

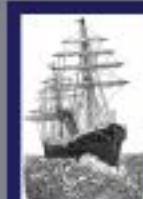


System Metrics Group, Inc.

Emergent Transportation Concepts, LLC



PLANNING FOR OPERATIONS STRATEGIC WORK PLAN



System
Metrics
Group



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1.0 Executive Summary

This report represents the Planning for Operations (P4Ops) Strategic Work Plan (SWP) developed on behalf of and in coordination with the California Department of Transportation (Caltrans) and many of its partner agencies. The Caltrans Request for Proposals stated the following objectives for the SWP:

The P4Ops SWP will be Caltrans' guide on Planning for Operations, creating a statewide framework for multimodal system management planning. It will identify the specific steps needed to implement multimodal system management planning at Caltrans and prioritize implementation actions. The outcome of developing the P4Ops SWP will be a blueprint for Caltrans business practices to deliver safe, sustainable and efficient operational strategies system-wide over the long term.

Background

It is important to get a brief understanding of the background and context of this project. It is always important to remember that Caltrans is the owner and operator of the State Highway System (SHS). For decades, Caltrans focused on building the SHS network and expanding it as demand increased. A big part of the more recent expansion has focused on building the High Occupancy Vehicle (HOV) lanes and networks, especially in urban areas. Today, the SHS has almost 52,000 lane miles¹. Of these, 1,755 lane miles² are HOV or priced managed lanes (which are HOV lanes that impose tolls on vehicles that do not meet occupancy requirements).

Moving forward, very little expansion is planned for the SHS over the next twenty years. This is due to environmental policies, today's high cost of expansion compared to its benefits, and an evolving understanding of the transportation/land use relationship. Managed lanes represent the largest expansion totaling almost 1,650 lane miles. However, this represents just over a three percent increase in lane miles planned over the current system. It is safe to say that the California SHS is now a mature system. Mature systems and businesses must shift their focus from expansion to maintenance and operations. Preserving the system that took decades and tens of billions of dollars to build is critical, in addition to optimizing system operations. Transitioning from an expansion mode to a preservation-and-operations mode requires an organizational and business process transformation.

In recent years, Caltrans has started transforming itself to focus on Transportation System Management and Operations (TSMO), while also focusing on environmental stewardship. This project is a continuation of this effort. This is especially important today with the advent of new technologies that are starting to change the world of transportation. Technologies such as private sector traveler information systems (e.g., WAZE), autonomous vehicles, connected vehicles, Integrated Corridor Management (ICM),

¹ <http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php>

² <http://www.dot.ca.gov/trafficops/tm/docs/Managed-Lanes-System-Plan-2016.pdf>

advanced ramp metering, and others will be key components of the future of operations of the SHS and beyond. Planning processes in Caltrans need to evolve to address these and other operational priorities.

Caltrans has been conducting P4Ops, but not in a systematic manner, mainly due to limited resources and skills (both hard and soft skills). A notable exception was the California Transportation Commission (CTC) requirement to develop Corridor System Management Plans (CSMPs) for corridors that received funding from the 2006 voter-approved Proposition 1B (The Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006). CSMPs received special funding and represented the first attempt at a truly operations-centric set of studies conducted by Caltrans in collaboration with its regional and local partners statewide. However, as Proposition 1B funding was exhausted, these plans were not routinely updated or refreshed. Even though P4Ops should be an ongoing activity, planning resources were needed to fulfill other commitments such as the development of Transportation Concept Reports (TCRs). Now planning has completed this commitment and is institutionalizing P4Ops into its business processes to address these emerging needs.

At the same time, the funding picture has recently changed. With the passage of Senate Bill 1 (SB 1), Caltrans now has a funding source for implementing operational strategies. Transportation Management Systems (TMS), a big component of operational strategies moving forward, have been strongly encouraged in the CTC's interim State Highway Operations and Protection Program (SHOPP) guidelines. Regional and local agencies are showing increased interest to use their voter-approved sales tax funds to implement promising operational projects. Therefore, moving forward, Caltrans must focus on P4Ops that lead to the identification of critical operational projects in collaboration with local and regional agencies.

Study Process

This SWP is the culmination of an extensive information gathering process both internally within Caltrans at Headquarters and the districts, as well as externally with numerous state, local and regional partner agencies. This effort included a review of policy documents such as the California Transportation Plan (CTP) and the Caltrans Strategic Management Plan (SMP) to identify linkages to and direction for P4Ops. The study was also guided by the P4Ops Charter Team, members of which provided feedback and ideas throughout the study. In addition, the study team coordinated with a number of parallel initiatives:

- **Asset Management³** – Caltrans has been developing a performance-based asset management process for allocating SHOPP funding. This process includes performance target-setting, identifying and nominating *anchor* projects that help meet these targets and complementing them with *satellite* projects nearby that can be implemented at the same time. This framework lends itself to include high-performing operational projects both as anchor or satellite projects.

Organizing for Corridor Management – Caltrans Division of Traffic Operations is in the process of re-organizing itself in select urban districts. The new organizational structure includes “corridor managers” and reduces functional silos by developing multi-functional

³ <http://www.dot.ca.gov/assetmgmt/>

corridor teams, although it does provide flexibility to the districts to tailor these changes to their own environment. This initiative also identified the critical knowledge, skills, and abilities (KSAs) needed to effectively implement this organizational change and support TSMO in general.

- **System Planning to Programming (SP2P)⁴** – The recently concluded SP2P study identified several improvements for the System Planning function to address statewide, regional and local priorities. These priorities included the need to focus the system planning work and products on comprehensive multi-modal performance assessments and asset management (including the critical operations analysis component).
- **Complete Transportation Framework (CTF)** –The CTF outlines a Caltrans planning and project development process that integrates Planning, Project Delivery, Operations and Maintenance. It facilitates the integration and collaboration of these programs' business processes. It implements Caltrans' Mission, Vision, Goals and Values, including support for the Caltrans business practices of performance management, asset management, collaboration and transparent decision-making.

More recently, the passage of SB 1 influenced P4Ops. It became necessary for this SWP to leverage the new SB 1 funding programs (e.g., Solutions for Congested Corridors). In addition to SB 1, several counties in California have sales tax measures (e.g., Los Angeles, Santa Clara) to fund transportation investments that can help alleviate congestion and provide multi-modal (including active transportation and transit) alternatives. Consequently, there is a renewed urgency to deliver effective projects to improve the quality of life for Californians.

Issues and Gaps

The study included a review of current internal planning processes within Caltrans to determine how system management (and especially operations) is integrated into these processes. While there has been recent progress in Districts 3 and 10, districts generally do not have a systematic process by which to integrate operations into planning processes and documents in order to establish an agreement on a high-priority list of strategies and projects.

Operational analyses and development of operational projects and strategies has been typically performed by district Traffic Operations staff, with minimal involvement of the Planning Division. Planning staff often do not have the knowledge, training or skills needed to effectively engage in operational issues. These include the basics of operational concepts (e.g., engineering judgment given requirements and standards, short- and long-term strategies and how they can be funded), operational analyses (e.g., intersection control evaluation, bottleneck identification, queue analysis, reliability analysis) and familiarity with data sources (e.g., Caltrans Performance Measurement System or PeMS, Inrix) and operations models (e.g., travel demand models, FREQ, microscopic and mesoscopic simulation models). These topics and skills will not transform planners into traffic engineers, but will be important for planners

⁴ http://www.dot.ca.gov/hq/tpp/offices/omsp/system_planning/documents/SP2P/SP2P_Final_Report_051517.pdf

to gain the credibility with operations staff. Note however that institutional barriers on how resources are shared/allocated among divisions do exist and should be addressed to the extent possible.

Conversely, Operations staff often does not have the familiarity with statewide and regional planning and programming processes and do not generally develop medium- to long-term operational plans, evaluate environmental impacts of operational projects, or participate actively in multi-modal regional planning activities. Both Planning and Operations staff therefore often lack the combination of both hard and soft skills necessary to conduct P4Ops with maximum effectiveness with external partner agencies. Both functions also do not adequately leverage the expertise Project Management can provide in assessing a candidate project's feasibility or pre-PID findings.

Processes do not exist for integrating multi-modal operational analyses and associated promising operational strategies into planning documents, nor have roles and responsibilities been clearly identified (both internally within Caltrans as well as externally with local partner agencies). As a result, many districts do not currently have a list of high-priority operations projects that both Planning and Operations develop jointly, and share with partners to advocate for programming of funds. How (and whether) "management and operations strategies are integrated into the transportation planning, programming, and project delivery processes" often occurs in an ad-hoc manner.

A Two-Pronged Strategic Work Plan

The intended outcome of the P4Ops SWP is to institutionalize system management planning in Caltrans culture, business practices, partnerships, and planning processes. As with any significant organizational and institutional change, this transition is likely to take several years to complete. However, there is an immediate short-term need to initiate some of the recommended actions to best position Caltrans for the new funding opportunities presented by SB 1, partner funding cycles, and upcoming RTP updates. Therefore, the P4Ops SWP distinguishes the short-term actions needed from the medium- and long-term actions that require more time. The P4Ops implementation road map is depicted in Exhibit 1 at the end of this section and is discussed in detail in Section 5 of this report. The highlights of this road map are summarized as follows:

- **Short-term (transitional phase):** The focus should be to develop a preliminary list of high-priority operational projects to feed into the next planning and programming cycles. These projects should be agreed-upon internally within Caltrans, "socialized" with regional and local partners, and then nominated for funding. They should influence the early rounds of SB 1 and new county sales tax funding if possible. These actions cannot wait for lengthy organizational changes, skill development efforts, or recommendations coming from new corridor studies. In addition, the CTC intends to develop Comprehensive Corridor Planning guidelines sometime after the SCCP program guidelines are finalized. In the meantime, the short-term actions emphasize building on recent studies and input from the Division of Traffic Operations. Planning staff should then organize these projects, perform a high-level evaluation, and share them with partners. After this collaboration, an initial list of high-performing operational projects will be available for subsequent planning and programming cycles.
- **Medium- and long-term (post-transitional phase):** The focus of medium- and long-term actions is on institutionalizing a framework for P4Ops that can be sustained. Caltrans planning should work with internal and external partners to conduct multi-modal corridor studies that will update

and/or augment the list of high-priority operational projects. To accomplish this, it needs to have an operations liaison function, enhance critical skills at the staff level, and collaborate with partners to establish multi-modal, multi-functional, multi-agency corridor teams. It may also be useful to have a planning liaison function in operations and possibly also in design to help evaluate project feasibility. Of course, other collaborative and performance-based projects may be added to the list by partner agencies as well. Institutionalizing these actions will require significant training of planning staff, especially for technical analyses. Developing both hard and soft skills and knowledge should be a priority over the next few years. The medium- and long-term actions are more ambitious and will likely require additional resources. But many of the regional and local partners have suggested the possibility of co-funding some of these actions.

