



Mainstreaming TSMO Through Collaboration With Information Technology: Experiences From Pennsylvania

INTRODUCTION

This case study describes how the Pennsylvania Department of Transportation (PennDOT) transformed the relationship between transportation systems management and operations (TSMO) and information technology (IT). This increased collaboration enabled PennDOT to move from a self-contained intelligent transportation systems (ITS) program to a more collaborative, mainstreamed TSMO program.

TSMO applies operational improvements to maximize the transportation system performance of existing transportation facilities and stretch limited funding. TSMO is a set of strategies that enables transportation agencies to implement low-cost solutions, balance supply and demand, provide flexible solutions to meet changing conditions, and benefit more areas and customers. TSMO benefits can include improved safety and reliable traffic flow, which result in reduced congestion, better quality of life, less wasted fuel, cleaner air, and economic advantages.

DEFINITION OF MAINSTREAMING TSMO

Mainstreaming TSMO within an organization makes management and operations strategies readily understood, considered, attractive, and available to relevant agency leadership and staff regardless of where they sit in the organization. Mainstreaming formalizes a TSMO program through comprehensive collaboration among a broad group of transportation management stakeholders (e.g., State and local DOTs, cities, counties, metropolitan planning organizations [MPOs], transit authorities, first responders, law enforcement, and legislators). This allows input based on knowledge, skills, and techniques from individuals in all programs that have a stake in improving the multimodal transportation system. Success in TSMO is not dependent on just one champion.

