DECEMBER 2019

Traffic Management Center

SERVICE LAYER PLAN

IOWA DOT

SMARTER | SIMPLER | CUSTOMER DRIVEN

Iowa Transportation Systems Management and Operations (TSMO)

Traffic Management Center (TMC) Service Layer Plan

Version 2.0

Prepared for:

Iowa Department of Transportation

Traffic Operations Bureau

Prepared by:

Kimley»Horn

April 2020

Revision History

Date	Version	Description
12/10/19	1.0	DRAFT Traffic Management Center Service Layer Plan
01/30/2019	1.1	Revised Traffic Management Center Service Layer Plan (draft final)
04/30/2020	2	Final Traffic Management Center Service Layer Plan

List of Abbreviations

ADSD	Automated Driving System Demonstration
AI	Artificial Intelligence
ATDM	Active Transportation and Demand Management
ATMS	Advanced Transportation Management System
CAD	Computer Aided Dispatch
CARS	Condition Acquisition and Reporting
C/AV	Connected and Autonomous Vehicles
CCTV	Closed Circuit Television
CJIS	Criminal Justice Information Services
CMM	Capability Maturity Model
IHSEMD	Iowa Homeland Security and Emergency Management Department
DMS	Dynamic Message Sign
DSS	Decision Support Systems
DOT	Department of Transportation
FHWA	Federal Highway Administration
FY	Fiscal Year
HH	Highway Helper
ICM	Integrated Corridor Management
IT	Information Technology
ISP	Iowa State Patrol
ITS	Intelligent Transportation Systems
IWZ	Intelligent Work Zone
JOP	Joint Operations Policy
MPO	Metropolitan Planning Organization
MVE	Motor Vehicle Enforcement
NWS	National Weather Service
RFP	Request for Proposals
TIM	Traffic Incident Management
TMC	Traffic Management Center
TSMO	Transportation Systems Management and Operations
UAS	Unmanned Aerial System

Table of Contents

List of Figures

List of Tables

1 Introduction

The Iowa Department of Transportation (DOT) Strategic Plan established an agency mission statement of getting you there safely, efficiently, and conveniently. Building upon this vision, Iowa DOT created a plan for Transportation System Management and Operations (TSMO) to provide a safe, efficient, and reliable system documented through eight service layer plans for the eight TSMO focus areas. These are shown in **Figure 1**. These service layer plans work in concert to proactively address the needs of the state's transportation system and provide Iowa DOT with specific recommendations to advance the highest priorities for the state's TSMO program.

The Traffic Management Center (TMC) Service Layer Plan lays the groundwork for developing the TMC of the future. Identifying the opportunities and creating a plan for improving the design and functions of Iowa DOT's TMC is vital for continuing to advance the state's TSMO vision and strategic priorities.

Figure 1. Suite of Iowa TSMO Service Layer Plans

1.1 Purpose, Content, and Intended Use

This TMC Service Layer Plan is the result of broad stakeholder feedback and input as well as coordinated strategies from several of the other Iowa TSMO Service Layer plans and serves as a roadmap for continuing to improve and expand Iowa's traffic management and operations capabilities. Through implementation of the recommendations contained in the TMC Service Layer Plan, Iowa DOT will create the TMC of the future while addressing the real issues that the TMC is facing today. Iowa's TMC is already a high-functioning facility that serves several critical transportation needs throughout the state, and it has continued to evolve to meet the growing demands of transportation operations and management. The future TMC will serve as an even more adept resource for Iowa DOT, partner agencies, and travelers throughout the state by making better use of data for real-time transportation management decisions, supporting multiple stakeholders with valuable data that empowers their ability to carry out missions, and fostering a technology environment that is nimble to be able to adapt to fast-changing technical advances in transportation operations.

The TMC Service Layer Plan is organized into the following sections:

- 2 – **Opportunities and Challenges:** Provides an outline of the key opportunities and challenges facing TMCs and Iowa DOT in relation to Iowa DOT's TSMO goals and objectives
- 3 – **Current TMC Operations and Services:** Describes the current structure and practice of Iowa DOT TMC and operational protocol
- 4 – **The Future of Transportation Management:** Describes key strategies for transportation management and the various technologies that exist for TMCs
- 5 – **Gap Analysis:** Summarizes stakeholder feedback to identify the gaps between the existing TMC and the vision for the TMC of the future
- 6 – **Action Recommendations:** Outlines the specific and practical ways that Iowa DOT can address the gaps and implement new technology and business processes to close those gaps
- 7 – **Service Layer Cost Estimate:** Estimates the cost of implementing the recommended projects
- 8 – **Performance Management:** Discusses how data can be used to improve process and performance reporting at the TMC
- 9 – **Service Layer Implementation:** Describes an implementation strategy and the need to assess the annual implementation status to stay current with evolving industry initiatives as well as progress from the other Service Layer Plans' implementation activities

1.2 Service Layer Plan Development Process

The TMC Service Layer Plan was developed by identifying the needs and opportunities for improving TMC operations in Iowa and examining how these needs relate to the other service layer plans. Essential to this process was broad input from a wide range of stakeholders, including those involved in day-to-day TMC operations, Iowa DOT Districts, communications and public information staff, law enforcement, and Iowa State University. There were several opportunities for stakeholders to identify strengths, challenges, and needs that they saw the TMC could address today and in the future. Feedback about current processes and systems at the TMC, as well as future needs and emerging technologies, provided valuable input on strategic priorities for Iowa's next-generation TMC capabilities.

Based on an existing document review and stakeholder outreach, an understanding was developed for where there are gaps in the TMC's functions and operations today. Next a thorough review of applicable technology and business processes was conducted and fit for the gaps identified. Finally, the cost of implementing these recommendations was estimated and the performance indicators and data analysis for process improvements were researched and discussed.

1.3 Relationship to other TSMO Service Layer Plans

Seven of the eight TSMO Service Layer Plans have been completed. Iowa DOT soon will be initiating the Active Transportation and Demand Management Service Layer Plan, which will be the final plan in the series. **Figure 2** illustrates the relationships between the TMC Service Layer Plan and the other seven service layer plans. The TMC will play a role in each of these service layers.

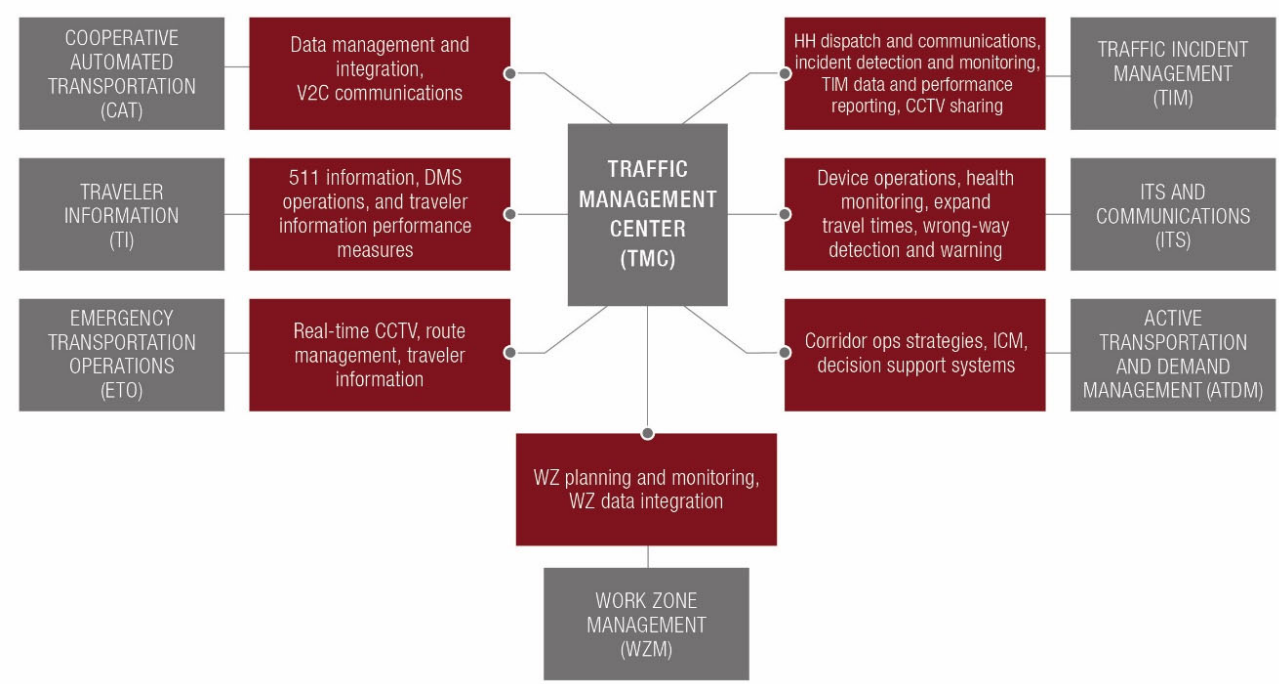

Figure 2. Iowa TSMO Service Layer Plan Relationships

Many of the service layer plan recommendations that referenced actions involving the TMC focused on improved data sharing and management processes and additional support for enhanced performance monitoring. The TMC's role for monitoring devices, assets and roadways means that the center's responsibilities transcend nearly all of Iowa's statewide TSMO functions. The role of the TMC in monitoring, coordinating, notifying, managing, and supporting a wide range of functions links the TMC to each of the other service layer focus areas. Key recommendations from these service layer plans that referenced TMC capabilities or systems have been carried forward into the recommendations for TMC actions. As these other service layer plans are implemented or updated, this TMC Service Layer Plan should also be reviewed and updated to maintain this important alignment among Iowa's TSMO program functions.

2 Opportunities and Challenges

Iowa's TMC has evolved from its initial focus as an operations support center to a full-service, 24/7/365 traffic management center with statewide and multi-state influence. The TMC has expanded and evolved to meet the continued needs of transportation operations and management and to accommodate the growing need for operations capabilities to be more proactive, rather than responsive. As an agency, Iowa DOT has set a mission statement of "getting you there safely, efficiently, and conveniently" and the key initiatives outlined in the department's Strategic Plan focus on:

- Performance management
- Data integration
- Portfolio and project management
- Organizational communication
- Workforce and knowledge management

The TMC plays a role in each of these key initiatives, and many of the strategic priorities for the agency echo similar priorities for the next-generation of the statewide TMC capabilities. The TMC needs to continue to be responsive to the evolving needs of Iowa DOT and innovations in the transportation operations arena while continuing to excel at the core operating responsibilities that are critical to providing a safe transportation system for residents and interstate travelers alike.

There are several key interstates that traverse Iowa and connect multiple states in the central United States. A key east-west route is I-80, and north-south interstate routes are I-29 and I-35. These routes are heavily traveled by freight operators and provide connectivity to neighboring states and metropolitan areas. Iowa DOT has a long history of multi-state collaboration with other Heartland area states to help manage mobility and safety and provide consistent traveler alerts on key interstate routes through this region. The need for real-time traveler notifications on these interstate routes has also driven the priorities for closed circuit televisions (CCTV) cameras, dynamic message signs (DMS), and other technologies that are used by the TMC to notify travelers and the freight industry of road conditions and potentially hazardous driving conditions.

2.1 Weather-Related Driving Conditions

The TMC plays a critical role in road weather management, particularly during winter months. Iowa has, on average, 30 snow events per winter season. In addition to winter driving conditions, there are floods, high wind warnings, and other emergencies that impact safe travel on Iowa routes. There are several established processes and procedures at the TMC to focus on monitoring key

In addition to winter driving conditions, there are floods, high wind warnings, and other emergencies that impact safe travel on Iowa routes.

corridors, communicating road impacts to travelers, and coordinating with Iowa DOT maintenance teams. Iowa DOT has integrated several data-driven processes into winter operations, and the TMC helps to support some of the data collection, tracking, and performance reporting to continually improve the department's collective response to winter events that impact roads and travel conditions. **Figure 3** shows an example of Iowa DOT's Dashboard that aggregates various data and provides a snapshot of current activities, including winter road conditions during winter months.

Figure 3. Iowa DOT Dashboard

According to Iowa DOT's *"How the Iowa DOT Does Winter,"* which calculates the "winter severity index," 2018-2019 was among the harshest winters of the last decade in terms of snowfall, freezing rain, blowing snow, and icy roads.

There will be a continued role for real-time operations capabilities to respond to the dozens of winter weather events that impact roads and travel conditions each year in Iowa. Many of these functions are currently carried out at the TMC facility, and some are carried out remotely using real-time communications and operating systems. As new technologies allow for more predictive capabilities,

analytics, direct communications with vehicles, and expanded interagency communications needs, the TMC will need to be able to expand its technical capabilities to take full advantages of these technology advances to improve safety and mobility during hazardous weather conditions.

