Integrated Corridor Management

IN THIS ARTICLE, WHICH WAS ORIGINALLY PUBLISHED IN THE MARCH/APRIL 2008 ISSUE OF *PUBLIC ROADS*, THE AUTHORS DISCUSS HOW USDOT AND EIGHT PIONEER SITES ARE ADDRESSING CONGESTION, EMPOWERING TRAVELERS, AND IMPROVING TRAVEL TIME RELIABILITY.

BY BRIAN CRONIN, STEVE MORTENSEN AND DALE THOMPSON

IN MAY 2006, THE U.S. DEPARTMENT of Transportation (USDOT) announced a major effort to reduce highway, freight, and aviation tie-ups—the *National Strategy to Reduce Congestion on America's Transportation Network* (the "Congestion Initiative"). Naming congestion as one of the greatest threats to the nation's economy, USDOT noted that businesses lose an estimated $200 billion per year due to freight bottlenecks, and drivers annually waste nearly 4 billion hours and more than 2 billion gallons of fuel in traffic jams (see Figure 1).

In *The 2007 Urban Mobility Report*, the Texas Transportation Institute calculated that in 2005 Americans who commuted during peak hours spent an average of 38 hours per year—beyond their normal commutes—in gridlock. The greatest congestion often occurs along critical transportation corridors, which link residential areas with business centers, sports arenas, and shopping areas. New road construction alone will not solve the growing problem: travel demand on U.S. roadways is outpacing available capacity.

One solution USDOT is pursuing is the concept of integrated corridor management (ICM). "The [ICM] initiative leverages the investments of agencies to improve the movement of people and goods along metropolitan corridors through a multimodal, integrated transportation management approach," says Federal Highway Administration (FHWA) Associate Administrator for Operations Jeff Paniati.

ICM optimizes the use of existing infrastructure and leverages underutilized capacity on the nation's urban corridors. ICM institutional partners manage the transportation corridor as a system rather than using the more traditional approach of managing roadways as individual assets (see Figure 2).

Paniati continues, "The integration of operations programs, such as traffic incident management, work zone management, traffic signal timing, managed lanes, real-time traveler information, and active traffic management, helps maximize the capacity of all facilities and modes across the corridors and allows for greater mobility."

USDOT is funding a 5-year initiative to help advance the state of the practice in the ICM field. As part of its knowledge and technology transfer (KTT) efforts, USDOT will share knowledge gained through the ICM Initiative with transportation practitioners around the country. The approach is expected to reduce travel times, delays, fuel consumption, emissions, and incidents, thereby increasing the reliability and predictability of travel.

"Perhaps the biggest potential benefit of ICM is the enhanced integration of corridor operations and the respective highway, arterial, bus, rail, and public safety systems that support these operations," says Steve Rochon, senior staff engineer at the Maryland State Highway Administration. "Some of this integration is already in place; however, ICM will take it to another level. [In Maryland,] integrating operations and systems across modes has the potential to greatly facilitate the movement of people and goods through the I–270 corridor [which terminates at the I–495 Capital Beltway surrounding Washington, DC]."

WHAT IS ICM?

Transportation corridors often contain underutilized capacity in the form of parallel routes—freeway and arterial lanes—single-occupant vehicles, and transit services that could be tapped to help reduce congestion. Frequently, traffic information is fragmented, outdated, or not completely useful. Also, networks often are operated independently, and efforts to reduce congestion so far have focused on optimizing individual networks.

The combined application of technologies and a commitment by network partners to work together have the potential to transform the ways that corridors are operated.

Recent advancements in intelligent transportation system (ITS) technologies, such as real-time traveler information and parking management systems, present opportunities to integrate operations and manage total corridor capacity (see Figure 3).

"To accomplish the goals of ICM, all our partner agency representatives put away their badges, as we intend to operate our corridor in a true multimodal, integrated, efficient, and safe fashion where the focus is on the transportation customer," says Koorosh Olyai, assistant vice president for mobility programs development at Dallas Area Rapid Transit.

With ICM, partner agencies manage the corridor as an integrated asset to improve travel time reliability and predictability, help manage congestion, and empower travelers through improved information and choices. In an ICM corridor, because of proactive multimodal management of infrastructure assets by institutional partners, travelers could receive actionable information based on the entire transportation network. Travelers then could shift to alternative transportation options—even during a trip—in response to changing traffic conditions (see Figure 4).

