



Methods and Tools To Estimate Staffing Needs for Traffic Management Systems (TMSs)

Transportation Management Center (TMC) Pooled Fund Study
Federal Highway Administration (FHWA)
December 2024





Presentation Outline

Topic	Slides
1. Process for identifying and estimating staffing needs	3–4
2. Assessing, preparing, and engaging in identifying TMS functions	5–7
3. Identifying TMS staffing needs	8–22
4. Developing a staffing approach	23–24
5. Implementing and evaluating the staffing approach and lessons learned	25–26
6. Resources and references	27–29





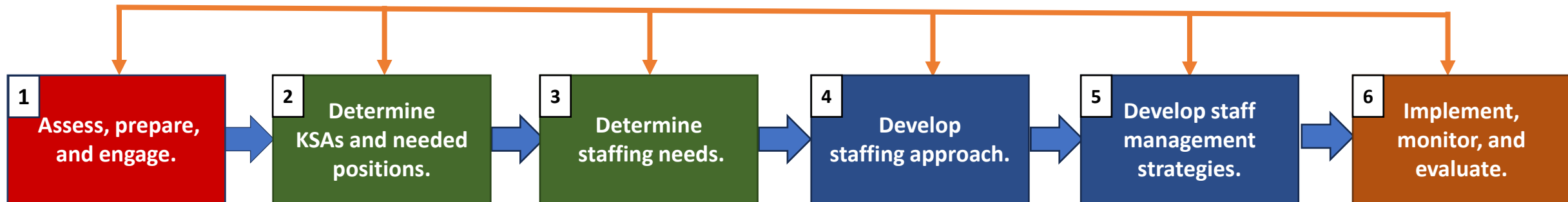
Challenges With Meeting TMS Staffing Needs

- Quantifying needed skills for TMSs.
- Understanding the metrics and data needed to estimate staffing.
- Hiring or developing staff with specific expertise.
- Training staff in specific technical areas.
- Modifying staff roles and job descriptions.
- Supporting TMSs with the range of needed skills and resources.
- Predicting or estimating future staffing needs.
- Expanding current capabilities and resources.
- Understanding changing demands that influence staffing needs.
- Understanding evolving TMS functions and services.



Process for Identifying and Estimating Staffing Needs

- Estimating staffing needs is part of an agency's process.
- Critical parts of the process for estimating staffing needs are as follows:
 - Identifying the TMS functions in step 1.
 - Determining the needed knowledge, skills, and abilities (KSAs) in step 2.
 - Forecasting the future demand and staffing needs and calculating the staffing levels in step 3.
 - Determining the preferred staffing approach in step 4.

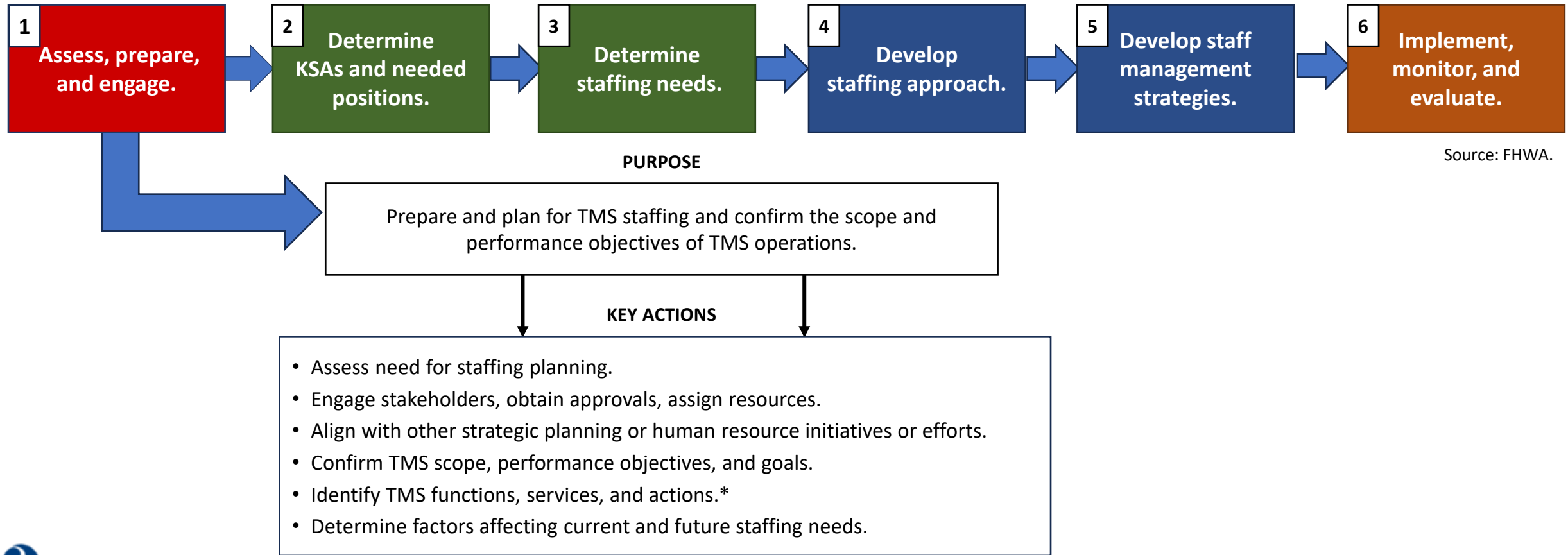


Source: FHWA.



Assessing, Preparing, and Engaging

Identifying TMS functions, services, and actions is critical to estimating staffing.



Source: FHWA.

*Critical action for estimating staffing needs.



What Are the Functions of a TMS?(1)

- A function is a capability or ongoing activity of a TMS that contributes to the accomplishment of the TMS's mission.
- Another TMS, the transportation system management and operations (TSMO) program, or another agency may sometimes perform and support functions.
- The functions performed or supported by a TMS and the demand for transportation management services by consumers determine the type and number of personnel needed.

Common TMS Staff Functions

- Monitor traffic.
- Control ITS devices.
- Maintain, repair, and troubleshoot ITS devices.
- Disseminate information.
- Manage personnel.
- Analyze data.
- Interface with media and public.
- Plan, recommend, and implement system and procedural upgrades.
- Coordinate with incident response agencies.
- Coordinate with other local and regional transportation agencies.



Potential Resources for Identifying TMS Functions

- TMS plans:
 - Need-based.
 - Link with broader plans that identify needed transportation actions.
- Concept of Operations (ConOps):
 - Describes the TMS and its functions.
 - Describes TMS staff roles, responsibilities, and interactions with various TMS subsystems, components, and functions.
 - Includes TMS use cases that provide:
 - Workflow context.
 - Details of systems or sources of information needed to accomplish tasks, make decisions, and anticipate results.
- TMS assessment:
 - Reviews and identifies needed improvements.
 - Provides insights into needs for workforce staffing, technical skills, and training.



