

Read-ahead Material for
**TRB Annual Meeting 2020 Workshop # 1030:
Vision, Concepts, and Capabilities for the Next Generation of Traffic
Management Systems (TMSs)**

Purpose and Overview of the Workshop

The purpose of this workshop is to provide information to help agencies make key decisions about transitioning to the next generation of TMSs. To make these decisions, agencies will need: a *clear vision*, a *concept of operations*, an *understanding of the desired capabilities*, and an *understanding of the resources needed*. These materials will help address the primary questions of whether to upgrade or replace the entire system, or to modify or replace elements of the system (e.g., software platform), technologies, and/or some or all of their field devices. They will also help agencies make informed decisions about what options to consider and what priorities to place on potential investments in: emerging technologies; innovative methods; automation of functions; active management and operation of traffic; and sharing and using emerging sources of information.

This workshop will feature a highly interactive breakout-session to allow participants to discuss how to **prepare a vision**, how to **develop a concept of operations**, and how to **identify key capabilities needed** for the next generation of their TMSs. Within each of those topics, participants will identify: **key issues to consider**; **successful practices**; and **available resources**. The vision for a next-generation TMS should address how the agency will improve and/or expand upon the core traffic management functions of detecting, analyzing, and reacting to various conditions.

Session 1: Developing a Vision, Concept of Operations and Capabilities for the Next Generation of TMSs – What Issues or Challenges Should Agencies Consider?

This session will: (1) Describe the **key features** of the next-generation of TMSs; (2) **Provide context** for how developing a **vision**, **concept of operations**, and **capabilities** will support agencies planning for or developing the next generation of their TMS, and clarify the meaning and intent of these three topics; and (3) Introduce the **information compiled about each topic**, which will provide a basis for the breakout discussion that will occur in Session 2 where participants to review, discuss and identify key issues.

Session 2 (BREAKOUT SESSION): Identify Issues to Consider, Successful Practices, and Resources to Use

Participants will be asked to select one of the following three topics, go to one of the tables assigned to that topic, and participate in the discussions at that table:

1. Preparing a vision for the next-generation TMSs
2. Developing a concept of operations for the next generation of TMSs
3. Identifying key capabilities needed for the next generation of TMSs

The list of key items the speakers identified in Session 1 are captured below for each of these topics. For their table's assigned topic, participants will discuss and identify the following items:

- i. Key issues for agencies to consider;
- ii. Successful practices or lessons learned; and
- iii. Available resources for agencies to use.

In the next session (*Session 3*), each table will report out on the top three ideas selected from all the suggestions for each of these items (e.g., key issues, successful practices, resources). The suggestions captured at each table will be included in a summary of the workshop, which will be posted on the TRB Freeway Operations Committee website (click [here](#), or paste into your browser:

https://sites.google.com/view/trbfreewayops-ahb20/meetings/annual-meetings/2020-annual-meeting#h.p_LjBnGp6yogNs)

Topic 1: Preparing a Vision for an Agency's Next Generation TMS

This topic explores how agencies develop a *vision* for their next-gen TMS. The underlying purpose of a vision is to identify a desired future state. Such a vision will describe, in general terms, how an agency will perform its work in the future—based on any of the following kinds of improvements:

- a) desired performance or influence on travel or travelers,
- b) improvements in how the TMS is managed and operated,
- c) new or enhanced operational strategies or practices,
- d) improvements to existing capabilities of the TMS, and/or
- e) entirely new functions or services supported by the TMS.

In other words, the focus will be on *what* the TMS will do (the “what” of the TMS)—without getting too deep into specific technologies or approaches (the “how” of the TMS). Developing a clear and compelling vision is a critical first step in moving toward a next-gen TMS. Public agencies are typically conservative with investments or upgrades to the systems, so it is well worth devoting significant initial effort to develop a strong aspirational vision, which is unconstrained—at least at the outset—by those more-conservative impulses.

A compelling vision will help agencies gain support for the desired improvements, and help narrow their focus. Narrowing the focus and prioritizing the functions they want to develop or improve is especially important, given the wide range of possibilities for next-gen TMSs—for example, they will be expected to *make more decisions in real-time; operate in a highly automated fashion; proactively manage and control traffic; coordinate and share information with other systems and service providers; and provide modular and expandable platforms, which will be easier for agencies to manage, maintain, and modify to meet their evolving needs*; and so on. These advances, and others, will need to be considered, given the new capabilities provided by emerging technologies, telecommunications, and new sources of data.

ACTION: Participants at each breakout table should review and suggest revisions or additions to the lists developed for each item (i.e., key issues, successful practices, resources). *In session 3*, each table will report out on the top three ideas selected from all the suggestions for each item.

