Driver Assistance: Navigation / Route Guidance, Driver Communications, and In-Vehicle Monitoring

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

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.

Driver assistance refers to a collection of capabilities and associated technologies to help augment key driving tasks, such as navigation, speed control, and parking. This fact sheet focuses on in-vehicle mobility assistance:

- In-vehicle navigation and route guidance systems with global positioning system (GPS) technology may reduce driver error, increase safety, and save time by improving driver decisions in unfamiliar areas.
- Integrated communication systems that enable drivers and dispatchers to coordinate re-routing decisions on-the-fly can also save time and money, and improve productivity.
- On-board monitoring systems track and report cargo condition, safety and security status, and the mechanical condition of vehicles equipped with in-vehicle diagnostics. This information can be presented to the driver immediately, transmitted off-board, or stored. In the event of a crash or near-crash, in-vehicle event data recorders can record vehicle performance data and other input from video cameras or radar sensors to improve the post-processing of crash data.

Benefits

In-vehicle navigation systems with GPS technology may reduce driver error, increase safety, and save time by improving driver decisions in unfamiliar areas. The systems may be linked to traveler information services to provide updated routing instructions that account for current and predicted traffic conditions.

Over the past decade, on-board and portable navigation systems have frequently been purchased and used by drivers to assist with driving directions and routing around congestion. Combining navigation systems and traveler information can create powerful tools to assist drivers.

Eighty-three percent of the audible alerts received by drivers were rated as either good or neutral, and only 13 percent were rated as bad. The alerts enhanced drivers’ situational awareness and improved safety on freeways.
The tables below show the benefits of these technologies in reducing fuel consumption and vehicle emissions.

Table 1: Benefits of Navigation/Route Guidance.

<table>
<thead>
<tr>
<th>ITS Goal</th>
<th>Selected Findings</th>
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| Energy & Environment          | In the Buffalo-Niagara region of New York, a green routing system for passenger vehicles showed:  
  - An average Carbon Monoxide (CO) emissions reduction of 16.77 percent, with only a 3.33 percent increase in the average travel time when the route was based on CO reduction.  
  - When the route was based on reducing Nitrogen Oxides (NOx), a 19.47 percent decrease was seen, with an 11.04 percent increase in travel time.  
  - When the route was based on reduced fuel consumption there was an average decrease of 5.55 percent gallons of gasoline used with a 12.7 percent increase in travel time (2013-00866).  
  For a long haul truck case:  
  - An 18.65 percent reduction in CO was seen with a 2.46 percent increase in travel time (2013-00866). |
| Energy & Environment          | Eco-routing features that assist drivers with navigation can improve fuel economy by 15 percent by identifying more fuel efficient routes and save them up to 30 percent in mileage when searching for a parking space when appropriate information is provided. Overall, combining multiple eco-driving applications was projected to reduce fuel consumption by 20 percent.  
  AVL systems can help commercial motor vehicles find more efficient routes which in effect can reduce VMT. An AVL/OBD technology solution identified eliminated 44,000 pounds of greenhouse gas emissions annually from the City of Napa’s vehicle fleet. (2012-00791) |

Table 2: Benefits of Driver Communication.

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| Energy & Environment          | A modeling study found that alerting drivers to the status of upcoming traffic signals led to smoother decelerations to the intersection.  
  Results showed that the drivers alerted to the red signal 360 m (1200 ft) ahead of the intersection reduced fuel consumption and CO₂ emissions by up to 40 percent for passenger vehicles and 38 percent for pick-ups and SUVs at the posted speed limit of 65 km/h (40 mph). (2011-00751) |
| Safety Customer Satisfaction  | Audible "slow traffic ahead" alerts can improve drivers’ situational awareness and increase safety on freeways.  
  The metric measuring variability in speed as drivers approached a queue supported the test hypothesis and confirmed that during the alert week, drivers experiencing the alerts exhibited smoother driving profiles.  
  When the system worked as intended, 83 percent of the alerts received by drivers were rated as either good or neutral, and only 13 percent were rated as bad. (2013-00823) |
| Energy & Environment          | Commercial motor vehicles (CMV) can use Access Management applications such as Pre-Pass to improve motor carrier safety and efficiency. These systems allow participating transponder-equipped commercial vehicles to bypass designated inspection stations and continue to move freight and reduce shipment times. In 2009, Pre-Pass saved an estimated 21 million gallons of fuel for commercial vehicles. (2012-00791) |
Table 3: Benefits of In-Vehicle Monitoring.