2.2 Continued Growth in Freight and Goods Movement

Iowa's transportation system facilitates movement of over 1 billion tons of freight (estimated value of $562 billion). According to the Iowa State Freight Plan this is expected to grow to nearly 1.3 billion tons with a value of $740B by 2030. There are multiple transportation assets in Iowa that are responsible for moving freight (see **Figure 4** taken from the State Freight Plan). Several key goals and strategies within the State Freight Plan point to the need to improve how Iowa DOT develops, monitors, and manages key routes on the network. Iowa's statewide TMC capabilities, existing and future, will have a critical role in facilitating those improvements on key freight routes.

Several of the goals and priorities identified in the State Freight Plan are directly relevant to Iowa's TMC:

- Target investment to address mobility issues that impact freight movements
- Right-size the highway system and apply cost-effective solutions to locations with existing and anticipated issues
- Optimize the freight transportation network to minimize cost and travel time and improve supply chain efficiency
- Provide real-time information on system conditions to support the movement of freight
- Leverage real-time information from users of the system to support advanced decision-making and incident avoidance

The State Freight Plan identified priority locations impacting freight operations, as shown in **Figure 4**. There is an important opportunity for the Iowa DOT TMC to elevate its role for monitoring, strategy development, and coordination with local agencies to address freight mobility and minimize bottlenecks. Many of these locations also represent urbanized areas where there is already an elevated focus on TMC monitoring and coordination. Additional operating procedures, data analysis, and strategy development could complement existing TMC processes.

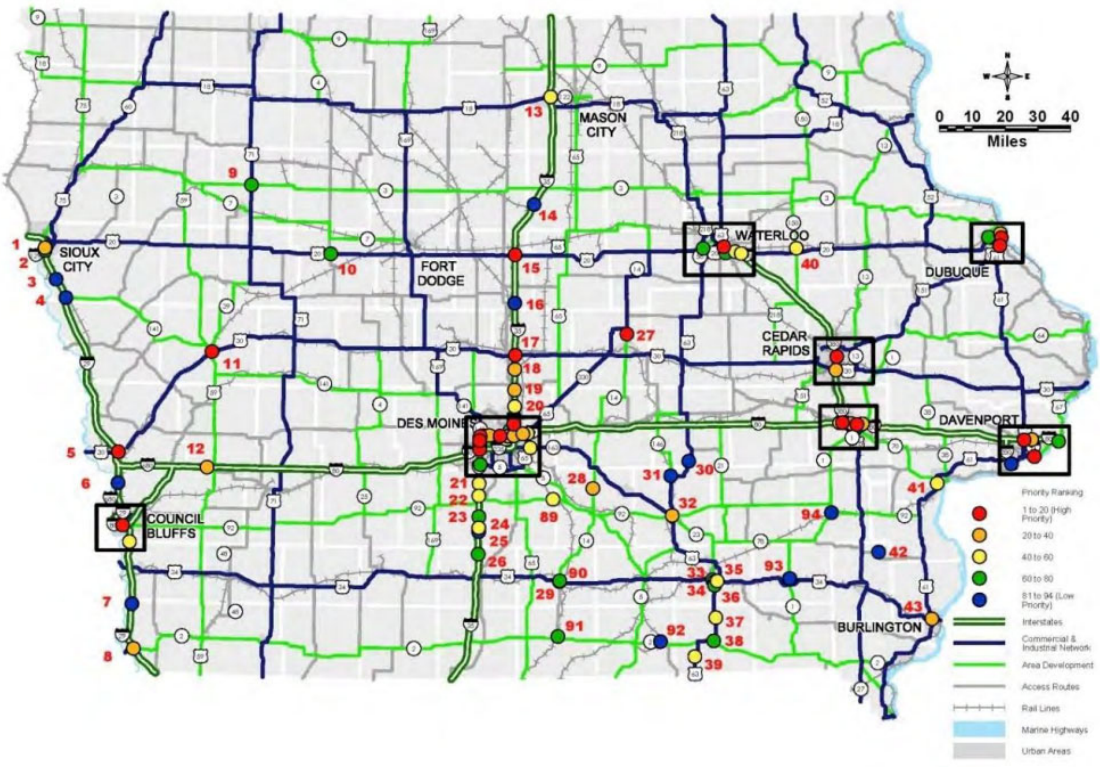

Figure 4. Multimodal Transportation Assets and Highway Freight Priority Locations

Source – Iowa Freight Plan Executive Summary (https://iowadot.gov/iowainmotion/files/Iowa%20State%20Freight%20Plan%20-%20Executive%20Summary%20-%20FAST%20Act%20Doc.pdf)

2.3 Future Direction for TMCs

Many traffic management centers are evaluating new operating capabilities that are needed to respond to increased demand for more proactive system operations. Some of these might be new or upgraded technologies at the TMC, others might be specialized staff/skill sets, and others might require new processes or interfaces with other agencies. Iowa DOT has been steadily growing and expanding its capabilities at the TMC through new systems and technologies, actively integrating new data sources into TMC operations, and collaborative operations with partner agencies.

Section 4 of this TMC Service Layer Plan identifies several important innovations and initiatives that are likely to shape future TMC operations in Iowa. Some of these programs could potentially influence near-term operations, such as Integrated Corridor Management, drones, and increased analytics capabilities.

In addition to technology advancements, there are some high-impact process improvements that could greatly shape future TMC operations in Iowa. Some examples include:

- A scan of statewide TMC operations around the country shows that several TMCs have some level of co-location as part of their business model. The most prevalent is combining law enforcement and transportation operations to promote improved coordination for incident management and response. TMCs in Arizona, California, Florida, Minnesota, and Nevada are examples of successful co-location models. There are other examples where multiple agencies are co-located in a central operating facility. These tend to be regional facilities, and Austin, San Antonio, and some districts in Florida include state and local law enforcement, emergency medical services, transit, managed lanes, and other functions in a central operations center. Although technology exists to facilitate information sharing among these partners, there are tremendous benefits to building stronger relationships among key agencies through more frequent in-person interactions provided by a co-located environment.
- Virtual TMC capabilities can help to provide more effective remote operations or can provide access to certain TMC functions by entities outside of the TMC, such as a District or traffic engineering group located in another part of the state. Virtual TMCs can be implemented at emergency management centers to provide a level of real-time visuals, and potentially control of certain functions. Strong operating processes and business rules would need to be in place to govern access and use of TMC operating systems by multiple users.

3 Current TMC Operations and Services

3.1 Overview of Iowa's Statewide TMC

The Iowa DOT TMC is a statewide center located in Ankeny, Iowa and operates 24/7/365. It is the hub of real-time traffic operations for the DOT road network, and Iowa DOT operates and maintains over 9,400 miles of interstate, U.S. highways, and state highways. There are two key aspects of the TMC operations: 1) the staff who provide active monitoring, coordination, and strategy implementation to respond to traffic and road impacts on Iowa's network, and 2) the systems used to support network monitoring, alerts, communications, and operations strategy implementation. These systems include the Advanced Transportation Management System (ATMS) software, Third Party Data sources, intelligent transportation system (ITS) field devices, and ITS and DOT networks that allow for real-time monitoring and control strategies. A central component of this infrastructure includes the TMC's video wall and control room shown in **Figure 5**.

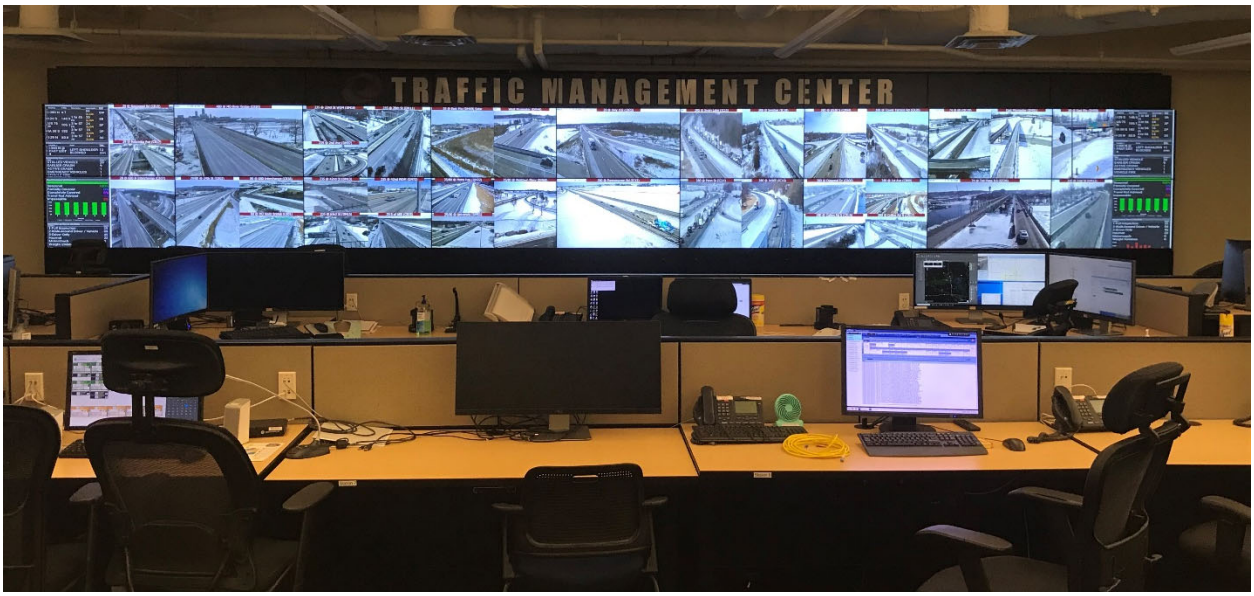

Figure 5. Iowa DOT Traffic Management Center

Operators at the Iowa DOT TMC communicate with state and local traffic incident responders, Highway Helper responders, Iowa DOT Motor Vehicle Enforcement (MVE) and Highway Maintenance Supervisors, and Resident Construction Offices to coordinate responses to impacts on the network. In addition to the TMC's role providing response coordination and communications during traffic incidents, staff at the TMC participate in pre-planning activities for work zones, forecasted severe weather events, and planned special events. The TMC also coordinates with neighboring states for key corridors such as I-80, I-35, and I-29.

During winter weather season, the TMC actively monitors the National Weather Service, other weather information systems, and corresponding alerts and will make appropriate adjustments to staff schedules to be sure there is additional coverage for large weather events. During major winter events, MVE can provide officers to assist in the TMC with monitoring and MVE field coordination. Information from the TMC is used by a variety of Iowa DOT groups and divisions, local agencies, and law enforcement agencies, and is also distributed to the public. Systems at the TMC are a key data source for traveler information tools like the 511-phone system, 511 road conditions website, social media (including Twitter and Facebook), and TV and radio media outlets.

Iowa DOT has been steadily building out a statewide network of corridor monitoring and management infrastructure. There is a higher density of devices and coverage in urban areas, but there are also several devices on statewide corridors. Cameras are located statewide, with the greatest presence along key corridors such as interstates and major metropolitan areas. Operators at the TMC have access to private-sector traffic speed and incident data for routes throughout the state, which provides comprehensive coverage on routes and corridor areas where Iowa DOT does not have its own monitoring infrastructure. The private sector data provides information at a glance regarding typical speed, slower than typical speed, or segments with stopped traffic. A partnership with Waze provides user-generated reports on incidents or slow traffic.

A high-level summary of key functions, roles, and responsibilities for Iowa's TMC is shown in **Figure 6.** These functions demonstrate the many responsibilities of the TMC for strategy planning, device and system monitoring, communications and notifications, and responding to events in real-time that impact road and travel conditions.

Figure 6. Iowa TMC Roles and Responsibilities

3.2 TMC Operations – Staffing and Systems

3.2.1 TMC Personnel

The Iowa TMC is staffed 24/7/365. Iowa DOT contracts with a service provider for operations staff to provide continuous coverage of the TMC and associated systems. Iowa DOT has used a contracted operations model for the last several years and has been able to effectively adjust that model to provide the optimum staffing levels needed to support TMC operations, even when weather or special events

require additional staffing support. Operators are trained in how to use the systems, how to follow Iowa DOT's standard operating procedures (SOP's) for operating the systems, and application of the proper protocols for notifying other entities when incidents, weather, or work zone operations warrant it. Iowa DOT's TMC SOP's and supporting documents outline specific notification protocols based on the type of incident or impact.

The TMC staff routinely coordinates with additional Operations Division staff, including the Traffic Operations Bureau. Staff in the Traffic Operations Bureau are directly responsible for the statewide ITS implementation, systems procurement, statewide traveler information program, and other key related functions, including managing the ITS maintenance contractors. Iowa DOT has contracts in place with maintenance service providers for the ITS field devices and for the communications network.

3.2.2 Iowa DOT TMC Systems and Equipment

Operators at the TMC actively monitor more than 400 cameras (including cameras linked to weather detection systems, permanent cameras, rest/parking areas, and weigh stations), activate DMS throughout the state, monitor multiple active work zones, and provide critical support and communications to assist with coordinating responses to major incidents and events (including weather).