A. Issues to consider when preparing a vision

• Inputs to consider when developing or updating a Vision for a TMS:

1. Known or expected transportation problems
2. Functions and services provided now or expected in future
3. Statewide, agency or regional strategic, TSMO, or program plans
4. Agency or TSMO program goals, objectives, and performance measures
5. TSMO feasibility studies or multi-year plans
6. TMS performance, capability assessment, or identified needs
7. Existing TMS designs and plans (e.g., architecture, vision, con ops, requirements)

• Challenges to consider with preparing a Vision for a TMS:

1. Do you have or want to have the ability to make changes to TMS (e.g., software platform, databases, interfaces with internal or external devices or systems)?
2. Do you store data in same format or use unstructured data? Do you want to make changes in how the TMS collects, saves, shares, and uses data with different groups?
3. Do you anticipate significant changes to the TMS architecture (e.g., distributed design with hubs vs. central processing of data) to support desired operation?
4. Do you have current or planned future resource constraints to consider in the vision that is influencing how the TMS is being managed, operated, or maintained?
5. Do you need to have the ability to manage multiple systems or manage them remotely?

B. Successful practices and available resources to use when preparing a vision

- New Mexico Feasibility Study – Albuquerque MPO Joint Traffic Management Center
- Caltrans TSMO Program —a Key Component in Caltrans’ Strategic Management Plan
- Georgia Regional Transportation Operations Program
- Kentucky Transportation Cabinet Using 3rd Party Data
- District of Columbia DOT Using Crowdsourced Data to Improve Operations

Topic 2: Developing a Concept of Operations for an Agency’s Next Generation TMS

This topic explores the challenges and issues to consider with developing a concept of operations (ConOps) for a next-gen TMS. A ConOps is a key element in the planning, design, development, and operation a system. The ConOps is a document that:

- Frames the overall system
- Answers fundamental questions (*who, what, where, when, why, and how*) about TMSs
- Takes into account perspectives of key stakeholders (e.g., *operator, user, maintainer*)
- Provides the foundation for developing *requirements, a verification plan, and TMS design*
- Guides decisions made throughout system’s life cycle (development, deployment, enhancements)

Establishing a solid, common understanding of how to develop a ConOps is important, because many agencies today may not follow structured planning or assessment processes prior to initiating the design or development of a new TMS. While surface-transportation infrastructure improvement projects have established processes to conduct feasibility, planning, and impact studies, there is nothing comparable to guide agencies in planning for projects involving TMSs. Pursuing major improvements to (or replacement of) a TMS without conducting a feasibility study or preparing a multi-year plan will hinder an agency’s ability to match their plans to available resources and capabilities needed to manage, operate, and maintain their TMS. These efforts should include a ConOps that will help an agency:

- Plan and develop a TMS in a manner that meet both their near- and long-term needs
- Plan and develop a TMS with a platform for cost-effective future expansion and enhancements
- Save time and resources in the processes of developing and procuring the system
- Ensure expected resources and capabilities align with what is necessary to manage, operate and maintain the currently deployed and planned future systems
- Manage the full lifecycle of the system, including future expansion, upgrades, and replacement

A ConOps should draw on and align with a region’s (or agency’s) TSMO plans, long-range transportation plans, or other strategic plans. While a ConOps plays a critical foundational role in the procurement process, its job is not done once procurement and development are completed—it should remain a “living” document. The ConOps needs to be updated and should continue to inform management decisions related to system operation, maintenance, upgrades, and ultimately decommissioning and/or replacement.

ACTION: Participants at each breakout table should review and suggest revisions or additions to the lists developed for each item (i.e., key issues, successful practices, resources). *In session 3*, each table will report out on the top three ideas selected from all the suggestions for each item.

A. Issues to consider when developing a ConOps for a TMS

- **Inputs to consider when developing or updating a ConOps:**
 1. Meets both their near- and long-term needs
 2. Frames the range of possible future operational strategies, services, and functions
 3. Portrays the desired levels of management and operation (e.g., day-to-day, events)
 4. Provides a platform for organized and cost-effective future expansion/enhancements

5. Saves time and resources when developing, managing, operating, and maintaining
6. Ensures that expected agency resources and capabilities align with what is needed to manage, operate, and maintain the system being planned and developed
7. Aligns with a region's or agency's TSMO plans and long-range transportation plans
8. Provides basis for planning and developing detailed system requirements and design
9. A ConOps should reflect how the system will be supported, managed, and operated

• **Challenges to consider with developing or updating a ConOps:**

1. How to consider, account for, or develop a flexible architecture and designs to accommodate future system changes and new capabilities?
2. What are the impacts of agencies sharing and using electronic messages with automated vehicles, connected vehicles, and travelers using mobile devices?
3. What are the impacts of sharing and using information generated by other systems, service providers, or 3rd parties?
4. How to reflect evolving or new functions or services?
5. How to reflect automating the operation of TMS or specific operational strategies?
6. What are the implications and what may be required to integrate analytics and prediction into the active management and operation of TMSs?