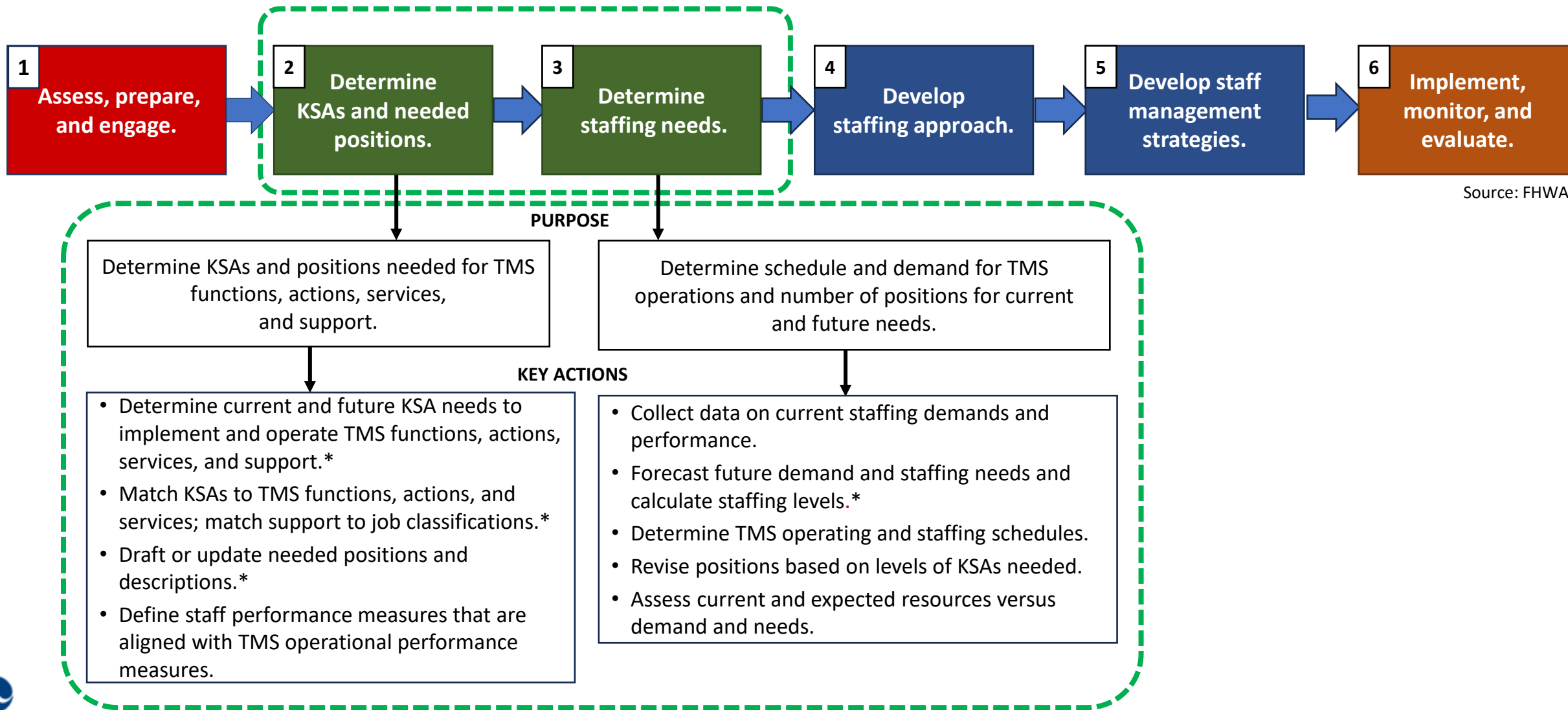


Challenges With Estimating Staffing Needs

- Identifying and collecting the right data.
- Determining the methodology to use to estimate needed staffing.
- Identifying and selecting appropriate performance measures.
- Understanding the metrics and data needed to estimate staffing.
- Predicting future staffing needs.
- Developing the capability to monitor and collect staff performance data and TMS demands.



Identifying TMS Staffing Needs



Source: FHWA.



*Critical actions for estimating staffing needs.



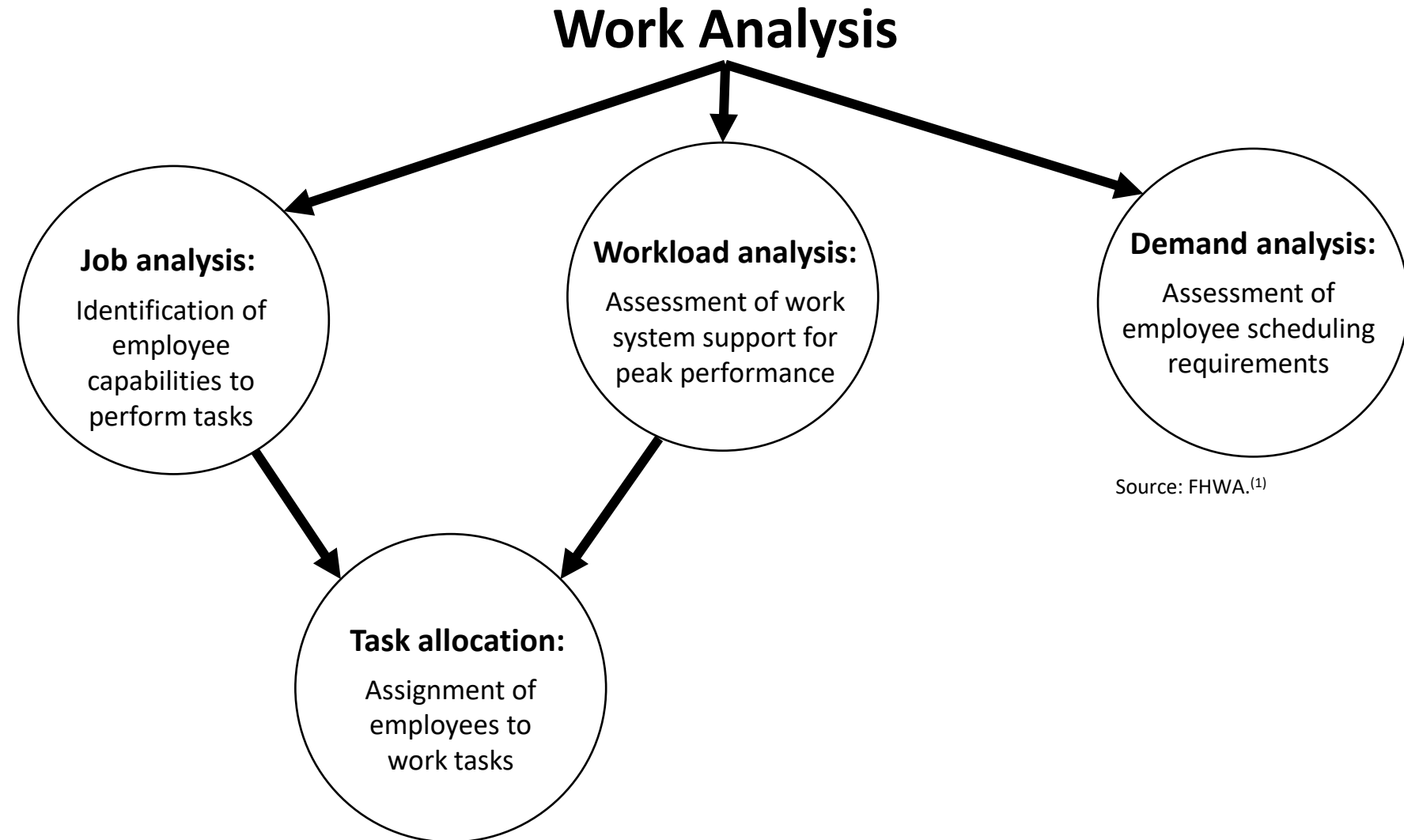
Identifying Current and Needed TMS Staff Positions

- Determine current and future KSA needs to implement and operate TMS functions, actions, services, and support.
- Match TMS functions, actions, services, and support to job classifications.
- Link job classifications to current and needed positions.
- Draft or update needed positions and descriptions.



