District Department of Transportation

# DDOT TSMO Plan

## Transportation Systems Management & Operations in Washington DC

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District Department of Transportation

# DDOT TSMO Plan

## *Transportation Systems Management & Operations in Washington DC*

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# 1. Strategic Foundations

The U.S. Federal Highway Administration (FHWA) recommends Transportation Systems Management and Operations (TSMO) programs contain three elements: strategic, programmatic, and tactical [8] as shown in ***Figure 1***. The following plan builds off these elements. Section 1, Strategic Foundations, establishes TSMO's benefit on the District Department of Transportation (DDOT) and Washington DC., Section 2, The TSMO Program, outlines the organizational structure and business processes necessary to achieve TSMOs strategic goals and objectives. Section 3, Implementation and Deployment, guides the tactical implementation of the plan with specific on-the-ground services, processes, and programs.

Sections 1 through 3 have sub-sections which address programmatic categories, tactical services areas, current status, existing gaps, and recommendations. The recommended strategies all fall under eight objectives, which are aligned with the plan's strategic goals, mission and vision.


**Figure 1** | TSMO Plan Elements

On July 23rd and 30th, 2014 a TSMO Capability Maturity Self-Assessment Workshop (TSMO CMM) was conducted for the DDOT. The results are shown in **Table *1***. Which shows DDOT falls along all levels of the TSMO CMM Assessment.

**Table 1** | 2014 TSMO CMM Self-Assessment Workshop

| Dimension | Score | Level 1 — Performed | Level 2 — Managed | Level 3 — Integrated | Level 4 — Optimized |
|---|---|---|---|---|---|
| **Business Processes (Planning and Programming)** | 2.5 | | Consensus regional approach developed regarding TSMO goals, deficiencies, B/C, networks, strategies and common priorities | Regional program integrated into jurisdictions' overall multimodal transportation plans with related staged program | |
| **Systems & Technology** | 2.5 | | Regional ConOps and architectures developed and documented with costs included; appropriate procurement process employed | Systems & technology standardized and integrated on a regional basis (including arterial focus) with other related processes | |
| **Performance Measurement** | 2 | | Output data used directly for after-action debriefings and improvements; data easily available on dashboards | | |
| **Culture** | 1.5 | Individual staff champions promote TSMO – varying among jurisdictions | Jurisdictions' senior management understands TSMO business case and educates decision makers/public | | |
| **Organization & Staffing** | 3 | | | TSMO managers have direct report to top management; job specs, certification and training for core positions | |
| **Collaboration** | 3.5 | | | Rationalization/sharing/ formalization of responsibilities among key players through co- training, formal agreements and incentives | High level of TSMO coordination among owner/operators (state, local, private) |

Creating a TSMO Plan is DDOT's first step in developing an official TSMO Program and elevating the agency's TSMO functions now and into the future.

## 1.1. Definition of TSMO

TSMO takes a holistic view of transportation operations by promoting a set of strategies to improve reliability, safety, and efficiency across agencies and jurisdictions. TSMO incorporates both institutional and technological activities to increase workflow efficiency within and between stakeholder agencies [1].

TSMO proactively manages many transportation users' needs by:

- Influencing travel demand in terms of location, time, and intensity of demand.
- Managing traffic and transit overcrowding.
- Anticipating and responding to planned and unplanned events (e.g., traffic incidents, work zones, inclement weather, and special events).
- Providing travelers with useful traffic and weather information [1].

TSMO includes efforts to operate the multimodal transportation system and activities to manage travel demand, thus crossing over political, modal, and jurisdictional boundaries. TSMO expands beyond just roads by emphasizing the door-to-door experience, regardless of the modes of travel. TSMO requires agencies to holistically consider the impacts on the entire transportation system rather than just a single corridor. This involves coordination and collaboration among multiple stakeholders, such as federal, state, and local agencies, first responders, and the private sector to achieve seamless interoperability [23].

### 1.1.1. Related Concepts

#### 1.1.1.1. Active Transportation and Demand Management

TSMO employs many of the same goals and functional strategies as Active Transportation and Demand Management (ATDM), which "improves trip reliability, safety, and throughput of the surface transportation system by dynamically managing and controlling travel and traffic demand, and available capacity, based on prevailing and anticipated conditions, using one or a combination of real-time operational strategies", according to the FHWA [29]. There are three main approaches to ATDM: Active Traffic Management, Active Demand Management, and Active Parking Management. DDOT will strategically incorporate Active Demand Management by utilizing information and technology to redistribute travel across less congested periods and routes, thus influencing mode choices. DDOT will also leverage Active Parking Management strategies by dynamically managing parking facilities to optimize utilization of parking capacity while influencing travel behavior [29].

#### 1.1.1.2. Integrated Project Delivery

Integrated Project Delivery (IPD) and TSMO share similar objectives, to make the project delivery process open, collaborative, transparent, and integrated. Both IPD and TSMO emphasize all key stakeholders are engaged early in the process, information is openly shared, stakeholders demonstrate trust and respect for one another, risk is appropriately distributed, and team success is tied to project success. In addition, the goal of both frameworks is to design, build and operate projects and systems as efficiently as possible [1].

## 1.2. TSMO Business Case

TSMO manages the transportation network more efficiently, improving the reliability of travel and customer safety. In addition, it reduces congestion, resulting in less wasted fuel and cleaner air, saves travel time, improves quality of life, and increases economic vitality by providing reliable delivery of goods and services.

### 1.2.1. The Issues

Reliable transportation is essential for economic health, as businesses depend on predictable travel times for employee scheduling and deliveries. Idling in traffic costs the U.S. trucking industry over $7.8 billion annually. In 2017, Washington, DC was the 6th most congested city in the U.S., and 13th globally, according to INRIX's annual Global Traffic Scorecard. In 2017, INRIX estimated congestion cost the city $6.1 billion [10]. In addition, residents, employees and visitors depend on safe, efficient and reliable transportation options to get to and from work, home, and play.

Congestion takes two different forms: recurring congestion, and non-recurring congestion. Recurring congestion, otherwise known as bottlenecks, occur when travel demand exceeds capacity by time of day, route, or mode. Reducing recurring congestion requires influencing travel times, modes, and routes through strategies such as ATDM; new arterial management methods such as operations asset management and traffic signal timing; congestion pricing; and travel demand management (TDM) [30].

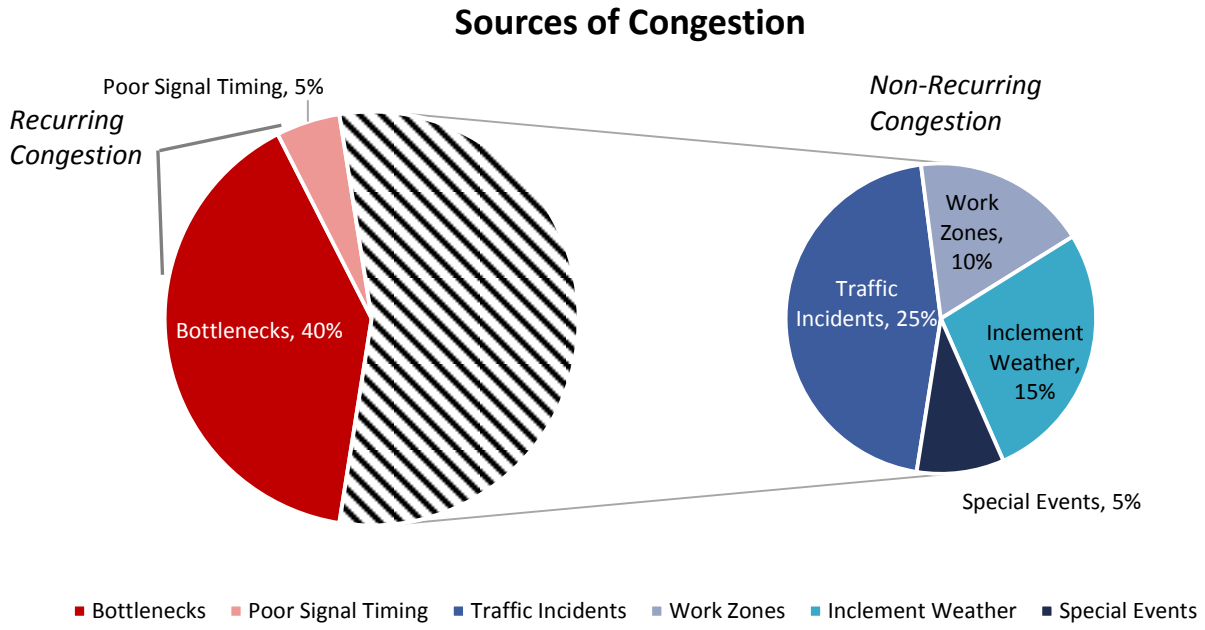


**Figure 2** | Sources of Congestion

Non-recurring congestion is caused by specific issues such as crashes, disabled vehicles, construction, adverse weather, and special events. Non-recurring congestion can be addressed through improved traffic incident management, work zone management, and road weather management. The FHWA estimates non-recurring events cause over half of daily congestion, as shown in **Figure *2*** [28]. In urban corridors, research has shown up to 70% of congestion is caused by non-recurring congestion. Traffic incidents account for approximately 25% of all congestion on U.S. roadways [22]. Incidents having longer duration are correlated with increased probability of secondary crashes. The likelihood of a secondary crash increases by 2.8% each minute the primary incident (both major and minor) continues to be a hazard. This increases the risk to drivers and responders and makes accessing the scene more difficult [11]. Further, every minute of blockage on a freeway travel lane increases delay after the incident is cleared by a factor of four [22].

Major traffic disruptions and emergencies draw significant attention, such as those caused by frequent WMATA Metrorail shutdowns and the crash on the Woodrow Wilson Bridge and transportation agencies are considered responsible. Operations teams often play a reactionary role when responding to events. Planning improvements and preparing for incidents and emergencies within the transportation network's operation is challenging.

Nationwide there is increased pressure for transparency, performance-based decision making, and demonstrated results. Accurate transportation system performance assessment requires data and analysis not broadly available at the planning and programming level.

Local governments are receiving diminishing federal transportation dollars due to declining fuel tax revenues and the depletion of the Highway Trust Fund making insufficient funding the new transportation reality. It is essential to manage the present system as efficiently as possible before adding new infrastructure.

### 1.2.2. The Context

The District's makeup, compared to other state-run DOTS has a unique and complex multimodal transportation system predicating the need for a robust TSMO program. DDOT is a state DOT serving city, county, and state functions, which adds additional roles and responsibilities to transportation operations. Tasked with serving the nation's capital, DDOT collaborates with many security and safety agencies to manage special events and incidents. These agencies include the National Park Police, the Capitol Police, the Metropolitan Police Department, Fire and Emergency Medical Services, DC's Homeland Security and Emergency Management Agency, and towing personnel.

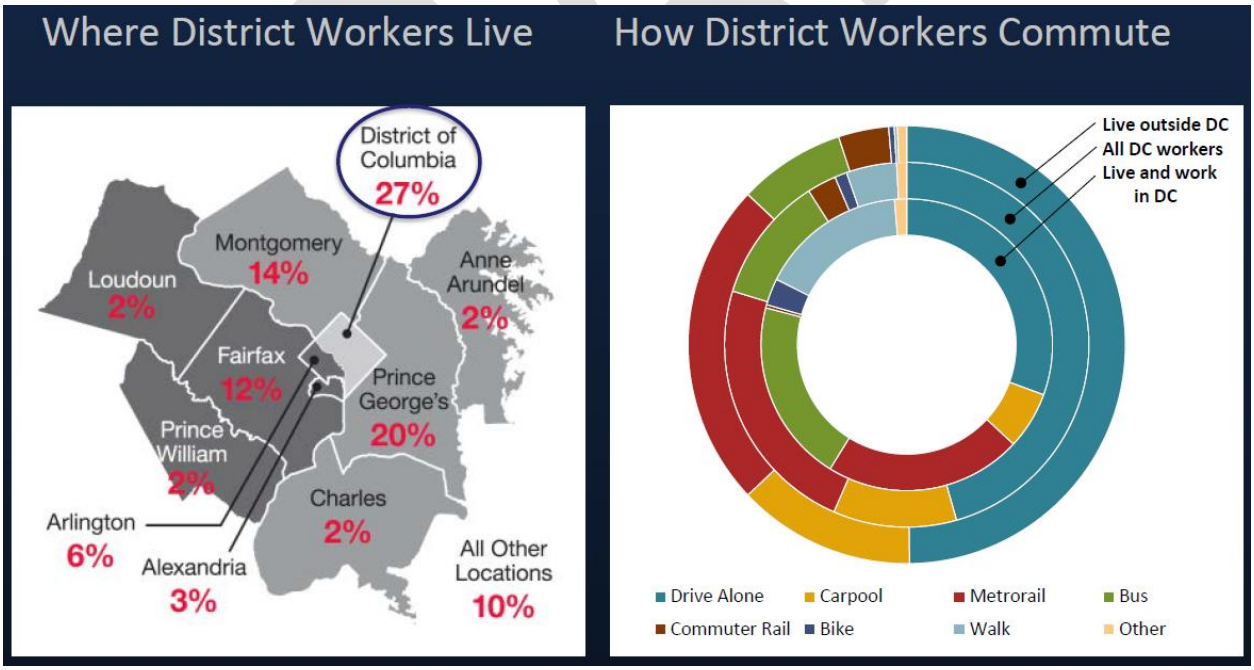


**Figure 3** | Home Counties and Commute Patterns of District Workers

The District serves a high proportion of out-of-state travelers, as shown in ***Figure 3*** being the seat of federal government. The city's population is approximately 700,000 but receives 500,000 daily commuters and 125,000 daily visitors, nearly doubling in size. Two out of three vehicles during rush hour periods are from out of state. One out of four vehicle trips entering the District are "pass through" trips, serving a destination outside of District boundaries. Because of this, DDOT's transportation operations must be accessible and interoperable across state lines. Regional coordination is key, with stakeholders including nearby city, county, state DOTs as well as local and federal security and safety agencies.

The District's transportation network is highly multimodal and has the 3rd highest percentage of non-single occupant vehicle mode share among U.S. cities. From 2007-2016, the District experienced the second-highest increase (over 5%) of commuters walking, cycling, or working from home of any U.S. city [16]. As of 2016, only 33% of District residents drove alone to work, and 37% of District households did not own a vehicle [19]. Because of this, unlike other state TSMO Programs, the District's cannot be vehicle-centric.

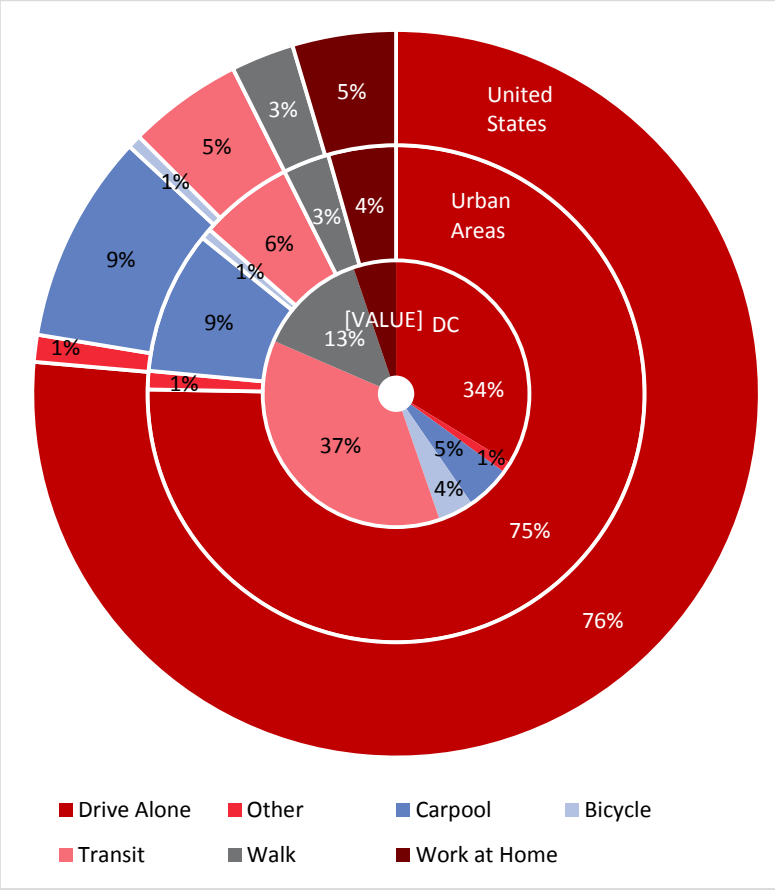


**Figure 4** | Comparison of Commute Mode Share for the United States, All Urban Areas and the District of Columbia [19]

According to averages from the 2012-2016 American Community Survey, the District's Median Household Income is $72,935, which is 32% higher than overall U.S. averages ($55,322). In addition, 55.4% of the population has a bachelor's degree or higher, compared to the national average of 30.3% [19]. The District's highly educated and compensated population lends itself to be technologically savvy. This customer base requires transportation agencies to provide a wide variety of real-time data, that is seamlessly integrated into smartphone applications and provide efficient, continuous, and personalized transportation options. Smart mobility will empower users to manage their travel experience from end-to-end by planning, booking, and paying for their trip through one outlet even if several providers are required to complete the journey. A recent Forbes

survey determined customers are ready to change their preferred mode of transportation and pay more to get access to digitally integrated technologies.

DDOT serves an arterial roadway system, unlike other state DOTs. There are only 15 miles of freeway within District boundaries, and most primary commute routes are along arterial streets. The District's characteristic requires DDOT to consider non-traditional TSMO strategies for complex arterial systems.

The District Mobility Project was developed in 2016 in response to the DC Council's request to assess the District's congestion for all surface modes and identify an actionable congestion approach. DDOT staff expanded the focus of the project to identify multimodal performance measures with reliable data sources and develop a data-driven framework for monitoring multimodal congestion and mobility in the District [4].

The District Mobility Project assessed measures of congestion, reliability, and accessibility. In analyzing the Travel Time Index (TTI) for the city, the researchers found traffic congestion worsens during weekday evening peaks, overall congestion on the roadway is dictated by arterial operations, and problem locations include the Key Bridge, Southeast Freeway, Chain Bridge, and New York Avenue NE. The report found strong correlation between TTI and Planning Time Index (PTI), because roads with high levels of congestion were also unreliable. Contributing to unreliable travel times are crashes and dignitary movements which require police escorts. The researchers found bus overcrowding is an issue on 40 routes during the morning peak period and 25 routes in the afternoon peak period. In the PM peak, average bus speeds are less than 10 mph, and in the downtown area are less than 5 mph. Buses arrived before their scheduled times during the AM, Midday, and PM Peaks, but later than the scheduled arrivals during the Early AM and Late-Night periods impacting their reliability. The 90 North from U St NW & 14th St NW to Calvert St NW & Biltmore St NW, and the W5 West from Anacostia Metrorail Station to St Elizabeth's Gate 4 had the most significant On-Time Performance issues. [4]. These components were combined with other measures to develop priorities for mobility, reliability and accessibility initiatives and projects in the District.

### 1.2.3. The Solution

TMSO solutions will help DDOT improve the mobility and reliability of the District's transportation network. Traffic incident management can decrease incident duration by 30% to 40% [25], in turn reducing congestion, and improving reliability and safety by reducing secondary crashes.