B. Successful practices and available resources to use when developing a ConOps

- Adaptive Signal Control Concept of Operations, City of Federal Way, WA
- Regional Traffic Operations Program Concept of Operations, Georgia DOT
- Houston ITS (HITS) Project Concept of Operations, City of Houston
- Managed Motorways Framework—VicRoads, Melbourne, Australia
- Connected and Automated Mobility Roadmap, UK Highways Agency
- Adaptive Traffic Signal Control Systems—Model System Engineering Document (FHWA)
- Rules of TMCs in Incident Management on Managed Lanes & Emergency Ops. (FHWA)
- Virtual TMC Management and Operations Guidance (FHWA)
- Weather Responsive Traffic Management ConOps & Signal Control (FHWA)
- Surface Transportation Weather Decision Support Requirements (FHWA)

Topic 3: Identifying the Capabilities Needed for an Agency's Next Generation TMS

This topic explores the challenges and issues agencies should consider with identifying the key capabilities for their next-gen TMS. "Capabilities" are conceptually similar to "requirements" but focus on the functions and services to be provided to meet the TMSs vision and ConOps. They should also address any scenario to be supported and provide a link between CopOps and requirements. The key capabilities play a role in the processes to plan, design, develop, or initiate a new or upgraded TMS.

There are a number key issues for agencies to consider with assessing current capabilities or future enhancements for a TMS. While the traffic management functions or services supported by a TMS may not change in the future, how these functions and services are carried out could substantially change. Emerging sources of data, innovative methods, and new technologies offer the potential to allow agencies to improve how they are managed and operated. Such enhancements will allow the next generation of TMSs to: be actively managed and operated; automate operation or use of specific functions; add new functions or services; capture and use new sources of data; share information with other systems or users; and continuously assess and improve performance.

ACTION: Participants at each breakout table should review and suggest revisions or additions to the lists developed for each item (i.e., key issues, successful practices, resources). *In session 3*, each table will report out on the top three ideas selected from all the suggestions for each item.

A. *Issues to consider when identifying key capabilities for a next generation TMS*

• ***Inputs to consider with assessing and selecting key capabilities:***

1. Quantify benefits of making improvements (e.g., staff, \$) to TMSs
2. Deciding on what data to capture, archive, manage, and share with others to use (e.g., unformatted, 3rd-party) based on current capabilities & available resources
3. Ability to manage and operate system (or several systems) remotely when needed
4. Ability to manage and make changes to software platform, products, or APIs
5. Cost effective methods to expand TMS area of coverage, services, or functions
6. Integrating new functions and services into existing systems or components
7. Resources needed to improve or replace components or entire TMS
8. Need to improve day-to-day management, operation, maintenance, and practices

• ***Challenges to consider with assessing and selecting key capabilities:***

1. Proactively managing & operating TMSs based on: expanded service areas, use of information from other sources (e.g., weather, roadway conditions), prediction of future conditions (e.g., traffic, events), and integrate emerging sources of data
2. Automate operation, use of operational strategies, and control plans based on use of analysis tools and technologies (e.g., AI, ML), real-time monitoring and prediction of future conditions, and innovative monitoring and surveillance approaches
3. Monitor, evaluate, and proactively report on travel conditions using emerging sources of data (e.g., 3rd-party, crowd-sourced, probe data, emerging sources, other systems)
4. TMSs & field devices cooperating w/ automated and connected vehicles & travelers (e.g., sharing electronic messages, collecting electronic messages, using, and archiving data)
5. Use operational strategies & control plans modified to use data from emerging sources
6. Agencies develop multi-year plans & obtain resources to manage TMS improvements
7. Architecture & design of TMSs will address and accommodate:
 - Modular subsystems that are easier to modify & maintain (e.g., procure, services, own)
 - Subsystems support components located & operating outside of TMSs (e.g., data storage)
 - Components and devices w/defined requirements to facilitate data sharing
 - Priority on agencies managing APIs to enable sharing data w/in TMS, ITS devices or other systems
 - Software and platforms to enable continual integration of new software, analysis tools or functions into the real-time management & operation of TMCs
 - Integrating proprietary, commercial-off-the-shelf, and open-source software
 - Evolution to field devices & hubs managing the use of operation strategies & control plans
 - Less reliance on central point (e.g., TMC) for real-time operation
 - Lower requirements & cost for backbone communication network

B. *Successful practices and available resources to use with identifying key capabilities*

- NITTEC Shared Traffic Information System
- Houston TranStar – shared management and operation of TMSs
- Caltrans Shared TMS Functions
- KC Scout – jointly operated bi-state organization
- Utah Automated Traffic Signal Performance Measures (ATSPM) and website
- Indiana DOT Interstate System Traffic Operations Dashboard