



U.S. Department of Transportation

Introduction

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

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Introduction

In 2018, the U.S. transportation system continues to face the ongoing challenges of improving safety, meeting rising demand, and mitigating congestion and environmental impacts. Motor vehicle crashes continue to be a leading cause of death among Americans. Fatalities from motor vehicle crashes rose in 2015, the most recent year data is available. [1] With the continual challenges facing transportation and mobility new technologies are being applied to improve safety and mobility and reduce the impact on the environment. This update include new content for new important and emerging topics in the transportation sector including: accessible transportation, connected vehicles – safety, mobility, and environment, automation, smart cities, and mobility on demand.

ITS Leads the Way

Over the past 30 years, the demand for the use of public roads has increased approximately 95 percent, as measured in vehicle miles traveled (VMT). Over this same period the number of lane miles on public roads has increased less than 9 percent. These statistics indicate a sharp rise in demand while capacity, in terms of the number of lane miles, has stayed relatively constant [2].

Recognizing that we can no longer build our way out of these problems, transportation professionals have turned to information and communications technology for solutions. Intelligent Transportation Systems (ITS) provide a proven set of strategies for advancing transportation safety, mobility, and environmental sustainability by integrating communication and information technology applications into the management and operation of the transportation system across all modes. Connected vehicle technology has the potential to enable many services provided by infrastructure or vehicle based ITS by benefiting from enhanced communication between vehicles and the infrastructure.

The ITS Knowledge
 Resources Database can
 be accessed at
<http://www.ITSKnowledgeResources.its.dot.gov>

The 2018 ITS Benefits, Costs and Lessons Learned Factsheets

This collection of factsheets presents information on the performance of deployed ITS, as well as information on the costs, and lessons learned regarding ITS deployment and operations. The factsheets, and the collection of three Web-based resources upon which it is based, have been developed by the ITS Joint Program Office (JPO) of the U.S. Department of Transportation (U.S. DOT) to support informed decision making regarding ITS planning and deployment. The 2018 update builds off the 2017 and 2014 factsheets. Where new information is available the factsheets have been updated and new factsheets have been added for new topics.

Measuring ITS Performance

ITS deployment impacts transportation system performance in six key goal areas: safety, mobility, efficiency, productivity, energy and environment, and customer satisfaction, each with its own set of performance measures.

- Safety is measured through changes in crash rates or other surrogate measures such as vehicle speeds, traffic conflicts, or traffic law violations.
- Mobility improvements are measured in travel time or delay savings, as well as travel time savings, and on-time performance. Travel time reliability is emerging as a new measure of travel dependability.
- Efficiency is typically represented through increases in capacity or level of service within existing road networks or transit systems.
- Productivity improvements can be documented in cost savings to transportation providers, travelers, or shippers.
- Energy and Environment benefits are typically documented through fuel savings and reduced pollutant emissions.
- Customer Satisfaction findings document the perception of deployed ITS by the traveling public, usually in the form of survey results.

Each factsheet highlights recent benefits, costs and lessons learned for the ITS technologies used in a specific application area. The findings presented include reference information and short identification numbers that are hyperlinked directly to the ITS Knowledge Resource database source for the information. These links provide additional information on each finding cited, along with links to the original source documents, when available.

ITS Knowledge Resources

The ITS Knowledge Resources (KR) database (www.ITSKnowledgeResources.its.dot.gov) contains summaries of the benefits, costs, and lessons learned regarding ITS deployment and operations. The Knowledge Resources organize eighteen years of information on specific ITS implementations, drawn primarily from written sources such as ITS evaluation studies, research syntheses, handbooks, journal articles, and conference papers. 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 ITS Benefits Database** provides measures of the effects of ITS on transportation operations according to the six goals identified by the U.S. DOT: safety, mobility, efficiency, productivity, energy and environmental impacts, and customer satisfaction. Each benefit summary includes a title in the form of a short statement of the evaluation finding, context narrative, and identifying information such as date, location, and source, as well as the evaluation details and methodologies that describe how the identified ITS benefit was determined.
- **The ITS Costs Database** contains estimates of ITS costs that can be used for developing project cost estimates during the planning process or preliminary design phase, and for policy studies and benefit-cost analyses. Both non-recurring (capital) and recurring or operations and maintenance (O&M) costs are provided where possible. Three types of cost data are available: unit costs, sample unit costs and system cost summaries.
- **The ITS Lessons Learned Database** provides access to the knowledge gained through the experience of deploying ITS experience primarily from case studies, best practice compendiums, planning and design reviews, and evaluation studies.

