC Calculation: (#11 / #10) * 100	31%	20%	31%	7%	11%
13 - Potential Market in HVC Calculation: (#12 * #9)	36794	90722	41378	38059	8973

Notes:

(a) - Schrank, Turner, & Lomax, "Estimates of Urban Roadway Congestion - 1990"
(b) - 1990 Census of Population and Housing
(c) - Business Directories: Austin, Dallas, Fort Worth, Houston, San Antonio
(d) - Survey Data

Time Savings Benefit Analysis

Assumptions: 60% Utilization by Company Employees
250 Work Days Per Year

Calculation: ($10/HR)(HR/60 MIN)(SAVINGS)(POTENTIAL MARKET)(60%)(250 DAYS/YR)/1,000,000

Dollar Savings Per Year (Millions)

	Urban Area				
Time Savings Per Person In Minutes	Austin	Dallas	Fort Worth	Houston	San Antonio
5	$5	$11	$5	$5	$1
10	$9	$23	$10	$10	$2
15	$14	$34	$16	$14	$3
20	$18	$45	$21	$19	$4

Time Savings Benefit Analysis

Assumptions: 80% Utilization by Company Employees
250 Work Days Per Year

Calculation: ($10/HR)(HR/60 MIN)(SAVINGS)(POTENTIAL MARKET)(80%)(250 DAYS/YR)/1,000,000

Dollar Savings Per Year (Millions)

	Urban Area				
Time Savings Per Person In Minutes	Austin	Dallas	Fort Worth	Houston	San Antonio
5	$6	$15	$7	$6	$1
10	$12	$30	$14	$13	$3
15	$18	$45	$21	$19	$4
20	$25	$60	$28	$25	$6

Time Savings Benefit Analysis

Assumptions: 100% Utilization by Company Employees
250 Work Days Per Year

Calculation: ($10/HR)(HR/60 MIN)(SAVINGS)(POTENTIAL MARKET)(250 DAYS/YR)/1,000,000

Dollar Savings Per Year (Millions)

	Urban Area				
Time Savings Per Person In Minutes	Austin	Dallas	Fort Worth	Houston	San Antonio
5	$8	$19	$9	$8	$2
10	$15	$38	$17	$16	$4
15	$23	$57	$26	$24	$6
20	$31	$76	$34	$32	$7

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# USERS

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
1	$35	$70	$105	$140
2	$70	$140	$210	$280
3	$105	$210	$315	$420
4	$140	$280	$420	$560
5	$175	$350	$525	$700
6	$210	$420	$630	$840
7	$245	$490	$735	$980
8	$280	$560	$840	$1,120
9	$315	$630	$945	$1,260
10	$350	$700	$1,050	$1,400
11	$385	$770	$1,155	$1,540
12	$420	$840	$1,260	$1,680
13	$455	$910	$1,365	$1,820
14	$490	$980	$1,470	$1,960
15	$525	$1,050	$1,575	$2,100
16	$560	$1,120	$1,680	$2,240
17	$595	$1,190	$1,785	$2,380
18	$630	$1,260	$1,890	$2,520
19	$665	$1,330	$1,995	$2,660
20	$700	$1,400	$2,100	$2,800
21	$735	$1,470	$2,205	$2,940
22	$770	$1,540	$2,310	$3,080
23	$805	$1,610	$2,415	$3,220
24	$840	$1,680	$2,520	$3,360
25	$875	$1,750	$2,625	$3,500
26	$910	$1,820	$2,730	$3,640
27	$945	$1,890	$2,835	$3,780
28	$980	$1,960	$2,940	$3,920
29	$1,015	$2,030	$3,045	$4,060
30	$1,050	$2,100	$3,150	$4,200
31	$1,085	$2,170	$3,255	$4,340
32	$1,120	$2,240	$3,360	$4,480
33	$1,155	$2,310	$3,465	$4,620
34	$1,190	$2,380	$3,570	$4,760
35	$1,225	$2,450	$3,675	$4,900
36	$1,260	$2,520	$3,780	$5,040
37	$1,295	$2,590	$3,885	$5,180
38	$1,330	$2,660	$3,990	$5,320
39	$1,365	$2,730	$4,095	$5,460
40	$1,400	$2,800	$4,200	$5,600
41	$1,435	$2,870	$4,305	$5,740
42	$1,470	$2,940	$4,410	$5,880
43	$1,505	$3,010	$4,515	$6,020
44	$1,540	$3,080	$4,620	$6,160
45	$1,575	$3,150	$4,725	$6,300
46	$1,610	$3,220	$4,830	$6,440
47	$1,645	$3,290	$4,935	$6,580
48	$1,680	$3,360	$5,040	$6,720
49	$1,715	$3,430	$5,145	$6,860
50	$1,750	$3,500	$5,250	$7,000
51	$1,785	$3,570	$5,355	$7,140
52	$1,820	$3,640	$5,460	$7,280
53	$1,855	$3,710	$5,565	$7,420
54	$1,890	$3,780	$5,670	$7,560
55	$1,925	$3,850	$5,775	$7,700
56	$1,960	$3,920	$5,880	$7,840
57	$1,995	$3,990	$5,985	$7,980
58	$2,030	$4,060	$6,090	$8,120
59	$2,065	$4,130	$6,195	$8,260
60	$2,100	$4,200	$6,300	$8,400