Each workstation has unobstructed views of the video wall, which displays real-time video feeds from closed-circuit television cameras located throughout the state. Images can be adjusted and scaled based on the need to monitor specific incidents, work zones, or other locations. Each workstation at the TMC allows operators to access the critical systems they need to use to monitor, manage, control, and communicate. **Figure 7** shows an example of an operator workstation at the Iowa DOT TMC.

Figure 7. Iowa TMC Operator Workstation

Operators at the Iowa DOT TMC use several systems to monitor and control devices, log events and incidents, and communicate with internal and external agencies. The statewide ATMS links Iowa DOT devices deployed statewide via the communications network and enables real-time viewing, control, and strategy implementation from the TMC. TMC operators also log incidents and events into TMC systems that provide traveler information, internal and external notifications, and social media posts. **Table 1** summarizes key systems used at the TMC.

Table 1. Iowa DOT TMC Operating Systems

Operating System	Description
ATMS Software	Planned and unplanned incidents are entered into this system, control ITS devices and activate DMS messages, and track incident activity to help manage incidents.
CARS	Incidents, planned work zones, and special events with restrictions or closures are entered into this system. It is the primary data source for the 511 platforms.
Digital Traffic System On-Ramp	Issues with ITS devices are entered into this system to be addressed by the ITS maintenance contractor.
Iowa TMC Dashboard	Operators use this custom database to input incidents from ATMS. The dashboard allows them to send and update reports on individual incidents or generate performance measurement and monthly incident summary reports.
INRIX Dashboard and Analytics	Private 3rd Party Data sources provide speed and congestion information for key routes. Operators can create a location-specific dashboard to monitor incidents and traffic where INRIX information is available.
Mobile Architecture for Communications Handling (MACH)	Provides location of Highway Helpers and real-time location information for the Iowa State Patrol, Motor Vehicle Enforcement, and other law enforcement agencies that use MACH.
Weatherview	Allows TMC operators to view corridor weather conditions.
Cypress	Real-time vehicle location information of Iowa DOT snow plows.
Iowa 511	TMC operators must monitor the system to ensure that the information is consistent with current road conditions and impacts.

Operating System	Description
Welcome Center/Driver's License Station Security Alarm System	The TMC monitors the security alarm system for the welcome centers and multiple Driver's License Stations throughout the state. Policies and procedures are in place if an alarm is triggered.
Meltwater	TMC operators use this system to monitor and respond to social media posts after hours and on weekends.

3.3 TMC Operations Priorities and Functions

Iowa's TMC serves as a central point of coordination and strategy implementation across a wide range of operations functions. Staff at the TMC serve in critical roles for real-time system management, activating traveler alert systems and issuing notifications to affected Districts, management, other state agencies, and neighboring states. As the only 24/7 traffic management facility in the state, the responsibilities of the TMC continue beyond typical business hours. The center is staffed around the clock and will bring in additional resources for large-scale events such as winter storms, weather events, extended incident closures, special events, or other impacts to the transportation network that require ongoing monitoring and coordination.

Figure 8 below provides an overview of the key roles and operations functions carried out by Iowa's statewide TMC. Additional details on these roles and responsibilities are provided following the table.

		TMC ROLE
Incident/Emergency	Traffic Incident Management (TIM)	» Actively monitor and manage traffic, using DMS, 511, and Highway Helper to accomplish Responder and Traveler safety » Work with local incident responders and DOT to establish diversion routes during major events
	Road Weather Management and Emergency Transportation Operations	» Monitor weather impacts on roadways, including viewing CCTV and data from various sources » Monitor and respond to response activities reported by ISP, Sheriff's departments, DOT field staff and other agencies. » Provide information on 511, DMS, and other traveler information resources
Planned Events	Work Zones	» Create public information plans for 511, and DMS » Monitor IWZ » Notify agencies of planned major construction impacts
	Special Events	» Perform traffic management planning for large-scale special events that will impact traffic
Information Sharing	Traveler Alerts and Notifications	» Notify travelers of incidents; This is a crucial function of the TMC » Provide information for 511 and social media platforms
	Communication	» Provide real-time communication and coordination with state agencies, local agencies, and neighboring states
Day-to-Day TMC Functions	Traffic Management Monitoring	» Use Intelligent Transportation Systems (ITS) technologies including cameras, detectors and other infrastructure » Monitor Waze alerts » Monitor 3rd Party Data sources for traffic delays and other impacts
	Data Management	» Aggregate traffic operations data to support TMC functions and evaluate performance
	Supporting Functions	» Iowa Welcome Center and Driver's License Security monitoring and response » ITS device system health checks

Figure 8. Iowa TMC Roles and Operations Functions

3.3.1 Incident and Emergency Operations

Traffic Incident Management (TIM)

The TMC's role to support safe and effective traffic incident management is perhaps one of the most vital functions of Iowa's TMC.

The TMC's role to support safe and effective traffic incident management is perhaps one of the most vital functions of Iowa's TMC. TMC operators continue to coordinate and support incident response, and update and distribute traveler information as it comes in in near real-time. The TMC coordinates with and dispatches Highway Helper personnel in the field and relays real-time incident information to travelers. Highway Helpers assist with incidents such as stranded vehicles and support other TIM responders with traffic control and emergency detours.

Road Weather Management and Emergency Transportation Operations

Iowa's TMC serves in an important role to coordinate the DOT's responses to large-scale weather events, road weather impacts, and emergency conditions, such as floods. The TMC has emergency response plans in place, including protocols for coordinating with Districts and neighboring states as well as issuing traveler alerts and warnings. The TMC uses cameras, data feeds, and real-time updates from field personnel to assess road weather conditions and impacts and implements strategies to warn drivers of hazardous conditions. The TMC updates the reporting systems that provide data to 511 and other resources to warn travelers of roadway impacts.

3.3.2 Planned Events

Work Zones

The TMC monitors Intelligent Work Zones (IWZ) where ITS tools are used, such as sensors and cameras, to monitor a project area 24/7. Operators then will apply various traveler information strategies to maintain traffic flow and safety through work zones, including updating messages on DMS, the 511 system, and social media platforms. TMC staff coordinate with District construction project managers for all aspects of work zone monitoring and management.

Special Events

Iowa DOT's TMC plays an active role in supporting major special events that impact the state highway network. Conducting an exercise in preparation for a special event also serves the purpose of practicing response to an unplanned event, as many of the functions overlap. Some of the events that require special planning and coordination with Iowa DOT and other emergency management partners include:

- Iowa State University football games
- University of Iowa football games
- Iowa State Fair
- Farm Progress Show
- NCAA basketball tournaments
- National security special events, such as campaign events with dignitaries requiring special security services

3.3.3 Information Sharing

Traveler Alerts and Notifications

One of the most integral functions of the TMC is providing traveler information. Notifying travelers of an incident ahead, delays caused by roadway construction, weather impacts, or planned major events that are impacting traffic conditions is a chief concern of TMC operation. Informing travelers of hazards or impacts on the road network can help drivers be aware of upcoming delays, prevent secondary crashes, protect responders on the roadway, and help drivers make informed decisions about their route.

To accomplish this, TMC operators input incident information into the Condition Acquisition and Reporting System (CARS) database for dissemination to 511 phone and website platforms and are responsible for activating and updating DMS. Traveler information is also shared across various social media applications, including Twitter.

Communication

The TMC uses an array of communications infrastructure, including fixed and mobile traffic sensors, non-enforcement traffic cameras, DMS, and infrastructure needed to gather and share information. As the only 24/7 TMC in the state, it serves a critical role for notifications and alerts for agencies as well as travelers. Several DOT divisions and groups and external agencies look to Iowa DOT's TMC for up-to-the-minute information on current traffic conditions, hazards impacting traffic, and emergency alerts. The TMC also routinely coordinates with neighboring states during major events impacting interstate highways or long-term closures that could affect traffic operations near state lines. More details about the TMC's communications responsibilities are provided in Section 3.4 of this Service Layer Plan.

3.3.4 Additional TMC Functions

Traffic Management Monitoring

Iowa's TMC monitors real-time CCTV camera feeds, traveler reports through the Waze data feed and private sector probe data provider (INRIX), radio communication from Highway Helper trucks, and input from field staff. All of these strategies help to provide the TMC with up-to-the-minute information on travel and traffic conditions on the state's highway network. As Iowa looks to potentially implement more active TSMO strategies, such as ramp metering, active traffic management, and integrated corridor management, this monitoring function will provide important situational awareness for these types of traffic management strategies.

Data Management

Systems that are monitored from and managed at the TMC generate a significant amount of data to support real-time operations as well as analysis and performance reporting. Data generated by TMC systems help to support not only TMC operations, but also several other key functions, including work zone planning, traffic incident management strategies, Highway Helper operations, and traveler alerts and notifications. Data stored within systems such as the ATMS and CARS databases needs to be accessed and used by other groups and departments outside of the day-to-day TMC functions. Making this data accessible and available is a key priority.

Supporting Functions

The Iowa TMC's functions also extend to support for monitoring security systems at Driver's License Stations and Welcome Centers throughout the state. As a 24/7 facility, the TMC can view security cameras, be notified of a panic button being pushed, and notify appropriate authorities of security breaches. The TMC also has a role for system performance monitoring, and device health checks. TMC staff generate and compile performance reports to support analysis and review of various TSMO programs and strategies, including incident response, work zone management, and road weather response strategies. Staff at the TMC often work closely with other departments for performance analysis and reporting.

3.4 TMC Stakeholder Coordination and Communications

The Iowa DOT TMC coordinates and interacts with many different stakeholders to carry out operations and management strategies. These include internal Iowa DOT stakeholders, external agencies, national service providers, neighboring states, freight operators, contractors, and the public. Because of the TMC's statewide role and influence, there are numerous points of contact and coordination for the TMC to effectively carry out its operations priorities. In some instances, the TMC is providing an important support function or sharing operations data to support other stakeholders' business and operations function. In other instances, the TMC is serving a lead role in monitoring, coordinating, and conducting response communications. Lastly, numerous stakeholders benefit from the capabilities, functions, and data generated by the TMC.

Figure 9 shows the range of internal and external stakeholders with which Iowa's TMC supports and interacts. More detailed descriptions of the TMC's roles and interactions with these stakeholders are also provided in this section.

Figure 9. Iowa DOT TMC Internal and External Stakeholders

3.4.1 Internal Iowa DOT Stakeholders

The TMC is the nerve center for many core transportation system management functions, and it interacts with several Iowa DOT Divisions, Bureaus, and Districts. Perhaps one of the most critical roles the TMC services is a conduit and liaison with Iowa DOT District operations. TMC operators routinely coordinate with District Highway Maintenance Supervisors, resident construction engineers and District maintenance staff, and MVE officers and captains for traffic incidents, road weather monitoring and response coordination, work zone planning and active work zone operations, and planned and emergency road maintenance.

In addition to real-time coordination with various internal entities, the TMC is also a key source of system data to support planning, performance monitoring and management, and planned work zone notifications. Staff at the TMC work with public information/communications staff at Iowa DOT to provide important updates for traveler alerting and notification systems, including 511 and social media.

3.4.2 External Agencies

Effective TMC operations requires that Iowa DOT coordinate with several external agencies. These agencies range from federal entities (including FHWA), counties and local governments, Iowa state and local law enforcement, emergency management, and neighboring states. Universities also are involved in various Iowa DOT studies, research, analysis, and other support, and this includes links to TMC functions. The TMC interacts with the following principal external stakeholders to carry out operations:

- Communicates with Iowa State Patrol (ISP) on response strategies for traffic incidents
- Notifies the internal and external stakeholders of incidents or planned highway maintenance
- Interacts with local 911 communication centers to verify incidents and coordinate response strategies
- Coordinates with city and county law enforcement agencies to share incident information
- Communicates with adjacent states to coordinate on strategies for major corridors (i.e., during winter weather events or emergency road operations)

3.4.3 Travelers

A crucial part of TMC operations is to make travel safe and reliable for commuters, the freight industry, and the full range of travelers that rely on Iowa's transportation system every day. Though many of the TMC functions may not be recognized by the typical traveler, these functions are essential to keeping traffic moving in a safely and efficiently. Some of the tangible ways that the TMC operators and systems interact with travelers include:

- DMS messages to provide alerts, warnings of incidents, delays, work zones, hazardous conditions, or weather impacts, as well as public safety messages through programs such as "Message Mondays."
- Alerts and ongoing updates that are distributed through 511, social media, and media outlets, and shared with WAZE and other traveler information sources.
- CCTV camera images, DMS messages, and incident information that are shared with the public via TV broadcasts.

3.4.4 Service Providers

The Iowa TMC coordinates with several service providers for different functions. Some of these providers are important data sources for traffic conditions or weather forecasts, and other providers are contracted to provide specific services to the TMC, such as staffing for operations and maintenance.

