

Des Moines Metropolitan Area ITS Strategic Plan

THOMAS KANE, T.H. MAZE, AND VINCENT P. PEARCE

The Des Moines Area Metropolitan Organization (MPO) completed an early deployment study for the Des Moines metropolitan area in late 1997. The purpose of the study was to develop a strategic plan for Intelligent Transportation System (ITS) deployment and to provide inertia for the development of ITS infrastructure. When the Federal Highway Administration sponsored the Des Moines metropolitan area's early deployment study, Des Moines was the smallest metropolitan area to undertake such a study. Therefore, there were no similar sized urban areas from which to draw examples. Further, although the metropolitan area and traffic volumes are growing, congestion is not seen as a significant problem in Des Moines. As a result of minimal traffic congestion, there was and is some skepticism among the transportation stakeholders in the need for Intelligent Transportation Systems (ITS). The development of ITS infrastructure is seen as even more problematic when the capital requirements for ITS must compete with the capital requirements of other, traditional transportation improvements. Despite the initial skepticism regarding the need for ITS and the ability to afford ITS, Des Moines area transportation stakeholders have become very supportive of the initiatives identified in the plan. The generation of support for ITS was developed through two galvanizing issues. The first was a focus on safety benefits of ITS as opposed to congestion reduction benefits. The second was to focus on the use of ITS to mitigate the impacts of the reconstruction of I-235. I-235 cuts across Des Moines running through the north side of the central business district and has been the single most important factors in forging commuting and development patterns in Des Moines areas. As a result, arterial streets which parallel I-235 will be greatly impacted by the diversion of traffic from I-235 which is likely to occur during reconstruction. ITS's ability to manage traffic under dynamic conditions provided an incentive for transportation stakeholders to rally behind the ITS strategic plan. The proposed paper will discuss the process used to develop the plan and review the plan's recommendations. One of the issues the plan attempts to address is the identification of technology appropriate for an urban area the size of Des Moines.

INTRODUCTION

Section 6055(b) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) authorized the Federal Highway Administration (FHWA) to provide grants to state, local transportation agen-

cies, and metropolitan planning organizations (MPOs) to conduct studies for the development of multi-year intelligent transportation systems (ITS) strategic deployment plans in metropolitan areas and along intercity corridors (1). The Intelligent Vehicle Highway Systems (IVHS) Early Deployment Planning Program was designed by FHWA to achieve ISTEA's objective of initiating the strategic planning process. The program initially targeted the 75 largest metropolitan areas, 30 major intercity corridors linking metropolitan areas and several statewide programs for the develop of ITS strategic plans. To date, the FHWA has 90 early deployment planning studies completed or underway (2). The Des Moines metropolitan area's ITS strategic plan was developed under this FHWA program.

Currently the Des Moines metropolitan area is the ninety-second largest metropolitan area in the U.S. (measured by population), therefore, Des Moines was not one of the targeted large urban areas. At the time the study was initiated (1995), it was the smallest metropolitan area to undertake such a planning effort (1996 estimated population of the Consolidated Metropolitan Statistical Areas is 427,000) (3).

Urban applications of ITS have been principally implemented to better manage traffic and incidents, provide traveler information, and manage public transportation in congested urban areas. Because of ITS's ability to mitigate congestion and unproductive traveler delays, the earliest applications of ITS technology appeared in large congested cities, and current ITS deployment activities are largely concentrated in large urban areas. This resulted in the Des Moines study having few examples of deployment in similar-sized cities to refer to, which raised the issue of what, if any, ITS deployment is appropriate in an area the size of Des Moines, with modest levels of congestion.