The underlying assumption and focus of the roadmap is to develop and maintain a list of high-priority operational strategies and projects to feed into the internal and external planning and programming cycles. Planning products that do not feed into these cycles will not add the value needed to demonstrate to travelers, elected officials, and policy makers that the taxes and fees for transportation purposes are improving their quality of life. Finally, note that organizational and process change is never easy. At such a large organization like Caltrans, change is sometimes resisted. Therefore, in order to implement these actions, executive and senior management must support the initiative, provide the direction to staff, and be staff champions to encourage them to “buy into” these changes and commit to them. Many an organizational and/or process change has failed in the past due to resistance and lack of strategic change management to support staff during the transition. Additionally, recognizing that many of the issues and gaps outlined in this document differ in extent and complexity at each District, it is recommended that District-specific implementation plans be developed as a logical next step to implementing this P4Ops SWP.

Simple Measures of Success

Evaluating the success of this P4Ops SWP should rely on simple measures. Of course, if projects get delivered, “before and after studies” to evaluate the effectiveness of the investments are important. But from a high-level, we suggest the following measures:

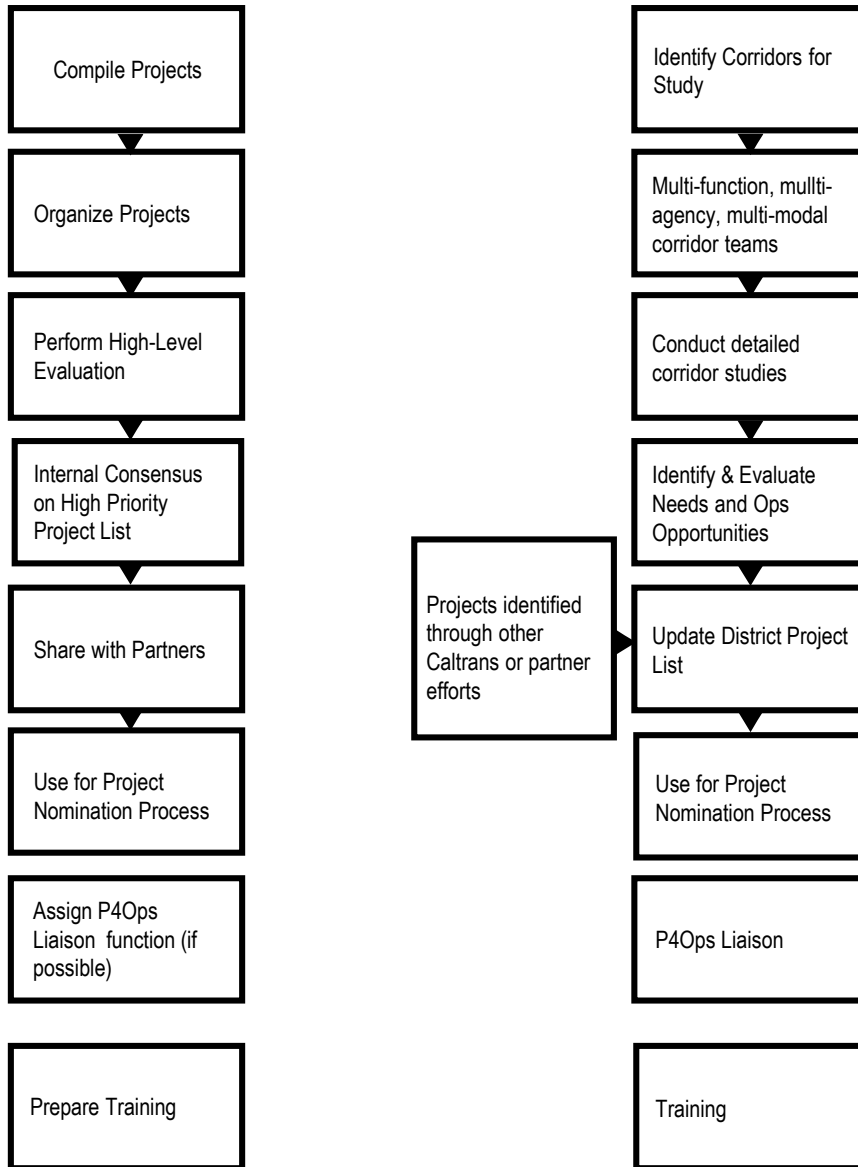
- Inclusion of High-Priority Operations Project List in Regional Transportation Plans (RTPs)
- Inclusion of High-Priority Operations Project List in District System Management Plans (DSMPs), including potential new opportunities identified through various analyses
- Inclusion of some of the High-Priority Operations Project List in SHOPP funding decisions (either as anchor projects or as satellite projects)
- Inclusion of some of the High-Priority Operations Project List in local and regional funding decisions
- Multi-functional, multi-modal, multi-agency corridor studies initiated (with Caltrans funding or with joint funding)
- Updating of Caltrans training plans and duty statements for staff carrying out P4Ops analyses and activities to reflect the necessary hard and soft skills required to successfully perform such functions.

Other measures can be useful, but the above list would at least reflect the success of collaboration, inclusion in performance-based planning and programming decision-making and a process by which to update the preliminary list of high-priority operations projects.

Exhibit 1: P4Ops Implementation Road Map

Transition Phase → **Post-Transition**

For initial SB-1 funding cycle and next RTP updates



2.0 Introduction

This section provides a brief introduction to the project, its purpose and objectives, and the context in which it was conducted.

2.1 Project Purpose and Objectives

Caltrans is interested in improving how it plans for transportation system management and network operations. Caltrans has been in the business of “P4Ops” (or system management planning) for as long as the agency has existed, but not in a systematic manner. Today, there is a new focus and emphasis on its importance.

The 2014 State Smart Transportation Initiative (SSTI) Report and the subsequent Caltrans Improvement Program emphasized the importance of shifting Caltrans’ emphasis to Transportation System Management and Operations, as well as strengthening the role of planning at Caltrans. Both the 2015 California Transportation Plan (CTP) and the 2015 Caltrans SMP set clear, measurable goals for system performance, stewardship, safety and efficiency. MAP-21 and the FAST Act also have performance reporting requirements to support performance-based decision-making, and both the State and regions have aggressive greenhouse gas (GHG) reduction targets to meet. Within this larger policy and institutional context, a P4Ops SWP was identified as being needed to outline the specific steps necessary to implement multimodal system management planning practices to achieve Caltrans goals.

A P4Ops Charter Team was created by the Caltrans Headquarters Office of Multimodal System Planning to serve as an advisory group to oversee the development of the Strategic Work Plan. This charter team was developed as part of a Division of Transportation Planning (DOTP) initiative to implement recommendations from a 2013 DOTP Value Analysis study. That study recommended incorporating operations and performance measurement into planning processes and documents. The P4Ops Charter Team has statewide, multi-functional, multi-agency membership, and has been meeting since April 2015 to begin identifying key P4Ops issues and needs.

The ultimate objective of this effort is to institutionalize P4Ops in Caltrans culture, business practices, partnerships and planning processes. This P4Ops SWP is intended to be Caltrans’ guide on P4Ops, creating a statewide framework for multimodal system management planning processes. The findings and recommendations in this SWP are a culmination of an extensive stakeholder engagement and information gathering process. The recommendations presented reflect the much of the input and feedback from Caltrans staff and partner agencies across the state.

2.2 A Time of Transition for Caltrans

The P4Ops SWP effort was initiated and conducted during a time of transition for the Department. Caltrans updated its Mission, Vision and Goals in 2015, which shift the focus from automobile-centric operations and capital expansion to multi-modal system management, operations and sustainability. The 2015 Caltrans SMP links goals with corresponding performance measures that the department is responsible for achieving. The SMP lists goals that go beyond improving the performance of the SHS, and therefore are not solely within Caltrans’ control.



Additionally, statewide legislation such as SB 375 and SB 743 outline new requirements for the way transportation and land use planning are conducted and the metrics by which performance impacts are assessed, such as mandating the development of Sustainable Communities Strategies and striving to reduce vehicle-miles traveled (VMT). These factors, combined with the two decades of funding evolution since the passage of SB 45 and the rise of locally-controlled transportation funding sources, point to the need for greater collaboration with internal and external partner agencies to achieve these larger, system-wide goals, and suggest that changes are needed to existing Caltrans processes, procedures, analysis techniques, and planning products.

