Information Management

ITS Benefits, Costs, and Lessons Learned: 2018 Update Report

U.S. Department of Transportation

Information Management

Data Archive
Multimodal Traveler Information Management
Performance Measurement

Highlights

- Information management systems incorporate data fusion from multiple sources and/or agencies, integration of both real time and archived information, and in some cases, data visualization.
- MAP-21 will require greater use of real time and archived data to support development and monitoring of performance measures.
- Cost is a significant factor – development and maintenance costs vary widely, and benefits are not easily quantified.

Introduction

This factsheet is based on past evaluation data contained in the ITS Knowledge Resources database at: www.itskrs.its.dot.gov. The database is maintained by the U.S. DOT's ITS JPO Evaluation Program to support informed decision making regarding ITS investments by tracking the effectiveness of deployed ITS. The factsheet presents benefits, costs and lessons learned from past evaluations of ITS projects.

Intelligent transportation systems collect large amounts of data on the operational status of the transportation system. Archiving and analyzing this data can provide significant benefits to transportation agencies.

Archived data management systems (ADMS) collect data from ITS applications and assist in transportation administration, policy evaluation, safety, planning, program assessment, operations research, and other applications. Small-scale data archiving systems can support a single agency or operations center, while larger systems support multiple agencies and can act as a regional warehouse for ITS data.

The 2012 transportation reauthorization law Moving Ahead for Progress in the 21st Century (MAP-21) has set up new requirements for performance-based transportation decision making, including establishing performance measures and targets in seven national goal areas such as congestion reduction and system reliability. Public agencies are seeking real time and archived data to provide metrics and measurements of system performance.

Example uses of archived ITS data include:

- Incident management programs may review incident locations to schedule staging and patrol routes, and frequencies for service patrol vehicles.
- Historical traffic information can be used to develop predictive travel times.
- Transit agencies may review schedule performance data archived from automatic vehicle location, computer-aided dispatch systems and/or automatic passenger counting systems to design more effective schedules and route designs, or to manage operations more efficiently.

As information management and data archiving systems evolve they are moving from archiving information from a single source or system to more complex implementations. In order to provide support for regional operations across jurisdictional and agency boundaries, data fusion from multiple sources and/or agencies, integration of both real time and archived information, and data visualization are being incorporated.

Information management and data archiving from both infrastructure and mobile sources in data environments are also the foundation of the Real-Time Data Capture and Management track of the ITS Research Program.

The collection and storage of data on transportation system performance often occurs at transportation management centers (TMCs). The transportation management centers chapter discusses TMCs in detail. In addition, the transit management chapter discusses the archiving and use of transit performance data.

Benefits

Data archiving enhances ITS integration and allows for coordinated regional decision making. Traffic surveillance system data, as well as data collected from commercial vehicle operations, transit systems, electronic payment systems, and road weather information systems have been the primary sources of archived data available to researchers and planners. Often the benefits of the archived data systems are not easily quantified. The archived data provides information not previously available, and enables analyses of problems and solutions not possible with traditional data. As more advanced data analysis techniques develop and the efficiency of data reporting systems are improved, additional examples of the effectiveness of information management systems will become available. Methodologies for computing the benefits of information management must be developed.

Table 1: Benefits of Information Management.

ITS Goal	Selected Findings
Customer Satisfaction	In Virginia, a web-based archived data management system (ADMS) was deployed to provide decision makers and other transportation professionals with traffic, incident, and weather data needed for planning and traffic analyses. An assessment of website activity indicated that 80 percent of the website usage was devoted to downloading data files needed to create simple maps and graphics. Overall, users were pleased with the ability of the system to provide a variety of data, but wanted more information on traffic counts, turning movements, and work zones, as well as broader coverage. (2008-00560)
Efficiency	In Portland, Oregon, the Tri-Met transit agency used archived AVL data to construct running time distributions (by route and time period) and provide enhanced information to operators and dispatchers. Evaluation data indicated that the reduced variation in run times and improved schedule efficiency maximized the effective use of resources. (2008-00587)
Productivity	The Iowa Department of Transportation (DOT) found that a project to make data reporting and analysis tools available to local law enforcement organizations resulted in an increase in officer-generated crash reports received electronically from 68 percent from 47 percent, allowing the agency to provide statewide crash data on a quarterly basis. At the beginning of the project, the available data was 1.5 to 3 years old. (2013-00882.)
Productivity	A study using archived data at five study locations with a variety of seasonal traffic patterns found that in some situations, up to 75 percent of all days can be missing data at urban locations when calculating annual average daily traffic statistics with archived ITS data. This finding challenges conventional procedures for the calculation of annual average planning statistics. (2013-00873)

Costs

The costs to develop ADMS vary based on the size of the system and features provided. Based on limited data available from a study of six transportation agencies that have established ADMS, costs for one system was $85,000 and $8 million for another. Four of the six systems were developed jointly with a university. Typically, the state DOT pays for the development with the university hosting the system. Operations and maintenance (O&M) costs were in a closer range, $150,000 to $350,000; these costs were usually on an annual basis.

