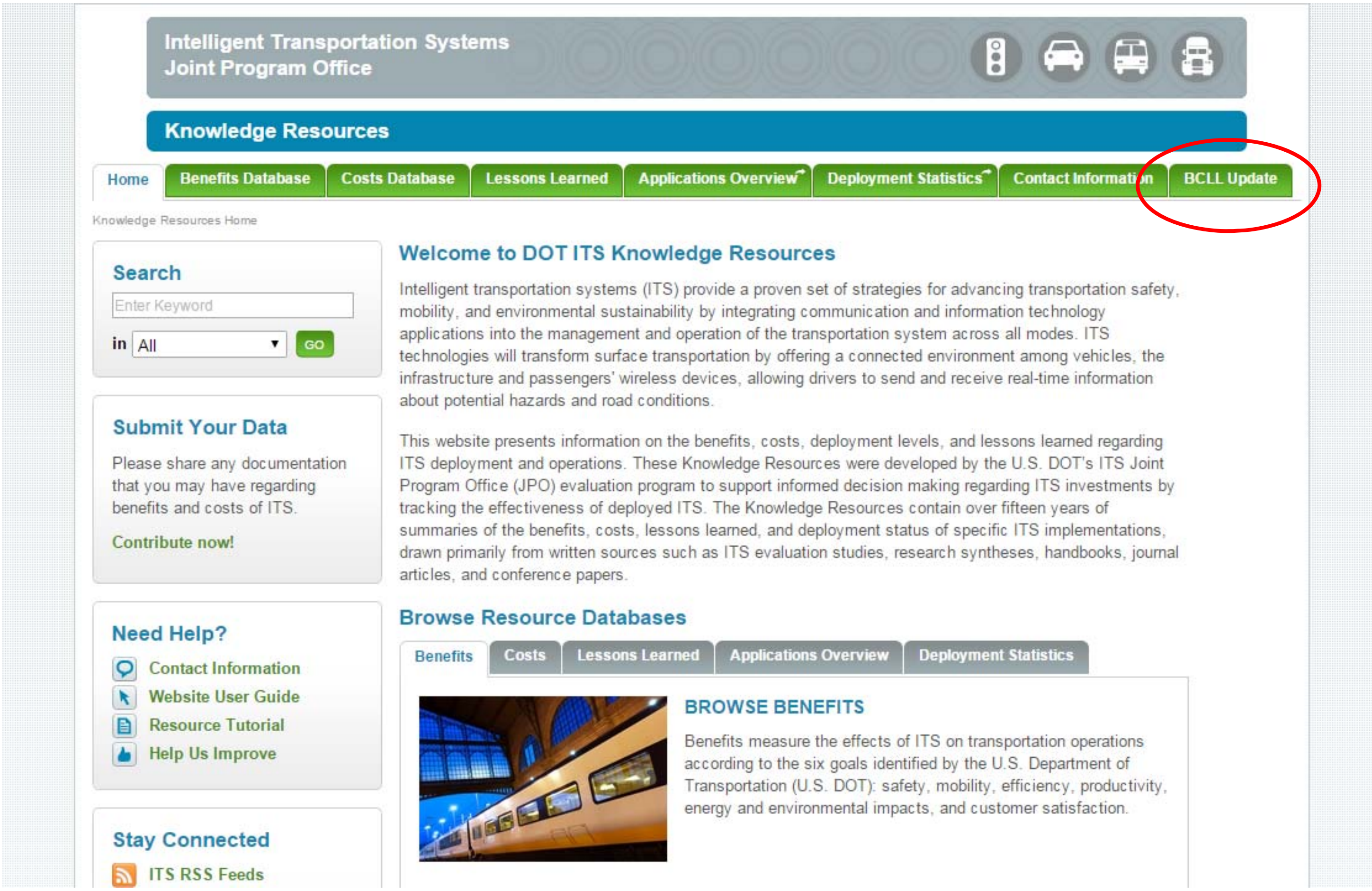
Demonstrating the Benefits and Costs of ITS: Using the Enhanced Knowledge Resources for your Next ITS Project

