1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

KING COUNTY

Signature Report

February 19, 2003

Motion 11657

Proposed No. 2003-0040.1 **Sponsors** Pelz

A MOTION approving the transit division response to the 2003 budget proviso requiring submission of a report on the results of a thirty-vehicle test of mobile data terminals proposed for installation in all transit accessible service vehicles.

WHEREAS, the adopted 2003 budget for the transit division declared that "$1,963,535 shall be expended only on CIP project A00010, ADA Fleet Mobile Data Terminals, after the council has received and approved by motion a report on the results of the transit division's mobile data terminals 30-vehicle pilot program," and

WHEREAS, the report has been completed to document the results of the mobile data terminal pilot program, and

WHEREAS, the results of the thirty-vehicle test show that mobile data terminal usage increases service efficiency;

NOW, THEREFORE, BE IT MOVED by the Council of King County:

The King County council hereby approves the transit division proviso response, which includes the report ADA Paratransit Mobile Data Terminal/Automatic Vehicle Location (MDT/AVL) Project: Results of 30 Vehicle Test, September 2002, submitted as Attachment A to this motion, and hereby authorizes the transit division to expend the $1,963,535 previously restricted by the proviso.

Motion 11657 was introduced on 2/3/2003 and passed by the Metropolitan King County Council on 2/18/2003, by the following vote:

Yes: 10 - Ms. Sullivan, Ms. Edmonds, Mr. von Reichbauer, Ms. Lambert, Mr. Pelz, Mr. McKenna, Mr. Constantine, Mr. Pullen, Mr. Gossett and Ms. Patterson
No: 0
Excused: 3 - Mr. Phillips, Ms. Hague and Mr. Irons

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

Cynthia Sullivan, Chair

ATTEST:

Anne Noris, Clerk of the Council

Attachments A. ADA Paratransit Mobile Data Terminal-Automatic Vehicle Location (MDT-AVL) Project Results of 30 Vehicle Test, September 2002

Attachment A

ADA Paratransit Mobile Data Terminal/ Automatic Vehicle Location (MDT/AVL) Project Results of 30 Vehicle Test, September 2002

November 6, 2002

RESULTS OF 30-VEHICLE TEST:
ADA Paratransit Mobile Data Terminal/Automatic Vehicle Location Project

Executive Summary

After a successful 3-vehicle proof of concept conducted in June 2002, mobile data terminals (MDTs) were installed in 30 *ACCESS* paratransit vehicles. The MDTs receive data from and transmit it to the paratransit scheduling/dispatch system, replacing the voice radio transmissions and manual recording and data entry that are currently used to direct the operation of *ACCESS* service.

The 30-vehicle test was implemented to:

- evaluate the impacts of the MDTs on productivity (passengers per vehicle service hour);
- test the use of the MDTs in a live operating environment and identify required changes in business process;
- identify any issues with integrating the MDTs with the scheduling software; and
- identify and test any system customizations.

Overall, the results of the test were very positive.

During the test period, the MDT vehicles carried more passengers per vehicle service hour than the non-MDT vehicles. If the MDTs had been installed in the entire fleet, the improvement would have represented a 4.0 percent increase in productivity. The increased productivity from MDTs needed to equal or exceed 3.6% in order to meet the improvement assumed in the budget.

The actual operation with the MDTs was extremely useful in demonstrating the necessary business process changes needed for successful implementation, including vehicle assignment and driver and dispatcher training. Some minor issues with integrating the existing systems and MDT customizations were discovered and corrected, clearing the way for the implementation of full-scale operation.

MDTs enhance productivity, reducing the total hours of service that are operated annually and the associated operating costs. In addition, the reduction in service hours lowers the number of paratransit vehicles that are required and reduces capital expenditures. Over the seven-year projected life of this equipment and a 4% productivity improvement, MDTs are projected to save a total of $3.5 million in addition to repaying the amount required to fund the capital project. This means the project will pay for itself in 5.8 years. The evaluation of the 30-vehicle test analyzed the cost impacts of a range of productivity improvements using fairly conservative assumptions. The project showed a positive net present value at a 5% rate of return, even at the lowest assumed level of increased productivity (3%).