Methods for Forecasting TMS Staffing Needs⁽¹⁾

Work analysis examines job-related activities and encompasses several methodologies that agencies can use to forecast TMS staffing needs.





TMS Job Analysis⁽¹⁾

- Determines basic elements of work.
- Assesses employee characteristics necessary to perform each element.
- Confirms employees possess the necessary attributes to perform each element.
- A job analysis may be:
 - Task-oriented—Determines specific elements of work:
 - Tasks.
 - Functions.
 - Positions.
 - Worker-oriented—Assesses employee characteristics:
 - Knowledge, skills, abilities, and other characteristics (KSAOs).
 - Training experience.
 - Performance level.





Example TMS Job Types For Consideration in Job Analysis

Functions	Typical Positions
Data Analysis	Traffic data scientist/statistician Data management specialist Visualization specialist
System Development	Traffic design engineer Systems engineer Computer engineer Telecommunications engineer
Real-Time Operations	TMS operator TMC shift supervisor TMC manager Cyber security engineer Traveler information specialist Public information officer Traffic incident management supervisor Transportation/electronics maintenance technician



TMS Workload Analysis (1)

- Assessment of work system support for peak performance.
- Considerations in three areas:
 - TMS workload:
 - Assessment of overall agency workload to enable prediction of staffing requirements.
 - Number of centerline or lane miles, number of intersections, number of TMS devices, number of incidents, and incident severity are commonly measured.
 - Employee workload:
 - Assess task resource requirements and whether employees can meet the resource demands.
 - Evaluate relative to resources available, based on the combination of tasks performed, the difficulty of the tasks, and the individual characteristics of the employee.
 - Attention:
 - Assessment of the attention required by staff for a particular task.
 - Generally categorized in three ways: (1) selective attention, (2) focused attention, and (3) divided attention.



Workload Analysis—Washington State Department of Transportation (WSDOT)¹

- Analysis is organized around agency function, with activity level estimates based on previous traffic operations experience.
- Functions within the TMS are rated based on how critical the functions are in terms of impacting:
 - Life safety (L).
 - Supporting regulatory control enforceable by law (R).
 - Advising travelers (A).
- Times associated with TMS operators and events are based on staff experience and “Guidelines for TMC Transportation Management Operations Technician Staff Development.”
- Full-time equivalent (FTE) staffing levels are based on a 40 h per week, 50 w per year resource allocation.
- WSDOT assumes total staff of 25 persons, operating the TMS 24 h per day, 7 d per week, 365 d per year.
- WSDOT used spreadsheet-based tools to estimate past staffing requirements.

¹WSDOT. 2012. *Evaluation of Operator Staffing Levels and Associated Space Requirements*. Unpublished internal document.



Workload Analysis—Washington State Department of Transportation (WSDOT)¹ (continued)

Function	Rating	Events	Metric	Operator Time/Event (minutes)	Mileage/Subsystem	Units	Annual Load (hours)	FTE Employees
Peak freeway operations	R/A	3.21	Per peak period	15	240	Miles	1,670	0.83
Incident management	A	2	Per peak period	15	180	Miles	1,040	0.52
Web page update (traveler information system)	A	2	Per peak period	5	1	Sites	347	0.17
Dynamic message sign	A	0.25	Per peak period	1	380	Signs	3,293	1.65
Interagency coordination	A	1	Per shift	30	10	Partners	300	0.15
Reversible roadway operations	R	2	Per shift	30	20	Miles	1,200	0.60
Logging	A	220,000	Per year	0.5	240	Actions	1,833	0.92
Maintenance dispatching	A	4,446	Per year	30	160	Trucks	2,223	1.11
Video and data sharing	R	5	Per week	90	10	Partners	3,900	1.95
Tunnel management	L	2	Per week	90	3	Sites	468	0.23

R = supports regulatory control; A = supports advising travelers; L = supports life safety.

© 2012 WSDOT.

¹WSDOT. 2012. *Evaluation of Operator Staffing Levels and Associated Space Requirements*. Unpublished internal document.



TxDOT Staffing Analysis¹

- Combines quantitative and qualitative analyses.
- Quantitative analysis includes:
 - Current staffing levels.
 - Annual turnover rate.
 - Number of ITS devices.
 - Centerline miles monitored.
 - Vehicle miles traveled.
- Qualitative factors include:
 - Job functions, including responsibilities outside the control room.
 - New technologies added to the TMS.
 - Upcoming major roadway projects.
 - Difficulty in filling positions.
 - Efficiency of current operation.

¹TxDOT. 2022. *Development, Integration, Implementation, and Maintenance Services for Traffic Management System (DIIMS) Transportation Management Center Staffing Analysis*. Internal document.





TMS Demand Analysis⁽¹⁾

- Identifies employee scheduling requirements.
- Predicts demand for TMS functions, actions, and services.
- Analyzes trends in demand (time-series analysis).
 - Trend component—upward or downward.
 - Seasonal component (weather, school, holidays).
 - Cyclical component—demand for TMS services tend to increase over time.
 - Random component.
- Estimates anticipated demand by regression analysis and similar means.



Demand Analysis—Florida DOT (FDOT)¹

- Uses historical values to develop factors in the subsequent calculation of FTE employee factors.
- Determines TMS staffing needs from historic values and user-input values.
- Calculates other elements of TMS staffing requirements, such as the number of events expected to occur within the fiscal year.
- Provides similar outputs for 19 other TMS staffing classifications, including information technology, public relations and marketing, and administration and reception.
- Embeds analysis in spreadsheet-based tools to estimate future demand for TMS services.

User-Defined Inputs	2024–2025
RTMC count	1
STMC count	3
Freeway center line miles	430.0
Freeway ramp meters	0
Arterial center line miles	465.0
Arterial signals	670
Express lane miles	22
Express lane ramp meters	12
Event growth rate (percent)	2.0
Example Spreadsheet Outputs	2024–2025
RTMC/STMC management	\$751,088
RTMC shift supervisor hours	8,760
STMC shift supervisor hours	12,480
Shift supervisor original loaded rate	\$54.00
Shift supervisor district rate	\$49.68

Source: FHWA.

RTMC = regional traffic management center;
STMC = statewide traffic management center.