- National Weather Service (NWS)
- Third Party Data Sources
- Consultants/Contractors

3.5 Strengths of Iowa DOT's TMC Operations

Iowa DOT's TMC is already functioning at a high level, and it serves several critical needs for real-time transportation system operations throughout the state. The TMC is an important and effective hub for information sharing and notifications, particularly when there are incidents, weather, and unplanned impacts to road conditions. As a 24/7 facility, the TMC supports around-the-clock system monitoring and can quickly respond to events that affect safety and mobility on the state's road network. The TMC routinely communicates with other state and local agencies, including law enforcement, emergency management, incident responders, rail operators, and even neighboring states to address system management needs.

A closer look at specific TMC processes, functions, and operations revealed several strengths of Iowa's current TMC operations. There are consistent processes in place for the TMC to respond to closures, incidents, work zones, and other events impacting travel. Similarly, there are established processes in place for strategic planning, implementation, and monitoring of work zone and special events. This is supported through strong communication between Iowa DOT Districts and other departments. Business practices at the TMC showed a good working relationship with the IT Department, which supports computer and equipment needs for the TMC. This relationship will be even more critical as newer technologies, networking, and data management strategies are integrated with TMC operations.

Over time, the TMC has been proactive in using and integrating crowdsourced data from private sector sources into TMC operating processes. Iowa DOT was among the first states to establish an agreement with Waze for alerts and uses INRIX data statewide for speeds and travel times. Third party crowdsourced data provides valuable information for corridors and road segments that are not instrumented with DOT infrastructure.

Recognizing that processes could be further improved, Iowa DOT selected a new ATMS provider, which will allow for a more integrated suite for the central operating platform, thereby limiting the need for operators to enter data into and monitor multiple systems. The new ATMS provider also will provide the means for better coordination between the ATMS and the event reporting systems that supply data to 511 applications. This integration will support more automated reporting functions, which will reduce the amount of time operations staff need to spend manually compiling system performance reports. Iowa DOT expects a full transition to the new ATMS in 2020. To accompany this new ATMS, there will be an update of TMC SOPs and associated training.

The TMC has performance measures in place and has made positive strides in gathering data from devices, systems, and private sector sources, storing this data centrally, and automating monthly reporting. The TMC also serves in the role of collecting and packaging centralized data for partners. The TMC will use performance data to identify expansion and improvement opportunities for TMC staffing and Highway Helpers and to identify routing and resource decisions.

4 The Future of Transportation Management

Transportation management has progressed significantly over the last few decades. Even with evolving technology capabilities that directly support more advanced transportation operations strategies, there is still a need to address a core suite of TSMO functions—detecting and responding to incidents, supporting safe work zone operations, notifying travelers of road and travel conditions, and providing for a safe and reliable travel experience throughout the state.

Iowa DOT has been implementing systems and technologies to address specific operations issues for more than three decades. An early adopter of technologies for weather impact detection and innovative freight-focused traveler information, Iowa will continue to test and implement cutting-edge systems to solve the state's biggest transportation challenges. The TMC systems will need to assess the opportunity for advancing transportation management systems and integrate these capabilities into its day-to-day operations as needed. The ATMS RFP identified requirements for several strategies that will help to elevate Iowa DOT's TMC operations and efficiency, including a more integrated interface between operating systems and traveler information systems, an enhanced video delivery system to improve how video is shared with partner agencies and travelers, and the ability to address current and future cybersecurity threats.

Iowa DOT is exploring several new operations capabilities that future TMC operations will need to address:

- Ramp Meters – A study is underway to evaluate ramp meters for congestion management in the Des Moines Metro area. If Iowa moves forward with implementing ramp meters, this technology could be another component of Iowa DOT's freeway management system.
- Freight and Commercial Vehicle Focused Technologies – Iowa DOT has recently implemented a truck parking system, shown in **Figure 10**, as part of a multi-state partnership. "Trucks Park Here" is focused primarily on I-80, but also includes portions of I-380, I-35, I-235, and I-29. The project includes detecting availability of truck parking spaces at select locations including rest areas, welcome centers, and participating truck stops. Availability information is provided through a dedicated website and is integrated into Iowa's 511. Obtaining real-time location information from freight operators remains a challenge.

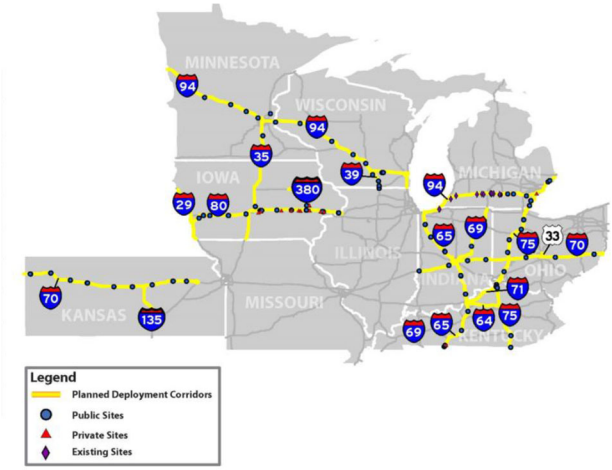

Figure 10. Truck Parking System Deployment Map

- Non-Emergency Lane Closure System – Iowa DOT is exploring the use of a non-emergency Lane Closure System. This system is envisioned to provide sensor and speed data to Iowa DOT to inform decisions about when it is acceptable to allow a lane closure based on real time traffic volumes.
- Integrated Corridor Management (ICM) – Iowa DOT is studying the use of ICM in the Des Moines Metro area to mature the management of roadways to consider the capacity of a corridor as a multimodal system and provide a broader range of benefits to the users. **Figure 11** shows the study area map for potential ICM implementations in the Des Moines area. ICM concepts will require the TMC to coordinate closely with local agencies for freeway-arterial coordination and could likely introduce new capabilities such as decision-support systems, adaptive control technologies, queue detection and warning, among other technologies.

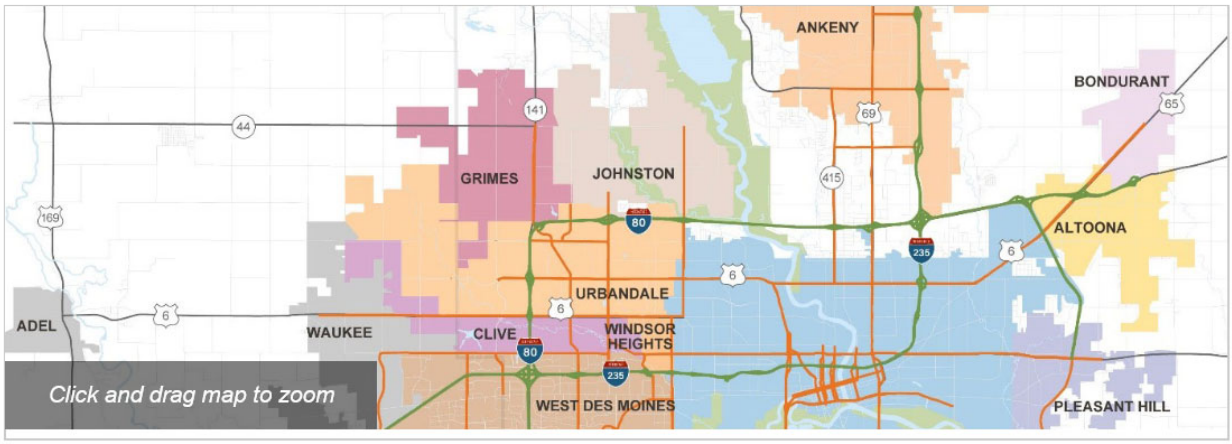

Figure 11. ICM Study Area Map of Des Moines

- Drones and Unmanned Aerial System (UAS) – Drones are currently used to monitor work zone safety and security in some construction projects. Drones for traffic management could support traffic monitoring across a broad area to better monitor rapidly changing conditions, particularly in areas where there are no cameras or detection infrastructure. Iowa State Patrol is using drones for crash investigations, and Iowa DOT is initiating discussions for future use of UAS in TMC operations.
- Video Analytics – The potential for quicker detection of stalled vehicles or congestion makes video analytics an attractive application, particularly if it can leverage existing CCTV cameras and video equipment already deployed on key corridors. Video analytics can be integrated with existing CCTV cameras like the one shown in **Figure 12**. Arterial operations in many regions already make use of video analytics to serve

Figure 12. CCTV Camera Installation

as detectors; freeway applications could help to alert of queues, crashes, stalled vehicles, and other impacts on the roadway.

- Signal Operations – Iowa DOT does not currently own or manage traffic signals from the TMC and does not have a traffic engineer on-site. With the future advancement of applications and systems (i.e., integrated corridor management, ramp metering, etc.), there will be an increased reliance on signal operations management as well as ramp meter signal operations. This could be a future consideration for the TMC based on outcomes from the ICM study.
- Road Condition Prediction – This capability involves analyzing various data sets and parameters (such as time of day, day of week, existing restrictions, and other variables) to predict when road conditions might surpass specific thresholds for both traffic and weather-related conditions. There have been significant advances in predictive weather applications, such as when roads or bridges might freeze or when certain visibility restrictions will be reached. Predictive traffic management applications are often part of complex Decision-Support Systems where real-time traffic data from multiple sources (DOT, law enforcement, third-party providers) is processed and predictions can be generated of future traffic conditions. Iowa DOT is currently investigating options for the application of road weather data to support operations, traffic management, and traveler information.
- Active Transportation Demand Management (ATDM) – Iowa DOT is in the early stages of identifying ATDM strategies for some areas and will soon be developing an ATDM Service Layer Plan. Potential strategies include dynamic lane control, hard shoulder running, variable (advisory) speed limits, and freeway/arterial coordination. Iowa DOT is also exploring queue detection and traffic signal timing needs.
- Cooperative Automated Transportation (CAT) – The Iowa DOT CAT Service Layer Plan provides a detailed review of CAT integration. Specifically, several actions are recommended for the next three years including identifying the infrastructure and data readily available, reviewing the governing guidelines, conducting a public education campaign, and implementing a pilot project. Further evaluation of strategies for improved TMC operations and performance measures are recommended as later actions. The TMC will play a critical role in the near-term in supporting data analysis and potential system operating needs as part of the first group of CAT priorities.

5 Gap Analysis

Multiple stakeholder workshops were conducted with a focus on evaluating the existing conditions and the future of TMC operations in Iowa, as described in Sections 3 and 4, respectively.

A Capability Maturity Model (CMM) framework was developed and tailored specifically for the statewide TMC context. This framework was used to guide a stakeholder group in September 2018 through discussions on strengths and weaknesses of the Iowa TMC across each of the six CMM dimensions: systems and technology, performance measures, culture, organization and staffing, collaboration, and business processes. This exercise identified key priorities that would advance capabilities at the TMC and prepare for evolving approaches to operations.

An electronic survey was distributed to several DOT stakeholders and other agencies that interact with the TMC including the ISP, Iowa State University, and contractors. This survey assembled key future trends that were likely anticipated in TMC operations and stakeholder perspectives on future TMC roles and functions. In addition, the survey collected activities regarding what the TMC should be doing differently from its current functions. Survey feedback formed the basis of a Future TMC Visioning session held in March 2019. This visioning session was designed as an interactive workshop that focused on these four areas:

- TMC and Emerging Technology
- Future TMC Operating Models
- Next-Generation Operations
- TMC and Data

Many of the “gaps” identified by key stakeholders focused on key needs for the future and ways that the TMC could capitalize or expand on existing functions and capabilities.

This section describes the gaps between the CMM and the Future TMC Visioning session and identifies specific focus areas for Iowa’s TMC. A full recount of the CMM workshop, which provides details for each of the identified challenges, is provided in **Appendix A**.

5.1 Emerging Technologies

The pace of evolving technology consistently provides new opportunities to support traffic management systems. The challenges and opportunities of these emerging technologies will have an impact on TMC operations and therefore will require a plan for integration. Iowa DOT is not alone in navigating strategies for applying new technologies and can benefit from a planned approach to preparing the culture and structure of TMC operations to integrate these anticipated changes.

A recent shift in transportation technology is the increase in partnerships with IT groups. Historically, ITS and IT have maintained separate networks, but as technologies related to network management become intertwined, there is an increased reliance on coordination between responsible departments. Transportation and IT stakeholders within Iowa have realized this need and are committed to sharing

resources. The use of contractor staff introduces another level of coordination for TMC operations. Contractor staff often require specific approvals for the System Manager to access cabinets and servers within the TMC, which reduces efficiency in operations and system management.