Although the Des Moines metropolitan area is experiencing growth, a respectable 8.8 percent rate of population growth from 1990 to 1996, congestion is not perceived to be a significant problem in the Des Moines area (3). The lack of significant congestion in the Des Moines area resulted in some skepticism about the need for ITS among the staff members of agencies responsible for transportation infrastructure in Des Moines area jurisdictions. The development of ITS infrastructure becomes even more problematic when the capital requirements for ITS must compete with the capital requirements of other, traditional transportation improvements. Despite the initial uncertainty regarding ITS, the transportation stakeholders in the region have become supportive of the ultimate ITS strategic plan because its recommendations are based on two galvanizing issues: 1) traffic safety and incident management on the area's freeway system, and 2) management of traffic during the reconstruction of the area's single most important highway facility, I-235.

T. Kane, Des Moines Area MPO, Argonne Armory, 602 East First Street, Des Moines, Iowa 50309-1881. T. H. Maze, Center for Transportation Research and Education, 2625 N. Loop Dr., Suite 2100, Ames, Iowa 50010-8615. V. Pearce, Booz-Allen & Hamilton, 8201 Greensboro Drive, Suite 609, McLean, Virginia 22102-3812.

ITS Planning Principles

Because intolerable congestion does not exist in the Des Moines metropolitan area, its freeway, transit service, and arterial streets provide a relatively good level of service. This implies that the Des Moines metropolitan area, unlike more congested urban areas, is not motivated to develop ITS services to avoid or mitigate large investments in capacity improvements to temper burgeoning congestion. Instead, the region has the opportunity to build up and target ITS infrastructure strategically, without being pressured to make investments to alleviate existing congestions. With the opportunity to be proactive, rather than reactive, the Des Moines ITS strategic plan was developed based on the following principles:

- Identify achievable, economically feasible, and sustainable early winners for ITS projects.
- Build the core infrastructure incrementally using interoperable systems, while recognizing that the development of the ITS infrastructure and the services identified require a long-term commitment.
- Develop core ITS infrastructure in partnership with other transportation development programs and stakeholders with similar objectives. Capitalizing on opportunities to work in parallel with other projects will help to accelerate the construction of ITS infrastructure.

Study Organization

The Des Moines Early Deployment study covered the MPO planning area which includes portions of four counties and 16 municipal jurisdictions. In addition to the metropolitan area local jurisdictions, the Iowa Department of Transportation (Iowa DOT), the Iowa Department of Public Safety (Iowa DPS, the home agency of the Iowa State Highway Patrol) and other metropolitan and local jurisdictions and private organizations (e.g., transit, enforcement, incident response, motor carriers, etc.) have a considerable stake in the development of ITS services. However, because ITS is not planned and deployed on a jurisdiction by jurisdiction basis, the agencies with regional responsibilities must lead deployment efforts. The Iowa DOT is the only agency with infrastructure management responsibilities throughout the region and, therefore, the ITS strategic plan recommends that the Iowa DOT take the lead, while the Des Moines Area MPO serves as the champion for the plan's implementation in partnership with local jurisdictions.

The ITS strategic plan's development was steered by a committee representing the major public and private transportation infrastructure stakeholders in the region. Following the appointment of the steering committee, the first major step in the study was to develop a transportation inventory of items relevant to the development of a strategic plan. The inventory included information related to mapping and data management systems, travel and transportation management systems, public transportation services and facilities, and the current status of the use of ITS services in the Des Moines metropolitan area. This part of the project resulted in a geographic information systems (GIS) database, which contained much of the inventoried information, including traffic signal and signal systems, traffic counts, traffic accidents, and programmed facility improvements.

Using the inventory of existing systems, facilities, traffic and transportation characteristics and attributes, and existing ITS services, the steering committee targeted five topic areas for further

development. The five topic areas are listed below, and although the topic areas do not cover all the ITS market packages, these were deemed to be the most important for application of ITS in the Des Moines metropolitan area.

- Incident Management
- Traveler Information
- Advanced Traffic Control
- Commercial Vehicle Operations
- Data Management

For each topic, a different approach was taken to study related issues and to identify candidate ITS applications. For incident management, traveler information, and advanced traffic control, a committee was developed to identify goals and objectives, institutional issues, and systems requirements. For commercial vehicle operations, project staff worked directly with the Iowa Motor Truck Association (IMTA), and the IMTA convened IMTA members to review the work developed by the project staff. Data management issues were identified through project staff discussions with technical staff for the constituent agencies and a meeting with constituent groups. The work in each of these topic areas resulted in the identification of specific market packages for further focused refinement.