With the Governor signing SB 1 into law in 2017, new funding sources have now been identified which provide a multitude of opportunities for Caltrans to collaborate with partner agencies to fund and deliver projects which improve multimodal transportation system management and operations. In particular, funding for the Solutions for Congested Corridors Program will be allocated by the California Transportation Commission (CTC) to projects designed *“to achieve a balanced set of transportation, environmental, and community access improvements within highly congested travel corridors throughout the state. Funding shall be available for projects that make specific performance improvements and are part of a comprehensive corridor plan designed to reduce congestion in highly traveled corridors by providing more transportation choices for residents, commuters, and visitors to the area of the corridor while preserving the character of the local community and creating opportunities for neighborhood enhancement projects.”*

Most of the goals outlined in SB 1, and in particular with the Solutions for Congested Corridors Program, align directly with the P4Ops SWP objectives. The fact that funding under the Solutions for Congested Corridors Program is specifically tied to projects coming out of a comprehensive corridor plan that make specific performance improvements highlights just how in-sync SB 1 is with Caltrans’ evolution, and more specifically, with P4Ops processes. SB 1 even goes so far as to formalize the requirement for collaboration between Caltrans and local/regional partner agencies, stating *“Preference shall be given to corridor plans that demonstrate that the plans and the specific project improvements to be undertaken are the result of collaboration between the department and local or regional partners that reflect a comprehensive approach to addressing congestion and quality-of-life issues within the affected corridor through investment in transportation and related environmental solutions. Collaboration between the partners may be demonstrated by a project being jointly nominated by both the regional agency and the department.”* This notion of formalized collaboration fits directly with the intended outcome of the P4Ops SWP to institutionalize collaborative, performance-based, multimodal system management planning in Caltrans culture, business processes, and partnerships.

Since the initiation of this effort, Caltrans has also implemented several initiatives to improve its planning processes that overlap with many of the recommendations in this P4Ops SWP:

Asset Management – Caltrans has been developing a performance-based asset management process for allocating SHOPP funding. This process includes performance target-setting, identifying and nominating *anchor* projects that help meet these targets and complementing them with *satellite* projects nearby that can be implemented at the same time. This framework lends itself to include high-performing operational projects both as anchor or satellite projects.

- **Organizing for Corridor Management** – Caltrans Division of Traffic Operations is in the process of re-organizing itself in select urban districts. The new organizational structure includes “corridor managers” and reduces functional silos by developing multi-functional corridor teams. This initiative also identified the critical knowledge, skills, and abilities (KSAs) needed to effectively implement this organizational change. Note that the corridor management structure was also partly adopted by the system planning in at least one district (District 3 in Sacramento).
- **System Planning to Programming (SP2P)** – The recently concluded SP2P study identified several improvements for the System Planning function to address statewide, regional and local priorities. These priorities included the need to focus the system planning work and products on comprehensive multi-modal performance assessments and asset management (including the critical operations analysis component).
- **Complete Transportation Framework (CTF)** – The CTF outlines a Caltrans planning and project development process that integrates Planning, Project Delivery, Operations and Maintenance. It facilitates the integration and collaboration of these programs' business processes. It implements Caltrans' Mission, Vision, Goals and Values, including support for the Caltrans business practices of performance management, asset management, collaboration and transparent decision-making.

Additional strategies are recommended in this SWP to address identified gaps, but all of the aforementioned efforts represent important progress.

2.3 Study Process

This SWP is the culmination of an extensive information gathering process both internally within Caltrans at Headquarters and the districts, as well as externally with numerous state, local and regional partner agencies. In addition to engaging the multi-functional P4Ops Charter Team throughout the development of the P4Ops SWP, the TSMO Steering Committee was also consulted to solicit Caltrans Executive Management feedback and secure buy-in on the SWP, as well as understand the similarities and differences between the TSMO and P4Ops initiatives for development and implementation of next steps. Joint workshops were held in coordination with the SP2P project with Caltrans and partner representatives from Northern California, Southern California, Central California, Rural Districts, Statewide agencies, and Caltrans headquarters.

The intent of these joint workshops was to provide a forum to follow up with executive-level staff who were interviewed as part of the SP2P project in a setting that included both Caltrans and external agency staff, and gather input on P4Ops concepts and priorities for inclusion in this SWP.

Both projects to some extent were investigating gaps and opportunities related to the manner in which transportation projects move from planning to the actual programming of funds. An extensive set of interviews with internal and external stakeholders was conducted to solicit input on issues related to the existing planning processes. This touched on many aspects of P4Ops. Some of the potential opportunities involve institutional and process change (including collaborative, performance-based planning with a focus on multimodal system operations and efficiency), which were useful to the development of this P4Ops SWP.

3.0 What Is P4Ops?

This section presents a California-tailored definition for P4Ops, discusses how P4Ops relates to Caltrans goals and objectives, identifies SB 1 metrics, and summarizes how P4Ops fits in with achieving policy goals and leveraging the new SB 1 funding.

3.1 Definition of P4Ops

One of the first tasks undertaken as part of the development of this SWP was to develop a practical, workable definition of P4Ops in the context of Caltrans' business practices and current Mission/Vision/Goals. One of the most important reasons for defining P4Ops is that it not only establishes a common understanding of what is meant by the term, but it also sets forth how wide of a net is being cast in terms of the processes, procedures and roles and responsibilities that fall underneath the umbrella of P4Ops.

Rather than start from scratch, the P4Ops Charter Team agreed that it would be best to work off of the existing definition of P4Ops as put forth by the Federal Highway Administration (FHWA), but to then modify it as appropriate to better fit the context and realities of California. The original FHWA definition is as follows:

“Planning for operations is a joint effort between planners and operators to integrate management and operations (M&O) strategies into the transportation planning process for the purpose of improving regional transportation system efficiency, reliability, and options.”

The resulting changed definition for California is as follows:

“Planning for operations is a joint, collaborative and systematic effort between planners and operators to integrate management and operations strategies into the transportation planning, programming, and project delivery processes for the purpose of achieving operational goals and objectives.”

The Charter Team agreed that the specific goals and objectives mentioned in the federal definition (system efficiency, reliability, and options) do not need to be listed out in the definition, because these goals can change over time. It was desired to have a definition of P4Ops that would withstand the test of time, even when specific goals and priorities change. Moreover, since both the CTP and the Caltrans SMP already outline statewide goals, the decision was made to simply rely on these goals and complement them with partner agency goals. This way, the P4Ops definition focused more on the process that will ultimately enable Caltrans to achieve its goals. The specific goals and objectives of the CTP and SMP are discussed below, and provide the current policy context under which P4Ops processes and procedures will need to be implemented.

3.2 Goals and Objectives

The CTP 2040 states that “California’s transportation system must provide equitable and effective mobility and accessibility. To enhance California’s economy and livability, it should be safe, sustainable, integrated,

and efficient.” The CTP therefore outlines the following six core goals and associated policies as shown on Exhibit 2:

1. Improve multimodal mobility and accessibility for all people
2. Preserve the multimodal transportation system
3. Support a vibrant economy
4. Improve public safety and security
5. Foster livable and healthy communities and promote social equity
6. Practice environmental stewardship

Exhibit 2: California Transportation Plan 2040



3.3 Caltrans Mission, Vision and Strategic Management Plan Goals

The Caltrans Mission Statement is to “Provide a safe, sustainable, integrated, and efficient transportation system to enhance California’s economy and livability.” The corresponding Vision is “A performance-driven, transparent, and accountable organization that values its people, resources, and partners and meets new challenges through leadership, innovation, and teamwork.” In support of this updated Mission and Vision, the SMP identifies the following five goals with corresponding sample performance measures for each:

3.3.1 Goal 1: Safety and Health

“Provide a safe transportation system for workers and users and promote health through active transportation and reduced pollution in communities.”

Strategic Objectives

- Zero worker fatalities
- Reduce user fatalities and injuries by adopting a “Toward Zero Deaths” practice
- Promote community health through active transportation and reduced pollution in communities.

3.3.2 Goal 2: Stewardship and Efficiency

“Money counts. Responsibly manage California’s transportation-related assets.”

Strategic Objectives

- Effectively manage transportation assets by implementing the asset management plan, embracing a fix-it-first philosophy
- Efficiently deliver projects and services on time and on budget

3.3.3 Goal 3: Sustainability, Livability and Economy

“Make long-lasting, smart mobility decisions that improve the environment, support a vibrant economy, and build communities, not sprawl.”

Strategic Objectives

- **People:** Improve the quality of life for all Californians by providing mobility choice, increasing accessibility to all modes of transportation and creating transportation corridors not only for conveyance of people, goods, and services, but also as livable public spaces
- **Planet:** Reduce environmental impacts from the transportation system with emphasis on supporting a statewide reduction of greenhouse gas emissions to achieve 80% below 1990 levels by 2050
- **Prosperity:** Improve economic prosperity of the State and local communities through a resilient and integrated transportation system.

3.3.4 Goal 4: System Performance

“Utilize leadership, collaboration, and strategic partnerships to develop an integrated transportation system that provides reliable and accessible mobility for travelers.”

Strategic Objectives

- Improve travel time reliability for all modes
- Reduce peak period travel times and delay for all modes through intelligent transportation systems, operational strategies, demand management, and land use/transportation integration
- Improve integration and operation of the transportation system
- Increase the number of Complete Streets features on State highways that are also local streets in urban, suburban, and small town settings
- Develop integrated corridor management strategies for those of highest statewide significance.

3.3.5 Goal 5: Organizational Excellence

“Be a national leader in delivering quality service through excellent employee performance, public communication, and accountability.”

Strategic Objectives

- Promote a positive work environment and implement a management system to maximize accomplishments, encourage innovation and creativity, and ensure staff performance is aligned with Department and State strategic goals
- Improve internal and external communication to better demonstrate professionalism and service levels to the public and stakeholders
- Improve partnerships with agencies, industries, municipalities, and tribal governments.

3.4 SB 1 Metrics

It is also important to recognize that certain fund sources also specify “scoring criteria” which often implies certain goals. The scoring criteria for the SB 1 Solutions for Congested Corridors Program are listed below:

1. Safety
2. Congestion
3. Accessibility
4. Economic development and job creation and retention
5. Furtherance of state and federal ambient air standards and greenhouse gas emissions reduction standards pursuant to the California Global Warming Solutions Act of 2006 (Division 25.5 (commencing with Section 38550) of the Health and Safety Code) and Senate Bill 375 (Chapter 728 of the Statutes of 2008)
6. Efficient land use
7. Matching funds
8. Project deliverability



As mentioned in the Introduction, the SB 1 Solutions for Congested Corridors Program states that “Preference shall be given to corridor plans that demonstrate that the plans and the specific project improvements to be undertaken are the result of collaboration between the department and local or regional partners that reflect a comprehensive approach to addressing congestion and quality-of-life issues within the affected corridor through investment in transportation and related environmental solutions.” This requirement for formalized collaboration between Caltrans and local/regional partner agencies aligns nicely with many of the CTP and SMP goals and objectives.

