Introduction

In 2014, the U.S. transportation system faces the ongoing challenges of improving safety, meeting rising demand, and mitigating congestion and environmental impacts. Motor vehicle crashes continue to be the leading cause of death among Americans aged one to 34 years old, with the total societal cost of crashes exceeding $230 billion annually [1]. Fatalities from motor vehicle crashes rose 5.3 percent in 2012, the first time since 2005 that fatalities have gone up [2]. In 2011, congestion caused urban Americans to travel an extra 5.5 billion hours and to purchase an extra 2.9 billion gallons of fuel for a congestion cost of $121 billion, up one billion dollars from the year before and translating to $818 per U.S. commuter [3]. The Texas Transportation Institute estimated the additional carbon dioxide (CO₂) emissions attributed to traffic congestion at 56 billion pounds – about 380 pounds per auto commuter [3].

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 [4].

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 2014 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.

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.
2013 Taxonomy Update

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 has been updated and reorganized since the last ITS Benefits, Costs, Deployment, and Lessons Learned Update in 2011.

The most significant change to the previous taxonomy classifications is the removal of the division between Intelligent Vehicle and Intelligent Infrastructure technologies. As emerging ITS technologies make use of the integration between vehicles and infrastructure, the new taxonomy of ITS Applications no longer uses the first level category and has organized all application areas under one umbrella of ITS. For example, in the previous taxonomy classification, the Crash Prevention and Safety application area fell under the Intelligent Infrastructure category, while the Collision Avoidance application area was categorized under the Intelligent Vehicle category. In the new classification scheme, these two areas have been combined under Crash Prevention and Safety with sub-categories representing both crash prevention and safety technologies and collision avoidance technologies.

Another improvement is the addition of specific application categories and sub-categories for new emerging research areas and trends. Some examples include alternative fuels, congestion and emissions pricing, speed harmonization and performance management. In addition, the new taxonomy includes an accompanying document with detailed definitions of all taxonomy categories and sub-categories.

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 20 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: 2014 Update Report. 2014. Publication Number: FHWA-JPO-14-115.

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 2014 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.

ITS Evaluation Trends

Looking back over the last three years, the most recent additions to the ITS knowledge resources indicate the following trends:

- Increasing benefits from congestion pricing, not only in added revenue, but also in better utilization of excess capacity in High Occupancy Vehicle (HOV) lanes achieved through HOV to High Occupancy Toll (HOT) conversions. There is increasing acceptance among travelers of paying for reliable trip times (2011-00769).
Advances in Integrated Corridor Management (ICM) strategies that allow transportation subsystems to operate in a coordinated and integrated manner. ICM solutions developed for three busy commuter corridors had projected benefit-cost ratios ranging from 10:1 to 22:1 over 10 years (2011-00736, 2011-00757, 2012-00804).

The emergence of crash avoidance technologies that utilize advanced radar and sensor technologies. In 2011, NHTSA evaluated an Advanced Collision Mitigation Braking System (A-CMBS) designed with forward sensing radar, an on-board electronic control unit, and sensors to monitor vehicle speed, brake pressure, steering angle, and yaw to predict and warn drivers of impending collisions, and automatically implement countermeasures to avoid or mitigate collisions. The report found that light vehicles that automatically activate in-vehicle alerts, seat belt tensioners, and braking systems can reduce fatalities by 3.7 percent (2013-00833).

Integration of new and traditional data sources to support performance measurement required by MAP-21 (2013-00649), and adoption of regional approaches to collecting and maintaining such data, such as the Regional Integrated Transportation Information System (RITIS) for the Washington DC metro area (2011-00583).

The adoption of adaptive signal control and transit signal priority to improve traffic flow resulting in reduced fuel consumption and emissions. For example, installation of adaptive signal control systems in two corridors in Colorado reduced fuel consumption by 2 to 7 percent and pollution emissions by up to 17 percent (2012-00808).

Demonstrations of connected vehicle technologies, such as the initial deployment of Smart Roadside Inspection Stations (SRIS), are showing the potential to reduce emissions and save money. SRIS showed the potential to reduce emissions annually by 6.57 metric tonnes by eliminating needless commercial vehicle inspections. SRIS enables inspectors to improve efficiency while maintaining enforcement levels at lower cost. At an average agency personnel cost of $45 per hour, the system would save $1,149,750 per year (2013-00859).

Moving to a Future Connected Vehicle and Autonomous Vehicle Environment

Connected vehicle research represents an opportunity to improve a number of the vehicle-based ITS applications described in the factsheets. Updated information provided to vehicles through in-vehicle technologies could, for example, provide warnings of cross traffic at approaching intersections or enable navigation systems to avoid congested areas based on current traffic conditions. Advances in autonomous vehicles offer the prospect of vehicle control systems that automatically accelerate and brake with the flow of traffic, preventing crashes, reducing congestion, and conserving fuel. Mobility for those disabilities will be greatly enhanced if the basic driving functions could be safely performed by the vehicle itself. For more information on connected vehicle and autonomous vehicle research activities, visit the website: www.its.dot.gov/connected_vehicle/connected_vehicle.htm.

References


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