The University of Maryland hosts the Regional Integrated Transportation Information System (RITIS) which collects, archives, and provides data fusion and visualization for agencies in the Washington, D.C. region and beyond. The system costs about $400,000 a year to maintain and operate (in 2011). Costs for an agency to integrate their data within RITIS have varied depending on the system and effort required for integration from a low of $15,000 to a high of $300,000.

A study of the feasibility and implementation options for establishing a regional data archiving system to help monitor and manage traffic operations in Northeast Illinois estimated the cost for developing software to integrate data from multiple agencies in a region and produce both historical and real-time reports as ranging from $700,000 (low) to $1,000,000 (high) (2011-00221).

Table 2: System Costs of Archived Data Management Systems.

Cost Category	Source	Min	Max	Cost ID
ADMS	Washington State TRAC System and Caltrans PeMS	$85,000 (initial R&D)	$8,000,000	2008-00173
Statewide Electronic Crash Data Collection System	Vermont, Virginia	$1,105,000	$2,272,209	2013-00280
Regional Data Archive	Northeast Illinois Regional Data Archive (estimate)	$700,000	$1,046,000	2011-00221

Table 3: Selected Archived Data Management Costs.

Cost Category	Source	Min	Max	Cost ID
Hardware Costs	Illinois Regional Data Archive (estimate)	$42,400	$46,400	2011-00221
Operations and Maintenance	Virginia ADMS	$150,000	$350,000	2008-00174
	University of Maryland RITIS	$400,000	$400,000	2011-00220
Software Development	Illinois Regional Data Archive (estimate)	$700,000	$1,000,000	2011-00221
Training	Caltrans PeMS	$350,000	$350,000	2013-00291

Lessons Learned

The SafeTrip-21 Initiative demonstrated the feasibility of alternative approaches to collecting and using traffic data. In some cases, applications demonstrated new sources of traffic condition data. In other cases, applications made use of traditional data in new ways. The SafeTrip-21 Initiative highlighted, for example, how the mass-market availability of GPS-enabled smart phones complements traditional fixed sensors as a new data source, as well as offers the potential to deliver personalized travel information (2013-00649). Among the lessons learned are:

- **Use new and traditional data sources to enhance traffic models and to help solve problems related to mode shift and travel demand**. Traffic model development can benefit from integrating traffic probe data with other data sources for both freeways and arterials. Several SafeTrip-21 tests showed that ITS technology is capable of collecting the data needed by traffic and transit operations agencies to collaborate and better understand mode shift and travel demands across modes.
- **Consider procuring traffic data and information, rather than building in-house data collection systems, to reduce costs**. Agencies have traditionally procured hardware, software, and systems that allowed them to collect, analyze, and produce traffic data, which likely proved to be a laborious effort. An emerging alternative is to procure data and/or information services as a more cost-effective, resource-efficient alternative to developing the data and/or end product internally.
- **Explore the potential of new consumer devices, applications and services for collecting new traffic data and combining it with traditional traffic data to be used in new and innovative ways**. For example, cell

phone GPS systems can alter the way traffic data is collected by leveraging the existing cell phone infrastructure to collect traffic data and transmit traffic information directly back to drivers.

- **Assess traffic data and information services carefully to ensure the quality and quantity of data and information needed**. The ability to deploy a traveler information concept is only as successful as the availability, timeliness, and accuracy of its data sources. Also, practical concerns of transportation professionals should govern their acceptance of new traffic data services and devices.

Case Study – Using Regional Archived Multimodal Transportation System Data for Policy Analysis

METRANS Transportation Center is a joint partnership of the University of Southern California (USC) and California State University Long Beach (CSULB). As one of the most congested areas in the country and a center for international trade and immigration, the Southern-California region has one of the largest transit-dependent populations in the country. METRANS' mission is to foster independent, high quality research to solve the nation's transportation problems; train the next generation of transportation workforce; and disseminate information, best practices, and technology to the professional community.