Information from MDTs will be used to enhance service quality. The MDT's real-time data transmission and automatic vehicle location (AVL) data will enable the

ACCESS call center to give much more accurate responses to "where's my ride?" inquiries than is currently possible. In the future, AVL data will also allow the *ACCESS* Rideline Interactive Voice Response telephone system to give customers a warning call to let them know that their van is a few minutes away. This is also expected to reduce the time that *ACCESS* vehicles wait for riders and allow curb-to-curb service that will further increase productivity. Most *ACCESS* service is currently "door-to-door" – that is, the driver accompanies riders to the door rather than meeting them at the curb – and thus schedules currently require more dwell time than would be needed in a door-to-door system.

The approved 2003 Transit capital budget includes $1.96 million to complete the installation of MDTs. Assuming the Council proviso is satisfied, rollout will begin shortly thereafter. The fleet should be fully equipped by the end of 2003.

Implementation of MDTs supports the adopted Paratransit Polices by improving system productivity and enhancing service quality. In addition, it is a critical step toward the effective implementation of curb-to-curb service, another adopted policy.

Background

Project Objectives: The implementation of Mobile Data Terminals and Automatic Vehicle Location technology in the *ACCESS* system is intended to achieve the following goals:

- Streamline communications by moving most administrative and operational transmissions from voice to digital communications, freeing voice communication capacity for emergency, priority, and exception messages.
- Improve service delivery and reduce operating costs through more efficient scheduling of trips and better management of cancellations and no-shows.
- Improve the availability and accuracy of *ACCESS* data, enabling better customer service and better monitoring and analysis of service.
- Eliminate after-the-fact data reconciliation ("trip editing") by digitally transmitting and recording performance data as services are performed.

Project History

The potential of MDTs to enhance *ACCESS* service delivery was first identified in 1995. At that time, the technology was just beginning to be developed. Transit has been waiting since that time for the technology to mature and for other successful paratransit implementations before proceeding.

- 1995: Funding for mobile data terminals was included in the 1996 capital budget request; $584,000 was appropriated. Few, if any, successful instances of paratransit MDT installations existed; none of them were at large sites.
- 1997-98: A business analysis recommended a "smart" MDT using cellular digital packet data (CDPD – the wireless data equivalent of cell phones) for data transmission, at least until it is determined whether migration of the

ACCESS mobile data application to a King County-owned network would be preferable.

- 1998: King County Council passed a proviso to the 1999 budget limiting funding to the original appropriation until the successful completion of the planned 30-vehicle test. Funding for the balance of the project continues to be carried in the Transit financial plan.
- 1999: Accessible Services staff learned of the Greyhawk Technologies' touch-screen mobile data terminal, then and still the only p.c.-based MDT with an interface to the Trapeze scheduling system. The system was not in use in any transit system.
- 2000: Greyhawk conducted a proof of concept in the paratransit fleet operated by DART in Dallas, Texas, and was awarded a contract to install their Windows 98 MDT. 200-plus DART vehicles are currently operational.
- 2001: Accessible Services obtained authorization to conduct sole-source procurement with Greyhawk as vendor. A Request for Qualifications was issued in August, and Greyhawk responded with a proposal.

Project Summary: The ADA Fleet Mobile Data Terminals Project (A00010) provides for hardware and software integration to automate the transmission and collection of paratransit data through touch-screen, pc-based mobile data terminals (MDTs) with a Windows CE operating system, odometer readers and global positioning-based automatic vehicle location (AVL) equipment in each *ACCESS* vehicle. The system allows real-time data collection and reduces voice radio traffic, minimizing dispatch and data entry staff requirements.

The MDTs receive data from and transmit data to the Trapeze scheduling/dispatch system. The scheduling system (Trapeze) recalculates schedules as each scheduled event is performed and as AVL transmissions are received, using actual trip times and vehicle locations. Freeing dispatchers from the time necessary to maintain voice radio contact with drivers and perform the currently required data entry is expected to allow them to proactively manage service, thus improving productivity and reducing operating costs.

The system will also enhance customer service, since call center staff will be able to accurately estimate vehicle arrival times when riders inquire about their ride. Additionally, when fully implemented, the automated data transmission and automatic vehicle location functionality will allow the *ACCESS* interactive voice response system to dial out to notify riders that their van is a few minutes away. The ability to accurately predict vehicle arrival times and to notify riders of impending arrivals will enable implementation of curb-to-curb service for most riders.

