Transportation Management Centers

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

Transportation Management Centers

Temporary TMCs

Permanent TMCs

Highlights

- New technologies and tools will need to continue to be integrated into TMCs including ICM strategies and decision support, social media, crowdsourcing, and connected vehicle data.
- Benefits of TMCs can be seen in safety, mobility, and the environment across all functionalities.

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.

Transportation or traffic management centers (TMCs) or transportation operations centers (TOCs) are an integral part of a transportation system. TMCs are responsible for operating the latest Intelligent Transportation System (ITS) technology including data collection, command and control of ITS devices, incident response, and communication for transportation networks. As deployments of ITS have increased over the last decade, state DOTs are continuing to implement TMCs to focus on the operations of their systems. TMCs are the focal point for agencies as they look to operate their transportation systems as efficiently as possible with the existing ITS infrastructure. New concepts are leading to the more effective use of the conventional ITS devices in the field.

Recent initiatives and concepts such as Integrated Corridor Management (ICM) and Active Traffic and Demand Management (ATDM) integrate more functionality into a single center for more responsive or even predictive traffic operation strategies. TMCs will be at the center of operating and maintaining these new systems. At the heart of ICM is a decision support system which consists of the set of procedures, processes, data, information systems, and people that support transportation system managers in making coordinated decisions to improve the collective performance of all transportation networks within a corridor. ICM seeks to integrate freeway, arterial, and transit systems together to make the entire transportation network more efficient.

Implementing Integrated Corridor Management (ICM) strategies on the U.S. 75 corridor in Dallas, Texas produced an estimated benefit-cost ratio of 20.4:1.

ATDM is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. Through the use of available tools and assets, traffic flow is managed and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency.

Under an ATDM approach, the transportation system is continuously monitored. Using archived data and/or predictive methods, actions are performed in real-time to achieve or maintain system performance. Both ATDM and ICM are being deployed across the country. Two U.S. DOT ICM Pioneer Demonstration sites (Dallas and San Diego) went live with systems in early 2013.

Other technology trends that are impacting TMCs are big data, social media and crowdsourcing, and the continual growth of mobile and wireless communications. TMCs are collecting more and more data every day with the potential for data directly from vehicles in the near future. Social media is being used more and more for traveler information, while crowdsourced data is being used to gather data from drivers to obtain travel times, incidents, and other roadway information from driver reports [1].

Smartphone applications are beginning to provide real-time individualized traveler information to users through crowdsourced data. These applications could be greatly enhanced with involment from TMCs by simply collecting and providing data to the applications and eventually the individual users. For example, data that in real-time can track the status of incidents on the roadway would be of great value to application developers and their end users [2].

Benefits

Benefits enabled by TMCs vary depending on the purpose and functionality of the TMC. Many TMCs are currently focused on freeway, arterial, or transit operations. Figure 1 shows ranges of benefits for select entries in the ITS Knowledge Resource database at: http://www.itsknowledgeresources.its.dot.gov/. Benefits can be seen with many different measures across multiple goal areas including mobility, safety, and the environment. In this case, TMC benefits include incident clearance time, delay reduction, queue reduction, crash reduction, and travel time.