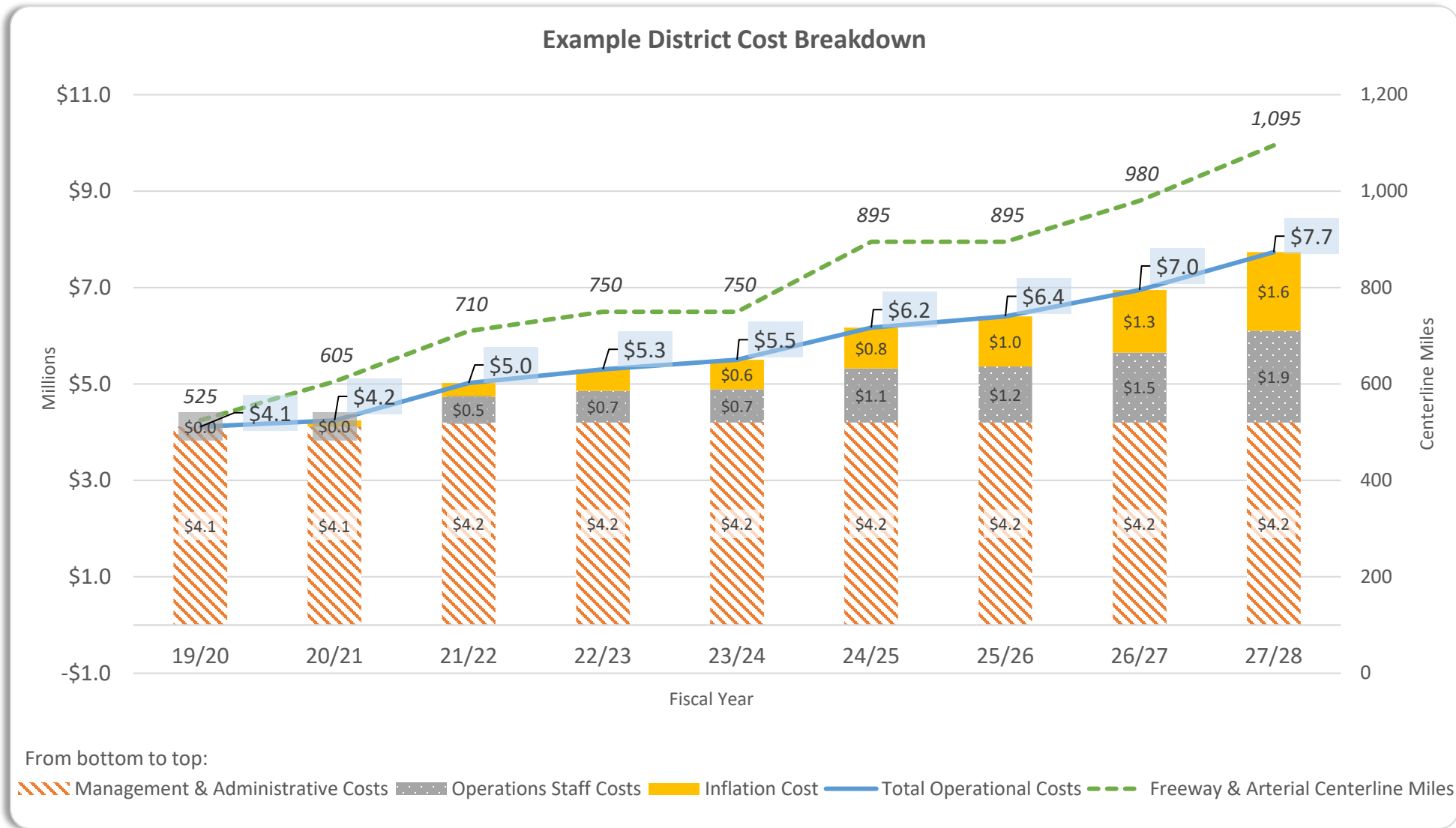
¹FDOT. 2022. *ITS Operations Budgeting Model v2.0*. Unpublished internal spreadsheet tool.



Demand Analysis—Florida DOT (FDOT)¹ (continued)

Florida DOT's spreadsheet tool provides a district-level cost breakdown summarizing annual costs, relative to user-defined changes in the roadway network.

¹FDOT. 2022. *ITS Operations Budgeting Model v2.0*. Unpublished internal spreadsheet tool.





Estimating TMS Staffing Without Formal Tools

- Minnesota DOT:¹
 - Adds new staff positions only when retirements are pending or existing personnel is transferred to a different position.
 - Hires staff as State employees for technical positions to improve staff retention, relative to private sector staffing.
 - Anticipates additional staffing needs to cover new shifts when the agency transitions to 24 h per day, 7 d per week operations.
- Utah DOT:²
 - Conducted benefit-cost analysis based on congestion and incident clearance, considering various factors, such as urban versus rural geography, number of incidents within a corridor, and traffic volume.
 - Transitioned to a matrix-style organizational structure so that Incident Management Team (IMT) support staff are managed regionally and statewide.
 - Approved additional IMT staff through executive decision and permanent TMC staff-to support TSMO initiatives.
- Pennsylvania DOT:³
 - Assesses staffing needs on an ad-hoc basis while working toward a formalized process.
 - Relies primarily on internal TSMO operations guidebook for staffing guidance.
 - Plans to develop a methodology to create a “snapshot” of staff requirements projected into the future.

¹Unpublished interview with Minnesota DOT. July 5, 2023.

²Unpublished interview with Utah DOT. June 29, 2023.

³Unpublished interview with Pennsylvania DOT. June 1, 2023.