Agreements between Iowa DOT and ISP have allowed for direct radio channels to be developed for the use of the TMC and IPS's State Radio Communication Center. This will allow direct radio communication and minimize the number of phone calls required to support effective coordination during incidents. A new console radio system has been implemented in the TMC and is used to monitor all six (6) Homeland Security and Emergency Management Department (HSEMD) regional channels. These channels are used by the ISP and State Radio for incident communication and dispatch. The TMC and the Highway Maintenance Supervisors (HMS) also have access to Talk Around Channels (TAC) that are used for large scale incidents and allow responders to have a direct line of communication at the scene.

Multiple software packages are currently used by the TMC, and this often introduces complexity and reduced efficiency for the operators. Iowa DOT's new ATMS software should help to streamline the number of systems with which operators need to interact, address the integration of the existing systems, and enhance operator access to field equipment operations; however, new technologies and their integration with existing systems within the TMC should be a consistent focus.

Lastly, TMC operators require robust workstations that use a range of software applications and are accessed by multiple users. Agencies typically follow a three-year lifecycle replacement for employee workstations; however, the wear and tear imposed on operator workstations requires more frequent maintenance and a shorter schedule for life cycle replacement. The TMC staff should work with Iowa DOT's IT department to establish an effective maintenance plan and a more frequent replacement/upgrade schedule.

5.2 Operating Models

Having a baseline understanding of internal operations and the operations of corresponding partners is foundational for collaboration efforts. Iowa DOT has realized that challenges with ensuring equal understanding exists across all groups. Iowa DOT has identified four key areas for improved collaboration that support enhanced operations.

- External partnerships: AAA, Trucking Association, MPOs
- Regional construction engineers and Traffic Critical Projects/Intelligent Work Zones
- Construction Awareness Seminar, TIM statewide conference
- Information Technology and the exchange of CCTV camera feeds between cities

Collaboration will support better understanding of roles and responsibilities across all partner agencies and improve efficiencies in TMC operations. Additionally, onboarding of new contractor staff should involve comprehensive training on functions, roles, and responsibilities for field personnel roles, work zones, and TIM on-scene management. Multi-agency training programs also can support improved understanding of partner agencies' roles and responsibilities.

There is a range of TMC operating models that can improve the collaboration and efficiency within the TMC. A multi-agency TMC would support a more collaborative environment for day-to-day operations. A mini-operations facility could provide as-needed support to operations during special events or serve as an emergency back-up operating center in the event of reduced operating capabilities at the primary TMC due to power loss or other similar constraints.

5.3 Data Sources

There is an abundance of data available that is generated through various TMC systems and TSMO activities, and acquiring the data is only the first step. Packaging and utilizing that data and making data available to others are additional challenges. Iowa DOT recognizes that despite progress with TMC performance reporting, there is an opportunity to maximize the use of the available data. Hurdles include the volume of data, the number of applications available, and the necessity to evaluate and determine the most effective options for TMC operations. Other considerations include data formatting, content, and the applicability of the data to the end users. Once these decisions are confirmed, it becomes paramount to educate the end users to maximize the success of the preferred data applications.

5.4 Resources and Staffing

Staffing and resource management is key to the success of TMCs. Functions within the TMC can create challenges for agencies to retain effective and experienced staff in operations roles. Career paths and career progression opportunities also pose challenges for growth and staff retention. Many transportation agencies are restricted by their resources in recruiting, hiring, and incentivizing staff. TMC functions require specific hours and shifts, which often limit the flexibility of staffing options. This limits the ability of an agency or contractor to provide alternate working schedules or staffing models for part-time employees. There is a significant time investment involved in training new operators so that they are fully versed in TMC operating processes and procedures.

5.5 Business Processes

To best support the adoption of newer technologies and effective training, comprehensive business processes should be developed and adopted by the TMC and partner agencies. To do so, funding sources must be identified for staffing and equipment as well as a strategy for continuous training and staff development.

Efficiency can be improved through the adoption of more integrated systems, automated data feeds, and data sharing between agencies. These relationships can be implemented informally, but formal adoption of agreements can better institutionalize these relationships. These relationships can include both public agency partnerships and agreements with private sector data providers such as weather and probe data.

Lastly, TMC stakeholders should be involved in key agency processes where they can add valuable insights, introduce potential cost efficiencies, and enhance decision-making during those agency processes. One key example is the project development process. Involving TMC perspectives from the planning stage of a project concept through construction and implementation can better support results that have an effective impact on day-to-day traffic management capabilities. Sharing insights on potential operations considerations or alternatives could help the DOT reduce design requirements, resulting in overall project cost savings.

6 Action Recommendations

Objectives and action recommendations were derived based on the state-of-the-industry trends and the desired functionality of the Iowa DOT TMC per input from the stakeholders. The objectives and recommendations were grouped into categories that align with gaps presented in Section 5 and the performance measures outlined in Section 7. The objectives for Iowa's TMC are shown in **Table 2** and provide a high-level target for maturing the TMC roles and responsibilities. The following sub-sections present the action recommendations, which provide more granular activities that can support growth of the TMC roles in alignment with each objective.

Table 2. TMC Objectives

Emerging Technologies	
	Capture 100% of traffic-impacting incidents on Iowa DOT Road System
	Increase TMC's ability to visually monitor work zones in areas not covered by CCTV camera surveillance
Operating Models	
	Co-locate key TSMO functions within the TMC to improve coordination and incident clearance
	Provide remote/virtual operating capabilities for TMC functions
Data Sources	
	Improve real-time data sharing between ISP and Iowa DOT TMC
	Increase accessibility of TMC data to support internal and external stakeholder functions
	Increase automation for TMC incident detection and notifications
Resources and Staffing	
	Increase knowledge and application of new technology by TMC operations staff
	Increase awareness of TMC operators of TSMO processes
Business Processes	
	Increase TMC involvement in Iowa DOT's project development and programming processes
	Increase awareness of TMC impact on safety and mobility

Each subsection below summarizes the action recommendations within each focus area and includes a call-out to present the objectives addressed by these recommendations. In some instances, actions correspond to specific activities that will enhance the TMC's operating capability or provide for increased effectiveness of an existing function. Other recommended actions address existing gaps, such as data availability, data sharing or data management. Additional recommendations provide important foundational steps in examining the future TMC operating environment and identifying strategies where technology could help to broaden the positive impact of Iowa's TMC on system management and operations.

6.1 Emerging Technologies

EMERGING TECHNOLOGY OBJECTIVES

- Capture 100% of traffic-impacting incidents on Iowa's State Road System
- Increase TMC's ability to visually monitor work zones in areas not covered by CCTV camera surveillance

State Interoperability Radio System Adoption – The TMC should explore opportunities to adopt the new state interoperability radio system that provides direct access to incident related radio traffic. The radio system will allow the TMC to monitor multiple channels and ensure that no communication is missed. Newer systems also provide the ability to assign priority to channels that typically experience heavy communication related to incidents. To further mature the operators' manual functions, newer systems can also provide the means to scan all channels to identify key words and phrases related to incidents. This automated scanning, can improve the efficiency of incident detection and verification.

Unmanned Aerial Systems – TMC stakeholders should develop and implement a strategy for UAS deployment that supports a wide range of operations and incident management applications. TIM programs across the country are testing and implementing UAS solutions as tools for monitoring incidents, congestion, end of queue, work zone activities, and incident response times. The use of UAS to improve and support TIM and accident reconstruction can strengthen partnerships with ISP. The use of drones to support TIM provides several benefits to the responders and the public—improved efficiency and accuracy of accident reconstruction, decreased incident clearance times, improved safety for the first responders, and reduction in secondary crashes.

Advanced Video Analytics – The TMC should evaluate the implementation of advanced video analytics to strengthen real-time operations, performance management, and congestion monitoring. Video analytics could be implemented with existing CCTV camera technology or with more advanced CCTV cameras with embedded analytics technology. Additionally, streaming video sources from connected vehicles, snow plows, drones, and smart work zones could further enhance the traffic management capabilities of the TMC. Potential applications include monitoring and analyzing how traffic navigates through work zones to better plan for work zone implementation strategies, improved performance assessments at specific locations or interchanges, and support for future adaptive traffic strategies. Lastly, the TMC should leverage private sector innovations for video-data based analytics that also enhance the impacts of the TMC.

6.2 Operating Models

OPERATING MODELS OBJECTIVES

- Co-locate key TSMO functions within the TMC to improve coordination and incident clearance
- Provide remote/virtual operating capabilities for TMC functions

Multi-Agency TMC Facility – The TMC should continue to assess the benefits of a collaborative environment that co-locates the TMC with ISP communications and dispatch teams. This will require a collaborative investment from both Iowa DOT and ISP. A multi-agency facility would support statewide TIM, corridor-focused TIM, information sharing, and performance management. As existing facilities continue to age and require significant investments to upgrade or replace, a multi-agency facility would provide a certain benefit related to the economies of scale from constructing a consolidated facility.

A multi-agency facility will require the development of a business plan and business case, a funding plan, and the identification of potential locations that meet the needs of all partner agencies. Regardless of the selected location (existing or new facility), stakeholder agencies would need to identify configuration requirements that support the inclusion of each function and managing staff.

Back-up/Virtual TMC – Create a virtual TMC to pilot capabilities that can be handled remotely in the event that a physical TMC may become non-functional. The pilot test should evaluate the ability to provide traffic management, data access, and communication protocol. Simultaneously, Iowa DOT should identify potential locations that can house a virtual TMC or provide the functionality of a physical back-up TMC. The baseline capabilities of the back-up and virtual TMCs should be clearly documented to capture what functions may not be as functional when compared to full TMC. As part of the location assessment, Iowa DOT should consider a potential partnership with ISP at an ISP communications center.

Private Sector Partnerships to Augment Operations – Create key alignments with the private sector. The TMC can use access to different types of data provided by private entities, such as fleets, original equipment manufacturers (OEMs), or other providers to enhance data for traffic management. This builds on some of the existing relationships that Iowa DOT has with data providers for traffic information, incidents and analytics. This may require specific business agreements to enable data exchanges with the TMC or use of the data for specific traffic management strategies. The TMC also should look at potential partnerships that support the integration of freight data into TMC operations.

6.3 Data Sources

CAD-TMC Integration – Integration of real time incident data from the computer aided dispatch (CAD) from ISP to the TMC. CAD data should be integrated with the ATMS software. Automatic access to CAD data could require TMC operators to complete certification with Criminal Justice Information Services (CJIS). This could be a high-impact, near-term, relatively low-cost improvement. Iowa DOT had previously tried to integrate ISP CAD data into its operations, but there were challenges with data filtering, duplicate data entries, and other technical issues. As CAD systems advance and with more sophisticated algorithms for filtering data available, this strategy should be re-examined. There is strong mutual benefit to both the Iowa DOT TMC and law enforcement agencies for automating CAD data into the TMC's operating systems.

DATA SOURCES OBJECTIVES

- Improve real-time data sharing between ISP and Iowa DOT TMC
- Increase accessibility of TMC data to support internal and external stakeholder functions
- Increase automation for TMC incident detection and notifications

Artificial Intelligence (AI) – Artificial intelligence is introducing new traffic management opportunities by implementing predictive applications and decision-support systems (DSS) within the TMC. Private solutions can be used to identify potential crash locations based on specific conditions like time of day, weather conditions, and congestion levels to improve proactive monitoring and operations. Integrating predictive data into the ATMS and refining the accuracy of the incident status will support enhanced prediction in future iterations. AI can also be used for data mining functions to scan social media posts regarding incidents and stranded motorists.

In Iowa, road conditions during weather events will be a key priority. Determining how to better use and apply forecast data during these events will be essential. Iowa DOT should explore how DSS can help to inform operational decision-making (i.e., incidents, events, weather, work zones).

Security and Accessibility of Big Data Management – Develop a data readiness strategy that defines methods for integrating different types of current and future data into TMC operations. This includes methods for managing the large volumes of data generated by CV/AVs. Data management strategies will likely include modifications to the ATMS software and an expansion of the 511/Traveler Information system. Data security also needs to be defined in response to potential threats and risks. It is also important to partner with the IT department.

6.4 Resources and Staffing

Integrate Skill Sets that Support Enhanced Operations – With the potential implementation of ramp metering or other ATM/ICM applications, there will be a need for additional skills within the TMC. Staffing of a traffic engineer can support the integration of newer transportation management technologies. A traffic engineer can also provide opportunities to liaise with local agencies to better coordinate traffic signal operations with freeway traffic diversions. Additional staffing roles can provide unique skillsets such as a meteorologist or data scientist.

Next-Generation TMC Operator Training – As new technologies are implemented, operators will require additional training to support the application of new traffic management strategies. New applications and processes, such as those anticipated with connected/automated vehicles, ATDM, drones, and other technologies will require additional training for operators to effectively integrate these new technologies and systems into operational practice. It will be important to align the training needs with implementation timeframes and schedules for the new systems and technologies.