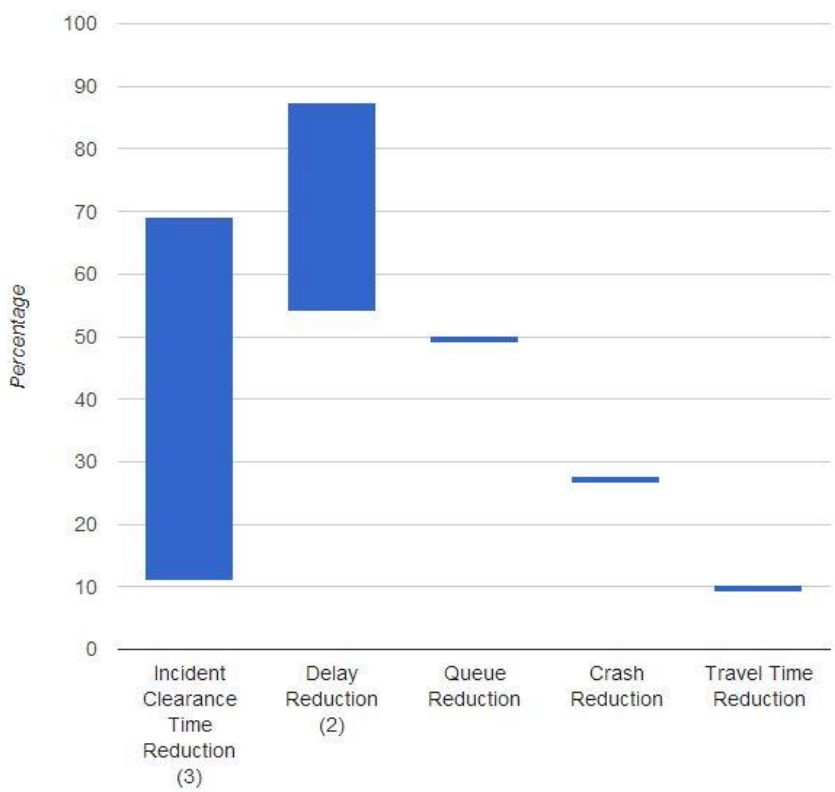

Figure 1: Range of Benefits for Transportation Management Centers (Source: ITS Knowledge Resources).

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 that there was only one data point.

The travel time reduction benefits in Figure 1 are based on an advanced traffic signal system in New York City. The key to this project was the adaptive decision support system that resided at a TMC facility for NYC. The system uses historic data as well as real-time conditions to determine the optimal operation of the signals. If a new plan is needed, it is presented to an operator for visual verification of conditions using the CCTV cameras before it is initiated. With this real-time congestion management system in place, NYC DOT was able to achieve 10 percent reductions in travel times through the initial corridor (2012-00810).

In a more recent study, system impacts were evaluated using a microscopic simulation model (VISSIM) to emulate traffic conditions on the I-95/I-395 corridor in northern Virginia. Applications and strategies investigated included variable speed limits, ramp metering, transit signal priority, HOT and HOV lanes, increased transit and parking capacity, and financial incentives in the form of reduced fees. Performance metrics measured with and without ICM included average vehicle flow, average travel times, average delays, and average emissions as agreed upon by corridor stakeholders. Simulation results indicated a comprehensive ICM program that promotes modal shift to transit on the corridor would reduce travel times in general purpose lanes by 58 percent and 48 percent during incident and non-incident conditions, respectively; have little impact on HOV lanes; and reduce overall travel times on a parallel alternate route (US-1) by 29 percent (2014-00932).

Costs

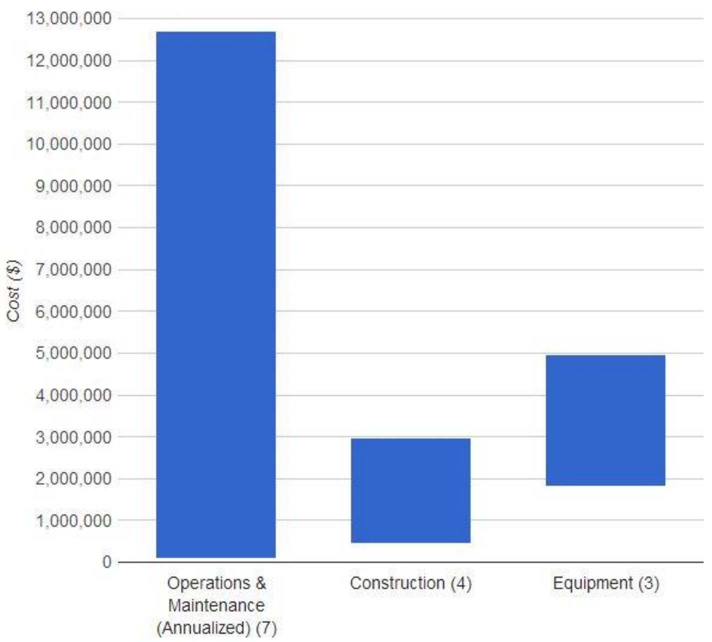

Figure 2: Range of Costs for Transportation Management Centers (Source: ITS Knowledge Resources).