TSMO strategies are often less expensive than capital solutions and represent a cost-effective use of taxpayer funds. The cost of adding lanes to an existing highway can be more than 10 times the annual cost of effective management [24]. Traditional road capacity adding projects have lower cost benefit ratios than TSMO strategies, especially those targeting specific locations and types of congestion. For example, the Ohio-Kentucky-Indiana (OKI) Regional Council of Governments and the Metropolitan Planning Organization (MPO) for the Cincinnati, Ohio region, recently conducted a cost benefit analysis which compared updating their regional traffic management and traveler information program, known as ARTIMIS, to adding a lane project in the same region. The ARTIMIS cost benefit ratio was 12:1, while the Traditional Roadway Widening Project had a cost benefit ratio of 1:1, as shown in **Table *2*** [27].

**Table 2** | Comparison of the costs and benefits of ARTIMIS, a TSMO Project, with a Traditional Roadway Widening Project

| Selected Measure | ARTIMIS – TSMO Project | Added Lane Project |
|---|---|---|
| **Miles of improvements** | 88 | 10 |
| **Fatality accidents** | -3.2% | +0.3% |
| **Mobility (time savings)** | 500 Hours | 800 Hours |
| **Travel time reliability saving** | 6,900 Hours | 5,800 Hours |
| **Emissions** | -3.6% to -4.5% | +0.3% to +1.4% |
| **Estimated *Annual* Benefit** | $53 Million | $35 Million |
| **Total Project Cost** | $40 Million | $800 Million |
| **Benefit/Cost Ratio** | 12:1 | 1.1:1 |

In addition, a 2012 arterial management project in Florida and the Metropolitan Area Transportation Operations Coordination's (MATOC's) had a cost-benefit ratio of 10:1 [9].

TSMO and Integrated Project Delivery (IPD) emphasize the importance of early collaboration in the project delivery process with all stakeholders to increase the value of the asset, reduce waste, and maximize efficiency through all phases of planning, design, and construction. TSMO emphasizes the importance of integrating Operations and Planning in the project development process. The MacLeamy Curve, shown in ***Figure 5***, demonstrates the importance of a project delivery approach through IPD. Making design decisions earlier in the project development process allows stakeholder to maximize positive outcomes and minimize the costs of changes, particularly regarding designer and design consultant fees [1].

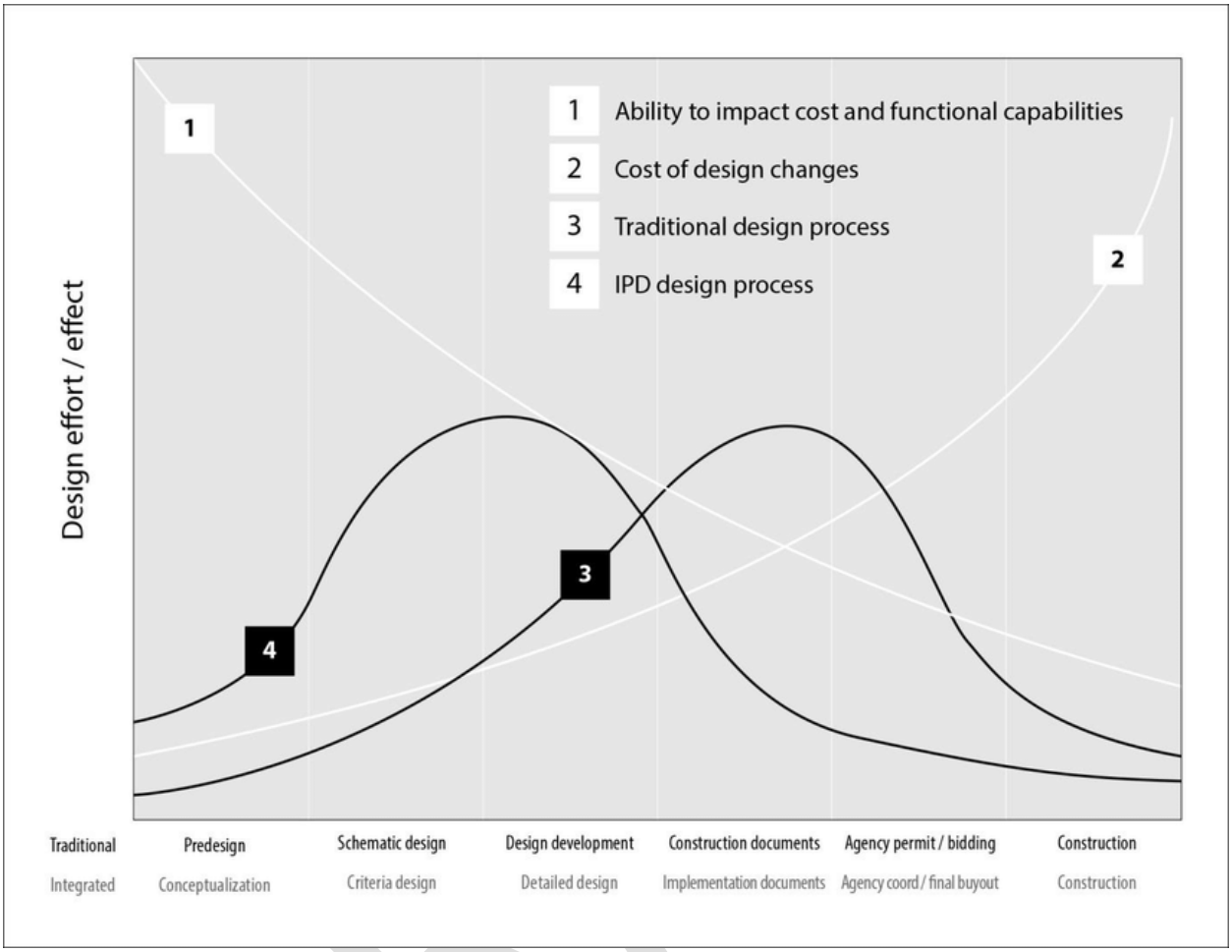


**Figure 5** | MacLeamy Curve - Effects of Moving Design Decisions Upstream in the Project Delivery Process [1]

TSMO solutions are effective in improving reliability and reducing congestion. Traffic signal optimization can decrease delay by 13% to 94% while improving safety at a fraction of the cost of infrastructure capacity expansion [25]. In a Utah VISSIM microsimulation model study, queue jumping and TSP led to a 13% to 22% reduction in BRT travel times, better corridor progression, lower intersection delays and number of stops, increased speeds (22%), and better travel time reliability and headway adherence [33]. Transit signal priority can yield a 2% to 18% saving in transit running time and reduce the number of buses needed in service [26]. Adaptive signal control, transit signal priority, and intersection improvements implemented during the Atlanta Smart Corridor project produced a benefit-to-cost ratio ranging from 23.2:1 to 28.2:1 [26].

Real time data from TSMO initiatives will better serve the District's unique context. TSMO plans focus on safety and maximizing existing transportation network efficiency, thus supporting high capacity multimodal modes.

## 1.3. TSMO Plan Purpose

The purpose of this plan is to articulate the benefits of TSMO throughout DDOT, define the Agency's TSMO strategic goals and objectives, link to other Agency plans and processes, and provide a road map to developing a TSMO program within DDOT. In addition, the plan outlines a 5-year implementation plan for initial TMSO program activities and services.

## 1.4. TSMO Vision and Mission

DDOT's TSMO vision and mission are designed to complement the Agency's vision and mission, both are provided in **Table *3***. DDOT's TSMO mission and vision were established using the Agency's to provide an overarching strategic direction.

**Table 3** | Overall DDOT and DDOT TSMO Vision and Mission Comparison [6]

| | TSMO | DDOT |
|---|---|---|
| **Mission** | Proactively operate a cohesive, sustainable transportation system that delivers safe and reliable movement of people and goods. | Develop and maintain a cohesive sustainable transportation system that delivers safe, affordable, and convenient ways to move people and goods—while protecting and enhancing the natural, environmental and cultural resources of the District. |
| **Vision** | The District Department of Transportation (DDOT) is committed to achieving an exceptional quality of life in the nation's capital by emphasizing safety, reliability and mobility in DDOT's transportation operations. | The District Department of Transportation (DDOT) is committed to achieving an exceptional quality of life in the nation's capital through more sustainable travel practices, safer streets and outstanding access to goods and services. Central to this vision is improving energy efficiency and modern mobility by providing next generation alternatives to single-occupancy driving in the city. |

## 1.5. Strategic Goals and Objectives

DDOT's TSMO strategic goals and objectives focus on outcomes for system users, implementing the TSMO mission and vision. These goals and objectives were derived from a variety of District plans and documents, including the District Mobility Report, DC's Vision Zero Plan, the Sustainable DC Plan, and

*MoveDC,* the District of Columbia's Multimodal Long-Range Transportation Plan. The TSMO goals and objectives align with those in *MoveDC*, as shown in ***Table 4*** and ***Figure 6***.

**Table 4** | moveDC Strategic Goals and Objectives [7]

**Citywide Accessibility and Mobility: Maximize system reliability and capacity for moving people and goods**

- *Increase the person-carrying capacity of the transportation system*
- *Improve system reliability*
- *Reduce financial barriers to the lowest-income transportation system users*
- *Accommodate the movement and management of freight and goods*
- *Integrate the District's transportation system with the region's transportation network*

**Safety and Security: Achieve zero fatalities and serious injuries on the District transportation network**

- *Improve safety for all users*
- *Improve redundancy of transportation networks to handle emergencies*
- *Expand sidewalk network*
- *Maintain ability to evacuate the District in case of emergency*
- *Preserve security of key functions without impacting the transportation system*

**Sustainability and Health: Achieve 75% of all commute trips in the District by non-auto modes**

- *Increase non-auto mode split*
- *Increase access to parks and green space*
- *Encourage active transportation for health benefits*
- *Reduce air and water quality impacts of transportation*
- *Prepare the transportation system for changing environmental and climatological conditions*

## Mission

DDOT is committed to achieving an exceptional quality of life in the nation's capital by emphasizing safety, reliability and mobility in DDOT's transportation operations.

## Vision

Proactively operate a cohesive, sustainable transportation system that delivers safe and reliable movement of people.

## Goals

## Objectives

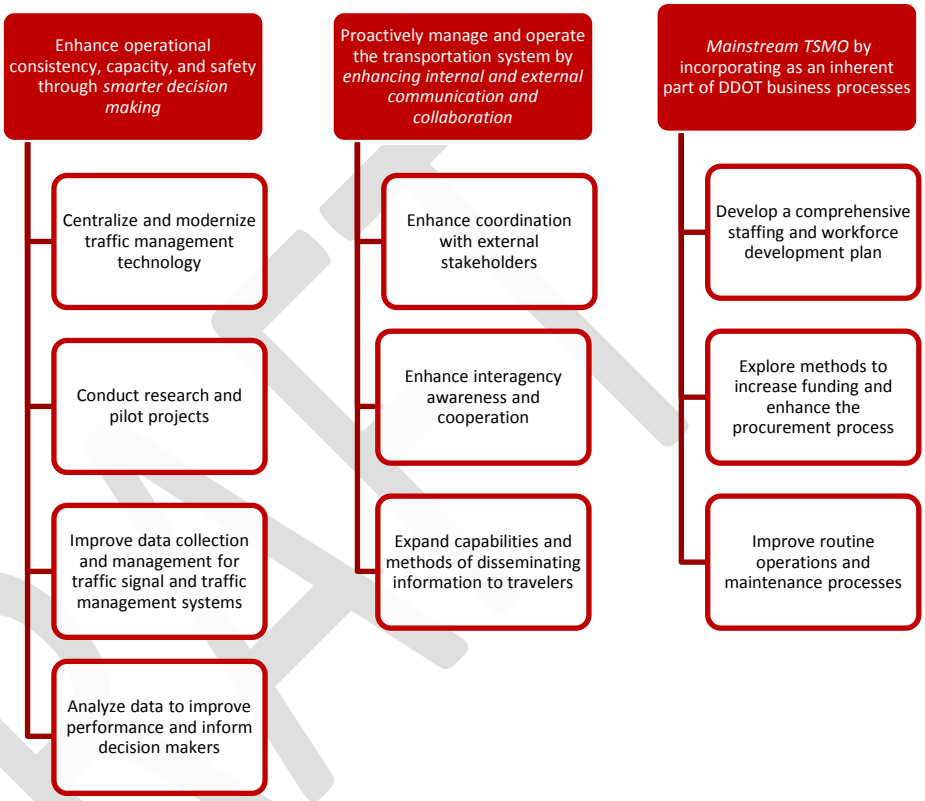


**Figure 6** | DDOT TSMO Outcome Goals and Objectives

The specific strategies that will be employed to accomplish these goals and objectives are shown in **Table *5***.

**Table 5** | DDOT's TSMO Goals, Objectives, and Strategies

| Goals | **Enhance operational consistency, capacity, and safety through *smarter decision making*** | | | | **Proactively manage and operate the transportation system by *enhancing internal and external communication and collaboration*** | | | ***Mainstream TSMO* by incorporating as an inherent part of DDOT business processes** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Objectives** | **Centralize and modernize traffic signal and traffic management technology** | **Conduct research and pilot projects** | **Improve data collection and management for traffic management systems** | **Analyze data to improve performance and inform decision makers** | **Enhance coordination with external stakeholders** | **Enhance intra-agency awareness and cooperation** | **Expand capabilities and methods of disseminating information to travelers** | **Develop a comprehensive staffing and workforce development plan** | **Explore methods to increase funding and enhance the procurement process** | **Improve routine operations and maintenance processes** |
| **Strategies** | Carry out upgrades to enable advanced signal system operations | Evaluate feasibility of adopting alternative strategies to improve reliability for multimodal operations | Improve accessibility and awareness of existing data across agency | Establish and track performance metrics to evaluate effectiveness of existing programs | Explore opportunities for enhanced resource sharing | Facilitate recurring interactions across agency divisions | Explore new means of communicating with the public | Enhance professional development opportunities for existing staff | Explore innovative contracting mechanisms | Create or revise standard operating procedures |
| | Improve CCTV system quality and accessibility | Investigate and conduct pilot projects for emerging technologies and strategies | Establish new sources private and public-sector data to improve situational awareness | Use data to optimize operations | Facilitate recurring opportunities for interagency communications | Integrate TSMO into planning documents | Install needed signage | Investigate need for additional staff resources | Explore new funding mechanisms | Improve resource management processes |
| | Acquire, replace, and repair supportive hardware | Evaluate utility of existing pilot technologies and strategies | Establish new sources of data to improve performance management | Use data to support investment decisions | Create and implement needed interagency agreements | | Investigate opportunities to collaborate on TDM outreach initiatives | Collaborate with HR to identify opportunities to improve flexibility in hiring and staffing | Integrate TSMO into existing budget and allocation processes | |
| | Improve field-to-center communications reliability and bandwidth | Research best practices | Integrate and consolidate information systems | | Explore new partnerships with the private sector | | | | | |

# 2. The TSMO Program

The TSMO Plan outlines the delivery of the TSMO program by identifying institutional and organizational changes. Challenges including leadership support, organizational structure, financing, workforce development, and strategies to promote a culture of TSMO beyond the agency are documented below.

## 2.1. Program Structure, Collaboration & Communications

DDOT was established in 2002 having previously been part of the Department of Public Works. Several years ago, DDOT was restructured to combine portions of the engineering staff with Planning teams under the Project Delivery Administration, to facilitate better coordination between Operations and Planning work.

As a standalone and recently restructured agency, TSMO should be integrated throughout DDOT. TSMO functions are already performed by a variety of Divisions within DDOT. Therefore, this plan recommends maintaining the existing organizational structure, but establish formal means of coordination, accountability, and authority to implement TSMO. This plan encourages DDOT to include additional agency functions and other District Agencies in the TSMO Program. The formalized process and strategy for integrating the TSMO Program both within and outside DDOT is outlined in Section 2.1.1.

### 2.1.1. Organizational Structure, TSMO Intra-Agency Integration & Internal Collaboration

DDOT's Operations Administration, and specifically the Transportation Operations & Safety Division (TOSD), will continue to be the lead implementation entity for the TSMO program. To implement a robust TSMO program, preexisting and newly defined TSMO-related work will operate under one umbrella and will expand to additional Agency divisions.

#### 2.1.1.1. Status

This section describes DDOT's primary TSMO stakeholders and the process through which the Agency will integrate TSMO. ***Figure 8*** shows DDOT's current Senior leadership organizational chart. ***Figure 9*** presents a detailed organizational chart of the teams leading DDOT's TSMO implementation, shown in red.

The structure of stakeholders, in order of greatest to least responsibility, is shown in ***Figure 7***. Collaborators and technical experts are the next tier of involvement and will implement the plan's

recommendations. These divisions include the *Parking & Ground Transportation Division, the Public Space Division, and the Maintenance Division* within the Operations Administration; as well as the *Traffic Engineering & Safety Division* with the Project Delivery Administration. Implementing the plan requires periodic consultation and engagement with the third tier consisting of: the *Planning & Sustainability Division and the Transit Delivery Division* within the Project Delivery Administration; the *Administrative Services Division* (ASD), *the Davis-Bacon Division* (DBD), *the Office of Contracting & Procurement* (OCP), *Office of the Chief Financial Officer* (OCFO) within the Administrative Administration; the *Information Technology and Innovation Division* (ITID), the *Performance Division*, and the *Support Services Division* within the Performance Administration; the *Public Information Division* (PID) and the *Policy & Legislative Affairs Division* within the External Affairs Administration; and the *Safety & Security Division* within the *Office of the Chief of Staff*. The fourth tier of involvement, shown in white, identifies other District Agencies including Homeland Security and Emergency Management Agency (HSEMA), the Metropolitan Police Department (MPD), Fire and Emergency Medical Services (FEMS) and the Office of the Chief Technology Officer (OCTO). The fifth tier, shown in gray, is composed of important regional stakeholders who will be engaged in implementing the TSMO plan, and include Federal security and safety agencies such as the National Park Police and the US Capitol Police; District Business Improvement Districts (BID); Metropolitan Area Transportation Operations Coordination (MATOC); the Metropolitan Washington Council of Regional Governments (COG); the private sector; as well as city, county, and state government agencies in Maryland and Virginia.