3.5 How P4Ops Fits In

The intended outcome of the P4Ops SWP is to institutionalize collaborative, performance-based, multimodal system management planning in Caltrans culture, business practices, partnerships, and planning processes. Therefore, P4Ops, as evidenced by the selected definition, is the combination of processes and corresponding institutional structure needed to better enable Caltrans and its partner agencies to achieve all of the goals outlined in the CTP and SMP, as well as be extremely well-positioned for SB 1 funding – particularly for the Solutions for Congested Corridors Program. Collaborative, performance-based multimodal system management planning is directly or indirectly implied by all of the goals identified in the CTP and SMP, and thus P4Ops is needed to successfully implement these policy directives and achieve the desired outcomes.

4.0 What is Caltrans Doing Now – Issues and Gaps

A viable P4Ops SWP for Caltrans must ensure that staff possess the necessary capabilities and expertise to conduct collaborative, performance-based multi-modal system management planning – or P4Ops – activities. An assessment was conducted of the current P4Ops state of practice within the Department. This includes the relationships and core competencies needed for P4Ops, and the issues and gaps related to P4Ops that currently exist. This assessment, and the associated opportunities for improvement described in the following chapter, can be used in a number of ways:

- Institutional and Organizational Relationships – How are the district Planning Divisions (in addition to HQ DOTP) and the district Divisions of Traffic Operations currently working together on P4Ops-related activities and how are Caltrans districts typically working with partner agencies on P4Ops activities?
- Skills and Resources – What current staff skills (both hard and soft) and available resources exist to lead and/or assist in P4Ops activities?
- Data, Tools, and Analytics – What data and tools do DOTP and the district Planning Divisions currently use, and what type of analytics does it perform related to P4Ops activities?

The overall assessment relied on interviews, five joint multi-agency workshops with senior management representatives from the districts and their local partners, P4Ops Charter team discussions, an off-site P4Ops workshop, and study team knowledge of existing P4Ops activities. These three areas are discussed in more detail in the remainder of this section.

4.1 Institutional and Organizational Relationships

Gaps and issues in this section relate to intra-district relationships (especially between the Planning and Traffic Operations Divisions) and relationships between districts and their corresponding partner agencies. Note that in many districts, and despite SB 1, the majority of transportation funding is controlled by regional and local agencies (especially self-help counties with their own dedicated transportation funding). Therefore, developing and maintaining a collaborative relationship with these partners can lead to funding of promising operational projects that produce the desired outcomes. This importance has just been magnified with the passage of SB 1, which strongly promotes collaboration between state and local agencies. In fact, Solutions for Congested Corridors program funding (\$250 million annually) explicitly requires such collaboration.

4.1.1 Intra-District Issues/Gaps

In general, districts do not have a systematic process by which to integrate operations into planning processes and documents. Yet, the Planning Division is typically the “official” liaison between districts and their partner agencies. Planning Division activities do not generally include operational analyses. Such analyses are typically performed by the Division of Traffic Operations, which highlights an institutional gap between the two divisions. For P4Ops to be truly effective at Caltrans, Planning and Operations staff have to work together.

Recent efforts in District 3 (Sacramento) and District 10 (Stockton) engaged staff from both divisions to develop ITS/Operations plans in coordination with their partner agencies. The Plan included developing consensus on high-priority operations projects on the SHS in the district. As a result, District 3 was able to co-fund performance-enhancing operational projects with their partners, using both SHOPP and local funding sources. District 10 will work closely with their partners to find funding opportunities as well. It is critical that other districts do the same and these two districts systematically and continuously update and refresh this list, preferably by conducting comprehensive corridor studies. The two districts also developed a Regional Concept of Transportation Operations (RCTO) as a high-level document that identifies the intended operational evolution of major corridors in the district. Again, the RCTOs were developed in coordination with partner agencies.

Many districts do not currently have a list of high-priority operations projects that both planning and operations develop jointly, evaluate, and share with partners. Developing a list of high-priority operational projects is not an easy undertaking. Whereas Operations may view a project as “implement ramp metering at location X”, planning and partner agencies often look more holistically over the long-term, such as “implementing ramp metering on corridor”. This may occur in steps, but it should still be seen as one project. That is how the Transportation Planning function, especially System Planning, can help organize projects that Operations staff identifies. Ultimately, this is taking a strategic approach as opposed to simply addressing what infrastructure is needed or where. The approach identifies what will be accomplished in the way of system performance with that infrastructure as a functional initiative in the short and medium term.

This strategy evaluation is consistent with asset management principles and partner agency expectations. It should include high-level cost estimation, benefit-cost analysis, and estimating greenhouse gas (GHG) emission reductions. Again, this is an area where Planning can help Operations. Planning staff often make use of the California Benefit Cost Model (Cal-B/C) and understand what information is needed by partner agencies. Operations staff may also use Cal-B/C, but they also understand the more technical underpinnings of detailed operational assessments and corridor analyses. In short, the two divisions will need to work more closely together in future P4Ops activities.

4.1.2 Engagement with Partner Agencies

P4Ops is most effective when the Caltrans system management and operations perspective is reflected in regional and local planning documents and programming decisions. Regional agencies must update their Regional Transportation Plans/Sustainable Communities Strategy (RTP/SCS) every four years. These plans generally include a list of projects to fund as part of the “constrained funding plan”. As a result, especially in urban districts, regional constrained funding plans should include operational strategies and projects that Caltrans identifies.

As a result, programming documents, such as the Regional Transportation Improvement Program (RTIP), rarely included these projects either. If a project is not included in the RTP/SCS, it cannot be programmed in the RTIP. This gap needs to be addressed. Operational projects identified by Caltrans need to be at least considered in planning and programming documents. Moreover, Districts may want to consider advocating for the high-performing operational improvements within the base assumptions and metrics of the RTP/SCS.

To achieve this effectively, interactions between districts and partner agencies must include the operations perspective. This happens on an ad-hoc basis today, but needs to be institutionalized. For

instance, several partner agencies now contact the Division of Traffic Operations directly, bypassing the Planning Division altogether. This happens frequently with managed lanes studies and projects. Yet planning needs to be involved or at least be “at the table” in order to fully represent the full planning priorities at Caltrans. This will not happen until Planning staff is perceived to also represent Operations perspectives, but cannot occur overnight until certain skills and abilities are developed within the Planning Division. This also requires district management support.

Moving forward, especially after the passage of SB 1, districts and partner agencies will collaborate on corridor plans and studies. The Division of Traffic Operations in select urban districts is currently organizing itself around the concept of corridor managers. A similar organizational change has not occurred in the district Planning Divisions. Therefore, it is unclear who in the district Planning Divisions will be involved in future corridor studies conducted in collaboration with partner agencies.

4.2 Skills & Abilities

A viable SWP for P4Ops must ensure that staff, especially system planning staff, possess the necessary capabilities and expertise to conduct collaborative, performance-based multi-modal system management planning – or P4Ops – activities. In addition to the aforementioned interviews and workshops, information was gathered from numerous national resources (most notably FHWA and AASHTO). There are many recent studies and reports on workforce issues in transportation agencies (several sources are listed in Appendix B). For this study we have focused on issues and guidance that we believe are most specific and relevant to Caltrans.

From a Human Resources perspective, the expertise and capabilities associated with specific jobs or positions are often summarized in the form of Knowledge, Skills and Abilities (typically referred to as “KSAs”). Rather than outlining specific KSAs, we have chosen to outline the core competencies needed for P4Ops and TSMO planning. The recently completed Organizing for Corridor Management Project developed an “Inventory of Required Knowledge, Skill Sets and Abilities; and Corridor Management Technical Assistance and Training Plan.” This inventory included a comprehensive list of KSAs geared specifically towards Connected Corridors, and was a useful resource for assessing P4Ops expertise needs.

4.2.1 Current State of P4Ops Staffing and Expertise in Caltrans

The following P4Ops issues/gaps have been identified in the area of skills/abilities:

- **Scattered specialized expertise** - There are many technical specialists related to P4Ops within Caltrans, some of whom are recognized as experts in their specialty areas. However, these specialists are scattered throughout the 12 districts, and in most cases are not generally available for consultation and support of other districts. Technical experts certainly do not exist on each P4Ops subject area in every district. Thus, no central repository of technical Operations expertise exists within the department. Instead, silos of expertise exist, which are occasionally connected through internal committees or ad hoc discussions, but no formal process for consistently sharing information and experiences currently exists. Finally, like most state transportation agencies, Caltrans has historically had a civil engineering orientation, focusing on project delivery. While this focus has been changing, the pool of P4Ops and TSMO expertise within the department is decidedly smaller than the expertise pool for other functions, such as highway design.

- **Brain drain** - Further exacerbating the issue of scattered technical knowledge is the reality of continuing and accelerating loss of staff with expertise and experience. This is not an issue confined to P4Ops and TSMO, nor is it limited to Caltrans. Transportation agencies throughout the nation are experiencing high volumes of retirements, especially with the Baby Boomers who were involved with the large-scale highway building era. The challenges caused by job vacancies and staff turnover affect all levels in the P4Ops hierarchy, from working staff to management.
- **Difficulty staying up-to-date** - The area of TSMO has experienced numerous advances in the last decade, with many new multi-modal strategies and technologies introduced in the field such as Managed/Express Lanes, Integrated Corridor Management (ICM) and Connected/Automated Vehicles. There is no formal process within Caltrans, such as a continuing education or systematic training program, to ensure that even a minimal proportion of staff stay up-to-date on current trends. Because TSMO technologies and strategies evolve rapidly, Caltrans staff is often unable to stay current, let alone think ahead to the future. As a result, many districts are left in a reactive mode to innovations proposed by others, as opposed to being proactive.
- **Resource limitations** - The challenges related to insufficient resources extend not only to the obvious staffing levels and training budget limitations, but also to administrative constraints such as the requirement to use broadly defined job classifications (such as “Transportation Engineer–Civil” which covers every possible engineering responsibility within Caltrans) and the specific distinction between the Engineer and Planner classes within Caltrans. The job classifications used within Caltrans are largely based on duties and assignments that mirror highway organizations of the past, and generally do not reflect the types of work activities involved with P4Ops. Some Duty Statements (both in the Planning and Operations Divisions) have not been updated in many years and are therefore largely outdated in terms of identifying some of the newer hard and soft skills required to successfully carry out P4Ops functions.

