TRB ANNUAL MEETING 2024 WORKSHOP #1004 SUMMARY –

Preparing, Conducting, and Summarizing the Results – Assessing Traffic Management Systems

Sunday, January 7, 2024, 9:00am – noon EST

Sponsoring Committees:

- ITS Committee (ACP15)
- TRB Freeway Operations Committee (ACP20)
- TRB Traffic Signal Systems Committee (ACP25)
- TRB Joint Subcommittee on Active Traffic Management (ACP 20-5)
- TRB Artificial Intelligence and Advanced Computing Applications Committee (AED50)
- TRB Regional Transportation Systems Operation (RTSMO) Committee ACP 10)
- Traffic Management Center Pooled Fund Study
- American Association of Highway and Transportation Officials (AASHTO) Committee on Transportation System Operations ITS Work Group
- International Bridge, Tunnel and Turnpike Association (IBTTA)
- European Association of Operators of Toll Road Infrastructures (ASECAP)
- ERTICO Innovation Platform Traffic Management 2.0 Work Group

Workshop Summary and Resources:

On Sunday, January 7, 2024, during the Transportation Research Board's 103rd Annual Meeting, a three-hour workshop was conducted focused on identifying information and practices to assist agencies with finding opportunities to improve transportation management system (TMS) capabilities and performance. This document provides a summary of: (i) each of the workshop's sessions; (ii) feedback from participants provided during the breakout session; and (iii) action items recommended for workshop co-sponsors to consider advancing in 2025 and beyond. This summary of the workshop, presentations, and other resources are available electronically on the National Operations Center of Excellence's (NOCoE's) web page and the TRB ITS Committee website.
(https://transportationops.org/traffic-management-systems-and-centers/Traffic-Management-System)

Workshop Planning Volunteers:

Alexander Wassman	*Missouri DOT*	Malika Seddi	*ASECAP*
Beverly Kuhn	*Texas A&M Transp. Inst.*	Mark Muriello	*IBTTA*
Dan Lukasik	*Parsons*	Martin Russ	*AustriaTech*
Evan Sullivan	*USDOT Volpe Center*	Matt Junak	*HNTB*
Fanis Papadimitriou	*Attikes Diadromes*	Matthew Hall	*VicRoads*
Greg Krueger	*HNTB*	Peter Marshall	*D2 Traffic Technologies*
Heng Wei	*University of Cincinnati*	Phil Masters	*Parsons*
Jianming Ma	*Texas DOT*	Preston Judkins	*Parsons*
John MacAdam	*MacAdam Consulting*	Raj Ponnaluri	*Florida DOT*
Jon Obenberger	*USDOT FHWA (workshop lead)*	Ryan McNary	*Pennsylvania DOT*
Joshua Brown	*Tennessee DOT*	Sampson Asare	*Noblis*
Leslie Jacobson	*LNJ Transp. Consulting*	Susanna Zammataro	*Int'l Road Federation – Geneva*

Introduction

Jon Obenberger (FHWA) welcomed participants and introduced the workshop purpose, objectives, and desired outcomes. He recognized workshop co-sponsors and those who led the workshop planning. The expected outcomes from the small group breakout sessions to occur during this workshop is to identify opportunities for TMSs to meet the objectives, performance expectations, functions and services, and capabilities needed to meet the needs and expectations of their agency, other agencies, systems, service providers, or customers. This workshop will share information in support of preparing for, conducting, assessing, and summarizing the results from assessing a TMSs capabilities, performance, and identifying possible improvement opportunities.

State of the Practice (Session 1)

Jianming Ma (Texas DOT) began Session 1 by outlining the major topics the workshop will cover, presentations which will frame these topics, and illustrating how attendees could leverage the information presented in Session 1 to their advantage in Session 2 discussions – and ultimately Session 3 report-outs. The following four presentations provided definitions, issues, and practices to consider in support of preparing for and conducting an assessment of the capabilities and performance of an agencies TMS.