"The Federal Transit Administration [FTA] is committed to supporting integrated corridor management," says Walter Kulyk, director of FTA's Office of Mobility Innovation. "Transit can offer additional corridor capacity and provide an option for travelers during normal operations and during planned and unplanned events. Also, transit ITS technologies increase transit flexibility, efficiency, and convenience for travelers."

The ICM Initiative focuses on providing real-time traveler information and multimodal operations and using technology to reduce congestion. "Historically state and local agencies have developed independent systems between freeways, arterials, and transit," says Freeway Operations Engineer Brian Kary of the Regional Transportation Management Center at the Minnesota Department of Transportation. "ICM will help bridge the gap between these systems, allowing them to function as one. By developing ICM on a corridor, transportation agencies can better utilize existing capacity along multiple networks, especially in times of incidents or special events."

Figure 1. The familiar sight of a congested highway like this one could improve with the ICM Initiative, which aims to help metropolitan areas realize significant improvements in the efficient movement of people and goods through aggressive, proactive integration and management of major transportation corridors.

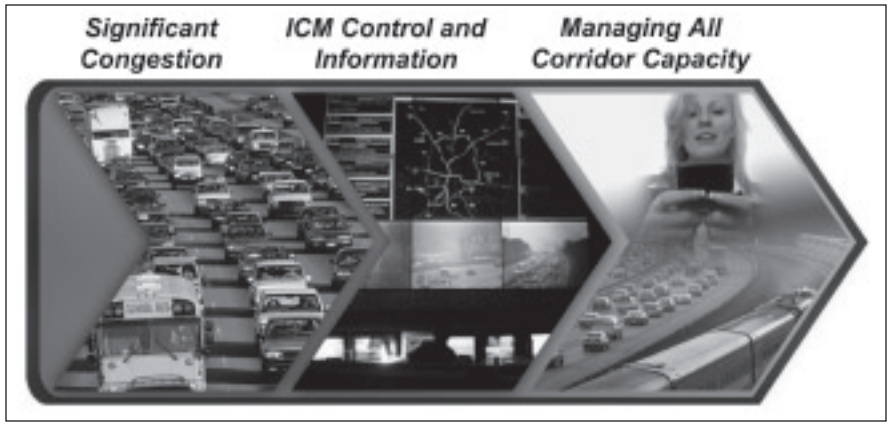


Figure 2. With ICM, the various partner agencies manage the transportation corridor as a system rather than the traditional approach of managing individual assets.

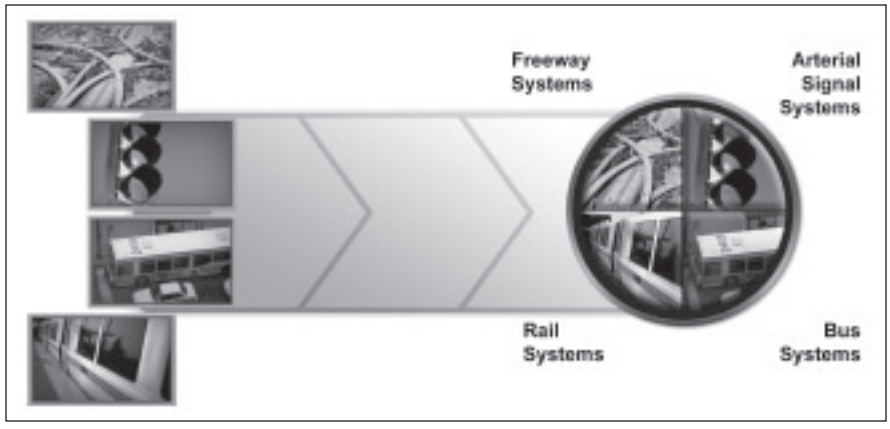


Figure 3. With ICM, the various modes of transportation and elements of the infrastructure are managed together in a given corridor or region, giving the public more travel options and easing congestion.