RESOURCES AND STAFFING OBJECTIVES

- Increase knowledge and application of new technology by TMC operations staff
- Increase awareness of TMC operators of TSMO processes

Integrated Training Program – Improve center-wide knowledge of field operations requirements and processes. TMC staff should be integrated with TIM Training, Work Zone/Construction Awareness seminars, Large-Scale event planning, and HH ride-along to support training for operations. The TMC also should promote awareness of TMC operations through peer exchanges with DPS/Communications Center.

6.5 Business Processes

Modernized TMC Processes, Procedures, and System Documentation – In parallel with the migration to the new ATMS software, the TMC should update and standardize TMC documentation related to systems, system interfaces, and current processes. Additionally, while new technologies are being implemented, accurate documentation of those technologies should be integrated with the other TMC processes and procedures. Good documentation will help to ease the impacts of staff transitions or contractor transitions, as key knowledge could be lost if it is not captured and documented.

Performance Based Reporting Plan – Develop a decision-based performance reporting approach for TMC operations. Identify gaps in the current data collection and develop mechanisms to address those gaps. An example of an additional data point that can better support operations is consistently tagging work zone crashes in crash reports. There is also a need to improve processes to provide data access to near-real time performance data, not just monthly or annual reports. The refined data set can then be utilized to focus resources on spot improvement needs (i.e., specific work zones, specific corridors) and generate responses in real-time in addition to after-action analysis.

BUSINESS PROCESSES OBJECTIVES

- Increase TMC involvement in Iowa DOT's project development and programming processes
- Increase awareness of TMC impact on safety and mobility

Integrate TMC Perspective into the Project Development Process – Current initiatives are underway to better integrate operations into the project development process. Iowa DOT should work with key groups to ensure that TMC considerations are integrated into the project development timeline, including concept development, project planning, and programming. The TMC can offer important insights as to operational needs within newly defined projects. Additionally, knowledge of upcoming projects would allow the TMC to better plan for future operating requirements.

Strategic Marketing and Promotions – Improve internal and external awareness of the TMC capabilities, critical partner agencies, roles, and the range of functions provided by the TMC. This education will continue to be important as future functions and capabilities are integrated into the TMC. Iowa DOT has developed short videos that demonstrate the different capabilities of the TMC, and these provide an excellent resource to show how systems work to improve safety, how the TMC responds to incidents, and the innovative processes already at work. The Iowa DOT TMC can further promote the value and benefit of the TMC by highlighting how the TMC was able to respond to specific weather events, incidents or large-scale special events and link benefits directly to the TMC capabilities.

Modernize Technology at TMC Workstations – By creating a maintenance and replacement schedule, workstation technology upgrades can be implemented at a more frequent interval. Line items within the necessary budgets should be defined to allow for system updates on a 2-3-year cycle. The costs associated with upgrades are captured on a bi-annual frequency and shown every other year.

7 Service Layer Cost Estimate

This section translates the recommendations into specific projects for the 5-year implementation plan. The projects are grouped according to the categories defined in the gaps, objectives, and recommendations.

Table 4 presents each of these projects and provides a suggested Fiscal Year (FY) for implementation and 1 of 3 relative values for three specific evaluation criteria: cost, duration, and resource demand for both in-house and contractor staff. Icons are used within the table to represent the qualitative assessment each project. The icons and descriptions are presented in **Table 3**.

Table 3. Project Evaluation Criteria

DURATION – the time required to implement the project		
 Less than 1 year	 1 – 3 years	 3 – 5 years
STAFFING LEVELS – the staffing level commitments to implement to project		
 Lower Staffing Levels	 Medium Staffing Levels	 Higher Staffing Levels
COST – capital cost for implementation of the project		
$ Less than $100K	**$$** $100K - $250K	**$$$** More than $250K

Table 4. Project Summary Table

Category	Project	Suggested FY	Cost	Duration	In-house	Contractor
Emerging Technologies	State Interoperability Radio System Upgrade	2022	$$			
	UAS Strategy	2020	$			
	UAS Pilot Project	2022	$$			
	Video Analytics Pilot	2021	$			
	Video Analytics Implementation	2023	$$			
Operating Models	Multi-agency TMC Facility – Business Plan	2022	$$			
	Multi-agency TMC Facility – Funding Acquisition	2024	$			
	Multi-agency TMC Facility – Land/Building Acquisition	2025	$$$			
	Virtual TMC Infrastructure	2021	$$			
	Back-Up TMC (mini video wall, equipment and integration)	2021	$$$			
	Pilot Program for PPP data integration	2020	$			
Data Sources	CAD/TMC Data integration	2020	$$			
	AI Pilot Project	2021	$$$			
	TMC Performance Measures Updates	2021	$$			
	Data Readiness Strategy	2020	$$			
Resources/ Staffing	Operations Staffing Plan	2022	$$			
	Training for New Technologies (annually)	2020	$			
	Budget for Training and Conferences (annually)	2020	$			
Business Processes	Update of Existing Documentation	2021	$$			
	SOP Revisions to Integrate ATMS Documentation	2021	$			
	Performance Based Reporting Plan	2020	$			
	Outreach for TMC Role within Project Development (in-house staffing, minimal costs)	2020	$			
	Marketing and Outreach Plan	2022	$$			
	TMC Workstation Budget and Lifecycle Plan	2020	$			

To guide Iowa DOT and their partners with programming, the capital expenditures are consolidated and summarized by year in **Figure 13**. The projects are proposed for specific fiscal years based on their dependency between other projects, priority for implementation, and anticipated impacts on the TMC's ability to improve their efficiency and delivery of the TMC functions. Some items are presented as annual or bi-annual costs and repeated accordingly to achieve an accurate total cost calculation. This estimation does not include existing baseline operations and maintenance costs, but instead captures capital costs in addition to the TMC's current operating budget.

As projects are refined, the cost estimates and anticipated schedule should be revised to provide a better view of the program costs for the TMC Service Layer implementation.

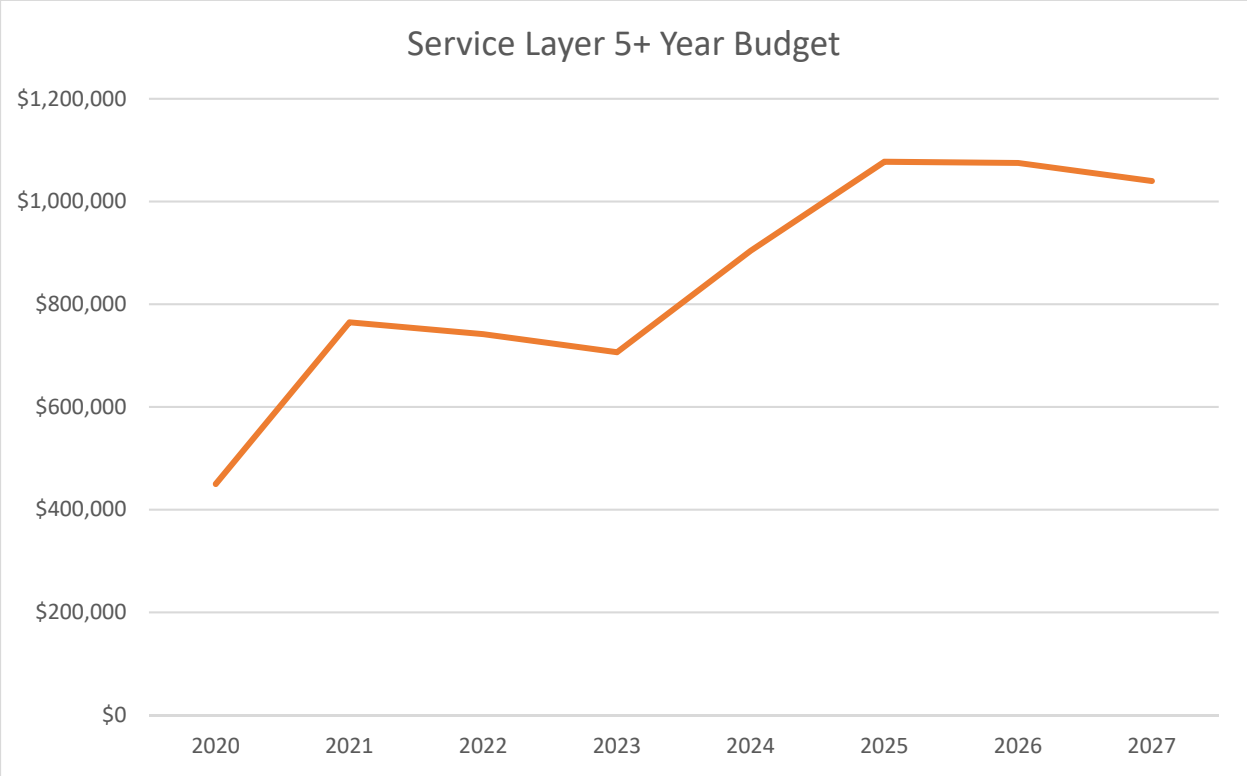

Figure 13. TMC Service Layer 5-Year Budget

8 Performance Management

Iowa DOT's TMC already supports performance monitoring for a wide range of different functions and TSMO activities. The TMC reports on measures ranging from TMC-initiated activities (such as types and numbers of DMS messages) to traveler information usage, work zone activity, and traffic incident management performance indicators, including incident clearance times, secondary crashes, or even crashes involving freight. In some instances, the TMC serves an important role in aggregating information from various TSMO programs and initiatives, such as Highway Helper activity, and 511 phone and web usage. Many of the current performance measures tracked are activity-based and track overall numbers of users or instances of an event. These are helpful to monitor trends over time, identify times of days or seasons where impacts might be more prevalent, and provide Iowa DOT and partners with valuable information to support resource allocation, training needs, or specific program improvements.

Several of the recommended actions in the TMC Service Layer Plan strive to enhance the TMC's role to be able to gather statewide situational awareness information through advanced technology applications and increase availability and access to TMC data by various groups and stakeholders to improve their operational objectives. This section presents recommended performance management strategies that capture the TMC's ability to expand its reach to improve system operations throughout the state as well as increase the overall cost-benefit of TMC operations by automating some of the performance management activities. Some of the current performance tracking is automated, but there is an opportunity to further leverage technology to generate performance indicators automatically and frequently, which will provide more real-time performance data to the TMC. This should, in turn, allow the TMC to respond to and implement strategies in response to real-time conditions.

It is further recommended that the TMC Service Layer Performance Management strategy continue to be integrated with the performance management requirements of other service layer plans as key initiatives are implemented. The TMC was identified by many of the other service layer plans as a key source for data to support several future recommendations, including supporting performance monitoring and management. There are also initiatives underway to develop a more robust data hub for Iowa DOT, and the TMC Service Layer Performance Management strategy should be reviewed and updated as the data hub progresses. **Table 5** presents current recommended Performance Measures aligned with the TMC objectives. As these performance measures are implemented, it is important to stay focused on the outcome of the activities that occur in the TMC. Some of the data collected may appear to be input focused, but the overall performance measure is intended to represent the outcomes of the TMC and assist Iowa DOT and its partners on making decisions related to effective program investments.

