TMC Operator Requirements and Position Descriptions

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1 INTRODUCTION

1.1 Background

TMC Operator Requirements and Position Descriptions was developed to provide guidance and recommended practices that traffic management center (TMC) agencies and practitioners are encouraged to use in their day to day activities related to the policies and procedures of their agency. Some of the challenges within the industry include failure to develop requirements and specifications when designing TMC systems, a lack of resources to support the final TMC design, and the failure of contractors to design a system that will actually be able to be supported based on available resources (i.e., funding and staffing) that the agency is expected to have. It is hoped that this document can help in overcoming some of these challenges by providing a mechanism to easily consider operator requirements based on the functions supported by the TMC.

TMC system engineering process activities involve more than just planning and design of TMCs. Some activities that may be undertaken in the initial phases of the system engineering process of a TMC include developing an operations concept for a traffic operations program or TMC, developing a maintenance concept for an agency or system, and developing staffing plans and resource requirements for a system. These activities can be facilitated through use of this document and accompanying tool.

Under Phase 1 of the project *TMC Operator Requirements and Position Descriptions*, the TMC Pooled-Fund Study set out to have a matrix developed relating operator knowledge, skill, and ability (KSA) requirements to TMC functions. The desire was for this resource to aid agencies in determining and preparing job classifications, recruitment and training requirements, and career paths for operators. The Phase 1 effort resulted in a document entitled *Guidelines for TMC Transportation Management Operations Technician Staff Development*. Following the Phase 1 effort, it was determined that the information provided in the document would be more useful if developed into a software tool. This document is the result of the Phase 2 effort, *TMC Operator Requirements, Position Descriptions, and Software*; it enhances the Phase 1 document in support of the software tool, referred to as TMCOps.

1.2 Purpose

The process and techniques identified in both *TMC Operator Requirements and Position Descriptions* and the automated tool can be used to support public agencies with different tasks. The tasks that can be supported could range from planning a TMC, designing a TMC, adding a function to a TMC, assessing workload for operators within the TMC, developing position descriptions, and assisting in developing a training program. The focus is on assisting practitioners with specific activities that agencies need to support or perform related to operators and the specific functions performed within a particular TMC.

This document is intended for use by regional, state, and local transportation agencies and their contractors; particularly those who need to write position descriptions, advertise, interview, hire,

train, and supervise TMC operations personnel. The requirements for TMC operations are presented in a series of matrices (appendix B, TMOT Requirements Matrices) that link TMC functions and tasks to the KSAs required to complete the tasks. The matrices are both a practical tool for staff development, and an analytical tool for management and TMC designers.

1.3 Objectives

The objective is to describe the process of developing KSA requirements for TMC operations personnel in such a way that operating agencies and contractors may:

- identify operations personnel KSA requirements associated with typical TMC functions and tasks;
- identify a framework for operations personnel training requirements based on the KSA requirements;
- develop operations personnel position descriptions and job classifications based on the tasks the operator is required to perform;
- and, consider the tasks performed by an operator in support of the systems engineering process of the TMC.

1.4 Software Tool

TMCOps, developed as part of this Phase 2 effort, partially automates the process of developing position descriptions and requirements, as described in this document. The tool is web based, and it provides a simple input method for identifying functions and tasks which characterize a TMC and determining the KSAs required to support those functions and tasks. Based on the KSA outputs generated by the tool, position descriptions and training program frameworks can be easily generated. The tool is intended to enhance the existing process of position description development.

The software tool objectives are:

- To put the material in this document in a format that is easy to use and requires little effort for the identification and development of operator requirements and position descriptions.
- To provide additional content related to position descriptions and to enhance the understanding of the process of developing operator requirements and position descriptions.
- To provide access to the information in this final document in support of the tool itself.

The tool consolidates the knowledge in this document, making the information available in a format that TMC managers, supervisors, and human resources personnel can use to easily and quickly arrive at the basic KSA requirements for operator jobs and associated tasks in their particular TMCs. The material in the document is used in the tool to step the user through the process of developing position descriptions. Other material is used to enhance the user

experience by providing background material and tool help. The material in the document is supplemented by new material in support of the background and processes described.

It is recognized that not all TMCs support the same functions. The software tool first allows users to select the functions which characterize the TMC, providing a level of customization for public agencies which support different tasks. Types of activities use of this tool may support include planning a TMC, designing a TMC, adding a function to a TMC, assessing workload for operators within the TMC, developing position descriptions, and assisting in developing a training program. Users can characterize the functions and tasks as either current or future capabilities, as needed (full dialog only), to obtain the necessary tool output in support of their activities. The outputs that can be generated by the tool are position descriptions, training programs, and a list of testable skills.

The tool and this document are free for distribution and use by the Federal Highway Administration (FHWA), the TMC Pooled-Fund Study members, and other public agencies and practitioners who are involved in developing TMC operator requirements and position descriptions.

1.5 ITS National Architecture Market Packages

While the software tool revolves around 16 possible TMC functions and their related tasks, some agencies use Intelligent Transportation Systems (ITS) National Architecture market packages to characterize TMC responsibilities. There are 75 market packages, which fall into eight areas: Advanced Traffic Management Systems (ATMS), Advanced Public Transportation Systems (APTS), Advanced Traveler Information Systems (ATIS), Advanced Vehicle Safety Systems (AVSS), Commercial Vehicle Operations (CVO), Emergency Management (EM), Archived Data (AD), and Maintenance and Construction Management (MCO).

The ITS National Architecture defines functions required for ITS, physical entities or subsystems where these functions reside, and the information flows that connect these into an integrated system. The ITS National Architecture is a guiding framework to be used as input in developing ITS standards to ensure national interoperability. Market packages consist of groups of elements (equipment packages) that work together to deliver a particular user service. They represent ITS services and implementation options. The 75 market packages are:

- ATMS01 Network Surveillance
- ATMS02 Probe Surveillance
- ATMS03 Surface Street Control
- ATMS04 Freeway Control
- ATMS05 High Occupancy Vehicle (HOV) Lane Management
- ATMS06 Traffic Information Dissemination
- ATMS07 Regional Traffic Control
- ATMS08 Incident Management System
- ATMS09 Traffic Forecast and Demand Management
- ATMS10 Electronic Toll Collection
- ATMS11 Emissions Monitoring and Management