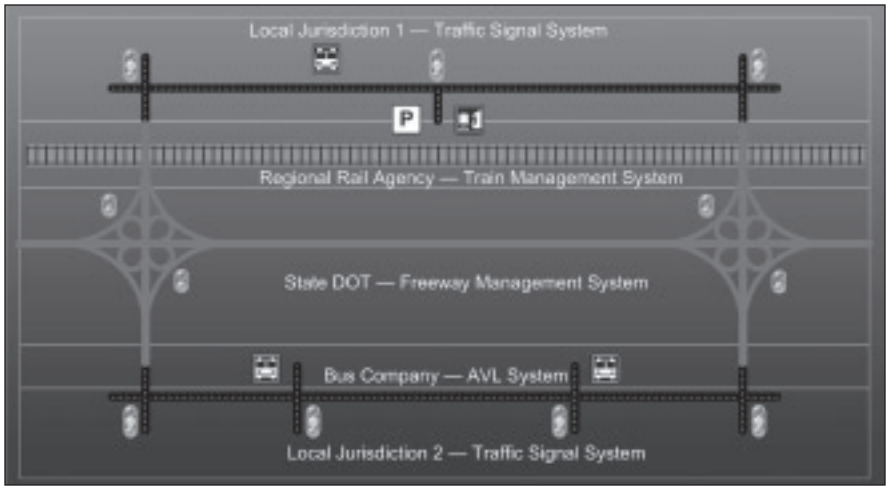


Figure 4. While driving in a future ICM corridor, a traveler could be informed in advance of congestion ahead on that route and seek alternative transportation options, as illustrated in this stylized representation of an ICM corridor.

How Is ICM Different From Traditional Approaches?

ICM is different from traditional transportation management in that its emphasis is on coordinated, multimodal, cross-network operations within a corridor. It also relies on the efficient use of existing network assets to manage congestion and empower travelers through improved information and greater choice.

ICM builds upon regional information sharing and management approaches to provide integrated operations along various corridors within a region; a region is likely to contain one or more corridors. ICM takes the next step from integrated operations at a corridor level to integrated management at a regional level, although ICM is distinct from regional approaches. Regional management focuses primarily on information sharing, coordination, and collaboration among agencies; however, ICM goes beyond regional collaboration to include cross-operations of the various networks within the region.

Integrated operations within a corridor apply to a variety of scenarios and challenges, including incident management, special event management, emergency management, managed lanes, and recurring congestion. Although regional management encompasses a number of similar activities, considering just what these various operational activities entail and how they are accomplished from both a corridor and broader regional perspective is important.

For example, although traveler information has a regional focus in terms of where it is obtained and how it is distributed, facilitating individual traveler needs requires that corridor information provide travelers with a means to compare their travel alternatives to help them make choices. This requirement means that the corridor travel conditions must be presented in a way that is network- and mode-neutral so that each alternative can be compared easily.

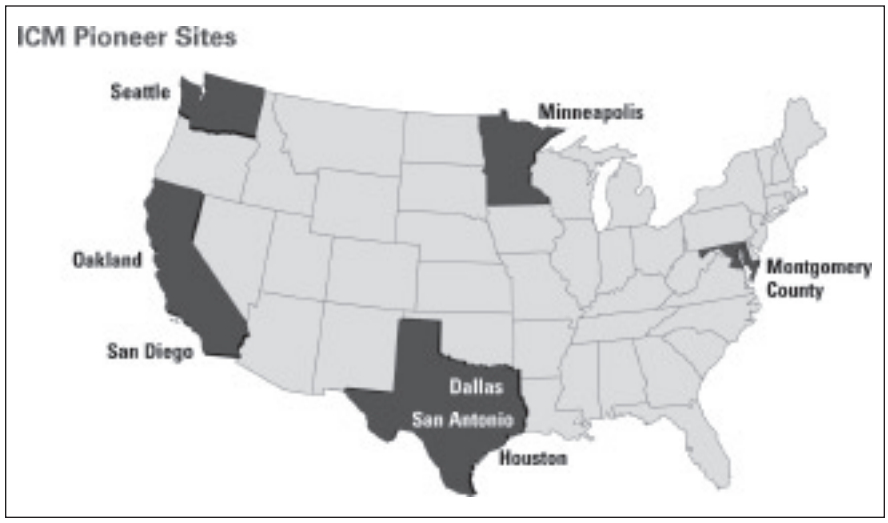


Figure 5. ICM Pioneer Sites.