To assist the subcommittees in visualizing traveler information systems, two static Internet home page systems were built. One of the systems presented transit information, including route and schedule information for all of the Des Moines Metropolitan Transit Authority's (MTA) fixed route service. The other provided information and identified points of interest to truck operators (e.g., locations where vehicles could be serviced or drivers could receive dental or medical services on a walk-in basis).

The next step in the planning process was to conduct a review of ITS technologies. To do this, a detailed evaluation was conducted of 169 technologies with respect to 12 criteria. The criteria included categorization and description of the technology, support of the technology, technology costs, and judgment evaluation of the technology's benefits and negative and positive attributes.

Given an understanding of the technology, an understanding of the issue to which ITS can be applied, and an inventory of what already exists, the project staff worked with the steering committee to identify specific ITS projects to be deployed over a 20-year planning horizon. The plan identified 45 separate projects or phases of activities to be developed in phases across the planning horizon. Most of the activities identified are to be completed or will be under way within the first five years of the planning period (1997 to 2002). The I-235 reconstruction, planned to start in the year 2002, provides a watershed for the proposed ITS projects. Prior to reconstruction, the focus is on the incremental establishment of ITS services in the urban area and implementation of management systems to ease congestion during reconstruction. During reconstruction, the focus turns to implementing ITS infrastructure on the I-235 corridor as part of the reconstruction. After reconstruction, the focus is turned to deployment throughout the urban area.

DEPLOYMENT RECOMMENDATIONS

Although it is clearly beyond the scope of this paper to discuss the proposed ITS deployment in any detail, proposed deployments are summarized below. Clearly the predominate area of deployment involves several interrelated ITS market packages to manage traf-