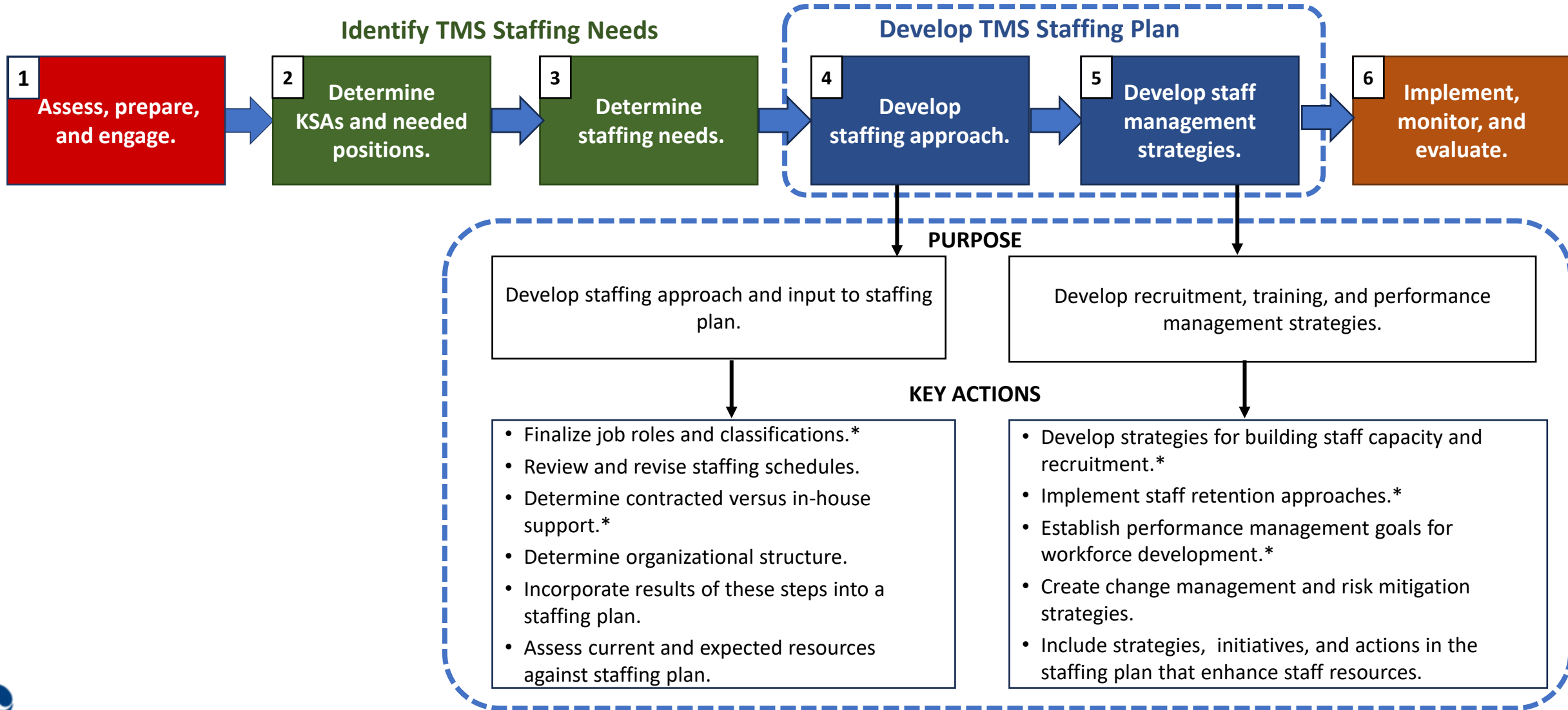


TMS Task Allocation⁽¹⁾

- Assigns discrete work activities to employees based on the results of job and workload analyses.
- Ensures the optimum allocation of work among employees or groups of employees.
- Supports the consideration of different staffing configurations.
- Supports estimating, identifying, and assigning staff for shifts or schedules.



Developing a Staffing Approach





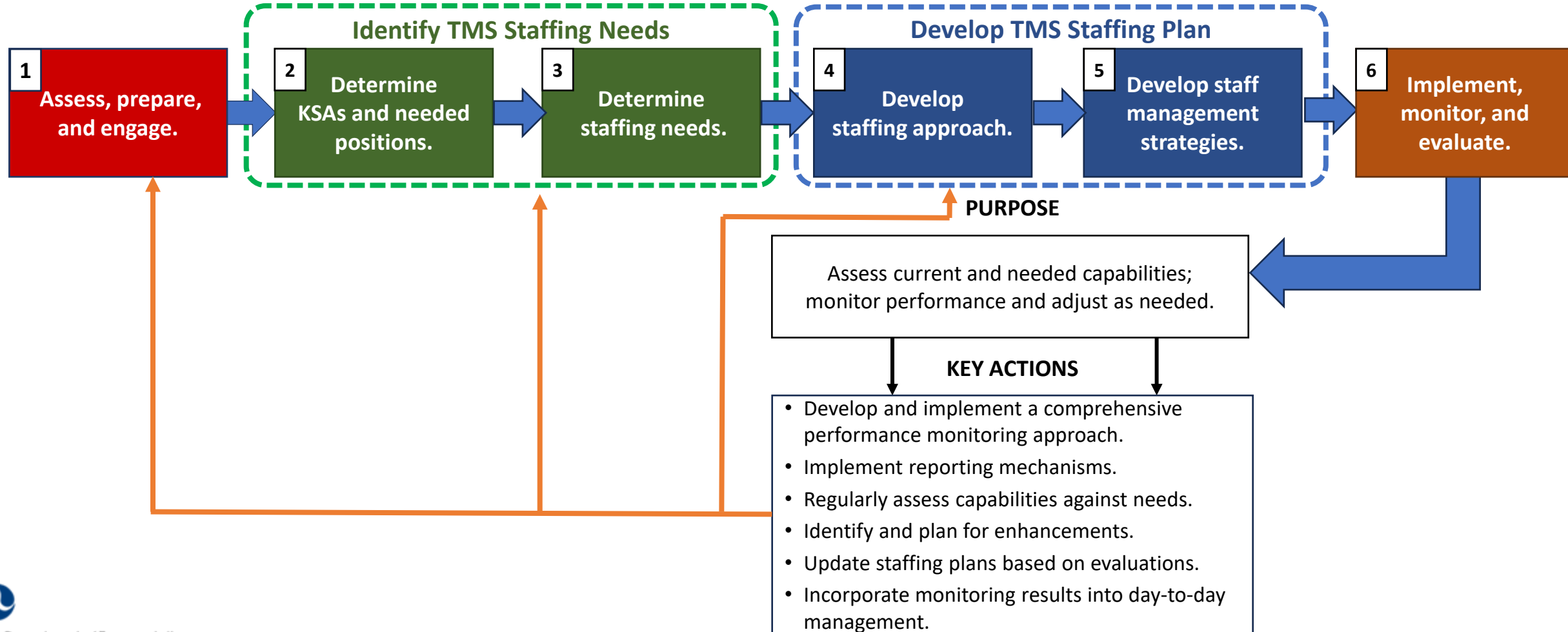
Key Actions in Estimating Staffing and Developing a Staffing Plan

- Finalize job roles and classifications.
- Determine contracted support versus agency staff.
- Develop strategies for building and maintaining staff capacity.
- Initiate and sustain efforts to recruit staff.
- Implement initiatives or activities to support staff development (e.g., retention programs or efforts, rotational assignments).
- Establish performance management goals, measures, reporting, and evaluation methods to support assessing current workforce and identify development needs.



Implement, Monitor, and Evaluate

Monitoring and reporting on staff performance is important for updating estimates for staffing and scheduling and managing staff resources, staffing plans, and feeds in day-to-day operations.



Lessons Learned

- Managers of TMSs may not use formal tools for estimating staffing needs.
- Agencies may rely on ad hoc processes to estimate staffing needs and resources.
- Agencies may not be able to fill the number of positions identified through the staff estimation process because of budget constraints, policies, or legislation.
- Cost-benefit analyses are commonly used to justify new staff positions when funding is requested.
- Staffing plans consider factors like organizational structure, agency staff versus contract staff, scalability (based on size, complexity, and capabilities), available agency resources and services provided (type and size of the area serviced, TMC operational hours), and gaps in current or future staffing needs.
- Changes in TMS demand, such as the number of incidents or number of ITS devices, can be considered in estimating staffing needs.