Staffing levels are established, for the most part, on estimated workloads. Allocating additional staff time for training can be difficult, and thus there are almost always tradeoffs between completing work assignments versus setting aside time for training/professional development. Given that most districts feel that they do not receive sufficient staff resources to match their existing workload, the tension between meeting workload commitments and allowing time for training will continue to exist. At the same time, budgets are rarely sufficient to cover all of the training needs that exist, and no formalized P4Ops curriculum currently exists. Annual resource allocations to the districts could, potentially, include a specific allotment for training for hard and soft skills for both Planning and Operations staff, but this approach would require tradeoffs with other production and workload priorities within both Divisions.

4.2.2 Expertise and Capabilities Needed for P4Ops

The skill sets required for P4Ops should be closely and deliberately aligned with the definition of P4Ops. To that end, the needed expertise and capabilities encompass more than specialized technical knowledge of system management and operational strategies. Moreover, recognizing that the span of P4Ops extends from initial Planning to Programming and to Project Delivery, the depth of knowledge needed at different points in this lifecycle will also differ. For example, a Planner should have a general understanding of the function of ramp metering and the institutional issues related to metering when devising a high-level corridor-wide strategy. An Operations engineer will need to have much more detailed knowledge of the

operational, technological, software & hardware aspects of metering when a project is defined and designed. In addition, more than Planners and Operations personnel are involved in P4Ops activities. Some understanding of P4Ops goals and principles will be needed from other internal Caltrans functions (such as Programming and Project Development) and from external partner agencies. Thus, there is a spectrum of staff capabilities that will be needed, ranging from generalists to specialists.

In addition, possession of “soft skills” is also essential for successful P4Ops activities. Given the collaborative nature of P4Ops, staff should be trained to effectively communicate and collaborate with internal and external partners and reach consensus on important technical and non-technical issues.

Exhibit 3 summarizes the core competencies needed for P4Ops, which correlate back to the six steps in the P4Ops Short-term Transition Plan. Brief descriptions are provided for the types of skills needed for Planning and Operations staff, and for staff in other functional areas where appropriate.

Exhibit 4 is a list of management and operations strategies that could be considered when conducting collaborative, performance-based multimodal system management planning activities. It was not feasible within the confines of this project to perform an exhaustive survey of all of the districts and Headquarters to determine what level of expertise exists for each of the strategies.

Exhibit 3: Core Competencies Required for P4Ops

CORE COMPETENCIES REQUIRED FOR P4Ops	
TSMO:	
<p>Practices and strategies focusing on actively managing the multimodal transportation network through the implementation of multimodal, intermodal, and often cross-jurisdictional systems, services, and projects. P4Ops is a component of TSMO. Implementations require the understanding of and adherence to the principles of System Engineering.</p>	<ul style="list-style-type: none"> • Planning: High-level understanding of TSMO concepts and strategies. • Operations: Detailed working knowledge of the full range of TSMO strategies and their applications, and system engineering principles. • Other functions: High-level understanding of TSMO concepts and strategies.
Multimodal Performance Measurement/System Monitoring & Evaluation:	
<p>Gathering and analyzing transportation performance data for all modes (freeways, arterials, transit, bicycles, pedestrians, freight).</p>	<ul style="list-style-type: none"> • Planning and Operations: Knowledge of data sources; ability to extract, analyze, and summarize relevant data.
Performance Reporting:	
<p>Summarizing and presenting data and information in meaningful ways at a variety of scales (location-specific, corridor, regional, statewide).</p>	<ul style="list-style-type: none"> • Planning and Operations: Understanding reporting needs of various audiences.

CORE COMPETENCIES REQUIRED FOR P4Ops

Problem & Need Identification:

Analysis and quantification of performance data to determine causes of problems and preliminary estimation of needs for all modes.

- **Planning:** Understanding of how problems are identified and quantified. Basic understanding of multimodal traffic engineering principles.
- **Operations:** Analytical skills needed to identify causes of problems and to quantify needs. Capabilities range from sketch planning activities and spreadsheet analyses (such as manual bottleneck calculations) to running microsimulation models.

Goals & Metrics Identification:

Defining goals and objectives based on both the Caltrans SMP and the strategic plans of partner agencies, and developing the corresponding measures and metrics to compare performance.

- **Planning:** Knowledge of departmental and regional operational goals; Familiarity with multimodal operations-oriented objectives and metrics.
- **Operations:** Understanding of multimodal operational goals and metrics, and how TSMO strategies can achieve them.

Project Identification:

Development of solutions & strategies based on the identified problems, needs and goals, which can move from concepts to actual projects.

- **Planning:** General knowledge of multimodal operational strategies and tools, and how they address problems and needs. Understanding of partner agency support for operational strategies.
- **Operations:** Detailed knowledge of the full range of TSMO strategies, and their effects and benefits as they relate to identified problems.

CORE COMPETENCIES REQUIRED FOR P4Ops

Multi-objective Performance Evaluation:

Analysis of proposed projects and strategies; generate broad set of performance metrics useful for comparing impacts and benefits of options.

- **Planning:** Knowledge of sketch planning tools; travel and traffic demand forecasting models; Ability to conduct Benefit-Cost analyses and Before & After studies.
- **Operations:** Detailed knowledge of multi-modal traffic engineering principles and ability to use entire suite of traffic analysis software (freeway, highways, arterials, intersections). Understanding of travel and traffic demand forecasting models.

Safety:

- **Planning and Operations:** General knowledge of multimodal safety issues and investigations; ability to access and understand safety data. (NOTE: Detailed safety investigations and development of safety projects are generally assigned to Traffic Safety staff.)

ITS Architecture:

Framework that identifies the institutional arrangements and technical integration necessary to interface a major ITS project with other ITS projects and systems.

- **Planning:** Knowledge of Regional ITS Architecture (including roles and responsibilities of participating agencies and stakeholders) and ITS standards supporting regional and national interoperability.
- **Operations:** Knowledge of system functional requirements, interface requirements and information exchanges with planned and existing systems and subsystems, and the sequence of projects required for implementation.

Programming:

- **Planning:** Knowledge of selection/scoring criteria, programming processes and timelines for both Caltrans-controlled fund sources as well as those of partner funding agencies, including the multi-objective SHOPP nomination and project selection process.
- **Operations:** General knowledge of internal and external programming processes and timelines, and key milestones.

Project Delivery:

- **Planning and Operations:** Knowledge of post-programming project delivery process, including design and construction phases.

CORE COMPETENCIES REQUIRED FOR P4Ops

Collaboration:

- Planning and Operations:** Soft skills such as consensus-building, negotiation and dispute-resolution techniques, leading to the ability to effectively communicate, cooperate and collaborate with internal and external partners.

Exhibit 4: P4Ops Management and Operations Strategies

partially derived from the From FHWA P4Ops website

P4Ops Management and Operations Strategies

(partially derived from the From FHWA Planning for Operations website)

Active Transportation and Demand Management:

The dynamic management, control, and influence of travel demand, traffic demand, and traffic flow on transportation facilities.

Arterial Management:

The management of arterial facilities in a manner that provides all multimodal users with a safe, efficient, and reliable trip. Includes Access Management and Traffic Signal Timing (including Transit Signal Priority, Emergency Vehicle Pre-emption, etc.).

Bottleneck Mitigation:

Focuses on recurring bottlenecks; i.e., those that are operationally influenced by design or function, and are impacted upon by traffic over-demand.

Congestion Pricing:

Encompasses roadway pricing that varies by time of day based on the level of congestion on the facility.

Integrated Corridor Management:

An approach that focuses on collaborative management of the transportation corridor as a system, rather than the more traditional approach of managing individual assets on the corridor. Partners manage the corridor as an integrated asset in order to improve travel time reliability and predictability, help manage congestion and empower travelers through better information and more choices.

Emergency Transportation Operations:

Providing users with a safe and efficient transportation system during an emergency situation.

P4Ops Management and Operations Strategies

(partially derived from the From FHWA Planning for Operations website)

Freeway Management:	The implementation of policies, strategies, and technologies to improve freeway performance. The overriding objectives of freeway management programs include minimizing congestion (and its side effects), improving safety, and enhancing overall mobility.
Freight Technology and Operations:	The effective management of the system for freight transportation. The goal of freight transportation is to move goods safely, efficiently, and reliably throughout the region. This may range from satisfying the customer (e.g., freight shippers, receivers, and carriers) to actual travel time on the system.
Managed Lanes:	Highway facilities or a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions.
Planned Special Events Traffic Management:	Special event management provides users with a safe and efficiently managed transportation system during a planned special event.
Road Weather Management:	Road weather management focuses on providing users with a safe and efficient transportation system during and after weather events.
Real Time Traveler Information:	Traveler information is designed to provide transportation system users with the information they need to choose the safest and most efficient mode and route of travel.
Traffic Incident Management:	Incident management is defined as verifying, responding to, and clearing traffic incidents in a manner that provides transportation system users with the least disruption.
Transit Operations and Management:	Transit operations and management is the operation and management of the transit system in a safe and efficient manner.
Travel Demand Management:	Travel demand management is defined as providing users with effective travel choices to shift or reduce the demand for travel in congested conditions.

P4Ops Management and Operations Strategies

(partially derived from the From FHWA Planning for Operations website)

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.