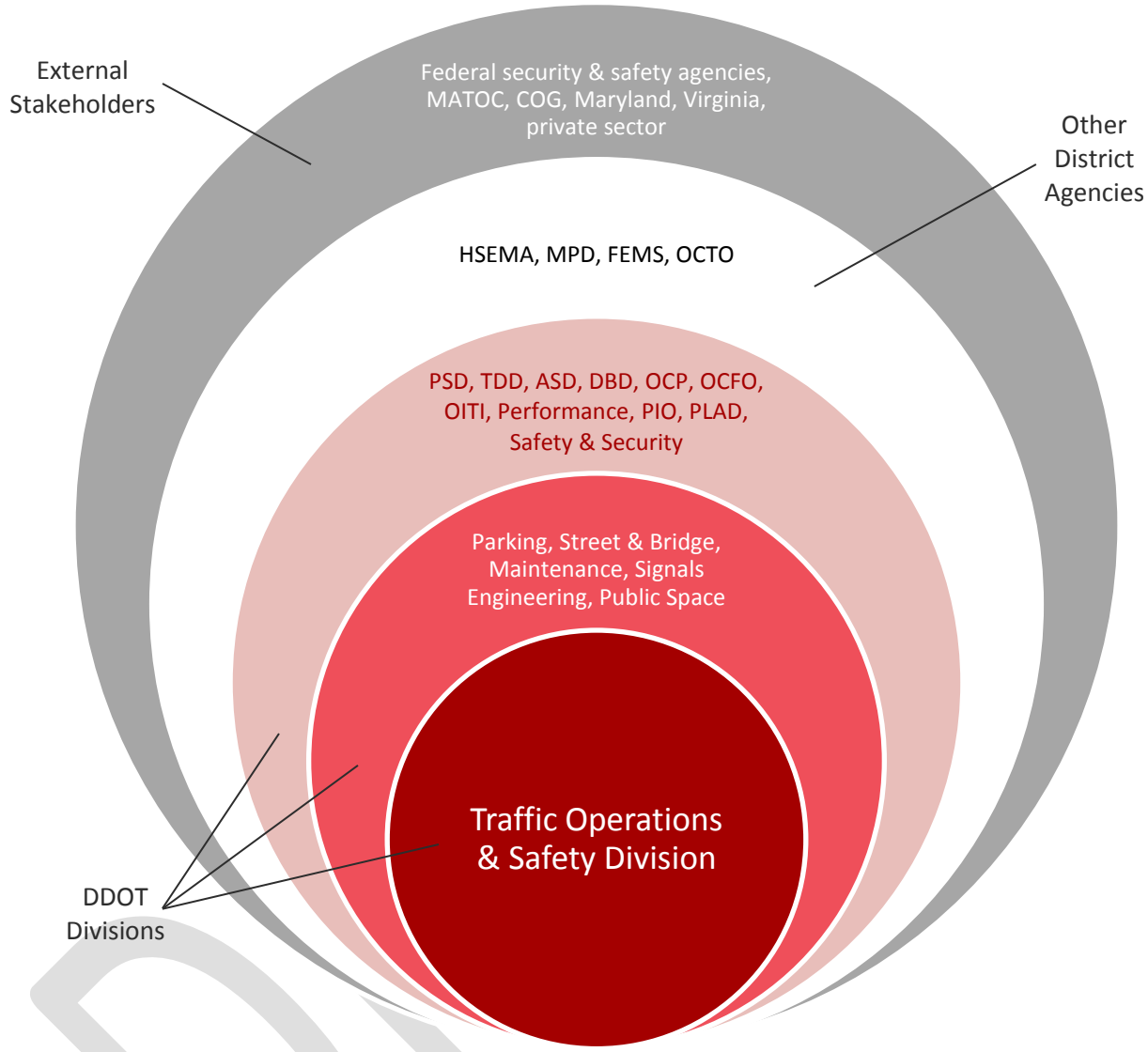


**Figure 7** | TSMO Sphere of Influence for Stakeholders in Washington DC region

The location of all of the Divisions listed in ***Figure 7*** within the organization of DDOT and their various Administrations are shown in ***Figure 8*** and ***Figure 9***. Figure 8 shows DDOT's Senior-Level Leadership and Figure 9shows key Operations and Project Delivery Administration stakeholders.

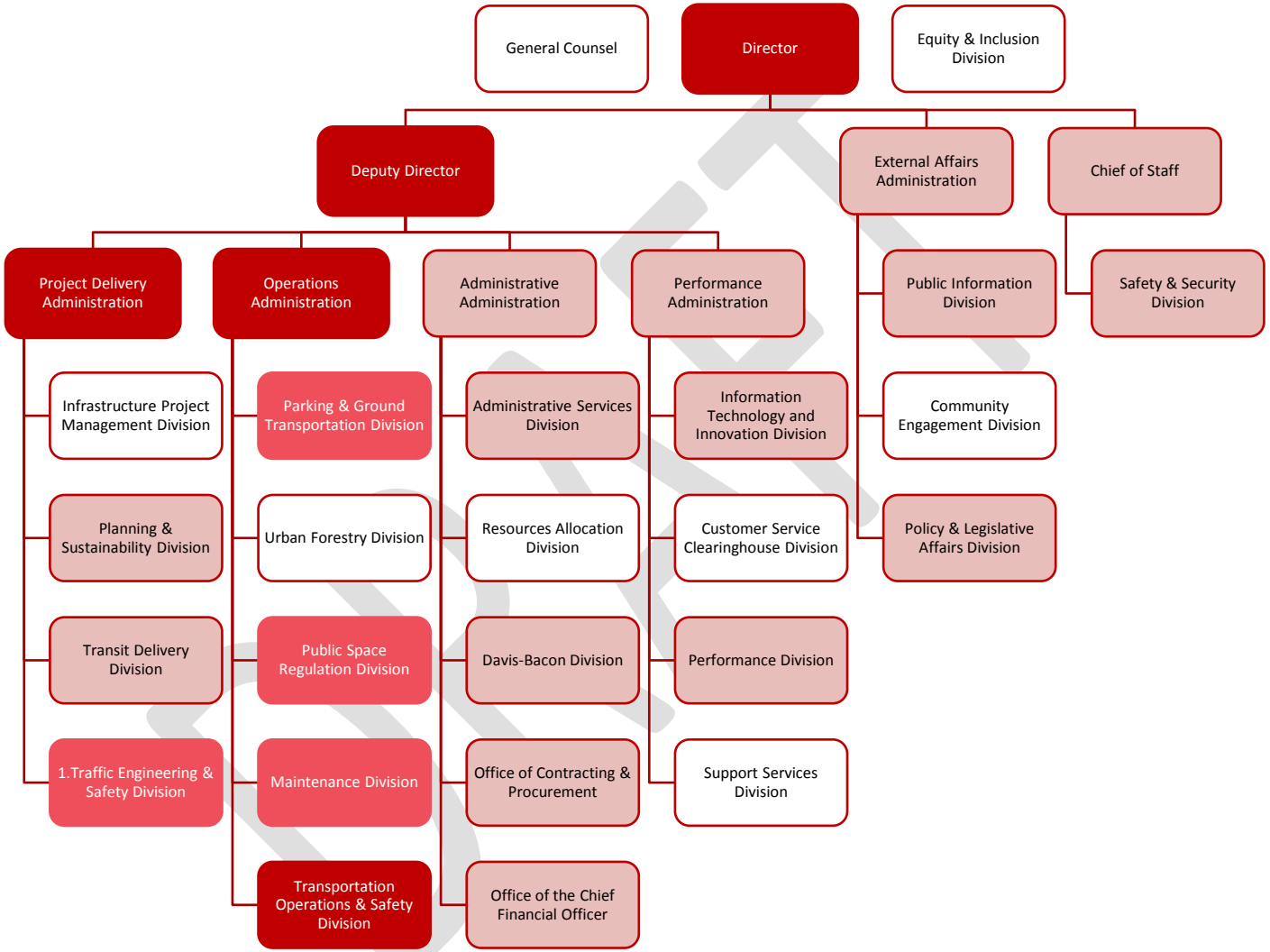


**Figure 8** | DDOT Senior Level Organizational Chart

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**DDOT TSMO Plan**

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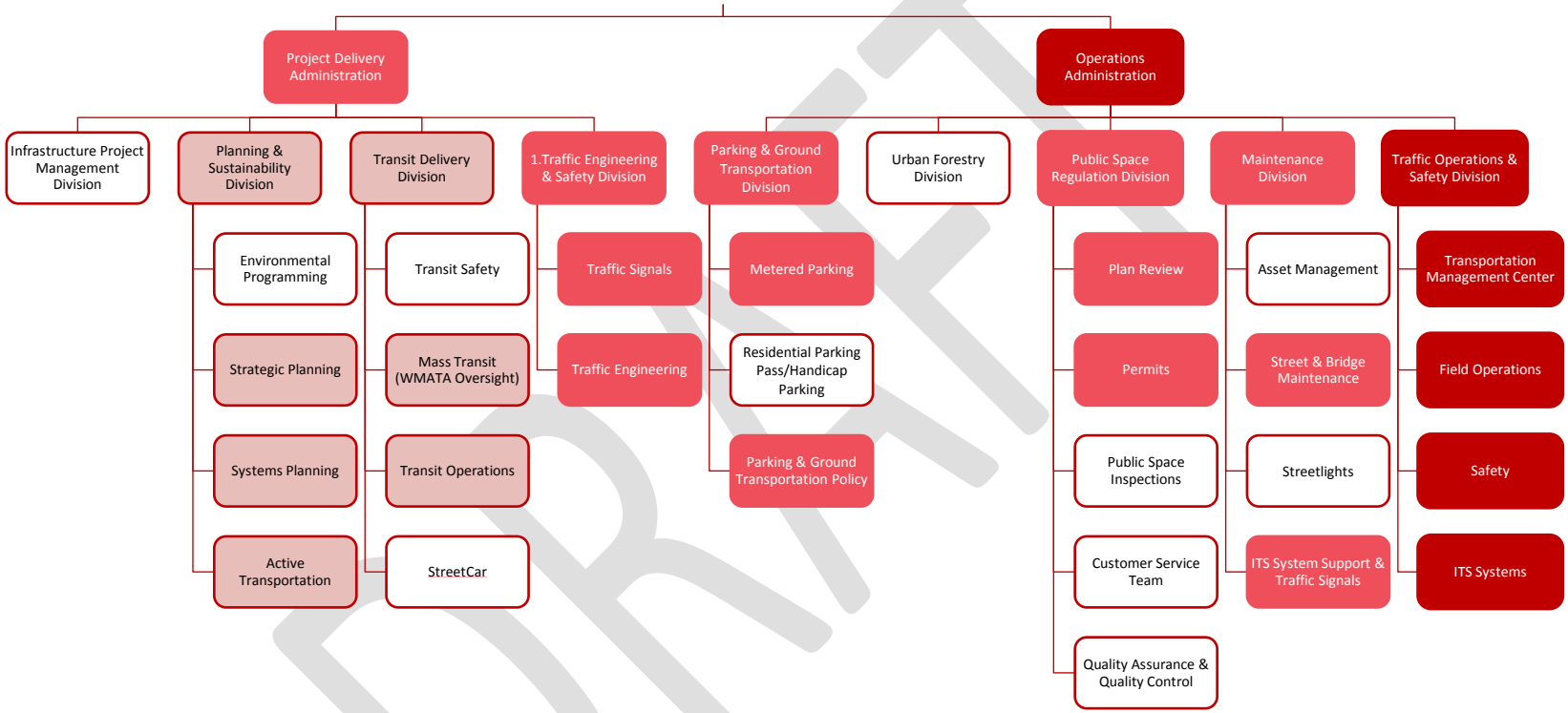


**Figure 9** | DDOT's TSMO Primary Stakeholders

Within the Operations Administration, the following Divisions perform primary TSMO-related tasks:

The *Traffic Operations & Safety Division* is composed of five branches and manages the day-to-day traffic operations for the District:

1. **Transportation Management Center Branch:**
    a. Roadway Operations Patrol Section — responds to traffic incidents, emergencies and city-wide events with trained personnel using towing and repair equipment;
    b. Traffic Management Center Section — manages a 24/7 traffic management center (TMC) at HSEMA and a traffic operations center at the Reeves Center to gather and disseminate traffic and emergency information using a network of cameras and other devices; and
    c. Traffic Control Officers Program — prevents congestion through enforcement and providing traffic control services at intersections throughout the District.
2. **Field Operations Branch** — fabricates, installs, and maintains traffic control devices such as signs and pavement markings through three branches: the Pavement Marking Equipment Branch, the Sign Fabrication Branch, and the Street Sign Installation Branch.
3. **Safety Branch:**
    a. Traffic Engineering & Inspections Branch — conducts traffic calming and traffic safety studies, installs traffic calming devices, and manages the school crossing guard program to assist students and pedestrians safely cross the District's intersections.
    b. School Crossing Guards Program — School Crossing Guards (AKA Safety Technicians) prevents congestion through enforcement and traffic control services; and assist students and pedestrians to safely crossing intersections.
4. **Intelligent Transportation Systems (ITS) Branch** — reviews, assesses, integrates, and implements the latest available technologies to enhance the District's transportation infrastructure.

The *Parking and Ground Transportation Division* manages operations and conditions for single and multi-space parking meters and the District's street, alley, bridge, tunnel and navigation lighting systems. The branches that will be most involved with TSMO work are:

1. **Parking Operations Branch** — operates and maintains single and multi-space parking meters, collects revenue, and manages meter payment programs such as pay by cell; and
2. **Parking and Ground Transportation Policy Branch** — supports parking and ground transportation policy development and analytics including the emergence of curbside users such as point-to-point carshare.

The *Maintenance Division* maintains the integrity, safety, and condition of transportation infrastructure assets. The branch most involved with TSMO work is:

**ITS System Support & Traffic Signals Branch** — maintains the District's Intelligent Transportation System (ITS) infrastructure including traffic signals, ITS communications network, CCTV camera systems, variable message signs, etc.

The *Public Space Regulation Division (PSRD)* oversees reviewing and approving permits for use of the public right of way, which requires coordination with TOSD for special events and work zone management.

Within the Project Delivery Administration, the *Traffic Engineering and Safety Division* is responsible for planning and designing the District's traffic control infrastructure and management assets for the safe and efficient movement of pedestrians and vehicles; coordinates and manages the completion of specialized multi-year projects involving conceptual development, design, implementation, and management of traffic control measures. This division consists of two branches:

1. **Traffic Signals Branch** — plans, designs, and constructs traffic signals to improve pedestrian and vehicular traffic safety/mobility and helps meet the traffic control demands in the District; and develops and implements optimized timing plans for the District's signal system in a five-year cycle to improve multi-modal traffic operations; and
2. **Traffic Engineering Branch** — plans, designs, and implements the Highway Safety Improvement Program, provides District-wide project plan review support, and manages the annual traffic data collection program for the District.

Within the Performance Administration, the **Support Services Division** plays a key logistical role during emergencies and special events. The branch most involved with TSMO work is:

**Fleet Management Branch** — manages the condition and utilization of DDOT fleet vehicles.

In addition to the primary stakeholders, there are several other DDOT Divisions and Branches who play an important role in implementing TSMO. The *Planning and Sustainability Division (PSD)* in the Project Delivery Administration, consults on the project development process and operational feasibility with Operations teams. DDOT's Research team promotes innovative solutions to transportation problems and works across the Agency to integrate new technology into DDOT's projects is housed in PSD. The *Transit Delivery Division* manages DC Streetcar and DC Circulator Operations, which requires intra-Agency coordination especially when adjusting traffic signal operations.

The **Street and Bridge Maintenance Branch**, in the Operations Administration *Maintenance Division*, is responsible for performing asphalt, masonry, and crack sealing of streets, alleys, and bridges, will

coordinate with Roadway Operations Patrol (ROP)to quickly repair potholes in high incident areas, and work with the Transportation Management Center Branch to coordinate work zone traffic control.

The Administrative Administration plays an important role in TSMO business processes by supervising human resources, training (ASD), contracting and procurement (OCP), and managing DDOT's local and federal funding (OCFO). The Performance Administration oversees the Agency's information technology, as well as tracking and reporting on the Operations Teams' performance. The External Affairs Administration leads external outreach efforts. They will aid in informing DDOT Divisions, other regional agencies, and the public about the TSMO program. The *Safety and Security Division*, under the Chief of Staff, manages the District's evacuation plan and supports workplace safety practices for Operations staff in the field.

There are several ways in which these Divisions and Branches coordinate with each other. Within TOSD, the TMC staff coordinate daily with ROP, Traffic Control Officers (TCOs), School Crossing Guards and Safety Technicians, and the ITS Systems Support Branch to respond to roadway incidents and other sources of non-recurring congestion. Planning staff host weekly Project Delivery team meetings and invite Operations staff to join. Operations managers and Performance Management run TranStat biweekly meetings aimed at reviewing data analysis, troubleshooting issues and planning for new or restructured programs. There are also many special topic, intra-Agency workgroup meetings, including one for Connected and Autonomous Vehicles.

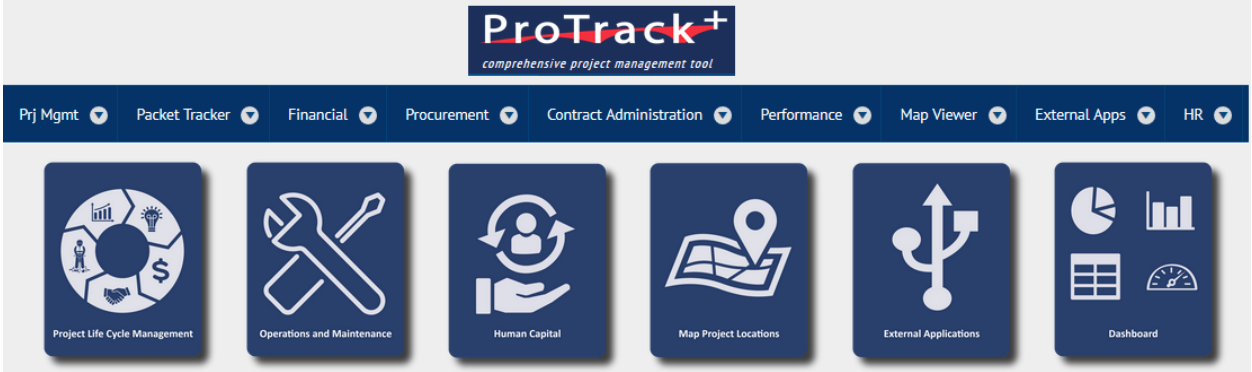


**Figure 10** | DDOT's ProTrack Plus Dashboard

DDOT's project management system, ProTrackPlus, provides teams the opportunity to share project information. ProTrackPlus' Map Viewer tool is useful in facilitating cross-team communication. A project manager can edit and display the geographical extent of a project in the Map View application and

display potential conflicts identified by project number and name, as well as Cityworks service requests within the project's boundaries. Map View's = Safety Stat layer displays all projects with a safety component. Furthermore, the Office of Information Technology and Innovation (OITI) plans to develop the "Calls for Project" entry form to notify project managers of potential conflicts with new projects based on the project's search radius.

#### 2.1.1.2. Limitations

To date, TSMO is not a specific agency focus. While many TSMO responsibilities sit within the Operations Administration, the Agency needs to memorialize TSMO roles and responsibilities across divisions. Historically, Planning and Operations have collaborated on an ad-hoc basis, limiting the Agency's ability to encourage multimodal transportation options. At times, Operations or Planning staff have been consulted too late in the project development processes to make meaningful contributions. TSMO cross-team collaboration is encouraged; however clear instructions and involvement is necessary. In addition, DDOT's TDM Program, *goDCgo*, and its Operations teams work completely independently, despite having a similar goal of managing transportation demand. This structure is attributed to limited staff capacity and the team's majority contractor composition. Despite several Active Transportation and Demand Management projects adopted across DDOT, no single team, staff person, or work group is dedicated to the long-term planning and management of these projects.

DDOT staff, and particularly Operations staff, are scattered throughout several different District facilities, making collaboration difficult. The opportunity for the agency to consolidate is minimal given the rapid pace of development in the District. T. Today, the primary TMC is located at the Unified Communications Center (UCC), in the former St. Elizabeth's Hospital Campus in Ward 8. The Frank D. Reeves Municipal Center, in Ward 1, is the former site of the main TMC, and now houses a small Traffic Operations Center (TOC). The communications network for the city's signal and ITS infrastructure is based at the Reeves Center, which would be difficult to relocate, as discovered during a planning project to investigate relocation.