Drennan Hicks, Noblis

ITS Benefits, Costs, and Lesson Learned: 2014 Update Report

http://www.itsknowledgeresources.its.dot.gov/



BCLL Update Report Page

http://www.itsknowledgeresources.its.dot.gov/its/bcllupdate/

Home | Benefits Database | Costs Database | Lessons Learned | Applications Overview | Deployment Statistics | Contact Information | BCLL Update

Knowledge Resources Home > 2014 BCLL Update Report > Introduction

ITS Benefits, Costs, and Lessons: 2014 Update Report

Download Full Report

View Fact Sheets

Executive Summary

Introduction

Alternative Fuels

Arterial Management: Surveillance

Arterial Management: Traffic Control

Commercial Vehicle Operations

Crash Prevention & Safety

Driver Assistance: Connected Eco Driving, Intelligent Speed Control, Adaptive Cruise Control, Platooning

Driver Assistance: Navigation, Driver Communication, and In-Vehicle Systems

Electronic Payment & Pricing

Emergency Management

Freeway Management: Overview

Freeway Management: Integrated Corridor Management

Information Management

Intermodal Freight

Roadway Operations & Maintenance

Road Weather Management

Traffic Incident Management

Transportation Management Center

Transit Management: Information Dissemination

Introduction

ITS Benefits, Costs, and Lessons Learned: 2014 Update Report

Download PDF

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 (CO_2) emissions attributed to traffic congestion at 56 billion pounds – about 380 pounds per auto commuter [3].

↑ top

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

↑ top

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.

Topic Areas

Sample Topic Area Report

http://www.itsknowledgeresources.its.dot.gov/its/bcllupdate/ArterialTrafficControl/

Home | Benefits Database | Costs Database | Lessons Learned | Applications Overview | Deployment Statistics | Contact Information

BCLL Update

Knowledge Resources Home > 2014 BCLL Update Report > Aterial Management: Traffic Control

ITS Benefits, Costs, and Lessons: 2014 Update Report

Download Full Report

View Fact Sheets

Arterial Management

- Surveillance
- Traffic Control
  - Adaptive Signal Control
  - Advanced Signal Control
  - Variable Speed Limits
  - Bicycle & Pedestrian
  - Special Events
  - Eco-Signal Priority
  - Eco-Traffic Signal Timing
- Lane Management
- Parking Management
- Information Dissemination
- Enforcement

Highlights

- Adaptive Traffic Signal Systems coordinate control of traffic signals across a signal network, adjusting the lengths of signal phases based on prevailing traffic conditions.
- SPaT applications, used in the connected vehicle environment, have the potential to increase safety, mobility, and reduce environmental impact at traffic signals.
- Improved traffic signal control continues to be one of the most cost effective ways to

Arterial Management: Traffic Control

Benefits | Costs | Lessons Learned | Case Study

Download PDF

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.

Traffic signal control systems are the primary tools used to manage the flow of traffic on arterial street systems. The primary objectives of these systems are to improve traffic flow, reduce traffic delays, and increase safety. Adaptive signal control systems coordinate control of traffic signals along arterial corridors, adjusting the lengths of signal phases based on prevailing traffic conditions. Advanced signal systems allow proactive traffic management by allowing traffic conditions to be actively monitored and archived, and may include some necessary technologies for the later development of adaptive signal control. Coordinated signal operations across neighboring jurisdictions may be facilitated by these advanced systems. Other related systems can be used to improve the safety of all road users at signalized intersections, including pedestrian detection, specialized countdown signal heads, and bicycle-actuated signals.

Connected vehicle technologies are facilitating research in new advanced signal systems. The Intelligent Transportation System (ITS) Joint Program Office's (JPO) Dynamic Mobility Applications (DMA) program is researching advanced signal operations under the Multi-Modal Intelligent Traffic Signal System (MMITSS) research bundle. One significant outcome from this research area is the Intelligent Traffic Signal System (ISIG) application.