Available Resources

- *Organizing for TSMO—Case Study 5: Organization and Staffing.*⁽²⁾
- *TMC Operator Requirements and Position Descriptions.*⁽³⁾
- *TMC Staffing and Scheduling for Day-to-Day Operations,* including a TMC ops tool.⁽¹⁾
- *Transportation Systems Management and Operations (TSMO) Workforce Guidebook.*⁽⁴⁾
- *Day-to-Day Management and Operation of TMSs and TMCs.*⁽⁵⁾
- *Aligning Traffic Management Center Staffing Capabilities for the Future of Systems Operations.*⁽⁶⁾
- *TMC Operator Requirements and Position Descriptions.*⁽⁷⁾





Additional Information on TMS Practices

- National Operations Center of Excellence (NOCoE) Traffic Management Systems and Centers portal.⁽⁸⁾
- TMC Pooled-Fund Study website.⁽⁹⁾



References

1. Wolf, M., D. Folds, J. B. Ray, and C. T. Blunt. 2006. *Transportation Management Center Staffing and Scheduling for Day-to-Day Operations*. Report No. FHWA-OP-06-XXX. Washington, DC: Federal Highway Administration.
2. Atkins, L., O. R. Brey, A. Hoekstra, and C. R. Lattimer. 2019. *Organizing for TSMO—Case Study 5: Organization and Staffing*. Report No. FHWA-HOP-19-067. Washington, DC: Federal Highway Administration.
3. FHWA. 2004. *TMC Operator Requirements and Position Descriptions: Draft Report*. Washington, DC: Federal Highway Administration.
4. Szymkowski, T., S. Ivey, A. Lopez, P. Noyes, N. Kehoe, C. Redden, and G. Fleming. 2019. *Transportation Systems Management and Operations (TSMO) Workforce Guidebook*. Washington, DC: National Academies of Sciences, Engineering, and Medicine.
5. NOCoE. 2022. “Day-to-Day Management and Operation of TMSs and TMCs” (web page). <https://transportationops.org/traffic-management-systems-and-centers/resources-traffic-management-system-and-centers/traffic-management-systems-and-centers/day-day-management-and-operation-tmss-and-tmcs>, last accessed November 25, 2024.
6. Burgess, L., and J. Dale. 2024. *Aligning Traffic Management Center Staffing Capabilities for the Future of Systems Operations*. Report No. FHWA-HRT-24-079. Washington, DC: Federal Highway Administration.
7. FHWA. 2022. “Completed Projects: TMC Operator Requirements and Position Descriptions, Phase 2—Interactive Software” (web page). <https://tmcops.fhwa.dot.gov/projects/tmcpreqp2.htm>, last accessed November 26, 2024.
8. NOCoE. n.d. “Traffic Management Systems and Centers” (web page). <https://transportationops.org/traffic-management-systems-and-centers>, last accessed November 11, 2024.
9. FHWA. “TMC Pooled-Fund Study (PFS)” (website). <https://tmcops.fhwa.dot.gov>, last accessed November 11, 2024.





Disclaimer

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this presentation only because they are considered essential to the objective of the presentation. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

Except for the statutes and regulations cited, the contents of this presentation do not have the force and effect of law and are not meant to bind the States or the public in any way. This presentation is intended only to provide information regarding existing requirements under the law or agency policies.





Speaker's Notes





Speaker's Notes (1/30)

None.

Speaker's Notes (2/30)

This presentation is organized as follows:

1. Introduction to estimating staffing needs, including challenges that agencies face. Provides an overview of the overall process for identifying and estimating staffing needs.
2. Provides a basic overview of preparing for estimating staffing needs, including the need to identify TMS functions that serves as a framework for staffing estimation methodologies.
3. Methods to identify TMS staffing needs. Introduces the concept of work analysis and discusses the various methodologies for conducting a workload analysis with examples from agencies in the US.
4. Identify key staffing estimating actions to develop an overall staffing approach.
5. It is important to implement the staffing plan and then monitor and evaluate its success. A summary the lessons learned from agencies through their experience in staffing estimation is also included.
6. Resources and references – Provides additional resources that are available to agencies for TMC operations and staffing of those operations.





Speaker's Notes (3/30)

Agencies face a number of challenges with meeting their needs for TMS staffing. Those include:

- Quantifying needed skills for TMSs.
- Understanding the metrics and data needed to estimate staffing.
- Hiring or developing staff with specific expertise.
- Training staff in specific technical areas.
- Modifying staff roles and job descriptions.
- Supporting TMSs with the range of needed skills and resources.
- Predicting or estimating future staffing needs.
- Expanding current capabilities and resources.



Speaker's Notes (4/30)

A TMS is comprised of various technologies, software, systems, processes, and human resources that manage the roadway network and respond to events that impact performance. Estimating staffing needs is part of an agency process. There are six parts/steps of the process for estimating staffing needs:

- Step 1 - Assess, Prepare, and Engage
- Step 2 - Determine KSAs and Needed Positions
- Step 3 - Determine Staffing Needs
- Step 4 - Develop Staffing Approach
- Step 5 - Develop Staff Management Strategies
- Step 6 - Implement, Monitor, and Evaluate

Of these 6 steps, steps 1, 2, and 4 are critical. The remaining slides will look in detail at each step.





Speaker's Notes (5/30)

The first step in estimating staffing needs is to Assess, Prepare, and Engage. Identifying TMS functions, services, and actions are critical for estimating staffing. The purpose of this step is to prepare and plan for the TMS staffing and confirm the scope and performance objectives of TMS operations. Some key actions an agency can conduct include but are not limited to:

- Assess need to for staffing planning.
- Engage stakeholders, obtain approvals, assign resources.
- Align with other strategic planning or human resource initiatives or efforts.
- Confirm TMS scope, performance objectives, and goals.
- Identify TMS functions, services, and actions.
- Determine factors affecting current and future staffing needs.





Speaker's Notes (6/30)

A function describes a capability or ongoing activity of a TMS that contributes to the accomplishment of the TMS's mission. These functions and actions may be performed or supported by another TMS, the TSMO program, or another agency. TMS staff functions can be directly related to transportation operations, such as traffic incident management, but can also include supporting activities such as information technology operations, maintenance, or administrative functions such as records management. The various functions supported by a TMS, coupled with the demand for transportation management services by consumers, determine the type and number of personnel needed.



Speaker's Notes (7/30)

Agencies can initially identify staffing needs based on inputs from TMS plans, a Concept of Operations (ConOps) or TMS assessment. A ConOps defines staff roles, responsibilities, and interactions with various TMS components, subsystems, and functions. A ConOps is useful because it includes 'use cases' that provide operators with workflow context, details of systems or sources of information that an operator can rely on to accomplish tasks, information on decisions to be made, and anticipated results. Identifying and documenting such use cases in a ConOps can capture different processes (anticipated tasks, responses, and procedures) or aspects of TMS operations. Examples of use cases include traveler information and incident monitoring.

The staffing identification process can also rely on a TMS assessment, which identifies the aspects of the TMS that are performing well and those that are not. It is especially important to understand the aspects of the TMS that are not performing well to determine how TMS staffing can contribute to improving performance.





Speaker's Notes (8/30)

As an agency begins to estimate their staffing needs, they may run into several challenges. Some of these challenges include:

- Identifying and collecting the right data.
- Determining the methodology to use to estimate needed staffing.
- Identifying and selecting appropriate performance measures
- Understanding the metrics and data needed to estimate staffing.
- Predicting future staffing needs.