- ATMS12 Virtual TMC and Smart Probe Data
- ATMS13 Standard Railroad Grade Crossing
- ATMS14 Advanced Railroad Grade Crossing
- ATMS15 Railroad Operations Coordination
- ATMS16 Parking Facility Management
- ATMS17 Regional Parking Management
- ATMS18 Reversible Lane Management
- ATMS19 Speed Monitoring
- ATMS20 Drawbridge Management
- APTS1 Transit Vehicle Tracking
- APTS2 Transit Fixed-Route Operations
- APTS3 Demand Response Transit Operations
- APTS4 Transit Passenger and Fare Management
- APTS5 Transit Security
- APTS6 Transit Maintenance
- APTS7 Multi-modal Coordination
- APTS8 Transit Traveler Information
- ATIS1 Broadcast Traveler Information
- ATIS2 Interactive Traveler Information
- ATIS3 Autonomous Route Guidance
- ATIS4 Dynamic Route Guidance
- ATIS5 Information Service Provider (ISP) Based Route Guidance
- ATIS6 Integrated Transportation Management/Route Guidance
- ATIS7 Yellow Pages and Reservation
- ATIS8 Dynamic Ridesharing
- ATIS9 In Vehicle Signing
- AVSS01 Vehicle Safety Monitoring
- AVSS02 Driver Safety Monitoring
- AVSS03 Longitudinal Safety Warning
- AVSS04 Lateral Safety Warning
- AVSS05 Intersection Safety Warning
- AVSS06 Pre-Crash Restraint Deployment
- AVSS07 Driver Visibility Improvement
- AVSS08 Advanced Vehicle Longitudinal Control
- AVSS09 Advanced Vehicle Lateral Control
- AVSS10 Intersection Collision Avoidance
- AVSS11 Automated Highway System
- CVO01 Fleet Administration
- CVO02 Freight Administration
- CVO03 Electronic Clearance
- CVO04 CV Administrative Processes
- CVO05 International Border Electronic Clearance
- CVO06 Weigh-In-Motion

- CVO07 Roadside CVO Safety
- CVO08 On-board CVO Safety
- CVO09 CVO Fleet Maintenance
- CVO10 HAZMAT Management
- EM1 Emergency Response
- EM2 Emergency Routing
- EM3 Mayday Support
- EM4 Roadway Service Patrols
- AD1 ITS Data Mart
- AD2 ITS Data Warehouse
- AD3 ITS Virtual Data Warehouse
- MCO1 Maintenance and Construction Vehicle Tracking
- MCO2 Maintenance and Construction Vehicle Maintenance
- MCO3 Road Weather Data Collection
- MCO4 Weather Information Processing and Distribution
- MCO5 Roadway Automated Treatment
- MCO6 Winter Maintenance
- MCO7 Roadway Maintenance and Construction
- MCO8 Work Zone Management
- MCO9 Work Zone Safety Monitoring
- MC10 Maintenance and Construction Activity Coordination

The 16 functions identified in this document and in the software tool can be roughly aligned with many of the market packages, though there is not a one-to-one mapping. If users of the software tool typically thinks in terms of market packages, they can choose the functions they feel best correspond to the market packages that characterize the TMC.

2 OVERVIEW

TMC Operator Requirements and Position Descriptions combines new research into TMC staffing requirements with existing practices in the United States to create a comprehensive procedure for developing the operations personnel position descriptions needed to properly staff a TMC. Matrices are used to show the relationships between TMC functions, operations personnel tasks, and the KSAs a person must possess to accomplish the required tasks. Training requirements for operations personnel are defined and discussed. A comparison of the operations personnel positions to the federal job classification system is also presented; the comparison provides insight into human resource considerations such as compensation requirements.

Successful operation of a TMC requires an organization. The organization must manage, operate, and maintain the TMC systems. The focus of the research and development of this document is the "control room," "control center," or "operations room" operating personnel, and not the management or supervision of these personnel. The focus is on the console or workstation operator. The word "operator" or "technician" used throughout this document describes a person who normally sits at a console or workstation on the "front line" of operations at a TMC. Maintenance technician positions, and engineering support positions, are not described.

The process the organization must follow to characterize the TMC operators begins with a characterization of the TMC itself. First, the functions of the TMC are identified. Next, based on the selected functions, the composite tasks performed in the TMC are identified, followed by the identification of applicable discrete tasks. Based on the discrete tasks, a list of KSAs is generated, which characterizes the KSAs necessary for operators at the entry, full performance, and advanced levels.

Figure 1 depicts the process as implemented in TMCOps. The process is part of the interactive dialog component of the tool. The tool also contains a glossary, list of acronyms, complete list of functions and tasks, tutorials, help, and a search function. This document can be browsed online or can be downloaded.