4.3 Data, Tools, and Analytics

The data and analytics survey conducted as a joint effort between the SP2P study and this project asked districts and partner agencies to identify the data and tools they use for analysis. Using the results of this survey, the study team identified several gaps in planning and operations that need to be addressed to facilitate operational analyses as follows:

- **Understanding of planning and programming processes** – Caltrans district staff, especially Operations staff, should gain an understanding of regional and statewide planning processes and how these processes and associated products influence funding and programming decisions.
- **Modeling** – Planning and Operations staff should gain a basic understanding of different transportation models and how they should be used. There are several types of transportation models used at Caltrans and its partner agencies. Planning staff, in particular, need to better understand the differences among models, and which ones are more suitable for operations analyses and why. Developing this understanding is very important both when interacting internally with Operations staff and externally with partner agencies.
- **PeMS** – Planning and Operations staff should be familiar with the Performance Measurement System (PeMS) and how it can be used for operational analyses and performance assessments. Caltrans has invested in developing PeMS for more than a decade. It provides data and analysis capabilities central to operational performance assessments, including bottleneck identification and corridor performance metrics (e.g., travel time, delay, and vehicle miles traveled). Planning (and Operations) staff need more familiarity with PeMS, including regular training and refresher courses.
- **Partner Priorities** – Caltrans district staff, especially Planning staff, need to better familiarize themselves with partner agency plans and associated performance measures used for decision-making. Even though Caltrans has adopted performance measures (described in the CTP and the SMP), it is important that Planning staff be familiar with partner agency plans and performance measures, including the major elements/assumptions of an RTP/SCS in the region, and be able to convey that information back to the other functional units and divisions within Caltrans.

- **Private Data Sources** – Many new data sources have become available in recent years. Examples include INRIX, HERE, and Google Traffic. All of these provide useful information, including speed, travel time, and reliability. Familiarity with and understanding of these new sources should be expanded at Caltrans, both with Planning and Operations staff.
- **Working knowledge of Cal-B/C** – When detailed modeling resources are not available, Cal-B/C provides Planning and Operations staff with the ability to conduct a high-level project assessment for a range of project types, including operational projects. The assessment includes an estimate of Green House Gas (GHG) emission benefits. Cal-B/C is a Caltrans product used often with grant submittals and other funding requests. Caltrans staff need more familiarity with the model, how to use it, and its limitations.

5.0 Recommendations

This section identifies recommendations for improvements for the three categories of issues/gaps discussed in Section 4.

5.1 Institutional and Organizational Relationships

Intra-district organizational relationships and institutional relationship opportunities for effective P4Ops can be summarized as follows:

- **Compile and Organize a List of High-Priority Operational Projects and Strategies** – Perhaps the most critical output of P4Ops is to develop and maintain/refresh the district list of high-priority operational projects based upon an evaluation of the benefits of these projects. In the short term, this will consist of compiling projects from Operations staff and recent studies conducted by Caltrans and its partners. Planning staff can help organize these projects and conduct a high-level performance assessment to assess their benefits. In the longer term, this list will be updated through more detailed and comprehensive performance assessments included as part of multi-modal, multi-functional, multi-agency corridor studies (discussed below).
- **Add an Operations Liaison function within the Planning Division** – Operations staffs tend to focus more on real-time activities. For System Planning and Operations staff to work more closely together, the process must be reasonably managed. Therefore, an opportunity exists to add an Operations Liaison function in System Planning to interface with the Division of Traffic Operations. That does not mean the liaison is the *only* interface, just the most frequent one. The person assigned this function should understand operations (as discussed previously) and be credible with Operations staff. The Division of Traffic Operations could also consider having a planning liaison function responsible for soliciting assistance and input from the Planning Division. Finally, for physical operational project identification and assessment, it may also be beneficial to have a Design Liaison function within the planning Division to provide input and feedback. This change will depend to a large extent on executive management support and senior staff coordination.

- **Lead or co-lead corridor studies** - SB 1 encourages Caltrans and its partners to conduct corridor studies and identify promising projects that reduce congestion. SP2P recommends Caltrans to work with its partners to conduct multi-modal, multi-jurisdictional corridor studies. Therefore, this recommendation is consistent with both. Caltrans should lead or co-lead such studies. In fact, over time, corridor studies will be the primary source for updating the list of high-priority operational projects to consider for funding.
- **Develop Multi-functional, Multi-modal Corridor Teams with Partner Agencies** – Conducting the aforementioned corridor studies will require assembling a multi-functional, multi-modal corridor team that includes Caltrans representatives as well as partner agencies. Caltrans representatives should include planning, operations, transit, and active transportation staff (perhaps some individuals can represent more than one function). After the study is completed, it is important to keep the team structure to monitor the funding and implementation of key projects, as well as to assess the ongoing performance of the corridor and translate that information back into investment and operational decision-making processes. Team continuity is very important and will be welcomed by partner agencies.
- **Develop knowledge of partner agency documents and priorities** – A useful exercise for Planning staff is to compile/summarize regional and local plans as well as goals and performance measures adopted. This will facilitate discussions with internal and external partners and the inclusion of these priorities in future Caltrans documents.

5.2 Skills & Abilities

The major opportunities can be divided into three groups as follows:

- **Knowledge transfer:** With the rapid depletion of P4Ops-related expertise and experience within Caltrans, there is an urgent need to transfer that knowledge before it is lost. This can take a variety of forms:
 - Update training to develop expertise beyond traditional traffic engineering subject matter (The Traffic Mobility Workshop has already taken steps to accomplish this). Include existing internal technical experts as instructors. Develop other training forums to include staff from the Planning Division and staff with a role in P4Ops activities from other functional areas, as well as staff from external partner agencies who are already working on TSMO initiatives. Training may need to be tailored to the different nature of urban, semi-urban and rural districts and regions.
 - Develop a comprehensive inventory of P4Ops existing expert knowledge throughout Caltrans. Estimate, to the extent possible, realistic timeframes for when the existing expertise will be lost. Identify succession planning opportunities.
 - Identify, inventory and disseminate P4Ops best practices, demonstration projects/efforts and case studies (from both Caltrans and other agencies nationwide).
- **High Priority Training and Updating of Duty Statements:** Recognizing that it will not be feasible to provide all of the training needed, even to accomplish the short-term P4Ops transition phase,

priority should be given to providing the training that is most immediately needed. We recommend the following subject areas and core competencies:

- Performance Monitoring and Reporting: This involves developing the ability to acquire transportation performance data by using available tools and information resources, and the ability to summarize and present the data in meaningful ways to a variety of audiences. Training on performance measurement, understanding the outputs and outcomes of the data, and the analysis tools available (such as PeMS) would be an obvious starting point.
- Data Analysis and Need & Problem Identification: This involves developing the ability to analyze the data, to identify and quantify needs and problems and to identify the most efficient and effective strategies. This expertise will be essential for Caltrans to lobby for funding controlled by other agencies, to compete for SB 1 funding and to implement the early steps in the Complete Transportation Framework. HQ Traffic Operations is considering development of a unit to assist with traffic data analyses.
- Multi-objective Performance Assessment: This involves analyses that can range from high-level Benefit-Cost analyses to detailed micro-simulation traffic modeling. For the generalist, a broad understanding of multimodal traffic operations principles and what metrics can be derived by using the various tools available is needed. The “Fundamentals of Traffic Engineering” course provides an excellent overview for this purpose. At the other end of the spectrum, development of detailed multi-modal traffic analysis expertise is needed through training on the use of the most commonly-used analysis tools and models. A draft “Caltrans Multimodal Mobility Analysis Desk Reference” is being prepared which provides guidance on different types of multimodal transportation analyses.
- Collaboration: This involves developing soft skills for both Planning and Operations staff, such as consensus-building, negotiation and dispute-resolution techniques, therefore leading to the ability to effectively communicate, cooperate and collaborate with internal and external partners.

On-line information and training resources are available from a variety of sources including FHWA and AASHTO. An important resource to consider is the ITS Professional Capacity Building Program of the US DOT Intelligent Transportation System Joint Program Office.

Once these staff training efforts for the aforementioned hard and soft skills have been started, it will also be important to update any associated Duty Statements for new staff recruitments that may perform P4Ops functions and activities. Many of the job classifications used within Caltrans are largely based on duties and assignments that mirror highway organizations of the past, and generally do not reflect the types of work activities involved with P4Ops. Duty Statements for both Planning and Operations staff will need to be revisited in order to ensure consistency with new training programs and make sure that the enhanced hard and soft skills required to successfully carry out P4Ops functions are included.

- **Implement the Related SP2P Recommendations:** The SP2P study recommended strengthening collaboration between the Planning and Operations Divisions at both the districts and Headquarters to establish new collaborative, performance-based, multi-modal system planning processes.

5.3 Data, Tools, and Analytics

All opportunities related to data, tools, and analytics relate to training. This includes general training on models, new data sources, PeMS, and performance measurement. This training can rely on internal expertise to the extent possible. Caltrans has modeling staff, a PeMS group in Headquarters, and has recently developed a comprehensive performance measurement document as part of the Organizing for Corridor Management effort.

PeMS training should at a minimum include the following areas that are needed for P4Ops activities:

- **Corridor Performance Measurement** – This includes corridor-wide measures such as Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), Vehicle Hours of Delay, and Reliability.
- **Bottleneck Identification** – This identifies bottlenecks or choke points that cause delays. Bottleneck-related queues can be estimated as well. Part of this can include investigation of ramp volumes, freeway interchange volumes, and ingress/egress volumes for HOV or managed lanes.
- **Trend Analysis** – PeMS stores multiple years of data and allows users to analyze trends of performance, bottlenecks, and volumes (demand).

PeMS analysis can be augmented with field observations and private data sources that may be available to districts, including vehicle occupancy counts for calculation of person-metrics. For instance, several regional agencies have purchased INRIX and make it available to districts. They also have conducted field counts and aerial surveys to supplement PeMS data, and have shared this data with Caltrans. Some districts (e.g., District 4) have developed expertise in using INRIX and analyzing these supplemental data sources. Other districts will require training. These private data sources often provide data on arterials as well, which allows for more comprehensive performance assessments. Other data sources to consider include HERE and Google Earth, which provide similar data as INRIX. Either way, developing proficiency in analyzing data and using or referring to existing tools will improve the credibility of Planning staff as they interact with Operations staff and external partner agencies.