Prior to creating DC's 311 system for city service requests, the former TMC served as an unofficial information clearinghouse for DDOT, enabling staff to become experts in all DDOT activities and forged important connections between Divisions. Today TOSD staff have limited interactions outside their immediate teams. This has impacted internal relationships and capacity to build agency-wide knowledge, resulting in a diminished public perception. Most evident of this is, when asked by the

public, TOSD staff are unable to verify the status of a project or alert relevant teams to issues noted in the field because of their diminished agency-wide contact.

Coordinating construction activities also requires collaboration. To reserve sections of the right of way for construction or work zones, developers and contractors submit a traffic management plan and apply for a permit through the Transportation Online Permitting System (TOPS). Submitted plans are individually approved, without consideration for other construction projects requiring similar or nearby street closures. Individually reviewing plans often creates a cascading congestion issue which could be mitigated by holistically reviewing construction projects.

DDOT's project delivery process has never been fully documented, compounding issues of cross-team collaboration. Due to the magnitude of documenting these processes, a 2016 initiative to formalize the project delivery process was never completed.

#### 2.1.1.3. Recommendations

To cultivate a TSMO culture, the Agency should incorporate TSMO as a core competency through policies, plans and procedures. Communicating the similarities between DDOT's existing goals and TSMO, will help elevate TSMO within the Agency's consciousness. TSMO strategies should be highlighted within DC's Multimodal Long-Range Transportation Plan, *moveDC*, which will be updated in 2019, and other strategic DDOT plans to reinforce DDOT's commitment. By highlighting TSMO, the program's full range of benefits for DDOT projects and services can be realized. The TSMO Action Plan should be updated on an annual basis and use the performance measures to evaluate the success of TSMO projects.

DDOT will incorporate TSMO into pre-existing processes to support agency-wide buy-in.. TSMO should be incorporated as a standard agenda item during regular Senior Staff meetings, weekly budget meetings, ongoing contracts meetings, and federal obligation status meetings to keep DDOT leadership engaged in TSMO functions. Each TSMO stakeholder Division should identify staff champions to support TSMO's integration into Agency functions. TSMO champions will participate in quarterly working group meetings and will be tasked with implementing the TSMO action plan. Working group topics should include IT, signals, ATDM, and emerging technology. Responsible TSMO champions will designate and verify Divisional points of contact to facilitate cooperation and communication.

For the District to reach its 75% non-SOV goal, managing transportation demand and improving collaboration between Operations and Planning teams is essential. Towards this end, the Agency should

consider creating a new branch within the Operations Administration dedicated to ATDM. In addition, to facilitate cross-team collaboration, DDOT should revive the project delivery process working group, identify opportunities to incorporate TSMO, and potentially devote consultant funds to the work as staff resources are limited.

There are technological improvements that could facilitate collaboration. For instance, within DDOT's project management system, ProTrackPlus, when requesting new funding a project manager must respond to several TSMO checklist items:

- Removing or Adding Lanes [Y/N]
- Is this an Intelligent Transportation Systems (ITS) project as defined in federal law and regulation, and therefore subject to federal rule 940 requirements? [Y/N]
- Intelligent Transportation Systems Project [Select Type]
- Intelligent Transportation Systems Architecture [Select Type]
- Does this project reduce travel time on highways and/or transit without building new capacity (eg: ITS, bus priority treatments, etc)? [Y/N]
- Does this project enhance safety for motorists, transit users, pedestrians, and/or bicyclists? [Y/N]
- Congestion management strategy benefits [Select]
- Do traffic congestion conditions necessitate the proposed project or program? [Y/N]
    - If so, is the congestion recurring or non-recurring? [Y/N]
- Congestion Management Documentation Form:
    - Indicate whether the proposed project's location is subject to or benefits significantly from any of the following in-place congestion management strategies [Select Multiple]
    - Transportation demand management measures, including growth management and congestion pricing
    - Intelligent Transportation Systems Technologies

ProTrackPlus should then alert the Operations teams when projects with similar criteria are selected for funding. Alerts should prompt the project manager to consult with the appropriate Operations stakeholders. Projects in the study or planning phase should be flagged to provide Operations staff sufficient lead time to make effective recommendations.

The Call for Projects entry form could be enhanced by providing tooltips explaining each component, to further educate DDOT employees about TSMO and other programs. Furthermore, ProTrackPlus Map Viewer could flag projects requiring the most significant TSMO intervention. These enhancements are recommended to ensure Operations teams are engaged, when they are not actively contributing or leading in the Agency's activities, as shown in ***Figure 11***.

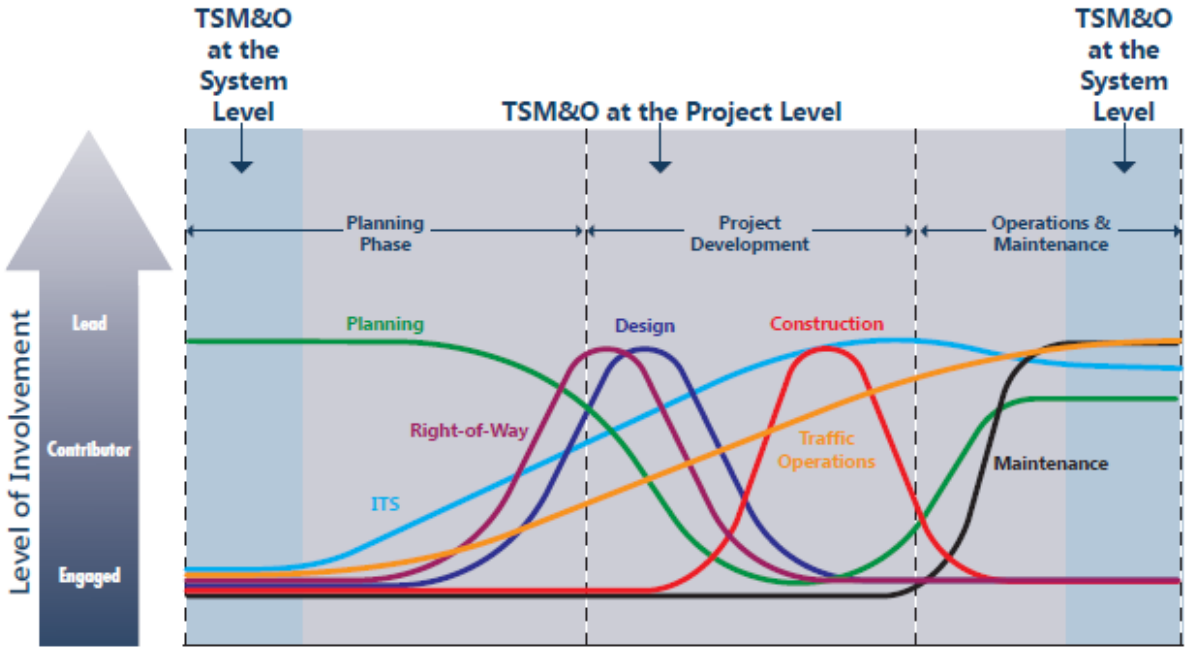


**Figure 11** | TSMO Program Roles and Responsibilities at the System and Project Levels [21]

To further integrate TSMO at the project level, DDOT should develop a strategy for improved construction coordination (e.g. avoid construction with similar location, duration, timeframe), by developing a work zone monitoring application. TOSD should work with the *Public Information Division* to highlight Operations teams successes and create a concise communications strategy for internal distribution and promotion. Improved performance management, communications tools, and training opportunities will help facilitate coordination between Operations teams. These strategies will be addressed later in this plan.

### 2.1.2. Collaboration with External Partners

TSMO strategies involve numerous stakeholders making it essential to keep everyone informed of new developments and can coordinate their work. Additional processes to foster collaboration and support TSMO should be established.

#### 2.1.2.1. Current Status

There are many avenues through which DDOT collaborates with external partners, but there is a need to enhance and supplement some of these efforts.

DDOT's primary TMC is co-located with the *Unified Communications Center* (UCC), operated by the District's Office of Unified Communications. The UCC consolidates the functions and communications of the Metropolitan Police Department (MPD), the Fire and Emergency Medical Services Department (FEMSD), the Homeland Security and Emergency Management Agency (HSEMA), and other safety and security services. HSEMA leads the planning and coordination of homeland security and emergency management efforts to ensure the District is prepared to prevent, protect against, respond to, mitigate and recover from all threats and hazards. TPB and HSEMA should review post incident reports and provide regional coordination regarding major incidents.

As part of the *Mayor's Special Event Task Group (MSETG)*, DDOT coordinates monthly with other District Agencies on the city's public safety planning efforts for events requiring interagency coordination. The Task Group, which is composed of District government agencies, Federal government agencies, and private sector emergency service organizations, is responsible for providing interagency reviews and assessments of the operational, public safety and logistical components of proposals for special events. MSETG also reviews post incident reports and provides local District Agency coordination regarding incidents.

DDOT is a member of the National Capital Region Transportation Planning Board (TPB), which is the federally designated metropolitan planning organization (MPO) for metropolitan Washington. TPB is housed at and staffed by the Metropolitan Washington Council of Governments (COG, the District's regional council. TPB hosts several TSMO Subcommittees which share best practices and provide an avenue for coordination and collaboration for the region. These subcommittees include:

*Systems Performance, Operations and Technology Subcommittee (SPOTS)* advises the TPB on matters of performance outcomes of the transportation system; transportation operations and management, including considering how Intelligent Transportation Systems (ITS) technologies can improve those operations; and emerging transportation technologies. The Subcommittee is currently chaired by a DDOT representative and provides a regional forum for coordination among Transportation Planning Board member agencies and other stakeholders.. SPOTS advises the development of the Regional ITS Architecture in accordance with the National ITS Architecture.

The *Traffic Signals Subcommittee* provides advice and assistance to the SPOTS Subcommittee. The group facilitates technology transfer and information sharing as it relates to state and local programs, and cooperation across jurisdictional boundaries in the operation of traffic signals.

The *Transportation Safety Subcommittee* coordinates with the three State Strategic Highway Safety Plans, advises the maintenance of the Safety Element of the Constrained Long-Range Plan, and serves as a forum to exchange information on best practices in transportation safety planning.

The *Commuter Connections Subcommittee* is comprised of state and local governments in the Greater Washington metropolitan area, several large employers, and a number of Transportation Management Associations and organizations. This Subcommittee provides overall technical review of the regional TDM Program elements. The Subcommittee reviews, provides commentary, and endorses reports and other products for release to the general public and regional stakeholders.

DDOT is a member of the *Metropolitan Area Transportation Operations Coordination* (MATOC), which is a joint operations program with the Maryland Department of Transportation (MDOT), the Virginia Department of Transportation (VDOT), and the Washington Metropolitan Area Transit Authority (WMATA) to improve information sharing between transportation operations centers. MATOC's mission is to provide situational awareness of transportation operations in and around the National Capital Region (NCR) through communicating consistent and reliable information that enables operating agencies and the traveling public to make effective and timely decisions. DDOT submits travel data to regional agencies using the Regional Integrated Transportation Information System (RITIS) Network and disseminates notices through MATOC. In addition, through MATOC, DDOT coordinates with VDOT, HSEMA and Maryland Coordinated Highways Action Response Team (CHART) on major construction activities and weather-events. HSEMA and MATOC release a special events calendar for the region to improve coordination.

DDOT has partnered with DC Sustainable Transportation (DCST), a nonprofit primarily steered by Business Improvement District leaders, on several initiatives. Their aim is to promote travel by transit, walking, and biking; to mitigate congestion and better manage curb space; and to prepare for mobility changes in the future with advancing technology.

In addition, DDOT is a member of the *I-95 Corridor Coalition*, which is a partnership of transportation agencies, toll authorities, public safety, and related organizations from the State of Maine to Florida. The Coalition provides a forum for key decision makers to address transportation management and operations issues of common interest. This volunteer, consensus-driven organization enables its myriad

state, local and regional member agencies to work together to improve transportation system performance.

DDOT also collaborates with the private sector. DDOT is providing Signal Phase and Timing (SPaT) data to external vendors and submits event and incident data to Waze. In addition, the agency is conducting a one-year pilot pick up and drop off zone for TNCs south of Dupont Circle in the evenings, an area of the city with a large nightlife scene. Parking was temporarily eliminated to accommodate the zone. The evaluation of this project will inform potential future partnerships with new transportation entities.

#### 2.1.2.2. Limitations

As recent incidents have demonstrated, from WMATA Metrorail shutdowns to fatal truck collisions, individual agencies in the Washington DC region are able to internally coordinate well but have difficulties responding to major events, especially ones across multiple jurisdictions. Technological difficulties and security concerns with sharing inter-Agency data has hindered this collaboration. For example, DDOT is unable to provide all incident data and CCTV feeds to RITIS because of network communications issues. DDOT is working on expanding its fiber communications network but has faced issues advocating for an on-street fiber network dedicated solely to transportation purposes, rather than integrating with the rest of the District's fiber network.

Many FEMSD and MPD personnel are unaware of ROPs existence and the role other Operations teams play regarding incident management. District-wide Traffic Incident Management (TIM) trainings had been a good avenue for building inter-agency connections. However, these trainings have not occurred for several years. In addition, the Department of Public Works (DPW) is the only District Agency with towing authority, but given DPW's capacity, the agency is not always able to respond to traffic incidents or assist in enforcing other DDOT priority projects.

Historically, Transportation Demand Management (TDM) programs and Operations staff have worked completely independently of each other. The Washington, DC region is no exception. Operations staff and Commuter Connections are generally unaware of one another's work. This results in limited collaboration to accomplish their joint goals of increasing the use of multimodal transportation options and the efficiency of the transportation network.

DDOT does not have a clear strategy for working with the private sector and integrating new technology to sustainably manage operations.

#### 2.1.2.3. Recommendations

Improved collaboration will increase safety and efficiency for both Operations teams and the traveling public. Multidisciplinary training can improve collaboration with external partners, such as emergency responders and towing personnel. The National Incident Management System (NIMS) training programs, which includes the Strategic Highway Research Program (SHRP2) Traffic Incident Management (TIM) training program can provide joint training opportunities. These trainings enable personnel from across regional agencies to familiarize themselves with each team's role in events, forge inter-agency personal connections, and provide learning and mentorship opportunities. DDOT Operations teams will need to work with FEMS staff to designate a new team to take over the organization of semi-annual TIM trainings. In addition, DDOT Operations staff should provide training sessions for MPD in-service and cadets about ROP, and other DDOT Transportation Operations staff functions. These trainings will also provide opportunities to share updates and gather feedback about the TSMO Program implementation as it gets underway. Additional training opportunities should be identified and recommended for each of the service areas to support DDOT's day-to-day TSMO work.

Besides trainings, there are other opportunities to foster inter-agency coordination and communication. For instance, an MPD police officer could be stationed on-site in the main TMC to facilitate interagency communications. DDOT's Safety and Security Division is working to update the Agency's evacuation plan. TOSD staff should reach out to this team to ensure TSMO elements are included in the plan and identify opportunities to improve coordination amongst agencies in the region. To improve DDOT's ability to share its data and monitor Operations assets, DDOT should engage with OCTO on opportunities for leveraging fiber connections and conduit space to expand the Agency's fiber communications network.

DDOT's Operations teams should work the Public Information Division to create a concise communications strategy and materials to inform regional agencies and stakeholders of the TSMO program. DDOT will leverage the existing SPOTS committee meetings, and other regional collaboration platforms to share the TSMO plan, communicate progress, and solicit feedback from regional agencies and stakeholders. In addition, DDOT will focus on sharing the most useful information with these entities, especially regarding all CCTV feeds and incident data to MATOC and RITIS.

As an initial step to integrate TDM and TSMO, DDOT should organize meetings between Commuter Connections Committee members and the region's Operations staff to share the work of each team. Next, TPB should create a new ATDM subcommittee comprised of TDM and TSMO professionals, to

explore and implement more real-time demand management strategies. For example, Operations staff should inform Commuter Connections members of corridors where recurring congestion occurs, to help target TDM outreach efforts.

DDOT should investigate new ways to partner with private transportation-related companies such as TNCs, navigation applications, and freight companies to manage traffic more efficiently and safely in the District. The Dupont Circle TNC pick up/drop off pilot could serve as a model for future collaborations. In addition, to assist in improving TIM in the District and the enforcement of other DDOT projects, DDOT should investigate creating a standing contract with private towing companies.

### 2.1.3. Communications, Marketing, and Outreach with Users

#### 2.1.3.1. Status

DDOT's Operations teams have several channels for communicating with the public. TOSD has fixed and portable Dynamic Message Signs and temporary signage. In addition, DDOT has a large social media presence, with Facebook, Twitter, You Tube, Flickr, Scribd, Tumblr, Pinterest, Instagram, and a blog. On its website, DDOT publishes a variety of news items, which can inform the public of major road closures and transportation-related topics through press releases, newsletters, and advisories. The District government has a 311-service request website, mobile application and call center. Also, DC government provides the option to subscribe to alerts via text or email, RSS feeds, and newsletters by topic.

DDOT has created a pilot Signal Phase and Timing Portal (SPaT), platform to share signal timing with private vehicles. DDOT's parkDC app provides real-time parking availability and rate information for the Penn Quarter and Chinatown neighborhoods in Washington, DC, in the area bounded by H Street, 3rd Street, E Street and 11th Street NW. *goDCgo*, DDOT's TDM team, coordinates and staffs events, and arranges one-on-one meetings with property managers. *Commuter Connections*, coordinated by COG, is the regional network of TDM organizations in the Metropolitan Washington DC area. Commuter Connections coordinates regional events and initiatives such as Bike to Work Day and has a robust communications and marketing presence in the region, including print ads and radio spots.

In terms of content, DDOT's Operations teams provides information about advanced notice of road closures and major events. *goDCgo* provides transportation information to the public and assistance in establishing commute benefits programs to employers, residential facilities, and hospitality and tourism companies. Commuter Connections provides trip planning assistance and ride matching services.

The majority of DDOT's Operations teams communications with the public are static, with the exception of fixed and portable DMS signs, and providing special event information to Waze and Google maps.

#### 2.1.3.2. Limitations

The public is unaware of TSMO, and not informed about the specific causes of traffic congestion, nor effective means of increasing mobility and reliability in a multimodal context. Operations teams have limited staff capacity to share information about their work and successes with the *Public Information Division*, which manages the Agency's public communications. In large part, this could explain the public's lack of knowledge of the existence of ROP, and lack of clarity regarding the specific authority TCOs and Safety Technicians possess to enforce traffic laws. This lack of awareness has led to confusion, requiring Operations staff to deescalate situations with disgruntled members of the public, which negatively affects staff morale.

*goDCgo* and Commuter Connections are reliant on employers, residential property managers, and hotel managers voluntary participation in their programs, which limits their potential impact on entities with high SOV use. In addition, these organizations are unable to influence travel behavior in real-time, which is a goal of ATDM Operations teams, who have the tools to monitor and impact traffic patterns in real-time.

Both Maryland and Virginia provide 511 services, whereas the District does not. 511 services allow the public to dial-in and receive real-time transit information. As more and more Americans rely on smart phones (currently at 77% [15]) and mobile navigation apps such as Google Maps or Waze, the usefulness of launching 511 services in the District may be limited. Currently, DDOT can share information with Waze but is in need of a better methodology for formatting special event and work zone data before making this information useful to the traveling public.

