Transit Management: Operations & Fleet Management

ITS Benefits, Costs, and Lessons Learned: 2017 Update Report

U.S. Department of Transportation

Transit Management

Operations & Fleet Management
- AVL/CAD
- Transit Signal Priority
- Planning
- Service Coordination

Information Dissemination
Transportation Demand Management
Safety and Security

Highlights

- Nationwide, transit signal priority systems have demonstrated travel time savings of 2 to 20 percent.
- Fleet tracking systems can address "bus bunching" by reducing large headway gaps by 40 percent.
- Coordinating demand response transportation across funding groups can increase the average number of passengers per revenue hour by up to 10 percent.

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.

In 2014, Americans took 10.8 billion trips on public transportation, which is the highest annual public transit ridership number in 58 years [1]. Though riders may be drawn to a public transportation for many reasons, they remain loyal to systems that are reliable and efficient. Transit operations and fleet management systems can help improve service reliability; decrease running time; reduce bus delays at intersections, missed trips, and allow for increased service without additional staff or vehicles.

The utilization of ITS for improving operations and fleet management in the transit industry has become widespread, with automated vehicle location (AVL), computer-aided dispatching (CAD), and transit signal priority (TSP) all now mature technologies. In 2015, 92 percent of fixed-route buses in the United States had AVL systems installed, an increase from just 59 percent in 2008 [2]. AVL data now provides the input into real-time traveler information systems and archived AVL data are inputs into the service planning and scheduling processes. The use of CAD and scheduling software have improved efficiency and reliability for both fixed-route and paratransit service. These tools have also improved the ability for transit agencies to coordinate their services. Transit Signal Priority (TSP) is also gaining in popularity as cities begin to recognize that improved bus service can encourage mode shift away from personal vehicles to transit, without large negative impacts to traffic traveling in the cross direction of bus routes with TSP.

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Benefits

A comprehensive TCRP report from 2010 on TSP provides a set of benefit ranges that may be experienced by an agency deploying TSP based on case studies from a few dozen cities. Transit travel time savings experienced were between 2 and 18 percent, with Los Angeles and Chicago seeing 7.5 and 15 percent decreases, respectively. Decrease in bus delay is heavily dependent on the priority guidelines set by the agencies, and thus has a wider range experienced by the cities examined for the report. Overall, agencies indicated that bus delay was reduced between 15 and 80 percent. Los Angeles had a 35 percent decrease in bus delay at intersections, while Oakland had a decrease of 5 seconds per intersection (2013-00847). Similar results in transit travel time savings were also experienced on Staten Island in New York, where signal priority along a 2.3 mile corridor led to 17 percent transit travel time savings (2013-00856). As part of a pilot test in Minneapolis, Minnesota, the University of Minnesota demonstrated a new TSP algorithm that lead to travel time savings of between 2.6 and 6.4 percent (2012-00814).

A TSP system in San Antonio has earned an ITE Transportation Achievement Award for its innovative use of "virtual" GPS-based detection zones.

The San Antonio region's first bus rapid transit (BRT) line – the VIA Primo – became operational in 2012 and featured a TSP solution that earned the system a Transportation Achievement Award by ITE. The first of its kind in the U.S, the Primo BRT system's TSP element uses "virtual" GPS-based detection zones that do not require emitters at every intersection. The virtual zones provide flexibility as they can be easily adjusted in response to changes in traffic flow due to special events or construction. Since its inception, the BRT system's TSP feature has helped the Primo vehicles adhere to their schedules and has reduced total travel times by 15-20 percent (2015-01005).

Figure 1 shows ranges of benefits for select entries in the ITS Knowledge Resource database at: http://www.itsknowledgeresources.its.dot.gov/. Benefits of TSP systems include travel time savings, and reduced delay for buses at intersections.

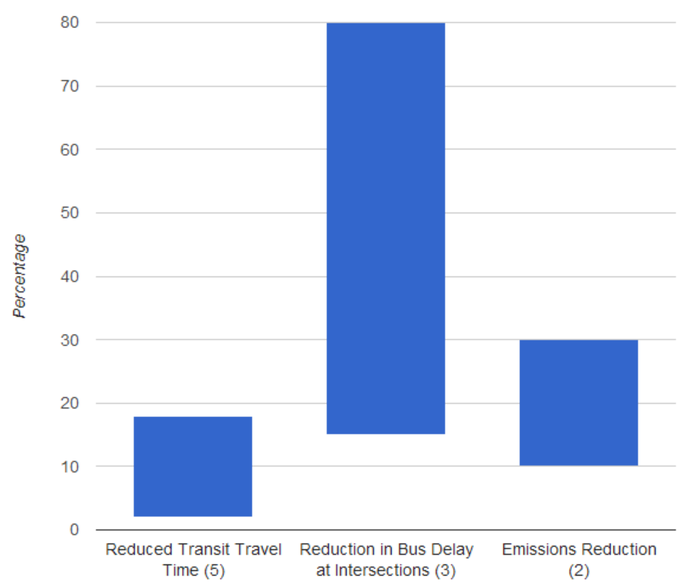

Figure 1: Benefits of Transit Signal Priority Systems (Source: ITS Knowledge Resources).