Current Operating Practice

Eligible riders call to reserve rides on *ACCESS* Transportation – demand response paratransit service for people who are unable to ride the regular Metro

transit bus due to a disability – one to seven days in advance. Their trips are scheduled by the Trapeze scheduling/dispatch system. *ACCESS* delivers approximately 3,500 trips per weekday. Nearly 25 percent of all trips booked are cancellations or "no shows". As many as 25 percent of the trips that are performed are ultimately completed by a route other than the one on which they were originally scheduled. As trips are marked as performed in Trapeze, the system recalculates schedules for the remainder of each route. On the day of service, the following events happen:

- Contracted service operators print paper manifests several hours before each route leaves the base.
- Dispatchers radio out cancellations and insertions to drivers.
- Dispatchers move trips from routes that are late, broken down, etc., to other routes that have space due to slack time, cancellations or no-shows. In theory, drivers radio in as each trip is completed. In reality, dispatchers poll drivers approximately once an hour to update system information, or drivers call in to report that they have a problem. Dispatchers update trip records when they learn that a rider has been picked up or dropped off, often estimating arrival times.
- Dispatchers spend much of their time doing data entry and do not have time to be proactive in identifying and correcting problems or managing the service.
- Call center staff are frequently unable to give accurate information to riders who call to inquire about their rides.
- Several call center staff are devoted to trip editing – reconciling the actual times and mileage recorded on the drivers' paper manifest with data entered into Trapeze. Edited data is not available until several days after the day of service. Odometer readings are entered for all stops only on federally required data collection days, limiting the availability of information on travel times or speed by distance. There is no trip editing at all for some kinds of data, such as elapsed time at each stop or fare collection.

Current Status/30 Vehicle Test

In 2002, King County and Greyhawk reached agreement on contract terms, with Greyhawk as prime contractor and system integrator and Trapeze as a subcontractor. If full funding is approved, the project will provide a total of 337 Windows CE-based touch-screen units with mapping capability to equip the *ACCESS* fleet, provide training units and spares.

The cost for the proof of concept and 30-vehicle test is $544,500, which will expend the project's current appropriation. The cost for the rollout phase, if approved, will be $1.96 million, for a total of $2.51 million. This amount is included in the 2003 Transit capital budget request. Assuming rollout can begin January 1, 2003, the fleet should be fully equipped by the end of September 2003.

In June 2002, Greyhawk conducted a two-day, three-vehicle proof of concept. Drivers performed copies of actual routes using the *ACCESS* call center's test environment and Greyhawk's link to the CDPD network. Despite some technical issues relating to the units themselves and communications with the Trapeze system, there were significant periods of time where the MDTs and Trapeze interacted flawlessly. Drivers' responses were generally positive, particularly to the availability of a map and AVL information on board the vehicle.

Based on the success of the proof of concept, Accessible Services authorized Greyhawk to begin the 30-vehicle test, in which units were installed in 27 revenue vehicles (six to 11 at each of the three service operators) and three road supervisor vehicles. In this phase, the MDT module was added to the Trapeze scheduling software in the *ACCESS* call center, utilizing King County's existing connection to the CDPD network.

Installation began the week of July 25, 2002, with the first MDT vehicles placed in service the week of August 5, 2002. MDTs were installed in additional vehicles and drivers trained in succeeding weeks. All 27 revenue vehicles were in service and 115 drivers trained by the end of August 2002. The vendor installed wiring in two spare vehicles at each of the three operating bases that participated in the test and placed one spare MDT unit and one training unit at each base. The formal evaluation period for the 30-vehicle test was September 3-30, 2002. MDT equipped vehicles were placed in weekend service beginning September 7, 2002, with as many as 25 units operating per day. Routes were operated from approximately 7:30 a.m. until 6:00 p.m. daily, the time when the bulk of *ACCESS* service takes place. Staff decided not to operate night service, since MDT support staff were not on duty, and because the providers needed time to maintain the MDT fleet.

Although MDTs have been used at a number of other sites, the touch screen technology is new and there are relatively few large systems using MDTs. To mitigate the potential risks of the project, a 30-vehicle test was planned in order to:

- evaluate the impacts of the MDTs on productivity and *ACCESS* costs;
- test the use of the MDTs in a live operating environment and identify required changes in business processes;
- identify and correct any issues from integrating the MDTs and the scheduling software; and
- identify and test modifications and customizations required for the MDTs.