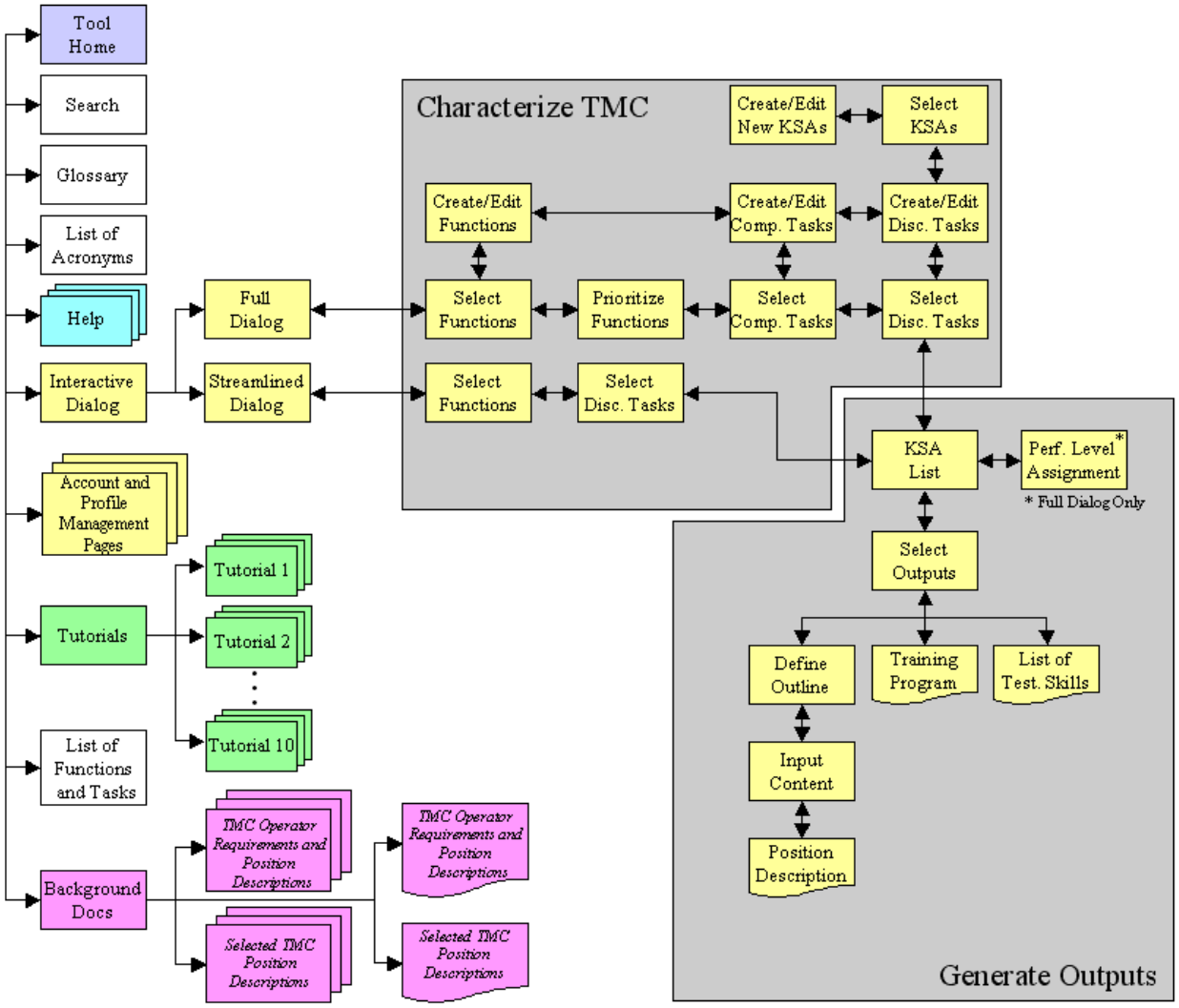

Figure 1. TMCOps page flow diagram.

2.1 How and When to Use this Document

Readers of this document will benefit by getting a better understanding of the background and basis for the software tool. The document also provides access to the complete list of tasks, KSAs, and training components which are used in the software tool. Finally, the document provides the opportunity to review comparable job classifications. It may be helpful to review this document prior to defining new functions or tasks (using the software tool).

2.2 Development of Position Descriptions

Position descriptions are written statements of the responsibilities and qualifications (KSAs) required to perform a job. Position descriptions are used for classification, recruitment, placement, training needs, performance evaluation, promotion, and other purposes. Position descriptions typically include a position title, the title of the supervisor, a position summary, a

listing of the principal duties, and a listing of KSAs. Tutorials in the software tool provide additional information on position descriptions.

To develop a position description, it is useful to understand the KSAs and operator requirements necessary to support a position. KSAs are derived from tasks, which are derived from functions; therefore, this is a hierarchical process. A list of KSAs alone is not enough to support development of a position description. They must be supplemented by explanatory text and other material, such as position requirements, to support personnel selection and management functions. Position requirements evolve, in part, from KSAs, but include hiring criteria that cannot be gleaned from the KSAs. Once the details have been identified, a format for the position descriptions must be selected and additional content required by the agency must be identified (e.g., job title, working conditions, tools and equipment used).

2.3 Phases in the Position Description Development Process

The process discussed in this document is the identification of operator requirements and development of position descriptions. The process involves the selection of functions used to characterize the TMC. Once functions are identified, the tables in appendix B can be used to identify related composite and discrete tasks. Discrete tasks can then be used to identify KSAs and the experience levels to which these are typically assigned. This information can then be integrated into a position description or used to specify a framework for a training program. The software program semi-automates the process by providing only necessary information for a given step in the process, and by automating the process of determining relationships between functions and tasks, tasks and KSAs, and KSAs with position descriptions.

The phases in the full dialog process, as depicted in Figure 1 are Select Functions, Prioritize Functions, Select Composite Tasks, Select Discrete Tasks, and Generate Position Descriptions. Each phase in the process can be described in terms of inputs, analysis, and outputs, and are described here in terms of the software tool functionality. The streamlined dialog involves a subset of this functionality.

Phase:	Select Functions
Inputs:	The 16 base TMC functions identified in the Phase 1 final report, as well as user selection of the functions performed by the TMC of interest, including designation of the functions as current or future.
Analysis:	User analysis involves the determination of which functions are relevant to the TMC, and whether they describe current or future functionality. The analysis by the software involves shortening the list.
Output:	Display of the selected functions
Phase:	Prioritize Functions
Inputs:	Outputs from the Select Functions phase and the user prioritization of the functions
Analysis:	User analysis involves identifying the order of importance of the functions in characterizing the TMC. The analysis by the software tool is the

	reordering of the functions and the association of the selected functions with composite tasks.
Output:	A list of composite tasks, grouped by function, listed in order of the function priorities
Phase:	Select Composite Tasks
Inputs:	Outputs from the Prioritize Functions phase and user selection of relevant tasks, including designation as current or future capabilities
Analysis:	The user analysis involves the determination of which composite tasks are or will be performed by the TMC of interest. The analysis by the software involves identification of the discrete tasks that are associated with the selected composite tasks.
Output:	A list of discrete tasks grouped by composite task
Phase:	Select Discrete Tasks
Inputs:	Outputs from the Select Composite Tasks phase
Analysis:	The user analysis involves the determination of which discrete tasks are or will be performed by the TMC of interest. The analysis by the software involves identification of the KSAs that are associated with the selected discrete tasks, calculation of frequency of occurrence, elimination of redundancies, and assignment of the KSAs to the three performance levels.
Output:	A list of required KSAs, the tasks that require each KSA, the performance level of each KSA, and the time frame (current, future, or both) in which the KSA is required

At the Select phases, it is also possible to create new functions, composite tasks, discrete tasks, and KSAs to support the characterization of the TMC.

Phase:	Generate Position Descriptions
Inputs:	User selected KSAs and tasks, as well as additional details that cannot be provided through this process (e.g., job title)
Analysis:	User analysis involves the identification of the applicable KSAs and tasks, as well as selection of additional items to include in the position description and identification of content to complete the position description. Tool analysis involves the listing of the selected KSAs and tasks in the position description and the ordering of content as specified by the user.
Output:	The completed position description

2.4 Organization of TMC Operator Requirements and Position Descriptions

Most readers of this document will not find it necessary to read each section. There are many types of expected users of this document and the associated software tool. The sections of the document are described below, along with mention of the anticipated users who will benefit most

from reading each section. In all cases, the sections are best read in the order in which they are presented.

Section 1, **Introduction**, identifies the purpose of the document and the relationship of the software tool to the document.

Section 2, **Overview**, describes the phases in the process and identifies how to use this document.

Section 3, **TMC Function and Tasks**, describes how the TMC functions and tasks used in the TMOT Requirements Matrices in appendix B were identified. The practitioner interested in quickly learning how to write position descriptions or develop a training program should skip this section. This section is provided for the engineer or researcher interested in the how the TMOT requirements matrices were developed.

Section 4, **TMOT Performance Levels**, describes how the KSA descriptions were developed to support the TMC functions and tasks. The practitioner interested in quickly learning how to write position descriptions or develop a training program should skip this section. This section is provided for the engineer or researcher interested in the how the TMOT requirements matrices were developed. Explanatory material to aid in understanding and using the matrices is provided. This section will help the TMC designer determine the KSA requirements of operations personnel based upon the TMC design. It may also help the manager who is writing position descriptions for new hires.

