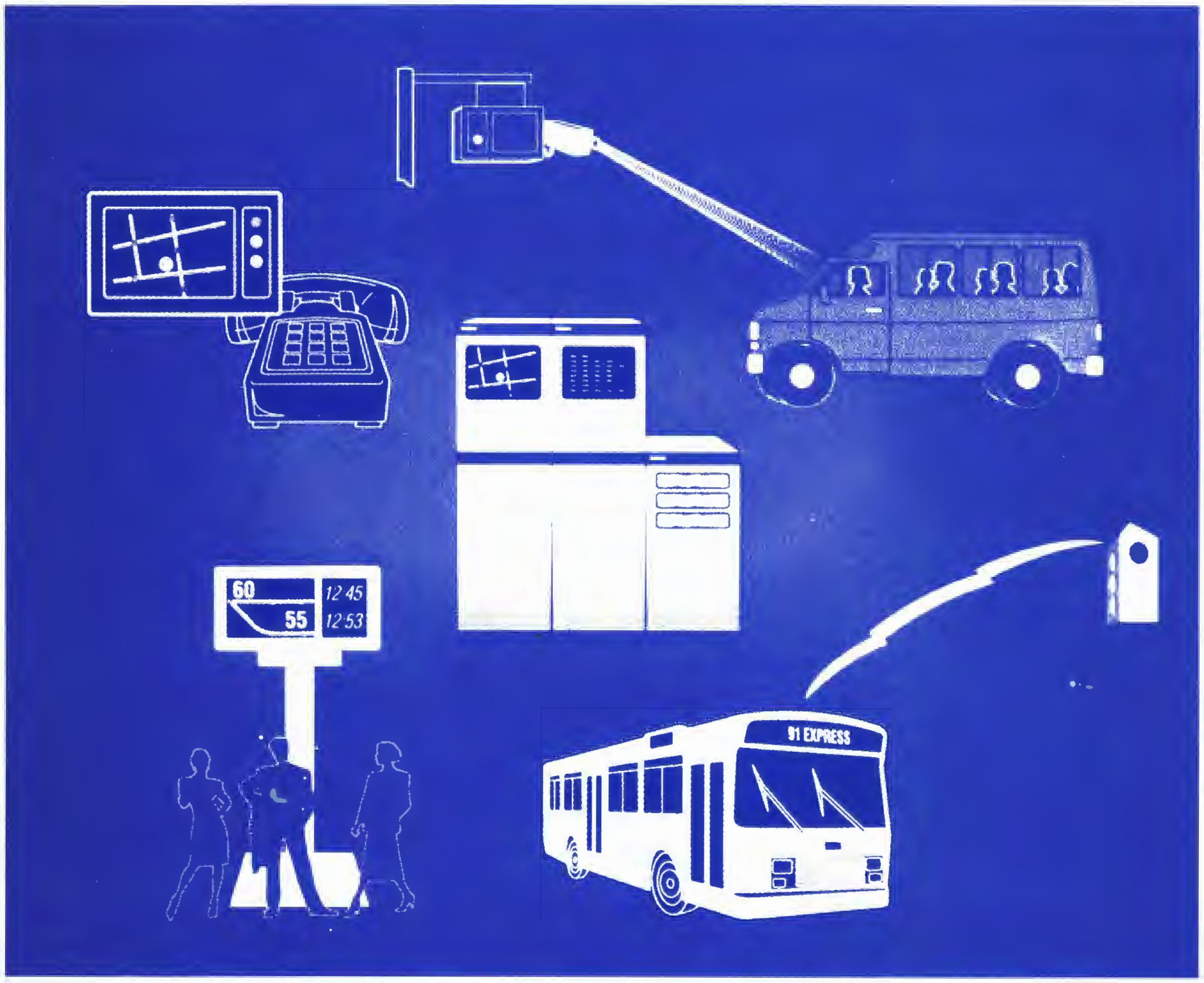
U.S. Department
of Transportation
Federal Transit
Administration

Bellevue Smart Traveler and Cellular Telecommunications

May 1993



ADVANCED PUBLIC TRANSPORTATION SYSTEMS PROGRAM
A Component of the Departmental IVHS Initiative

Office of Technical Assistance and Safety

Bellevue Smart Traveler and Cellular Telecommunications

Final Report
May 1993

Prepared by

Denise Pieratti, Mark Haselkorn,
and Cathy Blumenthal
Bellevue Transportation Management
Association
500 108th Avenue NE, Suite 210
Bellevue, Washington 98004

Prepared for

Office of Technical Assistance
Federal Transit Administration
U.S. Department of Transportation
Washington, DC 20590

Distributed in Cooperation with

Technology Sharing Program
U.S. Department of Transportation
Washington, D.C. 20590

DOT-T-93-36

PREFACE

Phase I of the Bellevue Smart Traveler project was funded by the Federal Transit Administration under the Advanced Public Transportation Systems (APTS) program. The grantee, the Municipality of Metropolitan Seattle (METRO), contracted with the Bellevue Transportation Management Association, a non-profit corporation in the state of Washington, to design and implement the operational test.

This report documents project planning and activities during the 11 months of project operations.

The report has been prepared for the Federal Transit Administration by Denise Pieratti of the University of Washington, who contributed valuable technical assistance during the project, and Cathy Blumenthal of the Bellevue TMA. The Bellevue TMA wishes to thank Professor Mark Haselkorn of the University of Washington for his assistance with preparing the final report, as well as for his participation in Smart Traveler Phase I and his development of Phase II; John Niles, for his early and continuing support in nurturing the project along; and the project staff for their cooperation on the varied data and collection activities. McCaw Cellular One deserves special thanks for its donation of cellular carphones and air time to the project, as well as providing continued assistance and support during the operational test.

EXECUTIVE SUMMARY

Phase I of the Bellevue Smart Traveler project was initiated as an operational test of innovative technology to enhance ridesharing using cellular telecommunications, voice mail and computerized real-time information in carpools and vanpools. The goal was to see if these technologies could be engineered and integrated into a new kind of information infrastructure, which could make carpools and vanpools a more effective and attractive mode of mass transportation.

A cooperative research and development partnership was formed between the Bellevue Transportation Management Association and McCaw Cellular One, which included a grant of six carphones with cellular phone service usage accounts for six months to provide an opportunity to test information technology in existing carpools. Six Bellevue TMA carpools were equipped with the phones and started using cellular communication in daily commuting.

Denise Pieratti, a University of Washington graduate research assistant, assisted with the project by reviewing related efforts, conducting surveys and providing a test phase of a driver information system. The goal of this test phase was to determine if real-time information delivered in a vehicle by cellular phone would provide a competitive edge for carpool and vanpool drivers in dealing with traffic conditions, thereby creating an incentive for commuters to try an alternative to SOV travel.

Two surveys, one for people in high occupancy vehicles and one for single occupancy vehicle commuters, were developed by Ms. Pieratti and administered by the Bellevue TMA staff to understand the commute habits and information needs of commuters to the Bellevue CBD. Survey results were analyzed and written up by Ms. Pieratti under the guidance of Professors Jan Spyridakis and Mark Haselkorn.

The potential of cellular technology as an incentive for car and van pooling was not proved by this study, perhaps because a more extensive information infrastructure needs to be developed. However, a number of significant findings indicate that there is potential for this and other communication technology to impact the individual commute experience, driver decisions and traffic management.

These findings include:

1. A significant number (42.3%) of SOV commuters in Bellevue were interested in a flexible, "instant" rideshare program.

2. Because they are more flexible, SOV commuters are more likely than car and van poolers to adjust their commute behavior based on real-time traffic information.

3. While poolers did not readily adjust travel behavior based on real-time traffic information, they felt access to such information enhanced their commute experience by making them feel safer and less stressed.

INTRODUCTION

BELLEVUE TMA OVERVIEW

Background

In its five year history, the Bellevue TMA has sought innovative ways to promote transit and ridesharing in the Bellevue, Washington Central Business District. As a partnership of the Municipality of Metropolitan Seattle (METRO), the City of Bellevue and the Bellevue Downtown Association, the TMA has balanced the ordinance requirements of the City regarding parking and transportation management policy with the needs of its clients who include high rise developers and large employers. The partnership with METRO has allowed the City of Bellevue and the business community (the Bellevue Downtown Association) to negotiate increased transit service to meet the needs of the commuter to the CBD.

Incentive Programs

Developing new incentives to promote transit, ridesharing, walking, biking etc. is what the TMA is all about. Cooperative efforts with the developers of high-rise buildings and large employers have lead to generous parking discounts for carpoolers/vanpoolers as well as free park days and reserved parking for transit, carpool, vanpool, biking, and walking commuters.

A guaranteed ride home program funded by METRO and administered by the TMA for Bellevue CBD employees involved in transit or ridesharing has proven to be a valuable incentive for HOV participants to remain committed to HOV travel.

Employer Support

The TMA's most challenging role is enlisting the support of employers to offer transit and rideshare incentives to their employees. The TMA has produced some real success stories with companies who have supported the TMA's goal to reduce single occupancy vehicle usage. Washington State's new Commute Trip Reduction law affecting employers of 100 or more commuting to one work site will offer the TMA the opportunity to work with employers in the CBD who in the past have not been supportive of transportation demand management. However, how to gain the cooperation of the smaller employer, less than 100 employees, still remains the greatest challenge.

HOV (High Occupancy Vehicle) Task Force

Recently the TMA's board of directors appointed a task force committee, consisting of Bellevue TMA board members and Central Business District employers, to develop new HOV incentives for downtown Bellevue. After two meetings the task force decided to focus their attention on developing an incentive program geared to the smaller employer (less than 100 employees). The group will continue to review HOV incentive programs underway in other cities with the goal of developing a program to attract the support of the smaller employer by providing positive incentives to encourage participation.

Programs currently under review include a "Commuter Check" program to facilitate the administrative requirement of transit and carpool subsidies for the employer, travel allowances in lieu of employer paid parking, employer subsidized universal transit passes available to all employees and a Commuter Challenge program intended to reward employers publicly for their contribution to increasing high occupancy vehicles.

The task force is due to make its final recommendation in January of 1993.

Rideshare Capabilities

In October, 1991 the TMA expanded its rideshare program by hiring a part-time rideshare coordinator to work directly with ridematch and vanpool applicants.

In December 1991, a PC terminal was installed in the TMA offices linking Bellevue to the Metro ridematch services main terminal in Seattle, WA. As a result, the TMA coordinator is able to achieve a quicker turn-around than previously in the delivery of ridematch printouts.

The coordinator has been particularly effective in assisting new Metro vanpool startups. Applicants to ridematch and vanpool programs are generally from different employers, which increases the challenge of creating a match. Having one person act as a "ride matchmaker" increases the TMA's ability to achieve success. Three vanpools have been added to the road since the coordinator began.

The TMA is also following the progress of a Rideshare Link software program. This ridematch program uses a PC-interactive, voice-response software system which answers telephones and performs rideshare matching automatically 24 hours a day, seven days a week. It depends upon the use of the 9-digit zip code system to identify geographical locations and has both regular ridematch and occasional rider capabilities. The program is currently in use at the University of California at Irvine and will be implemented in South Placer County, California, in the spring of 1993 through the South Placer TMA. This system could have potential for further development in conjunction with the Bellevue Smart Traveler information center project. The Bellevue TMA has an interest in offering a more flexible ridematch system with better accessibility to employees in downtown Bellevue.

BELLEVUE SMART TRAVELER: PHASE I

In April 1991, the Bellevue Transportation Management Association (TMA) defined a project called the Bellevue Smart Traveler in cooperation with local transportation experts, private industry, and the Federal Transportation Agency (FTA, formerly Urban Mass Transportation Administration (UMTA)) of the United States Department of Transportation (USDOT). The Smart Traveler project was designed as an operational test of innovative ridesharing technology, combining cellular telecommunications, voice mail, and computerized real-time information processing on the carpools and vanpools of Bellevue-Seattle's public transportation system. The intent of the project was to see if these technologies could be engineered and integrated into a new kind of information infrastructure which could make carpools and vanpools a more effective and attractive mode of mass transportation.

The initial objectives of this project were to:

1. design and plan a two-year demonstration of mobile communications and information services which increase the attractiveness and in turn the market share of suburban person trips in carpools and vanpools.
2. develop a set of information-based services and support for carpooling and vanpooling which increase substantially its attractiveness as a mode of travel.
3. show how to use mobile communications technology to make carpooling and vanpooling more flexible, more convenient, and faster as a door-to-door mode of travel.
4. engage the mobile telecommunications industry in a long-term effort to reduce congestion and increase mobility through increased use of HOV.

The research described in this report was predominantly in support of Objectives 2 and 3 and was performed by Denise Pieratti, a graduate research assistant at the University of Washington, in cooperation with the Bellevue TMA and under the direction of Professors Jan Spyridakis and Mark Haselkorn. TMA Objectives 1 and 2 are addressed under Bellevue Smart Traveler Phase II on page 45.

PROBLEM STATEMENT

The central question addressed by this study was:

Can cellular technology be used in concert with driver information services to make ridesharing more attractive?

In order to address this problem, it was necessary to understand the characteristics of Bellevue commuters in general; to understand if there are differences between those commuters who currently rideshare and those who do not, and if there are differences, what they are; and to evaluate whether or not traffic information delivered in-vehicle had an effect on commute decisions.

SCOPE

This research consisted of five phases. Phase 1 consisted of a review of existing traffic information systems that have relevance to this project. Phase 2 consisted of a survey of poolers and non-poolers to understand their commute patterns and information needs. Phase 3 evaluated the use of cellular telephones during the commute. Phase 4 tested the viability of, and interest in, in-vehicle delivery of traffic information. Phase 5 provided recommendations for information services that could be used to increase the attractiveness of pooling.

Activities in support of this research included:

- review existing relevant systems
- determine the characteristics and information needs of Eastside commuters
- compare Eastside commuters to Seattle commuters
- perform tests to assess the viability of, and interest in, delivery of real-time traffic information to vehicles
- provide recommendations for information services that can enhance the attractiveness of pooling

BACKGROUND

Mobility is essential to the economic growth of the United States and the well-being of its population. Traffic congestion has been increasing dramatically in urban areas, affecting the economy, lifestyle, and quality of living. This is mainly due to a large increase in the number of vehicles on the road and the number of vehicle miles travelled. For example, eight out of ten people who have jobs in downtown Bellevue travel to work alone in their own vehicles.[1] Until recently, congestion could be mitigated by building new roads, but that option, especially in areas with high population density with its related infrastructure or in areas with limited land available for development, is becoming increasingly more difficult. There are cost issues, environmental issues, land use issues, and federal legislative requirements that have impacts on continued road development. While additional construction is inevitable, more efficient use of existing roadways is essential. Additionally, over the past twenty years, falling per capita patronage and rising per patron costs of traditional bus and train service suggest that efficient and attractive alternatives to these transportation modes must be provided.

