The Bill Blackwood
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Automatic Vehicle Locator System

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ABSTRACT

This research paper examines the Automatic Vehicle Locator (AVL) system with respect to law enforcement applications. Presently, law enforcement agencies experiment with the latest technology to assist in officer safety and increase the quality of customer service to the citizens in the community. The AVL systems enables law enforcement agencies to monitor police vehicles continuously and enables management to adjust work schedules to meet response needs.

The three major technologies discussed are the Long Range Navigation (LORAN), dead reckoning system, and the Global Positioning System (GPS). The GPS system is the widely known form of detecting a vehicle's location.

The implementation of an AVL system is found to affect officer morale. It is recommended that employee input and training be used to reduce employee fear of "Big Brother".

The major costs of implementing an AVL system are dependant the type of communication system currently in place, the number of units purchased, whether to buy the system from an outside vendor, and training. These costs must be weighed against the potential benefits of increasing officer safety.

In conclusion, it is recommended that the AVL be strongly considered as a tool to increase officer safety and reduce the response times to calls for police service.

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Introduction

Police Departments across the nation, regardless of size, agree that officer safety is their most important concern. Their primary focus is to ensure that they keep up with the latest techniques available to assist in officer safety. Another focus that is almost as equally important is lowering the response time to calls for assistance thereby protecting citizen safety. In response to the numerous citizen complaints, police departments have been faced with the task of determining ways to decrease the high response times to calls for service.

The purpose of this research project is to investigate the use of the Automatic Vehicle Locator System (AVL). The AVL system is currently used by various departments to increase officer safety while assisting in decreasing response times to calls for service. Historically, police departments have depended solely on the dispatcher to determine which officer to send to a call. Officers have the responsibility of notifying the dispatcher of their locations. The AVL allows the dispatcher to know the location of an officer's vehicle within a distance of 30 feet at all times. This system will enable the dispatcher to quickly respond to the officers call for assistance in times of distress. It also allows the dispatcher to send the closest officer to a call for service.

Using information gathered from several sources such as police journals, books, and police agency surveys, research will first inform the reader how the AVL system is currently being used.

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Second, this research will explore the costs of the AVL system. Third, this research will address the advantages and disadvantages of the AVL system. And finally, but most importantly this research will address how to create an environment that accepts the AVL system.

The intended outcome of this research is to introduce to the Command Staff of the Dallas Police Department the latest technology currently being used by various police departments across the nation as a means to increase officer safety and decrease response times. The intent of this project is to provide them with enough information to make an informed decision to implement this system in the next five years.

HISTORICAL CONTEXT

Historically, police departments have relied on police dispatchers to make the call assignments based the officer's assignment to a geographic area. Dispatchers have the responsibility of knowing the status of each of the police vehicles that are available for duty and the vehicle's geographic location. The ability of the dispatcher to dispatch an officer quickly to an emergency call for police service is critical to the effectiveness of a police department.

The first of the AVL's, Long Range Navigation (LORAN), was designed for marine navigation and has been in use since the mid-1950's (Martel 5). The land-based transmitters are operated and maintained by the United States Coast Guard.

Searching for ways to reduce response times to calls for service is not new problem. In 1967, the Presidents Commission on Law Enforcement voiced its concerns regarding improving the police response times to calls for service (Martell 7). As a result, law enforcement agencies turned to

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navigational systems developed by the Department of Defense to pinpoint locations anywhere on earth.

Eight years after the President's Commission report, the installation of a computer-assisted dead reckoning system by the St. Louis (MO) Metropolitan Police Department represented the first full scale implementation of the Automatic Vehicle Locator (AVL) system in a major urban police department (Larson 1). This police department was the first to study the AVL system as a means to reduce response time and study the relationship of police vehicle locations to the occurrence of crime and the effects of directed patrol (Martell 10). The study was discontinued as a result of technical difficulties.

During the 1970's, a number of police departments in California experimented with AVL systems with negative results. Factors contributing to the failure of the system were mechanical failure, limited computer technology, and officer resistance. There was no data recorded to support the reduction of response times (Martell 7-9).