Section 5, **A Step by Step Process for Writing TMOT Position Descriptions**, provides a streamlined step-by-step process for writing position descriptions for TMOT personnel, using the matrices of appendix B. The writing of position descriptions is described for three TMOT levels:

- Entry Level
- Full Performance Level
- Advanced Level

Position descriptions for maintenance technicians, engineering support, system administrators, clerical, supervisory, and management personnel needed to run a TMC are not specifically covered; however, many of the principles utilized will apply and provide support for development of a comprehensive TMC organization. This section is intended for any user who is interested in writing position descriptions, and may be helpful for all users who wish to generate one of the software tool outputs.

Section 6, **TMOT Training**, describes training requirements for TMC operations personnel, and provides a complimentary matrix that identifies training specific to the functions, tasks, and KSAs presented in section 4. A sample training program is described. This section is intended for the manager who must create a training plan for new or advancing employees.

Section 7, **Comparable TMOT Job Classifications**, contains a discussion of position classification in language most useful to human resource professionals. This section also provides a comparison of the TMC operations personnel descriptions with the current federal job classification system utilized by the United States Department of Transportation. This section is intended for human resources personnel who may be interested in comparing position descriptions and pay scales to federal job classifications or who may be interested in classifying a position.

Appendix A, **Position Descriptions Reviewed**, provides a listing of the titles for the actual position descriptions reviewed in the process of preparing section 7.

Appendix B, **TMOT Requirements Matrices**, provides the TMOT requirements matrices, which show the relationship among functions, composite tasks, discrete tasks, and KSAs.

Appendix C, **Definitions Development**, provides a discussion of how the definitions used in the creation of the matrices and throughout the report were developed.

Appendix D, **Selection of the 16 TMC Functions**, provides a discussion of how the 16 TMC functions were selected for use in the matrices.

Appendix E, **TMOT Operations Terminology**, provides some terminology related to the process described in *TMC Operator Requirements and Position Descriptions*.

3 TMC FUNCTIONS AND TASKS

This section provides a discussion of the methodology for function and task list development. The practitioner interested in quickly learning how to write position descriptions or develop a training program should skip this section. This section is provided for the engineer or researcher interested in the analyses and material upon which the operator requirements matrices were developed.

The 16 functions are listed and described, and a brief understanding of how the appendix matrices were developed is provided. The ITS National Architecture market packages do not map directly to the 16 primary TMC functions identified in this document. There are 75 market packages in eight areas of transportation systems, but only 16 functions. The market package were not considered in the development of these functions, in part because much of the work was being done in parallel. The 16 functions are primarily related to the ATMS market packages, but also touch on APTS, MCO, EM, and AD.

3.1 Selection of the 16 TMC Functions for the Matrices

Sixteen TMC Functions were selected for inclusion in the TMOT Requirements Matrices of appendix B. The method by which the 16 functions were selected is described in appendix D, Selection of the 16 TMC Functions. The result of the process described in appendix D is the following list of TMC Functions for which TMOT tasks were developed. Note that this list only represents TMC functions which are supported by an operator; they do not include functions supported by maintenance, supervisors, or other TMC personnel. This list represents functions that are typical of North American TMCs; each of these functions are able to be broken down into tasks performed by the TMOT.

1. Provide Travel Information
2. Records Management
3. Congestion Management
4. Failure Management
5. Incident Management
6. Special Event Management
7. Traffic Flow Monitoring
8. Emergency Management
9. Provide/Coordinate Service Patrols
10. Reversible and HOV Lane Management
11. Traffic Signal System Management
12. Transit Vehicle Monitoring
13. APTS System Management
14. Environmental and Roadway Weather Information Systems (RWIS) Monitoring
15. Overheight Vehicle Management
16. Rail Crossing Management

Provide travel information is a TMC function that involves reporting highway conditions, delays, accidents, scheduled construction or other events, and preferred routes. The information

may be disseminated through various means, including dynamic message signs, highway advisory radio, the Internet, and telephone traveler information systems.

Records management is a TMC function that involves archiving and retrieving data about the operations and maintenance activities of the TMC. Activities include entering or recording data, generating and storing reports, and facilitating data warehousing.

Congestion management is a TMC function that involves identifying and responding to recurring congestion resulting from peak travel periods, as well as non-recurring congestion associated with incidents. Responses may include activating ramp meters, posting messages to dynamic message signs and HARs, and adjusting signal timing plans.

Failure management is a TMC function that involves identifying, responding to, and repairing failures of transportation system-related field equipment.

Incident management is a TMC function that involves detection, verification, response, and clearance of events including multi-car accidents, vehicle breakdowns, and accidents resulting from road debris or weather conditions.

Special event management is a TMC function that involves accommodating non-recurring events (such as sporting events, parades, motorcades, and construction) that are expected to have significant impact on the transportation system.

Traffic flow monitoring is a TMC function that involves viewing traffic data and video images in real time to evaluate traffic conditions for delays and hazards.

Emergency management is a TMC function that involves coordinating the response of emergency service providers (such as police, fire, EMS, and towing agencies) to emergency conditions (such as incidents, disabled vehicles, and signal malfunctions).

Provide/coordinate service patrols is a TMC function that involves identifying, verifying, and responding to requests for roadside assistance.

Reversible and HOV lane management is a TMC function that involves reconfiguring reversible lanes and HOV lanes, by manipulating gates and lane-use signals and visually verifying their status, to manage roadway capacity.

Traffic signal system management is a TMC function that involves implementing appropriate traffic signal timing plans to optimize arterial street traffic flow, and responding to signal malfunction reports.

Transit vehicle monitoring is a TMC function that involves monitoring and evaluating the operations of transit vehicles to ensure schedule adherence and to identify and minimize delays.

APTS system management is a TMC function that involves monitoring and evaluating the performance of public transit vehicles and systems to improve system performance, and providing transit information to improve service to users.

Environmental and RWIS monitoring is a TMC function that involves monitoring weather-related data (such as pavement temperature and surface conditions, visibility, and wind speed and direction) collected by remote sensors. The data are used to detect and forecast environmental conditions (such as icy roads or dense fog) that may affect travel on the roadway system.

Overheight vehicle management is a TMC function that involves the detection of and response to overheight vehicles to prevent accidents and damage to overhead structures.

Rail crossing management is a TMC function that involves monitoring railroad train operations and crossing control equipment such as signals and gates, and implementing appropriate response plans in the event of equipment malfunctions at crossings.

These 16 TMC functions have been differentiated to determine the associated TMC TMOT Tasks. They are referred to as "Task Integral" functions.

3.2 Differentiation of Tasks from Integral Functions

The process by which the integral functions were "differentiated" to obtain the TMOT tasks was characterized by an investigation of the input, process, and output activities likely to occur in support of each integral function. For each integral function, the essential activities associated with the function were identified. The essential activities were found to contain more than one discrete TMOT task, and for this reason were later described as "composite tasks" when assembling the requirements matrices. They are shown in the columns labeled "Composite Task Name" in the TMOT Requirements Matrices of appendix B. For each composite task, the "inputs" to the task were described. The input was defined as input to the TMOT, as opposed to input to a system. These inputs were used to develop the task descriptions. Once the descriptions were developed, the input column was deleted from the final version of the matrices.