Use of advanced information processing and communications technology to manage traffic and advise drivers is a way to achieve desired improvements in efficiency and safety. These technologies in combination are called Intelligent Vehicle/Highway

[1]Bellevue TMA promotional literature.

Systems (IVHS). In many states in the U.S. and in England, West Germany, and Japan, IVHS developments and applications are reducing travel time and increasing safety. The IVHS program in the U.S. consists of five programs: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Automated Vehicle Control Systems (AVCS) and the Advanced Public Transportation Systems Program (APTS). This research provides data that is relevant to APTS, ATMS and ATIS.

Advanced Traffic Management Systems

Advanced Traffic Management Systems (ATMS) permit real-time adjustment of traffic control systems and variable signing for driver advice. Their application in selected corridors has reduced delay, travel time, and accidents.

At the heart of an ATMS are data sources (e.g., sensors in traffic lanes) that identify the presence of vehicles travelling through the system. These data are communicated to distributed or central processors. Real-time analysis of traffic data and systems enables the ATMS to control traffic and ramp metering signals. When combined with other data sources (e.g., geographic information systems (GIS)) and other information medium, such as variable message signs, the ATMS allows traffic managers to indicate actions to be taken to improve system throughput. ATMS incorporate incident management procedures, switching traffic from freeways to arterials as required by incidents.

Advanced Traveler Information Systems

Advanced Traveler Information Systems (ATIS) provide specialized services that enable a traveler to be more efficient. The systems enable route planning from origin to destination. Delivery can be pretrip or displayed on an electronic map in the vehicle. Businesses or services that the driver may need can be located and a route to those locations indicated. ATIS permit communication between driver and ATMS for continuous advice regarding traffic conditions, alternate routes, and safety issues. When ATIS and ATMS are in full communication, drivers will be informed about incidents and alternate routes to avoid congestion. In addition to short-term response to accidents and congestion, ATIS can also be used to impact long-term behavior by repeatedly pointing out the benefits of pooling or transit. ATIS can also reduce traveler stress by letting people know what the problem is, even if no immediate alternatives are available.

Specific ATIS features include:

- vehicle location, map-matching navigation system,
- traffic information receiver,
- route-planning for minimum distance of travel,

- color video display for maps, traffic information and route guidance,
- an on-board database with detailed maps, business directory, specific locations of services, hospitals, and tourist-related information,
- information from traffic management centers on congestion, incidents and other traffic problems, and
- electronic vehicle identification for toll debiting.[2]

Advanced Public Transportation Systems

When information systems are used to enhance transit and paratransit (carpool and vanpool) options, they are called Advanced Public Transportation systems (APTS). Real-time traffic information is generally used for short-term congestion and incident response, but it could also be used to emphasize the travel benefits of alternative commuting, particularly travel time savings. Dynamic ridesharing is another example of a likely component of APTS. It attempts to improve the opportunity for increased ridesharing by providing flexible arrangements for carpool and vanpool trips.

The Bellevue Smart Traveler Phase I project examined ways in which mobile communications can be used to deliver information services directly to vehicles which would make ridesharing more attractive. This project combined elements of APTS, ATMS and ATIS research and technology. The viability, effectiveness, and desirability of cellular-based APTS was evaluated for its ability to impact the commute and change commuter habits. Surveys of Bellevue Commuters determined interest in and priorities for services and information of an APTS. This information will influence the direction of future traveler services in the Bellevue and Seattle areas.

---

[2]Mobility 2000, Intelligent Vehicle/Highway Systems 1990 Summary.

PHASE 1: REVIEW OF EXISTING RELEVANT TRAFFIC INFORMATION SYSTEMS

CURRENT RESEARCH IN COMMUTER INFORMATION SYSTEMS

A literature review of a relevant sample of ATMS and ATIS systems was performed to understand features and functions. It proved to be useful in identifying how similar user needs have been addressed.

Driver information systems research[3]

As part of an on-going project, the Transportation Research Institute of the University of Michigan evaluated nine driver-information systems suggested for cars in the 21st century. As part of their study, the authors propose a method for selecting the systems that will help government officials, planners, and researchers identify those features and functions that are of most benefit to drivers.

The systems investigated were: navigation, vehicle monitoring, traffic information, road-hazard warning, communications (phone), motorist services, in-car signing, office functions, and entertainment. Features and contents of these systems were identified and rated on: effect on accidents, impact on traffic operations, and driver needs and wants.

The authors used technical literature, concept cars, industrial liaisons, and in-house expertise to identify the functions and features that could be developed by the year 2000. The following table lists the features identified.

---

[3]Green, Paul, Serafin, Collen, Williams, Marie, and Paelke, Gretchen. What Functions and Features Should be in Driver Information Systems of the Year 2000

Function	Feature
Communication	• CB radio • Cellular phone • Radar detector
Entertainment	• Cassette/CD player • Radio • Television (broadcast TV or video, intended to keep drivers alert on long trips)
In-car signing	• Destination assistance (provides drivers on major roads with information on services available at upcoming exits/intersections) • Street signs • Traffic control
IVSAWS (Road Hazard)	• Compounding hazards (road situation made worse by a temporary state) • Construction • Crash site • Emergency vehicle • Railroad crossing • School bus/other special vehicles • Supplemental traffic control (traffic control measures that may be unfamiliar or unexpected
Motorist services	• Banking • Customs information • Destination assistance (provide drivers on any type of road with information about restaurants, hotels and other public facilities) • Transportation (provide drivers with information about other modes of transportation) • Yellow pages/commercial
Navigation/route Guidance	• Guidance Orientation • Trip computer • Trip planning
Office	• Calculator • Computing (word processing, spreadsheets, graphics, programming, electronic mail, and file management) • Dictation • Electronic calendar • Electronic directory • Fax
Traffic information	• Congestion • Construction • Freeway management (advisory speed postings, ramp and lane closure) • Parking • Traffic rules • Vehicle access • Weather
Vehicle monitoring	• Climate • Drivetrain • Engine/power • Ingress/Egress • Path controls • Safety systems (air bags and seat belts)

Table 1: Features and functions for driver information services that could be developed by 2000

The authors devised a scoring scheme and weighting methodology that allowed them to identify, recommend, and prioritize the systems that should be in cars of the future. The ten highest rated features were (in order):

Feature	Use
1. IVSAWS (road hazard)	crash site
2. In-car signing	traffic control
3. Traffic information	congestion
4. IVSAWS	compounding hazards
5. Traffic information	construction
6. Vehicle monitoring	braking and tires
7. IVSAWS	construction
8. IVSAWS	railroad crossing
9. Traffic information	traffic rules
10. Traffic information	freeway management

Table 2: Features and functions of driver information systems rated most beneficial

The preliminary analysis showed that office functions and motorist services are the only IVHS functions that might have a net negative effect, although all of these have qualities that drivers might want.

FastLine!, San Francisco Area[4]

This free service provides time-sensitive traffic and commuter information by telephone (1-415-777-1000) to the general public in the San Francisco Bay area. The service contributes to the goals of the Intelligent Vehicle/Highway Systems (IVHS) program through implementation of an Advanced Traffic Information Systems (ATIS). The slogan for FastLine is, "Helping to make the decision of *when*, *where*, and *how* to travel."

The service hopes to encourage commuters to move from single occupancy vehicles to high-occupancy vehicles (HOV) or mass transit by combining traffic information with direct connections to major transit agencies and ridesharing organizations in the Bay Area. By providing concise, regionalized traffic information, the service is expected to contribute to improved mobility, improved regional air quality, and energy conservation. The service has an advantage over radio reports because the traffic information is compiled for specific areas and is instantly available. During peak commute hours, the system is updated at least every 10 minutes with information received from local traffic information agencies. To attract callers, the service also provides local event and parking information.

Revenue to sustain the service is generated through 15 second commercial advertisements played prior to the requested information.

[4]Information obtained from promotional literature, conversations with Steve Wollenberg, President, InfoAccess, Inc., San Francisco, and system use.

The features and benefits of the system are:

Feature	Benefit
Instant road congestion information	• Avoid traffic congestion • Improved mobility and air quality • Energy conservation
Regionalized information	• Concise information for seven regions: East Bay, South Bay, Peninsula, San Francisco, North Bay, Bridges, Transit
Instant access to transit operators	• Increased transit use • Reduced congestion and commuter stress
Instant access to ridesharing agencies	• Decrease in single occupancy vehicles (SOV) • Commuter cost savings • Improved air quality
Free service	• Accessible from any telephone, including cellular
Updated every 10 minutes	• Current, accurate, and comprehensive information
Implementation of IVHS technology	• Determine near-term ATIS effectiveness

Table 3: Features and benefits of FastLine ATIS

TravTek, Orlando, FL[5, 6]

TravTek is a joint public-private sector project to develop, test, and evaluate an integrated advanced driver information system and supporting infrastructure. The system will provide motorists with navigation, real-time traffic information, route selection and guidance, and motorist information services. The TravTek systems were installed in one hundred 1992 Oldsmobile Coronados operating in a 1200 square mile area surrounding the city of Orlando, Florida. Seventy-five of the vehicles will be in a rental car fleet for use by visitors to the city. The remaining twenty-five will be used by local residents and for special controlled tests.

TravTek consists of three interrelated systems. The first is the Traffic Management Center (TMC), operated by the public sector. The TMC collects and fuses real-time traffic information from a variety of sources and broadcasts it to the TravTek vehicles. The second is the TravTek Information and Services Center (TISC), which supplies databases for the cars with information on local events, accommodations, and services. The last system is the vehicles equipped with the information system hardware and software, and on-board hardware for communicating with TISC and TMC.

[5]Rillings, James H., and Lewis, James W. TravTek. SAE Paper #912819, Published as SAE P-253, Vehicle Navigation and Information Systems Conference Proceedings, 2nd, 1991, Dearborn, MI.

[6]Search, a newsletter published by the Technical Information Department, General Motors Research Laboratories, vol. 27, no. 1, May 1992.

The software performs seven major functions:

Navigation-determines the vehicle location and displays it on an on-board map display.

Route selection-determines a minimum-travel time route based on road network data and travel times supplied by the TMC.

Route guidance-provides visual and audio information on vehicle location, directions, and traffic conditions.

Local information-provides information from an on-board database on hotels, restaurants, services, and local events.

Driver interface-controls the sequence and generation of all visual and auditory displays and interprets driver inputs.

Probe report-monitors the travel times of TravTek vehicles through sections of the road network and transmits the information back to the TMC.

Data logging-records most interactions by the driver with the TravTek system for later use to evaluate the way the drivers use the system.

After a twelve month operational phase, the TravTek system will be evaluated on: system and subsystem performance; driver performance and satisfaction; safety; trip and network efficiency; impact on the local area; feature preferences by drivers; benefits to non-users; and consequences to future standards. The project itself will be evaluated as a prototype public- and private-sector joint venture to develop and evaluate one aspect of intelligent vehicle-highway systems.

PacTel Cellular information system, San Diego, CA[7]

In November 1991 PacTel Cellular introduced a new, free information service for its customers in San Diego, California. The PacTel service includes the following information:

Traffic-related: roadside assistance, live traffic reports, and vehicle services

Financial: financial news, stock/bond updates, mortgage/housing rates, CD/money market rates, and gold/commodities

Travel and tourism: events, restaurants, attractions, hotels/motels, movies, conventions/trade shows

---

[7]Information obtained from an article in the San Diego Union, November 4, 1991. Calls to PacTel Cellular and Applied Response Systems (supplier of the system) were not returned.

Business: transportation, office support, business support, employment services

Personal: legal/medical referral, child care, moving/relocation, housekeeping, SDG&E/Pacific Bell

Fax service: to receive any requested information

Initially, the traffic information line connects the caller to a live Metro Traffic Control (commercial entity) reporter who provides specific traffic information based on the caller's location and destination. Acknowledging that there will be a problem if thousands of motorists simultaneously call Metro Traffic for travel information, recorded traffic information tailored to one freeway or a specific geographic area is being considered. A decision as to the appropriate interface will be made after testing the system and monitoring the call volume.

PacTel's new information services are free to all customers, who pay only the air use charge. Providers of services available on the system pay fees to PacTel. If service information is requested, the caller can be connected to the appropriate provider, if desired.

This service does not provide any information on ridesharing or mass transit alternatives.

SOCRATES, European consortium[8]

SOCRATES is a project in the European Communities' research program, DRIVE. Its objective is to investigate the use and feasibility of a Road Transport Informatics (RTI) system based on cellular radio, and to make recommendations which could lead to the use of a pan-European cellular radio system.

The SOCRATES concept is based on the collection, storage, and processing of road traffic information and on two-way information flow between vehicles and roadside infrastructures.

The common communication infrastructure allows for acquisition and dissemination of information that can be used in a variety of applications. The main applications are:

Dynamic route guidance-provide in-vehicle route information based on detailed knowledge of the road network and on current and forecasted road conditions.

---

[8]Catling, Ian, and Op de Beek, Frans. SOCRATES: System of Cellular Radio for Traffic Efficiency and Safety. SAE Paper #912747, Vehicle Navigation and Information Systems Conference Proceedings, 2nd, 1991, Dearborn, MI.

Advanced traffic control-enables traffic managers and automatic traffic control systems to control traffic flows in order to optimize the efficiency of the road network.

Parking management and information systems-allows drivers to locate the most convenient parking space based on information relayed from parking facilities.

Fleet management-provide facilities for fleet managers to monitor vehicles and efficiently schedule and control vehicles.

Public transport management and information systems-allow dynamic vehicle scheduling, passenger information services, and public transport fleet management.

Hazard warning-provide in-vehicle warnings of road and weather hazards.

Emergency call-provide an emergency call facility, activated by the driver or by automatic crash sensors.

Emergency paging-page individuals over the communication infrastructure.

Automatic debiting-provide the ability to charge drivers for tolls or road charges.

Driver information-enable in-vehicle delivery of information on traffic conditions, specific problem spots, and availability of services.

Tourist information-provide information specific to the needs of tourists.

Data for traffic management and traffic planning-enable improved traffic monitoring.

Trip planning-allow pre-trip planning based on road network and traffic conditions.

SOCRATES is using cellular radio as the basic communication medium. Cellular radio provides the means for two-way communications and is part of the existing communication infrastructure. Two demonstration sites have been implemented.