- Assessing Traffic Management Systems, Pete Marshall [D2 Traffic Technologies]
- Topic 1: Preparing for and Conducting a TMS Assessment, Dan Lukasik [Parsons]
- Topic 2: Assessing TMSs Capabilities and Performance, John MacAdam [MacAdam Consulting]
- Topic 3: Identifying Opportunities and Approaches for Improving TMSs, Matt Junak [HNTB]

Components of these presentations referenced the methods, practices, and issues to consider with assessing the capabilities and performance of an agencies Transportation System Management and Operations Program developed by AASHTO and FHWA. The presentations also referenced information being developed by FHWA to support agencies assessing the capabilities and performance of TMSs. Figure 1 illustrates the process which was reviewed and discussed as an opportunity to assess TMSs.

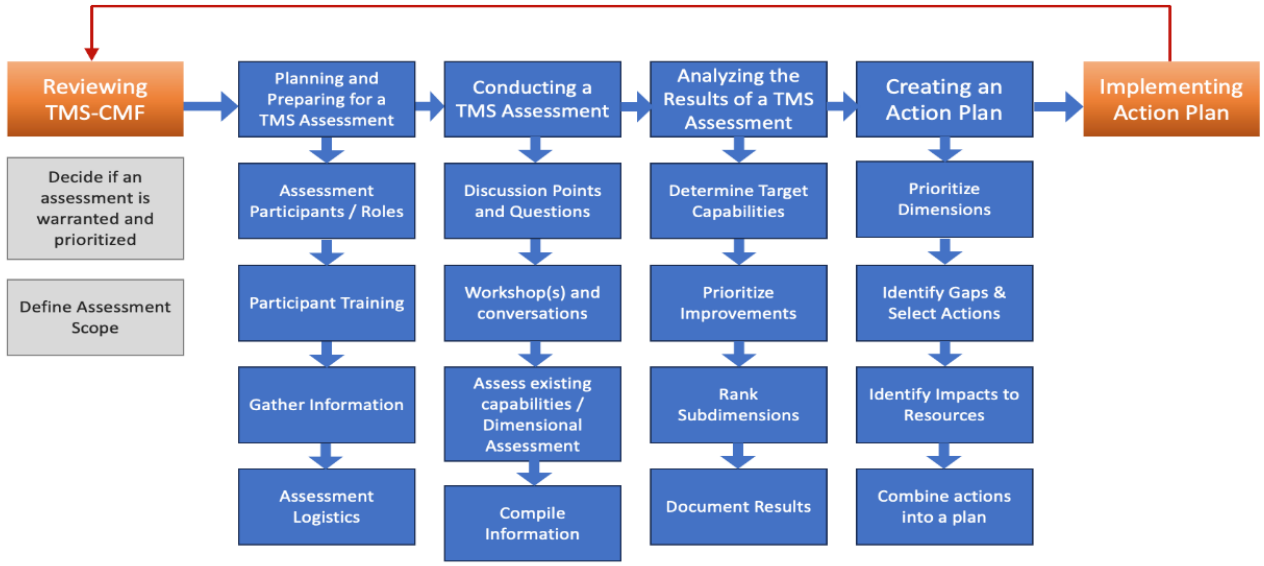

Figure 1: The TMS Assessment Process (FHWA)

Table 1 illustrates the 9 proposed dimensions and examples of possible subdimensions or issues to consider in support of assessing the capability and maturity for each dimension in the assessment process.

Table 1: FHWA's capability maturity framework (CMF)[1]

Dimensions or Process Areas	*Examples*
1. Business Process	Plans, Programs, Budget
2. Systems & Technologies	Approach to Designing, Developing, and Implementing Systems
3. Performance Measurement	Use of Performance Measures
4. Workforce	Improving Capability of Workforce
5. Culture	Changing Culture and Building Champions
6. Collaboration	Improving Working Relationships and Operations
7. Day-to-day Management & Operations	Preparing for, Managing, and Operating Daily
8. Day-to-day Maintenance & Repair	Planning for, Managing, and Conducting Daily Maintenance and Repairs
9. Sharing and Using Data	Activities to enable sharing and use of data with sources external to TMS