Speaker's Notes (9/30)

Steps 2 and 3 in estimating staffing help an agency Identify TMS Staffing Needs. Step 2 involves determining KSAs and positions needed for TMS functions, actions, services, and support. Examples of key actions include:

- Determine current and future KSA needs to implement and operate TMS functions, actions, services, and support.
- Match TMS functions, actions, services, and support to job classifications.
- Draft or update needed positions and descriptions.
- Define staff performance measures aligned with TMS operational performance measures.

Step 3 involves determining the TMS operations schedule, demand, and number of positions for current and future needs. Examples of key actions include:

- Collect data on current staffing demands and performance.
- Forecast future demand and staffing needs and calculate staffing levels.
- Determine TMS operating and staffing schedules.
- Revise positions based on levels of KSAs needed.
- Assess current and expected resources versus demand and needs.





Speaker's Notes (10/30)

Different methods might be needed for assessing needs for specific positions serving a particular TMS. Agencies should consider whether staffing needs should be assessed for the entire TMS or for specific functions, services, or activities. Positions within the TMC should be similar within the context of functions, services, and actions supported. Regardless of the estimation approach or strategy adopted, agencies should consider incorporating position descriptions, KSAs, level of required supervision or oversight, the influence of remote or distributed operations, and location of support services (such as whether information technology resources are provided on on-site or are remote/on-call). Once needed staff positions have been identified, agencies can draft or update needed positions and descriptions.





Speaker's Notes (11/30)

Forecasting potential TMC staffing needs can be a complex undertaking. To that end, FHWA has developed an overall framework for work analysis, a generic term for examining job-related activities performed by an employee, that might be leveraged by agencies. This work analysis process encompasses the following methodologies: job analysis, workload analysis, demand analysis, and task allocation. Each of these is discussed in more detail in the following slides.



Speaker's Notes (12/30)

These methodologies are undertaken to determine the basic elements of work and assess the employee characteristics necessary to perform each element. A job analysis may be used to confirm that employees possess the necessary attributes to perform the duties of their positions. A job analysis can generally be oriented in one of two ways:

- A task-oriented job analysis determines specific elements of work with a focus on the work to be accomplished by employees within three levels of consideration: tasks, functions, or positions. The most basic and meaningful of these is task focused. Examples of specific tasks for a TMC employee are analyzing sensor data for speeds and delays for traveler information updates or operating cameras for congestion verification. A key element of each task in this analysis is the incorporation of a specific work-related goal (providing traveler information updates and verifying congestion as per the examples provided). Tasks should be broken down into steps but not too detailed. Tasks can be further organized into functions supported by the TMC or specific positions filled by TMC employees.
- A worker-oriented job analysis is focused on employee characteristics required for successful job performance. These characteristics may be examined within three levels: (1) knowledge, skills, abilities, and other characteristics (KSAO's), (2) training experience, or (3) performance level. KSAOs are the most basic elements of employee characteristics. Knowledge refers to the specific information necessary for job performance, while skills relate to proficiencies in performing tasks. Abilities refer to enduring capabilities.





Speaker's Notes (13/30)

Staffing level requirements are dependent on the service provided, tasks performed, number of shifts, anticipated support from other systems and service providers, and TMC coordination capabilities. This slide summarizes basic functions and skill sets associated with the primary program areas associated with TMC operations. This list is not comprehensive. Functions and associated skills are likely to evolve over time, particularly with increasing automation.



Speaker's Notes (14/30)

These processes are intended to maximize the performance capability of employees and determine whether work systems are designed to enable peak performance by employees. By analyzing workload relative to human performance, agencies can identify and design the work system in terms of tasks and equipment such that employee performance is optimized. Three factors are often considered in analyzing workload:

- **TMC Workload** – Assessing overall agency workload is necessary for predicting scheduling requirements and is commonly measured in terms of the number of centerline or lane miles, the number of intersections, the number of miles or routes, the number of incidents and incident severity, the number of vehicles in operation, and the number of vehicle miles traveled per day. A TMC with oversight of multimodal operations might consider a number of people served during a certain time period.
- **Employee Workload** – This measure can vary based on a number of factors including the combination of tasks performed, the difficulty of the tasks, and the individual characteristics of the employee. Employee workload should be evaluated relative to the resources available for the tasks required with the objective of determining whether the employee has the requisite resources available.
- **Attention** - TMC operations are concerned primarily with monitoring transportation infrastructure; a task that requires the attention of human observers. The attention required for a particular task is therefore of critical importance to assessing workload requirements. Attention for TMC required tasks can be categorized in three ways: (1) selective attention, (2) focused attention, and (3) divided attention. Selective attention is required when an employee must alternate their attention between two or more sources of information





Speaker's Notes (15/30)

The Washington Department of Transportation (WSDOT) has used spreadsheet-based tools in the past for estimating staffing requirements. An exercise, undertaken by CH2M Hill, was organized around agency function with activity level estimates based on previous traffic operations experience. Functions within the TMC were rated based on how critical they were to the TMC mission in terms of impacting life safety (L), supporting regulatory control enforceable by law (R), or advising travelers (A). The times associated with operators and events were based on staff experience and FHWA's Guidelines for TMC Transportation Management Operations Technician Staff Development. Full Time Equivalent (FTE) staffing levels were based on a 40-hour-per-week and a 50-week per-year resource allocation. The team responsible for assembling this exercise assumed that a total staff complement of 25 persons would be operating the TMC 24 hours per day, seven days a week, 365 days per year.





Speaker's Notes (16/30)

This slide shows a selection from WSDOT's spreadsheet tool showing how the contribution of each activity is estimated to contribute to the TMC's overall annual workload. An important characteristic of WSDOT operations in the Seattle metropolitan area was the use of its own software platform and reliance on in-house employees. Software engineers often participated in live operations and there was a high degree of automation. As such, the effective loading of ATM operator staff might need to be higher for application for TMC operations in other areas of the country. This reflects the need to consider unique agency attributes when utilizing tools for TMC staffing estimation.



Speaker's Notes (17/30)

TxDOT uses a staffing analysis that combines some quantitative measures and some qualitative measures. The quantitative measures include:

- Current staffing levels.
- Annual turnover rate.
- Number of ITS devices.
- Centerline miles monitored.
- Vehicle miles traveled.

Qualitative measures include:

- Job functions, including responsibilities outside the control room..
- New technologies added.
- Upcoming major roadway projects.
- Difficulty in filling positions.
- Efficiency of current operation.

The quantitative analysis provides that baseline number of staff needed. The qualitative factors provide adjustments either up or down from the baseline. For example, introducing new technologies might increase the estimate by a staff person as would major construction projects getting underway. However, a stable, experienced existing workforce, indications of efficient operation, might reduce the estimate by a staff person.



Speaker's Notes (18/30)

These methodologies determine employee scheduling requirements by forecasting the need for employees' time based on the demand for TMC services. Various demand prediction models may be used.

Agencies may use time series data recorded over equally spaced intervals and ordered by occurrence (e.g., daily average number of incidents occurring each month). These are most useful in cases of consistent demand that are expected to continue into the future.