SmartRoute, Boston, MA[9]

SmartRoute is a privately developed, advanced driver information system which provides real-time, location-specific, on-demand traffic information. A fully integrated system that combines traffic data collection, data management, and data fusion was developed and is operational in Boston. The system collects static and real-time traffice information, integrates and manages the information, and disseminates the information through telephone, fax, and computer links.

---

[9]Liebensy, John P. An Advanced Traveler Information System Providing Real-Time, Location-Specific On-Demand Traffic Information. SAE Paper #912859, Vehicle Navigation and Information Systems Conference Proceedings, 2nd, 1991, Dearborn, MI.

The SmartRoute data gathering system utilizes conventional and high technology means to gather static and real-time information on traffic and roadway conditions. The static information consists of those conditions known about ahead of time such as scheduled construction and special events. Real-time information is gathered from a variety of sources: airplane, corporate helicopters, television cameras, electronic scanning of emergency radio bands, and probe vehicles.

This information is funnelled into the operations center where it is fused and an assessment made of the information subscribers need to know. The synthesized information is transferred into audio and digital output.

Subscribers can access the information by cellular or regular telephone, fax, or computer. They receive a detailed report on conditions on specific roadways, including delay times and alternative route suggestions. The information provided by the system has an aging period of 15 minutes.

Houston program, Houston, TX[10]

A public-private venture is underway in Houston to improve the accuracy and timeliness of real-time traffic information available to motorists, commercial operators, and transit agencies. A system is under development which uses the concepts and technologies of IVHS to collect travel times and incident data directly from vehicles travelling in the I-45 North Freeway/US-59 (Eastex) Freeway corridor. This system utilizes everyday commuter vehicles equipped with cellular telephones and AVI transponders as moving sensors in the traffic stream. Travel time information is obtained by monitoring the time it takes for commuters to travel between pre-established reference locations in a corridor. The travel information is transmitted to a central communications center where it is processed and provided to users through multiple communications medium. After an initial pilot study, an AVI system will replace the cellular telephones as the reporting link.

The system was designed to provide accurate traffic information to motorists, transit operators, and commercial vehicle dispatchers. With more accurate information, these operators can make informed route, mode, and departure time decisions in response to incident information. These decisions are expected to result in overall travel time and fuel savings.

---

[10]Balke, Kevin N., McCasland, William R., Levine, Steven Z., Dudek, Conrad L. Collection and Dissemination of Real-Time Travel Time and Incident Information with In-Vehicle Communication Technologies. Vehicle Navigation and Information Systems Conference Proceedings, 2nd, 1991, Dearborn, MI.

Traffic Reporter, Seattle, WA

Traffic Reporter is a real-time, PC-based, graphical, interactive information system developed by the University of Washington in cooperation with the Washington State Department of Transportation (WSDOT). The goal of Traffic Reporter is to influence commuter behavior and decisions concerning alternate routes, departure times, and transportation modes.

Traffic Reporter receives traffic data collected from sensors embedded in the pavement at approximately one-half mile intervals along four major interstate and state routes. The data is transmitted to a central mainframe computer every second. A microprocessor gathers the detector data for one-second intervals and sends these data to a central mainframe computer. At the Traffic Systems Management Center in Seattle, a mainframe computer receives the microprocessor data and produces one-minute summaries of these data which are then transmitted to a personal computer. These data are converted to estimated travel speeds and times by Traffic Reporter. All traffic information is currently displayed on a graphical display. Specific trip information is accessed interactively with a mouse or touch screen interface.

Traffic Reporter displays traffic information on a graphical representation of a map of the travel corridors of the region. The following data is available:

- color-coded speed ranges
- status bar showing current time and date, and the time the traffic information was received
- specific information, such as average miles per hour at a specific data station
- specific trip information, such as average speed and travel time between two selected freeway ramps; comparison of current travel time to that of a normal trip; or comparison of regular lane versus HOV or Express lanes.

SUMMARY AND APPLICATIONS TO BELLEVUE SMART TRAVELER

The above systems represent ATMS, ATIS, or combined systems whose purpose is to provide accurate, real-time traffic information to motorists and traffic managers, ease congestion, and enable drivers to be more efficient. FastLine!, the PacTel system, and SmartRoute are ATIS. Examples of programs that combine elements of both systems are TravTek, SOCRATES, the Houston program, and Traffic Reporter.

Several program provide facilities for delivery of traffic and driver information via cellular telephone: FastLine!, PacTel Cellular (San Diego, CA), and SmartRoute. FastLine! is the only system whose express purpose is to move commuters from single occupancy vehicles to high occupancy vehicles, and therefore has the most direct application to the Bellevue Smart Traveler program. The Houston program uses cellular technology to provide a two-way information link with driver information delivered to the vehicle and traffic information delivered back to a traffic control center.

Traffic Reporter has obvious applications to the Bellevue Smart Traveler because of its geographic coverage.

If one considers the driver information systems recommended by Michigan researchers for the year 2000, the highest rated services relate to traffic conditions, especially real-time situations such as incidents and temporary states. These situations impact drivers as they are traveling; therefore, in-vehicle delivery is required. It is not clear, however, whether this study considered features as impacting long-term travel behavior, which is more relevant to Bellevue Smart Traveler and other efforts to reduce SOV travel.

PHASE 2: SURVEY OF COMMUTERS

A survey of commuters was conducted to understand their commute patterns and information needs. Both drive-alone and rideshare commuters traveling to the Bellevue CBD were surveyed. Data from this survey conducted for Bellevue single-occupancy and rideshare commuters were compared with existing data from two earlier large surveys of Seattle-area commuters. The first of these earlier surveys was of Bellevue Commercial Business District commuters and was conducted in 1990. The second was conducted in 1989-90 as part of WSDOT's Freeway Arterial Management Effort (FAME). There were two objectives for this phase: (1) to determine if Bellevue commuters had different commute characteristics, commute patterns, or information needs than did Seattle commuters, and (2) to determine if commute patterns were significantly different for Bellevue SOV commuters versus poolers, and if so, if these differences could be leveraged to change commute habits.

It should be noted that the following section presents information from three different surveys. There were variations in purpose, methodology, and audience for these surveys. Therefore, it is not always possible to compare the data directly. Even where data appears to be comparable, conclusions based on the data need to be examined further.

1990 BELLEVUE CBD TRANSPORTATION MODE USE STUDY

In 1990, a Transportation Mode Split Survey of Bellevue Commercial Business District (CBD) was undertaken by the City of Bellevue for two major purposes:

- To establish a baseline of transportation/mode uses among all CBD employees against which changes can be measured.
- To compare the results for office buildings with results from a 1984 mode split study.[11]

This study was part of a continuing effort to address traffic congestion in downtown Bellevue. The results of this survey are presented here for information and for comparison with the data from the new 1992 survey that was conducted as part of this research.

Summary of Research Design

Methodology: The methodology used for the survey was similar to that used in a series of self-administered surveys conducted by METRO and the City of Seattle. Specified buildings were selected and questionnaires were distributed to all employees in the building, and later collected after the employees completed them.

---

[11] 1990 Bellevue CBD Transportation Mode Use Study prepared for the City of Bellevue by the Gilmore Research Group, January 1991.

Sample: The sample was selected from the business and occupation tax listing. An estimate was made of the number of employees in each business. Based on size, they were separated into five groups. A random sample of buildings was selected from within each of the five size groups. The sample was adjusted to insure a cross section of industries and a balanced geographical representation.

Data collection: A customized survey was developed for this study, using prior transportation survey instruments as a base. Questionnaires were provided to building managers in large buildings. A cover letter from the mayor, explaining the purpose of the survey, accompanied the form. Participants were given approximately one week to complete the survey. A response rate of approximately 40% was achieved.

Data analysis: Data was weighted to be representative of the Bellevue CBD building population based on available information about the proportion of buildings of various sizes. Frequencies and cross tabulations were processed by custom computer software. Several types of analysis were undertaken to provide baseline data on commute characteristics by building size and industry and to increase the potential for increasing high occupancy vehicle usage.

Findings

The following section presents highlights of the Gilmore Research Group's 1990 survey of commuters to the Bellevue CBD.

Demographics: This study determined that commuters into the Bellevue CBD had these characteristics:

- The average commute trip to work was 24 minutes for SOV drivers, 33 minutes for rideshares, and 47 minutes for bus riders.
- The majority of CBD commuters start work between 7 am and 9 am (75%) and leave work between 4 pm and 6 pm (72%). The peak time for starting work is 8 am (25%) and leaving work is 5 pm (24%).
- Most Bellevue CBD commuters live in Bellevue (27%) and adjacent eastside communities (40%). Sixteen percent (16%) reside in Seattle.
- Bus commuters tend to be younger and have lower incomes than other workers. They also tend to have fewer vehicles in their household. One in three bus commuters is in a professional or managerial position, 19% have incomes over $55,000 per year, and 27% commute from Seattle.

- Ridesharers are more likely to be female and in families with multiple cars and wage earners. They also tend to commute further distances than average.

Commute Mode Split: This 1990 study found that Bellevue CBD has a very different commute mode split pattern than downtown Seattle. A much higher percentage of Bellevue CBD commuters appear to use SOV travel than do Seattle commuters, who have much higher bus use. Bellevue employees in large buildings (over 900 employees) are less likely to drive alone to work than employees in small buildings (under 100 employees). Office workers are more likely to use HOV modes than either retail or consumer service workers.

	Bellevue	Seattle [12]
Drive alone	80.6%	44%
Carpool	9.3%	11%
Bus	7.3%	39%
Vanpool	0.4%	not reported
Other	2.3%	not reported

Table 4: Commute mode split for Bellevue, 1990

Change in Commute Mode: Twenty-five percent (25%) of commuters did not work in Bellevue CBD the year before the survey (1989-1990). Eight percent (8%) of commuters into Bellevue CBD changed their commute mode within the year prior to the study. Work or residence changes were the most frequently cited reason for the change. Commuters who switched from driving alone cited saving money and avoiding traffic congestion. Commuters who switched from mass transit to private automobiles cited timesavings and the ability to run errands.

HOV Incentives: The survey found that most commuters are aware of HOV incentives, such as free or reduced price carpool and vanpool parking, reserved parking, HOV information centers, transportation fairs, and transportation coordinators. Other HOV incentives, such as travel time savings, were not included in this survey.

The majority (72%) of CBD workers who drive to work park free.

Single occupancy vehicle drivers rely on friends or relatives for a ride if they need an alternate way to get to work on a particular day. If the need were long-term, most commuters preferred to take the bus than rideshare. If parking costs were to increase significantly, 16% of single occupancy vehicle drivers would consider taking the bus, 8% would consider ridesharing, and 36% would continue driving alone. Over half (60%) of drive-alone commuters showed some interest in bus incentives and 36% showed interest in carpool and vanpool incentives. Workers also expressed interest in a guaranteed ride home in case of an emergency (18%), assistance in finding a vanpool or carpool (18%), and bus pass discounts (16%).

[12] Metro and City of Seattle data

1988-89 FAME MOTORIST INFORMATION SURVEY

A Motorist Information Survey was conducted by University of Washington investigators as part of a project sponsored by the Washington State Department of Transportation (WSDOT) and the Federal Highway Administration under the State's Freeway Arterial Management Effort (FAME)[13]. This survey gathered information about motorist behavior and decision processes, particularly as they relate to the design and delivery of motorist information.

The survey results showed that motorists have greater flexibility as to when they can leave work for home than when they leave home for work, experience some stress during their commute, and most value saving commute time. They are more likely to change their routes from work than from home, to divert to known routes than unknown routes, and to be influenced by traffic information, congestion, and time of day. Traffic information has the greatest influence on route choice and departure time; therefore motorists prefer to receive this information before they enter a freeway. All motorists rely most on commercial radio for receipt of traffic information and find it useful.

Detailed findings from the survey for Seattle-area commuters are not presented here because a series of papers are readily available. The data are summarized in Appendix A: Survey Data. The data was re-analyzed and statistics for single occupancy vehicles and high occupancy vehicles was compiled from the larger data set. Those data are compared (following section) to the data from the 1992 Bellevue TMA survey.

1992 BELLEVUE SURVEY

Although there was data from the 1990 survey of Bellevue commuters who travel to the CBD, that survey was not focussed specifically on information needs that could make ridesharing more attractive. The information in this section is part of original research conducted as part of this study. As part of this study, the data from the 1989-90 FAME survey was re-analyzed. Statistics for single-occupancy and high-occupancy (3 or more per car) vehicles were compiled from the source data.

Summary of research design

Methodology: In keeping with other surveys of motorists, it was decided to use a mail-in survey. This methodology has greater chance of reaching the target audience, could be easily administered, and could be developed quickly.

Survey design: Two surveys, one for car/van poolers and the other for single-occupancy vehicle commuters, were designed for this phase of the study. The contents of the

[13]Spyridakis, J., Barfield, W., Conquest, L., Haselkorn, M., and Isakson, C. (1991) Surveying Commuter Behavior: Designing Motorist Informationi Systems. Transportation Research-A, Vol. 25A, No. 1, pp.17-30.

surveys were based on specific information needs of this study, a review of the previously described motorist information surveys, and suggestions from Bellevue TMA staff. An attempt was made to design questions that would provide data that could be directly compared with data from the two previous surveys.

The rideshare commuter survey was pretested by two drivers who matched the characteristics of the target audience. Two questions were modified based on the pretest. The single occupancy vehicle survey was not pretested as almost all of the questions were the same on the rideshare survey.

Sample: The goal in performing the survey was to understand the commute habits and information needs of commuters to the Bellevue CBD and to compare these data with those of previous surveys. Data from both single occupancy vehicles and poolers was collected for comparison and to determine if there were district characteristics between groups. No effort was made to screen commuters other than to ensure that their commute to work ended in the CBD.

After consultation with the staff of the Bellevue TMA, it was decided to mail out the survey forms for high occupancy commuters with the semi-annual carpool registration forms sent to car and vanpools registered with the Bellevue TMA. By this method, it was ensured that the target population was reached. Since the registration form had to be returned to remain eligible for commuter incentives, the survey forms could be easily returned with little effort on the part of the commuter. Although an expected response rate for a mail-in survey is about 20%, it was hoped that this administration method would produce a higher rate.

Surveys for drive along commuters would be distributed to two companies that participate in the Bellevue TMA and have a relatively high percentage of drive-alone commuters. Employee Transportation Coordinators (ETC) within the companies would distribute and collect the survey forms. Both companies had good working relations with the Bellevue TMA and participated in the survey with hope that the data from the survey could be used to increase the percentage of their employees that shared rides.