To identify the discrete TMOT tasks that make up the composite tasks, an iterative method was applied, which consisted of listing all of the things a TMOT might do, in reaction to the input, to accomplish the composite task. The discrete actions are by definition the TMOT tasks. This iterative process was applied until the TMC function was sufficiently broken down into representative logical activities broad enough to describe what KSAs might be required to accomplish the function.

The process of listing discrete tasks was structured but subjective, and modification of the task lists in the TMOT Requirements Matrices of appendix B may be required to accurately reflect the true operational requirements of any legacy[1] system.

This differentiation process, applied to the 16 Task Integral TMC Functions, resulted in the development of over one thousand (1000) discrete TMOT tasks. Appendix B to this report contains the TMOT Requirements Matrices. Each matrix contains task differentiations for the identified composite tasks.

3.2.1 Sample Differentiation

Table 1 is a sample of the differentiation output from Appendix B, showing one of many worksheets used to differentiate the Incident Management task integral function to obtain the corresponding TMOT tasks. The first column shows the name of the composite task, and the next three columns comprise the discrete tasks.

Table 1. Sample differentiation, one iteration, one composite task.

F-5. Incident Management	Tasks		
Respond to Police Notification (Aural) of Incident	Receive call and note	incident	information
	Determine	incident	location from police
	Select camera at	incident	location
	Operate camera for	incident	verification
	Record/enter	incident	conditions
	Provide	incident	notifications
	Enact	incident	response
	View/create/modify	incident	response scenario
	Enable	incident	response scenario
	Monitor/modify	incident	response scenario

The composite task selected here implies that the TMOT discovers the incident based upon radio or telephone calls from the police, and then initiates a series of tasks in reaction to the input.

3.2.2 Composite and Discrete Tasks

Each function contains from 1 to 21 composite tasks. This reflects the variation in level of complexity and responsibility necessary for accomplishing each function. The greater the number of tasks for a given function, the greater the need for multiple personnel to support that

[1] In the ITS National Program Plan, a legacy system is defined as a system that existed prior to the adoption of the ITS National Architecture.

function. Analysis of composite and discrete tasks provides significant information necessary for accomplishing appropriate staffing and workload distribution.

The composite tasks represent the general task requirements for an operator performing a given function. The composite tasks would likely be included in a position description to describe the responsibilities of the operator. The discrete tasks, on the other hand, are further broken down into operator performance level and each discrete task has KSAs associated with it. The KSAs are used to develop position descriptions and to determine training requirements for operators.

Once the KSAs are identified, descriptions of operator performance levels can be developed. Three performance levels are discussed: entry level, full performance, and advanced. These performance levels are described in detail in the next section.

4 TMOT PERFORMANCE LEVELS

The previous section outlines the process by which 16 Traffic Management Center Functions were identified and then broken down into over one thousand discrete TMOT tasks. The TMOT tasks are reflected in the series of 16 TMOT requirements matrices in appendix B. The tables of appendix B identify the human resource requirements necessary to accomplish the TMOT tasks. This section defines knowledge, skill, and ability, and the relationships of KSAs to the three performance levels: entry, full performance, and advanced. These three performance levels are described in detail.

4.1 TMOT KSA Description

The KSA description is a way of expressing the capabilities required to perform in a specific position. TMOT knowledge is defined as the intellectual possession and command of (1) the information necessary to qualify for the TMOT position (entry level); and (2) the information that must be acquired after assuming a position in order to perform TMOT tasks. The knowledge of a TMOT or TMOT position candidate may be assessed by measuring the accuracy of responses to a set of TMC operations related questions. TMOT skill is defined as an assessment of the level of proficiency in exercising knowledge and/or performing TMOT tasks. Skill of a TMOT may be assessed by task performance time and accuracy assessments. TMOT ability is defined as the basic intellectual and physical capacities necessary to successfully perform in a TMOT position, acquire the necessary skills, and apply the necessary knowledge. The ability of a TMOT or TMOT position candidate may be assessed by aptitude tests or may be assumed based on level of education and job history.

4.2 KSAs and Performance Level

The Entry Level identifies TMOT KSAs that will be required for most candidates to be hired. For the most part, candidates being considered for hiring will not have much specific subject knowledge required by a TMC operator position. However, they will have to possess basic KSAs that will permit them to acquire more subject-specific KSAs required to advance in a developmental position to the full performance level. The KSA assumes TMC operation with the English language only. A special case specific to a particular TMC (or perhaps only a limited number of positions in a specific TMC) is conversational Spanish. This is entirely possible where the size of the Hispanic population in a metropolitan area is sufficient to warrant hiring a TMOT conversant with English and Spanish.

Entry level KSAs need to be measured through written testing, structured interviews, and/or review of prior job experience and education or training prior to the hiring decision. If the candidate has related or comparable traffic management experience in a TMC or organizations that require monitoring and evaluation of traffic incidents (including air traffic), these experiences can be substituted for direct testing. For some KSAs such as knowledge of English usage and grammar, completion of high school courses will indicate a high likelihood that the candidate possesses the requisite knowledge to be effective in the prototypical TMC.

Hiring decisions are most often based on competitive review of the candidate's background. While the candidates may not be fully proficient in each KSA, they will have to meet a minimum requirement, essentially equivalent to the generic KSAs inherent in the five activity tables provided in section 6. This is particularly true since many of the TMC operators are in civil service positions and are selected for TMC service based upon merit factors. Merit factor selection is characterized by the use of objective criteria or written tests that are used to independently rank and rate all applicants on common factors such as language skills or quantitative ability. Depending upon the particular hiring system used by a TMC, there may be a requirement for a rating and ranking process which is intended to hire those candidates who rate higher on the KSAs and who is, therefore, most likely to be the best qualified. This document describe the KSAs to be used in the hiring process; however, they do not provide the criteria to make rating distinctions for each KSA. In many North American highway TMCs, including those who participated in the development of the *Guidelines for TMC Transportation Management Operations Technician Staff Development*,[2] written tests and structured interviews are used to determine the best qualified candidates. The participating TMCs shared as much detail as possible regarding these rating and ranking instruments, stopping short of providing information that would compromise their validity and reliability should they be published.

Once the employee is hired, he or she will be assigned to a developmental (entry level) position. Through a combination of job assignments and training, the employee in the developmental position may progress to the full performance level.