The ICM Initiative has three objectives:

- Demonstrate how operations strategies and ITS technologies can efficiently and proactively speed the movement of people and goods in major transportation corridors through integrated management of all networks in a corridor.
- Develop a toolbox of operational policies, cross-network operational strategies, integration requirements and methods, and analysis methodologies needed to implement effective ICM systems.
- Demonstrate how proven and emerging ITS technologies can coordinate operations between separate corridor networks to increase effective use of the corridor's total transportation capacity.

The ICM Initiative "offers the opportunity to truly advance transportation operations in a multimodal manner," says Shelley J. Row, director of USDOT's ITS Joint Program Office. "Many cities have invested significant resources in ITS infrastructure for highways, arterials, and transit systems. It's time to leverage this investment and operate the system in a coordinated manner that encompasses technical, operational, and institutional coordination" (see sidebar, this page).

USDOT SELECTS ICM PIONEER SITES

In September 2006 USDOT selected eight Pioneer Sites to act as critical partners in the development, deployment, and evaluation of ICM strategies: Dallas, Houston, and San Antonio, TX; Oakland and San Diego, CA; Minneapolis, MN; Montgomery County, MD; and Seattle, WA (see Figure 5).

The eight sites are recognized leaders in congestion management. Their efforts under the ICM Initiative are expected to contribute directly to more efficient, faster moving, and safer corridors for the future. USDOT believes that each site's corridors include assets and qualities characteristic of many other corridors across the nation and that they lend themselves to ICM. For example, all the sites have implemented real-time signal control on their arterials. Many have deployed high occupancy vehicle and value-pricing strategies, while others have established advanced bus op-

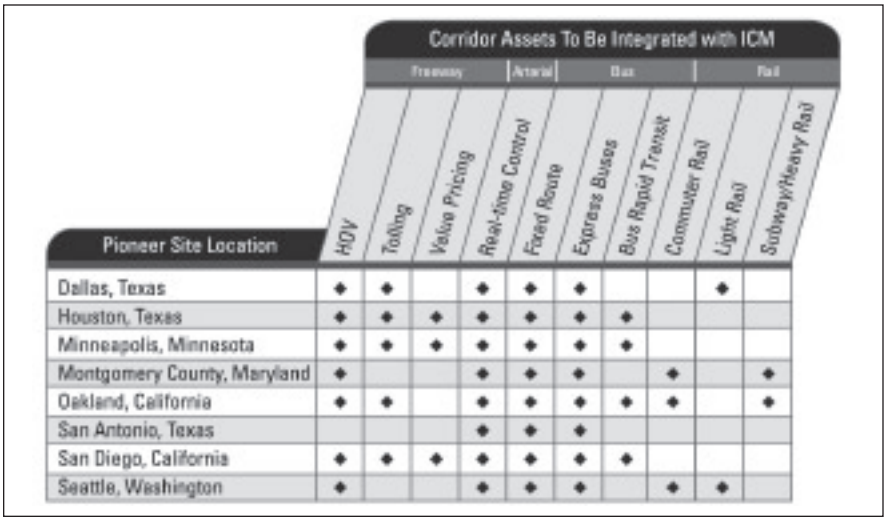


Figure 6. Pioneer Sites and their assets.

erations that include express bus and bus rapid transit services (see Figure 6).

THE FOUR PHASES OF THE ICM INITIATIVE

The ICM Initiative will be implemented in four phases designed to promote innovation in the development of new approaches for managing existing assets efficiently within a corridor. Ultimately the phases will help USDOT and the Pioneer Sites identify and advance promising ICM approaches that can serve as critical next steps in the nation's efforts to reduce traffic congestion. Note that phases 2 through 4 occur concurrently to some extent (see Figure 7).

Phase 1: Foundational Research

Phase 1 was completed in early 2006 and included research into the current state of corridor management in the United States, principal examples of ICM-like practices around the world, initial feasibility, and development of preliminary technical guidance such as a generic concept of operations for ICM to serve as a resource for sites seeking to develop their own concepts.