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# US

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use 5 Minutes	10 Minutes	15 Minutes	20 Minutes
61	$2,135	$4,270	$6,405	$8,540
62	$2,170	$4,340	$6,510	$8,680
63	$2,205	$4,410	$6,615	$8,820
64	$2,240	$4,480	$6,720	$8,960
65	$2,275	$4,550	$6,825	$9,100
66	$2,310	$4,620	$6,930	$9,240
67	$2,345	$4,690	$7,035	$9,380
68	$2,380	$4,760	$7,140	$9,520
69	$2,415	$4,830	$7,245	$9,660
70	$2,450	$4,900	$7,350	$9,800
71	$2,485	$4,970	$7,455	$9,940
72	$2,520	$5,040	$7,560	$10,080
73	$2,555	$5,110	$7,665	$10,220
74	$2,590	$5,180	$7,770	$10,360
75	$2,625	$5,250	$7,875	$10,500
76	$2,660	$5,320	$7,980	$10,640
77	$2,695	$5,390	$8,085	$10,780
78	$2,730	$5,460	$8,190	$10,920
79	$2,765	$5,530	$8,295	$11,060
80	$2,800	$5,600	$8,400	$11,200
81	$2,835	$5,670	$8,505	$11,340
82	$2,870	$5,740	$8,610	$11,480
83	$2,905	$5,810	$8,715	$11,620
84	$2,940	$5,880	$8,820	$11,760
85	$2,975	$5,950	$8,925	$11,900
86	$3,010	$6,020	$9,030	$12,040
87	$3,045	$6,090	$9,135	$12,180
88	$3,080	$6,160	$9,240	$12,320
89	$3,115	$6,230	$9,345	$12,460
90	$3,150	$6,300	$9,450	$12,600
91	$3,185	$6,370	$9,555	$12,740
92	$3,220	$6,440	$9,660	$12,880
93	$3,255	$6,510	$9,765	$13,020
94	$3,290	$6,580	$9,870	$13,160
95	$3,325	$6,650	$9,975	$13,300
96	$3,360	$6,720	$10,080	$13,440
97	$3,395	$6,790	$10,185	$13,580
98	$3,430	$6,860	$10,290	$13,720
99	$3,465	$6,930	$10,395	$13,860
100	$3,500	$7,000	$10,500	$14,000
101	$3,535	$7,070	$10,605	$14,140
102	$3,570	$7,140	$10,710	$14,280
103	$3,605	$7,210	$10,815	$14,420
104	$3,640	$7,280	$10,920	$14,560
105	$3,675	$7,350	$11,025	$14,700
106	$3,710	$7,420	$11,130	$14,840
107	$3,745	$7,490	$11,235	$14,980
108	$3,780	$7,560	$11,340	$15,120
109	$3,815	$7,630	$11,445	$15,260
110	$3,850	$7,700	$11,550	$15,400
111	$3,885	$7,770	$11,655	$15,540
112	$3,920	$7,840	$11,760	$15,680
113	$3,955	$7,910	$11,865	$15,820
114	$3,990	$7,980	$11,970	$15,960
115	$4,025	$8,050	$12,075	$16,100
116	$4,060	$8,120	$12,180	$16,240
117	$4,095	$8,190	$12,285	$16,380
118	$4,130	$8,260	$12,390	$16,520
119	$4,165	$8,330	$12,495	$16,660
120	$4,200	$8,400	$12,600	$16,800

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# US

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
121	$4,235	$8,470	$12,705	$16,940
122	$4,270	$8,540	$12,810	$17,080
123	$4,305	$8,610	$12,915	$17,220
124	$4,340	$8,680	$13,020	$17,360
125	$4,375	$8,750	$13,125	$17,500
126	$4,410	$8,820	$13,230	$17,640
127	$4,445	$8,890	$13,335	$17,780
128	$4,480	$8,960	$13,440	$17,920
129	$4,515	$9,030	$13,545	$18,060
130	$4,550	$9,100	$13,650	$18,200
131	$4,585	$9,170	$13,755	$18,340
132	$4,620	$9,240	$13,860	$18,480
133	$4,655	$9,310	$13,965	$18,620
134	$4,690	$9,380	$14,070	$18,760
135	$4,725	$9,450	$14,175	$18,900
136	$4,760	$9,520	$14,280	$19,040
137	$4,795	$9,590	$14,385	$19,180
138	$4,830	$9,660	$14,490	$19,320
139	$4,865	$9,730	$14,595	$19,460
140	$4,900	$9,800	$14,700	$19,600
141	$4,935	$9,870	$14,805	$19,740
142	$4,970	$9,940	$14,910	$19,880
143	$5,005	$10,010	$15,015	$20,020
144	$5,040	$10,080	$15,120	$20,160
145	$5,075	$10,150	$15,225	$20,300
146	$5,110	$10,220	$15,330	$20,440
147	$5,145	$10,290	$15,435	$20,580
148	$5,180	$10,360	$15,540	$20,720
149	$5,215	$10,430	$15,645	$20,860
150	$5,250	$10,500	$15,750	$21,000
151	$5,285	$10,570	$15,855	$21,140
152	$5,320	$10,640	$15,960	$21,280
153	$5,355	$10,710	$16,065	$21,420
154	$5,390	$10,780	$16,170	$21,560
155	$5,425	$10,850	$16,275	$21,700
156	$5,460	$10,920	$16,380	$21,840
157	$5,495	$10,990	$16,485	$21,980
158	$5,530	$11,060	$16,590	$22,120
159	$5,565	$11,130	$16,695	$22,260
160	$5,600	$11,200	$16,800	$22,400
161	$5,635	$11,270	$16,905	$22,540
162	$5,670	$11,340	$17,010	$22,680
163	$5,705	$11,410	$17,115	$22,820
164	$5,740	$11,480	$17,220	$22,960
165	$5,775	$11,550	$17,325	$23,100
166	$5,810	$11,620	$17,430	$23,240
167	$5,845	$11,690	$17,535	$23,380
168	$5,880	$11,760	$17,640	$23,520
169	$5,915	$11,830	$17,745	$23,660
170	$5,950	$11,900	$17,850	$23,800
171	$5,985	$11,970	$17,955	$23,940
172	$6,020	$12,040	$18,060	$24,080
173	$6,055	$12,110	$18,165	$24,220
174	$6,090	$12,180	$18,270	$24,360
175	$6,125	$12,250	$18,375	$24,500
176	$6,160	$12,320	$18,480	$24,640
177	$6,195	$12,390	$18,585	$24,780
178	$6,230	$12,460	$18,690	$24,920
179	$6,265	$12,530	$18,795	$25,060
180	$6,300	$12,600	$18,900	$25,200