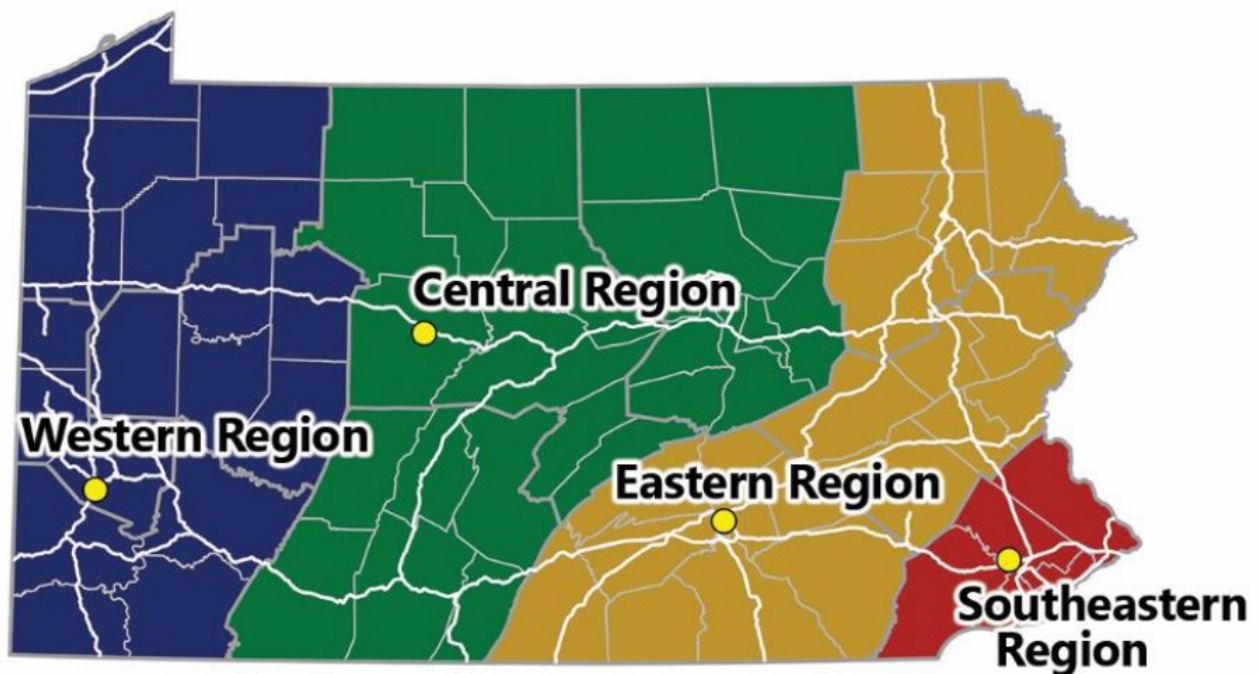
RATIONALE FOR MAINSTREAMING

Mainstreaming TSMO helps transportation agencies align, rather than compete, across programs to accomplish long-term system performance goals for the transportation system. Mainstreaming TSMO integrates a broader range of strategies throughout transportation departments and related agencies and organizations. It engages planners, designers, operators, and construction and maintenance staff, and it touches all aspects of mobility, including congestion, air quality, sustainability, safety, security, reliability, and related quality-of-life concerns. The goal of mainstreaming is to routinely include TSMO strategies as an equal player to address transportation needs within a community or region, along with other options to improve transportation system performance.

This case study focuses on removing the institutional barriers between TSMO and IT to improve the efficiency, security, and effectiveness of the ITS solutions underpinning TSMO strategies. Many TSMO strategies benefit from or even rely on ITS technology for effective implementation because ITS enable monitoring, situational awareness, real-time adjustments, and response to changing conditions and disruptions. TSMO staff need not only typical IT services but also unique technology support for many TSMO services they provide to customers and use to safely manage and operate the transportation system. Many of these services are critical and are provided in realtime, and technology disruptions can quickly impact safety and travel. Strengthening the connections between TSMO and IT can improve understanding of respective needs and facilitate solutions that enable and increase capabilities for delivering TSMO while meeting IT objectives.

TSMO AT PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

PennDOT has an active and maturing TSMO program housed in its Highway Safety and Traffic Operations Division. Elements of the TSMO program are also spread across PennDOT's 11 districts and 4 operating regions (figure 1). Each region operates a regional traffic management center.



Source: Pennsylvania DOT, 2018, *TSMO Strategic Framework for Pennsylvania*.

Figure 1. Pennsylvania Department of Transportation (DOT) regional traffic management center regions.

The program's primary TSMO business areas¹ are:

- Inclement weather
- ITS and traffic signals
- Work zones
- Traffic incidents
- Special events
- Bottlenecks
- Traffic management centers
- Traveler information
- Connected/autonomous vehicles

In 2018, PennDOT laid out the State's direction for TSMO in the *TSMO Strategic Framework for Pennsylvania*. That same year, PennDOT published the *TSMO Program Plan for Pennsylvania* to communicate its approach for achieving the vision set forth in the *TSMO Strategic Framework for Pennsylvania*. PennDOT has also published several in a series of TSMO guidebooks to clarify how TSMO will be integrated into the DOT's planning, operations, design, and maintenance processes. Regional operations plans have also been developed in each of PennDOT's four TSMO planning regions.²

INFORMATION TECHNOLOGY SERVICES IN THE COMMONWEALTH OF PENNSYLVANIA

In 2017, Pennsylvania began centralizing all its State IT resources. Prior to 2017, each agency in the State had in-house IT bureaus. During the centralization, PennDOT reassigned IT staff to the Office of Administration. Most of the IT staff that had been a part of PennDOT before the transformation remained colocated with PennDOT staff and continued to support the agency. Although the reassignment did not significantly change the nature of IT support for PennDOT, funding transferred to the Office of Administration to provide for the revised IT support structure.

Information technology support for the business functions of PennDOT and other State agencies is centralized under the IT services division of the Governor's Office of Administration. These IT services are organized under various delivery centers that support different State agencies. The Infrastructure and Economic Development Delivery Center serves PennDOT and supports the Pennsylvania Emergency Management Agency and the Department of Community and Economic Development. The delivery center employs approximately 10 to 12 staff members. Support from the IT staff members includes network systems support for the traffic management centers (TMCs), video sharing, and data analysis tool development.

¹ Pennsylvania Department of Transportation. n.d. "TSMO Business Areas" (web page). <https://www.penndot.pa.gov/ProjectAndPrograms/operations/Pages/TSMO-Business-Areas.aspx>, last accessed January 12, 2023.