Discussions (Session 2)

Susanna Zammataro (International Road Federation - Geneva) asked attendees to form breakout discussion groups based on the topics references in Session 1 they found most appealing. The TMS assessment process and the CMF's nine dimensions were synthesized into the following six areas for different breakout groups to discuss:

1) Assessment process: Preparing for & Conducting a TMS Assessment
2) Assessment process: Opportunities for Improvements – TMS Assessment Action Plans
3) TMS CMF Dimensions 1 & 2 (Business Process + TMS & Technologies)
4) TMS CMF Dimensions 3 & 4 (Performance + Workforce)

[1] https://ops.fhwa.dot.gov/tsmoframeworktool/index.htm

5) TMS CMF Dimensions 5 & 6 (Culture + Collaboration)
6) TMS CMF Dimensions 7, 8, 9 (Mgmt. & Ops. + Maintenance & Repair + Sharing/Using Data)

During Session 2, each breakout group's notetakers wrote down major discussion items in an online notetaking document. Breakout groups were encouraged to discuss and comment on items identified during Session 1's framing presentations. An emphasis was placed on participants discussing new issues to consider specific to a process (e.g., issues to consider, information needed, analysis to conduct) or dimension (e.g., subdimensions, issues to determine a level of capability). Near the close of Session 2, each group was asked to identify the top three items they would report-out during Session 3.

Discussion Results – Report-out (Session 3)

Les Jacobson (LNJ Transportation Consulting) facilitated the report outs on the results from each discussion group. The following section synthesizes these report-outs and the notes each group submitted.

Topic 1: Assessment process: Preparing for & Conducting a TMS Assessment

Several potential actions could enhance TMS efficacy. In no particular order, the suggested actions for agencies are to:

- Evaluate the performance of existing systems to identify areas for improvement. This assessment should scrutinize the efficiency, reliability, and adaptability of current TMS platforms.
- Ascertain whether the capabilities inherent in a TMS are fully utilized and then engage with corresponding TMS-related activities and training programs to meet contemporary needs and challenges. Understanding the relevance of a TMS in the context of its current environment is vital for informed decision-making and agency resource allocation.
- Understand that the assessment step sequence might vary across different agencies. This work will implores agency staff to define subdimensions within the assessment process as assessment variations become clear. This will ensure that a tailored approach that meets the unique requirements of each agency.

These actions will likely require:

- TMS Assessment champions, leaders, and decision makers within an agency
- Knowledge regarding external and internal agency needs
- Explicit understanding of assessment actions
- Feedback from users and system engineers
- Operational partner(s)

Before taking action, there are several issues to consider:

- Agency IT policy (and if there even is one)
- Law enforcement organization(s) associated with agency jurisdiction
- Data governance & privacy (data/cyber security rulemaking)
- TSMO maturity and awareness of that maturity
- Identification of TSMO needs TSMO driven effort? What does it mean? Identify the needs
- Why should we need to do this (TMS), majority is few people(2-3) is handling the TMS.
- Work force development (transit)
- Skills, capabilities
- Timeline (reevaluate)

Several resources that may help include:

- Institutionalized (and further institutionalizing) TMS practices at the agency
- Executive leadership (leadership support)
- Policy-makers (TMS discipline support)
- ITS architecture
- Formal commitments to action (within the agency, among stakeholders)

Examples of successful practices are:

- The FHWA CMF (especially regarding workforce development)
- New ITS strategies in New York
- FDOT active lane management
- Parallel assessment models (potentially) in some transit agencies

Topic 2: Assessment process: Opportunities for Improvements – TMS Assessment Action Plans

Participants suggested that crafting a TMS comprehensive action plan entails several steps. These steps could ensure assessment effectiveness and continuity of routine assessments. Participants suggested a notional TMS action plan outline:

- Delineate immediate, short-term, and long-term objectives, encompassing both recurring and one-time assessments. Conducting this baseline assessment serves as an action plan cornerstone, prioritizing key areas such as software deployment based on importance and urgency. This baseline assessment should focus on two components:
  - Staff assessment
  - Software assessment (especially software compatibility and operator training)
- Evaluate the maturity level aids in gauging progress and identifying areas for improvement. As part of maturity evaluation, participants suggested that participants:
  - Secure consistent funding sources
  - Evaluate performance measures and metrics
  - Evaluate how users are engaging with TMS technology
  - Conduct stakeholder workshops prior to deploying
  - Consider overall reliability (faith in the system is valuable)
  - Evaluate the time it takes to do given tasks – could be different for each TMC
- Perform gap analysis and scrutinize data quality, sources, governance, and validation are integral for informed decision-making. Throughout the process, articulating the rationale behind each step will ensure clarity and alignment with overarching objectives. Participants suggested that gap analysis:
  - Look at how to address the gaps (training and technology mentioned above)
  - Determine if data quality affects operations
  - Document and track effectiveness measures
- The gap analysis should keep in mind that
  - Different TMC operators might have different perceptions of data quality and trust/reliability
  - Sensor data, probe data, and video analytics may reinforce each other or produce inconsistencies, even with something like incident detection

Participants brainstormed several TMS action plan best practices:

- Operationalizing knowledge transfer in assessments and action plans, as they facilitate the dissemination of expertise and best practices. (New Jersey Department of Transportation's (NJDOT's) was cited as a successful example of this, via deployment of its Advanced Traffic Management System.
- Identifying the agency fatal flaw. (Participants cited the failure of cloud services, disaster recovery as fatal flaw examples.)

Topic 3: TMS CMF Dimensions 1 & 2 (Business Process + TMS & Technologies)

Participants suggested bifurcating Topic 3 and sequentially allocated equal time to CMF Dimensions 1 & 2.

Business Process

Possible additional dimensions

- Business process –
    - Asset management and maintenance: enhancing performance measures and optimizing business processes)
    - Policy changes and legislative support: empowering entities to enact necessary business process measures.

  *Participants suggested while business processes are integral to TMS evaluation, there's a possibility that those business processes are intertwined with other dimensions.

- TMS & Technologies –
    - Participants had no additional subdimensions to suggest for TMS & Technologies

Subdimensions agencies such consider

- Business process –
    - Business process: Placing a business process in each one of the CMF dimensions because they must be funded somehow)
    - Combine dimensions: Nesting Dimensions 7, 8, and 9 as subdimensions into other dimensions.

- TMS & Technologies –
    - Annual technology review plan: Ensures systems are "current," up-to-date, and maintained,
    - IT governance: Implementing measures to safeguard data and infrastructure.
    - Cybersecurity: Protecting against cyber threats and vulnerabilities.
    - Repair/maintenance: Preventing asset stagnation and ensuring optimal functionality.
    - Business process: Evaluating and streamlining operational workflows.
    - Device inventory: Ranking devices relatively poor, acceptable, good, etc. based on performance levels for targeted upgrades.
    - Integrating emerging technology: Utilizing sensor data and traveler journey planners to enhance TMS capabilities.
    - Emerging technology: Staying updated on new technologies and opportunities for TMS enhancement.

Information and analysis needed

- Business process –
    - Remain updated on emerging technologies is crucial for enhancing TMS functionality.
    - Treat IT as a separate business process, aligning IT infrastructure and operations with TMS objectives.

    - Integrate short-term and long-term planning into programmatic business processes demands careful consideration of organizational goals and resource allocation.
    - Review and update Standard Operating Procedures (SOPs), especially IT SOPs, ensures seamless TMS operation. (By scrutinizing these areas, the TMS can be optimized for improved performance and efficiency.)

- TMS & Technologies –
    - Up-to-date information on how vehicle technologies are changing.