The Schaumburg, Illinois Police Department has been operating the first law enforcement Global Positioning System (GPS) AVL since January 1992 (McLaughlin 1-6).

As technology advanced so did the interest in AVL systems. Police departments across the nation began investigating the AVL system as a means to not only reduce response times but to increase officer safety. Today, because of cost and other factors, there are a greater number of smaller police departments with the AVL system than large metropolitan police departments. Police departments as a whole, have been slower than fire departments or emergency medical services to take advantage of the AVL systems.

REVIEW OF LITERATURE or PRACTICE

To utilize AVL, three main components are required: (1) The ability to determine the location of the vehicle; (2) The ability to communicate the vehicle's location to those who need to know (i.e., the dispatch center; and (3) The ability to translate the vehicle's location, generally computed in latitude/longitude, into a format meaningful to the dispatcher (McLaughlin 1).

There are three popular means available to detect the location of a moving vehicle (McLaughlin 1-6): the Long Range Navigation System (LORAN), dead reckoning, and Global Positioning Satellite (GPS). The LORAN and the dead reckoning systems are land-based units that require radio frequency using radio antennas placed throughout the service area. The GPS system uses space satellites to track the location of police vehicles on the ground.

The LORAN system requires the police vehicle to be equipped with a receiver that receives signals from on at least three fixed transmitters on the ground. The receiver uses triangulation to calculate the vehicle's latitude and longitude. LORAN signals are not reliable due to electromagnetic distortions caused by power lines, neon signs, and railroad tracks (McLaughlin 1-6). In metropolitan cities these distortions would have a negative impact on the success of the system. Dead reckoning uses vehicle speed, travel time, and compass direction to compute the vehicle's estimated location with respect to known position (Siuri 171). Odometer measurements and electronic compass headings in the vehicle are fed into an onboard vehicle mini-computer that correlates that information

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with a digital map base. The digital map base provides constant re-calibration points for the computer that is relayed to the dispatcher on a digital map.

A flaw in the dead reckoning system is the system's inability to accurately pinpoint a vehicle's location (McLaughlin 1 - 6). Without map matching to constantly compare the dead reckoning system to an on-board copy of a map, for every mile driven, the location of a vehicle can be off by up to 100 feet. Map matching logic recognizes that a vehicle is not always on a road and makes corrections.

Global Positioning Systems (GPS) are the mostly widely known form of detecting a vehicle's location. GPS is the U. S. Department of Defense's network of NAVSTAR satellites that orbit the earth at a very high altitude. Three satellites are required in order to determine the location of a vehicle. The GPS provide longitude and latitude readings of a vehicle with an accuracy of less than 100 feet. Because the satellites are orbital, many of the problems associated with land based systems are avoided (McLaughlin 1 - 6).

Trimble Navigation, a leader in AVL technology, includes dead reckoning software in GPS receivers so that a vehicle driving into a garage or blocked by an overpass doesn't interrupt the AVL computations. The unit reads the speed, distance, and direction of the vehicle from sensors and continues to compute the vehicle's location. When the satellite signal resumes, it updates the location data from the GPS satellites (Allen 48).

Some AVL implementations combine dead reckoning, map matching and GPS. Dead reckoning with map matching will keep the vehicle's location matched to a map. The addition of GPS will correct occasional errors. The combination of all three systems, however, becomes more costly than

the dead reckoning system alone (McLaughlin 1-6).

Most AVL systems combine global positioning systems with computer aided-dispatch software to pinpoint a vehicle's location within inches. Lieutenant Tom Osterman, Schaumberg Police Department, states that commonly used police beats just can't account for adjacent beat officers when making Computer Aided Dispatch (CAD) recommendations. With AVL and GPS, the dispatchers are always certain they are sending the closest unit, making apprehension more certain (Allen 47).