² Pennsylvania DOT's TSMO documents can be accessed at <https://www.penndot.gov/ProjectAndPrograms/operations/Pages/default.aspx>.

COLLABORATION BETWEEN TSMO AND INFORMATION TECHNOLOGY

EARLY INTERACTIONS

The early years of TSMO saw little coordination between PennDOT operations staff and IT. The ITS program often planned, developed, and deployed ITS solutions in isolation, without consulting IT staff. This resulted in ITS deployments and TMCs that relied on incompatible systems and lacked communication with one another throughout the State. TSMO used incompatible technologies in part due to the lack of standards or communications protocols provided to contractors deploying ITS, which created operational inefficiencies. One clear example of such inefficiency was that staff needed to log in to over 20 different software packages to post a single message (e.g., an America's Missing: Broadcast Emergency Response (AMBER) Alert) on variable message signs across the State.

PennDOT's ITS program included a single IT staff member in the planning meetings for the development of its 2008 ITS strategic plan. The plan resulted in a list of ITS equipment that the ITS program wanted to deploy; however, neither the ITS nor the IT division had the staff capacity needed to effectively manage and support the proposed ITS expansion. This realization prompted both divisions to recognize the need for a more integrated planning process.

This realization led to the creation of the Intelligent Transportation Program in 2009, which enabled better ITS project coordination among divisions, including the Bureau of Maintenance and Operations, the Bureau of Planning and Research, PennDOT Information Technology division, the project management office, the districts, and the Pennsylvania Turnpike. In this new program, IT and ITS staff collaborated on every ITS project, and IT and ITS leadership met once per month to oversee projects. Projects with significant IT elements were managed by staff members from the IT division.

The ITS program helped clarify the roles of IT and ITS staffs in operations projects. ITS staff defined the needs and business requirements for managing the transportation system, and IT staff applied the expertise needed to meet the requirements. Both the IT and ITS communities acknowledged that they each had a stake in the deployment of ITS and that they needed to work together to be successful.

TSMO EFFORTS ADVANCED THROUGH COLLABORATION WITH INFORMATION TECHNOLOGY

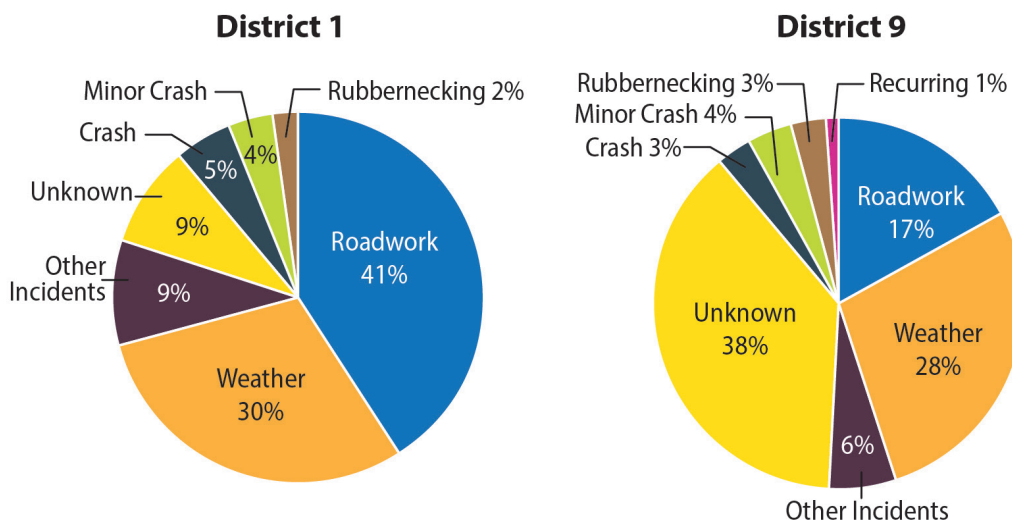
This section describes efforts to increase collaboration beyond ITS projects to include IT support for ongoing TSMO efforts.