The Full Performance KSA Level is what is required for a TMOT to carry out his/her responsibilities with a minimum of guidance and direction. The full performance KSA level is often referred to as a journeyman position in the federal sector. The supervisor, based on job performance, will typically monitor, measure, and determine the degree to which the TMOT possesses these KSAs. Depending upon the TMOT staff size, scope of operation, and civil service requirements, there could be continued written civil service testing, structured interviews, or measurement of TMOT responses to simulated traffic management incidents to reconfirm supervisory judgment. On-the-job training (OJT) and experience are the primary methods to qualify for this level, though supplemental training courses provided during official hours are desirable to support career advancement. The full performance KSAs identified in this document are prototypical, based upon tasks identified for the 16 TMC task integral functions. TMC managers and supervisors may customize these KSAs based on the operational requirements of their specific organization, such as the specific requirements of operating non-integrated, stand-alone legacy systems or any unique, unusual, or non-standardized equipment/software in use.

Advancement from the entry level to the full performance level may be considered to be a part of "a career ladder" as opposed to a competitive process in which employees compete with each other for a limited number of positions. Unlike the screening and evaluation process involved in

[2] The TMCs which participated in the development of KSAs were Maryland CHART operated by the Maryland State Highway Administration, Georgia Navigator operated by the Georgia Department of Transportation, the Phoenix Freeway TMC operated by the Arizona Department of Transportation, and the Minneapolis TMC operated by the Minnesota Department of Transportation. The TMC Manager from New York State Department of Transportation (NYSDOT) Region 1 in Albany served as the Pooled Fund Study (PFS) liaison.

selecting candidates for the entry level, advancement to full performance KSA level is to be based upon a more objective assessment of the individual TMOTs capabilities to perform at this level. It is only necessary for TMC managers to determine that employees possess the required full performance KSAs, as opposed to establishing criteria designed to rate employees against each other on each KSA. Some TMCs have established certification programs to assist in the decision-making process leading to the full performance level. Adoption of these practices will reduce staff turnover by providing a focus on career advancements through enhanced capabilities.

The Advanced KSA Level is what is required for a TMOT to perform independently as an expert in various functions at a TMC. Attainment of this level is measured by combining TMOT experience with advanced training and may also vary by the specific functional requirements of a TMC. For example, not all TMCs have assigned the management of ramp meters, control of overheight vehicles, management of rail crossings, adjustment of signal plans, or planning for special events to the TMOT. Attainment of the advanced level is reflective of the management controls applied by the TMC managers and the discretion and judgment exercised by the TMOT. Therefore, the advanced TMOT's job duties may be similar to those performed by the full performance employee, but the advanced level employee is provided more latitude or independence to exercise these duties by only receiving guidance about overall TMC priorities.

When a TMOT has attained the advanced KSA level, he or she has acquired the expert KSAs to accomplish more complex assignments; and these assignments need to be reflected in a new position (job) description, different from full performance. Training or mentoring other employees, developing special event traffic plans, or recommending improvements to traffic information systems are examples of additional duties that could change the job description of the advanced level operator. These should only be added to the position description if they are continuing and significant.

Advanced training courses must be developed and made available to assist the TMOT to qualify for the advanced level; however, ultimately, it will be the TMOT's responsibility to demonstrate his/her qualifications for this level. This could be determined by successful completion of advanced formal courses, supervisory judgment on the operator's performance, particularly in difficult situations, and trial assignments to special projects. Several North American highway TMCs already have formal certification programs which include testing. It is recognized that if almost all of the identified KSAs are attained, then there is a powerful argument for the operator to be recognized at the advanced level. An operator could reach a minimum number of KSAs to attain the advanced level and, therefore, there should be some pay differential between the employees meeting the minimum and the maximum KSA requirements.

It will be up to each TMC to determine whether there will be limits on the number of employees who may be at the advanced level at any one time or whether all employees who possess the required KSAs may be assigned to the advanced level at the same time. If there are limits, it may be necessary to develop a competitive process, which assesses an employee's relative strengths on each KSA. But if there are no limits, it will only be necessary to determine that the employee possesses the required KSAs.

4.3 Justification for the Advanced Level TMOT

By definition, every TMC must have full performance TMOTs in order to be considered an operational facility. In addition, if an operating agency has invested in the hardware and software required to provide advanced functionality, it follows logically that this TMC would also invest in hiring and training to provide advanced KSA level TMOTs capable of using the technology. Unfortunately, this has not always been the case. It is expected that TMCs operating in any of the seventy five major metropolitan areas in the U.S. where ITS is deployed or targeted to be deployed, would develop at least two advanced level TMOTs for a TMC within three to four years after commencement of operations. Three to four years is likely to be enough time to hire and train an advanced TMOT, or train a full performance TMOT to achieve the advanced level, before the loss of benefit exceeds the useful life of the investment in technology, normally considered a minimum of five years.

The differences between the full performance level TMOT and the advanced level TMOT are based on the individual employee's increasing in-depth expertise, and the corresponding reliance placed upon the employee by first level supervisors and TMC management. This will include TMOT capabilities to independently conduct critical TMC assignments without close supervision or direction. To advance to this level, the selected employee generally has more than 2 years of increasingly responsible experience as a full performance TMOT. A number of the responsibilities may be the same between full performance and advanced level employees, but the individual's completion of those responsibilities is significantly different at each level in the following factors:

- The required KSAs.
- The management controls applied by the supervisor.
- The discretion and judgment exercised by the employee.

4.3.1 Advanced Level KSAs

The advanced TMOT may not be required to possess every KSA listed below; however, the employee should have a substantial number of these KSAs. For example, if an employee demonstrates the capability to recommend changes in policies, procedures, or information systems, or independently design a new traffic management plan to alleviate chronic congestion, the employee may be considered qualified at the advanced level because of the complexity and judgment of skills represented by these KSAs. Because there are many and varied KSAs recommended within the advanced level, there should be flexibility at TMCs to recognize at least two of the three differential KSA requirement levels within a broad compensation range (pay band). This concept will be described in further detail in section 7, on Classification. The TMOT employee may be required to demonstrate increased knowledge and abilities by passing an advanced level TMOT Certification Test (if applicable at a particular TMC). A representative menu is defined in the preliminary KSA Task Matrix that follows, and is summarized below:

The advanced level TMOT employee will have to demonstrate qualifications in several of the following areas of knowledge:

- Understand selection of traffic signal timing selection plans to support freeway diversion.
- Understand traffic management systems for arterial roads, including time-of-day, traffic responsive, and adaptive controls.
- Understand HAZMAT incident policies, procedures, and codes.
- Be cognizant of techniques to respond to and correct minor TMC equipment or software problems, and diagnose equipment problems based upon the loss of expected operational functionality.
- Understand capabilities and limitations of TMC ramp metering policies and procedures, and be able to adjust metering rates to relieve unacceptable queues at ramp meters. Knowledge of corridor metering algorithms that may be in use.
- Understand emergency management and evacuation policies/procedures.
- Be cognizant of capabilities/limitations of advanced ITS measuring (i.e., heuristics, or learning through trial-and-error).