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# US

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
181	$6,335	$12,670	$19,005	$25,340
182	$6,370	$12,740	$19,110	$25,480
183	$6,405	$12,810	$19,215	$25,620
184	$6,440	$12,880	$19,320	$25,760
185	$6,475	$12,950	$19,425	$25,900
186	$6,510	$13,020	$19,530	$26,040
187	$6,545	$13,090	$19,635	$26,180
188	$6,580	$13,160	$19,740	$26,320
189	$6,615	$13,230	$19,845	$26,460
190	$6,650	$13,300	$19,950	$26,600
191	$6,685	$13,370	$20,055	$26,740
192	$6,720	$13,440	$20,160	$26,880
193	$6,755	$13,510	$20,265	$27,020
194	$6,790	$13,580	$20,370	$27,160
195	$6,825	$13,650	$20,475	$27,300
196	$6,860	$13,720	$20,580	$27,440
197	$6,895	$13,790	$20,685	$27,580
198	$6,930	$13,860	$20,790	$27,720
199	$6,965	$13,930	$20,895	$27,860
200	$7,000	$14,000	$21,000	$28,000
201	$7,035	$14,070	$21,105	$28,140
202	$7,070	$14,140	$21,210	$28,280
203	$7,105	$14,210	$21,315	$28,420
204	$7,140	$14,280	$21,420	$28,560
205	$7,175	$14,350	$21,525	$28,700
206	$7,210	$14,420	$21,630	$28,840
207	$7,245	$14,490	$21,735	$28,980
208	$7,280	$14,560	$21,840	$29,120
209	$7,315	$14,630	$21,945	$29,260
210	$7,350	$14,700	$22,050	$29,400
211	$7,385	$14,770	$22,155	$29,540
212	$7,420	$14,840	$22,260	$29,680
213	$7,455	$14,910	$22,365	$29,820
214	$7,490	$14,980	$22,470	$29,960
215	$7,525	$15,050	$22,575	$30,100
216	$7,560	$15,120	$22,680	$30,240
217	$7,595	$15,190	$22,785	$30,380
218	$7,630	$15,260	$22,890	$30,520
219	$7,665	$15,330	$22,995	$30,660
220	$7,700	$15,400	$23,100	$30,800
221	$7,735	$15,470	$23,205	$30,940
222	$7,770	$15,540	$23,310	$31,080
223	$7,805	$15,610	$23,415	$31,220
224	$7,840	$15,680	$23,520	$31,360
225	$7,875	$15,750	$23,625	$31,500
226	$7,910	$15,820	$23,730	$31,640
227	$7,945	$15,890	$23,835	$31,780
228	$7,980	$15,960	$23,940	$31,920
229	$8,015	$16,030	$24,045	$32,060
230	$8,050	$16,100	$24,150	$32,200
231	$8,085	$16,170	$24,255	$32,340
232	$8,120	$16,240	$24,360	$32,480
233	$8,155	$16,310	$24,465	$32,620
234	$8,190	$16,380	$24,570	$32,760
235	$8,225	$16,450	$24,675	$32,900
236	$8,260	$16,520	$24,780	$33,040
237	$8,295	$16,590	$24,885	$33,180
238	$8,330	$16,660	$24,990	$33,320
239	$8,365	$16,730	$25,095	$33,460
240	$8,400	$16,800	$25,200	$33,600

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# US

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
241	$8,435	$16,870	$25,305	$33,740
242	$8,470	$16,940	$25,410	$33,880
243	$8,505	$17,010	$25,515	$34,020
244	$8,540	$17,080	$25,620	$34,160
245	$8,575	$17,150	$25,725	$34,300
246	$8,610	$17,220	$25,830	$34,440
247	$8,645	$17,290	$25,935	$34,580
248	$8,680	$17,360	$26,040	$34,720
249	$8,715	$17,430	$26,145	$34,860
250	$8,750	$17,500	$26,250	$35,000
251	$8,785	$17,570	$26,355	$35,140
252	$8,820	$17,640	$26,460	$35,280
253	$8,855	$17,710	$26,565	$35,420
254	$8,890	$17,780	$26,670	$35,560
255	$8,925	$17,850	$26,775	$35,700
256	$8,960	$17,920	$26,880	$35,840
257	$8,995	$17,990	$26,985	$35,980
258	$9,030	$18,060	$27,090	$36,120
259	$9,065	$18,130	$27,195	$36,260
260	$9,100	$18,200	$27,300	$36,400
261	$9,135	$18,270	$27,405	$36,540
262	$9,170	$18,340	$27,510	$36,680
263	$9,205	$18,410	$27,615	$36,820
264	$9,240	$18,480	$27,720	$36,960
265	$9,275	$18,550	$27,825	$37,100
266	$9,310	$18,620	$27,930	$37,240
267	$9,345	$18,690	$28,035	$37,380
268	$9,380	$18,760	$28,140	$37,520
269	$9,415	$18,830	$28,245	$37,660
270	$9,450	$18,900	$28,350	$37,800
271	$9,485	$18,970	$28,455	$37,940
272	$9,520	$19,040	$28,560	$38,080
273	$9,555	$19,110	$28,665	$38,220
274	$9,590	$19,180	$28,770	$38,360
275	$9,625	$19,250	$28,875	$38,500
276	$9,660	$19,320	$28,980	$38,640
277	$9,695	$19,390	$29,085	$38,780
278	$9,730	$19,460	$29,190	$38,920
279	$9,765	$19,530	$29,295	$39,060
280	$9,800	$19,600	$29,400	$39,200
281	$9,835	$19,670	$29,505	$39,340
282	$9,870	$19,740	$29,610	$39,480
283	$9,905	$19,810	$29,715	$39,620
284	$9,940	$19,880	$29,820	$39,760
285	$9,975	$19,950	$29,925	$39,900
286	$10,010	$20,020	$30,030	$40,040
287	$10,045	$20,090	$30,135	$40,180
288	$10,080	$20,160	$30,240	$40,320
289	$10,115	$20,230	$30,345	$40,460
290	$10,150	$20,300	$30,450	$40,600
291	$10,185	$20,370	$30,555	$40,740
292	$10,220	$20,440	$30,660	$40,880
293	$10,255	$20,510	$30,765	$41,020
294	$10,290	$20,580	$30,870	$41,160
295	$10,325	$20,650	$30,975	$41,300
296	$10,360	$20,720	$31,080	$41,440
297	$10,395	$20,790	$31,185	$41,580
298	$10,430	$20,860	$31,290	$41,720
299	$10,465	$20,930	$31,395	$41,860
300	$10,500	$21,000	$31,500	$42,000