Data collection: In February 1992, approximately 200 surveys were mailed to Bellevue CBD commuters who needed to re-certify their participation in a carpool or vanpool. This certification process is administered by the Bellevue TMA. A stamped envelope was provided as an incentive to return the forms, including the survey form. Surveys were collected at the TMA offices for about a month. Ninety-five surveys were returned. No surveys were returned after that time.

The surveys for single occupancy vehicle commuters were distributed to the two companies by Bellevue TMA staff. The surveys were distributed by the transportation coordinator, who also followed up with the employees. Eighty-five surveys were distributed. Seventy-five were returned after about 2 weeks. No surveys were received after that date. Over ninety-five percent (95.9%) of the surveys returned were from drive-alone commuters. Data from commuters in high-occupancy vehicles who responded to the SOV survey were not tabulated for the results.

Data analysis: The data from the surveys were analyzed using StatView, a software program for the Macintosh computer, at the University of Washington. Frequency analyses were calculated for all variables for the total sample.

In addition to analyzing the data from this survey, the data from the 1988-1989 FAME survey were analyzed again by narrowing the sample to one person per car and for three or more people per car. The FAME data is for motorists who traveled on the Interstate 5 southbound corridor to downtown Seattle. For the purposes of this study, the definition of high occupancy vehicle was **three or more** occupants per car. This definition was in effect for the Seattle roadways at the time of the survey, and continuing its use provides consistency with the FAME data. This provides a basis for comparison of Seattle-area high-occupancy vehicle commuters to those in this 1992 Bellevue survey.

There were 2,651 respondents who drove alone to work from the 1989-90 FAME survey sample. There were 160 respondents who shared a vehicle with at least two other people in that sample.

Findings

The following results are grouped similarly to the major sections of the original survey: (1) demographics; (2) commute characteristics; (3) route choice; (4) information preferences; and (5) rideshare preferences.

The data are presented in the following order: Bellevue SOV driver, Bellevue Pooler, Seattle SOV driver, and Seattle HOV commuter. Where possible, the data are presented in tables or charts to facilitate comparison.

Demographics: The sample of Bellevue drive-alone commuters consisted of a higher percentage of females (56.8%) than males (43.2%). The majority of respondents in the SOV category were under 40 years of age (59.7%), and most were between 31 and 40 years of age (40.3%). Most respondents are married (68.5%) while 31.5% are single.

Even fewer males (36.8%) than females (63.2%) made up the Bellevue pooler respondents. The age spread was also greater among the poolers. Although the majority of respondents were still under 40 (56.3%), age 31 and under (25.8%), 31 to 40 (30.34%), and 41-50 (25.8%) were well represented. The majority of respondents were married (75.5%), while 24.5% were single.

The sample for Seattle SOV drivers consisted of 48.9% male and 51.1% female. The majority (59.7%) were under 40. Marital status was not reported for this survey.

The sample of Seattle-bound high occupancy commuters consisted of 47.5% males and 52.5% females. The majority of respondents were under 40 years of age (63.2%). Twenty six point nine percent (26.9%) of the respondent were under 31 years of age, 36.3% were between 31 and 40, and 23.1% were 41-50 years old. Marital status was not reported for this survey.

Gender	Bellevue SOV	Bellevue pooler	Seattle SOV	Seattle HOV
Male	43.2	36.8	48.2	47.5
Female	56.8	63.2	50.3	52.5

Table 5: Gender distribution of survey respondents

Age category	Bellevue SOV	Bellevue pooler	Seattle SOV	Seattle HOV
under 31	19.4	26.0	23.5	26.9
31-40	40.3	30.3	36.2	36.3
41-50	33.3	25.8	25.9	23.1
51-59	6.9	14.6		
60 and older	0.0	2.3		
51-64			13.0	12.5
65 and older			1.4	1.3

Table 6: Age distribution of survey respondents

There is a wider variance in the gender and the age distribution of the Bellevue SOV/pooler commuters versus the Seattle SOV/HOV commuters. The age variance is probably due to the small sample size of the Bellevue surveys rather than significant differences between the two populations. The variations in the gender distribution appear to be supported by the findings of the 1990 Bellevue CBD Mode Split Study, which reported 39% male respondents and 61% female respondents. This may indicate that women are more apt to fill out and return surveys. It may also indicate that the Bellevue CBD worker force is predominantly female.

Commute characteristics: Commute characteristics were examined according to the situational aspects of the commute and by motorists' attributes.

Situational aspects reported were distance and time duration of the commute. For the Bellevue SOV driver, the average reported commute distance was 13.2 miles. The trip from home to work was slightly shorter (26.2 minutes) than from work to home (27.5 minutes). For the Bellevue pooler, the commute distance averaged 15.5 miles. Travel times were 30.6 minutes from home to work and 34.1 minutes from work to home. For the Seattle SOV driver, the average distance travelled was 14.7 miles. The commute took 31.4 minutes from home to work and 35.3 minutes from work to home. For the Seattle HOV commuter, the average commute took 34.6 minutes from home to work and 38.0 minutes from work to home. The average distance travelled was 18.6 miles.

	Bellevue SOV	Bellevue pooler	Seattle SOV	Seattle HOV
Distance traveled	13.2	15.5	14.7	18.6
Time from home to work	26.2	30.6	31.4	34.6
Time from work to home	27.5	34.1	35.3	38.0

Table 7: Situational commute characteristics of survey respondents

In summary, the Seattle commuter travels slightly farther to work and takes longer to do it. The commute home for the Seattle-area commuter is longer than the trip to work. Bellevue drive-alone commuters generally drive a shorter distance and take a shorter period of time than do Bellevue poolers, who travel a longer distance and for longer periods of time. Bellevue poolers take longer for the commute from work to home than home to work. This may be due to the fact that travel times were self-reporting, and time to run errands may be included. Commuters may be more concerned with arriving at work on time and may drive faster on the way to work. The differences between the Eastside commuters and the Seattle commuters may be due to the fact that the travel times were self-reported or to the fact that the commuter faces heavier traffic congestion in the evenings. The findings for the Bellevue commuters are compatible with those from the 1990 Bellevue CBD Transportation Use Study which found that the average commute time to work was 23.7 minutes for drive-alone commuters and 32.5 minutes for carpool/vanpool commuters. The average commute time from work was 26.2 minutes for drive-alone commuters and 35.6 minutes for poolers.

Motorists' attributes include the respondents' flexibility in the time they can leave home for work and the importance of commute qualities. Bellevue SOV respondents varied their work hours from day to day frequently (38%) or occasionally (42.2%). Slightly under twenty percent never varied their work hours from day to day. Respondents were able to vary the time they start work by an average of 30 minutes and the time they leave work by an average of 35.6 minutes. The majority of respondents worked fixed hours set by their employers (39.1%), while 23.2% worked fixed hours of their own choice or variable hours of their own choice (20.3%). Eleven point six (11.6%) percent of the respondents worked irregular hours with no fixed patterns.

Bellevue pooler respondents most often were able to vary their work hours on a day to day basis only on an occasional basis (63.8%). Twenty-eight point seven percent (28.7%) could never vary their work hours, while 7.4% were frequently able to vary their work hours on a day to day basis. When they could vary their work hours, the time was an average of 25.2 minutes starting work and 28.5 minutes leaving work. Most respondents worked fixed hours set by their employer (47.4%), fixed hours of their own choice (30.9%), or variable hours of their own choice (13.7%). A small percentage (3.2%) worked irregular hours with no set patterns.

A different set of questions was asked on the FAME survey and so the responses are not directly comparable. The FAME survey asked respondents to rate the flexibility they had in leaving home for work and in leaving work for home.

Seattle SOV drivers had more flexibility in leaving from work than they did in leaving for home. The majority of respondents had some flexibility (450.2%), while 34.4% had a lot, and 15.3% had very little flexibility in leaving home for work. The majority had some flexibility in leaving work for home (50.1%), while 18.4% had a lot and 31.3% had very little flexibility in leaving work for home.

Seattle HOV respondents had some (43.0%), or very little (53.8%) flexibility in the time they left home for work, with only 3.2% having a lot of flexibility. Reporting on their flexibility in leaving work for home, 12.7% had a lot, 47.5% had some, and 39.9% had very little flexibility.

In summary, several generalizations can be made about the quality of motorists' commutes. Drive-alone commuters typically have more flexibility in varying their commute hours than do poolers. All groups have more flexibility in the time they leave work than when they leave home, but HOV commuters and poolers have less overall flexibility than their drive-alone counterparts. When commute hours could be varied, it was on an occasional basis.

Information preferences: Bellevue survey respondents were asked about their use of traffic information and how it influenced their commute. They were also asked their opinion about other information services.

The following table shows the degree to which receiving traffic information from the listed sources impacts the respondents' commute. In this question, the actual use of a particular medium was not as important as the degree to which the information influenced or affected the commute decision. Commercial radio is the source most frequently used. The information delivered by radio most frequently impacts commutes.

A second question asked if the respondent received traffic information from any medium. Many SOV respondents (42.5%) do not receive traffic information from any source, while less than 10% of the poolers respondents do not receive traffic information from any source.

	Bellevue SOV				Bellevue pooler			
Effect of traffic information on commute	A lot	Some	Very little	Not at all	A lot	Some	Very little	Not at all
Television	3.3	6.6	9.8	80.3	3.7	13.6	21.0	61.7
Commercial radio	21.1	25.4	14.1	39.4	14.1	37.2	16.0	31.9
Telephone	0.0	1.8	7.3	90.9	2.7	1.3	13.3	82.7

Table 8: Effect of traffic information on changing commute for Bellevue commuters

The survey question on the FAME survey was slightly different than the question asked of the Bellevue commuters. Seattle area drivers were asked how much help they got from television or commercial radio while they were commuting. For drive-alone commuters, commercial radio was the preferred medium with 53.4% stating that it provided a lot of help, 35.0% stating it provided help some of the time, 9.0% stating that it helped very little, and 1.2% stating that it never provided any help. Television was of less help, with 4.1% responding that it helped a lot, 19.7% responding that it helped some, 31.9% stating that it helped very little, and 28.9% stating that television never helped.

Seattle HOV commuters stated that commercial radio was a more helpful source for traffic information. These commuters reported that it helped a lot (56.4%) or some (37.8%) during their commute. Television was rarely used for traffic information, with 49.3% of the respondents never receiving any help from it. Television helped the commute for HOV commuters very little (25.7%) or some (20.3%).

	Seattle SOV				Seattle HOV			
	A lot	Some	Very little	Not at all	A lot	Some	Very little	Not at all
Television	2.9	13.7	23.4	59.9	4.7	20.3	25.7	49.3
Commercial radio	54.0	35.4	9.1	1.2	56.4	37.8	5.8	0.0

Table 9: Degree to which traffic information helped Seattle commuters

The differences in the perceived help or effect on the commute reported by the Bellevue CBD commuters versus the Seattle commuters is probably due to the way the question was expressed and interpreted. It is also possible that traffic conditions have changed so much between the time of the two surveys that receiving traffic information today has much less of an impact on commute decisions.

Bellevue respondents were asked to indicate any changes they make to their commute if they used any of the above sources (television, commercial radio, or telephone). They could indicate more than one change to their commute pattern. The SOV respondents were most likely to change their route (84.8%) or departure time (55.3%). HOV respondents were more likely to change their route (60.6%) and their departure time (31.0%) but with much lesser frequency.

	Bellevue SOV	Bellevue pooler
Change route	84.8	60.6
Change departure time	55.3	31.0
Change pickup location	not applicable	0.0
Change mode of transportation	2.2	2.8
Can't make any changes because of the needs of others with me	not applicable	5.6

Table 10: Changes made to commute as a result of traffic information-Bellevue commuters

Bellevue respondents were asked to predict what they would do if up-to-the minute traffic information were available. The responses were very similar to the current response to traffic information. It does not seem likely that the quality and timeliness of current information is a factor in commute decisions.

	Bellevue SOV	Bellevue pooler
Change route	80.0	57.5
Change departure time	52.7	28.8
Change pickup location	not applicable	0.0
Change mode of transportation	3.6	1.3
Can't make any changes because of the needs of others with me	not applicable	17.5

Table 11: Potential changes made to commute as a result of real-time traffic information-Bellevue commuters

Respondents were asked if other types of information services delivered to their vehicle would help make their commute easier or more pleasurable. The following table summarizes the responses.

	Bellevue SOV	Bellevue pooler
Instantaneous traffic reports that include impacted areas with amounts of delays	55.4	55.0
Flexible scheduling of ride to or from work	36.4	16.7
Route guidance	22.8	21.7
Access to their company's electronic mail	14.3	21.7
Stock market reports	10.7	6.7
Restaurant reservations and menus	1.8	6.7
Other	10.7	11.7

Table 12: Information preferences for Bellevue commuters

For the single-occupancy respondents, the "other" category answers were varied and generally facetious in nature. For the poolers, the "other" category cited most frequently was "none of the above."

In summary, both commuter groups indicated that they would make route changes if traffic information indicated such a change would be beneficial. A substantially greater percentage of drive-alone commuters would make route changes, reflecting their tendency to have more flexibility in their commute. Poolers may be tied to specific routes because of their passenger pickup locations. More than half of the drive-alone commuters would change departure time, again reflecting their greater flexibility. The guarantee of accurate, real-time traffic information did not significantly change the tendency to change current commute habits. Multiple-occupancy vehicle commuters seem to be interested in receiving a wider variety of information during their commute than SOV drivers. This may reflect the fact that in a pool, passengers are free for other activities, while in a SOV, driving must be the major focus. Again reflecting their ability to be flexible, a significant number of SOV drivers were interested in being able to schedule a ride on an as-needed basis.

Rideshare preferences: Survey respondents were asked their attitudes towards ridesharing, their ridesharing patterns, and their opinions towards ridesharing information services.

Flexibility and convenience were items checked most often by survey respondents as reasons why Bellevue SOV respondents did not rideshare. The following table shows other reasons for deciding not to rideshare.

Reason	Percent of SOV responses
I want the flexibility of determining when I leave to or from work.	24.6
I want the convenience of having my own car to run personal errands.	17.5
I need my own car to perform work-related errands.	15.8
I experience less hassle/stress when I take my own car.	8.8
It's too difficult to arrange for a rideshare.	3.5
I prefer being alone during my commute.	3.5
I'm not sure how to join or establish a car or vanpool.	1.8
I feel safer in my own car.	0.0
There is no incentive from my employer or building to rideshare.	0.0
Other	24.6

Table 13: Reasons why SOV drivers do not rideshare

The "other" responses related to the need for flexibility: appointments during the day, child care arrangements, need to be available in case of emergencies, and school commitments after work.