The advanced level employee will have to demonstrate several of the following skills and abilities independently:

- Interpret conflicting or ambiguous data, in incident management.
- Train/mentor other operators at lower levels (both entry and full performance), and expertise to conduct OJT.
- Make decisions and respond in unprecedented situations (e.g., non-standard messages, plane landing on highway, atypical HAZMAT spill).
- Recognize when to override automated incident response systems or change automated traffic signal timing plans.
- Resolve problems created by competing/conflicting needs or concerns of other traffic management entities.
- Recommend improvements to traffic information systems and network operations.
- Recommend improvements to traffic management systems and plans.
- Evaluate ramp meter queues and adjust timing of ramp meters.
- Develop traffic management plans for special events and/or other areas of potentially chronic congestion.
- Independently troubleshoot minor problems with equipment and software.
- Resolve issues from the conflicting needs or concerns of traffic management personnel outside of the control room.

- Represent the TMC at meetings to develop traffic management plans for special events.

4.3.2 Level of Supervision

The advanced level TMOT employee is expected to function independently and will:

- Receive only administrative direction and guidance from the manager of the TMC or 1st level supervisor on overall TMC priorities. He/she operates independently in selected situations requiring special expertise, without requiring supervisory direction.
- Determine the methodology to achieve the desired traffic management results, and operate independently in day-to-day TMC operations.
- Serve as the "senior technical expert" on the operations floor for lower level operators.

4.3.3 Relevant Policies and Procedures

The policies and procedures for the full performance TMOT employee generally will consist of the Operations Manual for the specific TMC, and other applicable procedures or directives which apply to the operation of the TMC. At the advanced level, the TMOT uses initiative, extensive experience, broad knowledge of traffic management principles, and judgment in interpreting, adapting, and/or deviating from these policies for application to specific and often unprecedented traffic problems, special events, and areas of chronic congestion.

The advanced employee may also analyze operational results of incident response plans and recommend changes in existing policies, procedures, traffic information systems, and network operations as appropriate.

4.3.4 Sample Responsibilities and Assignments at the Advanced Level

The advanced level TMOT employee could:

- Make independent decisions, and use discretion on the override of the automated system; discretion in determining specific Dynamic Message Sign and/or ATIS traffic message(s); independent development of incident response plans in unprecedented situations; and independent decisions on methodology to correct automated system errors.
- Provide guidance and advice on complex traffic management issues to other operators, and is sought for guidance in unprecedented cases or controversial traffic incidents.

- Be assigned as a TMC team leader for specific projects affecting the center's operations and procedures. The employee may provide technical direction to lower level operators on these projects.
- Mentor lower level operators, and conduct certification tests for operators advancing to the full performance level. Employee may conduct OJT as a result of his/her senior level expertise.
- Be involved in coordinating resolution of chronic congestion problems for special events, (i.e., games, concerts, etc.) with other involved transportation management organizations. The resolution of these problems will not be based on a precedent or a guideline, which is directly applicable.

4.4 TMC Functions and Related KSAs for the TMOT

Using language common to both the human resources field and the transportation field, the generic human resources KSA activity group tables in section 6.3 are used to establish the link between TMC functions and the ultimate KSAs. An indicator of the generic activity group (I-V) appears for every TMOT task in the appendix B matrices. This forms part of the ultimate requirements matrix, whereby traceability is provided between the generic human resources KSAs and the specific KSAs developed to support the TMC Functions. The end result is a set of matrices that allows a TMC manager to select the function in his or her TMC, determine the TMOT KSAs required for the entry level, full performance, and advanced positions supporting that function, and convey these requirements in phraseology that is consistent with human resources industry practices.

4.4.1 KSA Development

Every TMOT task requires specific knowledge, skill, and ability to perform. Representative KSAs have been developed for over one thousand discrete TMOT tasks identified in appendix B. Fortunately, there is significant redundancy, and a relatively small number of KSAs have been identified that serve a very large number of tasks. To "View Detector Data," for example, the TMOT has to have multiple KSAs. The "on-going purpose" or function, for which the TMOT is viewing the data, may or may not require a different, or special, KSA for that task. Identical KSAs can support different functions. In addition to the five generic KSAs developed from a human resources perspective (identified in section 6.3), two types of specific TMOT KSAs have been developed from a transportation engineering perspective. The two types are "General," specifically G-1 through G-6 (dark green), and "Special," specifically S-10 through S-200 (spaced in increments of 10 to allow for future expansion) (bright green). Table 2. TMOT KSA Requirements. provides a sample of these comprehensive TMOT KSAs; the complete table is provided in appendix B.

These KSAs are suggested based upon the typical tasks of the matrices in appendix B. Just as the typical tasks in the matrices need to be adjusted to fit legacy systems, the KSAs will require adjustment to fit the human resource practices of the operating agencies. The KSAs in Table 2. TMOT KSA Requirements. are suggestions based upon reviews of position descriptions from

several agencies and the experience of the author. The specific educational requirements are suggestions; however, these must be tailored based upon the requirements of the specific TMC.

Table 2. TMOT KSA Requirements.

KSA Designator	*TMOT Activity Type*	*Knowledge*	*Skill*	*Ability*
G-1	Utilize GUI at MKV workstation.	Operation of a standard computer workstation in a windowing applications environment. Response to system queries and messages. Use of menus. Data entry and standard field editing. Understanding of real time device control and command execution.	Navigate between four or more multiple open application windows. Data entry of X WPM with X% accuracy (40 WPM is minimum, 50 is recommended. Accuracy must be 97% or higher). Use of available macros to accelerate editing of data fields. Execute single control command for a single, or up to X multiple devices (depends on ATMS software).	Comprehend and read English as demonstrated by successful completion of X grade English course (default is 10^{th} grade). Windowing software mastery, specifically the X operating system (default is Microsoft Windows). Minimum of High School Education with X years of on-the-job experience using computers (recommend 2 years) or 4 year college degree.
S-20	View Video Images.	Stationary and moving object recognition in a two (2) dimensional representation of a three (3) dimensional field of view.	Determine if image objects viewed are abnormal, anomalous, and reflect any danger to safe and efficient transportation. Daytime and nighttime operation skills required. Demonstrated skill level to detect a single event in X images (default = 6 images), in X seconds (default = 10 seconds).	Scan multiple monitors and note changes over time to objects and images as demonstrated by X years experience in a multi-monitor environment (default = 2 years), or demonstrated ability.

4.5 The TMOT Requirements Matrices

Each of the 16 functions appears in requirements matrix tables in tables B-3 through B-18 in appendix B. These tables are used to identify the specific performance KSAs required for each function. The first column in the table, labeled "Composite Tasks," displays the name of the composite task that each set of discrete TMOT tasks is associated with. Each composite task is assigned a number (e.g., F-3, T-1, meaning Function 3, Task 1). The next column, labeled "Num," assigns a number to each discrete TMOT task within the associated composite task. The tasks are numbered consecutively within a composite task. The column labeled "Discrete TMOT Tasks" shows all of the discrete tasks for each function. The total number of discrete tasks for each function is shown in parentheses next to the column label.