District Planning staff training should also address sketch-level performance assessments, modeling and how to interpret the associated results. Modeling tools include:

- **Caltrans Benefit/Cost Model (Cal-B/C)** – This model was developed internally by Caltrans and is often used for sketch-level analyses. It provides the ability to test some operational projects (both physical operational projects and transportation management system projects) as shown in Exhibit 5, albeit at a high level. Although not as accurate as some of the models discussed below, it allows for a quick assessment when resources are not available for more detailed modeling.

Exhibit 5: Table B — Operational Projects in Cal-B/C

Hwy Operational Improvement		Transp Mgmt Systems (TMS)	
Auxiliary Lane		Ramp Metering	
Freeway Connector		Ramp Metering Signal Coord	
HOV Connector		Incident Management	
HOV Drop Ramp		Traveler Information	
Off-Ramp Widening		Arterial Signal Management	
On-Ramp Widening		Transit Vehicle Location (AVL)	
HOV-2 to HOV-3 Conv		Transit Vehicle Signal Priority	
HOT Lane Conversion		Bus Rapid Transit (BRT)	

- Travel Demand Models (including activity-based models)** – These models are used by MPOs in developing RTPs/SCSs to evaluate air quality attainment, the level to which SB-375 targets will be achieved in the future, and to project transit ridership. Many Planning Division staff are familiar with these models, but perhaps not with their limitations. Travel demand models are not adequate to estimate benefits of operational projects, nor do they project bottlenecks or queues. Post-processing tools (such as IDAS) are able to use travel demand model outputs for high-level estimation of ITS benefits, and simulation models typically use similar model outputs for its analyses.
- Macro-Simulation Models** – These models include FREQ (used typically by Operations staff) and TOPL (developed by UC Berkeley). They allow for basic freeway operations analyses and allow for testing basic freeway operational improvements. FREQ at the moment is not supported and TOPL is still in the development phase.
- Meso-Scopic Models** – These models have become increasingly popular with some partner agencies. They do not model individual vehicles, but can include freeways and arterials. They are viewed by some as more appropriate for analyzing regions or sub-regions. They are relatively expensive to develop. While Caltrans staff does not need to learn how to use these models, they need to be able to evaluate the reasonableness of and interpret the results.
- Micro-Simulation Models** – These are the most expensive models to develop and maintain. Many CSMPs were developed with the use of micro-simulation. For corridors that have models that were developed during previous studies, updating and maintaining these models in partnership with Operations staff should be much less extensive. But again, Caltrans staff needs to be able to review the model for reasonableness since the quality of the modeling can vary significantly.

Developing and training Planning staff in using data and tools appropriate to P4Ops is important. Resources may become an issue since Planning staff also have to analyze additional transportation priorities, including transit, complete streets, and active transportation. This is where more coordination with Operations staff becomes increasingly important, so that it can be determined how and who will conduct, provide oversight for and/or review the necessary analyses for comprehensive multi-modal corridor performance assessments.

6.0 Action Plan

Caltrans is already taking numerous steps to update its existing processes in response to the changing transportation landscape. While successful implementation of many of the proposed recommendations will be controlled internally within Caltrans, others will require endorsement and cooperation from local transportation partner agencies. Even in the post-SB 45 era, Caltrans and the CTC continue to have an official role in guiding the development of RTPs through the CTC's RTP Guidelines and Caltrans's Regional Planning Handbook, its approval authority over the Overall Work Program, and its long-range planning guidance through the California Transportation Plan. In addition, the CTC is developing its guidelines for SB 1 funding and evaluation criteria.

This P4Ops SWP is an important internal tool for successfully implementing multi-modal system management planning at Caltrans. The SWP will serve as a blueprint for Caltrans business practices to deliver safe, sustainable and efficient operational strategies system-wide over the long term, in collaboration with local and regional partner agencies. The information gathered from internal and external partners is valued and the recommendations and actions taken from this effort present an important opportunity for Caltrans to make important changes to its planning functions statewide.

6.1 Implementation Road Map

An implementation road map is included in Exhibit 6 which lays out how the recommended strategies described in Section 5 of this SWP can be sequenced, particularly through the Transition Phase. The reality is that FY 2017/18/19 will be years of transition for the DOTP. It is suggested that Caltrans comprehensively document and evaluate the effectiveness of the changes made, fine-tune processes and make improvements as needed, and use this information to prepare its work plans for future years.

Also, recognizing that comprehensive multi-modal, multi-functional system management planning extends beyond the DOTP and district Planning Divisions, it is also recommended that the other divisions within Caltrans, as well as external partner agencies, evaluate their internal processes to better serve the traveling public and meet the goals outlined in the CTP.

In the medium to long-term, the SWP suggests roles for Caltrans Planning and Operations staff (also shown on Exhibit 6). They are divided into three types of roles: Operations lead, Planning lead, and co-lead by both. These roles recognize that P4Ops addresses more than the SHS. Related P4Ops activities include assessments of transit, active transportation, and complete streets. Moreover, comprehensive system performance management includes environmental, sustainability, and livability metrics. All of these activities should continue to be led by the Planning Division within the larger framework of multi-modal, multi-functional, multi-agency corridor studies.

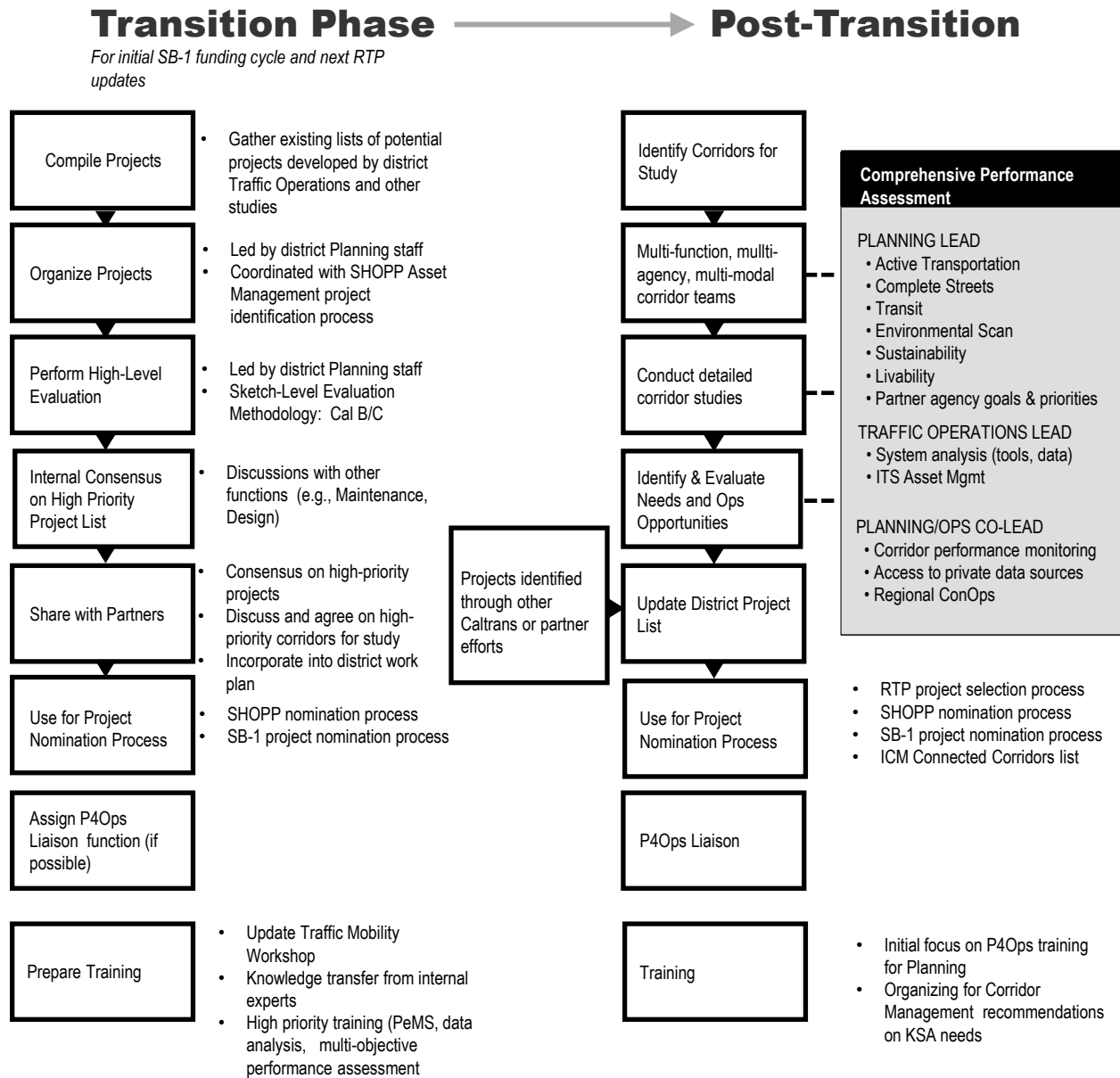
For highways, Operations staff will continue to lead detailed traffic analyses and ITS asset management activities. Planning staff can then lead corridor-level multi-modal performance analyses as well as help provide access to shared private data. Planning can also perform benefit-cost analysis as needed using the Cal-B/C model. Of course, other collaborative and performance-based projects may be added to the list by partner agencies as well.

Moreover, recognizing that many of the issues and gaps outlined in this document differ in extent and complexity at each District, it is recommended that District-specific implementation plans be developed

as a logical next step to implementing this P4Ops SWP. This will allow specific roles and responsibilities between Planning, Operations, and external partner agency staff to be detailed in response to the unique context in which each district operates.