The ITS Knowledge Resources Home page integrates the Knowledge Resources databases described above, as well as provides a mapping application, help information, an upload feature to encourage the collection of new information sources, and comment and feedback mechanisms.

ITS Taxonomy

The ITS Knowledge Resources are organized according to a [taxonomy of 16 application areas](#), with sub-categories for each application area. With the emerging research in ITS technologies such as connected vehicles, the taxonomy was updated and reorganized just before the last ITS Benefits, Costs, Deployment, and Lessons Learned Update in 2014.

As ITS research continues to evolve, additional updates to the taxonomy, including new application areas and sub-categories, may be identified.

Report Organization

This report has been designed to be flexible for the user. The purpose is to make the information readily available, whether by accessing it through the web, a mobile device or tablet, or by printing sections on one or more application areas. There are a total of 31 factsheets representing the 16 taxonomy areas. Four of the taxonomy areas (arterial management, freeway management, transit management, and driver assistance) have enough data to require more than one factsheet.

The factsheets include tables, charts, images, and case studies that are available to use in reports or briefings as needed to convey the advantages of using ITS technologies and applications in specific areas or regions. The citation for these resources is: U.S. DOT. *ITS Benefits, Costs, and Lessons Learned: 2018 Update Report*. 2018. Publication Number: FHWA-JPO-18-641.

The online versions of the factsheets feature interactive graphs that contain various metrics represented by the bars of the graphs. The bars represent a numeric range, indicating the range of impacts reported by sources in the databases. Each metric has a number after the text, representing the number of data points used to create the range; no number means only there was only one data point. When moused over and selected or clicked, the bar opens a 'tooltip' with more detailed information. The tooltip contains the sub-headline of each benefit or cost entry with the data point from the entry that is incorporated into the range of the bar. The text is hyperlinked to the entry on the ITS Knowledge Resource website (www.itsknowledgeresources.its.dot.gov). All data depicted is from 2003 to 2018 unless otherwise stated in the factsheet. To remove the tooltip from the screen, select or click the same bar a second time and the tooltip will disappear.

The findings presented in these factsheets include reference information and short identification numbers that are hyperlinked directly to the ITS Knowledge Resource database source. These links provide additional information on each finding cited, along with links to the original source documents, when available online.

New Topics

Accessible Transportation

In 2010, the U.S. Census reported that approximately 56.7 million people in the U.S. (18.7 percent of the U.S. population) had some type of disability. This is an important consideration as transportation has long been thought to be instrumental in enhancing access to education, jobs, healthcare, and independent living within communities. Individuals with disabilities currently suffer a 63 percent unemployment rate, with half of the household income and three times the poverty rate of people without disabilities. Recently, a user needs assessment on transportation challenges faced by people with disabilities, veterans with disabilities, and older adults, conducted by the United States Department of Transportation's Accessible Transportation Technology Research Initiative (ATTRI), concluded that needs and barriers vary by sub-population and type of disability. Specific barriers identified by ATTRI stakeholders included lack of or inaccessible signage, maps, and announcements; lack of information on arrival times, transfer times, and travel distance; and inconsistent accessible pathway infrastructure.

Automation

Autonomous vehicles also known as self-driving, driverless, or robotic vehicles are defined as computer-equipped vehicles that can be driven and operated without active control by a human driver. Using integrated sensor systems, complex algorithms, and automated vehicle (AV) technology, autonomous vehicles can plan routes, navigate through traffic, negotiate lane changes and turns, manage speeds, and assist with parking. With AV technology, a variety of new functions are expected over the next several years as connected vehicle (CV) applications are refined and implemented in accordance with governmental regulations and controls.

While not required for autonomous driving, CV applications are expected to enhance the operational capacity of autonomous vehicles networks and bring about a variety of benefits such as improved situational awareness for increased safety,

improved fuel economy, reduced parking needs, and increased mobility for those unable to drive. To help realize these benefits, the United States Department of Transportation (USDOT) Intelligent Transportation Systems Joint Program Office (ITS JPO) has made Advancing Automation a key strategic priority.