As part of phase 1, USDOT worked with the Intelligent Transportation Society of America to form a multimodal stakeholder group consisting of representatives from the public and private sectors. As a result of the phase 1 research, USDOT decided to move forward with the ICM Initiative.

USDOT documented the phase 1 foundational research in a set of technical memoranda, all of which are available on the Web-based ICM Knowledgebase at www.its.dot.gov/icms/knowledgebase.htm. (See "A Wealth of Information" on page 44.)

Phase 2: Corridor Tools, Strategies, and Integration

Phase 2 began in September 2006 and will run concurrently with phases 3 and 4 through fiscal year (FY) 2011. The goal of phase 2 is to develop the tools and components necessary to support ICM operations and apply those tools in one or more site demonstrations. Phase 2 also will include analyzing the benefits expected to be derived from implementing ICM systems.

This phase will develop analytic tools and methods that enable the implementation and evaluation of ICM strategies. The phase will include limited laboratory testing of ICM strategies; selection and calibration of modeling and simulation tools; and application of the modeling tools using real-world data from a test corridor to generate insights into the potential mobility impacts of specific strategies under a range of conditions or scenarios, such as planned special events, peak flow congestion, and incidents. Modeling of the test corridor is expected to be completed in late spring/early summer 2008.

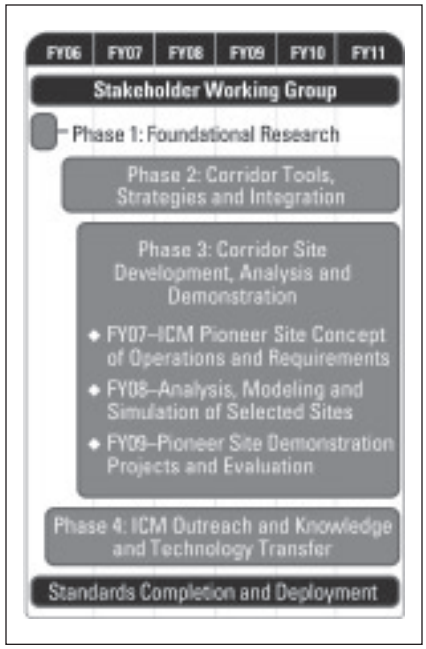


Figure 7. The four phases of the ICM Initiative.

The outcomes of this phase will help decisionmakers identify gaps; evaluate ICM strategies; and invest in the best combination of strategies to minimize congestion, improve safety, and help estimate the benefits resulting from ICM across different transportation modes and traffic control systems. Knowledge of the analysis methodologies, tools, and possible benefits of ICM strategies will be made available to the Pioneer Sites and the entire transportation community. The overall effort of phase 2 will result in validated and tested methodologies to support ICM analysis (see sidebar, this page).

Analysis, Modeling, and Simulation (AMS)

The goal of the Phase 2 AMS effort is to test and validate methodologies that can support analysis of ICM strategies and help generate insights on expected benefits of implementing ICM. The AMS methodologies will be applied to a test corridor using a host of sample ICM strategies. The USDOT selected the San Francisco Bay Area's I-880 corridor to serve as the test corridor after a careful review of more than 20 candidate locations.

USDOT will use the resulting AMS methodologies from Phase 2 as well as existing tools to model ICM strategies in up to three Pioneer Site corridors as part of Phase 3 of the ICM Initiative in FY08. This modeling will help identify cost-effective ICM strategies and help prioritize ICM investments based on expected performance.

USDOT expects to announce the Phase 2 results, as well as the Phase 3 modeling sites, in summer 2008.

Phase 3: Corridor Site Development, Analysis, and Demonstration

In phase 3, USDOT will model up to three ICM approaches developed by the Pioneer Sites using the analysis tools that were developed and refined in phase 2. It will then fund the demonstration and evaluation of ICM approaches at up to three Pioneer Sites. Together, the modeling, demonstration, and evaluation will provide comprehensive insight into the ICM strategies and approaches with the greatest potential. Phase 3 consists of three stages:

Stage 1: Concept Development (FY 2007). All eight Pioneer Sites are developing site-specific concepts of operations and requirements documents. Each site also will provide sample data for evaluation. The sites began working on this stage in October 2006 and are expected to complete concept and requirements development in spring 2008.