#### 2.1.3.3. Recommendations

Operations teams should work with the *Public Information Division* to create an overarching plan to communicate information about the TSMO Program to the public. This plan should include provisions for communicating the roles of various Operations team including ROP, TCOs, and Safety Technicians to the public. In addition, a section of this plan should contain strategies for informing ANC commissioners, DC City Council members, and other political representatives in the District regarding the importance of TSMO to assist with advocating for increasing funding for TSMO.

Commuter Connections and *goDCgo* can support the TSMO program by educating stakeholders and promoting real-time travel demand management activities to internal and external customers. The TSMO Program can help the *goDCgo* team better target their outreach by identifying particularly congested corridors where TDM interventions are needed, and by promoting TDM initiatives through their communications tools. These coordination and collaboration activities will develop support from the public, partners and decision makers for the TSMO Program.

### 2.1.4. Objectives and Strategies

**Table 6 |** Program Structure, Collaboration & Communications Objectives and Strategies

| Objectives | Strategies |
|---|---|
| Enhance coordination with external stakeholders | Facilitate recurring opportunities for interagency communications |
| | Create implement needed interagency agreements |
| | Explore opportunities for enhanced resource sharing |
| | Explore new partnerships with the private sector |
| Enhance intra-agency awareness and cooperation | Facilitate recurring interactions across agency divisions |
| | Integrate TSMO into planning documents |
| Expand capabilities and methods of disseminating information to travelers | Investigate opportunities to collaborate on TDM outreach |
| | Install needed signage |
| | Explore new means of communicating with the public |

## 2.2. Business Processes

Many tasks performed by DDOT can be classified as TSMO. By updating and reevaluating the Agency's business processes, we can ensure TSMO activities are carried out in a more coordinated, efficient and effective manner. This includes systems regarding Budgeting and Accounting (Section 2.2.1), Procurement and Contract Management (Section 2.2.2), Research and Development (Section 2.2.3), and Policies and Guidelines Management (Section 2.2.4).

### 2.2.1. Budgeting and Accounting

DDOT's current TSMO efforts rely on federal allocations from the Highway Trust Fund. Staff capacity and local match dollars are limited, which impacts the Agency's ability to pursue grant funding for new projects. Both the city and the Agency should prioritize TSMO funding to improve reliability, safety and

efficiency for the District's transportation network. DDOT should investigate new revenue sources and contracting methods to expand funding for new TSMO initiatives.

#### 2.2.1.1. Status

The majority of DDOT's TSMO projects are federally-funded. Since these funds require a local match, it is important to evaluate both the federal allocation and local budget processes. For local capital and operating funds, the budget process begins in September/October, when all District Agencies receive instructions to develop a budget request and target budget amount for the following fiscal year. In November/December, the Mayor and the Chief Financial Officer reviews all Agency requests. In January/February, the current services baseline budgets are formulated, which outlines the amount each Agency needs to maintain its existing services and legal obligations. In March/April, the Mayor's budget is released and reviewed. In May/June, the DC City Council votes on the budget. Upon council approval, the final budget is submitted to the U.S. Congress for approval. The fiscal year begins on October 1st, and any local funding must be spent within that year.

For federal funds, DDOT begins the final project selection process, the Call for Projects, as the Mayor and City Council finalize the city's budget. The Call for Projects lasts approximately one month (April to May). This is followed by an internal quality control process to ensure all project submittals are complete. Then, the Chief Officer and Senior level team prioritize projects according to the state of good repair, ongoing operational projects, larger required projects, *moveDC* compliance, and additional considerations. Towards the end of the summer, final projects are selected, and the yearly obligation plan is developed depending on the amount of federal funding available to the District. The final project list includes any additions from the Mayor and City Council.

A significant portion of DDOT's projects are federally-funded through the Highway Trust Fund. Generally, federal funds contribute towards 83% of projects, with a 17% local match requirement. The majority of the District's local match is provided from motor fuel tax revenues, which can be supplemented by public rights-of-way permit revenues if necessary. ***Figure 12*** shows the District's FY 2019 proposed master projects to which the $207,104,077 of the Highway Trust Fund Budget will be distributed. According to the FY19 Budget documents, "It is anticipated that FHWA will make $173,072,257 of federal aid available for HTF projects. The proposed local match HTF budget of $34,031,820 is based on estimates of local HTF revenues and anticipated local match requirements. Each year DDOT produces a multi-year HTF financial report as required by DC Code § 9-109.02(e) to

ensure that there are sufficient financial resources to match FHWA grants for transportation projects" [14].

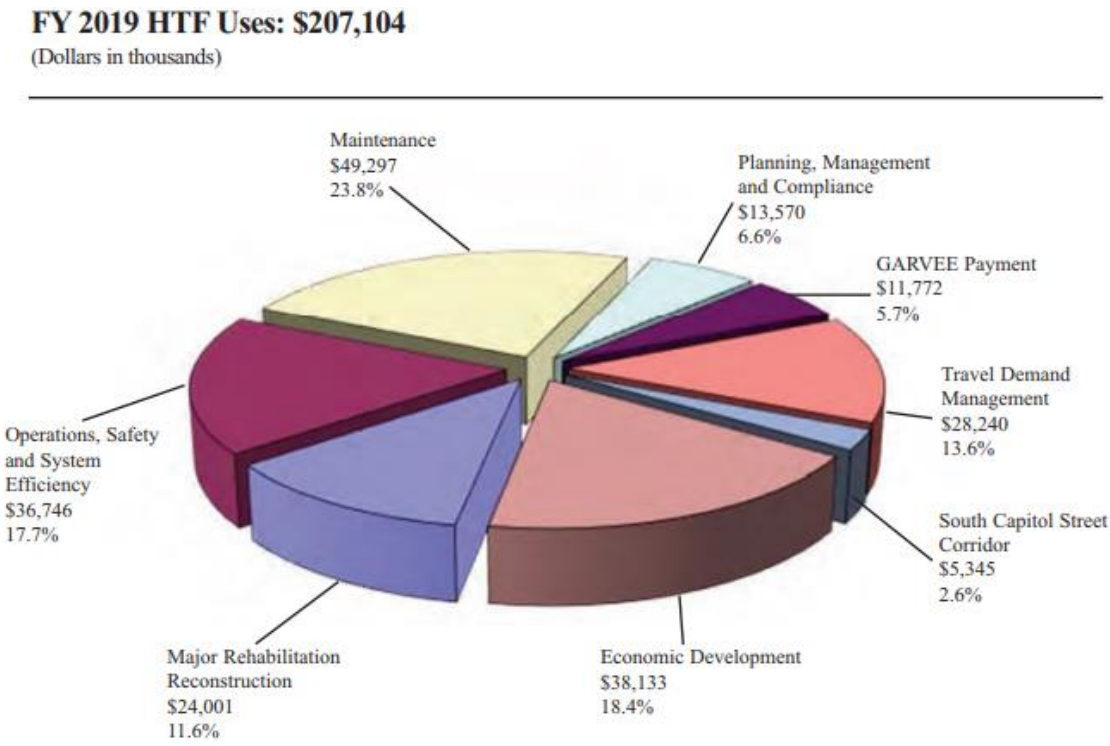


**Figure 12** | FY2019 HTF Uses [14]

In the District's Budget, most TSMO activities fall under the *Operations, Safety, and System Efficiency* (OSSE) category, although some can also be found in *Maintenance*, and *Travel Demand Management*. The main OSSE budget project categories are as follows:

a. Traffic operations and improvements including ITS
b. Signal and streetlight system operations and upgrades
c. Safety program
d. Safe Routes to School
e. Livable Streets
f. Freight and motor coach program
g. Parking program [14].

***Table 7*** shows the funding phases and sources for OSSE projects for FY 18-24.

**Table 7** | Operations, Safety, and System Efficiency HTF 2019 [14].

(Dollars in Thousands)

| Funding By Phase - Prior Funding | | | | | | Proposed Funding | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase | Allotments | Spent | Enc/ID-Adv | Pre-Enc | Balance | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | 6 Yr Total |
| (03) Project Management | 12,978 | 0 | 0 | 0 | 12,978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (04) Construction | 45,532 | 0 | 0 | 0 | 45,532 | 36,746 | 46,874 | 42,576 | 40,911 | 49,640 | 64,696 | 281,443 |
| TOTALS | 58,511 | 0 | 0 | 0 | 58,511 | 36,746 | 46,874 | 42,576 | 40,911 | 49,640 | 64,696 | 281,443 |

| Funding By Source - Prior Funding | | | | | | Proposed Funding | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | Allotments | Spent | Enc/ID-Adv | Pre-Enc | Balance | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023 | FY 2024 | 6 Yr Total |
| Highway Trust Fund (0320) | 10,306 | 0 | 0 | 0 | 10,306 | 6,192 | 7,898 | 7,174 | 6,893 | 8,364 | 10,901 | 47,423 |
| Federal (0350) | 48,205 | 0 | 0 | 0 | 48,205 | 30,554 | 38,976 | 35,402 | 34,017 | 41,275 | 53,795 | 234,020 |
| TOTALS | 58,511 | 0 | 0 | 0 | 58,511 | 36,746 | 46,874 | 42,576 | 40,911 | 49,640 | 64,696 | 281,443 |

| Full Time Equivalent Data | | | |
|---|---|---|---|
| Object | FTE | FY 2019 Budget | % of Project |
| Personal Services | 55.9 | 8,347 | 22.7 |
| Non Personal Services | 0.0 | 28,399 | 77.3 |

Every two years the Washington DC Statewide Transportation Improvement Program (STIP), provides an updated list of all upcoming projects receiving federal funding. Regionally significant projects are also included in the Metropolitan Washington region's six-year Transportation Improvement Program (TIP). Minor changes to the STIP and TIP may be made monthly. TSMO-related projects in the FY 2018-2022 TIP Project List are shown in ***Table 8***.

**Table 8** | District of Columbia TIP TSMO-related Capital Costs [5]

| Project Title | **Total Funds FY18-22 (in $1,000)** |
|---|---|
| **Weigh in Motion Maintenance and Truck Size and Weight Program** | $ 8,101 |
| **District TDM (goDCgo)** | $ 18,480 |
| **Citywide Traffic Safety Improvements: data collection, design, engineering, CCTVs, work zone Management, Transportation Asset Management Plan,** | $ 63,019 |
| **Traffic Operations Improvements Citywide: ITS, MATOC, ATMS, TMCs, Moveable barrier system** | $ 67,522 |
| **Commuter Connections Program** (Regional TDM Program) | $ 5,030 |
| **Professional Capacity-Building Strategy** | $ 6,497 |
| **Traffic Signal Maintenance and Optimization NHPP-STP** | $ 78,762 |
| **High-level review of managed lanes P3 on Rochambeau Bridge, SE/SW Freeway, I-295** | $21,309 |
| **Off-Hours Freight Delivery Pilot Project** | $ 140 |

| | |
|---|---|
| **Fiber communication network upgrade for DDOT traffic signal system** | $ 960 |
| **Interstate Mile Marker Installation Project** | $ 1,000 |

DDOT's TSMO budget is largely federally funded for both projects and salaries with local District funding covering the remaining portion. ***Table 9*** shows the budget for DDOT's TSMO-related divisions in the Mayor's Proposed FY19 Operating Budget document. The table shows the amount of local District funding spent in these divisions, including full-time equivalents (full-time staff positions). Since the Agency was restructured after FY 2017, programs are tracked differently, accounting for the zeros listed in Table 9.

**Table 9 |** FY19 Proposed Operating Budget and FTEs by Division/Program and Activity [13]

| | **Dollars in Thousands** | | | | **Full-Time Equivalents** | | | |
|---|---|---|---|---|---|---|---|---|
| | Actual FY 2016 | Actual FY 2017 | Approved FY 2018 | Proposed FY 2019 | Actual FY 2016 | Actual FY 2017 | Approved FY 2018 | Proposed FY 2019 |
| **Maintenance Division** | 0 | 0 | 11,662 | 12,062 | 0 | 0 | 72 | 70.4 |
| **Traffic Operations and Safety Division** | 0 | 0 | 26,338 | 21,884 | 0 | 0 | 276.4 | 283 |
| **Transportation Engineering and Safety Division** | 0 | 0 | 119 | 205 | 0 | 0 | 1 | 1 |
| **Intelligent Transportation Systems** | 118 | 67 | 0 | 0 | 2.5 | 2.8 | 0 | 0 |
| **Special Events** | 625 | 1,246 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Transportation Ops and Traffic Mgmt** | 10,742 | 14,192 | 0 | 0 | 7.7 | 8.6 | 0 | 0 |
| **Traffic Services Field Operations** | 699 | 560 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Snow** | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |

#### 2.2.1.2. Limitations

DDOT has applied for several federal grants to enhance TSMO in the District, including the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative and the Smart Cities Challenge, but was unsuccessful in these attempts. DDOT is unable to implement many of the traditional TSMO strategies other agencies employ because the District only has 15 miles of freeways, potentially resulting in a less competitive application. In addition, funding is not guaranteed and many federal grants require 50% cost sharing which make them less accessible for a city which would have to plan out funding several years in advance and has many competing responsibilities and needs Furthermore, there is little staff availability to apply for grants.

In the past, DDOT has relied on infrastructure-heavy Operations investments with costly ongoing maintenance. The excitement around ITS investments has often resulted in the ballooning of interested parties and the approval of pet projects, which do not always meet overall agency goals. In addition, vendors tend to shop around for an agency to serve as a project sponsor, and DDOT does not have a unified approach to vet and respond to pitches.

#### 2.2.1.3. Recommendations

This plan will help DDOT identify priority projects and ensure future investments positively impact residents and visitors, advance the mission and vision of the agency, and give staff critical hands-on experience. This framework should assist Operations staff in advocating for and prioritizing TSMO within DDOT and the overall District's budget.

In budgeting for projects, DDOT needs to improve its stakeholder coordination to ensure the agency meets requirements around public space, and documents are well written. In addition, DDOT needs to develop a unified approach to vet and respond to vendor pitches for new technology.

DDOT should also explore additional opportunities to finance new initiatives. For instance, DDOT currently provides Signal Phase and Timing (SPaT) data to external vendors free of charge. However, this data can be monetized. Also, DDOT should investigate utilizing design, build, operate contracts and public-private partnerships; a popular method of financing transportation projects, especially since 2014 when DC passed legislation for such agreements. Furthermore, DDOT may wish to evaluate whether staff resources should be dedicated to apply for TSMO grants, or whether they should focus on implementing projects within the existing budget.

### 2.2.2. Procurement and Contract Management

#### 2.2.2.1. Status

*Solicitation*

Project Managers (PM) request contract solicitation through the ProTrackPlus platform. Project Managers must submit the following documents to request a solicitation: Engineer's Estimate Amount and Statement of Work (SOW); Project Phase; and the Contracting Officer's Technical Representative (COTR), if known.

*Task Order*

A "task order", means a task, delivery, or call order for supplies and/or services placed against an established contract. To submit a task order request, a Project Manager must provide the following information: Project Name, Budget, Funding Type, SOW Title, Project Phase, Estimated Amount, and Contract Type: Architecture & Engineering (A&E) or Indefinite-Delivery-Indefinite-Quantity (IDIQ). For each A&E Task Order, Project Managers are required to select a minimum of three contractors. For each IDIQ Task Order, a Project Manager must select one contractor.

*Office of the Chief Financial Officer*

The Office of the Chief Financial Officer (OCFO) Budget Officer reviews, approves, and assigns a Budget Analyst to a solicitation or task order request on behalf of the OCFO. The Budget Analyst reviews and provides budget attributes to solicitations or task order requests. For projects with Capital Funding and Federal Budget, Budget Analysts are required to provide a Funding Verification document. In addition, the OCFO is tasked with assessing if FHWA approval of a project is necessary. Once approved by the OCFO, Solicitation and Task Order Requests are then sent to the Office of Contracting and Procurement (OCP).

*Office of Contracting and Procurement*

The Contract Officer reviews, approves and assigns a solicitation or task order request to a Contract Specialist on behalf of OCP. After a solicitation or task order is assigned to a Contract Specialist, they will review and generate a solicitation number. Once the solicitation number is created, the Project Manager edits the project's location information, as well as the estimated project start and end dates. OCP will

then publish the project's general information and solicitation documents available to potential contractors through District Transportation Access Portal (DTAP).

*District Transportation Access Portal*

DTAP's Solicitation site provides a list of the projects open for vendors to bid on. DTAP's Architecture & Engineering (A&E) site provides a list of projects already tasked to vendors covered under existing projects.

#### 2.2.2.2. Limitations

ITS and traffic management is rapidly changing, and the current length of time required to undergo contracting and procurement limits DDOT's ability to quickly adapt and incorporate new systems. DDOT has begun testing other approaches, such as P3s and "sandboxes" but the scalability of these approaches is unclear, especially as vendors' willingness to demonstrate or pilot for reduced cost fades quickly as the technology matures. DDOT does have several performance-based contracts, however the agency has not consistently enforced them, which removes the contractor's incentive to improve service delivery.

#### 2.2.2.3. Recommendations

Given the rapid changes in technology, it may be necessary for operations teams to work with OCP to develop methods to expedite bid, proposal and contracting processes. DDOT should enhance performance-based contracts by expanding and strengthening contractor's reporting requirements, or by increasing internal enforcement capacity. In addition, contracts should incorporate updated data sharing and collection requirements to inform performance management and decision making. DDOT can quickly adapt to changing technology by exploring simple procurement methods for emerging technology pilots.

### 2.2.3. Research and Development

#### 2.2.3.1. Status

Within the *Planning and Sustainability Division* (PSD), DDOT's in-house Research, Development, and Technology Transfer Program (the Research team) manages the Agency's research program and coordinates with various internal Agency stakeholders performing research projects. They promote innovative solutions to transportation problems and work with other departments to integrate new technology into DDOT's projects. In addition, DDOT has a research partnership with a regional college

and university consortium led by Howard University. This consortium conducts research projects for DDOT and connects students to career opportunities in transportation. DDOT Operations teams have partnered with the Research team on several projects to date, shown in ***Table 10***. DDOT's research program will play a key role in facilitating future studies.

**Table 10** | Operations Research Projects

| **Name/Description** | Year |
|---|---|
| District Mobility Project assess the performance of the city's transportation network from a system-wide and multimodal perspective | 2016 - ongoing |
| parkDC: Multimodal Value Pricing Pilot for Metered Curbside Parking in Penn Quarter/Chinatown | 2016 - ongoing |
| Smart DC: Smart City Challenge application, a nationwide competition sponsored by the US Department of Transportation encouraging cities to envision how smart technology can help them meet future transportation challenges | 2016 |
| Speed Data Study: Evaluation and comparison of speeds on roadways that had received safety and traffic improvements, before and after the projects were implemented | 2010 |
| Traffic Operations and Parking Plan for the Baseball Park: Provides guidance on how transit riders, drivers, pedestrians and bicycle riders will safely and efficiently travel to and from the new Baseball Park on South Capitol Street | |
| Petworth Parking Management Plan: Analysis of parking regulations and supply around the Georgia Avenue/Petworth metro rail station, in preparation for new development in the area | 2010 |
| On-Site Berths and the Curbside Implications: Freight trip generation research project | Current |
| Analysis of Per-Ride Fare Data for Capital Bikeshare | Current |
| Automated Enforcement of Bus Lanes and Bus Zones | Current |
| Experimental Study for Non-standard Pedestrian Crossing Signs in DC | Current |

DDOT has implemented several pilot projects to reduce congestion. The ParkDC pilot, uses demand to set prices in a downtown neighborhood, to reduce congestion by reducing the time to find parking. Researchers have found anywhere from 8-30% of congestion in central cities is caused by motorists circling for parking [16]. In addition, DDOT is conducting a one-year pick up and drop off zone evening pilot for TNCs south of Dupont Circle to reduce congestion caused by double-parking and blocking bus loading zones in an area with a large nightlife scene.