Regression analysis may be used to estimate anticipated demand. Such methodologies utilize one or more predictor variables (such as the number of registered cars or weather) to predict an outcome variable such as the number of traffic incidents or traffic volume. Regression models also rely on past demand to predict future demand but may incorporate other predictor variables such as population, expanding the agency's predictive ability. These other variables may predict changes in demand before they are evident through the time series models described above. The best predictor variables are unrelated to each other (avoids overlap in prediction) and are highly related to the outcome variable.

A time series analysis may include four components:

- Trend component –This takes the form of a general upward or downward movement over time. Average demand for TMC varies little week to week relative to the other time series components.
- Seasonal component –This takes the form of a consistent, recurring movement upward or downward from the trend component over a particular interval of time. Weather, school holiday schedules, and similar events that affect the demand for TMC services are often considered as seasonal components for demand estimation.
- Cyclical component –This is a recurrent upward or downward movement with a cycle lasting one year or longer. Demand for TMC services, for example, tends to increase overtime in response to population growth in urban areas. The cyclical component of demand will generally drive a gradual increase in the need for more TMC staffing and resources.
- Random component –These refer to erratic, unpredictable changes without a pattern such as traffic incidents.





Speaker's Notes (19/30)

The Florida Department of Transportation (FDOT) relies on spreadsheet-based tools in estimating staffing requirements for TMC operations. FDOT's approach uses historical values to develop factors in the calculation of Full-Time Equivalent employee factors for its regional and satellite TMC operations. FDOT's spreadsheet tool uses these values along with user defined and inputted values to determine TMC staffing needs in terms of the annual hours per position and associated budget requirements. User defined inputs calculate other elements of TMC staffing requirements such as the number of events expected to occur within the fiscal year. The model provides similar outputs for 19 other TMC staffing classifications including information technology, public relations & marketing, and administration & reception.





Speaker's Notes (20/30)

This slide provides example model inputs for the 2023 – 2024 fiscal year and example outputs in terms of required hours and budget for regional and satellite TMC management staff using the Florida DOT's spreadsheet tool.



Speaker's Notes (21/30)

Minnesota has adopted a public sector staffing model for its centers. Because it is a public sector agency, staffing decisions are highly contingent on the availability of funding. New staff positions are created only when there is an impending retirement or when existing personnel must be transferred to a different division within the TMC. However, hiring staff as state employees for technical positions helps in staff retention. The agency plans to eventually be operational 24 hours a day, seven days a week which will result in additional staffing needs to cover the new shifts. TMC staff have indicated they do not have any formal processes or tools for estimating these needs. However, they have noted that improved coordination between TMCs within and outside of the metro area, as well as collaboration of resources, will be highly beneficial for agency operations.

The Utah DOT's Traffic Operations Center (TOC) and ITS division are managed by the Traffic Management Division (TMD). The Traffic Operations Group incorporates the Control Room Operators, the Weather Group, and the Incident Management Team (IMT). The TOC control room operates 24 hours a day, seven days a week and alerts the traveling public about weather events, special events or crashes that could cause delays. Sharing incident management staff across multiple regions has been a challenge. As such, UDOT conducted a benefit cost analysis based on congestion and incident clearance considering factors such as urban versus rural geography, number of incidents within a corridor, and traffic volume. As a result of this analysis, UDOT transitioned to a matrix style organizational structure, so IMT support staff are managed regionally and statewide. Based on this analysis, agency executives approved additional staff for the IMT and permanent staff for the TMC to support TSMO initiatives.





Speaker's Notes (21/30) (continued)

In Pennsylvania, the Statewide Transportation Management Center (STMC), four Regional Transportation Management Centers (RTMC) and two District Traffic Management Centers (DTMC) are structured functionally and are focused primarily on roadways. They oversee operations of the freeway and major arterial systems via ITS devices, freeway service patrols, communication with emergency responder agencies, and coordination with districts and other agencies. STMC staff focus on the development of performance metrics and operational strategies to improve mobility and minimize the impacts of congestion. The current framework for assessing staffing needs is ad-hoc with the DOT working towards a formalized process. DOT staff rely primarily on their TSMO operations guidebook for staffing guidance. During major winter events, staffing is adjusted “on the fly” to address events as warranted. More staff are required in incident response and management, particularly at work zones. The DOT is planning on starting with a “snapshot” of current requirements and projecting those into the future but does not have a methodology formalized yet. However, DOT staff anticipate that reduced staffing and changes in existing duties will occur as a result of further service automation.





Speaker's Notes (22/30)

Task allocation methodologies assign discrete work activities to employees based on the results of job and workload analyses. Task allocation activities thus ensure the optimum allocation of work among employees in different scheduling configurations. The results from a job analysis and a workload analysis help determine how to assign work to employees or groups of employees.





Speaker's Notes (23/30)

Steps 4 and 5 will lead to the development of a TMS Staffing Plan.



Speaker's Notes (24/30)

Step 4 involves developing the TMS Staffing plan and staffing approach. The key actions for estimating staffing needs are:

- Finalize job roles and classifications.
- Determine contracted vs in-house support.

Although not directly involved in estimating staffing needs in the current estimation process, Step 5 can contribute to the next staffing estimation process by::

- Developing strategies for building staff capacity and recruitment to improve to reduce the need to hire more skilled staff in the next staffing estimation process.
- Implementing staff retention approaches to reduce the need to hire as many staff in the next estimation process..
- Establishing performance management goals for workforce development to support building staff capacity and improve retention.





Speaker's Notes (25/30)

The last step in the process to estimate staffing needs is Implement, Monitor, and Evaluate. The purpose of this step is to assess current and needed capabilities, monitor performance and adjust as needed. Some key actions include:

- Develop and implement a comprehensive performance monitoring approach.
- Implement reporting mechanisms.
- Regularly assess capabilities against needs.
- Identify and plan for enhancements.
- Update staffing plan based on evaluations.
- Incorporate monitoring results into day-to-day management.

The results of this step can also be used to improve the staffing estimation process.



Speaker's Notes (26/30)

The variety of TMC services, functions, and job types is a challenge for applying tools and methodologies uniformly across operators in the United States. TMCs differ in terms of the complexity of the services they provide and the associated job requirements for providing and supporting those services. TMC managers are often unable to properly utilize formal tools rely on ad hoc technical processes for estimating staffing needs. Staffing decisions are often made when funding becomes available. Cost-benefit analyses are commonly utilized to justify new staff positions when funding might need to be requested, but such exercises are generally not part of ongoing, routine staffing estimation strategies. As an initial step, agencies should evaluate the necessary staffing in terms of positions and for meeting weekly work assignments and daily work schedules. Staffing plans can be developed for each component of TMS and help make the business case for additional resources or re-aligning current TMC staffing resources based on system upgrades, expansions, or other significant operational changes. Staffing plans also help the agency identify methods to recruit staff with specific skill sets and can assist in assessing staff capabilities for future enhancements.





Speaker's Notes (27/30)

None.



Speaker's Notes (28/30)

None.



Speaker's Notes (29/30)

None.





Speaker's Notes (30/30)

None.