Each of the objectives was met. Impacts on productivity and potential cost savings are described below. The MDTs required significant changes in vehicle assignment, driver training and many other aspects of operations. Working with a steering committee of drivers, dispatchers, mechanics and other operator staff helped define and plan these changes and was useful, as well, in identifying modifications and customizations. Staff and the committee kept an on-going list

of issues and have systematically worked through these in regular meetings with both vendors.

The MDT vehicles were assigned the same routes each day. While *ACCESS* routes vary from day to day, there is typically some consistency for each day of the week. For example, 30 to 40 percent of each Monday's schedule on each route will generally be the same. The selected routes share the following characteristics:

- the routes had productivity that was roughly average for the system;
- the routes had no structural factors that would prevent improvement in productivity; and
- the routes had consecutive numbers, for ease of management in dispatch and radio programming.

Results of 30-Vehicle Test

It should be noted that the test took place over a very short period of time. MDTs represent a significant business process change across the *ACCESS* program. Drivers, dispatchers and management were, and in some cases still are, on the learning curve of adapting to their use. However, the early results are extremely promising. Although the official test period has ended, *ACCESS* continues to use the MDT units in revenue service.

Productivity: The key measure of efficiency in paratransit service is passengers per vehicle service hour (VSH). As productivity increases, a given number of passengers can be carried with fewer VSH, and thus at lower cost. Additionally, as fewer VSH are used, a smaller fleet is required to perform the service, and capital costs are thus reduced.

During the 30-vehicle test, the productivity of the MDT routes was notably better than that of the non-MDT routes – three percent on weekdays and 7.8 percent on weekends. Overall, had the entire fleet been equipped with MDTs, system productivity would have increased by 4.0%.

It is too soon to say why there was such a difference between weekday and weekend service. Weekend service operates at a much lower volume than weekday – an average of 98 routes per weekend day in September 2002, compared to 273 weekday routes. Consequently, the routes with MDTs comprised a larger portion of the weekend fleet. Perhaps this allowed dispatchers to be more efficient in moving trips between vehicles than on weekdays. Or, since weekend drivers and dispatchers tend to be the employees with the least seniority, perhaps these employees were most able to benefit from the assistance the MDTs provide.

Weekend productivity has been significantly lower than weekday productivity, potentially offering more room for improvement. The lower productivity is due in part to the smaller pool of trips, available for grouping. Another factor may be that

cross-county weekend trips are generally direct, while comparable weekday trips usually require that the rider transfer from one *ACCESS* van to another. The result is that there is significantly more deadhead time and mileage (vehicle time and mileage with no passengers on board) on weekends than weekdays, even though weekend trip lengths are comparable to weekday.

Productivity (Passengers per Vehicle Service Hour) during 30-Vehicle Test

	MDT Routes	Non-MDT Routes	Difference
Weekday routes	1.67	1.62	3.0%
Weekend routes	1.39	1.29	7.8%

Potential Cost Savings:

Previous cost analyses for the project assumed a 3.6% productivity improvement, but the initial results indicate greater improvements may be possible. Each scenario assumes that half of the productivity improvement is achieved in 2003 and the full improvement in 2004, with no further increases in productivity. Each scenario is compared to the 2002 average rides per VSH of 1.57, which was used as the baseline in the 2003 budget process. When adjusted for the implementation of MDTs, productivity in 2004 was projected to be 1.63 rides/VSH.

The majority of the cost savings results from the reduction in operating costs that come from improved productivity -- delivering the same volume of rides with a smaller number of vehicle service hours. Costs of the MDT system are also offset by a reduction in fleet capital, since a smaller fleet will be required to perform the smaller number of hours. A range of potential cost savings is presented below.

Potential Cost Savings Due to MDTs

Productivity Improvement	System Productivity	Cumulative Savings, 2002-2009 (7-year life)	Years to Repay System Costs
3%	1.62	$2.0 M	6.4
4%	1.63	$3.5 M	5.8
5%	1.65	$4.9 M	5.1

The project showed a positive net present value at a 5% rate of return, even at the lowest assumed level of increased productivity (3%).

The 2003 proposed budget and associated financial plan include the projected improvement to productivity from implementing MDTs.