Stage 2: Modeling of Pioneer Site ICM Strategies (FY08–FY09). Using the resources, methodologies, and tools developed in phase 2, USDOT will analyze and model ICM strategies and systems at up to three Pioneer Sites to gain insight into the potential mobility impacts of ICM strategies. USDOT expects to announce the sites that will participate in this stage after completion of stage 1.

Stage 3: Demonstration and Evaluation (FY09–FY11). After the stage 2 modeling and analysis is complete, USDOT will select up to three Pioneer Sites to demonstrate ICM concepts that could be applicable to a broad range of corridors around the country. These sites will demonstrate the application of institutional, operational, and technical integration approaches in the field and document implementation issues and operational benefits. USDOT expects to announce the sites that will participate in this stage after completion of stage 2 (see sidebar, this page).

Phase 4: ICM Outreach and Knowledge and Technology Transfer

In phase 4, a comprehensive set of resources will be used for KTT to transportation practitioners around the country interested in implementing ICM in their corridors. More than 20 ICM stakeholders, including representatives from each Pioneer Site, contributed to development of the ICM KTT strategy using virtual collaborative technology.

KTT resources will be made available to transportation practitioners through the Web-based ICM Knowledgebase, peer-to-peer training such as Web-based seminars and mobile workshops, conferences, and printed materials such as factsheets and guidance documents. The KTT mission is to equip practitioners in corridors around the country to implement ICM. The following resources currently are available on the Web site: the generic ICM concept of operations, the ICM implementation guide, requirements guidance, technical guidance on corridor definitions and other topics, and outreach documents such as factsheets and a quarterly newsletter.

As part of phase 4, USDOT will host two outreach events to raise awareness about ICM and the leadership undertaken by the Pioneer Sites. The events will provide a platform for developing and disseminating outreach materials—including the newsletter, brochures, articles, press

A Wealth of Information

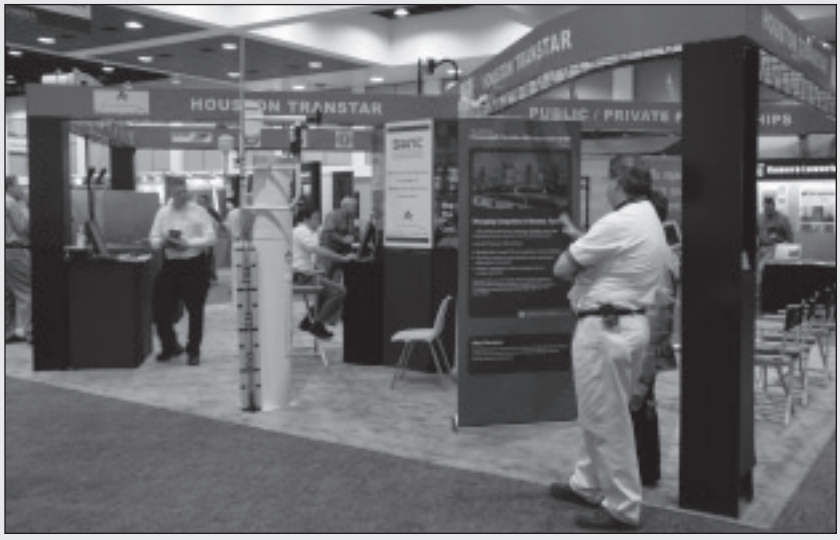
The key ICM KTT products include the ICM Knowledgebase and the quarterly newsletter (see Figure 8).

USDOT unveiled the Knowledgebase at the ITSA annual meeting in June 2007. The readily searchable, Web-based reference tool provides transportation professionals with the knowledge and tools they need to implement ICM in their corridors. The Knowledgebase contains cutting-edge knowledge developed through the ICM Initiative, such as the generic concept of operations as well as lessons learned and resources from the Pioneer Sites.

Designed with input from ICM stakeholders, the Knowledgebase is intended to help users conveniently access the information they need. Users may search by keyword or browse the contents by accessing a number of views, including type of resource (guidance, lessons learned, presentation, etc.), associated systems engineering or ICM life-cycle step, publication date of document, or conference/event. The Knowledgebase also saves users time by providing short document abstracts; usage guidance for target audiences; and other information, including file size and number of pages, to help users determine which documents are most useful to them before opening or downloading. Documents are added regularly as the ICM Initiative progresses.