TMCs are a critical component of the shift in emphasis of state DOTs from building infrastructure to managing and operating the existing systems. Operations and Maintenance (O&M) is one of the largest portions of a TMC cost, as shown in Figure 2. This column represents annual O&M costs as reported by seven agencies. The large range can be explained by size of the agency (statewide or local) as well as the TMC housing a single agency or integrating multiple agencies into a single TMC. Personnel costs are generally the greatest percentage of O&M costs. The construction costs in Figure 2 cover planning and building a TMC, and the equipment costs include general hardware such as computers, servers, and video walls.

Costs for TMCs vary dramatically depending on the functionality of the TMC, if it is a multi-agency or multi-jurisdictional TMC, level of ITS deployment required, and the communication costs. Regardless of the specific functionality, the highest portion of the cost of a TMC over its useful life will likely be in the Operations and Maintenance of the centers and its systems. For example, planners in Portland, Oregon have estimated the operational cost of a full-capacity regional transportation management center at approximately $36 million over a five-year period (2015-00339).

Lessons Learned

The report titled *Impacts of Technology Advancements on Transportation Management Center Operations* identifies many of the trends discussed in this fact sheet in TMC operations. The report lists several lessons to help TMCs move forward with new technologies and tools (2013-00642):

- **Develop a data fusion engine to merge data from multiple sources, such as travel time information coming from toll tag readers, Bluetooth sensors, and/or third party providers.** An automated data fusion engine is designed to integrate multiple forms of raw data from different types of sensors, process and arrange the data into subsets, and present them in a way that provides a clear, more accurate picture for the operator to draw conclusions from, creating situational awareness.
- **Develop procedures and protocols for use of social media.** Develop a uniform policy for DOT use of social media, such as Facebook, Twitter, and video distribution platforms such as YouTube, among others. Social media can provide an important connection to users to disseminate travel warnings and alerts, as well as promote projects or public interest campaigns.
- **Support two-way information exchange via social media.** Social media can provide a valuable tool to reach out to travelers and residents, but also can provide an important source of data for the TMC.

- **Utilize crowdsourcing for traffic information, incident information, and feedback on department performance, pavement roughness, etc.** Crowdsourcing would enable real-time feedback from users on a variety of transportation issues and impacts, with an emphasis on crowdsourced information.

Case Study – TRANSCOM's DFE-SPATEL Data Analysis Tool

TRANSCOM is a coalition of 16 transportation and public safety agencies in the New York, New Jersey, and Connecticut Tri-State region. It was created over thirty years ago to provide a cooperative, coordinated approach to regional transportation management in order to improve mobility and safety for the traveling public across the region. Through its Operations Information Center (OIC), TRANSCOM collects and disseminates construction and incident real-time information to and from 100 data centers across the region. Additionally, TRANSCOM's OpenReach System incorporates data from all 16 member agencies (and many other affiliates) into a single platform to support coordination and enhanced operational and situational awareness. Information provided includes: highway and transit incidents, construction, and special events data; real-time travel times and speeds; closed circuit TV feeds; variable message sign (VMS) locations and messages; and highway advisory radio (HAR) locations. It is also the source of 511 traveler information.

The DFE/SPATEL tool generates a regional view of roadway and transit conditions every 2 minutes and develops measures for reporting.