For comparative purposes, productivity increases of both 3% and 5% are also calculated. Even at three percent, the system would save up to $500,000 per

year in *ACCESS* operating costs and would produce cumulative operating and capital savings of $2.0 million between 2002 and 2009, repaying itself in 6.4 years. Staff expect that the life of the MDT system will be at least seven years. It is anticipated that productivity will increase beyond 4% as schedulers, dispatchers and operators become more familiar with the system.

The MDTs will enable additional future cost savings that were not included in this analysis. Once the entire fleet is equipped with MDTs, the *ACCESS* Interactive Voice Response system will be able to dial out to notify riders that their bus is a few minutes away. Not only will this increase customer convenience, it will enable *ACCESS* to begin providing curb-to-curb service for most customers, which is expected to further enhance productivity. Presently, it is unrealistic to expect riders to wait out of doors in rainy weather or after dark for the entire 30-minute pickup window. With the dial-out notification, riders can be waiting when their vehicle arrives.

Customer Service

Because of the real-time nature of data transmission with the MDTs and the frequent availability of AVL data, the *ACCESS* call center will be able to give much more accurate responses to "where's my ride?" inquiries from customers than is currently possible. Although Trapeze, even without MDTs, recalculates each route's schedule any time a trip is updated by a dispatcher, the sheer volume of radio traffic in a voice-only system typically leaves dispatch unable to update routes in a timely manner. When a rider calls for an estimated time for a van without MDTs, the dispatcher must either reach the driver by radio or simply estimate a time for the rider based on the last information available.

Staff also expect that customers will react enthusiastically to receiving a warning call to let them know that their van is a few minutes away. These calls will be performed by *ACCESS* Rideline, the Interactive Voice Response telephone system, but are only possible due to the real-time information from MDT system. The dial-out system will be developed and tested in late 2002. The system will be implemented after the MDT rollout is complete, to avoid confusing customers with phone calls only at times when they are scheduled on an MDT route.

Driver Acceptance

Driver acceptance of the MDTs was generally positive, although a few drivers did express some resistance to using them. Staff distributed a survey to the drivers who participated in the test. Surveys were returned by 44 of the 115 drivers who were trained (a 38% return rate). Drivers who responded reported that:

- 93% preferred having less voice radio contact with dispatch;
- 91% described the MDT as very or somewhat easy to use;
- 78% felt the MDTs make it much easier or a little easier to do their job;
- 73% would much or somewhat prefer to drive an MDT van; and

- 61% felt the map was very or somewhat useful, although 69% report using the map to find locations they have not been to before and 49% use it for locations they only go to occasionally.

Overwhelmingly, the drivers' comments indicated that the reduced interaction with dispatch made for fewer distractions and allowed them to pay more attention to driving and their passengers. Although drivers had some complaints about the MDTs map, they liked having access to it and its route-finding capabilities, and nearly all used the map to find unfamiliar addresses.

The only mixed response was whether the MDTs reduced or increased the amount of time it takes drivers to do their job. Only 47% felt the time it took to do their job was much or a little shorter. This ambivalence may be because drivers were still required to complete a paper manifest, although they were instructed to answer the question as if they were using only the MDT. Once MDTs are fully implemented, the paper manifest will no longer be required.

Risk Mitigation

The MDT project continues to have an element of risk. However, staff is managing the project to mitigate the risk.

- There is limited paratransit experience with large-scale MDT implementations of any type; software and/or hardware could fail to handle the volumes of data being transmitted or otherwise not perform as expected.

  Tactic: Contract is performance-based. Significant amounts will be held back until system acceptance.

- The CDPD network could experience increases in radio traffic, thus delaying transmission times, before a decision is made to migrate the MDT system to a King County data network or CDPD technology could become obsolete.

  Tactic: Accessible Services and Greyhawk are working with King County ITS and Radio Project staff to identify the most appropriate of the next generation of wireless data communication technologies. These are already being tested and a new method of data transport will be selected prior to rollout.

Conclusion

The MDT demonstration met and exceeded expectations. The system supports the goals of the adopted Paratransit Policies, improving system efficiency and enhancing the quality of service. The information provided by the MDT system is a key element in moving forward to implement curb-to-curb service. While not totally risk free, these results suggest that moving forward to complete the implementation of MDTs will be a good investment. Even using fairly conservative assumptions in the financial analysis, the project demonstrated the potential to save a minimum of $3.5 million in operating and capital expenses over its life.