The Knowledgebase is part of an overall ICM Web site, available at www.its.dot.gov/icms. More information on the Knowledgebase is available at www.its.dot.gov/icms/knowledgebase.htm.

The quarterly newsletter, launched in June 2007, informs transportation practitioners about the latest developments in the ICM Initiative and highlights the latest knowledge and technology transfer materials. The newsletter is available at www.its.dot.gov/icms/new_newsletter.htm.



Source: April Armstrong, SAIC

Figure 8. Attendees of the 2007 ITSA annual meeting had the opportunity to network with representatives of the ICM Pioneer Sites and ask questions of the people leading the development of ICM strategies. Here, attendees look at posters at the ICM showcase.

ICM in Action

For examples of ICM in action, please visit the ICM website at www.its.dot.gov/icms. The website contains examples of how ICM concepts have been applied to real situations as well as a generic concept of operations that shows how ICM could be applied to a generic corridor. In addition, the Pioneer Sites' ICM concepts of operations will be posted to the ICM website by spring 2008.

kits, and visual presentations—that can be customized by regions around the country to raise awareness about ICM in their areas (see sidebar, this page).

NEXT STEPS

USDOT is committed to equipping transportation practitioners across the country with tools to implement ICM, which representatives from the Pioneer Sites describe as the "next logical step for the nation's corridors." The Pioneer Sites have developed their own concepts of operations, based on the generic version, and are developing requirements documents for their ICM concepts.

USDOT expects to post the Pioneer Sites' concepts of operations and requirements documents, as well as lessons learned from these activities, on the ICM Knowledgebase (www.its.dot.gov/icms/knowledgebase.htm) in late spring/early summer 2008. Early results from the analysis and modeling efforts using the test corridor also should be available in late spring/early 2008. Further, USDOT will host panel discussions, workshops, and webinars over the next year to transfer knowledge to interested transportation practitioners.

Visit the ICM Web site at www.its.dot.gov/icms to learn more about upcoming ICM KTT resources and events, sign up to receive the ICM newsletter, or bookmark the ICM Knowledgebase. For more information, contact Brian Cronin at 202–366–8841 or brian.cronin@dot.gov; Steve Mortensen at 202–493–0459 or steven.mortensen@dot.gov; or Dale Thompson at 202–493–3420 or dale.thompson@dot.gov.

Note: Quotes/facts referenced throughout this article are from *National Strategy to Reduce Congestion on America's Transportation Network*, www.fightgridlocknow.gov/docs/conginitoverview070301.htm, accessed April 2007 and Texas Transportation Institute, *2007 Urban Mobility Report*, tti.tamu.edu/documents/mobility_report_2007_wappx.pdf, accessed November 2007. ■

BRIAN CRONIN
is the ICM program manager for USDOT's Research and Innovative Technology Administration and the congestion program coordinator for the ITS Joint Program Office (JPO). He is JPO's lead representative to USDOT's Congestion Initiative. He is also the technical representative for the Montgomery County, MD, and San Antonio, TX, Pioneer Sites. He has worked in the field of transportation and ITS technologies for 13 years. He is a member of ITE.

STEVE MORTENSEN
is a senior ITS engineer with FTA's Office of Research, Demonstration and Innovation. He supports the ICM Initiative, Congestion Initiative, Transit Operations Decisions Support System Demonstration, and other transit ITS projects. He has worked in the field of transportation and ITS technologies for 14 years and is the technical representative for the Pioneer Sites in Dallas, TX; Oakland, CA; and San Diego, CA.

DALE THOMPSON
is a transportation research specialist in the FHWA Office of Operations Research and Development, and he has been working in transportation operations for 20 years. As FHWA's ICM research coordinator, he is responsible for leading ICM research in technical integration, ICM decision support systems, surveillance and detection, modeling and simulation analysis, and systems engineering support. He is the technical representative for the Pioneer Sites in Houston, TX; Minneapolis, MN; and Seattle, WA.

Note: This article was originally published by the Federal Highway Administration in the March/April 2008 issue of *Public Roads*. Reprinted with permission.