When asked what factors would induce SOV respondents to rideshare, the ability to arrange for rides on a casual basis was most frequently cited (43.9%). The ability to get a guaranteed ride home in an emergency was the next frequent response (26.3%).

Factors that would make respondent more likely to rideshare	Percent of SOV responses
Ability to arrange for shared rides on a casual basis (not a set schedule)	43.9
Guaranteed ride home in an emergency	26.3
Assistance in finding a vanpool or carpool	19.3
More HOV lanes on freeways or on/off ramps	8.8
Reserved parking	8.8
Reduced fares for vanpools or carpools	7.0
Reduced parking rates	7.0
HOV lanes in city streets	3.5
Priority traffic information not offered to single occupancy vehicles	0.0
Other	31.6

Table 14: Factors that would make SOV drivers more likely to rideshare

The respondents who checked "other" cited company car available for employees during the day, child care on site, employer-subsidized programs, better schedules for municipal transportation, and a change in personal situation as factors that would cause them to consider ridesharing.

The interest in an "instant" rideshare program was assessed. Survey respondents were asked if they would be interested in a city-sponsored program that would let them arrange to rideshare on a trip-by-trip basis. Interest among SOV was relatively high, and among poolers relatively low.

	Bellevue SOV	Bellevue pooler
Yes	42.3	18.2
No	57.7	81.8

Table 15: Interest in a city-sponsored "instant" rideshare program

The factors that would influence their participation in a program of this type were assessed. The respondents were asked to check all factors that would influence their participation, so the totals add up to more than 100%.

Factors that would influence participation	Bellevue SOV	Bellevue pooler
The service would have to be flexible	87.1	61.9
The cost, if any, would have to be minimal	73.3	52.4
The service would have to be very safe	41.9	33.3
I want to know that the other participants were prescreened and certified	19.4	23.8
I would have to know the other participants	13.0	9.5
Other	6.5	14.3

Table 16: Factors that would influence participation in a city-sponsored "instant" rideshare program

Commuters who checked "other" stated that the service would have to be reliable. One commuter also wanted the use of such a service to influence the costs of parking on days that a personal car was necessary.

Bellevue poolers were asked about their ridesharing experience. When asked to express their satisfaction with ridesharing, 82% expressed a lot of satisfaction and 17% expressed some satisfaction. Although the reasons for deciding to rideshare were varied, employer or building incentives and saving money were cited most frequently.

Factors for ridesharing	Percent of pooler responses
Employer or building incentives	54.5
Save money	24.7
Prefer to ride with family, friends, or coworkers	7.8
Less hassle/stress	3.9
Prefer to having someone to talk to during commute	2.6
Save time because we can use the HOV lanes	1.3
Safety during the commute	0.0
Other	5.2

Table 17: Reasons poolers rideshare

Commuters who checked "other" cited the ability to commute with family members and environmental factors as reasons for ridesharing.

Rideshare characteristics: The majority of Bellevue pooler respondents rideshare to work five days per week (87%). Less than ten percent (9.8%) rideshare to work four days per week and only 3.3% rideshare to work three days per week. The commute from work to home follows similar patterns, with 81.5% sharing rides five days per week, 13% four days per week, and 3.3% sharing rides three days per week.

When asked why they don't rideshare on a particular day, 52.7% said they needed their own cars to run personal errands to or from work. Twenty-two percent (22%) always rideshare, 13.2% have flexible schedules, and 12.1% need their car for work.

Most pooler respondents rideshare with one other person (47.3%), while 38.5% share a vehicle with two other people. 8.8% share a ride with four other people, while 1.1% commute to work with four other people. When asked if they shared a ride with family members, 26.3% rideshare with a family member, while 68.4% do not share a ride with any family member.

Most poolers pay for their rides by trading driving (34.4%) or by sharing gas (20%). Employer subsidies cover the entire cost for 16.6% of the respondents. Payments by the month are made by 26.7% of the respondents.

Poolers notify fellow ridershares in the vehicle (61.8%), by phone the evening before (24.2%), or by phone at work (13.3%) if they will not be riding the next day.

The majority of ridesharers meet at Park and Ride facilities (59.3%).

In summary, SOV drivers do not rideshare because they need or prefer to have more flexibility in their commute. The ability to arrange for shared rides on a casual basis, a guaranteed ride home in case of an emergency, and assistance in finding a vanpool or carpool are the most important factors that could convince them to move from a SOV to a pool. Poolers share rides to save money or to qualify for building or employer incentives. They typically share rides five days a week. When they are unable to rideshare, it is because they need a personal vehicle for a specific purpose on a specific day.

Interest in a city-sponsored "instant" rideshare program was high for SOV drivers, with 42.3% interested in the idea and 57.7% not interested. This is a significant finding. Pooler commuters were less interested in the idea, with 81.8% not interested. This high disinterest is probably due to the satisfaction already felt by current traditional ridesharing.

SUMMARY OF PHASE 2

The survey of commuters was conducted to understand if there were differences between commute patterns and information needs for commuters to Bellevue versus Seattle. A second objective was to determine if commute patterns were significantly different for Bellevue SOV versus pooler commuters, and if so, if these differences could be leveraged to change commute habits.

There were no major differences between the commute characteristics, habits, or information needs of Bellevue versus Seattle commuters. The largest difference was in the gender split, with a larger proportion of Bellevue CBD commuters being female. The split is consistent for both SOV and HOV/pooler commuters. There are marginal differences for commute times and distances traveled between the four groups surveyed. The Bellevue commuter has a shorter distance to travel to work and it takes a shorter period of time. For both geographic areas, SOV commuters had greater flexibility in their commute.

Commercial radio is the preferred method for delivery of traffic information. If changes are made to the commute based on received information, it is most likely to be a route change. Instantaneous traffic information delivered to a vehicle is not considered a factor in making the commute more pleasurable for the Bellevue CBD commuters.

The most significant difference between SOV and pooler commuters, for the purpose of this study, was SOV drivers' willingness to take part in a flexible rideshare program, while poolers were not. Presently, SOV drivers do not rideshare because they need or desire more flexibility. Over 40% of SOV drivers would consider ridesharing if it could be made flexible. Poolers generally share rides to receive incentives and to save money.

In conclusion, there are few significant differences between the commute habits of Bellevue CBD and Seattle commuters. SOV drivers within the Bellevue CBD might take part in a rideshare program that was flexible and convenient, but poolers probably would not. Since reducing the percentage of SOV drivers is a primary goal, this finding is encouraging. It emphasizes, however, the need for developing a flexible rideshare program.

PHASE 3: CELLULAR TELEPHONE USE

PURPOSE AND SCOPE

The purpose of this phase was to provide real-world experience of the suitability, use, and appropriateness of cellular technology to increase the attractiveness of ridesharing.

Six registered vehicles in the Bellevue TMA rideshare program were selected to participate in a six month demonstration study. These vehicles were provided with cellular telephones and access to traffic information and other services on demand, which potentially gave them (among other things) an advantage over SOV drivers in finding the best route to their destination. We wanted to see if these advantages could be exploited as a means to increase the market share for shared rides.

The participants were encouraged to talk about the program on an on-going basis, both with the TMA and with each other via voice mail. All calls made by the vehicle occupants were to be recorded and reported to the TMA on a monthly basis. Each carpool used a log sheet to record date, time, location at time of call, who or what was called, reason for call, result of call, effectiveness of the call (on a scale of 1 to 5), and any comments the users may have. The log system allowed the use and effectiveness of the cellular phones to be monitored and evaluated. The TMA could assess what dial-up services were used, how often they were used, and how effective they were; the type of situations where the cellular technology proved most useful; and when and where the use of cellular phones was most effective.

RESEARCH DESIGN

Methodology

As part of the Bellevue Smart Traveler project, McCaw Communication's local subsidiary, Cellular One, agreed to donate six cellular phones and subsidized usage accounts for six months. The drivers or passengers were to use the phone in any manner that they desired to help make commute decisions or enhance the desirability of ridesharing.

Sample

The sample consisted of six car/van pools who were registered with the Bellevue TMA and who agreed to participate in a study assessing the use of cellular technology to the commute experience. These commuters were selected for this six month operational test before a researcher from the University of Washington was involved in this project. The participants were selected at random from the list of registered poolers. An attempt was made to provide diversity in distance and length of commute, geographic location, and buildings within the Bellevue CBD.

The commuters, their hours, and commute routes are as follows:

Identification	Car or Van	Commute Hours	Route
Group A	Car	6:00-7:00 am 4:30-5:30 pm	Tacoma to Bellevue. Typical route: I-5 North to I-405 North. Will occasionally take I-90.
Group B	Car	6:40-7:40 am 4:30-5:15 pm	Vashon Island to Bellevue. Route includes ferry.
Group C	Car	6:00-7:00 am 5:15-6:00 pm	Auburn to Bellevue Typical route: SR 167 to I-405 North
Group D	Van	6:50-7:30 am 4:45-5:30 pm	Ravenna to Bellevue Typical route: I-5 South to SR 520 East to I-405 South
Group E	Car	5:30-6:00 am 2:00-3:30 pm	Bothell to Bellevue Typical route: I-405 South
Group F	Van	6:45-7:30 am 4:30-5:45 pm	Puyallup to Bellevue Typical route: SR 167 North or SR 18 North to I-405 North

Table 18: Summary of participants in cellular telephone test

Data collection

The telephone use was recorded by the participants on log sheets supplied by the Bellevue TMA. A sample is in Appendix B. The date, location at the time of the call, person or service called, reason for call, result, and measure of effectiveness was recorded. These log sheets were to be sent to the TMA monthly.

Three meetings were held with the commuters during this test. During the meetings, they discussed how they used the telephones, problems encountered, and their satisfaction with the technology as a means of enhancing the commute experience.

Data analysis

The log sheets sent to the TMA by the commuters were reviewed to assess frequency of calls, purpose of calls, reported satisfaction with the call, and patterns of use. No statistical analyses were performed on the log data.

FINDINGS

Patterns of phone use

In general, most calls were made for business purposes. At the start of the test, some calls were made to a WSDOT telephone line that offers recorded traffic information for all Seattle-area freeways (622-CARS). After a few calls to this information line, most of the commuters felt that the traffic information provided was not timely or relevant. Another frequent use of the telephones was to report violators of the travel lanes designated for high-occupancy vehicles.

Voice messaging

Voice mail accounts were created for each commuter group. These accounts were infrequently accessed. Messages left in the mail boxes did not receive any replies. At an early meeting, several of the commuters indicated that they did leave messages for each other, but this use apparently stopped after the novelty wore off.

SUMMARY

The cellular telephones in and of themselves did not provide an incentive for ridesharing nor did they significantly enhance the commute experience. Commuters reported they felt safer and less stressed when they had access to the telephones, but all indicated that they would not purchase cellular telephones and service solely for these reasons.

The lack of telephone-based services to access is a probable cause for the lack of impact of the cellular technology on the commute.

The characteristics of the participants also contributed to the findings. Because the destinations of the participants were so varied, there was no reason to use the cellular technology to communicate with each other. More positive findings may have been obtained if all of the participants had the same, or similar destinations. The telephones could have facilitated communication between the car or vanpools as they rearranged passengers, travel times, and pickup locations.

PHASE 4: REAL-TIME TRAFFIC INFORMATION DELIVERED TO VEHICLE

The purpose of this phase was to evaluate how commuters would react to receiving real-time traffic information during their commute and to assess the impact and benefit of this information on their normal commute patterns.

The test was introduced at a meeting with the six cellular-using carpools held in January 1992. The purpose and logistics of the test were presented, the responsibilities of the commuters were reviewed, and a map of the area of freeway covered by the WSDOT traffic sensors (thus the coverage of the Traffic Reporter system) was provided. Some of the details for the test, such as the exact start date and the phone number to call for traffic information, were not available at this meeting. The commuters were asked to listen to their voice mailboxes for more information.

RESEARCH DESIGN

Methodology

The test was run using real-time traffic information as displayed by the University of Washington-developed Traffic Reporter ATIS. The system was accessed at a terminal in the Department of Technical Communication at the University of Washington.

The carpoolers were to phone in before they were at decision points in their commute. Information about the commute based on the information displayed by Traffic Reporter system was provided to the commuter by a person sitting at the Traffic Reporter terminal. The system displayed predicted time from origin to destination, average speed along the route, and areas of congestion. Information on alternative routes could also be provided so the commuters would have sufficient information with which to make route decisions.

The information provided to each commuter was logged by the Traffic Reporter operator to keep track of the information provided.

When the carpoolers had arrived at either work or home, they were expected to call in and report on their commute. They were to report what route they actually took, what influenced their decision, if the information provided was used to influence their decision, whether or not they were satisfied with the information, and if they found the information useful. This information was added to the log sheets. A follow-up survey after the test was over was used to evaluate the impact on the commute and benefit of the in-vehicle delivery of traffic information.

Sample

The test was run with the six commuter groups who were provided with cellular telephones as part of the Bellevue Smart Traveler program. Please refer to the previous section for information on their commute times and typical routes.

Data collection

The test was originally scheduled for the week of February 17th, but as there was a holiday that week, the start date was rescheduled for the end of February. The test was rescheduled again and was run March 3 through March 9, 1992. During the time that the exact start date was being determined, the carpoolers were kept up to date by weekly voice mail messages. The participants were notified by voice mail about 2 days before the test was actually to start.

The test ran from 6:00 am to 8:00 am and 4:30 pm to 6:00 pm from Tuesday, March 3 through Monday, March 9, 1992. The hours coincided with the commute hours of the majority of participants. The hours of commuter Group E fell outside of the period typically considered the "Seattle commute." No effort was made to schedule the test to include that carpool.

The first morning of the test, no phone calls from the participants were received. During the day, direct phone calls to most of the carpoolers were made (Group E was not contacted because of their commute hours). The driver of Group B could be not be reached by phone. This carpool did not participate in this study. Voice messages (in their company's system) were left for the drivers of Groups D and F. Because of communications problems, only four of the six commuter groups in the Bellevue Smart Traveler program were participants in this test. Call volume did pick up during the remainder of the week. Please refer to the following table for call volumes.

	March 3	March 4	March 5	March 6	March 9
Morning	0	3	4	3	2
Afternoon	2	2	1	2	3

Table 19: Call volumes during test of in-vehicle delivery of traffic information

To understand what information was important to the commuters, the information delivery process varied during the test. On the afternoon of the first day of the test, preferred route information, based on the requests of the participants, was provided. Interest in alternate route information was determined by asking the participants if they wished to hear it. The second day of the test, an overall traffic condition report was provided. The commuters were asked if they wanted specific route information. The third and remaining days of the test, general traffic condition information was not provided. The commuters were provided with speed, time, and congestion information about all possible routes they could take to their destination.