*Interoperable Traffic Management Centers:*³ Previously, PennDOT had 11 districts, each responsible for traffic management on a 24/7 basis. Finding that a full-time traffic management center in each district was unnecessary, PennDOT established four regional TMCs throughout the State. This allowed regional TMCs to cover for other TMCs during off-hours, such as overnights, weekends, and holidays. This was a major effort by IT staff to enable TMCs to take over operations for one another. This effort strengthened network security, led to the development of a centralized platform and standardized video controllers and software, provided system interoperability, and enabled other PennDOT TMCs to control video cameras and ITS equipment. PennDOT is now working with Maryland and Delaware DOTs to share video across the States.

TMC interoperability provides system resiliency in case of power outages or other events. This work prepared the PennDOT TMCs to transition quickly to remote operations in response to the COVID-19 pandemic in early 2020. Collaboration with IT staff brought into focus procurement decisions and the need to manage the lifecycles of ITS devices in the field. When procuring technologies, such as traffic cameras, TMCs now consider the full lifecycle cost, including replacement timelines and updates to security standards. The IT staff helped TMCs better manage their existing equipment and make more informed procurement decisions.

Operational Performance Data Analysis: PennDOT TSMO staff work closely with IT staff, who have data science expertise to better understand transportation system performance and PennDOT's operations performance as an agency. IT staff help build data analysis tools to track how well TMCs are performing and identify challenges and opportunities to improve operations. With support from the IT staff, PennDOT developed State- and district-level congestion pie charts that identify the causes of congestion on Pennsylvania's core roadway network (figure 2). The data visualizations enable TSMO staff to better target investments for reducing congestion.

³ Tomlinson, D., B. Taylor, C. Shuey, B. Freeze, J. Kirk, and L. Jacobson. 2020. "Webinar Series, Part 1: Achieving Better Coordination Between Operations and IT." Presented at the National Operations Center of Excellence Webinar Series. Washington, DC: National Operations Center of Excellence.