The online versions of the factsheets feature interactive graphs that contain all the data points included in the ranges. Here, 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.

"Bus bunching" is another issue facing city transportation networks. In 2015, the Chicago Transit Authority (CTA) implemented the Bus Transit Management System (BTMS) in an effort to address the long waits that were resulting from uneven bus headways. The system featured a new two-way bus communication system between drivers and the CTA control center, allowing the control center to more precisely monitor how the vehicles are spread out by tracking speed changes and pushing alerts to drivers when necessary to adjust the route accordingly. Testing showed significant improvement to bus service, with bus "big gaps"— defined as larger-than-scheduled periods of time between buses — on nine of the busiest South Side bus routes having dropped an average of nearly 40 percent (2016-01127).

Costs

The cost of deploying an AVL system for a vehicle fleet ranges from $10,000 to $20,000 per vehicle (2009-00190). Cellular or radio communications costs also need to be considered when deploying AVL systems because it is used for location "polling". TSP emitter costs can range from $50 to $2,500 per vehicle, with TSP detectors ranging from $2,500 to $40,000 depending on whether or not the existing signal controller is new enough to have TSP added or if new signal controllers need to be installed (2013-00286, 2008-00155).

Software and hardware costs for retrofitting the 1,800 CTA buses with the Bus Transit Management System mentioned in the previous section were estimated at $8.8 million (2016-00369).

Oakland, California's AC Transit recently upgraded the District's CAD/AVL system to replace an old system run on unsupported software and aging servers. In addition, the new system provides voice, data and text communications with the Operations Control Center (OCC), a real-time passenger information system, and a vehicle safety solution that permits the OCC to disable a coach in the event of unauthorized use or other incident. The system cost $21.1 million to implement for a fleet size of approximately 575 vehicles (2016-00368).

In a similar AVL system upgrade, the city of Markham, Canada proposed a system that included an in-house technology platform designed to communicate with the vehicles through a vehicle on-board computer, which has been further integrated to communicate with in-vehicle devices such as salt-spreaders, proximity switches, pressure sensors, RFID readers and more. The solution also included a back-end service with specialized reports to meet customer requirements. Hardware, software, and labor components for wireless data and voice communication functions totaled $164,058 for the first year for a fleet of 265 vehicles. The maintenance contract for the entire fleet was estimated to cost $64,719 per year (Canadian dollars) (2014-00303).

Lessons Learned

In an NCHRP synthesis that documented the practice associated with designing, implementing, and operating ATM on arterials, the Utah DOT and the San Francisco Metro Transit Authority (SFMTA) detailed their experience with implementing TSP around Salt Lake City and in the Bay Area. While the transit industry tends to deploy customized solutions to meet each specific agency's needs, the following lessons learned from Utah DOT and SMFTA can be generally applicable to the development and deployment of other TSP systems. (2016-00744)

- Placement of TSP activation detectors is important; ensure any priority maximizes benefit to transit vehicles while minimizing delay to others.
- Not all signals need the same amount of priority. A more balanced approach for all users could be allowing less priority at major intersections and more at minor intersections. The theory was that a little more delay for the transit vehicle at major intersections is fine if they will move faster through the minor ones.
- Do not neglect associated maintenance. There is more than the initial capital cost of the system. If a system is not maintained, it will not work.

Case Study – Mobility Services for All-Americans (MSAA) Coordination Simulation Study

The concept that coordinating demand-response services across agencies and funding sources results in better and more efficient services is widely accepted. However, quantitative analysis on the benefits of coordination was lacking. This study simulated three levels of coordination using actual trip data from two rural demand-response transit agencies in North Carolina and South Carolina (2013-00888). The authors utilized the funding sources to categorize trips into three groups: Medicaid, aging-related (Aging), and other.

The simulation tested three coordination scenarios: Some Coordination, More Coordination and Full Coordination. Some Coordination only coordinates trips within each of the three funding categories. Passengers with trips classified as "Aging" can only ride on vehicles assigned to the Aging group and with other Aging passengers. Passengers in the Medicaid and Other groups are assigned with similar restrictions. More Coordination simulates the effect of a Medicaid brokerage model, where Medicaid trips are scheduled separately from all other trips (Aging and Other trips and vehicles are combined). Full Coordination allows any trip from any funding category to be scheduled on any available vehicle.

The analysis used scheduling software to automatically optimize scheduling of trips. The results show a reduction in both total revenue distance and total revenue hours ranging from 7 to 13 percent when comparing the Some Coordination scenario to the Full Coordination scenario. Additionally, the average number of passengers served per revenue hour increased by approximately 10 percent. These efficiencies gained from greater coordination of trips would allow the agencies to serve a greater number of passengers without needing to increase their staff or number of vehicles.

References

[1] Miller, Virginia. Transit News Press Release, "Record 10.8 Billion Trips Taken On U.S. Public Transportation In 2014." American Public Transportation Association. March 2015. http://www.apta.com/mediacenter/pressreleases/2015/pages/150309_ridership.aspx

[2] Dickens, M. Trends in Public Transportation Vehicle Fleets. Passenger Transport. 2015. http://www.apta.com/passengertransport/PT/Passenger%20Transport_Dec_21%202015_vehicle%20database.pdf

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

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