DDOT is in the initial stages of exploring Connected and Autonomous Vehicles (CAV) technology. Presently, the Research team coordinates a CAV workgroup meeting. For ROP vehicles, DDOT recently installed on-board units (OBUs) with Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, GPS transponders, pothole detection, road surface temperature detection, and CCTV camera feeds with PTZ. These OBUs provide real-time situational awareness on critical arterials and

freeways, and as the first use of outside CV technology in the Agency, are a way to promote and build up DDOT's experience with this new technology. The Agency has implemented a pilot Vehicle-to-Infrastructure (V2I) partnership with external vendors, in which signal phase and timing (SPaT) data is shared directly with onboard vehicle technology, allowing drivers to view when signals are going to change on their dashboards. Over 600 intersections in the District have the ability to share this data. In addition, DDOT and DC Sustainable Transportation (DCST) are partnering on a study which will evaluate and make recommendations about the short and mid-term impacts of autonomous vehicles (AVs) on the District. In addition, a local Business Improvement District released a request for information (RFI) in March 2018 to explore the possibility of running an autonomous shuttle as a transit solution. The advantage of a BID-run project is an expedited procurement process. DDOT is supporting this process by providing technical expertise and guidance and managing the permitting process.

#### 2.2.3.2. Limitations

The primary limitation for Research and Development in TSMO is staff capacity. The DDOT Research team has two full-time staff, which are supplemented by its internship program. The Research team assists other DDOT teams formulate their research projects, but the bulk of the work is conducted by non-Research staff members. It is not always possible to prioritize the most important investments and dedicate resources to potential research projects and because both Operations and Research have limited capacity.

#### 2.2.3.3. Recommendations

New Operations research projects should evaluate the feasibility of adopting alternative strategies to improve reliability for multimodal operations, evaluate the utility of existing pilot technologies and strategies, research best practices, and facilitate pilot projects for emerging technologies and strategies. This plan prioritizes several joint Operations and Research projects, itemized in the strategies section at the end of this section.

To guide CAV deployment in the future, DDOT should create a CAV strategic plan with agency-wide input. Such a plan should include several components, including: identifying potential pilot projects and testing locations, crafting new legislation and policy needs, developing an evaluation methodology, identifying potential funding sources, developing CAV design procedures and equipment specifications, creating a communications strategy, and prioritizing projects for implementation. New policies or legislation should provide incentives and disincentives to encourage the use of high-capacity CAVs to help the District to reach its 75% non-SOV mode share goal by 2032.

### 2.2.4. Policies and Guidelines

#### 2.2.4.1. Status

the District has several helpful policies and guidelines for implementing TSMO. These include two regional Memorandum of Agreements (MOAs): MATOC and CapWIN. Capital Wireless Information Net (CapWIN) is a coalition of regional law enforcement, fire, EMS, and transportation agencies to advance data communications for daily operations and event coordination across all participating agencies. Also, FEMSD has tailored some TIM training materials specific to the District's roadway condition and layout. Lastly, the District is one of a handful of jurisdictions with authorizing legislation already in place to permit autonomous vehicles to operate on its streets.

#### 2.2.4.2. Limitations

The District needs several new laws and agreements to facilitate Traffic Incident Management. All 50 U.S. states, except the District, have passed "Move Over" laws which require motorists to change lanes and or slow down when approaching an authorized vehicle with flashing lights on the side of the road. Additionally, the District does not have a "Driver Removal/Move It" law, which requires motorists involved in minor crashes to move their vehicles out of travel lanes. In addition, the District does not have a "Quick Clearance" agreement, which clarifies the responsibilities of first responders, emergency personnel, DDOT, and DPW to clear vehicles and debris from the roadway for normal traffic operations to resume as quickly as possible.

#### 2.2.4.3. Recommendations

A "Quick Clearance" MOU had been under review by several local agencies for several years. DDOT should re-start the process of negotiating this agreement as it will greatly facilitate traffic incident management in the District. In addition, DDOT should inform DC councilmembers and the Mayor about the importance of passing "Move Over" and "Move It" laws to protect first responders and reduce non-recurring congestion. These laws are currently part of the 2nd proposed Vision Zero rulemaking, which was submitted to the City Council over the summer of 2018. In addition, DDOT needs to create and update several standard operating procedures (SOPs) for its Operations teams, which is discussed in greater detail in ***Section 3***.

### 2.2.5. Objectives and Strategies

**Table 11** | Business Processes Objectives and Strategies

| Objective | Strategies |
|---|---|
| Develop a comprehensive staffing and workforce development plan | Collaborate with HR to identify opportunities to improve flexibility in hiring and staff |
| | Enhance professional development opportunities for existing staff |
| | Investigate need for additional staff resources |
| | Enhance professional development opportunities for existing staff |
| Explore methods to increase funding and enhance the procurement process | Explore new funding mechanisms |
| | Explore innovative contracting mechanisms |
| | Integrate TSMO into existing budget and allocation processes |
| Improve routine operations and maintenance processes | Improve resource management process |
| | Create or revise standard operating procedures |

## 2.3. Resources

DDOT is in the process of shifting its philosophy from system expansion to system management due to the availability of multifunctional field sensors with better data storage, power management, and built-in communications in a smaller footprint; the increasing availability of probe vehicle data; and better and more accessible data processing and analytics. In addition, Operations teams are shifting from a single occupant vehicle (SOV) focus, to a more multimodal operations management approach which require staffing, resources, and data management changes. This shift will align with the Agency's and City's environmental and transportation mode share goals. To help prioritize future TSMO needs, an assessment of current resources and gaps are presented below.

### 2.3.1. Staffing and Workforce Development

This section is concerned with staffing and workforce development for specific divisions in the Operations and Project Delivery Administrations. Many of the recommendations developed here are applicable throughout the Agency. Implementing an effective TSMO program requires a cultural and business shift as well as technological change. Some of the Agency's outstanding needs include integrating philosophy, technology, and soft skills into educational programs; positioning transportation

as a viable career direction for professionals in other fields where expertise is needed; and defining new and updating position descriptions given continuously evolving technical gaps. Developing a comprehensive staffing plan is a critical first step in addressing these needs. This plan should address the need to hire multi-skilled and flexible staff, address morale issues, fulfill training needs, assess resource availability, estimate future demand, and present strategies to meet shortfalls.

#### 2.3.1.1. Status

TOSD, the Parking Operations Branch within the City-wide Program Support Division, and the Traffic Engineering and Safety Division will be the primary actors in implementing many of the recommendations in this plan, while the ITS Systems Integration and Development Branch team (in TOSD) will lead planning, deployment and integration of new systems. Each team's description of duties is provided in Section 2.1.1.1.

Due to changes in technology and operational demand, TOSD employees need to be flexible and have a wide variety of knowledge and skills. TOSD personnel have demanding jobs that require daily interaction with the public , remaining outside in all types of weather, and working on major holidays. Staff participate in several trainings upon being hired, including on-the-job trainings. In addition, Operations staff participate in annual PACE conference trainings.

The Transportation Operations & Safety Division (TOSD) is one of the largest Divisions in the agency because of the number of Traffic Control Officers and Safety Techs. DDOT recently reached sufficient staffing levels for its Safety Tech team. Due to complaints about absences from the public, the Research team conducted a study of Safety Tech absenteeism. They found absence rates were no more frequent than in any other line of work, but due to inadequate staffing levels and their public position absences were more noticeable. To address this, DDOT hired more staff, and the Agency now has a reserve of Safety Techs available to work on-call in case of any last-minute absences, ensuring all children in the District can access their schools safely.

#### 2.3.1.2. Limitations

The District's recruitment process inhibits TSMO functions. The current hiring process limits job postings to specific traditional job categories, instead of attracting individuals with multiple skillsets required for the changing work. In addition, the majority of position descriptions have outdated requirements, which are difficult to update because of the necessity of negotiating with labor unions.

Educational and professional development gaps also limit TSMO integration at DDOT. Soft skills, such as interpretation, customer service, resourcefulness, agility, interpretation, are becoming increasingly critical. For example, low morale on some teams has highlighted the need for managers to receive supervisory training to assist in building productive relationships with employees. Also, staff need targeted refresher courses on best Operational practices and safety. However, professional and vocational curricula are either not readily available or not comprehensive enough. For example, while TCOs and Safety Techs receive on-the-job training, there is not an official training program for this important work. In addition, staff often lack willingness or ability to adapt to changing conditions. Furthermore, there are several long-term staff members, responsible for crucial Operations work who have not been able to train successors or document their knowledge.

Managers of TCOs and Safety Techs are responsible for important Operations functions, while having dozens of direct reports. Work demands leave little time in managers' schedules for personnel management or strategic planning, and TOSD does not have any mid-level staff dedicated to operational planning. This situation has contributed to TOSD operating in a reactive, rather than a proactive way.

DDOT needs to improve managing staff resources. In the past, DDOT has committed Operations teams to new functions before evaluating staff capacity as illustrated when DDOT assumed responsibility from the police department of managing special events traffic  without analyzing resources, which led to a staffing shortage. On occasion, DDOT has hired new staff without budgeting for their required equipment. This has left TCOs without necessary supplies, such as with reflective coats in the wintertime or limited fleet vehicles to transport certain shifts to their worksites.

#### 2.3.1.3. Recommendations

To address these challenges, DDOT should develop a TSMO staffing plan. The staffing plan should address three key objectives: education and professional development, recruiting new talent, and staff motivation. In addition, this plan should categorize all TSMO positions and capabilities throughout the Agency, assess resource availability, estimate future demand, and present strategies to meet shortfalls. The costs of staffing and equipment for special event management should be quantified to assist the agency in meeting commitments and advocating for sufficient funding. Increasing staffing levels for front line workers will provide better flexibility in scheduling. Hiring planners and mid-level staff to assist in TSMO Program implementation will also enable Operations teams to be more strategic in their work.

Education and professional development is an important focus of the staffing plan. DDOT Operations teams, in coordination with the **Workforce and Organizational Development Branch** in the

*Administrative Services Division,* need to organize regular, targeted training opportunities for staff at all levels. These trainings should include academies for specific disciplines with special emphasis in the National Incident Management System (NIMs). DDOT should encourage TCO, ROP, and TMC staff to enroll in professional certification programs and create a custom training program for the District's TCO intersection operations. In addition, TOSD managers should develop an introductory TSMO training session to take place during existing, recurring training conferences for Operations staff. Importantly, trainings should employ accessible, user-friendly technology to ensure information retention.

TSMO Champions will serve an important role in motivating staff attendance in trainings. Safety Techs have time for trainings during school breaks, so managers should work to schedule trainings during this time. DDOT should provide management training to supervisors and leaders and consider hiring additional management staff to distribute direct report load.

Operations staff should create a mentorship program to foster institutional knowledge retention and provide opportunities for advancement. As a part of this program, managers should arrange opportunities for inter-jurisdictional exchanges, including visits to other states' TMCs, and deployment centers. Managers should also coordinate with other teams to provide crossover training opportunities for staff to learn about each other's work.

These education and professional development initiatives will provide crucial hands-on experience in preparation for real-world events.

Operations managers will need to work with DCHR to better navigate the current hiring process and highlight flexible candidates with a variety of skillsets. The staffing plan should outline means for staff involved in the hiring process to network outside of traditional spaces, including leveraging professional organizations, attending local technology and data-oriented meetup groups, and through social media. Existing internship and fellowship programs should be better utilized to recruit staff with needed skillsets and experiences. Changes to the budgeting and recruitment processes should be made to improve the recruitment process. For instance, when new staff are hired, budgets should include new equipment to ensure no employee lacks the proper safety gear or access.

### 2.3.2. Resource Management and Systems Engineering

Multifunctional field sensors, greater probe data availability, and improved data analytics have shifted DDOT's resource management focus from infrastructure expansion to system management. As previous

resource plans were created with an infrastructure-reliant focus, they will need to be updated to account for a TSMO Resource Management Plan.

#### 2.3.2.1. Status

Including systems engineering in planning and design is important for sustaining a quickly evolving TSMO program. DDOT is committed to systems engineering approaches with deployments because systems engineering reduces project costs and duration, while increasing performance and quality.

Several plans play an important role in systems engineering for the Washington, DC Area. The Metropolitan Washington Regional Intelligent Transportation Systems Architecture (MWRITSA) was last updated on December 13, 2007. The District of Columbia ITS Architecture was developed in 2011 [3]. The DDOT ITS Master Plan was completed in December 2013.

DDOT's current TSMO assets are listed below.

- Field Assets
  - CCTV cameras
  - Fixed Dynamic Message Signs (DMS)
  - Portable DMS
  - Reversible DMS
  - Roadway sensors – traffic volume, speed, classification
  - Traffic signals
  - ROP vehicles
  - WIM stations
- TMC Facilities
  - HSEMA – primary, co-located with other agencies
  - Reeves Center – secondary, signal control
  - HQ – secondary, situational awareness for leadership
- Communications
  - 270-mile copper and fiber network
  - "last mile" wireless links, cellular, and GPRS communications, and connections between TMCs provided by DC Net, the telecommunications provider of the DC Government's Office of the Chief Technology Officer.
- Software and Data Resources (*see Section 2.3.3*)
- Standard Operating Procedures and User Guides (*see Section 3*)

DDOT's Operations teams are continually working to improve and better manage their TSMO field assets. The Traffic Engineering & Safety Division has a Traffic Signal Optimization Program to improve each traffic signal in the system every five years, with some regularly targeted adjustments. The Agency has implemented several National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) standards. To allow for better integration with the central ATMS, easier maintenance,

and reduced costs, DDOT intends to implement NTCIP standards for the city's 1,600+ traffic signals. DDOT recently added 22 CCTV cameras along freeways, and construction is underway on the backbone fiber-optic network along freeways to improve remote connection for viewing and controlling CCTV cameras, dynamic message signs, and traffic signals. The Agency has begun construction to add 36 CCTV cameras on critical arterials. DDOT recently added Connected Vehicle on-board units with GPS to its ROP vehicles with the capability to detect speed, road surface temperature, and potholes. In addition, ROP vehicles are now equipped with mobile CCTV cameras and dynamic message signs.

#### 2.3.2.2. Limitations

The DDOT ITS Master Plan does not reflect current priorities and technological advances. In addition, with frequent changes and deployments, it can be difficult to keep track of all of the assets in the field.

#### 2.3.2.3. Recommendations

This plan largely replaces the ITS Master Plan. Previously, DDOT had been focused on infrastructure-heavy investments for the Agency's ITS program but TOSD is working to shift that focus to infrastructure-light TSMO. For instance, instead installing roadway sensors, which require ongoing maintenance, it may be more cost effective and accurate to purchase traffic volume and speed data from INRIX or other sources. Also, for the Multimodal Value Pricing Pilot for Metered Curbside Parking in the Penn Quarter/Chinatown neighborhood, instead of installing sensors in every parking space to assess parking occupancy, DDOT supplemented a reduced number of in-ground sensors with historic usage data.

DDOT should develop a TSMO Resource Management Plan. This plan should employ a systems engineering approach; include a complete inventory of all assets; ensure all assets are centralized; and prioritize and identify funding for the maintenance, upgrades and replacement of the District's various TSMO assets, including traffic control devices, communications infrastructure, data, public outreach platforms and other ITS devices. This plan should also outline an approach and protocols for the adoption of new technology.

### 2.3.3. Data Management

DDOT's Operations teams use data for some decision support; however, the Agency could expand the use of data for decision support and to enhance other business practices. Operations teams have struggled with obtaining reliable data, standardizing and integrating many disparate data sources, and working with non-traditional data sources.

### 2.3.3.1. Status

DDOT's various Operations teams collect a wide variety of data and have developed a data curation program. Operations teams use traffic and incident data to guide decisions around ROP deployment, CCTV camera monitoring, and special event planning. **Figure *13*** shows the existing data sources Operations staff use to provide situational awareness and evaluate performance.

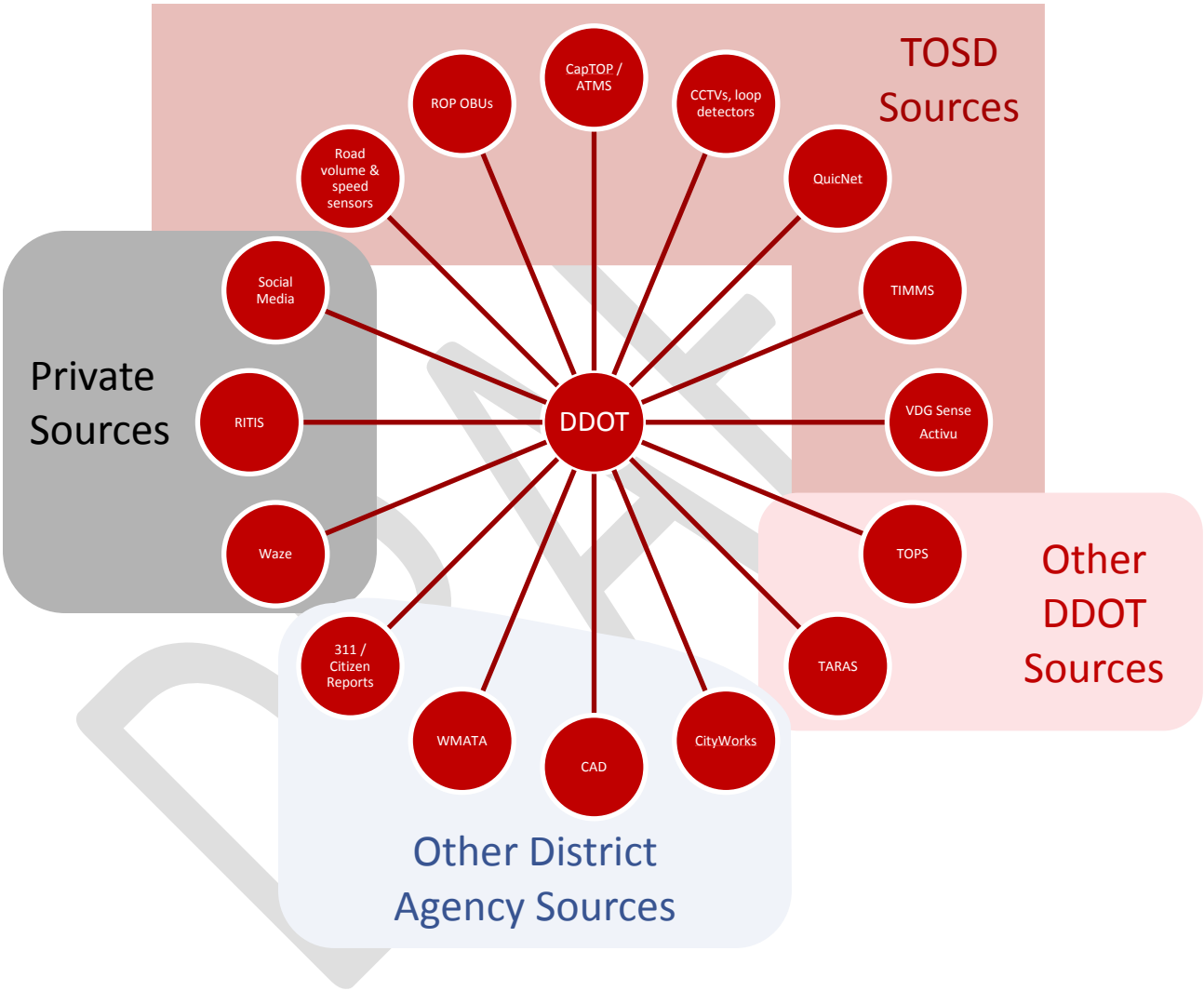


**Figure 13** | DDOT Operations Data Sources

- CapTOP/ATMS and associated databases – event management, DMS control, CCTV control
- QuicNet – traffic signal control
- RITIS – regional event and travel time information
- CADD – information on MPD events
- TOPS – information on active occupancy permits

- TIMMS – traffic signal status and repair tracking, maintained by contractor
- CityWorks – reporting other infrastructure repair needs
- VDG Sense – videowall system for 55 M St and Reeves Center
- Activu – videowall system for HSEMA/JAHOC
- TARAS – software that manages crash data MPD reports.
- INRIX data – vehicle speed and travel time data
- WMATA – vehicle occupancy and real-time location data
- Citizen reports via call centers, and 311 website/application – incident detection and service requests
- Social media, particularly Twitter – incident detection and service requests
- CCTV cameras and real time loop detectors – incident detection and special event information
- Roadway volume and speed sensors (video, acoustic, microwave) – vehicle speed and volume data
- Roadway volume, speed, and classification sensors (loops and infrared) – vehicle speed and volume data
- ROP On Board Units - Automatic Vehicle Location (AVL) for ROP vehicles – real-time ROP vehicle locations

Operations teams have expanded data archiving and curation, by processing raw data, performing quality assurance procedures, and inputting missing data based on historical trends. Also, TOSD repackages the data in a standardized format, particularly through the creation of dashboards in Tableau, to assist in performance-based decision making. In addition, Operations teams are geocoding their data to identify spatial trends and improve performance. The majority of data generated by TMC and ROP is already geocoded; DDOT has GPS devices on most of its ROP vehicles and plans to install additional devices on the remaining vehicles. In addition, the Office of Information Technology and Innovation, is working to create a Collector application to provide real-time information with the locations of TCO deployments. Also, DDOT developed a Signal Phase and Timing (SPaT) portal and is sharing real-time signal timing data with outside vendors to provide drivers with “time-to-green” in in-vehicle displays at over 600 intersections.