In general, the commuters indicated in the follow up phone calls that the information provided was correct and approximated the conditions they found on the freeways.

The information provided to the commuters was recorded on log sheets as it was provided. Actual route choice and satisfaction in the quality of the data was recorded on the same form when the commuters made their follow-up phone calls.

After the test was completed, a follow-up survey was mailed to the driver of each of the four vehicles which participated in the test. Two vehicles did not participant in the test and were not sent surveys.

Data analysis

The log sheets were reviewed to determine if the information provided influenced the route taken by the commuters. The reported feeling of satisfaction with the information were ranked. No statistical analyses were performed on the data.

FINDINGS

When provided with the option to receive alternate route information, the poolers were only interested in hearing about the route they had already chosen to take home. They did not want to hear about other options.

When presented with information on corridor route conditions, the participants did not want to hear more specific information once they were apprised of the general traffic conditions of their route corridor.

These commuters were more interested in receiving general specific traffic information, tailored for their areas of interest, than they were in receiving route alternatives.

Almost all of the participants did not feel that they had route options. One reason for the perceived lack of route options is the geographic location of a participant's home versus work location. A second reason for the perceived lack of route flexibility is due to routing mandated by prior decisions. Two carpools used routes that were not covered by roadway sensors that provide source data to Traffic Reporter (Highway 18 and 167) system. Once they decided to take one of these routes, typically far south of Seattle, they were locked into having to take I-405 N to reach Bellevue. These carpools liked to receive the traffic information but used it more as a confirming message than for decision support.

SUMMARY

In the previously reported survey, commuters involved in the Bellevue Smart Traveler project generally felt that being able to access real-time, accurate traffic information while commuting would affect their commute and commute decisions. This limited test found that traffic information delivered to certain vehicles does not impact their commute decisions. However, these participants liked receiving real-time traffic information even if it was not used for decision support. The fact that a person was on the other end of the phone, providing a personal touch, gave them a higher degree of trust in the information provided and a comfort level for their commute.

In the meetings, they indicated they were interested in being able to access typical office functions (electronic mail, voice mail, simple computing) that enable them to extend their work days, address upcoming or last minute business, and provide more flexibility as they commute.

The people chosen to participate in the Bellevue Smart Traveler did not have, or did not feel as if they had, route flexibility. Because they are part of a unit who depends on all members, they did not have departure time flexibility. Therefore, they may demonstrate that car/van poolers are not the primary audience for real-time traffic information for decision support.

FINDINGS AND RECOMMENDATIONS

The use of cellular technology to make ridesharing more attractive was not proved by this study. Nevertheless, the findings indicate that there is potential for this technology to have significant impact on the individual commute experience. This section summarizes key findings and recommendations based on this study.

PHASE 1

Findings

Phase 1 consisted of a literature review of ATIS and ATMS that were relevant to Bellevue Smart Traveler. The purpose was to understand features and functions and identify how similar user needs were met.

Seven systems and research into driver needs in the year 2000 were reviewed. Most relevant were FastLine!, specifically designed to move people from single-occupancy vehicles, into multiple-occupancy vehicles or mass transit, and a system designed by PacTel for its San Diego, CA customers to provide traffic information via cellular telephone. Traffic Reporter, largely because of its geographical coverage, was also crucial.

Recommendations

These three systems should be monitored to determine their success. Significant findings from the operational tests of these systems can be evaluated for applicability to the City of Bellevue and the Bellevue CBD and incorporated into the next phase of this project.

PHASE 2

Findings

Phase 2 was a new survey of Bellevue CBD commuters and a re-analysis of existing data from a 1989-90 survey of Seattle-area commuters.

Bellevue CBD commuters are more likely to be female than male, a difference that is more pronounced for the pooler population. The pooler to Bellevue CBD travels an average of 15.5 miles to work, taking 30.6 minutes to work and 34.1 minutes to home. The Bellevue drive-alone commuter travels an average of 13.2 miles to work, with the trip taking 26.2 minutes to work and 27.5 minutes to home.

Drive-alone commuters typically have more flexibility in varying their commute hours than do poolers, and travel less distance taking less time.

Both groups of commuters are likely to change their commute based on information from commercial radio. A substantially greater percentage of drive-alone commuters were more likely to make route changes than poolers, reflecting their overall tendency for greater flexibility in their commute. More than half of the drive-alone commuters would change their departure times, again reflecting their greater flexibility.

A significant number (36.4%) of drive-alone commuters were interested in being able to schedule a ride to or from work on an as-needed basis.

Drive-alone commuters are most concerned with flexibility and convenience. Factors that could incent them to ride-share include the ability to arrange for a ride on a casual basis and a guaranteed ride home in case of an emergency.

A significant number (42.3%) of drive-alone commuters were interested in a city-sponsored "instant" rideshare program that allows commuters to arrange for a ride on a trip-by-trip basis. Poolers were less interested in such a program (18.2%) probably reflecting the fact that they are already in established pools and overall have less flexibility. For SOV drivers, flexibility is the key to such a service. Cost was much less important factor to either drive-alone commuters or poolers.

Recommendations

These findings indicate that there is significant interest among drive-alone commuters to the Bellevue CBD for a casual, trip-by-trip rideshare program. Flexibility and convenience were the most important factors in such a service. Continued research into the development of a program of this type is highly recommended.

In addition, user requirements for in-vehicle information services need to be further investigated.

PHASE 3

Findings

Phase 3 was an operational test into the use of cellular telephones to increase the attractiveness of ridesharing to current poolers.

When delivered to existing carpools and vanpools, the use of cellular telephones did not provide an incentive for ridesharing nor did they significantly enhance the rideshare experience. Commuters reported feeling safer and less stressed because of the telephones in the car.

The use of this technology was hampered by an insufficiently developed information infrastructure. Once this infrastructure is further developed, cellular telephones may prove more valuable.

Recommendations

It is recommended that the use of cellular telephones to affect the commute be tested again after more telephone-based information services are available. Tests should also be conducted on SOV commuters, not just poolers.

PHASE 4

Findings

Phase 4 tested the effect of in-vehicle receipt of real-time traffic during the commute. Based on this feasibility test, car/van poolers are interested in receiving real-time traffic information more as a means to make the commute more pleasant than as a decision support mechanism. Although this short-test did not change the commute patterns of any of the participants, they all reported that they liked receiving traffic information in-route. Real-time traffic information for a specific route was the most desired service. These commuters liked the fact that a person operated the system and supplied them with information.

Recommendations

This study did not test the impact of in-car, real-time information over time. Such long-term use may lead to behavior modifications that did not occur during the one-week test. It was also inconclusive as to whether or not this information must be available solely in-vehicle, or if driver decisions can effectively be made prior to departure. The need for a human operator should be further evaluated. These are aspects worth studying further.

ASSESSMENT OF RESEARCH DESIGN

This section provides an analysis of the research design for the Bellevue Smart Traveler project.

Subject selection

There were important limitations in the study sample for Phases 3 and 4 of this project.

- There were too few participants (six) for conclusive findings.
- The majority of participants had little choice of routes during their commute or they tended not to want to change routes.
- Many participants commuted to Bellevue from the south, where the roadways have limited sensor coverage. They tended to make commute decisions early in the commute and were almost done with their commute before they could find out traffic conditions. Another carpool exclusively used SR 520 no matter what the traffic conditions were because alternate routes added substantially to the distance traveled. Participants who commuted within the area covered by the WSDOT roadway sensors may have contributed more effectively to the test of the effectiveness of delivering traffic information in-vehicle on commute decisions.
- One participant commuted outside of heavy traffic hours and rarely encountered delay due to commute traffic.
- There was generally limited compliance with test requirements.
- Participants had no reason to use the telephones to share information between themselves.
- It may have been better to select participants who traveled at the same times to approximately the same locations. The telephones could have been used to share traffic information between pools. The telephones could have been used to exchange pool members when necessary.

BELLEVUE SMART TRAVELER PHASE II[14]

At the beginning of the project the TMA intended to design and plan a two-year demonstration of mobile communications and information services, which would increase the attractiveness of suburban travel by carpool or vanpool. However, results from Bellevue Smart Traveler Phase I point to the need for improving information services for commuters before cellular telecommunications can be used as an effective tool in influencing high occupancy vehicle travel.

In response to these findings, the second phase of Bellevue Smart Traveler will focus on the application of Advanced Traveler Information Systems (ATIS) as a means of addressing urban congestion. In the past, however, these systems have focused more on helping drivers avoid problem spots and incidents than on enhancing transit and paratransit (carpool and vanpool) options. We now need to apply ATIS technology to creating and enhancing alternative commuting options instead of simply enhancing the single occupancy vehicle (SOV) commute. Urban traffic congestion can be alleviated by applying ATIS technology, not only to encourage transit and paratransit use, but to make that use more flexible, reliable, safe and time efficient. In other words, we need to focus on the development of an Advanced Public Transportation System (APTS) for Bellevue and other urban centers with similar characteristics.

Ridesharing programs can provide a means for organizing paratransit. However, a major obstacle to conventional ridesharing programs is that potential users are often reluctant to commit to a long-term, relatively inflexible transportation schedule. Dynamic ridematching attempts to address this obstacle by allowing drivers and commuters to not only schedule regular commuting trips, but also to flexibly arrange an "instant" carpool or vanpool. Such a feature should be part of an APTS. However, there are a number of problems to be overcome before a successful dynamic ridematching program can be implemented. These problems are not only technological, but include organizational and logistical issues in getting people together, ensuring the safety of participants, and balancing driver demands with rider conveniences.

There is also need for exploration of APTS use of real-time travel information. This information has generally been used for short-term congestion and incident response. In an APTS this information can be used to emphasize the travel benefits of alternative commuting, particularly travel time savings. Appropriately presented, this information can produce a long-term change in a significant percentage of SOV commuters, particularly those we have labeled in previous work as "pre-trip changers."

The project will address these and other problems in the context of designing a Traveler Information Center for a downtown Bellevue office building.

---

[14]Exerpted from: Spyridakis, J., Haselkorn, M., proposal for Bellevue Smart Traveler Phase II: Using Traveler Information to Reduce SOV Commuting

Appendix A: Survey data

Dear Bellevue Downtown Traveler:

The Bellevue Transportation Management Association (TMA) and the University of Washington are working to provide you with additional services to make your commute easier and more enjoyable. Before developing new information services and technologies, we would like to get your opinion on some important issues.

We are asking people who work in the downtown Bellevue business district to provide information on their commute habits. The results of this survey wili be used to design new services that will make your commute easier.

DIRECTIONS

There are 4 sections in this survey. The entire survey takes about 10 minutes to complete. When you have finished the survey, please return it to your survey coordinator or in the postage-paid envelope provided.

SECTION 1

1. Do you normally share a ride to work in a personal vehicle (including a METRO van) with at least one other person?

4.11 Yes (Please skip to section 3)

95.9 No (Please continue with Section 2)

SECTION 2

1. Why **don't** you ride share? Please check your **most** important reason. (Please check only one.)

17.5 I want the convenience of having my own car to run personal errands.
15.8 I need my own car to perform work-related errands.
6.8 I'm not sure how to join or establish a car- or vanpool.
3.5 It's too difficult to arrange for a rideshare.
8.8 I experience less hassle/stress when I take my own car.
3.5 I prefer being alone during my commute.
0 I feel safer in my own car.
24.6 I want the flexibility of determining when I leave to or from work.
0 There is no incentive from my employer or building to ride share.
24.6 Other (please tell us why) ____________________

____

2. Which of the following changes would make you more likely to ride in a carpool or vanpool?

7.0 Reduced parking costs
8.8 Reserved parking
7.0 Reduced fares for vanpools or carpools
19.3 Assistance in finding a vanpool or carpool
8.8 More HOV lanes on freeways and on/off ramps
3.5 HOV lanes in city streets
26.3 Guaranteed ride home in an emergency
0 Priority traffic information not offered to single occupancy vehicles
43.9 Ability to arrange for shared rides on a casual basis (not a set schedule)
31.6 Other (please tell us why) ____

____

SECTION 3

1. On a typical workday, how long does it take you to get from home to work and from work to home? Please include the time from door to door, both to and from work, even if the time is the same.

From home to work: ________ hours and 26.19 minutes

From work to home: ________ hours and 27.49minutes

2. How long is your commute? 13.22 miles

3. How often do you vary your work hours from day to day?

38.0 Frequently 42.2 Occasionally 19.7Never

4. By how many minutes can you vary the time you currently start and leave work? If you can't vary the time, please check none.

Starting work: 29.89 Minutes ______None

Leaving work: 35.62 Minutes _____ None

5. Which of the following best describes your work schedule?

39.1 Fixed hours set by employer
23.2 Fixed hours of my own choice
20.3 Variable hours of my own choice
11.6 Irregular, no set pattern
2.9 Rotating shifts
2.9 Other (please tell us) ________________________________

____

6. How much does receiving traffic information from any of these sources impact your commute?

Television	3.3	A lot	6.6	Some	9.8	Very Little	80.3	Not at all
Commercial Radio	21.1	A lot	25.4	Some	14.1	Very Little	39.4	Not at all
Telephone	0	A lot	1.8	Some	7.3	Very Little	90.0	Not at all

42.5 I don't receive any traffic information from any of the above sources.

7. If you checked any of the above methods in Question 6, what changes do you make?

55.3 Change departure time
84.8 Change route
0 Change pickup location
2.2 Change mode of transportation (For example, from car to bus)
4.3 Other (please tell us what) ______

8. If up-to-the-minute traffic information were available, would you use it to change your:

52.7 Departure time
80 Route choice
1.8 Pickup location
3.6 Transportation mode
9.1 Other (please tell us) ______

9. What other kinds of information or services **delivered to your vehicle** would make your commute more pleasurable?

55.4 Instantaneous traffic reports that include impacted areas with amount of delays
10.7 Stock market reports
14.3 Access to your company's electronic mail service
1.8 Restaurant reservations and menus
36.4 Flexible scheduling of your ride to or from work
22.8 Route guidance
10.7 Other (please tell us) ______

10. If you could participate in a city-sponsored service that let you arrange for ridesharing on a trip-by-trip basis, rather than having to join a scheduled van- or carpool with set departure times for an extended period of time, would you be interested?