Exhibit 6: P4Ops Implementation Road Map

P4Ops Strategic Work Plan Implementation Road Map



Appendix A – Sample mapping of KSAs between Connected Corridors Senior Planner and P4Ops Senior Planner

Corridor Management – Senior Corridor Planner

Knowledge

- K1: Knowledge of the principles of Caltrans' Transportation Management System (TMS).
- K2: Knowledge of the principles of Transportation Systems Management and Operations (TSMO).
- K3: Working knowledge of Caltrans' Traffic Operations Management Information System (TOMIS).
- K4: Knowledge of the basic principles of Caltrans' System Management philosophy and integrated corridor management concepts and strategies.
- K5: Knowledge of statewide, regional and local multi-modal planning procedures.
- K6: Knowledge of general transit planning principles and performance measures.
- K10: Knowledge of Caltrans' organization, department policies and financial constraints and procedures.
- K17: Knowledge of the systems engineering process used to develop and maintain ITS applications.
- K18: Knowledge of systems and applications used to monitor and analyze transportation data.
- K22: Basic knowledge of HOV, and tolled managed lanes system design and operational engineering.
- K24: Knowledge of Caltrans Traffic Operations Program policies, procedures, and programs.
- K25: Knowledge of the Caltrans Project Development process, including the appropriate development and use of various Project Initiation Documents (PIDs) and Project Initiation processes.
- K26: Knowledge of Risk Analysis processes.
- K27: Knowledge of a wide variety of Performance Measurement metrics.
- K28: Knowledge of stakeholder agencies' processes and systems.
- K29: Knowledge of internal contracting terms and procedures.
- K30: Knowledge of different types of stakeholder agreements.
- K32: Knowledge of organizational restructuring.
- K33: Knowledge of strategic planning.

Skills

- S2: Experience implementing policies, procedures, standards and implementation of multi-modal transportation systems.
- S3: Operating and integrating results from multiple computer applications
- S7: Negotiating.
- S14: Use computers to write and develop charts and diagrams; evaluate and transfer data into relevant information.
- S15: Initiate, develop, complete, and interpret a Needs Analysis.
- S17: Acquire Performance Measurement data and information from a variety of sources.
- S18: Present Performance Measurement data and information in a variety of formats and media.
- S19: Perform simulation and modeling of various corridor management strategies.
- S20: Perform Before and After Studies; evaluate and report the findings.
- S21: Perform Cost-Benefit Analyses; evaluate and report the findings.
- S23: Development, interpretation, and presentation of maintenance performance measurement data and information (MTTR, MTBF, etc.).
- S24: Perform Alternatives Analysis, and evaluate and report the findings.

Abilities

- A1: Establish and maintain friendly and cooperative relations with those contacted in the course of the work.
- A2: Communicate clearly with partner agencies, such as MPOs, Transit Agencies, Transportation Network Companies and other transportation providers and stakeholders.
- A3: Problem-solve, and create innovative methods to reduce costs and improve processes.
- A4: Organize and prioritize work assignments.
- A5: Analyze and evaluate program goals, budget data, and work methods.
- A7: Manage multiple projects and coordinate staff activities to complete assignments.
- A9: Accomplish mission optimally with allocated resources.
- A10: Program, schedule, and prioritize the development and implementation of traffic engineering projects and safety programs.

- A11: Set goals and track performance measurements.
- A23: Ability to write correspondence and prepare reports.
- A26: Ability to prepare technical correspondence and comprehensive reports.
- A27: Ability to address an audience effectively and participate in public presentations.
- A28: Ability to analyze situations accurately and adopt an effective course of action.
- A29: Ability to effectively communicate and coordinate both orally and in written form, with all levels of management and employees in headquarters, in the districts, and outside the organization.
- A30: Ability to work independently.
- A31: Ability to identify and resolve issues.
- A35: Ability to develop succinct and relevant duty statements for team members.
- A36: Ability to develop Risk Assessments, and evaluate and communicate the results.
- A37: Ability to develop succinct and relevant stakeholder agreements to be executed by Caltrans and partner agencies.
- A38: Ability to acquire Performance Measurement data and information from a variety of sources.
- A39: Ability to interpret and present Performance Measurement data and information in a variety of formats and media.
- A41: Ability to develop, interpret, and present maintenance performance measurement data and information (MTTR, MTBF, etc.).
- A42: Ability to perform Alternatives Analyses, and evaluate and report the findings.

Appendix B – Resources

ITS Professional Capacity Building Program

<https://www.pcb.its.dot.gov>

From the US DOT Intelligent Transportation System Joint Program Office. This program provides the ITS workforce with flexible, accessible ITS learning through training, technical assistance and educational resources. The program assists transportation professionals in developing their knowledge, skills, and abilities to build technical proficiency while furthering their career paths

FHWA PlanWorks Decision Guide

<https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide?phaseId=3>

The Decision Guide streamlines the transportation process by systematically building in collaboration. It was developed using examples of successful practice and with input from all partners in transportation decision making. Each key decision from long range planning through permitting is represented by a folder.

NOCOE 2016 Workforce Summit Proceedings and Implementation Plan Final

<https://www.transportationops.org/publications/nocoe-2016-workforce-summit-proceedings-and-implementation-plan-final>

The National Operations Center of Excellence’s (NOCoE) identified workforce development as one of the focus areas that would provide value to the Transportation Systems Management and Operations (TSMO) community and hosted a two-day summit on TSMO workforce development on June 22–23, 2016. The proceedings and findings from its two-day workforce development summit are presented in this document for the TSMO community, participants and partners. The goal of the summit was to identify viable actions that NOCoE can either influence and encouragement the development of additional resources for TSMO workforce development. In preparation for the summit, NOCoE produced three white papers focused on the current workforce environment for the TSMO community prepared in advance of the summit. The white papers provided context and discussion starting points by focusing on four key issues: institutional context for TSMO in transportation agencies, professional capacity building needs vs. available resources, recruitment, retention, and career development.

NCHRP Report 798 -The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decision making

<http://www.trb.org/main/blurbs/172210.aspx>

NCHRP Report 798 examines how the planning function in state departments of transportation (DOTs) can more effectively support strategic decision making in the increasingly complex environments that state DOTs operate within. A self-assessment tool provides a thoughtful and methodical approach to identifying opportunities for increasing the value of planning as well as the skill sets and expertise that planning professionals need to realize that potential. The report should be of immediate use to DOT executives, senior planning managers, and educators.

AASHTO TSMO Guidance: Organization / Workforce Dimension

<https://www.transportationops.org/publications/aashto-tsmo-guidance-organization-workforce-dimension>

These three documents are guidance on improving agency capability in TSMO with respect to the organization/workforce dimension, as developed through NCHRP 03-94 and SHRP2 L06, available in this database. Organization/workforce is important to TSMO because “efficient execution of processes supporting effective programs requires appropriate combination of coordinated organizational functions, and technical qualified staff with clear management authority and accountability.” The three documents represent specific guidance on organization/workforce in the form of improvement targets, strategies, and key actions for agency advancement in capability from “performed” to “managed” (Level 1 to 2), “managed” to “integrated” (Level 2 to 3), and “integrated” to “optimized” (Level 3 to 4). The guidance covers four key sub-dimensions of organization/workforce: program status, organization structure, staff development, and staff recruitment and retention. Agency examples and reference documents are also provided for each level change.

Domestic Scan 13-01 Cross Training

<https://www.transportationops.org/tools/domestic-scan-13-01-cross-training>

Domestic Scan 13-01 reviewed innovative and best practices on how agencies are using cross-training, for what reasons, and when it appears to be most appropriate. Cross training was defined as training that prepares an employee hired for one job function to perform another job function. The term is often used interchangeably with job rotation or job shadowing. Cross-training is used to help develop employees, stabilize workflow, prepare for succession planning, improve teamwork, and make up for job losses due to budget cuts. Ten agencies' practices were reviewed: Caltrans; Connecticut DOT; Iowa DOT; Missouri DOT; Ohio DOT; Tennessee DOT; Utah DOT; Virginia DOT; Oregon DOT; and the National Institutes of Health. Each agency provided best practices. For example, Tennessee DOT cross-trains maintenance workers and summer construction workers to allow for a more flexible and resilient workforce that can be better utilized year-round. The Domestic Scan found many benefits to cross-training, such as increased employee engagement and retention, more flexible employees with broader skill sets, and potential cost-savings in effectiveness, efficiency, and turnover.

Congestion Management Process (CMP)

https://ops.fhwa.dot.gov/plan4ops/focus_areas/cmp.htm

This guidebook provides practitioners with an understanding of the individual elements of a CMP and includes practical examples of how to implement a successful process based on lessons learned from MPOs across the country. The Process Model included in this document is intended to assist practitioners in their efforts to integrate the CMP into the metropolitan transportation planning process, including the development of the MTP and the TIP.

Congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods. A congestion management process (CMP) is a systematic and regionally-accepted approach for managing congestion that provides accurate, up-to-date information on transportation system performance and



assesses alternative strategies for congestion management that meet state and local needs. The CMP is intended to move these congestion management strategies into the funding and implementation stages.

ESRI Solutions for Transportation Planning

<https://dot.esri.com/portal/home/index.html>

ESRI (a.k.a. Environmental Systems Research Institute) is an international supplier of geographic information system (GIS) software, web GIS and geodatabase management applications. The ESRI Transportation Practice has worked closely with a number of DOT's to help promote ideas and develop solutions that streamline the early phases of Transportation project submission and screening. This is one of the simplest areas where maps and geospatial analysis can significantly improve the planning process; by helping planners and designers develop better scopes of work for projects, estimate more accurate construction costs, enhance early environmental coordination and risk mitigation, and streamline permitting. Originally developed in partnership with MassDOT, the MassDOT Project Planning System (MaPPS) for a project development tool provides a user friendly web-based mapping application supporting the following primary workflows:

- **Planning:** Online project need and initiation using map-centric approach
- **Analysis:** Planning-phase environmental, safety and vulnerability screening
- **Reporting:** Design and analysis recommendations for scopes of work & initial construction estimates
- **Coordination:** Planning phase agency review/commenting and sharing