Connected Vehicles

The U.S. Department of Transportation's (USDOT's) Connected Vehicle program is working with state and local transportation agencies, vehicle and device makers, and the public to test and evaluate technology that will enable cars, buses, trucks, trains, roads and other infrastructure, and our smartphones and other devices to “talk” to one another. Cars on the highway, for example, would use short-range radio signals to communicate with each other so every vehicle on the road would be aware of where other nearby vehicles are. Drivers would receive notifications and alerts of dangerous situations, such as someone about to run a red light as they're nearing an intersection or an oncoming car, out of sight beyond a curve, swerving into their lane to avoid an object on the road. Connected Vehicle technologies aim to tackle some of the biggest challenges in the surface transportation industry--in the areas of safety, mobility, and environment.

Safety

Safety applications center on the basic safety message (BSM), a packet of data that contains information about vehicle position, heading, speed, and other information relating to a vehicle's state and predicted path. Connected Vehicle safety applications will enable drivers to have 360-degree awareness of hazards and situations they cannot even see. Through in-car warnings, drivers will be alerted to imminent crash situations, such as merging trucks, cars in the driver's blind side, or when a vehicle ahead brakes suddenly. By communicating with roadside infrastructure, drivers will be alerted when they are entering a school zone, if workers are on the roadside, and if an upcoming traffic light is about to change.

Mobility

In the connected vehicle environment real-time data is captured from equipment located on board cars, trucks, and buses and from the network of connected vehicle field infrastructure. These data will be transmitted wirelessly and used by transportation managers in a wide range of applications to manage the transportation system for optimum performance. As a result of over five years of application prototyping, demonstration and assessment, six bundles representing 17 connected vehicle applications concepts were developed to measure mobility impacts.

Environment

Environmental applications developed through the Applications for the Environment: Real-time Information Synthesis (AERIS) program envisioned a transportation system in which all transportation users, regardless of mode, would have the information needed to make better and greener transportation choices, at any time and in any place. The environmental component of the ITS Joint Program Office's (JPO's) connected vehicle research program, AERIS, officially kicked off in 2009 with a vision of “Cleaner Air through Smarter Transportation”. Employing a multimodal approach, the AERIS Research Program aimed to encourage the development of technologies and applications that support a more sustainable relationship between transportation and the environment chiefly through fuel use reductions and resulting emissions reductions.

New factsheets have also been added for each Connected Vehicle Pilot site: New York City, Tampa, and Wyoming.

Smart Cities

With Intelligent Transportation Systems (ITS) laying the groundwork for innovative transportation solutions, many cities are currently serving as laboratories for new types of transportation services and cleaner transportation options leveraging those solutions. Smart Cities are emerging as a next-generation approach for city management by taking steps forward along the transportation technology continuum. Integrating ITS, connected vehicle technologies, automated vehicles, electric vehicles, and other advanced technologies – along with new mobility concepts that leverage the sharing economy – within the context of a city will provide enhanced travel experiences and make moving people and goods safer, more efficient, and more secure. By enhancing the effective management and operation of the transportation system, smart city solutions can leverage existing infrastructure investments, enhance mobility, sustainability, and livability for citizens and businesses, and greatly increase the attractiveness and competitiveness of cities and regions. The Smart City concept will connect transportation and non-transportation services to improve city services and the quality of life for residents.

Mobility on Demand

Mobility on Demand (MOD) is a multimodal, integrated, accessible, and connected transportation system in which personalized mobility is a key objective. MOD enables the use of on demand information, real-time data, and predictive analysis to provide individual travelers with transportation choices that best serve their specific needs and circumstances. Modes facilitated through MOD providers can include: carsharing, bikesharing, ridesharing, ridesourcing, microtransit, shuttle services, public transportation, and other emerging transportation solutions.

References

[1] FHWA Office of Safety, "Facts & Statistics," http://safety.fhwa.dot.gov/facts_stats/, last accessed January 30, 2014.

[2] U.S. DOT ITS Joint Program Office, *ITS ePrimer*, 2013. <http://www.pcb.its.dot.gov/eprimer/module1.aspx>

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