Source: USC

With funding secured from Los Angeles County Metropolitan Transportation Authority (Metro), METRANS owns and operates an ADMS which archives historical highway, arterial and public transit system performance data from Regional Integration of Intelligent Transportation Systems (RIITS), which includes data from Metro, Caltrans, City of Los Angeles Department of Transportation (LADOT), California Highway Patrol (CHP), Long Beach Transit (LBT) and Foothill Transit (FHT). The vast and diverse database includes data from roadway traffic sensors, CCTV video feeds, on-board AVL units, transit passenger counters and accident reports.[1]

A research team from USC's Price School of Public Policy wanted to apply these data sources to urban planning by utilizing the ADMS archives to analyze the impact of the capital investment in the Phase 1 addition of the LA Metro Expo Line. The Expo Line project was touted by officials as an investment that would improve access and mobility of residents and employees and increase transit mode share, all while alleviating congestion. The team was most interested in the effect the rail project had on local freeway and arterial system performance, stating that while transit investments are often promoted as a way to reduce congestion, there is very limited literature on the examined impacts of new rail lines on traffic.

For the study, data pulled from geo-located sensors along the I-10 Freeway and arterial roads over a three-month "pre-Expo Line" period that lasted from November 2011 to January 2012 was compared against three months of "post-Expo Line" data that was collected from November 2012 to January 2013.[1] The team used close to 1 million records from freeway sensors and almost 16 million from arterial road sensors. The researchers found that the records revealed that the Expo Line had little, if any, impact on local arterial or freeway congestion. It did, however, initiate a significant overall rise in transit ridership across the Culver City-Downtown Los Angeles corridor along the Expo Line.

The USC team was awarded the 2017 Chester Rapkin Award by the Association of Collegiate Schools of Planning (ACSP) for the work described in their paper "Using Regional Archived Multimodal Transportation System Data for Policy Analysis: A Case Study of the LA Metro Expo Line".[2] Those involved with the project hope that the findings outlined in their report help transit planners design better projects that increase transit patronage and meet objectives or expectations.

> **Unlike many transportation agencies where data is collected for real-time operations and disposed of, METRANS ADMS archives this data in a systematic fashion to facilitate effective decision making using predictive data.**

Regarding the power of Big Data in transportation, the Southern California region is one of the first areas in the country that are systematically storing real-time data sets in this manner. The ability to do before/after studies opens new possibilities as far as measuring, monitoring and evaluating the performance of systems and new infrastructure projects. One notable application is with predictive route planning. Most existing route-planning algorithms operate on "detect and avoid," however with a data archive such as METRANS', agencies can "predict and avoid," allowing them to plan their schedules better. This manner of utilizing predictive data for effective decision making is all a part of the process to transition Los Angeles to a Smart City.

Case Study – USDOT's *ITS Public Data Hub* Data Sharing Platform

Source: USDOT

The ITS JPO and its multimodal partners are dedicated to providing open access to archival and real-time publicly funded research data. Beginning in 2018, the ITS Public Data Hub became the USDOT's primary storage and access system for ITS data. By providing access to these data, the USDOT aims to enable third-party research into the effectiveness of emerging ITS technologies, preliminary development of third-party applications, and harmonization of data across similar collections. Features of the ITS Public Data Hub include: timely access to data from ongoing ITS projects; the ability to create visualizations and conduct analysis online; an enhanced user interface for viewing, filtering, and downloading ITS data; and the ability to save and share analysis of ITS data. As of February 2018, there are over 138 datasets (and counting) available on the data hub.

Similar to the USDOT's now deprecated Research Data Exchange (RDE), the ITS Public Data Hub offers several visualization tools that users are encouraged to play around with. Six prototype visualization elements are available for viewing at https://www.its.dot.gov/data/visualizations/. The Data Lens feature within the ITS Public Data Hub provides users with a data dashboard-type interface that allows them to create map and chart dashboard cards based on various data through cross filtering. Such cross filtering allows users to see how information in one dashboard card relates to another.