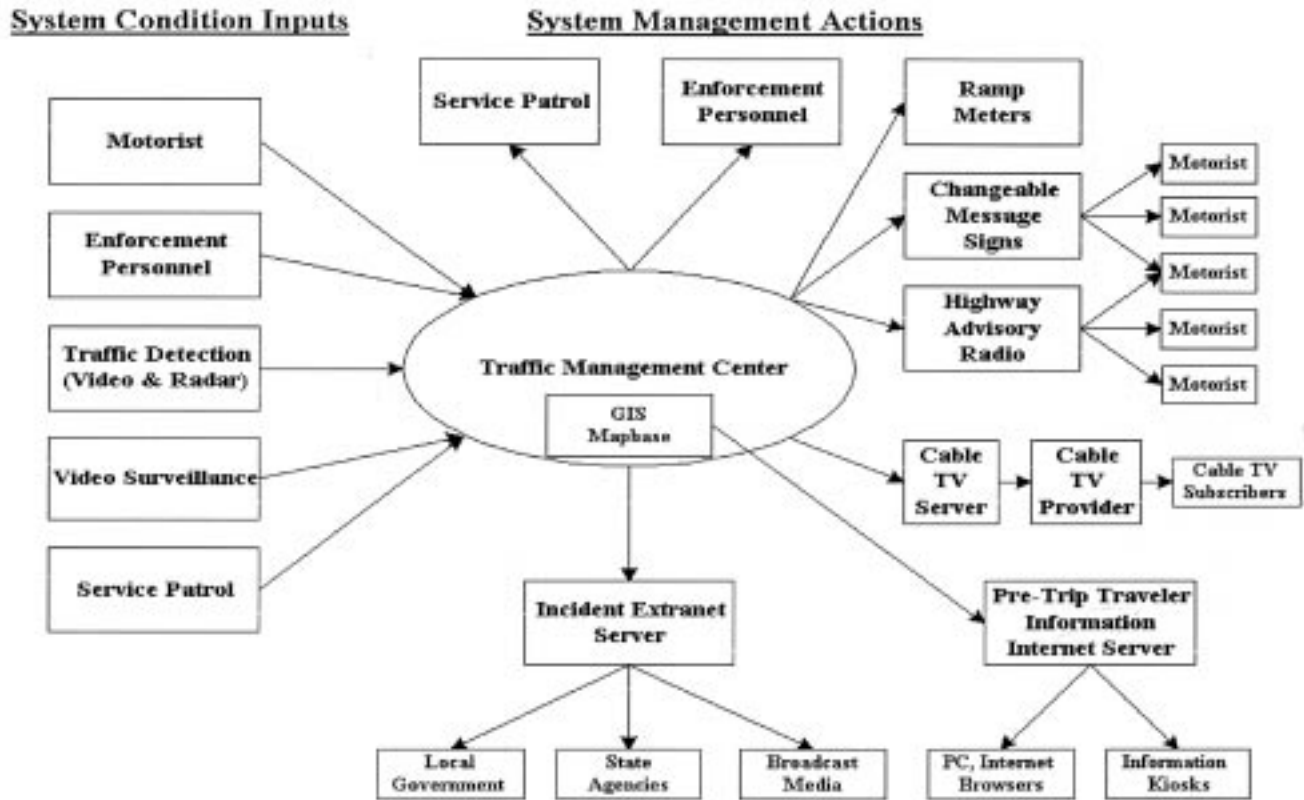


FIGURE 1 High-level transportation management center system.

fic (both on arterial streets and the freeway system), to provide traveler information, and to manage incidents. The development of a transportation management center (TMC) is a common requirement to traffic and incident management and traveler information. The plan addresses other areas where more modest deployment of ITS applications are planned involving advanced public transportation systems and commercial vehicle operations.

Traffic and Incident Management and Traveler Information

Currently there is no formal coordination of highway operations throughout the urban area. For example, which organization is responsible for clearing and managing an incident on the interstate system depends on the incident's location. Incidents occurring on the interstate system that are within a municipal boundary are the responsibility of the municipality. On parts of the system which are located in unincorporated areas, incidents are the responsibility of the Iowa Highway Patrol. In addition, the Iowa DOT recognizes that it shares the responsibility of the operation of the urban interstate system. As one example of the Iowa DOT concern for traffic management, it has erected changeable message signs (CMS) at the I-35 and I-80 northeast and southwest entrances to the Des Moines metropolitan area's interstate system.

Incident management operations of governmental organizations are coordinated informally, but no formal agreements or management structure exists, except in the case of extreme emergencies,

where the Emergency Management Division of the Iowa DPS uses its statutory authority to manage an incident.

Plans for systems to support traffic and incident management and traveler information were divided into three time frames: 1) prior to I-235 reconstruction, 2) during I-235 reconstruction, and 3) following I-235 reconstruction.

Prior to I-235 Reconstruction

All the traffic and incident management and travel information systems planned are based on the assumption that a transportation management center (TMC) will be developed. The TMC will receive data from field data collection units (detectors and cameras) and observation data from field personnel (service patrol operators and enforcement) and motorists, fuse the data and coordinate or direct field personnel, manage traffic control systems and incident responders, and provide traveler information.

Although no firm recommendations were made on the location of the TMC, an attractive location involves locating the facility jointly with the central Iowa Highway Patrol dispatching center in STARC Armory. There is ample room in the armory for a TMC and there should be synergy between the Highway Patrol dispatchers and the TMC operators. The implementation of the TMC also requires that adequate communication system capacity be developed and a fiber optic network communication system is proposed with a loop that follows the I-235 and I-35/80 highway loop and

later an outer loop around the east and south sides of the urban area following U.S. 65 and Iowa 5 (interstate design standard facilities). This design results in two self-healing, concentric loops.