To support the processing and accuracy of various overlapping data feeds, TRANSCOM developed the Data Fusion Engine (DFE). The DFE receives and analyzes public agency data from travel time measurement devices (e.g., loops, TRANSMIT, Bluetooth, GPS, Navtech) used by its partner agencies. It also uses data from private vendors, such as HERE's feed of real-time travel speeds. This type of private data enhances arterial coverage that may not be covered by public sensors or instrumentation. The DFE collects real-time and historical information from including:

- Events: incidents, construction, special events (highway and transit)
- Roadway: travel times, speed, and volume
- Transit: trip times, vehicle location, and stop arrival/departure times

In an effort to attain its strategic goals and enhance coordination, TRANSCOM developed a web-based data analysis tool around its DFE called Selected Priorities Applied to Evaluated Links (SPATEL) tool (a.k.a. DFE/SPATEL). The DFE/SPATEL tool consists of thirteen distinct tools and applications that provide utility to a cross section of users within member agencies. The DFE references a regional network model (links, nodes) of over 250,000 links and generates a normalized aggregated regional view of roadway and transit conditions every 2 minutes. In coordination, SPATEL supports ongoing operational needs of member agencies using historical data archives and develops performance measures for planning and federal reporting.

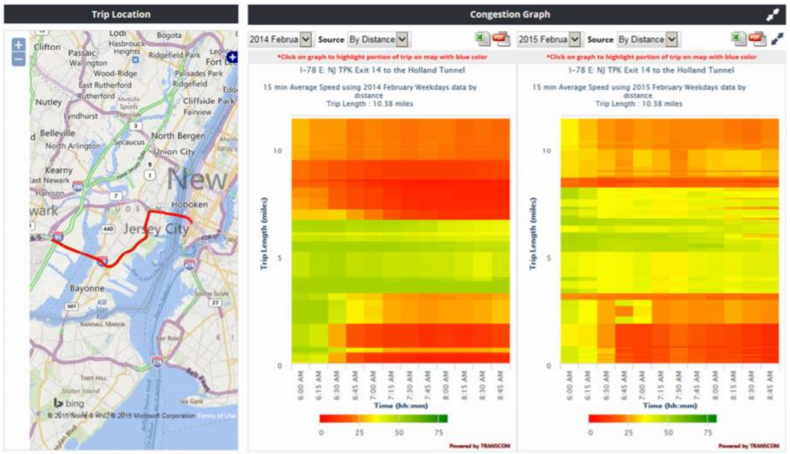

Figure 3: DFE-SPATEL Trip Map and Congestion Graphs

(Source: TRANSCOM).

The Historical Travel Time Analysis Tool was used to assess whether using the shoulder and lane control signal provided travel time improvements during the Pulaski Skyway Reconstruction. Overall, SPATEL was able to demonstrate that the opening of an additional lane saved approximately 2.5 minutes of travel time over the 3 hour period. The result is a concrete measure of benefits, justifying the relatively minor additional cost for O&M of the lane signal on the shoulder.

References

[1] Federal Highway Administration, "Impacts of Technology Advancements on Transportation Management Center Operations", January 2013. http://www.ops.fhwa.dot.gov/publications/fhwahop13008/fhwahop13008.pdf

[2] Intelligent Transportation Systems Joint Program Office, *Transportation Management Center Data Capture for Performance and Mobility Measures Reference Manual*, March 27, 2013. http://ntl.bts.gov/lib/47000/47500/47563/FHWA-JPO-13-055_Final_Pkg_508.pdf

[3] Intelligent Transportation Systems Joint Program Office, "Longitudinal Study of ITS Implementation: Decision Factors and Effects", April 2013. http://www.its.dot.gov/research/pdf/longitudinal_study.pdf

[4] TRANSCOM. "An Introduction to TRANSCOM's DFE/SPATEL Data Analysis Tool (Draft White Paper V0.4)", June 2015. http://isgnew.infosenseglobal.com/white-paper/TRANSCOM-DFE-SPATE.pdf

[5] NYCDOT and NYSDOT. "ICM-495 Technical Memorandum: Corridor Operating Conditions, Inventory, and Needs (COIN)", June 10, 2016.

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