Table 5. Performance Measures by Objective

TMC Objective	Performance Measure	Data Sources/Needs
Emerging Technology		
Capture 100% of traffic-impacting incidents on Iowa's State Road System	Method of incident detection. • Number of incidents identified through AI data mining of public safety radio • Number of incidents managed and monitored from the TMC through UAS • Number of incidents detected through video analytics (where deployed) • Number of incidents detected through 3rd party data sources	Source data needs to be readily available from alternate incident detection methods to easily identify how the TMC was notified of incidents. Automate this source data within Iowa DOT ATMS.
Increase TMC's ability to visually monitor in areas not covered by CCTV camera surveillance	Incident detection from UAS. • Number of areas that are actively monitored in real-time using UAS	UAS data verifying drone usage for traffic monitoring
Future Operating Models		
Co-locate key TSMO functions within the TMC to improve coordination and incident clearance	Reduce the time for TMC operators to verify incidents and traffic impacts Reduce notification times for incidents impacting travel lanes Increase cost-benefit of TMC operations	Timestamp of incident notification and TMC verification (CAD and ATMS timestamps) Incident response and clearance times Operating costs for participating agencies
Provide remote/virtual operating capabilities for TMC functions	Increase the number of incidents that can be viewed/managed through distributed operations	Number/frequency of remote incident management sessions logged in ATMS

TMC Objective	Performance Measure	Data Sources/Needs
Data Sources		
Improve real-time data sharing between ISP and Iowa DOT TMC	Automate data transfers to TMC systems from law enforcement CAD for incident notifications, incident updates, and incident close-out notices	Number of automated incident notifications from ISP CAD to TMC ATMS **Link to improved performance for incident notifications, response, and clearance*
Increase accessibility of TMC data to support internal and external stakeholder functions	Stakeholder access to data. • Number of users that can access TMC data • Number of work zone incidents tagged in TMC systems	Number of unique users Number of unique sessions Average usage/access frequency per month and per year of TMC data
Increase automation for TMC incident detection and notifications	Incident detection alerts generated from AI technologies.	Number of distinct, predictive alerts **Link to TMC notification time, TMC response time, and number of alerts generated from TMC based on predictive information*
Resources and Staffing		
Increase knowledge and application of new technology by TMC operations staff	Identify and deliver specific technical training	Number of trainings identified and completed Number of TMC staff that received training
Increase awareness of TMC operators of TSMO processes	Peer exchange opportunities (ISP comm center, Highway Helper Ride-Alongs)	Number of peer exchange events annually that include TMC staff TMC staff feedback on benefit of peer exchanges

TMC Objective	Performance Measure	Data Sources/Needs
Business Processes		
Increase TMC involvement in Iowa DOT's project development and programming processes	Percentage of projects that involve operations during project development. • Number of specific contributions made by TMC staff involved in project development process • Number of projects that that involve TMC staff	Project opportunities that engage TMC staff Ratio of projects in the DOT work program that involve TMC staff
Increase awareness of TMC impact on safety and mobility	Promote and highlight TMC impacts through internal and external publications and features • Number of internal publications and features that highlight TMC roles and functions • Number of external publications and features that highlight TMC roles and functions	Number of internal news stories Number of tweets, retweets or likes on social media platforms such as Twitter, YouTube, and Facebook that feature the TMC's role in supporting an incident/event

9 Service Layer Implementation

Implementing the recommendations in this TMC Service Layer Plan will be an investment of time, staff resources, and funding. It is recommended that a core group of Iowa DOT Traffic Operations Bureau staff be charged with championing the Service Layer Plan and leading implementation decision-making of the recommendations contained in the plan. This group's responsibilities would include:

- Periodic review and assessment of implementation priorities and progress;
- Coordination with other stakeholders and groups for implementation requirements and support for specific activities that will help to facilitate a successful implementation;
- Identification of funding or partnering opportunities that could help to accelerate certain recommendations. This could also include identifying potential partnerships with private technology developers to pilot emerging technologies such as UAS, AI or video analytics to support TMC operations;
- Development of a strategy to facilitate the performance management recommendations contained in this plan; and
- Coordination with champions from other Service Layers to coordination on their respective plans' implementation recommendations that involve the TMC.

While the previous sections have described the path for Iowa DOT from existing conditions to a future integration of emerging technologies, this service layer plan is intended to be a living document. Section 7 outlines several projects, indicating the duration, cost, and staffing resources for each. The fiscal year is also provided for budgeting and planning purposes. However, periodic returns to the action recommendations by the core group is suggested. Recommendations involving other agencies and partnerships are likely to be impacted by varying interests and initiatives of partners. A re-evaluation of priorities will be necessary to ensure the action recommendations remain relevant to all parties.

Emerging technologies and data source action recommendations have been developed based on Iowa DOTs needs as well as the current direction of these technologies within the industry. It will be imperative to keep a pulse on the industry advancements and conduct a re-evaluation to confirm the recommendations stay current with the changing technologies. Understanding the budget implications as well as other action recommendation dependencies will position Iowa DOT to accelerate projects as opportunities arise.

Using this TMC Service Layer Plan as a guideline for action recommendations will enable Iowa DOT to effectively use the resources available while positioning themselves to develop the TMC of the future. Taking full advantage of industry advancements and trends will allow Iowa DOT to live out its commitment to providing safe and efficient transportation services to the public.

10 Appendix A: CMM Workshop Output

Iowa DOT TMC Business Processes: Planning and Programming / Business Processes

Workshop Outputs

Strengths Cited	Challenges Cited
• Iowa DOT establishes a 5-year plan for TMC costs; this is reviewed and updated annually. • Equipment for TMC operations (computer workstations, internal network, etc.) is handled as part of a separate plan. • Inventory conducted annually and identify needs and equipment replacements (computers, workstations, video recording system). • Equipment is typically funded through the IT budget, TMC office supplies are funded through office budget. • TMC staff have input into budgeting for specific needs. • TMC has a good relationship with IT to support computer and equipment needs for the TMC. IT is generally responsive to TMC needs and issues. • Communication between the TMC and construction (and other groups) has improved. • There are consistent processes in place at the TMC to respond to closures, incidents, work zones and other events regardless of geographic location. • TMC uses Waze and Inrix data to identify incidents in areas without camera coverage throughout the state. • Maintenance has daily interaction (sometimes called to incidents when maintenance staff is not needed). • Maintenance tries to notify TMC of all maintenance activities due to lane closures.	• Limited funding for TMC equipment needs in the short term – usually addressed through 5-year plan. • Some law enforcement staff may not be as aware of the TMC business processes. Some interact daily, but others do not have the consistent relationship and interaction to support the understanding. • A need to understand the processes that occur once a call is received and how the TMC acts in response to the call ("day in the life of an incident"). • Communication with dispatch can sometimes be a challenge. Always looking for better methods of communication beyond phone conversation, such as radio, MACH, email, and CAD. • Processes have improved over time but was not within a clear plan. This will be the first plan to guide the next phase of growth. • Are there opportunities to coordinate maintenance and weather activities within traveler information tools? Snow plow operations, National Weather Service warnings, paint crew in area, etc. • At times, planning is very ad hoc. Need a plan for how to look at newer technologies and capabilities (i.e., CCTV for detection or analytics), and how to integrate with TMC planning processes.

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Ad-hoc planning for TMC functions, vision not well defined; TMC processes specific to Iowa DOT	Some planning for asset management; processes for specific corridors or region, but not consistent statewide; some TMC processes documented	TMC operations needs captured in budget, standardized processes, consistent review/update of TMC strategic direction	TMC vision is integrated in all aspects of DOT business; Planning for Operations is standard practice; asset lifecycle cost is part of five-year programming processes; processes are regional
Consensus	1.5			

Workshop Actions to Advance to the Next Level

- Define future TMC process that should be implemented and identify budgeting strategies to achieve those goals.
- Need plans for investigating new technologies.
- Need to follow through on ideas, concepts.
- Look at peer practices to identify improved processes – staff exchange and peer state exchanges. Look at potential peer exchange/collaborative workshop with TMC and local communication dispatch centers (state radio staff).
- Dedicated staff documenting and updating procedures.

Iowa DOT TMC Systems and Technology

Workshop Outputs

Strengths Cited	Challenges Cited
• System manager contract support staff has been key to improving/expanding TMC processes, has helped to integrate processes, and automate some processes which has helped to improve consistency of information. • ATIS/ATMS procurement and new system. Iowa DOT is hopeful that a new ATMS will help to streamline what are now duplicate processes and multiple systems with which operators must interact. • System manager has been able to address several issues that IT probably would have, but the TMC has been able to accelerate issue resolution with a resource that is responsive to TMC priorities and schedules. • Iowa DOT has been proactive in using and integrating data from private sector sources into TMC operating processes. Iowa DOT was among the first states to establish an agreement with WAZE for alerts and uses INRIX data statewide for speeds and travel times. Both of these have been a key success for the TMC and for TMC operations. • Planning for technology – more open, flexible, acknowledges that technology and services will change (i.e., WAZE was not part of a spec 2 years ago, but now critical to TMC operations). • Service Layer approach is helping to look at technology needs, and how those might influence TMC decisions. TMC Service Layer will be factoring in needs from the Traveler Information, ITS/Communications, CV/AV and others.	• Current ATMS is a challenge in how it handles some device modules, and how it interfaces (or doesn't) with tools like 511/traveler information systems and private sector probe data/private sector alerts (INRIX/WAZE respectively). • Current ATMS requires operators to engage with multiple modules, different systems, and results in a lot of duplicate processes to enter, monitor and manage data. There has been progress toward streamlining some of these processes but need to work toward a more integrated system so that operators only need to interact with one system. • Need better understanding of IT and how to partner better with IT. TMC took initiative to get a resource in the TMC (Rebecca) to develop and link systems – IT viewed this as the TMC doing their own thing. TMC priorities are not necessarily IT priorities. The IT "red line" indicates if your project gets done or not. • Historically ITS and IT have had separate networks. IT does not manage the ITS network. IT has committed to get a resource to help with ITS network. Hopefully that helps with communication/coordination between these groups. • System manager is a contractor, and IT rules are not always accommodating/need specific approvals from IT to access cabinets, servers, etc. • Portable DMS board provider – software system that enables TMCs to communicate with PDMS boards – any changes need to go through ATMS contractor. Current ATMS is not handling the PDMS well. Similar issue with some cameras in work zones, older camera technology, etc. • Challenge with the radio system and Highway Helpers. Radio reception in many areas is missing or very unreliable. Need to elevate this communication issue to work toward resolving it. • Could be better communication/coordination between Highway Helper and TMC systems. At one point, the ATMS had a software module for HH to use to enter site and response information – the software went down and hasn't been replaced/fixed. • Need a single ticketing system to log events/operator actions. • Technology and system planning has been somewhat ad-hoc. New ATMS procurement emphasizes open data requirements to allow for changes in some of the provider/data environments, but there could be more the TMC can do to emphasize and promote interoperability.

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Ad hoc approaches to system implementation; systems engineering not applied consistently; procurement processes; ITS architecture is outdated; individual systems that are not integrated	Some elements of SE are used, including ConOps, architectures, developed and documented with costs included; TMC monitors some field systems; SE process applied to some aspects of TMC operations; some emerging technology considerations	Systems, technology standardized and integrated on a regional/corridor basis; statewide SOPs updated used; integrated statewide network; SE process is mainstreamed into TMC business practices; integrated systems	Architectures and technology routinely upgraded to improve performance; systems integration/ interoperability maintained on continuing basis; Strong support for adopting advanced technologies
Consensus		2		

Workshop Actions to Advance to the Next Level

- Need to develop system documentation to capture current processes, capture current system use
- Statewide radio issue needs to be resolved – impacting Highway Helper operations and TMC coordination with HH. Need to develop some specific action strategies, identify specific champions, roles, responsibilities.
- CAD data feeds – need to work with ISP to address (need to better define what these are – check TIM service layer)
- Develop data management plan (how to fill in gaps – move to data/performance measures)
- Need to determine how future/emerging technologies will impact TMC. This will largely be addressed through the TMC Service Layer task, as well as through supporting service layers (i.e., CV/AV)

Iowa DOT TMC Data and Performance Measurement

Workshop Outputs

Strengths Cited	Challenges Cited
• TMC has made some positive strides in gathering data (from devices, systems and private sector sources), storing this data centrally, and automating monthly reporting. TMC is a collection point of centralized data, and the TMC has a desire to continue the role of collecting and packaging this data for partners. • Monthly trends are shown in monthly reports, outliers are also being noted. • Law Enforcement is capturing incident clearance on crash reports. • The TMC shares data with others through various reports and recurring meetings, particularly for after-action debriefs (AAR). AAR reports for major incidents, for flooding reports (summarize incidents based on time stamps for flooding occurrence), winter events, etc. • Claims management receiving a report nightly – to note which incidents include damage to infrastructure (roads, bridges, signs, etc.). • Current Bureau-wide initiative is underway to look at performance measures to assess what data different groups are capturing and what that data is being used for – are we using it? what can it support? • Previous iteration of the monthly report included operator specific performance measures. TMC still uses this data internally, but not reporting in monthly report. • Ad hoc performance measures based on significant or unique incidents – usually focused on requests from senior management based on high profile incidents/events. • Law Enforcement does use TMC performance reports and will send to officers statewide once received to review performance of responders. • Fully automated report – TMC reviews the automated outputs to confirm outliers that could influence data, and TMC staff will refine if needed. • Newer report is more transportation focused as opposed to process focused in reporting. • Joint Operations Policy Statement (JOPS) – has identified some goals; have developed a report capturing actual performance against achieving those goals (also align in Culture). • Have used various data elements to do a benefit/cost analysis of the Highway Helper program. TMC will use performance data to identify expansion/improvement opportunities for Highway Helpers and will use performance data for routing/resource decisions.	• Other than Highway Helper, it is not clear how performance data is being used to guide or inform TMC operating decisions. • Some recent changes with the performance format affected the audience that was using the data. Graphics were helpful to show trends, quick summaries of system performance, and for quickly communicating information to media/leaders. Used to share graphics on social media tools. Now that the graphics are gone, it requires the user to spend more time reviewing the details of the information. Would be helpful if there was a better balance of tabular data and summary graphics. • Need to align end users with format and content – are users getting the information they need, or just the information that is available? Would be helpful to do some focused training with different groups (Iowa DOT Districts, Law Enforcement, Maintenance) on the different types of data available from the TMC, how they can use TMC data to support doing their jobs, etc. • TMC gets a lot of data but is not really maximizing it (partially attributed to the current ATMS technology). • There's a lot of data/technology out there, need a way to sift through and see what will really be valuable for operations functions and for performance analysis functions. • In the past, TMC would get CAD feeds from ISP dispatch. TMC would be notified of incidents that were occurring. Interest in getting CAD feeds re-established. Previous attempt was a challenge to filter CAD data. • Some TMC alerts are not aligning with the information on the crash reports – specifically in work zones (could add process to include report number in the incident data so the data is available in the EIN.). Looking to connect crashes to liquidated damages for delays in construction completion, so having this information all in one place would make that process easier. Would be better to focus requests on specific areas/locations to balance workload demands for extracting case numbers. Also need to coordinate with claims on the proposed process. • 511 Statistics were included in previous reports, but no longer included in monthly report – it required a significant amount of time to compile this information to be able to include. If it could be automated or streamlined, would consider including 511 stats as a standard part in the performance reports. • Need to assess MAP21 reporting requirements and how TMC can support those requirements. Different groups tracking and reporting on various metrics, using different data sets. Could be more efficient as an organization, and provide more consistent performance reporting, if there was better coordination on the overall strategy. • TRACS data – crash data connection is not reliable. Currently getting shape files and other data. Data gets sent monthly to Iowa State. Looking to automate this. Data is scrubbed with more general data points. • Not certain if incident clearance times are being captured consistently, and there is not a good way to find out about incidents where we are not capturing this information. • Need a consistent strategy for classifying secondary crashes. Example - are secondary crashes due to queue from crash in a work zone considered a "work zone" incident?