43.2 Yes 57.5 No

11. If you answered yes to Question 10, what features about this service would be important to you? (check all that apply)

87.1 The service would have to be flexible.
41.9 The service would have to be very safe.
73.7 The cost, if any, would have to be minimal.
19.4 I want to know that the other participants were prescreened and certified.
13.0 I would have to know the other participants.
6.5 Other (please tell us what) ______

SECTION 4

1. What is your home zip code? ________ What is your work zip code? ________

2. Are you: 43.2 Male 56.8 Female

3. Are you: 68.5 Married 31.5 Unmarried

4. What is your age? 31 and under: 19.4; 31-40: 40.28; 41-50: 33.33; 51-59: 6.9; over 60: 0

5. Would you be willing to be contacted for a follow-up interview about your commute patterns? If so, please fill out the following information. All information will be kept confidential.

Name ____

Address ____

City/Zip ____

Work phone ____________________ Home phone ____________________

________ I prefer to be contacted at work between the hours of __________ and ______________

________ I prefer to be contacted at home between the hours of __________ and ______________

Check both if you have no preference.

Are there any other comments you have about ridesharing? ______________________________

____

____

____

____

____

____

____

____

____

____

Thank you! Please return this survey to your survey coordinator or

in the postage paid envelope provided.

Dear Bellevue Downtown Traveler.

The Bellevue Transportation Management Association (TMA) and the University of Washington are working to provide you with additional services to make your commute easier and more enjoyable. Before developing new information services and technologies, we would like to get your opinion on some important issues.

You are part of a select group of TMA-registered downtown Bellevue car- or vanpoolers who are being asked to complete the following questions. The results of this survey will be used to design new services that will make your commute easier.

DIRECTIONS

There are 3 sections in this survey. Please complete all of the sections. The entire survey takes about 10 minutes to complete. When you have finished the survey, please return it with your carpool registration form in the postage-paid envelope provided.

SECTION 1

1. How satisfied are you with ridesharing?

   82 A lot 17 Some 0 Very little

2. Why do you ride share? Please check your most important reason. (Please check only one.)

   54.5 Employer or building incentives (subsidized parking, reserved parking, other)
   3.9 Less hassle/stress
   2.6 Prefer having someone to talk to during commute
   7.8 Prefer to ride with family, friends, or coworkers
   0 Safety during the commute
   1.3 Save time because we can use the HOV lanes
   24.7 Save money
   5.2 Other (please tell us why) ______________________________

   ____

3. How many days per week do you ride share?

   To Work: 5 days: 87.0, 4 days: 9.8, 3 days: 3.3 per week
   From Work: 5 days: 81.5, 4 days: 13, 3 days: 3.3, 2 days: 0, 1 day:1.1 per week

4. When you don't rideshare, what are the reasons? (Check all that apply.)

   22 I always rideshare.
   52.7 I need my car for personal errands to or from work.
   12.1 I need my car for work purposes.
   3.3 I can work at home sometimes.
   1.1 I prefer the convenience of having my own car.
   13.2 My schedule at work is flexible or changes often.
   25.3 Other (please tell us why) ______________________________

   ____

5. How many other people are usually in the car or van during your commute?

To Work: 0 people:1.1, 1 person:47.3, 2 people: 38.5, 3 people: 8.8, 4 people: 1.1 in the car or van.

From Work : 1 person: 48.4, 2 people: 39.6, 3 people: 7.7, 4 people: 1.1 in the car or van.

6. Do you rideshare with family members?

26.3 I only rideshare with family members.
5.3 Family members are part of my car- or vanpool, but not the only other rider.
68.4 I don't rideshare with any family members.

7 How do you pay for your ride?

26.7 By the month
2.2 Per week
0 Per trip
34.4 By trading driving with other person(s) in my car pool or vanpool
20 By sharing gas costs with other person(s) in my car pool or vanpool
16.6 Don't pay; employer subsidizes entire costs

8A. If you are not going to ride share on a particular day, how do you normally tell the other people in your car- or vanpool?
61.8 In the vehicle the day before
24.4 Call other poolers the evening before
13.3 Call other poolers at work
22.2 Other (please tell us how) ____________________

____

8B. How would you like to be able to notify the others? ____________________

____

9. Where do you meet your carpool or vanpool on your way to work?

Currently	Preferred	
2.3	1.6	At my home
59.3	61.3	At a Park and Ride lot
26.7	27.4	Other (please describe) ____________________

____

SECTION 2

1. On a typical workday, how long does it take you to get from home to work and from work to home? Please include the time from door to door, both to and from work, even if the time is the same.

From home to work ____ hours and 34.1 minutes

From work to home ____ hours and 28.5 minutes

2. How long is your commute? 15.48 miles

3. How often do you vary your work hours from day to day?

7.4 Frequently   63.8 Occasionally   28.7 Never

4. By how many minutes can you vary the time you currently start and leave work? If you can't vary the time, please check none.

Starting work: 25.19 Minutes _____ None
Leaving work: 28.5 Minutes _____ None

5. Which of the following best describes your work schedule?

47.4 Fixed hours set by employer
30.9 Fixed hours of my own choice
13.7 Variable hours of my own choice
3.2 Irregular, no set pattern
0 Rotating shifts
3.2 Other (please tell us) ____

____

6. How much does receiving traffic information from any of these sources impact your commute?

Television	3.7 A lot	13.6 Some	21.0 Very Little	61.7 Not at all
Commercial Radio	15.0 A lot	37.2 Some	16 Very Little	31.9 Not at all
Telephone	2.7 A lot	1.3 Some	13.3 Very Little	82.7 Not at all

________ I don't receive any traffic information from any of the above sources.

7. If you checked any of the above methods in Question 6, what changes do you make?

31.0 Change departure time
60.6 Change route
0 Change pickup location
2.8 Change mode of transportation (For example, from pool to own car)
5.6 Can't make any changes because of needs of others with me
9.9 Other (please tell us why) ____

____

8. If up-to-the-minute traffic information were available, would you use it to change your:

28.8 Departure time
57.5 Route choice
0 Pickup location
1.3 Transportation mode
17.5 I can't change anything because of the needs of others with me
13.8 Other (please tell us) ____

____

9. What other kinds of information or services delivered to your vehicle would make your commute more pleasurable?

55.0 Instantaneous traffic reports that include impacted areas with amount of delays
6.7 Stock market reports
21.7 Access to your company's electronic mail or voice mail services
6.7 Restaurant reservations and menus
16.7 Flexible scheduling of your ride to or from work
21.7 Route guidance
11.7Other (please tell us) ______________________________

____

10. If you could participate in a city-sponsored service that let you arrange for ridesharing on a trip-by-trip basis, rather than having to join a scheduled van- or carpool with set departure times for an extended period of time, would you be interested?

18.2 Yes 81.8 No

11. If you answered yes to Question 10, what features about this service would be important to you? (check all that apply)

61.9The service would have to be flexible.
33.3 The service would have to be very safe.
52.4The cost, if any, would have to be minimal.
23.8 I would want to know that the other participants were prescreened and certified.
9.5 I would have to know the other participants.
14.3Other (please tell us why) ______________________________

____

SECTION 3

1. What is your home zip code? ________ What is your work zip code? ________

2. Are you: 36.8 Male 63.2 Female

3. Are you: 75.5 Married 24.5Unmarried

4. What is your age? 31 and under: 25.96, 31-40: 30.24, 41-50: 25.8, 51-59: 14.6, over 60: 2.25

5. Would you be willing to be contacted for a follow-up interview about your commute patterns? If so, please fill out the following information. All information will be kept confidential.

Name ______________________________
Address ______________________________
City/Zip ______________________________
Work phone ____________________ Home phone ______________________________
________ I prefer to be contacted at work between the hours of __________ and __________
________ I prefer to be contacted at home between the hours of __________ and __________
Check both if you have no preference.

Please feel free to add any additional comments you may have about ridesharing on a separate sheet.

Thank you! Please return this survey with your carpool registration in the envelope provided.

Motorist Information Survey

The Washington State Department of Transportation and the University of Washington are working together to improve the traffic information you receive before and during your travel on Seattle area freeways. To make traffic information more effective for you, we need to know about your commute and use of traffic information. Please fill out this questionnaire carefully, selecting the most appropriate answers for your situation. Feel free to add short comments to the right of your answer if it requires explanation. All responses are confidential.

A. Your Commute

1. In an average week, how many **days** do **you drive I-5** to or from **work** anywhere between Lynnwood and downtown Seattle?

❑ 7	❑ 6	❑ 5	❑ 4	❑ 3	❑ 2	❑ 1	❑ 0
3%	8.5%	66.5%	4.2%	3.3%	2.5%	2.5%	9.1%

(If zero, please skip to Section C, next page.)

2. Please tell us where you usually enter and exit I-5 when you commute.
   Southbound-- Average miles = 8.34
   Northbound-- Average miles = 8.65

3. Estimate your driving . . .
   Distance between home and work, excluding detours and errands: 14.92 miles
   Time from **home to work**, excluding detours and errands: 31.41 minutes
   Time from **work to home**, excluding detours and errands: 35.15 minutes

4. How much **flexibility** is there in the time when you . . .

	A lot	Some	Very little
Leave home for work	13.1%	48.9%	37.7 %
Female	9.8	45.0	45.1
Male	16.4	52.7	30.9
Leave work for home	29.2%	49.9%	20.7%
Female	25.2	49.6	25.2
Male	32.9	50.5	16.6

5. How much **stress** do you experience during your usual commute to and from work?

	A lot	Some	Very little
All	14.8%	57.6%	26.4%
Female	16.0	60.5	23.6
Male	14.2	56.4	29.4

6. During your commute, how much importance do you place in . . .

	A lot	Some	Very little
Saving commute time	66.8%	28.8%	4.3%
Female	71.2	25.3	3.5
Male	62.6	32.2	5.2
Reducing commute distance	17.7%	38.6%	43.6%
Female	20.1	41.5	37.7
Male	14.6	35.9	49.4
Increasing commute safety	54.4%	35.6%	9.8%
Female	60.6	33.3	6.11
Male	48.9	37.9	13.1
Increasing commute enjoyment	37.5%	43.0%	19.4%
Female	39.9	43.1	17.0
Male	35.2	43.3	21.6

7. How many people (including yourself) usually are in the car when you commute?
   0.3% = 5 or more 1.1% = 4 3.1% = 3 18.6% = 2 75% = 1

B. Your Route Choices

1. How **familiar** are you with north/south routes that can be used as alternatives to I-5?
   62.3% Very 32.8% Somewhat 4.8% Not at all

2. How often do you modify or change the route you travel from . . .

	Frequently	Sometimes	Rarely
Home to work	6.1%	30.7%	63.1%
Work to home	14.3%	43.4%	42.2%

3. How often do the following factors affect your choice of commuting routes?

	Frequently	Sometimes	Rarely
Traffic reports and messages	28.0%	48.1%	23.9%
Actual traffic congestion	28.6%	50.0%	21.4%
Time of day	23.4%	37.6%	38.9%
Weather conditions	8.0%	28.9%	63.1%
Time pressures	12.7%	35.4%	51.8%

4. Where are you most likely to choose your commuting route? (Check one only.)

❑ At home or work	❑ On city streets	❑ Near entrance ramps	❑ On I-5
33.8%	23.0%	25.6%	15.7%

5. When you are commuting, what length of delay on I-5 would cause you to divert to . . .

An alternate route that you know	16.31 minutes
An alternate route that you do not know	25.51 minutes

C. Traffic Information

1. From which media have you ever received traffic information?

(Check all that apply in each column.)

	None	Before & While	Column A Before driving	Column B While driving
TV	70.4%		29.4	----
Electronic message sign over I-5	46.9%		----	53.1%
Advisory radio indicated by flashing lights on highway sign	56.4%		----	43.6%
Commercial radio station	2.4%	64.5%	6.0%	27.1%
Phone	92.5%	0.4%	6.1%	1.0%
CB Radio	97.1%	0.4%	0.2%	2.4%
None	96.1%	0.7%	2.7%	0.4%

2. From which medium would you prefer to receive traffic information?

(Check one only **in each column.**)

	Column A Before driving	Column B While driving
TV	❑	---
Electronic message sign over I-5	---	❑
Advisory radio indicated by flashing lights on highway sign	---	❑
Commercial radio station	❑	❑
Phone	❑	❑
CB Radio	❑	❑

3. How much **help** do you get from traffic information delivered by . . .

	A lot	Some	Very little	Never used
TV	3.3%	15.1%	24.2%	57.4%
Electronic message sign over I-5	7.1%	28.4%	44.3%	20.1%
Advisory radio indicated by highway sign	5.1%	24.7%	37.7%	32.3%
Commercial radio station	54.6%	35.2%	8.6%	1.3%
Telephone highway construction hot line	0.5%	2.1%	4.9%	92.5%

4. **When you are on I-5**, how often does **traffic information** cause you to divert to an alternate route?

❑ Frequently	❑ Sometimes	❑ Rarely	❑ Never receive information
6.2%	46.2%	44.1%	3.4%

5. **Before you drive**, how often does **traffic information** influence . . .

	Frequently	Sometimes	Rarely	Never receive
The time you leave	13.5%	43.1%	32.1%	11.3%
Your means of transportation (e.g., car, bus)	1.9%	5.7%	57.3%	35.0%
Your route choice	12.7%	49.0%	29.2%	9.1%

6. At what point do you **prefer** to receive traffic information? (Check one only.)

❑ Before driving	❑ On city streets	❑ Near entrance ramps	❑ On I-5
53.2%	22.4%	15.9%	3.8%

7. If continual up-to-the-minute traffic information were available in the following ways, would you use them?

Traffic information delivered via phone hot line	33.7% Yes	66.2% No
Radio station dedicated to traffic information	92.1% Yes	7.8% No
Traffic information delivered via computer	15.3% Yes	84.5% No
Cable TV station dedicated to traffic information	25.4% Yes	74.3% No

8. Which of these services would you like to see developed first? (Check one only.)
   - 7.3% Traffic information delivered via phone hot line
   - 86.2% Radio station dedicated to traffic information
   - 1.3% Traffic information delivered via computer
   - 3.6% Cable TV station dedicated to traffic information
   - 0.9% Checked more than 1 row

9. Which of the following are available to you? (Check all those items that are usually in working order.)

Radio:	❑ Home	❑ Office	❑ Car
Phone:	❑ Home	❑ Office	❑ Car
TV:	❑ Home	❑ Office	
TV cable hook-up:		❑ Home	❑ Office
Computer:	❑ Home	❑ Office	

D. For Classification Purposes

1. What is your home Zip Code? ______________ your work Zip Code? __________

2. Are you: 50.7% Male 48.8% Female

3. What is your age?
   24.5% (F = 30.7%; M = 18.5%) = Under 31
   36.6% (F = 38.7%; M = 34.5%) = 31-40
   24.6% (F = 21.5%; M = 28.5%) = 41-50
   12.3% (F = 8.6%; M = 16.0%) = 51-64
   1.5% (F = .52%; M = 2.5%) = 65 and over

4. What is your annual income, before taxes, for your entire household?

Income	All	Fem.	Male	Income	All	Fem.	Mal
No income	0			40,000-49,999	14.9%	14.7%	14.8%
Under $10,000	0.8%	0.9%	0.8%	50,000-59,999	16.1%	14.8%	17.3%
10,000-19,999	6.0%	8.6%	3.6%	60,000-74,999	14.7%	12.8%	16.7%
20,000-29,999	12.8%	17.8%	7.9%	75,000-100,000	11.0%	9.5%	12.4%
30,000-39.999	14.3%	15.2%	13.6%	Over 100,000	9.4%	5.8%	12.9%

5. Would you be willing to take part in a follow-up interview about your use of traffic information? If so, ple the following. A more detailed discussion of your commute would help us improve your travel on Seattle All information will be kept confidential. **1,698 responded yes**

Dept. of Technical Communication, University of Washington
Bellevue TMA
Bellevue Smart Traveller Program

You recently participated in a research project jointly sponsored by the Bellevue TMA and the University of Washington. The purpose of the study was to evaluate if cellular technology can enhance the commute experience. Your participation in this study was greatly appreciated.