Time Savings Benefit Analysis

Assumptions: Use One Work Day a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# US

Dollar Savings Per Year Based on Time Savings Per Use

	Time Savings Per Use			
Number of Users	5 Minutes	10 Minutes	15 Minutes	20 Minutes
301	$10,535	$21,070	$31,605	$42,140
302	$10,570	$21,140	$31,710	$42,280
303	$10,605	$21,210	$31,815	$42,420
304	$10,640	$21,280	$31,920	$42,560
305	$10,675	$21,350	$32,025	$42,700
306	$10,710	$21,420	$32,130	$42,840
307	$10,745	$21,490	$32,235	$42,980
308	$10,780	$21,560	$32,340	$43,120
309	$10,815	$21,630	$32,445	$43,260
310	$10,850	$21,700	$32,550	$43,400
311	$10,885	$21,770	$32,655	$43,540
312	$10,920	$21,840	$32,760	$43,680
313	$10,955	$21,910	$32,865	$43,820
314	$10,990	$21,980	$32,970	$43,960
315	$11,025	$22,050	$33,075	$44,100
316	$11,060	$22,120	$33,180	$44,240
317	$11,095	$22,190	$33,285	$44,380
318	$11,130	$22,260	$33,390	$44,520
319	$11,165	$22,330	$33,495	$44,660
320	$11,200	$22,400	$33,600	$44,800
321	$11,235	$22,470	$33,705	$44,940
322	$11,270	$22,540	$33,810	$45,080
323	$11,305	$22,610	$33,915	$45,220
324	$11,340	$22,680	$34,020	$45,360
325	$11,375	$22,750	$34,125	$45,500
326	$11,410	$22,820	$34,230	$45,640
327	$11,445	$22,890	$34,335	$45,780
328	$11,480	$22,960	$34,440	$45,920
329	$11,515	$23,030	$34,545	$46,060
330	$11,550	$23,100	$34,650	$46,200
331	$11,585	$23,170	$34,755	$46,340
332	$11,620	$23,240	$34,860	$46,480
333	$11,655	$23,310	$34,965	$46,620
334	$11,690	$23,380	$35,070	$46,760
335	$11,725	$23,450	$35,175	$46,900
336	$11,760	$23,520	$35,280	$47,040
337	$11,795	$23,590	$35,385	$47,180
338	$11,830	$23,660	$35,490	$47,320
339	$11,865	$23,730	$35,595	$47,460
340	$11,900	$23,800	$35,700	$47,600
341	$11,935	$23,870	$35,805	$47,740
342	$11,970	$23,940	$35,910	$47,880
343	$12,005	$24,010	$36,015	$48,020

Time Savings Benefit Analysis

Assumptions: Use Two Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Users

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
1	$70	$140	$210	$280
2	$140	$280	$420	$560
3	$210	$420	$630	$840
4	$280	$560	$840	$1,120
5	$350	$700	$1,050	$1,400
6	$420	$840	$1,260	$1,680
7	$490	$980	$1,470	$1,960
8	$560	$1,120	$1,680	$2,240
9	$630	$1,260	$1,890	$2,520
10	$700	$1,400	$2,100	$2,800
11	$770	$1,540	$2,310	$3,080
12	$840	$1,680	$2,520	$3,360
13	$910	$1,820	$2,730	$3,640
14	$980	$1,960	$2,940	$3,920
15	$1,050	$2,100	$3,150	$4,200
16	$1,120	$2,240	$3,360	$4,480
17	$1,190	$2,380	$3,570	$4,760
18	$1,260	$2,520	$3,780	$5,040
19	$1,330	$2,660	$3,990	$5,320
20	$1,400	$2,800	$4,200	$5,600
21	$1,470	$2,940	$4,410	$5,880
22	$1,540	$3,080	$4,620	$6,160
23	$1,610	$3,220	$4,830	$6,440
24	$1,680	$3,360	$5,040	$6,720
25	$1,750	$3,500	$5,250	$7,000
26	$1,820	$3,640	$5,460	$7,280
27	$1,890	$3,780	$5,670	$7,560
28	$1,960	$3,920	$5,880	$7,840
29	$2,030	$4,060	$6,090	$8,120
30	$2,100	$4,200	$6,300	$8,400
31	$2,170	$4,340	$6,510	$8,680
32	$2,240	$4,480	$6,720	$8,960
33	$2,310	$4,620	$6,930	$9,240
34	$2,380	$4,760	$7,140	$9,520
35	$2,450	$4,900	$7,350	$9,800
36	$2,520	$5,040	$7,560	$10,080
37	$2,590	$5,180	$7,770	$10,360
38	$2,660	$5,320	$7,980	$10,640
39	$2,730	$5,460	$8,190	$10,920
40	$2,800	$5,600	$8,400	$11,200
41	$2,870	$5,740	$8,610	$11,480
42	$2,940	$5,880	$8,820	$11,760
43	$3,010	$6,020	$9,030	$12,040
44	$3,080	$6,160	$9,240	$12,320
45	$3,150	$6,300	$9,450	$12,600
46	$3,220	$6,440	$9,660	$12,880
47	$3,290	$6,580	$9,870	$13,160
48	$3,360	$6,720	$10,080	$13,440
49	$3,430	$6,860	$10,290	$13,720
50	$3,500	$7,000	$10,500	$14,000
51	$3,570	$7,140	$10,710	$14,280
52	$3,640	$7,280	$10,920	$14,560
53	$3,710	$7,420	$11,130	$14,840
54	$3,780	$7,560	$11,340	$15,120
55	$3,850	$7,700	$11,550	$15,400
56	$3,920	$7,840	$11,760	$15,680
57	$3,990	$7,980	$11,970	$15,960
58	$4,060	$8,120	$12,180	$16,240
59	$4,130	$8,260	$12,390	$16,520
60	$4,200	$8,400	$12,600	$16,800