This application uses high-fidelity data collected from vehicles through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications as well as from pedestrian and non-motorized travelers. This ISIG application seeks to control signals and maximize flows in real time. The ISIG application also plays the role of an overarching system optimization application, accommodating transit or freight signal priority, emergency vehicle preemption, and pedestrian movements to maximize overall network performance.

Benefits

↑ top

Benefits

Arterial management systems manage traffic along arterial roadways, employing traffic detectors, traffic signals, and various means of communicating information to travelers. These systems make use of information collected by traffic surveillance devices to smooth the flow of traffic along travel corridors. Advanced signal systems include coordinated signal operations across neighboring jurisdictions, as well as centralized control of traffic signals which may include some technology applications for the later development of adaptive signal control.

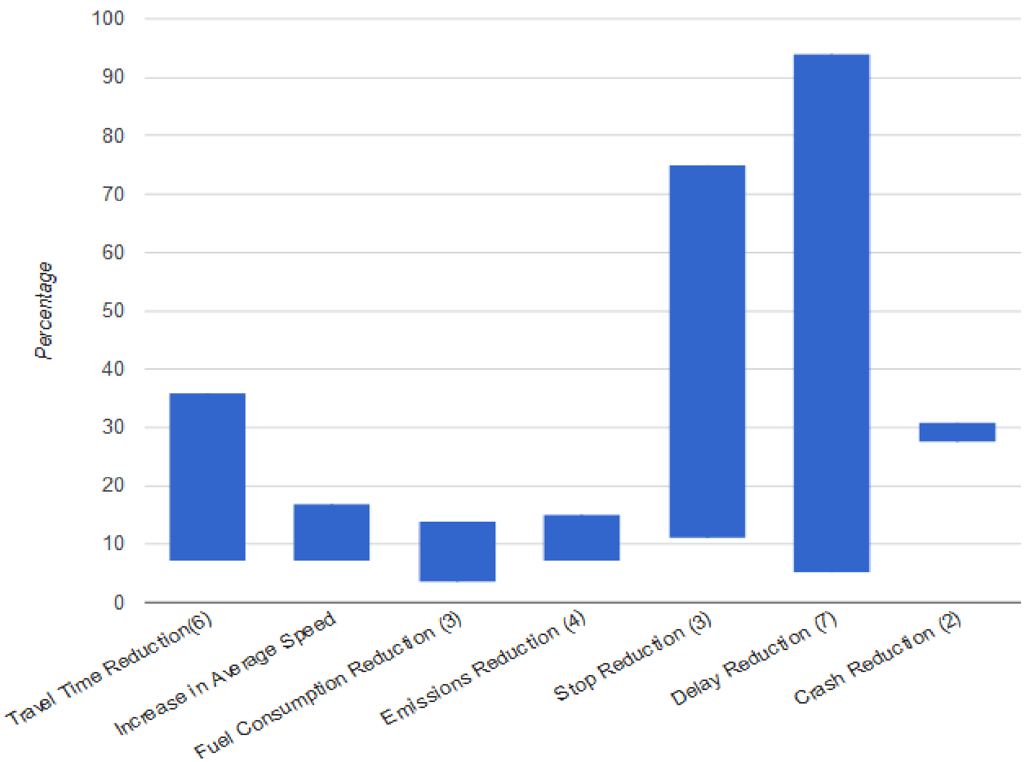


Figure 1: Advanced Signal Control benefits found in the Knowledge Resource database from 2003 to 2013 (Source: ITS Knowledge Resources).

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.

Costs

↑ top

Costs

ITS Knowledge Resources Database provides a variety of system costs for traffic control strategies including advanced and adaptive traffic control systems. As technology for adaptive traffic control systems continues to improve and mature, the costs to implement such systems continue to go down.