One phase of the study was to understand if commuter behavior or the commute experience would be affected by receiving real-time traffic information during a commute. As a final evaluation for this study phase, can you please complete this survey? There were only five groups participating in this study, so it is extremely important that you, as driver, return this form. A stamped envelope is included for your convenience.

Sincerely,

Denise D. Pieratti, Research Assistant

Please answer these questions based on your experience and feelings after participating in the one week test during which you received traffic information via cellular telephone during your commute.

1. The information I received about traffic conditions was useful.

   1 Strongly Agree **3** Agree ☐ Neither Agree/Disagree ☐ Disagree ☐ Strongly Disagree

2. Did you prefer to receive information that is: ☐ Area-specific. **4** Route-specific.

3a. The information I received about traffic conditions influenced my commute.

   1 Strongly Agree **2** Agree ☐ Neither Agree/Disagree **1** Disagree ☐ Strongly Disagree

3b. If you checked Strongly Agree or Agree in the above question (3a), what changes did you make? Commuter 1: "I did not make any route changes because report did not warrant any. I was, however, prepared to make changes to my route if necessary." Commuter 2: "Change routes on a daily basis depending on traffic conditions." Commuter 3: "We travel early on SR 520. Most often we gave you information. It would have been disastrous for us to take I-90" Commuter 4: Did not alter my route.

3c. If your commute was not influenced by the information you received about traffic information, what value did the information have? Commuter 3: "Period of time [of test] was not long enough to be of great help."

4. Would you use a service like this? **34** Yes ☐ No

5. Not taking into account the cost of a cellular telephone and cellular service, how much would you be willing to pay for real-time traffic information delivered to your vehicle during your commute? Commuter 1: $1.00/day, Commuter 2: very little, Commuter 3: $5.00/month Commuter 4: Nothing

Thank you very much. Please return this survey in the stamped envelope as soon as possible.

Appendix B: Forms used in this study

SECTION 4

1. What is your home zip code? ________ What is your work zip code? ________
2. Are you: ___ Male ___ Female
3. Are you: ___ Married ___Unmarried
4. What is your age? ______
5. Would you be willing to be contacted for a follow-up interview about your commute patterns? If so, please fill out the following information. All information will be kept confidential.

Name ____

Address ____

City/Zip ____

Work phone ______________________ Home phone ______________________

________ I prefer to be contacted at work between the hours of __________ and ______________

________ I prefer to be contacted at home between the hours of __________ and ______________

Check both if you have no preference.

Are there any other comments you have about ridesharing? ________________________________

____

____

____

____

____

____

____

____

____

____

____

Thank you! Please return this survey to your survey coordinator or in the postage paid envelope provided.

Dear Bellevue Downtown Traveler:

The Bellevue Transportation Management Association (TMA) and the University of Washington are working to provide you with additional services to make your commute easier and more enjoyable. Before developing new information services and technologies, we would like to get your opinion on some important issues.

We are asking people who work in the downtown Bellevue business district to provide information on their commute habits. The results of this survey will be used to design new services that will make your commute easier.

DIRECTIONS

There are 4 sections in this survey. The entire survey takes about 10 minutes to complete. When you have finished the survey, please return it to your survey coordinator or in the postage-paid envelope provided.

SECTION 1

1. Do you normally share a ride to work in a personal vehicle (including a METRO van) with at least one other person?

________ Yes (Please skip to section 3)

________ No (Please continue with Section 2)

SECTION 2

1. Why don't you ride share? Please check your most important reason. (Please check only one.)

________ I want the convenience of having my own car to run personal errands
________ I need my own car to perform work-related errands.
________ I'm not sure how to join or establish a car- or vanpool.
________ It's too difficult to arrange for a rideshare.
________ I experience less hassle/stress when I take my own car.
________ I prefer being alone during my commute.
________ I feel safer in my own car.
________ I want the flexibility of determining when I leave to or from work.
________ There is no incentive from my employer or building to ride share.
________ Other (please tell us why) ______________________________

____

BELLEVUE SMART COMMUTER
MOBILE COMMUNICATIONS LOG

DATE	LOCATION AT TIME OF CALL	CALL TO	REASON FOR CALL	RESULT	EFFECTIVENESS
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5
					1 2 3 4 5

Comments: ______________________________

1 = not helpful at all; 5 = very helpful

2. Which of the following changes would make you more likely to ride in a carpool or vanpool?

________ Reduced parking costs
________ Reserved parking
________ Reduced fares for vanpools or carpools
________ Assistance in finding a vanpool or carpool
________ More HOV lanes on freeways and on/off ramps
________ HOV lanes in city streets
________ Guaranteed ride home in an emergency
________ Priority traffic information not offered to single occupancy vehicles
________ Ability to arrange for shared rides on a casual basis (not a set schedule)
________ Other (please tell us why) ____

____

SECTION 3

1. On a typical workday, how long does it take you to get from home to work and from work to home? Please include the time from door to door, both to and from work, even if the time is the same.

From home to work: ________ hours and ________ minutes

From work to home: ________ hours and ________ minutes

2. How long is your commute? __________ miles

3. How often do you vary your work hours from day to day?

________ Frequently ________ Occasionally ________ Never

4. By how many minutes can you vary the time you currently start and leave work? If you can't vary the time, please check none.

Starting work: _____ Minutes _____ None

Leaving work: _____ Minutes _____ None

5. Which of the following best describes your work schedule?

________ Fixed hours set by employer
________ Fixed hours of my own choice
________ Variable hours of my own choice
________ Irregular, no set pattern
________ Rotating shifts
________ Other (please tell us) ________________________________

____

6. How much does receiving traffic information from any of these sources impact your commute?

Television	___ A lot	___ Some	___ Very Little	___ Not at all
Commercial Radio	___ A lot	___ Some	___ Very Little	___ Not at all
Telephone	___ A lot	___ Some	___ Very Little	___ Not at all

________ I don't receive any traffic information from any of the above sources.

7. If you checked any of the above methods in Question 6, what changes do you make?

___ Change departure time
___ Change route
___ Change pickup location
___ Change mode of transportation (For example, from car to bus)
___ Other (please tell us what) ____

____

8. If up-to-the-minute traffic information were available, would you use it to change your:

________ Departure time
________ Route choice
________ Pickup location
________ Transportation mode
________ Other (please tell us) ____

____

9. What other kinds of information or services **delivered to your vehicle** would make your commute more pleasurable?

________ Instantaneous traffic reports that include impacted areas with amount of delays
________ Stock market reports
________ Access to your company's electronic mail service
________ Restaurant reservations and menus
________ Flexible scheduling of your ride to or from work
________ Route guidance
________ Other (please tell us) ____

____

10. If you could participate in a city-sponsored service that let you arrange for ridesharing on a trip-by-trip basis, rather than having to join a scheduled van- or carpool with set departure times for an extended period of time, would you be interested?

________ Yes ________ No

11. If you answered yes to Question 10, what features about this service would be important to you? (check all that apply)

________ The service would have to be flexible.
________ The service would have to be very safe.
________ The cost, if any, would have to be minimal.
________ I want to know that the other participants were prescreened and certified.
________ I would have to know the other participants.
________ Other (please tell us what) ____

____

9. What other kinds of information or services **delivered to your vehicle** would make your commute more pleasurable?

________ Instantaneous traffic reports that include impacted areas with amount of delays
________ Stock market reports
________ Access to your company's electronic mail or voice mail services
________ Restaurant reservations and menus
________ Flexible scheduling of your ride to or from work
________ Route guidance
________ Other (please tell us) ____

____

10. If you could participate in a city-sponsored service that let you arrange for ridesharing on a trip-by-trip basis, rather than having to join a scheduled van- or carpool with set departure times for an extended period of time, would you be interested?

________ Yes ________ No

11. If you answered yes to Question 10, what features about this service would be important to you? (check all that apply)

________ The service would have to be flexible.
________ The service would have to be very safe.
________ The cost, if any, would have to be minimal.
________ I would want to know that the other participants were prescreened and certified.
________ I would have to know the other participants.
________ Other (please tell us why) ____

____

SECTION 3

1. What is your home zip code? ________ What is your work zip code? ________

2. Are you: ___ Male ___ Female

3. Are you: ___ Married ___Unmarried

4. What is your age? ______

5. Would you be willing to be contacted for a follow-up interview about your commute patterns? If so, please fill out the following information. All information will be kept confidential.

Name ____
Address ____
City/Zip ____
Work phone ____________________ Home phone ____________________
________ I prefer to be contacted at work between the hours of ____________ and ____________
________ I prefer to be contacted at home between the hours of ____________ and ____________
Check both if you have no preference.

Please feel free to add any additional comments you may have about ridesharing on a separate sheet.

Thank you! Please return this survey with your carpool registration in the envelope provided.

Dear Bellevue Downtown Traveler:

The Bellevue Transportation Management Association (TMA) and the University of Washington are working to provide you with additional services to make your commute easier and more enjoyable. Before developing new information services and technologies, we would like to get your opinion on some important issues.

You are part of a select group of TMA-registered downtown Bellevue car- or vanpoolers who are being asked to complete the following questions. The results of this survey will be used to design new services that will make your commute easier.

DIRECTIONS

There are 3 sections in this survey. Please complete all of the sections. The entire survey takes about 10 minutes to complete. When you have finished the survey, please return it with your carpool registration form in the postage-paid envelope provided.

SECTION 1

1. How satisfied are you with ridesharing?

________ A lot ________ Some ________ Very little

2. Why do you ride share? Please check your **most** important reason. (Please check only one.)

________ Employer or building incentives (subsidized parking, reserved parking, other)
________ Less hassle/stress
________ Prefer having someone to talk to during commute
________ Prefer to ride with family, friends, or coworkers
________ Safety during the commute
________ Save time because we can use the HOV lanes
________ Save money
________ Other (please tell us why) ____

____

3. How many days per week do you ride share?

To Work: _______ days per week From Work: ________ days per week

4. When you don't rideshare, what are the reasons? (Check all that apply.)

________ I always rideshare.
________ I need my car for personal errands to or from work.
________ I need my car for work purposes.
________ I can work at home sometimes.
________ I prefer the convenience of having my own car.
________ My schedule at work is flexible or changes often.
________ Other (please tell us why) ____

____

5. How many other people are usually in the car or van during your commute?

To Work: __________ people in the car or van.

From Work : __________ people in the car or van.

6. Do you rideshare with family members?

________ I only rideshare with family members.
________ Family members are part of my car- or vanpool, but not the only other rider.
________ I don't rideshare with any family members.

7 How do you pay for your ride?

________ By the month
________ Per week
________ Per trip
________ By trading driving with other person(s) in my car pool or vanpool
________ By sharing gas costs with other person(s) in my car pool or vanpool
________ Don't pay; employer subsidizes entire costs

8A. If you are not going to ride share on a particular day, how do you normally tell the other people in your car- or vanpool?
________ In the vehicle the day before
________ Call other poolers the evening before
________ Call other poolers at work
________ Other (please tell us how) ____

____

8B. How would you like to be able to notify the others? ______________________________

____

9. Where do you meet your carpool or vanpool on your way to work?

Currently	Preferred	
_____	_____	At my home
_____	_____	At a Park and Ride lot
_____	_____	Other (please describe) ______________________

SECTION 2

1. On a typical workday, how long does it take you to get from home to work and from work to home? Please include the time from door to door, both to and from work, even if the time is the same.

From home to work ____ hours and ____ minutes

From work to home ____ hours and ____ minutes

2. How long is your commute? _____ miles

3. How often do you vary your work hours from day to day?

________ Frequently ________ Occasionally __________ Never

4. By how many minutes can you vary the time you currently start and leave work? If you can't vary the time, please check none.

Starting work: _____ Minutes _____ None
Leaving work: _____ Minutes _____ None

5. Which of the following best describes your work schedule?

________ Fixed hours set by employer
________ Fixed hours of my own choice
________ Variable hours of my own choice
________ Irregular, no set pattern
________ Rotating shifts
________ Other (please tell us) ____

____

6. How much does receiving traffic information from any of these sources impact your commute?

Television	_____ A lot	____ Some	____ Very Little	____ Not at all
Commercial Radio	_____ A lot	____ Some	____ Very Little	____ Not at all
Telephone	_____ A lot	____ Some	____ Very Little	____ Not at all

________ I don't receive any traffic information from any of the above sources.

7. If you checked any of the above methods in Question 6, what changes do you make?

________ Change departure time
________ Change route
________ Change pickup location
________ Change mode of transportation (For example, from pool to own car)
________ Can't make any changes because of needs of others with me.
________ Other (please tell us why) ____

____

8. If up-to-the-minute traffic information were available, would you use it to change your:

________ Departure time
________ Route choice
________ Pickup location
________ Transportation mode
________ I can't change anything because of the needs of others with me
________ Other (please tell us) ____

____

Name________________________________ Date________________________________

Time	Entrance or location	Destination	Information provided

Feedback: Time___________

	Not Very				Very
How satisfied were you with the information provided?	1	2	3	4	5
How useful did you find the information provided?	1	2	3	4	5

Time	Entrance or location	Destination	Information provided

Feedback: Time___________

	Not Very				Very
How satisfied were you with the information provided?	1	2	3	4	5
How useful did you find the information provided?	1	2	3	4	5

NOTICE

DOT-T-93-36

DOT-T-93-36

TECHNOLOGY SHARING

A Program of the U.S. Department of Transportation