#### 2.3.3.2. Limitations

A major issue DDOT is facing is the lack of reliable data collected, particularly regarding incident response times. When an incident is cleared, MPD and FEMS do not report when they leave the scene to

TMC which results in incident records remaining open in CapTOP long after normal traffic operations have resumed. This situation makes it difficult to accurately evaluate incident response performance.

Another issue for TMC operators is the sheer number of data sources to monitor. For instance, MPD's CAD (Computer-Aided Dispatch) includes non-transportation related calls, which require active screening by an operator. Waze generates a large amount of data on incidents, but there is potential for duplicative and inaccurate reporting. In addition, TMC operators must enter some events into multiple systems, which is inefficient.

DDOT contracts with several entities to manage operations work and deploying new technology. However, some new systems' data are difficult to access, analyze, and edit because contracts with outside vendors lack specific instructions.

The DDOT Performance Division, in the Performance Administration, is the ideal candidate to assist the TSMO team in rearranging their data structure; however, this their capacity is limited. The Performance Division is responsible for developing, tracking, and reporting the Department's performance metrics in a timely manner to ensure strategic goals are met. It also works to improve business processes and analysis of the work order management system, permitting system, and other work processing databases.

#### 2.3.3.3. Recommendations

The Operations Administration plans to strengthen its TSMO data management processes in the following ways:

- **Database Consolidation/Integration** – filter and integrate all data sources into one single system for reporting, monitoring, and addressing events. This will eliminate the need for duplicate data entry, reduce the burden on operators to monitor several systems, and more accurately represent TSMO functions.
- **"Big Data" Analytics** – Develop capabilities to use emerging and non-traditional data sources, such as Waze and other location-based services, to identify behavior trends and support existing TSMO service areas. Harnessing large datasets like these will paint a clearer and more holistic view of the how the District's transportation system is used.

DDOT Operations teams should consult with the Performance Division and OITI to identify the most efficient ways to integrate its data sources and incorporate non-traditional data sources. DDOT should evaluate current Operations staff capacity to undertake these responsibilities and hire additional staff if necessary.

### 2.3.4. Objectives and Strategies

**Table 12** | Resources Objectives and Strategies

| Objective | Strategies |
|---|---|
| Analyze data to improve performance and inform decision makers | Establish and track performance metrics to evaluate effectiveness of existing programs |
| | Use data to optimize operations |
| | Use data to support investment decisions |
| Centralize and modernize traffic management technology | Acquire, replace, and repair supportive hardware |
| | Carry out upgrades to enable advanced signal system operations |
| | Improve field-to-center communications reliability and bandwidth |
| | Improve CCTV system quality and accessibility |
| Conduct research and pilot projects | Investigate and conduct pilot projects for emerging technologies and strategies |
| | Evaluate feasibility of adopting alternative strategies to improve reliability for multimodal operations |
| | Evaluate utility of existing pilot technologies and strategies |
| Improve data collection and management for traffic management systems | Establish new sources of data to improve situational awareness |
| | Integrate and consolidate information systems |
| | Improve accessibility and awareness of existing data across agency |

# 3. Implementation and Deployment

This section contains DDOT's TSMO implementation plan, which outlines the efforts to improve infrastructure, communications, or workflow procedures that support major service areas for TSMO.

## 3.1. TSMO Priorities for Services, Projects, and Activities

Before advancing to the next level in the TSMO Capability Maturity Model (CMM) greater coordination and systems management is necessary. In addition to the programmatic objectives and strategies identified in ***Section 2***, DDOT identified several tactical objectives and strategies to guide the immediate implementation of TSMO by Operations teams. The tactical recommendations were developed to realize the TSMO goals and objectives. They were informed by a series of interviews with Operations staff and

best practices research. Individual strategies are characterized by the primary service area in the tables below. These tables show the primary service area for each strategy; however, many of the strategies could be categorized under several different service areas. The tactical objectives are provided in bold typeface in the tables.

### 3.1.1. TSMO Service Areas

There are five service areas the TSMO implementation plan will focus on:

1. Arterial Management
2. Emergency/Incident Management
3. Special Event Management
4. Traveler Information
5. Work Zone Management

These service areas were chosen because the District's dominant transit mode is managed by WMATA (an independent agency), primarily arterial system, special events, and pace of new development.

#### 3.1.1.1. Arterial Management

To improve DDOT's arterial management, Operations teams will focus on improvements in traffic monitoring and data collection, multimodal management, and traffic signal management.

##### 3.1.1.1.1. Current Status

As previously mentioned, the District's arterial surface transportation system has less than 15 miles of freeway, and has the third-highest percentage of non-vehicle mode share among US cities.

The District's TMC in the UCC and the TOC in the Reeves Center monitors the District's transportation conditions using CCTVs, ROP OBUs, QuicNet, RITIS, ROP, TCO, Safety Tech dispatches, MPD and FEMS computer aided dispatch (CAD), VDG Sense and Activu, Twitter, citizen reports via call centers, and 311 requests. The TMC communicates with ROP, TCOs, Safety Techs and Fleet Maintenance crews using 900 megahertz radios and mobile phones. There is an SOP document for the TMC.

DDOT has deployed Transit Signal Priority along 16$^{th}$ Street and Georgia Avenue/7$^{th}$ Street. The ROP vehicles' OBUs are being utilized to improve real-time situational awareness on critical arterials and freeways to enhance Operations via data and to promote the use of CV technology. DDOT is exploring Connected and Autonomous Vehicles (CAV) technology to better manage arterial transportation through the SPaT pilot, partnership with DCST on the AV study, and support of the BID-run AV shuttle study.

#### 3.1.1.1.2. Limitations

DDOT needs to enhance and expand its policies, guidelines and SOPs for performing TSMO functions. In addition, there are available, but underutilized, data sources which could improve situational awareness and performance management. Elements of DDOT's signal and supportive hardware is phasing out and requires frequent maintenance. Parts of DDOT's CCTVs and communications networks have limited bandwidth and accessibility.

The TMC's monitoring efforts are primarily focused on road conditions for personal vehicles and are less equipped to monitor bicycle, pedestrian and transit travel. Multimodal operations data is less accessible than vehicle data, and modeling software for bicycling, walking, and transit is very expensive. Transit ridership has decreased in recent years in Washington, DC while TNC use has increased. Vehicle traffic congestion in the region has shifted due stable fuel and automobile prices. The District will need to try more innovative strategies to maintain the appeal of its multimodal transportation options and achieve the goal of 75% non SOV mode share by 2032.

In addition, like many cities, accommodating increasing demands for curbside space is a challenge due to the prevalence of TMCs and the growth in online shopping. Both trends increase congestion when vehicles stop or park illegally and double park.

#### 3.1.1.1.3. Recommendations

DDOT's SOPs should be more user-friendly and into a digitized, searchable format. Additional SOPs need to be written on TCO intersection operations, work zone management, portable DMS deployment, and real-time signal adjustments.

Before DDOT is able to expand SPaT data sharing to other automobile companies and potentially monetize the data, Operations teams need to create a real-time repository of signal timing plans and standardized MAP data. In addition, they will need to develop a data portal and vetting process for partner access to MAP data, signal timing plans, and real-time signal timing.

DDOT should employ several strategies to encourage multimodal travel. The Signal Optimization Program should prioritize sustainable transportation modes above SOVs. . In addition, DDOT should evaluate the costs and benefits of implementing congestion pricing schemes and expanding the parkDC pilot and evaluate the Dupont Circle TNC loading zone pilot to inform future efforts in demand-based curbside management.

DDOT needs to establish new private and public-sector data sources, and integrate and consolidate information systems to improve situational awareness. In addition, DDOT will need to evaluate the utility of existing pilot technologies and strategies, and assess the costs and benefits of emerging technology deployments before deploying new ITS assets.

#### 3.1.1.2. Emergency & Incident Management

Emergency management is designed to provide users with a safe and efficient transportation system during an emergency. Incident management is defined as verifying, responding to, and clearing traffic incidents in the least disruptive manner towards transportation system users [31].

##### 3.1.1.2.1. Status

DDOT partners with several District, regional, and federal agencies to manage incidents and special events.. The TMC detects incidents and emergencies through several means: CCTVs, MPD, 311, RITIS, HSEMA, and dispatches from ROP or TCOs in the field. Then TMC staff will coordinate DDOT's response to these events, through traffic signal adjustments; deploying TCOs, ROP and/or dynamic message signs (DMS), FEMS and MPD. For minor incidents on lower volume roadways, TMC staff will monitor the incident and potentially deploy a TCO. ROP drivers lead the response for minor repairs or disabled vehicles on high volume arterials or freeways. For major collisions and incidents on high volume arterials or freeways, MPD and FEMS lead the response, but ROP and TCOs manage traffic operations while investigations are conducted, and ROP assist in clearing debris or vehicles. Following major incidents, HSEMA conducts after-action exercises with TMC operators, ROP, TCOs, police, fire, EMS, and event organizers/staff.

DDOT has several helpful Emergency & Incident Management policies and guidelines. There are SOPs for both the TMC and ROP.

##### 3.1.1.2.2. Limitations

The District lacks laws, policies, and guidelines that would improve incident management. Traffic Incident Management (TIM) trainings have not occurred in the District for several years. Further the District would benefit from improved collaboration between incident management agencies, and updated methods for communicating information about incidents to the public. The primary sources informing incident management personnel deployments are on-the-job training and knowledge of the city's traffic patterns, rather than analyzing emerging patterns in incidents over time. In addition, the District's freeway system is lacking mile markers, which makes it difficult to communicate the exact

location of incidents. Some of DDOT's CCTV feeds remain inaccessible to certain stakeholders, which reduces situational awareness.

#### 3.1.1.2.3. Recommendations

DDOT should expand coordination with external stakeholders to improve emergency and incident management in the District, including interagency agreements, new legislation, and cross-agency networking. All personnel responding to traffic incidents need to receive training, which requires inter-agency collaboration. Also, improving the District's capacity to integrate new data sources into existing platforms will improve situational awareness, as well as the ability of teams to use data to optimize Operations and enhance performance management. In addition, TOSD needs to create and revise SOPs that pertain to emergency and incident management. The ITS team needs to Improve CCTV system quality and accessibility as well as field-to-center communications reliability and bandwidth to improve situational awareness.

### 3.1.1.3. Special Event Management

Special event management provides users with a safe and efficiently managed transportation system during a planned special event. Strategies for improving special event management include providing traveler information, parking management, and multi-agency coordination and training [31]. As the nation's capital, this initiative is important due to the large number of events held each year.

#### 3.1.1.3.1. Status

The wide variety of District hosted events are coordinated by many stakeholder agencies. The Mayor's Special Event Task Group (MSETG) plays an important role in vetting plans and coordinating between different agencies for major special events. DDOT employs a variety of strategies to manage special events, including scaling deployment based on the size and character of the event. Depending on the size and nature of an event, DDOT will develop Traffic Operations and Parking Plans (TOPPs), deploy TCOs to manage traffic at intersections, deploy ROP personnel to assist with road closures and DMS deployments, require TOC personnel to adjust signal timing, and/or monitor will monitor CCTVs and other sources to alert field staff to changing conditions. In addition, DDOT provides road closure information for major events to Google and Waze.

#### 3.1.1.3.2. Limitations

DDOT has years of experience in managing special events but needs solutions to evaluate and standardize existing practices, in addition to continuous updates to traffic management technology. In addition, there are opportunities to improve multimodal congestion management at special events.

#### 3.1.1.3.3. Recommendations

The District should better utilize existing data sources and integrate new data sources, particularly regarding bicycle and pedestrian movements, to improve special event management and inform DDOT leadership about the challenges and successes of Operations work. DDOT should modernize traffic management technology to improve special event management, particularly when staff are working in mobile units and deployed in the field. DDOT needs to standardize routine operations and maintenance processes, including developing and improving SOPs, in addition to other routine operations and maintenance processes.

### 3.1.1.4. Traveler Information

Traveler information is designed to provide transportation system users with enough information to choose the safest and most efficient mode and route of travel. Common strategies for improving traveler information include collecting and sharing data on travel conditions and providing trip planning tools [31].

#### 3.1.1.4.1. Status

DDOT's Operations teams have several channels for providing transportation information to travelers. TOSD deploys both fixed and portable Dynamic Message Signs and temporary signage. Through DDOT's website, alerts, press releases, newsletters and social media, the Agency can inform the public of major road closures and other transportation-related topics. goDCgo assists properties in the District in providing information about travel choices to their residents, employees, and/or visitors. DDOT provides real-time special event road closure information to Google and Waze. DDOT's parkDC app provides real-time parking availability and rate information for the Penn Quarter and Chinatown neighborhoods in the area bounded by H Street, 3rd Street, E Street and 11th Street NW. DDOT's pilot Signal Phase and Timing Portal (SPaT) represents the future of providing hyper-local and real-time traveler information to the public.

#### 3.1.1.4.2. Limitations

Some of DDOT's road closure data is not detailed enough to share with the public. The District lacks comprehensive truck route and mile marker signage on its freeways. In addition, DDOT's operations teams are not currently working with the Washington region's TDM entities to help manage transportation demand. Furthermore, there are currently no branches of DDOT dedicated to active transportation demand management, rather, several teams are engaged in this type of work.

#### 3.1.1.4.3. Recommendations

To improve the provision of traveler information, DDOT needs to install signage, improve data collection and management, explore emerging public communication means, and pursue collaborations on TDM outreach initiatives. To support the Agency's multimodal goals, DDOT should create an ATDM branch within the Operations Administration, and expand the ParkDC pilot outside of Chinatown/Penn Quarter neighborhood to communicate parking availability to the public and reduce parking demand and/or circling for parking.

### 3.1.1.5. Work Zone Management

Work zone management involves organizing and operating areas impacted by road or rail construction to minimize traffic delays, maintain safety for workers as well as travelers, and accomplish the work efficiently [31]. The primary strategies DDOT will focus on to improve work zone management are improving construction coordination, data management, and traveler information.

#### 3.1.1.5.1. Status

To request the right of way for a work zone or construction staging area on public space, project managers must submit a public space permit application, as well as a temporary traffic control plan to DDOT's Permitting Center. Users must submit these applications electronically, either through an online application) the Transportation Online Permit System (TOPS)) or by scanning documents at the Permitting Center. In the Public Space Regulation Division (PSRD), the Public Space Permit team processes all applications for public space permits, including occupancy permits for work zones, while the Plan Review team provides technical reviews and comments for public space permit applications. The Public Space Locator is an online interactive map application that gives the public the ability to view permits on an interactive map.

#### 3.1.1.5.2. Limitations

Although applicants must submit the timeline for their projects, real-time changes to these timelines are not available in DDOT's GIS permit data, which limits the availability to coordinate construction activities and provide accurate work zone data to the traveling public. The DDOT Work Zone Temporary Traffic Control Manual, which is provided as a resource for project managers in preparing temporary traffic control plans, has not been updated since 2006. In addition, there is currently no SOP on work zone management.

#### 3.1.1.5.3. Recommendations

Greater coordination is needed between PSRD and TOSD to develop a process for identifying and coordinating conflicting road closures. In addition, DDOT should improve its existing work zone data, integrate it with traffic management systems, and investigate sharing this information with navigation application providers. Finally, DDOT's divisions should update its policies, guidelines, and resources regarding work zone management

## 3.2. Performance Assessment

DDOT's Operations teams, with assistance from the Performance Management Division, will assess the performance of the TSMO program, as well as the efficiency and reliability of the transportation network, on an annual basis.

### 3.2.1. Status

This plan drew on many previous efforts to develop performance measures for DDOT's TSMO program, which are shown in **Table *13*** below.

TOSD traditionally has collected performance data pertaining to Traffic Incident Management. The graphic in ***Figure 14*** shows the steps involved in identifying, responding to, and clearing a traffic incident, including the difference between the Roadway Clearance time and the Incident Clearance Time.