Adaptive signal control technologies (ASCTs) have been proven effective in providing operational benefits, but agencies in the United States have been slow to adopt these technologies. One of the major reasons for slow ASCT implementation is lack of knowledge about the operational and safety benefits and costs of ASCT. A nationwide report found that the cost of ASCT per intersection was estimated between $46,000 and $65,000. Excluding the outliers, with seven agencies reporting, the average cost to implement ASC technologies averages to $28,725 per intersection to implement. The average cost of ASCT was given by the type of system as well as the type of detection technology. The average cost of ASCT per intersection was highest when used with video detection and lowest when used with magnetometer detection technology. (2013-00278)

Table 2 provides system costs on a per intersection basis derived from several projects across the country. Details for each of these projects can be found in the ITS Knowledge Resources Database.

Table 2: Adaptive Signal Control Project Costs

Project Date	Total Project Cost	Number of Intersections	Cost per Intersection	Region	Cost ID
January 2013	$28,725	1	$28,725 (Average based on responses from 8 agencies)	Nationwide	2013-00278
July 2012	$176,300	8	$22,037	Colorado	2012-00273
July 2012	$905,500	11	$82,318 (Includes infrastructure upgrades)	Colorado	2012-00272
2010	$65,000	1	$65,000	Nationwide	2012-00249
2010	$1,708,029	18	$94,890 (includes infrastructure upgrades)	Georgia	2011-00237

↑ top

Lessons Learned

Lessons Learned

Commit to acquiring the proper level of staffing and knowledge required for the operations and maintenance of Adaptive Traffic Control System (ATCS) prior to deployment.

Adaptive Traffic Control Systems (ATCSs) are powerful and complex tools that require a level of expertise for proper maintenance and operations. While ATCS may be viewed as a labor-reducing way of deploying signal timing plans, the experience of domestic and international ATCS agencies demonstrates the importance of having the level of staffing and knowledge in ATCS required for maintenance and operations. Key recommendations for ATCS agencies to consider in training, operations, and maintenance include the following:

- Beware of the perception that an ATCS is a hands-off type of system that will lower the labor or expertise requirements compared to standard traffic control systems.
- Be certain to receive ATCS training not only during the initial deployment of ATCS, but continuously throughout initial validation to solve operational problems or issues as they arise.
- Develop a working understanding of the principles of an ATCS.
- Beware that implementing successful ATCS operations may require a switch in the type of labor from maintenance to operations.

ATCS deployments can bring significant benefits to traffic performance, but it requires a commitment to training and acquiring proper levels of staffing for operations and maintenance. ATCS operations are sufficiently complex that traffic engineers, in general, need at least four to six months to acquire a general understanding of these systems (in contrast to an experienced signal timing engineer who needs about two months). Indeed, one of the most important ATCS issues for smaller agencies is retaining ATCS-proficient staff. Acquiring the proper knowledge and technical expertise to operate an ATCS empowers an agency to maintain the system and realize substantial benefits to users of the transportation network in which it is deployed. (2012-00619)

Case Study

↑ top

Case Study – Eco-Traffic Signal Timing: Preliminary Modeling Results

The AERIS Eco-Traffic Signal Timing application is envisioned to be similar to current traffic signal systems; however the application's objective is to optimize the performance of traffic signals for the environment. The application collects data from vehicles, such as vehicle location, speed, and emissions data using connected vehicle technologies. It then processes these data to develop signal timing strategies focused on reducing fuel consumption and overall emissions at the intersection, along a corridor, or for a region. The application evaluates traffic and environmental parameters at each intersection in real-time and adapts so the traffic network is optimized using available green time to serve the actual traffic demands while minimizing the environmental impact. (2014-00912)