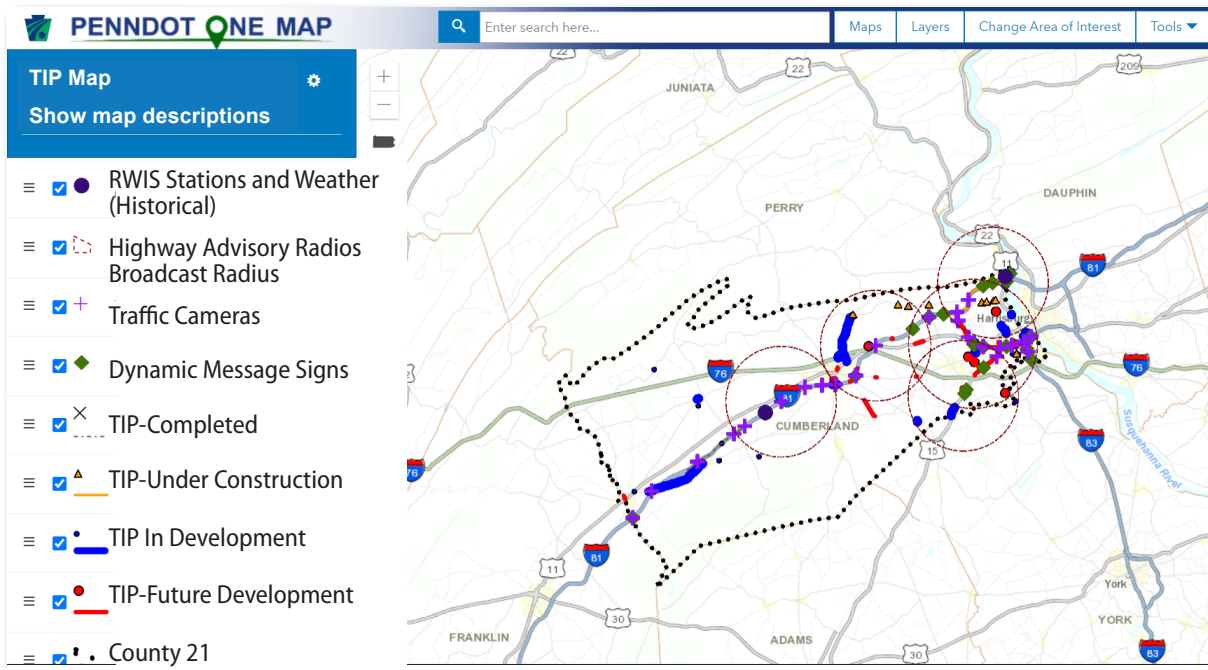


Source: Pennsylvania DOT.⁴

Figure 2. 2018 Congestion Pie Charts for Pennsylvania Department of Transportation Districts 1 and 9.

Pennsylvania IT staff also helped create One Map, a web-based geographic information system based mapping application for highway and bridge projects in Pennsylvania’s 12-Year Program and regional transportation improvement plans (figure 3). One Map allows PennDOT to use data layers to examine if-then statements and support TSMO planning decisions about locations and which operations tactics to use (e.g., placement of ramp meters and other ITS assets).

⁴ Pennsylvania Department of Transportation. n.d. “TSMO Business Areas” (web page). <https://www.penndot.pa.gov/ProjectAndPrograms/operations/Pages/TSMO-Business-Areas.aspx>, last accessed January 12, 2023.



PENNDOT = Pennsylvania DOT; RWIS = road weather information system.

Source: Pennsylvania DOT.

Figure 3. Pennsylvania Department of Transportation (DOT) One Map web application displaying intelligent transportation systems assets on road projects in its Transportation Improvement Program (TIP).⁵

With IT staff support, PennDOT also discovered that by combining data sources, it could identify up to 50 percent more traffic alerts to include on the dashboard TMCs use to identify incidents.

Signalized Corridor Connectivity: IT staff worked with PennDOT’s TSMO program to improve traffic signal connectivity on corridors. They created a standardized policy for signal technology and developed a central system for TMC command and control of signal systems. IT staff are connecting older corridor signal systems with existing corridors in the network. PennDOT has found that the traffic signal connectivity effort ensures consistency and improves the ability to effectively manage signals.

Fiber Optic Backbone Deployment: When PennDOT leadership decided to pursue future fiber-optic developments, TSMO and IT staff collaborated to define the fiber deployment plan. They brought in an expert consultant in fiber deployment to supplement the effort. The plan was a combined effort among the staffs from IT, ITS, and other relevant PennDOT stakeholders and became the backbone for identifying what the deployment will look like and what infrastructure is needed.

⁵ Pennsylvania DOT. n.d. “PennDOT One Map” (website). <https://gis.penndot.gov/onemap/>, last accessed June 29, 2021.

SUMMARY

During the past decade, the PennDOT TSMO program has gained clear benefits from building a collaborative relationship with the IT division. TSMO staff has come to recognize that IT staff bring an added skill set and can help achieve goals more efficiently. Likewise, the IT community also shifted its perspective from that of a gatekeeper to a problem-solver in support of mutual organizational goals. This change in viewpoint allowed the TSMO and IT communities to recognize the unique expertise and skills the other offered and move ahead by defining roles based on expertise.

The collaboration between TSMO and IT staffs in Pennsylvania improved the security and resiliency of the State's transportation system and DOT operations, enabled efficiency using interoperable systems, and saved PennDOT time and money. In addition, the IT staff applied their data science and analysis tool development skills to help TSMO managers better understand transportation system performance issues to make more informed planning and operations decisions. Ultimately, this relationship enabled PennDOT to make more effective use of its resources.⁶

NON-BINDING CONTENTS

Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. While this document contains nonbinding technical information, you must comply with the applicable statutes and regulations.

⁶ Additional information is available from FHWA on the coordination of IT and TSMO functions within transportation agencies. See https://ops.fhwa.dot.gov/plan4ops/focus_areas/integrating/it.htm.

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