Other issues to consider:

- Business process –
    - Procurement processes (e.g. delays due to procurement process requirements)
    - Full systems engineering procurement tends to deviate from off-the-shelf products

- TMS & Technologies –
    - Technology maturity (pilot and perform assessment before deploying)
    - Practical resources and needs for every agency need to be a level 4 in all dimensions
    - Need for business process guidance
    - Data integration technologies are constantly changing as other technologies advance
    - Conflicting business practices across partner agencies

Topic 4: TMS CMF Dimensions 3 & 4 (Performance + Workforce)

Possible additional dimensions

- Assessment team (defining the multi discipline team members of a TMS assessment)
- Funding and programing
- Stakeholders (identified and involved early on)

Subdimensions agencies such consider

- Performance –
    - Publicize: Advertising the successful outcomes of a TMS via performance measures (especially performance related)
    - Equity: Equitably incorporating underrepresented (socio-economic) users and stakeholders and measuring progress along the way
    - Environment: Aiming to mitigate negative affects of transportation to non-attainment areas
- Workforce –
    - Staff empowerment: Demonstrating to staff the impacts of their work and enabling feedback and leadership action mechanisms
    - Staff classification, title, and uniformity: Clarifying job descriptions that align with TMS planning
    - Staff capacity: Creating and formalizing a workforce development process

Information and analysis needed

- Career structures and information about building/connecting career ladders via job classifications and responsibilities
- Workforce development link with educational system and career pipelines
- Synergy of resources among agencies

Other issues to consider:

- Stakeholder priorities
- Personally Identity Information (privacy)

Topic 5: TMS CMF Dimensions 5 & 6 (Culture + Collaboration)

Possible additional dimensions

- Participants had no additional subdimensions to suggest for both culture and collaboration.

Subdimensions agencies such consider

- Culture –
    - TMS integration: Comprehending TMS benefit, roles, and responsibilities (understanding, acceptance, and connection with overall TSMO effort)
- Collaboration –
    - Stakeholder integration: Understanding and communicating the stakeholders that should be at the table (MPO, LEO, IT, Municipalities, front-line, etc.)
    - Resource partnerships: Sharing resources within the agency (inventory and integration of different data within the agency for repurpose)

Information and analysis needed

- Culture –
    - Big picture understanding of the ROI
    - Business cases and demonstrations regarding how the overall TMS program meets the agency's goals
- Collaboration –
    - Evaluations of relevant agreements in place (especially for third party data)
    - Tabletop exercises (TTXs) at small scale as one strategy to overcome collaboration issues (especially IT in TMS)
    - Storytelling as a component of the ROI business case(s) to instill internal and external TMS culture (reinforces practician/continuity, recruits champions)
    - Peer exchanges to develop cross-section support
    - Workshops that foster relationships, share best practices, identify opportunities

Other issues to consider:

- Consider other CMM framework and research if there are other assessments that should occur

Topic 6: TMS CMF Dimensions 7, 8, 9 (Mgmt. & Ops. + Maintenance & Repair + Sharing/Using Data)

Possible additional dimensions

- Management and operations –
    - Redundancy plan and ability to securely operate remotely, integrated with the asset management system (Redundancy, Accessibility, and Integration)
- Maintenance and repair –
    - Standardization between APIs, providing transparency on the accuracy and timeliness, and multiple levels of data access control to protect sensitive data (Standardization, Transparency, and Accessibility)
- Sharing/using data –

- Workforce development to provide the necessary IT support to handle and prepare for upcoming needs and necessary redundancy implications (Workforce Development Strategy)

Subdimensions agencies such consider

- Management and operations –
  - Redundancy
  - System accessibility
  - Integration
  - Asset management
- Maintenance and repair –
  - Standardization
  - Availability of accuracy details
  - Availability of data timeliness (granularity)
  - Levels of access control
- Sharing/using data –
  - Number of IT / data science support staff
  - Contingency planning to prepare for challenges

Information and analysis needed

- Management and operations –
  - Systems redundancies
  - System remote access
  - Remote systems in compliance with cybersecurity standards
  - Two-way integration availability between TMS and asset management
- Maintenance and repair –
  - APIs in proper use and apply a standard data framework
  - 3rd parties providing accuracy and timeliness information
  - Sensor-based data supporting accuracy and timeliness evaluations
- Sharing/using data –
  - IT request efficiency
  - New technology evaluations before implementations (and redundancies when they fail)