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Some outputs measured and reported for some aspects of TMC operations; typically historical performance information	Some elements of TMC performance are tracked and reported; focus is primarily on usage/activity reports assessing trends; some real-time data is used for operational decision-making at the TMC	Performance outcomes guide recommend operational improvements; real-time data routinely used for decision-making; TMC uses some real-time data from other centers/sources	Operational decisions based on multi-jurisdictional real-time information; performance management strategy guides innovation at the TMC.
Consensus		2		

Workshop Actions to Advance to the Next Level

- Iowa DOT TMC has made some progress with TMC performance reporting. The current statewide study looking across a range of groups and divisions, identifying performance reporting needs, and will support further progress toward a coordinated performance monitoring, management and reporting strategy.
- Need to develop a strategy that educates key users on what TMC data/reports are available, discuss what types of formats and reporting frequency would best suit specific user groups.
- Need to develop a data use and management plan – priority data types for TMC operations, priority data types for TMC to share with external audiences, how to use data for TMC operations decision-making, how to address data gaps (coverage, quality, accuracy), needed partnerships for data acquisition and management (i.e., TMC needs to partner with ISP for more complete crash reporting, role of Iowa State to support data management and performance, address CAD interface and data sharing issues, etc.). Incorporate strategies for how the TMC can adjust and respond to changing requests for data.
- Need to assess MAP21 and JOPS reporting requirements and how TMC reporting can support those requirements.
- Consistently define what incidents should be tagged as a work zone incident. Primary goal to consistently tag all crashes that are occurring in the work zones to support reports.

Iowa DOT TMC Culture

Workshop Outputs

Strengths Cited	Challenges Cited
• Iowa DOT contracts for a range of functions, including TMC operations. Integrating contractors with DOT roles can provide both positives as well as challenges. • Iowa DOT and the TMC have learned from contracting experiences over the years and are able to improve processes as a result (i.e., have gained more experience with impacts of contracting on TMC operations over time, been able to make improvements to address challenges that were not anticipated early, etc.). • TSMO Plan and process helped to elevate awareness of different operations processes and roles, including the TMC's role. • TMC / OTO is included in larger construction projects; Need to be involved more consistently to assess impacts on existing infrastructure and TMC operations (moving a DMS at the beginning of a project) • Good coordination between TMCs and Districts for work zones. TMC develops DMS plans to support construction projects in advance of WZ activity. • Marketing/Awareness/Understanding – educating partners on the essential activities that TMC can provide (the TMC Brand) – some good progress in recent years. • Many law enforcement agencies across the state understand what the TMC is and the role. Can build on this foundational knowledge that the TMC exists to promote additional tools and resources the TMC can provide.	• There are pockets within Iowa DOT that understand the TMC role, but some do not. Communications surrounding the TSMO plan is focusing on this outreach. • Some partners do not understand the role and value of the TMC or how the TMC can benefit the partners. • Contractors coming in do not have DOT foundational knowledge to support their delivery of the functions – there is usually a pretty steep learning curve. • Language barrier between DOT staff and newer contractors. • Suggest training for operators to go in the field and experience what is required of field staff – will provide a better understanding for operators of what field crews are dealing with. • Recommend "Day in the life of an incident" training session to step through each phase of the incident – will be beneficial for multiple responders, including TMC operators. • Getting OTO involved in the project development process. There are some entrenched processes for project delivery that aren't always responsive to evolving types of projects (i.e. technology). • RAGBRAI (statewide bike ride) AAR report discovered a lot of coordination issues; need to build on the actions identified. • Further refinement of roles and responsibilities on who to communicate with within the MVE and ISP. • Look at ride-along activities for operators with snow plow or HH to experience field scenarios; could also look at ride-along for partner agencies' staff.

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Individual staff champions promote operations; TMC operations priorities based primarily on champion focus areas; TMC not often included in WZ or event planning, incident debriefing, etc.	Role of TMC acknowledged but connection to core ops areas is not always recognized; TMC engaged in pre-planning for WZ, TIM and PSE based on individual relationships;	TMC is a core program, agency values TMC role and input to key processes, TMC operating needs factored in early as part of other planning/scoping decisions	TMC highly integrated with many processes, agency sees TMC as a valuable asset, high value on TMC data
Consensus		2		

Workshop Actions to Advance to the Next Level

- Need to work on strategies to promote awareness of TMC role, functions and capabilities with external partners. Need branding/marketing strategy for the TMC for internal and external audiences.
- Better define the TMC roles and responsibilities.
- Getting the operations culture integrated into the project development process.
- Promote better understanding through collaborative training activities – "day in the life", ride-alongs, TIM training for TMC operators.

Iowa DOT TMC Organization and Staffing

Workshop Outputs

Strengths Cited	Challenges Cited
• Staff levels for TMC operators have some better definition; still need to develop specific certifications. This has been a recent development – framework is in place and currently working on checklist for different levels (Operator 1 has the certification items outlined). • TMC contract has evolved over the years to be able to figure out what the optimum staffing level is. • Performance outcomes (specifically operator performance – number of incident/events worked on, increased number of WZ) was used as a data point to help justify staff. • Operating processes have gotten much more consistent – helps provide continuity with turnover. • Dedicated training coordinator for TMCs elevates consistency of training - Training program has gotten more rigorous to help emphasize the multi-tasking role. • TMC operator retention has improved – limited turnover in the last year. Change to operator levels and advancement opportunities has helped retain strong TMC operators. • Creating more processes for operators to QC (DOT doesn't review incidents). • Social Media training on how best to respond to public (TMC supports social media monitoring nights and weekends).	• Sometimes there have been challenges keeping and retaining good staff – starting to make progress with this. • Operator turnover is challenging for external partners. • Recruiting, hiring, training, onboarding, etc. is probably 5-6 weeks from the time new hire process starts. That is optimistic - if someone gives 2 weeks' notice, it is hard to backfill in a short timeframe and here are challenges with coverage for several weeks. • Unemployment in Iowa is low, not a lot of applicants across the board – harder to attract good candidates. • Still working through balance of roles and responsibilities between DOT and contractor when it comes to the TMC. • Challenges/issues with how to coordinate with contract staff. • Highway Helper – drive trucks with Iowa DOT logo and interact with the public – yet it is a challenge being able to clearly identify program management roles. • Training is the biggest investment for TMC or Highway Helper – if they leave after a month or two, that is a big investment DOT has made in staff already. • There are some different levels with TMC operator and Highway Helper. Salary has some slight increases, but many of the job responsibilities are the same.

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Individual staff champions promote operations; TMC functions learned mostly OJT; career path for TMC is limited and not well defined;	Core KSA's identified and help support TMC ConOps; roles for in-house and contractor staff are defined; some training, but limited external training opportunities; communication between DOT and contractors is fragmented and event-based	TMC career path is clearly defined; established and successful training program; performance standards are clear and documented; good communication between Iowa DOT staff and contractors	Commitment to ongoing training and professional development; strong retention of staff due to career path and advancement opportunities; strong and well-known performance standards
Consensus		2.5		

Workshop Actions to Advance to the Next Level

- Between 2-3 / closer to 2, working to 3. One vote for 1.5.
- Consider some alternate staffing models to incorporate part time.
- Fully implement TMC training and career path framework that has been developed.
- Day in the life of an incident (cross-reference with Culture. Promote better understanding for TMC operators and responders).
- SHRP 2 TIM training for TMC operators.

Iowa DOT TMC Collaboration

Workshop Outputs

Strengths Cited	Weaknesses Cited
• Media, LE and other agencies have access to CCTV (goes through ATMS). • Emphasis on being a good info sharing partner with Law Enforcement – TMC wants to do more peer exchanges with State Radio Communications Centers. Both need to better understand each other's processes. • Relationship with MVD is good – operators can see, first hand, the impact that their role makes. • Highway Helper – usually very strong public feedback, very positive. • Doing some visits to Districts to see how they can cooperate and work together better. • Districts use private traffic control companies to help patrol in work zones. • Dashboard provides information on neighboring state contacts, other agency contacts. There will be some coordination elements with District near the other state, and then gets relayed to the TMC. • Tabletop exercise between Iowa and Minnesota have been effective to promote better coordination during winter operations. • TMC will put messages out if they are aware of a closure on corridor that will impact travel in Iowa. • JOPS agreement in progress. Will include tow bans, etc. There will be an implementation plan/rollout when complete. Iowa JOPS is modeled after the WSDOT JOPS agreement – all driven by incident response and clearance goals. • Towing community getting more engaged in TIM Coalition and TIM training. • TMC has an established towing policy. • TIM in SE Iowa has helped foster better understanding and collaboration. • Statewide conference in Ames – will be beneficial to have TMC attendance and perspective. • Developing a TIM Field Manual –this was a recommendation from the TIM Service Layer Plan. • Collaboration for WZ Enforcement has been good. • There is a lot of good synergy coming out of planned special event, work zone coordination.	• Some challenges getting complete information about real-time events from various sources (i.e. State Radio System). • State Patrol recognizes they could do better reaching out to TMC. More staff on State Patrol should get a better understanding. Improve collaboration between TMC and State Patrol. There is good awareness of the TMC role/function at the higher levels of ISP staff but need other ranks to develop relationships. • Internally Iowa DOT could have a better understanding of the TMC role and function. • Could be better collaboration with other external partners, like AAA, Trucking Association or MPOs. A lot of collaboration focus is with TIM responders or internal groups (Regions). • Weekly construction reports aren't very helpful – find some ways to make it more effective. • Several groups rely on some of the TMC reports for resource planning. OH/OW permits needs longer duration on CARS to show it is an active event – WZ events expiring needs to have District call to extend. Field construction does not operate with a 7-10 day advance schedule. • Field responders especially will benefit from better understanding of TMC functions with WZ, TIM, etc., and all of the tools they use (this is also echoed in Culture dimension). • TMC should participate in the construction awareness annual seminars. • TMC needs to get data from private traffic management/barricade companies about when they are active, where, any incidents, etc. • Could do a better job defining specific roles for county maintenance supervisors, sheriff, towing, etc. • Improve TMC operator awareness of TIM on-scene requirements. • Need to make sure the state backfills some of the champions for TIM training. • Some partners could do better about reaching out to Region construction engineer to see how to best handle impacts in work zones.

Level	1 — Performed	2 — Managed	3 — Integrated	4 — Optimized
Criteria	Relationships ad hoc, and on personal basis (public-public, public-private)	Collaboration with external partners is formal, and usually driven by specific needs, TMC roles still fragmented and event-based; real-time collaboration with public safety for incidents	Multi-agency and coordinated operations for planned events; some partnerships for key corridors; TMC role defined and understood	Multi-agency response strategies are mainstreamed into TMC operations; operating processes and procedures documented and used frequently
Consensus		2		

Workshop Actions to Advance to the Next Level

- Understand roles/responsibilities across the spectrum of staff – peer exchanges will help (such as with ISP, Highway Helper, Region construction); collaborative training will help (i.e., TMC staff participate in SHRP2 TIM Training).
- TMC should know when QTC (private traffic control company) or similar company is active – could help support better information exchanges about incidents in work zones.
- Develop a more formal outreach program for agency partners and external partners (AAA, Iowa Trucking Association, Media, other data partners, universities, app developers) about what the TMC does.
- Follow through with implementation and rollout on JOPS – identify where the TMC fits in to supporting JOPS activities and goals and integrate with TMC SOPs and training.
- Establish practice for involving TMC and others in after-action debriefing, involving TMC in construction awareness seminar, and TIM statewide conference, and TMC operator understanding of TIM on-scene processes and procedures.