The AVL system gives law enforcement management the ability to monitor where their units are at all times and adjust work patterns to suit exactly what is happening. Data gathered from AVL systems can determine which beats are the most active during each of the three shifts. Changes can be made in beat alignments to accommodate activity. Officers are less likely to stray from their appointed rounds if they know that their vehicles can be tracked throughout the shift (Strandberg, 40).

AVL systems can be programmed to monitor events that are specific to law enforcement. These events include but are not limited to driver emergency, driver status, speed and direction of a vehicle, and playback capabilities that document the sequence of events that occur in an incident (StarTrac, Inc., Personal Communication, August 11, 1999). The dispatcher would have better control in hot pursuit scenarios in which the propensity for a greater number of vehicles to enter could be avoided.

The North Carolina Highway Patrol and the Detroit Police Department both utilize the AVL/GPS system. They responded to a survey that was sent to their departments regarding the system.

The North Carolina Highway Patrol (NCHP) currently has the GPS installed in their Mobile

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Digital Terminals (MDT) that are mounted in their police vehicles. The purpose of implementing the system was to give the dispatchers immediate and continuous knowledge of the vehicle's location without having to verbally ask the officer. Their current system is being updated to allow an officer the ability to know where they are being dispatched by looking at the map on their MDT instead of referring to a paper map. They are also updating their current system to allow the officers the ability to know where the other officers are in the field. Allan Sadowski, NCHP, stated that until every officer can see the location of the other officers in their assigned sector, the GPS is only a useful tool to the dispatcher and to management.

The Detroit Police Department has been using the GPS system since 1988. The purpose of the Detroit implementing the system was to have better response times to calls for service. Lieutenant Brad Davis, Detroit Police Department, stated that the ability to send the closest officer to a call has been one of the major advantages of having the system. He cited the GPS has allowed the dispatcher to find a police unit that had lost radio contact with the dispatcher. Most important, Lieutenant Davis stated that the GPS system has reduced the officers response times to calls for service. Lieutenant Davis stated that there has been a reduction of response time since their Department started using the GPS system. Although this research has been unable to find statistical data to support a reduction in response times, many companies that produce the systems make this claim.

The Dallas Fire Department has been using the AVL system since 1989. D. Morrison, Dallas Fire Department, stated prior to the implementation of the GPS system, their dispatchers always had to ask the paramedics for their location in order to determine who was closer to a call. With the system in place, the AVL system has made making assignments to calls much simpler. Mr. Morrison

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stated that prior to the implementation of the system, the firemen were given training into how the AVL system worked. During this training, departmental superiors ensured that the system was not designed to punish them for being somewhere other than the station or at a call. The ability to get to a call much faster and reducing the response times was the focus of the training.

As recently as May 19, 1999, Police Chief Ben Click, Dallas Police Department, announced that a policy change intended to speed officers' response to 911 calls resulted in a 48% increase in response times. The policy required 911 operators to dispatch calls immediately instead of relying on their discretion to assign calls to officers who might be closer.

DISCUSSION OF RELEVANT ISSUES

While management may feel comfortable knowing the location of all of their personnel, police officers on the streets may be concerned about 'Big Brother' (McLaughlin 1- 6). The Detroit Police and the NCHP both noted in their surveys that their officers expressed resentment at being watched. The impact of AVL technology will have a dramatic effect on the management of patrol resources. In order to make the existing workforce comfortable with the AVL system, management should be open with the officers in a timely manner. Officers should be told of the impending system at least six months in advance. Proper training should be given to the officers regarding the role of the system within the department. Emphasis should be placed on officer safety in order to prevent officers from degrading the usefulness of the system. Managers should encourage feedback from the officers concerning the AVL system. Managers must also resist the lure of replacing the monitoring capabilities of computerization with the proper functions of the first line supervisor.

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When implementing a system, a policy should be written to prevent tampering with the device. Most systems are wired to the battery in order to prevent the system from being turned off. The software in the receiver can also be programmed to alert the dispatcher if the system has been tampered.