Other issues to consider:

- Management and operations –
  - Preparation ahead of time (especially scenario testing)
  - Distributed TMS Operations, enabling redundancy
    - Integrate IT stakeholders (especially regarding cybersecurity)
    - Connect management and operations with workforce development
  - TMS Procurement
  - 3rd party relationships – business agreements that allow for future sharing and use cases

Action Planning & Immediate Next Steps (Session 4)

Raj Ponnaluri (Florida DOT) requested feedback from participants on the list of possible next steps and activities the co-sponsors may consider advancing in 2024 and 2025. Workshop co-sponsors expressed significant interest in further collaboration, to continue exchanging information, and conduct other activities in support of agencies assessing the capabilities, maturity, and performance of TMSs. The co-sponsors also expressed their support to

conduct a workshop during the 2025 TRB Annual Meeting focusing on the staffing needs and plans for TMSs. The proposed future actions the co-sponsors support are provided below.

Actions Co-sponsors Support:

1. Conduct workshop during 2025 TRB Annual Meeting. Possible topics to consider:
   - Sharing and Using Different Types of Data in Traffic Management Systems (TMS).
   - Methods to Identify Staffing Needs and Developing or Updating Staffing Plans for TMSs.
   - Enabling the Sharing and Use of Open-Source or Agency Owned Software or Application Programming Interfaces.
   - Preparing for and Virtually Managing and Operating TMSs.
   - Data Subsystems and Data Management Plans for TMSs.
2. Facilitate the sharing of information on TMS portal of National Operations Center for Operations Excellence website: https://transportationops.org/traffic-management-systems-and-centers
3. Join and contribute funds to TMC Pooled Fund Study to support developing resources to support agencies improving TMS capabilities and performance (Extended to April 2027):
   - Completed, current & planned new projects: https://tmcpfs.ops.fhwa.dot.gov
   - Process conducted annually to identify and prioritize, develop, and select proposals for new projects (e.g., 3 new projects in 2024, 15 proposals to consider for 2024)
4. Facilitate the sharing of information and highlight practices – NOCoE TMS webinar series:
   - Identify topics for future webinars.
   - Promote planned TMS webinars and identify agencies and possible speakers for anticipated webinars in 2024-2025:
     i. Locating Incidents Outside Surveillance Areas
     ii. Using Geofencing to Actively Monitor, Collect, and Share Information
     iii. Opportunities for TMSs to Share Information on Incidents
     iv. TMSs Role With Using Variable Speed Limits (VSL) During Adverse Weather Events
     v. TMSs Actively Managing and Operating Part-time Shoulder Use
     vi. Methods and Tools to Estimate Staffing Needs
     vii. TMCs Actively Managing the Use of Queue Warning Messages on Freeways
     viii. Performance of Staff Managing and Operating TMSs
5. Support the planning and participate in the Symposium Exploring the Future of Managing Traffic the last week of June, 2025 (Marrakech, Morrocco)
6. Explore partnerships to propose, sponsor, and conduct research to advancing TMSs:
   - Data Management Plans and Data Subsystems for TMSs, Selected for 2024 NCHRP Program
   - Integrating New Software Subsystems and Software Within Evolving TMSs, Submitted for 2025 NCHRP Program
   - Other topics identified by TMC Pooled Fund Study or other groups (e.g., TRB ITS Committee)

Closing: (Session 5)

Jon Obenberger (workshop lead, TRB ITS Committee, and USDOT FHWA) thanked participants, volunteers, and other co-sponsors of this year's workshop. Jon prompted workshop co-sponsors in the room to make final remarks. Several co-sponsors that were unable to attend submitted pre-recorded video remarks for use at the end of the workshop. A compilation of pre-recorded remarks is available at: https://youtu.be/9XplBXCqBSE.