Time Savings Benefit Analysis

Assumptions: Use Two Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Users

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use: 5 Minutes	10 Minutes	15 Minutes	20 Minutes
61	$4,270	$8,540	$12,810	$17,080
62	$4,340	$8,680	$13,020	$17,360
63	$4,410	$8,820	$13,230	$17,640
64	$4,480	$8,960	$13,440	$17,920
65	$4,550	$9,100	$13,650	$18,200
66	$4,620	$9,240	$13,860	$18,480
67	$4,690	$9,380	$14,070	$18,760
68	$4,760	$9,520	$14,280	$19,040
69	$4,830	$9,660	$14,490	$19,320
70	$4,900	$9,800	$14,700	$19,600
71	$4,970	$9,940	$14,910	$19,880
72	$5,040	$10,080	$15,120	$20,160
73	$5,110	$10,220	$15,330	$20,440
74	$5,180	$10,360	$15,540	$20,720
75	$5,250	$10,500	$15,750	$21,000
76	$5,320	$10,640	$15,960	$21,280
77	$5,390	$10,780	$16,170	$21,560
78	$5,460	$10,920	$16,380	$21,840
79	$5,530	$11,060	$16,590	$22,120
80	$5,600	$11,200	$16,800	$22,400
81	$5,670	$11,340	$17,010	$22,680
82	$5,740	$11,480	$17,220	$22,960
83	$5,810	$11,620	$17,430	$23,240
84	$5,880	$11,760	$17,640	$23,520
85	$5,950	$11,900	$17,850	$23,800
86	$6,020	$12,040	$18,060	$24,080
87	$6,090	$12,180	$18,270	$24,360
88	$6,160	$12,320	$18,480	$24,640
89	$6,230	$12,460	$18,690	$24,920
90	$6,300	$12,600	$18,900	$25,200
91	$6,370	$12,740	$19,110	$25,480
92	$6,440	$12,880	$19,320	$25,760
93	$6,510	$13,020	$19,530	$26,040
94	$6,580	$13,160	$19,740	$26,320
95	$6,650	$13,300	$19,950	$26,600
96	$6,720	$13,440	$20,160	$26,880
97	$6,790	$13,580	$20,370	$27,160
98	$6,860	$13,720	$20,580	$27,440
99	$6,930	$13,860	$20,790	$27,720
100	$7,000	$14,000	$21,000	$28,000
101	$7,070	$14,140	$21,210	$28,280
102	$7,140	$14,280	$21,420	$28,560
103	$7,210	$14,420	$21,630	$28,840
104	$7,280	$14,560	$21,840	$29,120
105	$7,350	$14,700	$22,050	$29,400
106	$7,420	$14,840	$22,260	$29,680
107	$7,490	$14,980	$22,470	$29,960
108	$7,560	$15,120	$22,680	$30,240
109	$7,630	$15,260	$22,890	$30,520
110	$7,700	$15,400	$23,100	$30,800
111	$7,770	$15,540	$23,310	$31,080
112	$7,840	$15,680	$23,520	$31,360
113	$7,910	$15,820	$23,730	$31,640
114	$7,980	$15,960	$23,940	$31,920
115	$8,050	$16,100	$24,150	$32,200
116	$8,120	$16,240	$24,360	$32,480
117	$8,190	$16,380	$24,570	$32,760
118	$8,260	$16,520	$24,780	$33,040
119	$8,330	$16,660	$24,990	$33,320
120	$8,400	$16,800	$25,200	$33,600