Methodology

Preliminary simulation and modeling was conducted for this application using a 6 mile segment of El Camino Real in Northern California. The corridor contains 27 signalized intersections operating actuated coordinated signal timing plans; however for the purposes of this analysis, the baseline conditions assumed fixed timing plans. The modeling team used a genetic algorithm to optimize the traffic signal timing plans for the corridor with the objective of reducing fuel consumption and emissions. The genetic algorithm determined an optimal cycle length for the corridor, green times for each phase, and signal offsets for each signalized intersection. Phase sequences were not changed. To determine the optimal timing plans, outputs from the Paramics microsimulation model were sent to an API that interfaced with the Environmental Protection Agency's MOtor Vehicle Emissions Simulator (MOVES) model. Traffic and emissions outputs from Paramics and MOVES, respectively, were then sent to the genetic algorithm which developed new timing plans. These new timing plans were then sent back to Paramics and the process continued for numerous iterations until the genetic algorithm determined an optimal timing plan that reduced CO_2 emissions for the entire corridor. Sensitivity analysis included varying the following parameters: penetration rate of connected vehicles, congestion levels, percentage of trucks, and optimizing for emissions versus delay. The method used to determine optimized timing plans for this study considered an offline optimization approach. More advanced connected vehicle applications and algorithms may perform the optimization online, similar to adaptive signal control systems but leveraging connected vehicle data and technologies.

Conclusions

- There is up to 5% improvement in fuel consumption and environmental measures at full connected vehicle penetration, while a 1% to 4% at partial connected vehicle penetration in a fully coordinated network.
- Optimizing for the environment resulted in a 5% fuel consumption reduction, whereas optimizing for mobility resulted in 2% reductions in fuel consumption.
- Driving a typical vehicle 8,000 miles per year on arterials equates to $70 of savings per year per vehicle.
- SUV (lower MPG) savings are $110 per year per driver.
- A fleet operator with 150 vehicles would save $16,500 per year.

Utilizing Google Graphs

http://www.itsknowledgeresources.its.dot.gov/its/bcllupdate/ArterialTrafficControl/