The cost of implementing an AVL system will be dependant on several factors. The first factor will be the type of communication system currently in place. Many medium-sized to larger police departments utilize the Computer Aided Dispatch system (CAD). A CAD system utilizes a computerized geographic base file to partially automate the call answering, processing, and dispatching of a police dispatch center (Larson 2). Alone, a CAD system makes a recommendation of the closest officer to answer a call based on the location of the call in relation to the beat. A CAD system integrated with AVL can recommend the nearest police unit based on the officer's actual location in the field. If a police department does not currently have a CAD system, then the company providing the AVL service will have to build an AVL system that will work with dispatch system currently in place.

The next factor to consider that will determine the cost of the AVL system is the decision to buy the system from an outside vendor or build the system in-house. Many cities have their own communication and information system experts that can integrate an AVL system into their current network. They simply have to buy the equipment, program the software to meet the needs of their department, and install the equipment.

The next factor to consider is how many AVL/GPS units to purchase. Will the units be mounted in all vehicles assigned to the police department? Or will the units only be mounted in patrol vehicles?

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The tracking devices can be installed in the vehicles alone, inside the Mobile Data Terminals, and lately into the cellular phones that are mounted inside the police vehicles. What about monthly maintenance costs? The police department will have to decide whether the systems will be placed in the supervisors' vehicles or will only the patrol officers have the systems? With an average AVL/GPS unit costing $1695 each, much consideration must be given to the number of units being purchased (StarTrac, Inc., Personal Communication, August 11, 1999).

The cost of training the supervisors and dispatchers that will primarily utilize the system is also a factor that must be considered when determining the cost of implementing the system. The decision will have to be made how to train each dispatcher without slowing down current operations.

The most important factor to consider when contemplating whether or not to implement an AVL system is the benefits. The first benefit that should be considered is officer safety. When an emergency alarm is activated, the dispatcher is alerted visually and audibly, the location of the activating vehicle is known immediately from the display, and the computer-selected closest cars are identified for quick dispatch (Larson 38).

Another benefit of the AVL system is the ability of the patrol officer to communicate a change in status instantly to the dispatcher; whereas with the voice radio only, the officer might wait for clear channel status which could include considerable delay. The dispatcher can organize work tasks better, permitting some digital inquiries to accumulate before acknowledging if other matters have higher priority. Voice radio does not have this flexibility (Larson 41).

CONCLUSION/RECOMMENDATIONS

As stated in the introduction, the purpose of this research paper is to introduce to the Command Staff of the Dallas Police Department the latest technology currently being used by various police departments across the nation as a means to increase officer safety and decrease response times. The AVL system offers a police department an alternative to the current system of dispatching calls to the officers in patrol, thus improving dispatch efficiency and coordination. Although there are no statistics to confirm that AVL systems reduce response times, the system has taken the guesswork from the dispatcher and made it easier for the dispatcher to make assignments.

When considering implementing an AVL/GPS system, increasing officer safety should be the most important factor. An AVL can monitor the status, speed, and location of a police vehicle. In a hot pursuit scenario, the AVL system can be particularly useful in reducing the confusion over the number of police vehicles enroute.

Based on the research conducted for this paper, it is apparent the AVL/GPS systems can also improve the operations of a police department by giving management the opportunity to evaluate call load and patrol activity. Having the system will lessened the likelihood that an officer will leave his area of assignment unless requested to by the dispatcher.

Management should give special consideration to how implementation of this system will affect officer morale. Management should ensure that police personnel are educated on the purposes of the system. It should be emphasized that the main purpose of the system is to increase officer safety and reduce response times.

As mentioned earlier, the Dallas Police Department recently announced that a policy change they

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implemented to speed officers' response to 9-1-1 calls resulted in a 48% increase in response times. Instead of the dispatcher sending the closest police officer to a call, the dispatcher sent the first available officer. The Department must consider utilizing the technology already available to the Dallas Fire Department as a tool that would assist in reducing the response times while increasing officer safety.

Although cost will play a major factor in the final decision whether or not to implement the system, the benefits of implementing the system can not be ignored. The benefits of the system will undoubtedly increase the safety of the officers while increasing the quality of service to the citizens of Dallas.

RESERVE

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