Time Savings Benefit Analysis

Assumptions: Use Two Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Use

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
121	$8,470	$16,940	$25,410	$33,880
122	$8,540	$17,080	$25,620	$34,160
123	$8,610	$17,220	$25,830	$34,440
124	$8,680	$17,360	$26,040	$34,720
125	$8,750	$17,500	$26,250	$35,000
126	$8,820	$17,640	$26,460	$35,280
127	$8,890	$17,780	$26,670	$35,560
128	$8,960	$17,920	$26,880	$35,840
129	$9,030	$18,060	$27,090	$36,120
130	$9,100	$18,200	$27,300	$36,400
131	$9,170	$18,340	$27,510	$36,680
132	$9,240	$18,480	$27,720	$36,960
133	$9,310	$18,620	$27,930	$37,240
134	$9,380	$18,760	$28,140	$37,520
135	$9,450	$18,900	$28,350	$37,800
136	$9,520	$19,040	$28,560	$38,080
137	$9,590	$19,180	$28,770	$38,360
138	$9,660	$19,320	$28,980	$38,640
139	$9,730	$19,460	$29,190	$38,920
140	$9,800	$19,600	$29,400	$39,200
141	$9,870	$19,740	$29,610	$39,480
142	$9,940	$19,880	$29,820	$39,760
143	$10,010	$20,020	$30,030	$40,040
144	$10,080	$20,160	$30,240	$40,320
145	$10,150	$20,300	$30,450	$40,600
146	$10,220	$20,440	$30,660	$40,880
147	$10,290	$20,580	$30,870	$41,160
148	$10,360	$20,720	$31,080	$41,440
149	$10,430	$20,860	$31,290	$41,720
150	$10,500	$21,000	$31,500	$42,000
151	$10,570	$21,140	$31,710	$42,280
152	$10,640	$21,280	$31,920	$42,560
153	$10,710	$21,420	$32,130	$42,840
154	$10,780	$21,560	$32,340	$43,120
155	$10,850	$21,700	$32,550	$43,400
156	$10,920	$21,840	$32,760	$43,680
157	$10,990	$21,980	$32,970	$43,960
158	$11,060	$22,120	$33,180	$44,240
159	$11,130	$22,260	$33,390	$44,520
160	$11,200	$22,400	$33,600	$44,800
161	$11,270	$22,540	$33,810	$45,080
162	$11,340	$22,680	$34,020	$45,360
163	$11,410	$22,820	$34,230	$45,640
164	$11,480	$22,960	$34,440	$45,920
165	$11,550	$23,100	$34,650	$46,200
166	$11,620	$23,240	$34,860	$46,480
167	$11,690	$23,380	$35,070	$46,760
168	$11,760	$23,520	$35,280	$47,040
169	$11,830	$23,660	$35,490	$47,320
170	$11,900	$23,800	$35,700	$47,600
171	$11,970	$23,940	$35,910	$47,880
172	$12,040	$24,080	$36,120	$48,160

Time Savings Benefit Analysis

Assumptions: Use Three Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Users

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
1	$105	$210	$315	$420
2	$210	$420	$630	$840
3	$315	$630	$945	$1,260
4	$420	$840	$1,260	$1,680
5	$525	$1,050	$1,575	$2,100
6	$630	$1,260	$1,890	$2,520
7	$735	$1,470	$2,205	$2,940
8	$840	$1,680	$2,520	$3,360
9	$945	$1,890	$2,835	$3,780
10	$1,050	$2,100	$3,150	$4,200
11	$1,155	$2,310	$3,465	$4,620
12	$1,260	$2,520	$3,780	$5,040
13	$1,365	$2,730	$4,095	$5,460
14	$1,470	$2,940	$4,410	$5,880
15	$1,575	$3,150	$4,725	$6,300
16	$1,680	$3,360	$5,040	$6,720
17	$1,785	$3,570	$5,355	$7,140
18	$1,890	$3,780	$5,670	$7,560
19	$1,995	$3,990	$5,985	$7,980
20	$2,100	$4,200	$6,300	$8,400
21	$2,205	$4,410	$6,615	$8,820
22	$2,310	$4,620	$6,930	$9,240
23	$2,415	$4,830	$7,245	$9,660
24	$2,520	$5,040	$7,560	$10,080
25	$2,625	$5,250	$7,875	$10,500
26	$2,730	$5,460	$8,190	$10,920
27	$2,835	$5,670	$8,505	$11,340
28	$2,940	$5,880	$8,820	$11,760
29	$3,045	$6,090	$9,135	$12,180
30	$3,150	$6,300	$9,450	$12,600
31	$3,255	$6,510	$9,765	$13,020
32	$3,360	$6,720	$10,080	$13,440
33	$3,465	$6,930	$10,395	$13,860
34	$3,570	$7,140	$10,710	$14,280
35	$3,675	$7,350	$11,025	$14,700
36	$3,780	$7,560	$11,340	$15,120
37	$3,885	$7,770	$11,655	$15,540
38	$3,990	$7,980	$11,970	$15,960
39	$4,095	$8,190	$12,285	$16,380
40	$4,200	$8,400	$12,600	$16,800
41	$4,305	$8,610	$12,915	$17,220
42	$4,410	$8,820	$13,230	$17,640
43	$4,515	$9,030	$13,545	$18,060
44	$4,620	$9,240	$13,860	$18,480
45	$4,725	$9,450	$14,175	$18,900
46	$4,830	$9,660	$14,490	$19,320
47	$4,935	$9,870	$14,805	$19,740
48	$5,040	$10,080	$15,120	$20,160
49	$5,145	$10,290	$15,435	$20,580
50	$5,250	$10,500	$15,750	$21,000
51	$5,355	$10,710	$16,065	$21,420
52	$5,460	$10,920	$16,380	$21,840
53	$5,565	$11,130	$16,695	$22,260
54	$5,670	$11,340	$17,010	$22,680
55	$5,775	$11,550	$17,325	$23,100
56	$5,880	$11,760	$17,640	$23,520
57	$5,985	$11,970	$17,955	$23,940
58	$6,090	$12,180	$18,270	$24,360
59	$6,195	$12,390	$18,585	$24,780
60	$6,300	$12,600	$18,900	$25,200