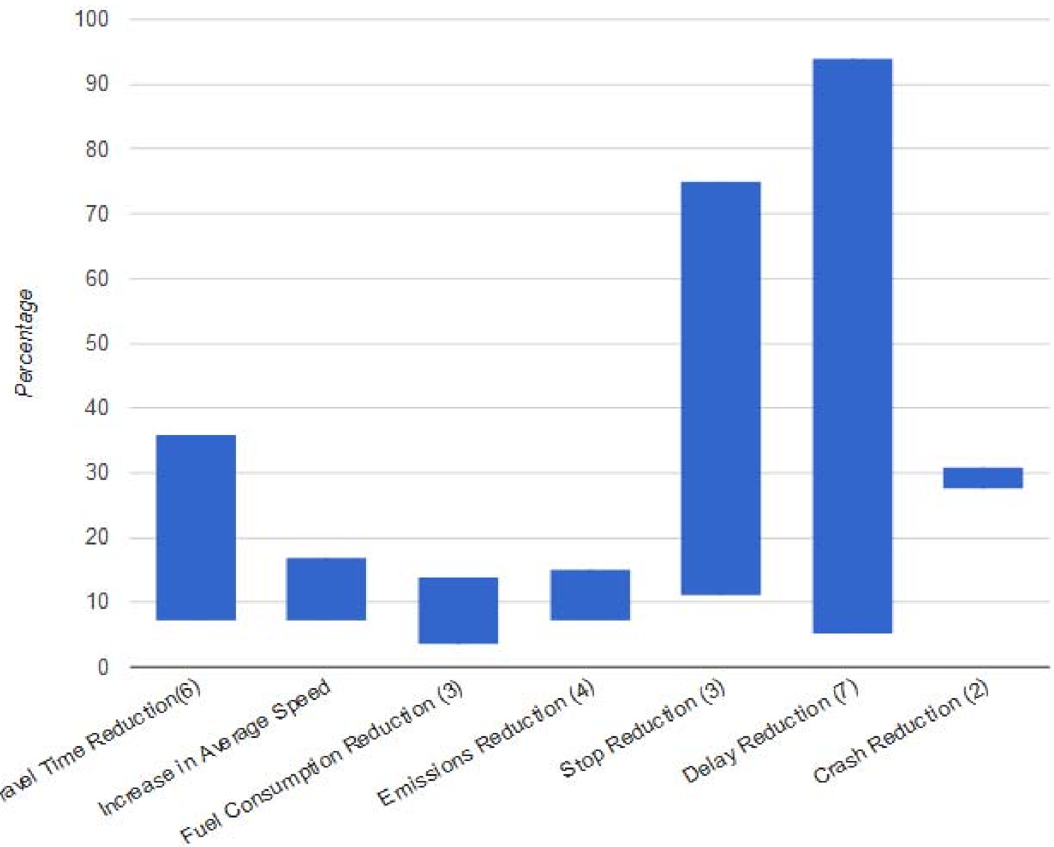


Figure 1: Advanced Signal Control benefits found in the Knowledge Resource database from 2003 to 2013 (Source: ITS Knowledge Resources).

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.