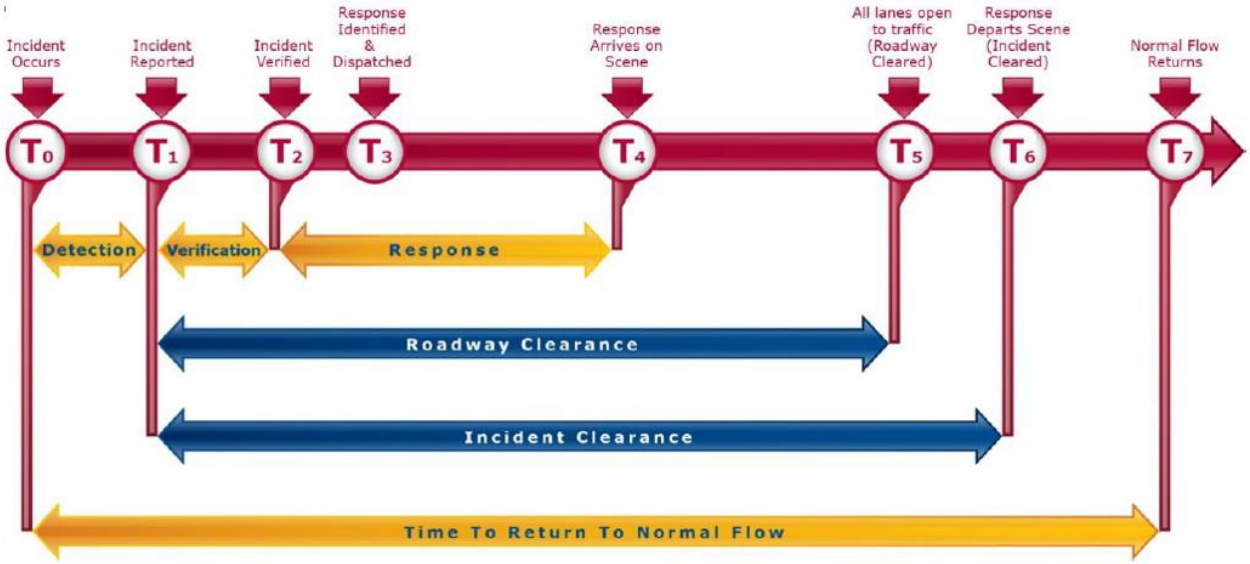


**Figure 14** | Traffic Incident Timeline

Operations staff have created several performance management dashboards in DDOT's online Tableau platform, which include:

- Portable DMS Status – number of communications timeouts by device
- TMC Performance
  - Number and types of events responded to by each operator, and by each shift
  - Number of recent traffic signal events by shift
  - Number of open disabled vehicle and collision events by shift
  - Number of events opened by and closed by individual operators
- ROP Performance
  - Response & On Scene Time for addressing Collision and Disabled Vehicle events
  - Response & On Scene Time for events reported by ROP staff
  - Total event types addressed by shift
  - Total event types addressed by individual drivers

While many of these measures are too specific to evaluate the TSMO program, all can be used to measure certain TOSD teams' performance and to optimize individual Operations tasks.

The District Mobility Project identified multimodal performance measures with reliable data sources monitoring multimodal congestion and mobility in the District, and many of these metrics were incorporated into the TSMO performance measures. The Performance Management Division has identified Transportation Performance Measures for DDOT as required by Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act, which are incorporated in the TSMO performance measures [20].

### 3.2.2. Limitations

DDOT has struggled with obtaining accurate data, particularly regarding incident clearance times from FEMS and MPD, because the agency has limited access to the original data sources, or in other cases because the data collection process does not sufficiently provide detailed or timely information. In addition, many of DDOT's TSMO-related data sources are not readily accessible outside of the team in charge of data collection. Partly because of these limitations, DDOT has not been able to proactively analyze data to improve performance and inform decision makers for some Operations functions.

### 3.2.3. Recommendations

To address these issues, DDOT should continue to refine its data collection and management processes. DDOT should use data to optimize operations, and support investment decisions. Based on the vision,

mission, goals and objectives in the TSMO Plan, as well as available data sources, the metrics in ***Table 13*** should be used to evaluate the performance of the TSMO Program.

**Table 13** | TSMO Performance Metrics

| # | Measure | Definition | Service Area | Source | Objective | 2-year target | 4-year target |
|---|---|---|---|---|---|---|---|
| **1** | Percent of the person-miles traveled on the Interstate that are reliable+ | Increase Level of Travel Time Reliability (LOTTR), calculated as the 80th percentile speed divided by the 50th percentile speed for each reporting segment in each of four (4) time periods for the entire year. If LOTTR ≥ 1.5, the segment is considered unreliable. | Arterial Management | National Performance Management Research Data Set (NPMRDS) | Conduct research and pilot projects | 23% | 24% |
| **2** | Percent of the person-miles traveled on the non-Interstate NHS that are reliable+ | Increase Level of Travel Time Reliability (LOTTR), calculated as the 80th percentile speed divided by the 50th percentile speed for each reporting segment in each of four (4) time periods for the entire year. If LOTTR ≥ 1.5, the segment is considered unreliable. | Arterial Management | National Performance Management Research Data Set (NPMRDS) | Centralize and modernize traffic signal and traffic management technology | n/a | 60% |
| **3** | Truck Travel Time Reliability Index+ | Increase the 95th percentile speed divided by the 50th percentile speed for each reporting segment in each of five (5) time periods for the entire year. | Arterial Management | National Performance Management Research Data Set (NPMRDS) | Improve data collection and management for traffic management systems | 4.0 | 4.0 |
| **4** | Annual Hours of Peak Hour Excessive Delay Per Capita+ | Reduction in the number of person-hours spent in congested conditions, defined as when speeds are slower than 20mph or 60% of the posted speed limit, whichever is greater, on all NHS routes, for weekday rush hours only. | Arterial Management | National Performance Management Research Data Set (NPMRDS) | Expand capabilities and methods of disseminating information to travelers | n/a | 26.5 |
| **5** | Zero fatalities and serious injuries by 2024 | Reduction in the number and severity of injuries in crashes | Emergency / Incident Management | DDOT Crash Database | Improve routine operations and maintenance processes | 150 | 50 |
| **6** | Decrease in Average Dispatch Time | Reduction in the average time from when an incident is reported to the time when the TMC personnel dispatch ROP or TCOs | Emergency / Incident Management | ATMS | Enhance coordination with external | 2% | 5% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (%) | | | | stakeholders | | |
| **7** | Incident Clearance Time (minutes) | Reduction in the average time between the first recordable awareness of the incident and the time at which the last responder has left the scene. | Emergency / Incident Management | ATMS | Enhance coordination with external stakeholders | 90 | <90, <60 for incidents w/injuries |
| **8** | Roadway Clearance Time (minutes) | Reduction in the average time between the first recordable awareness of an incident (detection, notification or verification) by a responding agency and first confirmation that all lanes are available for traffic flow. | Emergency / Incident Management | ATMS | Enhance coordination with external stakeholders | 90 for 50% of all incidents | 90 for 75% of all incidents |
| **9** | Increase in Average Bus Speed (%)* | Percentage increase in average bus speeds for WMATA and Circulator buses between time points on congested roadways during peak travel times. | Arterial Management | Automatic Vehicle Location (AVL) data | Centralize and modernize traffic signal and traffic management technology | 2% | 5% |
| **10** | Non SOV Mode Share (%)*+ | Increase the percentage of non-single occupancy vehicle travel | Traveler Information | ACS TIGER/Line Census Tract Shapefiles | Expand capabilities and methods of disseminating information to travelers | 36.9% | 37.2% |
| | *Metrics with * are used in the District Mobility Project [4]*<br>*Metrics with + are used in the District's Federal Performance Measures* | | | | | | |

TSMO performance measures were identified for each objective, and some measures may be used for multiple objectives. The majority of metrics can be classified as outcome-based, in that they assess the effects of the TSMO Plan implementation on the traveling public, such as travel time reliability. Others are considered output-based measures, which evaluate how successful an Agency is in performing particular types of Operations services, such average dispatch time and average incident clearance time.

Performance assessment is an iterative process, and therefore the measures in ***Table 13*** are subject to change. The measures identified are based on reliable, available data sources, but as Operations teams improve their data collection and management methods, new metrics may become available. In addition, as the TSMO Program is implemented new issues, processes, and priorities may emerge, and therefore the program's performance assessment measures must also adapt. The performance measures should be evaluated and updated every year, concurrently with the TSMO Action Plan updates (Section 3.3).

Once the TSMO Program is underway, Operations teams with assistance from the Performance Management Division should identify specific targets and timelines for each of these metrics. This monitoring effort should occur annually together with updates to the TSMO Action Plan, to indicate if targets have been achieved. As time progresses and monitoring is performed, the Operations teams should assess the need for adjustments to the initial set of recommended strategies and objectives, in addition to the performance metrics.

## 3.3. Annualized Actions and Deployment

The annualized action plan in ***Figure 16*** was developed using the goals and objectives to prioritize strategies, in addition to an assessment of the investment level (funding, amount of required coordination, and staff time) required to implement each task. The full assessment of each programmatic and tactical strategy is provided in

*Appendix A: Objectives and Strategies* Matrix. Strategies that are high priority and require lower investment are scheduled for the first fiscal year. The priority level decreases or stays the same, and the investment level increases or remains the same in the following fiscal years. The colors of each action indicate the team that will be the lead in implementation.

In general, the ITS team, which is in DDOT's Traffic Signals Branch, will coordinate the effort of implementing TSMO at DDOT. However, input and support will be needed from many different teams within DDOT, which are shown in ***Figure 15***.

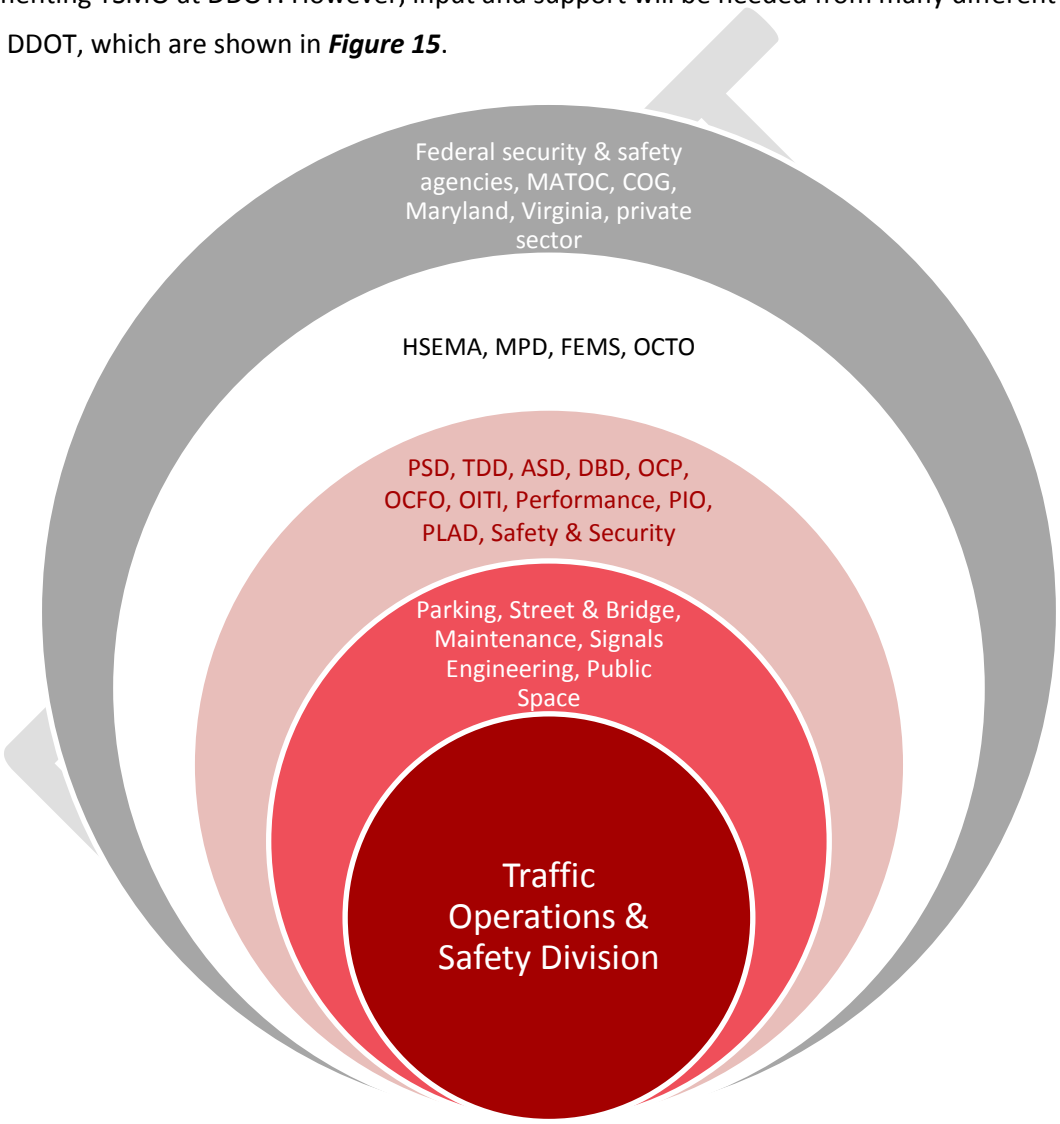


**Figure 15** | TSMO Stakeholder Responsibility Levels in the Washington DC Region

The Divisions in red and bright pink will need to directly take charge of implementing many aspects of the TSMO Program, while those shown in light pink, white and gray will periodically be engaged or

consulted in the implementation process. **Figure *16*** demonstrates how these responsibility levels will be incorporated into the annual action plan for TSMO implementation

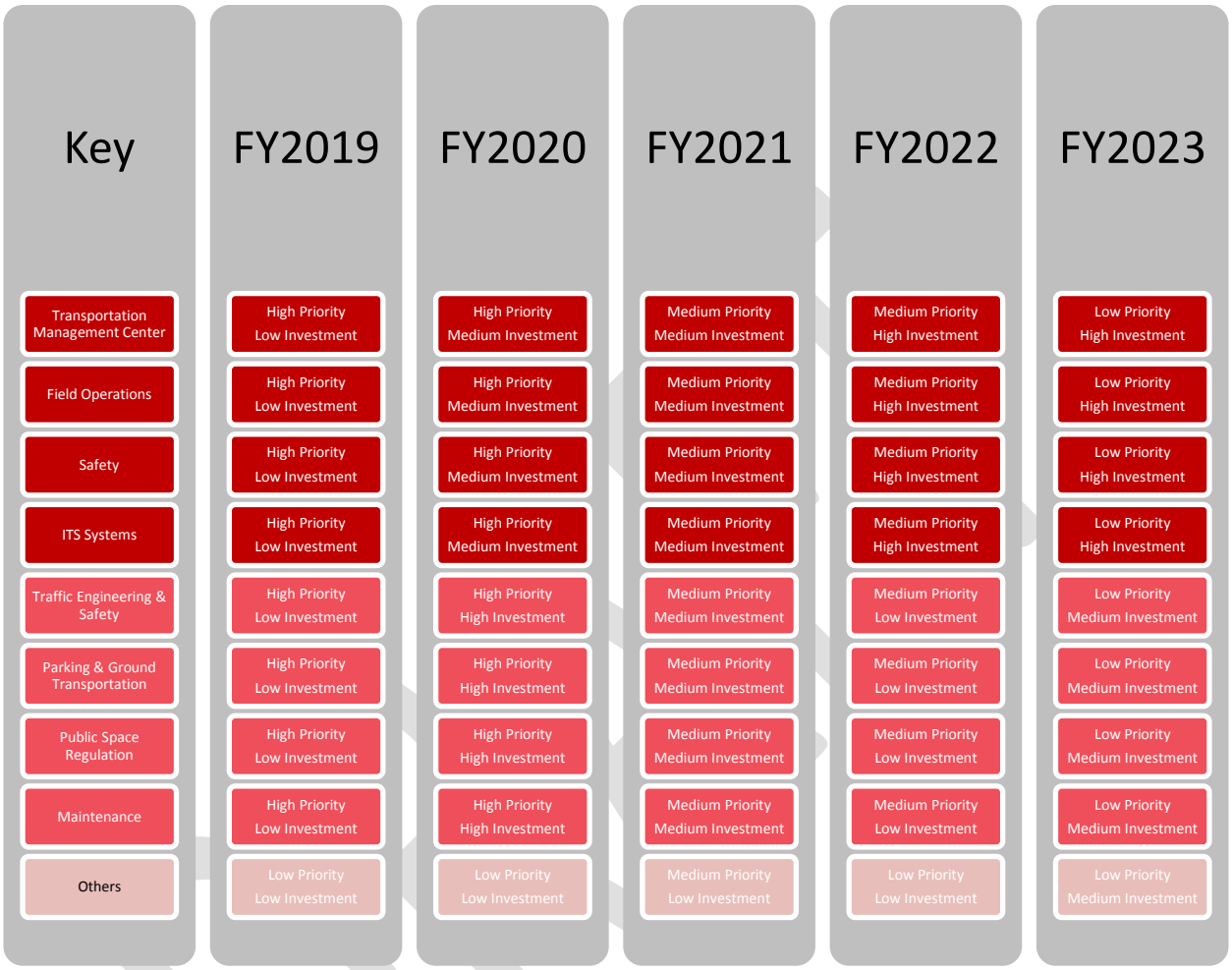


**Figure 16** | Action Plan by Fiscal Year

The ITS team, with input from each TSMO workgroup, will develop a detailed action plan for each fiscal year, outlining all of the elements that will be needed to accomplish each TSMO strategy. The workgroups will each be tasked with identifying new needs. A section of this action plan is provided in ***Table 14***.

**Table 14** | Sample Detailed Action Plan for FY2019

| | |
|---|---|
| **Strategic Objective:** | |
| **Project Lead:** | Programmatic/Tactical Objective: |
| **Implementation Team:** | Programmatic/Tactical Strategy: |

| | |
|---|---|
| | Actions: |
| **Advisory Teams:** | Action 1.1. |
| | Action 1.2. |
| **Resources needed:** | Action 1.3. |
| | Deliverables: |
| **Timeline:** | Deliverable 1.1 |
| | Deliverable 1.2 |
| **Prerequisites:** | Outcome: |
| | |

## 3.4. Prioritization Matrix

The project prioritization matrix in ***Table 15*** is an evaluation tool to assist in the selection of potential TSMO projects for implementation, within each tactical and programmatic strategy. Several of the measures were adopted from the moveDC prioritization criteria and are indicated with an asterisk (*). Each measure is given a weighted value (all weights total 100 points), and higher-weighted actions will be given higher priority.

**Table 15** | Project Prioritization Measures

| Goal | Measure | Description |
|---|---|---|
| **System Reliability (25 points)** | Incident Duration | Will the project reduce average dispatch, incident clearance roadway clearance times? |
| | Performance of the NHS | Does the project increase the percent of the person-miles traveled on the NHS that are reliable? |
| | Truck Travel Time Reliability Index | Does the project increase the reliability of freight travel? |
| **System Efficiency (25 points)** | Address Congestion | Does the project reduce the annual hours of peak hour excessive delay per capita |
| | Average Increase in Bus Speeds | Will the project improve average travel speeds in congested areas by 5% percent within 4 years? |
| **Safety (20 points)** | Zero fatalities and serious injuries by 2024* | Is the project designed to improve system safety and/or address an existing safety deficiency? |
| **Multimodal (15 points)** | Non-Auto Mode Split* | Does the project contribute to a reduction in the use of SOVs within the District? |

| | | |
|---|---|---|
| **Infrastructure Lite (5 points)** | Annual Maintenance Cost Benefit Ratio | Will the project increase reliability, efficiency, and safety without adding additional fixed infrastructure? |
| **Mainstream (10 points)** | Prioritized in existing plans | Is the project/activity recommended in an existing District or regional plan, such as moveDC, ITS Master Plan, Strategic Highway Safety Plan, Vision Zero, COG Long Range Transportation Plan (Visualize 2045) |

**** measures that are derived from the moveDC plan prioritization criteria***

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# 5. Appendix A: Objectives and Strategies Matrix

Tactical Objectives and Strategies

| ID | Strategy | Objective | Tactical Service Area | Priority | Investment Level | FY |
|---|---|---|---|---|---|---|
| **** are strategies that are similar or identical to District Mobility actions*** | | | | | | |
| ***^ are strategies that are similar or identical to recommendations that are included in MoveDC*** | | | | | | |