Time Savings Benefit Analysis

Assumptions: Use Three Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Use

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
61	$6,405	$12,810	$19,215	$25,620
62	$6,510	$13,020	$19,530	$26,040
63	$6,615	$13,230	$19,845	$26,460
64	$6,720	$13,440	$20,160	$26,880
65	$6,825	$13,650	$20,475	$27,300
66	$6,930	$13,860	$20,790	$27,720
67	$7,035	$14,070	$21,105	$28,140
68	$7,140	$14,280	$21,420	$28,560
69	$7,245	$14,490	$21,735	$28,980
70	$7,350	$14,700	$22,050	$29,400
71	$7,455	$14,910	$22,365	$29,820
72	$7,560	$15,120	$22,680	$30,240
73	$7,665	$15,330	$22,995	$30,660
74	$7,770	$15,540	$23,310	$31,080
75	$7,875	$15,750	$23,625	$31,500
76	$7,980	$15,960	$23,940	$31,920
77	$8,085	$16,170	$24,255	$32,340
78	$8,190	$16,380	$24,570	$32,760
79	$8,295	$16,590	$24,885	$33,180
80	$8,400	$16,800	$25,200	$33,600
81	$8,505	$17,010	$25,515	$34,020
82	$8,610	$17,220	$25,830	$34,440
83	$8,715	$17,430	$26,145	$34,860
84	$8,820	$17,640	$26,460	$35,280
85	$8,925	$17,850	$26,775	$35,700
86	$9,030	$18,060	$27,090	$36,120
87	$9,135	$18,270	$27,405	$36,540
88	$9,240	$18,480	$27,720	$36,960
89	$9,345	$18,690	$28,035	$37,380
90	$9,450	$18,900	$28,350	$37,800
91	$9,555	$19,110	$28,665	$38,220
92	$9,660	$19,320	$28,980	$38,640
93	$9,765	$19,530	$29,295	$39,060
94	$9,870	$19,740	$29,610	$39,480
95	$9,975	$19,950	$29,925	$39,900
96	$10,080	$20,160	$30,240	$40,320
97	$10,185	$20,370	$30,555	$40,740
98	$10,290	$20,580	$30,870	$41,160
99	$10,395	$20,790	$31,185	$41,580
100	$10,500	$21,000	$31,500	$42,000
101	$10,605	$21,210	$31,815	$42,420
102	$10,710	$21,420	$32,130	$42,840
103	$10,815	$21,630	$32,445	$43,260
104	$10,920	$21,840	$32,760	$43,680
105	$11,025	$22,050	$33,075	$44,100
106	$11,130	$22,260	$33,390	$44,520
107	$11,235	$22,470	$33,705	$44,940
108	$11,340	$22,680	$34,020	$45,360
109	$11,445	$22,890	$34,335	$45,780
110	$11,550	$23,100	$34,650	$46,200
111	$11,655	$23,310	$34,965	$46,620
112	$11,760	$23,520	$35,280	$47,040
113	$11,865	$23,730	$35,595	$47,460
114	$11,970	$23,940	$35,910	$47,880
115	$12,075	$24,150	$36,225	$48,300

Time Savings Benefit Analysis

Assumptions: Use Four Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Users

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
1	$140	$280	$420	$560
2	$280	$560	$840	$1,120
3	$420	$840	$1,260	$1,680
4	$560	$1,120	$1,680	$2,240
5	$700	$1,400	$2,100	$2,800
6	$840	$1,680	$2,520	$3,360
7	$980	$1,960	$2,940	$3,920
8	$1,120	$2,240	$3,360	$4,480
9	$1,260	$2,520	$3,780	$5,040
10	$1,400	$2,800	$4,200	$5,600
11	$1,540	$3,080	$4,620	$6,160
12	$1,680	$3,360	$5,040	$6,720
13	$1,820	$3,640	$5,460	$7,280
14	$1,960	$3,920	$5,880	$7,840
15	$2,100	$4,200	$6,300	$8,400
16	$2,240	$4,480	$6,720	$8,960
17	$2,380	$4,760	$7,140	$9,520
18	$2,520	$5,040	$7,560	$10,080
19	$2,660	$5,320	$7,980	$10,640
20	$2,800	$5,600	$8,400	$11,200
21	$2,940	$5,880	$8,820	$11,760
22	$3,080	$6,160	$9,240	$12,320
23	$3,220	$6,440	$9,660	$12,880
24	$3,360	$6,720	$10,080	$13,440
25	$3,500	$7,000	$10,500	$14,000
26	$3,640	$7,280	$10,920	$14,560
27	$3,780	$7,560	$11,340	$15,120
28	$3,920	$7,840	$11,760	$15,680
29	$4,060	$8,120	$12,180	$16,240
30	$4,200	$8,400	$12,600	$16,800
31	$4,340	$8,680	$13,020	$17,360
32	$4,480	$8,960	$13,440	$17,920
33	$4,620	$9,240	$13,860	$18,480
34	$4,760	$9,520	$14,280	$19,040
35	$4,900	$9,800	$14,700	$19,600
36	$5,040	$10,080	$15,120	$20,160
37	$5,180	$10,360	$15,540	$20,720
38	$5,320	$10,640	$15,960	$21,280
39	$5,460	$10,920	$16,380	$21,840
40	$5,600	$11,200	$16,800	$22,400
41	$5,740	$11,480	$17,220	$22,960
42	$5,880	$11,760	$17,640	$23,520
43	$6,020	$12,040	$18,060	$24,080
44	$6,160	$12,320	$18,480	$24,640
45	$6,300	$12,600	$18,900	$25,200
46	$6,440	$12,880	$19,320	$25,760
47	$6,580	$13,160	$19,740	$26,320
48	$6,720	$13,440	$20,160	$26,880
49	$6,860	$13,720	$20,580	$27,440
50	$7,000	$14,000	$21,000	$28,000
51	$7,140	$14,280	$21,420	$28,560
52	$7,280	$14,560	$21,840	$29,120
53	$7,420	$14,840	$22,260	$29,680
54	$7,560	$15,120	$22,680	$30,240
55	$7,700	$15,400	$23,100	$30,800
56	$7,840	$15,680	$23,520	$31,360
57	$7,980	$15,960	$23,940	$31,920
58	$8,120	$16,240	$24,360	$32,480
59	$8,260	$16,520	$24,780	$33,040
60	$8,400	$16,800	$25,200	$33,600

Time Savings Benefit Analysis

Assumptions: Use Four Work Days a Week, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# User