Benefit Entries Composing Graph

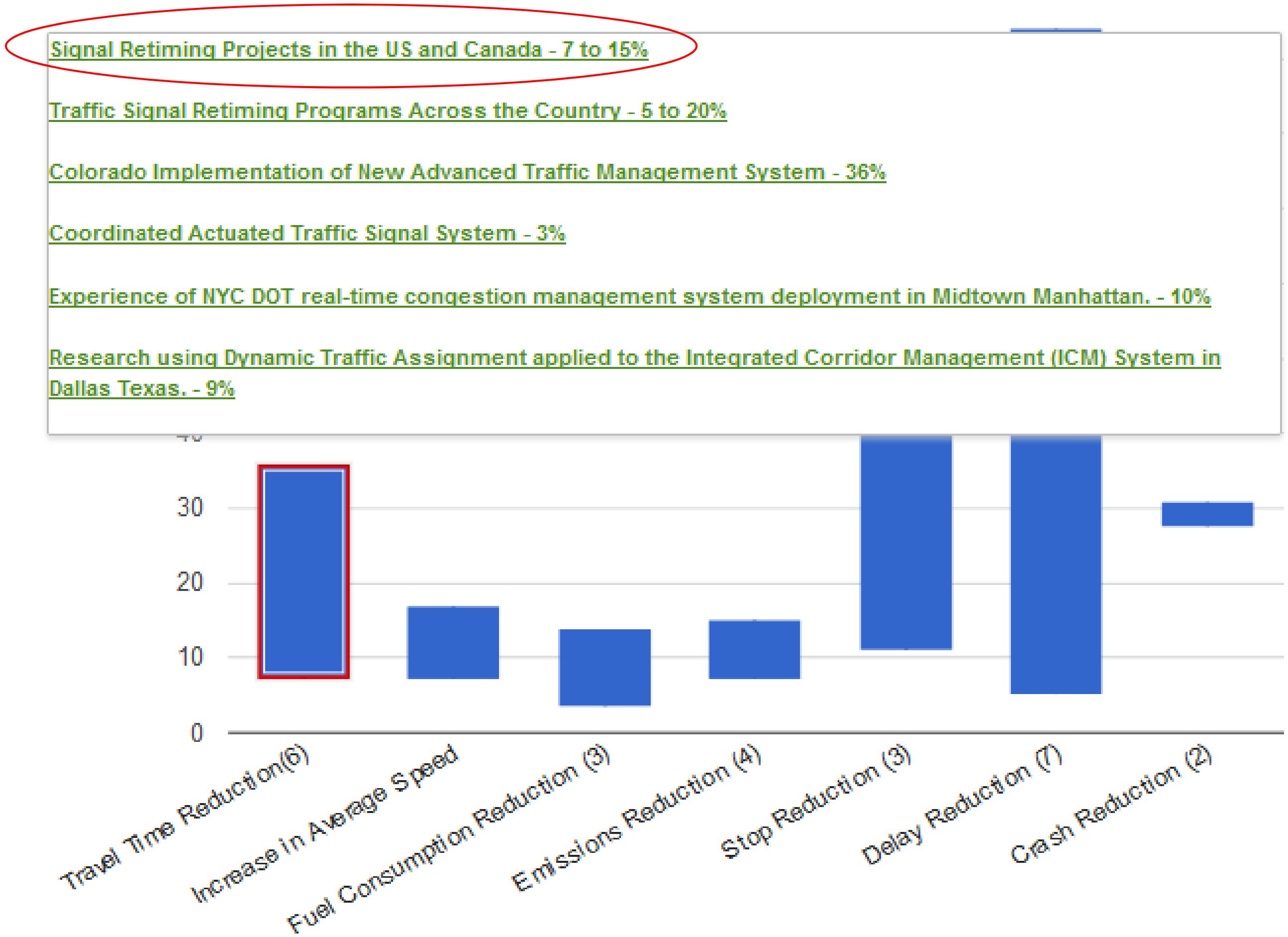


Figure 1: Advanced Signal Control benefits found in the Knowledge Resource database from 2003 to 2013 (Source: ITS Knowledge Resources).

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.

Selected Benefit Summary

http://www.itsbenefits.its.dot.gov/its/benecost.nsf/ID/97F8C11DD155DCCD852575D10069682F?OpenDocument&Query=Home

Home | Benefits Database | Costs Database | Lessons Learned | Applications Overview | Deployment Statistics | Contact Information | BCLL Update

Knowledge Resources Home > Benefits Database > Search >> Summary

Search

Enter Keyword

in Benefits GO

Benefits Database

- Overview
- About Benefits
- Browse Benefits
- Map Benefits
- Latest Updates
- Frequently Asked Questions
- Available Documents
- Links

Submit Your Data

Please share any documentation that you may have regarding benefits and costs of ITS.

Contribute now!

Need Help?

Contact Information

Website User Guide

Benefit

In Espanola, New Mexico the implementation of a traffic management system on NM 68 provided a decrease in total crashes of 27.5 percent and a reduction in vehicle delay of 87.5 percent.

New Mexico Implmentation of a Traffic Management System

September 2, 2008
Espanola; New Mexico;
United States

E-mail | Post a Comment

Summary Information

In 2008, the evaluation was completed for the new traffic management system in the City of Espanola, New Mexico, implemented in June 2006. The system consists of eight signalized intersections on NM 68 and deployment included new traffic signal controllers and cabinets, new video detection equipment, a fiber optic communication system, a wireless communication system, traffic management system hardware and software, and system integration. The traffic management system connects to a traffic operations center located at the New Mexico Department of Transportation general office in Santa Fe. The system has expansion capabilities of at least 30 additional intersections.

RESULTS

Prior to signal system improvements, the eight project intersections operated independently. Before/after data collection and analysis was performed for evaluation purposes. After the system was deployed , in 2006, the traffic management system benefits included:

- a decrease of 27.5 percent in total crashes compared with previous years.
- a reduction in vehicle delay of 87.5 percent, improving the level of service (LOS) on NM 68 from a LOS F to a LOS A.

The system has had a positive impact on travelers and indirect impacts include a reduction in vehicle emissions and energy consumption.

Benefit Comments

No comments posted to date

Source

NM 68, Riverside Drive City of Espanola, New Mexico ITS Project Final Evaluation Report

Author: Remkes, C., Montoya, M., Magno, C.