One of the principal focuses for ITS application in the Des Moines metropolitan area is to prepare for I-235's reconstruction and traffic management during reconstruction. Therefore, to establish priorities for the incremental deployment of ITS, the study team used the urban travel demand model to determine routes which are most likely to be impacted as a result of capacity reductions during I-235 reconstruction. To do this, the twenty-four hour travel demand was run under scenarios where capacity at locations along I-235 were reduced to zero, and the resulting increase in traffic volumes were displayed on a map using a geographic information system (GIS). The results clearly identified which routes need to be improved in advance of the reconstruction. This analysis not only helped to target improvements on the interstate system, but also identified the need to improve traffic control and signing along parallel arterial streets. The resulting recommendations included:

- Development of a highway service patrol, consisting of private or public sector operators with direct communication to the TMC and with an established control structure over the deployment and activities conducted by the service patrol (regardless of whether they are public or private)
- Development of a freeway incident management plan for the entire metropolitan area
- Placement of surveillance cameras along I-235 and along major diversion routes
- Placement of traffic detectors at locations throughout the I-235 and I-35/80 loop (using radar and video technologies)
- Demonstrate and test ramp meters along the existing freeway system and on ramps with high accident rates
- Placement of changeable message signs along principal diversion routes and at locations in advance of possible route change locations (intersections)
- Implementation of a low-power highway advisory radio (HAR).
- Development of a GIS mapbase which may be used to transmit incident condition/location information to responding agencies using an Extranet; transmit traffic conditions using the Intranet to kiosks and personal browsers; and through a similar server, send information over the government access cable TV channel
- Develop agreements between local jurisdictions and implement interjurisdictional signal coordination along diversion routes which cross municipal boundaries.

Figure 1 shows a high-level system architecture for the TMC.

During Reconstruction of I-235

During the reconstruction of I-235, the traffic and incident management and traveler information systems are likely to be most effective in managing traffic diverted from I-235. Reconstruction of I-235 is expected to last roughly five years, and during this period, only a small number of ITS field assets are recommended in the plan. These assets consist of locating CMS and HAR along I-35 and I-80 past the systems interchanges on the northeast and southwest ends of the metropolitan area.

Following Reconstruction of I-235

Following reconstruction of I-235, additional field assets (detectors, CMS, video, and cameras) will be located along the interstate design standard facilities being constructed around the east and south of the metropolitan area (U.S. 65 and Iowa 5).

System Costs

The systems recommended for traffic and incident management and traveler information were designed to keep in perspective the appropriate system cost and technology for a medium-sized urban area like Des Moines. Parts of the system should be implemented in conjunction with the reconstruction of I-235 and the construction of the new south outer loop. In addition, the TMC is proposed to be located in an existing facility with existing communications infrastructure which further reduces costs. Further, the highway system is not densely populated with field devices (detectors, cameras, CMSs, etc.).

Depending on how the communication services are procured, the complete system is estimated to cost \$150,000 to \$300,000 per interstate mile under management, including the costs associated with TMC. The low estimate assumes the Iowa DOT will barter right-of-way easements for communication services, and the high estimate assumes that the Iowa DOT will develop its own communication network. The relative frugality of the system is illustrated when costs are compared to planning estimates used by the Minnesota Department of Transportation (MnDOT). The MnDOT estimates that it will cost \$500,000 per mile of freeway to place an existing freeway under management, not including the cost of the TMC.

Advanced Public Transportation Systems

The transit authority in Des Moines (the Des Moines Metropolitan Transit Authority or MTA) already has a program where automatic vehicle location (AVL) systems have been installed on transit vehicles and, therefore, is already using ITS technology. In addition to its existing ITS features, two additional ITS functions were recommended for the MTA: 1) electronic fare payment, and 2) traffic signal prioritization.

Electronic Payment

Electronic fare payment typically allows the rider to pay using a card. Information is stored on the card using either a magnetic strip or a microchip. The services offered with a card can be viewed by the openness of the card's use and the functionality of the card. For example, a simple card with a magnetic strip on it may allow the user to store value either equivalent to the value of a specific number of trips or equivalent to riding the transit system over a certain length of time (week, month, or year). Such a card is a closed card because it can be used for only one purpose. On the

other hand, a credit card is an open card because it can be used for multiple purposes and by multiple merchants, and possibly even for paying transit fares.