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	Time Savings Per Use			
	5 Minutes	10 Minutes	15 Minutes	20 Minutes
61	$8,540	$17,080	$25,620	$34,160
62	$8,680	$17,360	$26,040	$34,720
63	$8,820	$17,640	$26,460	$35,280
64	$8,960	$17,920	$26,880	$35,840
65	$9,100	$18,200	$27,300	$36,400
66	$9,240	$18,480	$27,720	$36,960
67	$9,380	$18,760	$28,140	$37,520
68	$9,520	$19,040	$28,560	$38,080
69	$9,660	$19,320	$28,980	$38,640
70	$9,800	$19,600	$29,400	$39,200
71	$9,940	$19,880	$29,820	$39,760
72	$10,080	$20,160	$30,240	$40,320
73	$10,220	$20,440	$30,660	$40,880
74	$10,360	$20,720	$31,080	$41,440
75	$10,500	$21,000	$31,500	$42,000
76	$10,640	$21,280	$31,920	$42,560
77	$10,780	$21,560	$32,340	$43,120
78	$10,920	$21,840	$32,760	$43,680
79	$11,060	$22,120	$33,180	$44,240
80	$11,200	$22,400	$33,600	$44,800
81	$11,340	$22,680	$34,020	$45,360
82	$11,480	$22,960	$34,440	$45,920
83	$11,620	$23,240	$34,860	$46,480
84	$11,760	$23,520	$35,280	$47,040
85	$11,900	$23,800	$35,700	$47,600
86	$12,040	$24,080	$36,120	$48,160

Time Savings Benefit Analysis

Assumptions: Use Every Work Day, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/Y

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	5 Minutes	10 Minutes	15 Minutes	20 Minutes
1	$175	$350	$525	$700
2	$350	$700	$1,050	$1,400
3	$525	$1,050	$1,575	$2,100
4	$700	$1,400	$2,100	$2,800
5	$875	$1,750	$2,625	$3,500
6	$1,050	$2,100	$3,150	$4,200
7	$1,225	$2,450	$3,675	$4,900
8	$1,400	$2,800	$4,200	$5,600
9	$1,575	$3,150	$4,725	$6,300
10	$1,750	$3,500	$5,250	$7,000
11	$1,925	$3,850	$5,775	$7,700
12	$2,100	$4,200	$6,300	$8,400
13	$2,275	$4,550	$6,825	$9,100
14	$2,450	$4,900	$7,350	$9,800
15	$2,625	$5,250	$7,875	$10,500
16	$2,800	$5,600	$8,400	$11,200
17	$2,975	$5,950	$8,925	$11,900
18	$3,150	$6,300	$9,450	$12,600
19	$3,325	$6,650	$9,975	$13,300
20	$3,500	$7,000	$10,500	$14,000
21	$3,675	$7,350	$11,025	$14,700
22	$3,850	$7,700	$11,550	$15,400
23	$4,025	$8,050	$12,075	$16,100
24	$4,200	$8,400	$12,600	$16,800
25	$4,375	$8,750	$13,125	$17,500
26	$4,550	$9,100	$13,650	$18,200
27	$4,725	$9,450	$14,175	$18,900
28	$4,900	$9,800	$14,700	$19,600
29	$5,075	$10,150	$15,225	$20,300
30	$5,250	$10,500	$15,750	$21,000
31	$5,425	$10,850	$16,275	$21,700
32	$5,600	$11,200	$16,800	$22,400
33	$5,775	$11,550	$17,325	$23,100
34	$5,950	$11,900	$17,850	$23,800
35	$6,125	$12,250	$18,375	$24,500
36	$6,300	$12,600	$18,900	$25,200
37	$6,475	$12,950	$19,425	$25,900
38	$6,650	$13,300	$19,950	$26,600
39	$6,825	$13,650	$20,475	$27,300
40	$7,000	$14,000	$21,000	$28,000
41	$7,175	$14,350	$21,525	$28,700
42	$7,350	$14,700	$22,050	$29,400
43	$7,525	$15,050	$22,575	$30,100
44	$7,700	$15,400	$23,100	$30,800
45	$7,875	$15,750	$23,625	$31,500
46	$8,050	$16,100	$24,150	$32,200
47	$8,225	$16,450	$24,675	$32,900
48	$8,400	$16,800	$25,200	$33,600
49	$8,575	$17,150	$25,725	$34,300
50	$8,750	$17,500	$26,250	$35,000
51	$8,925	$17,850	$26,775	$35,700
52	$9,100	$18,200	$27,300	$36,400
53	$9,275	$18,550	$27,825	$37,100
54	$9,450	$18,900	$28,350	$37,800
55	$9,625	$19,250	$28,875	$38,500
56	$9,800	$19,600	$29,400	$39,200
57	$9,975	$19,950	$29,925	$39,900
58	$10,150	$20,300	$30,450	$40,600
59	$10,325	$20,650	$30,975	$41,300
60	$10,500	$21,000	$31,500	$42,000

Time Savings Benefit Analysis

Assumptions: Use Every Work Day, Two Weeks Vacation Per Year

Calculation: ($10/HR)(HR/60 MIN)(MIN/USE)(# USE/WK)(42 WKS/YR)(# Users

Dollar Savings Per Year Based on Time Savings Per Use

Number of Users	5 Minutes	10 Minutes	15 Minutes	20 Minutes
61	$10,675	$21,350	$32,025	$42,700
62	$10,850	$21,700	$32,550	$43,400
63	$11,025	$22,050	$33,075	$44,100
64	$11,200	$22,400	$33,600	$44,800
65	$11,375	$22,750	$34,125	$45,500
66	$11,550	$23,100	$34,650	$46,200
67	$11,725	$23,450	$35,175	$46,900
68	$11,900	$23,800	$35,700	$47,600
69	$12,075	$24,150	$36,225	$48,300