Published By: FHWA

Source Date: September 2, 2008

EDL Number: 14464

Rating

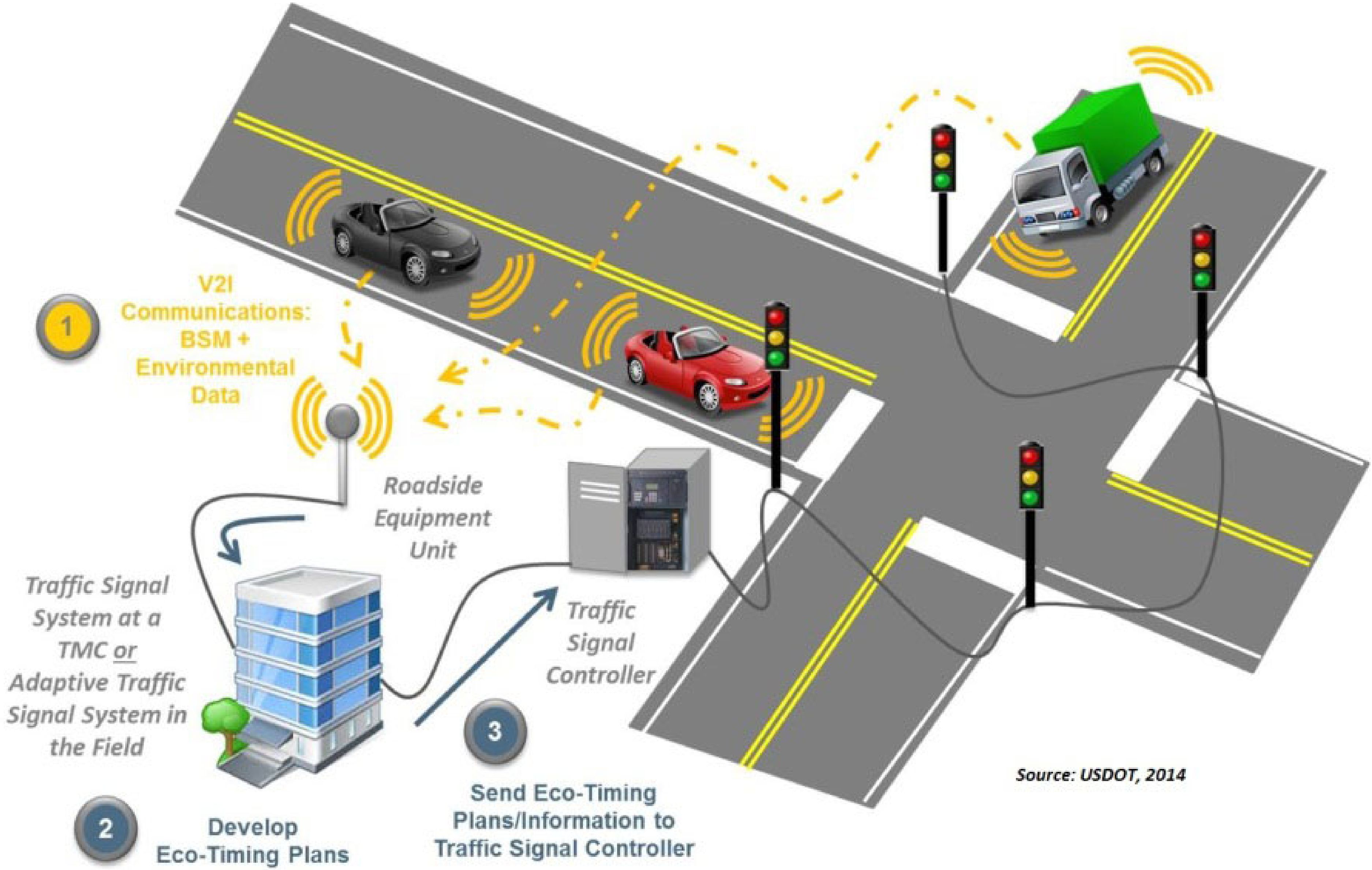
Average User Rating

1.6 (5 ratings)

Rate this Benefit

(click stars to rate)

BCLL Fact Sheet Graphics



PDF Versions of Fact Sheets

http://www.itsknowledgeresources.its.dot.gov/its/bcllupdate/factsheets/