A card with a microchip imbedded is considered a smart card because the chip allows the card to perform computations rather than calculating the transaction through a host computer, similar to a common credit or debit card. Not only does a smart card allow for computations on the card, but it can also store much more information. Thus a smart card allows much more functionality.

In the case of the MTA, it is recommended that they initially start with a closed, paper ticket and magnetic strip system, while looking for other organizations or institutions which are also interested in electronic payment. It generally takes several applications to make the fixed cost associated with a smart card itself and the reader technology worthwhile. Commonly a financial institution offering credit, debit, and banking services on a smart card can provide enough uses for card holders to make migration to a smart card worthwhile. Later when other organizations or institutions, in partnership with the MTA, create enough uses to make smart cards cost effective, the MTA can migrate to the use of smart card technology.

Traffic Signal Prioritization

For bus operations on arterial streets, typically 30 percent of their run time is spent being delayed at traffic signals. Where traffic signal prioritization has been used, typically the delay at intersections is reduced by half. Prioritization does not preempt the normal operation of a traffic signal, but instead extends the green to allow an approaching bus to pass while the traffic signal is still green or advances the phasing so that green is started early for an approaching bus. This creates benefits both for the bus patrons, by reducing their delay, and for other motorists by moving the bus through the intersection more quickly.

Currently the downtown Des Moines traffic signal system is being upgraded. It was recommended that signal prioritization be implemented as part of the new system. Assuming experiences in downtown Des Moines are positive, prioritization could be adopted by signal systems in other portions of the metropolitan area in the future.

Commercial Vehicle Operations

Commercial Vehicle Operations (CVO) market packages mostly involve either functions which are the private responsibility of the

carrier (e.g., automated dispatching and fleet management) or are under the purview of the state and federal government (e.g., electronic screening, automated safety inspections, and electronic procurement of credentials). Although most CVO applications are not under the control of public organizations in the urban area, three actions were recommended. They are:

- Encourage state officials in Iowa and in adjacent states to adopt the applications market packages and system architecture defined as part of the national ITS program
- Maintain the static commercial traveler information system developed as a task within this project. (For more information see [4])
- Purchase the necessary computer hardware and software to allow the City of Des Moines Fire Department Hazardous Material Response Team to join the Operation Response Team.

CONCLUSIONS

This paper summarizes recommendations made in the Des Moines ITS Strategic Plan. Des Moines does not have the traffic congestion which has caused larger urban areas to embrace ITS. As result, the principal forces which are motivating the deployment of ITS are not to mitigate reoccurring or incident-induced congestion. The two principal motivations are to increase traffic safety and to reduce and manage the impacts of the reconstruction of I-235. In addition, because the Des Moines metropolitan area has modest requirements for traffic and incident management and traveler information, the density of field devices and the related costs are much lower than similar deployment in larger urban areas.

REFERENCES

1. Baldwin, B.D. Status of ITS Early Deployment Planning and Other ITS Deployment Initiatives of the U.S. Department of Transportation. *Proceedings of the Semisesquicentennial Transportation Conference*, May, 1996, Ames, Iowa.
2. ITS Deployment Support, Program Overviews, taken from the U.S. Department of Transportation ITS World Wide Web page, <http://www.its.dot.gov/deploy/INTRO.GB.htm>, 1998.
3. U.S. Bureau of the Census, *Estimates of the Population of Metropolitan Areas*. Washington, D.C., 1996.
4. Maze, T.H., C.P. Albrecht, and M.K. Kuntmeyer. Design and Development of a Prototype Commercial Vehicle Operator Information System. *Proceedings for the 4th World Congress on Intelligent Transportation Systems*, Berlin, Germany, October 1997.