<table>
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<tbody>
<tr>
<td>Safety</td>
<td>Participating drivers from two motor carriers (identified as Carrier A and Carrier B) drove a vehicle equipped with a Driving Behavior Management System (DBMS) for 17 consecutive weeks while they made their normal, revenue-producing deliveries. For severe safety-related events, a 59.1 percent reduction in mean rate of severe safety-related events per VMT was observed at Carrier A and a 44.4 percent reduction was observed at Carrier B. (<a href="#">2011-00698</a>)</td>
</tr>
<tr>
<td>Productivity</td>
<td>By using an In-Vehicle Data Recorder (IVDR) to enable pay as you drive (PAYD) car insurance, drivers can save up to 60 percent on their car insurance premiums. A Brookings Institution study estimates that 63.5 percent of all households would experience savings with PAYD insurance, and such savings would amount to an average of $270 per vehicle and $496 per household, among households that do save. (<a href="#">2011-00717</a>)</td>
</tr>
<tr>
<td>Energy &amp; Environment</td>
<td>Idle-off stop-start systems integrated into vehicle designs can also be monitored by fleet management systems to reduce truck emissions up to 83 percent at truck rest stops. (<a href="#">2012-00791</a>)</td>
</tr>
</tbody>
</table>

**Costs**

**Costs and Outlook of On-Board Equipment for Connected Vehicles ([2013-00288](#))**

Respondents of the Connected Vehicle (CV) Technology Industry Delphi study overwhelmingly reaffirmed the consensus that Dedicated Short Range Communication (DSRC) is needed for cooperative, active safety systems, while third generation (3G) and fourth generation (4G) cellular communications tend to be thought of as appropriate for other applications.

DSRC was commonly viewed as being standard equipment by 2017. The majority think the applications will be built-in by that point. Below are consensus unit costs to include on-board DSRC equipment in vehicles:

- **Cost to Vehicle Manufacturers of Embedded DSRC** - In both rounds of the study, when asked how much it will cost vehicle manufacturers (in US$) to add a DSRC radio as embedded equipment, respondents gave a median response of $148 to $175 for 2017 and $73 to $75 for 2022. The second round means were $148 for 2017 and $73 for 2022.

- **Cost Added to Base Vehicle Price for Connected Vehicle Technology** - Regarding what connected vehicle technology will add to the base cost (in US$) of a new vehicle for the consumer, the median in both rounds was $350 for 2017 and $300 for 2022. The second round means were $335 for 2017 and $260 for 2022.

- **Consumer Cost to Add DSRC as Aftermarket Equipment** - The cost to the consumer (in US$) to add DSRC as aftermarket equipment, had a media estimate of $200 for 2017 and $75 for 2022. The second round means were $233 in 2017 and $113 in 2022.

**Lessons Learned**

**Consider New Approaches to Address Distracted Driving when Designing and Developing ITS Applications ([2013-00651](#))**

The SafeTrip-21 Initiative advanced knowledge and technological solutions to reduce distracted driving. The U.S. DOT tested a variety of technologies in a number of locations in California as well as along the I-95 corridor on the east coast. Below are some of the lessons learned during the evaluation of the SafeTrip-21 Initiative that focused on improving safety with the deployment of these applications:
• Assess vehicle location, speed and direction along with the ability to predict potential driving path conflicts and transmit alerts to the driver to provide needed capability to minimize driver distraction.

• Communicate alerts designed to orient drivers to general traffic conditions ahead, and therefore, make them more attentive to the driving environment to help reduce driver distraction.

• Use "Geofencing" as an approach to limiting driver distraction.

• Continue to explore avenues for advancements in technology to prevent driver distraction as well as instilling a safety culture mindset to support the goal of a change in driver behavior.

### Case Study – Crash Avoidance Metrics Partnership (CAMP) Driver Acceptance Clinics [1]

From August 2011 through January 2012, the Crash Avoidance Metrics Partnership (CAMP) held driver acceptance clinics to introduce drivers to vehicle-to-vehicle communications aimed at reducing traffic accidents and saving lives.

The clinics were held in six different locations around the country: the Michigan International Speedway, Brainerd International Raceway in Minnesota, Walt Disney World Speedway in Orlando, FL, the Virginia Tech Smart Road, the Texas Motor Speedway and Alameda Naval Air Station.

The clinics used 24 vehicles from eight participating automakers, each with its own system to provide safety information to drivers. The systems used sounds, lights, displays, and seat vibrations to alert drivers of various threats. A total of 688 drivers tested several scenarios that involved applications of connected vehicle technology including:

- Emergency electronic brake lights
- Forward collision warning
- Blind spot warning/ lane change warning
- Do not pass warning
- Intersection movement assist
- Left turn assist

### Results

- More than four out of five participants, or 82 percent, strongly agreed that they would like to have vehicle-to-vehicle safety features on their personal vehicle.

- In addition, more than 90 percent of the participants believed that a number of specific features of the connected vehicle technology would improve driving in the real world, including features alerting drivers about cars approaching an intersection, warning of possible forward collisions, and notifying drivers of cars changing lanes or moving into the driver's blind spot.

- In 12 focus groups held with 96 participants, the most common reaction to the technology was that saving a life or many lives far outweighs the potential drawbacks of dependency, complacency or over-reliance on the technology.

### References


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