A key milestone for ITS JPO was to have up-to-date data from an ongoing project available on the data hub. This is being accomplished with the Wyoming Connected Vehicle Pilot data that is being added to the ITS Public Data Hub in near-real time. Available data online includes a live running log of approximately one day's worth of sanitized Basic Safety Messages (BSM) as well as a sample of Traveler Information Messages (TIMs) generated by several test vehicles and roadside equipment within the Wyoming Connected Vehicle Pilot. Users also have the opportunity to access the full data set through a standard application programming interface (API). A great volume of data is expected to be generated by the Wyoming Pilot. In late 2018 when the pilot is operating at full-scale, the system expects to have over 400 connected vehicles generating up to 115 million records a day. The New York City and Tampa Pilots are expected to have an even larger volume of data once their data connections are set up.[3]

A sample analysis performed on the Wyoming Pilot data on the ITS Public Data Hub is portrayed in the screenshot below. In the screenshot, the right hand side shows all the BSMs from the one day sample mapped out along the I-80 corridor in Wyoming, while the left hand side shows three histograms: one breaking down vehicle messages by speed, one on the time the message was generated, and the third on vehicle heading. Within the Data Lens feature, users have the ability to click on specific areas of the map to drill down and do a geographic analysis on where higher concentrations of messages are and what types of messages they are.

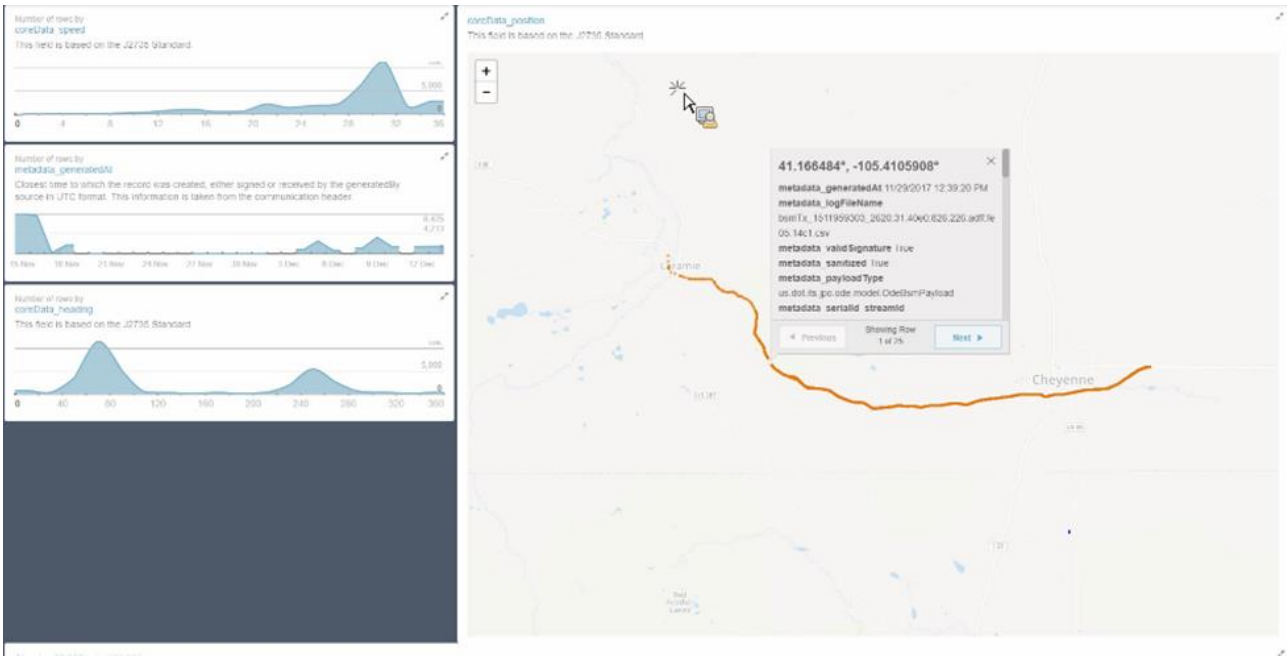

Figure 1: Sample Visualizations of the Wyoming Connected Vehicle Pilot Data within the ITS Public Data Hub[3]

References

[1] Rhoads, Mohja. "Using 'Big Data' for transportation analysis: A case study of the LA Metro Expo Line," 9 October 2014. https://www.slideshare.net/otrec/expo-ppt-portland-oct-2014

[2] Kredell, Matthew, "Price study on Expo Line's traffic impact wins planning journal's best paper award," USC Price News, 10 November 2017. https://priceschool.usc.edu/price-study-on-expo-lines-traffic-impact-wins-planning-journals-best-paper-award/

[3] Gold, Ariel and James O'Hara, "ITS Public Research Data Update Webinar," Presented on 25 January 2018. http://itsa.adobeconnect.com/pea1mfcm39fv/

All other data referenced is available through the ITS Knowledge Resources Database, which can be found at http://www.itsknowledgeresources.its.dot.gov/.