The next column, labeled "Generic HR KSA," lists the Generic HR KSA for the task. The Generic HR KSAs are described in section 6.3. The column labeled "General KSAs" displays the general KSAs, G-1 through G-6, that form the base level tasks required for a TMOT to participate in delivery of any of the 16 Task Integral TMC functions; these general KSAs are identified by the dark green entries in table B-2. The column labeled "Special KSAs" displays any special KSAs, S-10 through S-230, that may be required for a task. The special KSAs are defined in the light green entries in table B-2.

The final column, labeled "TMOT KSA Level," indicates the performance level (Entry Level, Full Performance, or Advanced) at which the task is expected to be performed. (By definition, any task performed by a lower-level TMOT can also be performed by a higher-level TMOT.)

Based on the information provided in appendix B for Function 3, a TMC manager could conclude that if the TMC performs Congestion Monitoring, and expects a TMOT to “Respond to an ATMS Detected Congestion Event,” then the indicated KSAs (1-6, 10, 20, 50) will be required. If an entry level operator is used, the event can only be handled up to the point of classification, at which point a full performance operator would need to take over to perform notifications and work with a response plan. Special KSA 50 is required and, therefore, a testable skill level, “respond to all alarms received in less than 10 seconds for each alarm,” and educational requirement exists to qualify the TMOT for the task.

The matrices allow for the customization of a TMOT staff based upon not just the functions to be supported, but the specific implementation of the functions planned.

5 A STEP BY STEP PROCESS FOR WRITING TMOT POSITION DESCRIPTIONS

One of the primary purposes of *TMC Operator Requirements and Position Descriptions* is to provide TMC Managers with the ability to assemble position descriptions that reflect the true requirements of the TMC in a way that will help human resource specialists and civil service personnel classify and hire the right people to get the job done. Position descriptions are written statements of the responsibilities and qualifications (KSAs) required to perform a job. Position descriptions are used for classification, recruitment, placement, training needs, performance evaluation, promotion, and other purposes. Position descriptions typically include a position title, the title of the supervisor, a position summary, a listing of the principal duties, and a listing of KSAs. It is generally recommended that they be no more than two pages in length. Tutorials in the software tool provide additional information on position descriptions.

The following step-by-step process presents a suggested approach to utilizing the matrices in appendix B for the development of TMOT position descriptions. This is the process that is facilitated by TMCOps. Each step describes how to use the tables in appendix B, and how the process is facilitated through use of the software tool.

5.1 Step 1: Select and Prioritize TMC Functions

Select the matrices in appendix B for each TMC function you have in the TMC where the TMOTs will work. Simply copy the pages needed from the appendix, or contact the author or FHWA for an electronic copy of the spreadsheets used to generate the tables.

Prioritize the TMC Functions in the order of importance to your TMC. The order of importance in this case should not necessarily be the "most critical" functions, but the functions expected to occupy the greatest percentage of a TMOT's time. There is no right or wrong prioritization; however, there is a benefit to identifying and dealing with the most time consuming tasks the TMOTs will perform first, as this will most quickly establish KSAs common to more than one function.

If your TMC has a function that is not listed, the matrix format and the methodology described in section 3.2 *Differentiation of Tasks from Integral Functions* can be used to develop a new matrix for that function. Use of one of the 16 matrices in appendix B that is similar to the new function will be a good starting point.

If your TMC has functionality planned for a future time that will not be in place when TMOTs are hired, the function still needs to be selected, and the KSAs that function requires should be considered as future requirements that may already be covered, or may need to be added to the position descriptions, depending upon what functions are required from the start.

To perform this step using the tool, select the check boxes for each function that currently characterizes the TMC or that may characterize the TMC in the future. If the TMC has a function that is not listed, the tool provides a form that can be completed to define a new

function. Once all functions have been selected, the reduced list is presented for prioritization. The tool can generate separate outputs for current and future functionality. In the streamlined dialog, there is no selection of current or future, no new function definition, and no function prioritization; this step simply involves selecting the relevant functions.

5.2 Step 2: Select the Composite Task Descriptions for Each Function

Starting with the highest priority TMC Function selected in Step 1, circle or highlight the "Composite Task Name" (leftmost column in the matrix) based upon your TMC's specific functionality. Identify the composite tasks for each TMC Function.

If your TMC has a task not listed for the function, simply describe the task using the format of the matrices and using the task definition in appendix E. A simple mnemonic is to think of a task as an "action" upon a "thing"; each task should describe the nature of the TMOT action (i.e., Respond, Monitor, Note, Assess, Evaluate, etc.) to be taken upon some thing (i.e., Data, Alarm, etc.).

Using the software tool (full dialog only), review the list of composite tasks, grouped by selected function. As with the functions, check the boxes for current and future functionality for the composite tasks performed in the TMC. If the TMC has a composite task that is not listed, the tool provides a form that can be completed to define a new task.

5.3 Step 3: Identify the KSAs for Each KSA Level TMOT Position (Entry, Full Performance, and Advanced)

Starting with highest priority Functions, and the Composite Tasks selected, identify the KSAs required for a TMOT. This is accomplished as follows: for each composite task, identify and read the task description in the columns "Discrete TMOT Tasks" where there is a check in the KSA level column (i.e., "Entry Level") on the same line. If you expect the TMOT at this level to perform this task, circle or record the general KSA (1 through 6) for which the KSA column is checked on that line. Follow the line to the end, and record the number of any "Special KSA" identified on the same line.

It is suggested that you start with the entry level KSAs first, as the full performance will build upon that level. Advanced should be done last.

Continue down the matrix, noting the KSAs, general and special, required for the TMOT KSA level under consideration. Once a KSA is selected for the position description, identification of additional occurrences is unnecessary, unless the TMC manager wishes to know "how often" or what percentage of the TMOT's tasks will require the use of that KSA. Evaluation of the importance of the KSA to the position may influence the overall staffing plan, in that a manager might assign a task to a different performance level rather than requiring of a TMOT a KSA that will seldom be used. To evaluate the importance, simply continue down the entire list, and note the number of occurrences of that KSA for the tasks selected.

Using the software tool, review the discrete tasks, grouped by composite task and function. As with the functions and composite tasks, check the boxes for current and future functionality for the discrete tasks performed in the TMC. If the TMC has a discrete task that is not listed, the tool provides a form that can be completed to define a new discrete task (full dialog only). Once the discrete task list is submitted, a KSA list (with redundancies removed) is presented. The user can choose to view the KSA list by performance level. The frequency of occurrence is provided for each KSA.

5.4 Step 4: Identify KSAs, by Level, for all TMC Functions Selected

The process of Step 3 can be repeated for all functions, for each KSA level, until the full complement of required KSAs is known for each position. To create the basic position description, it is unnecessary to identify multiple occurrences of the same KSA, unless for the purposes of evaluation noted in Step 3.

The software tool handles this in the previous step.

5.5 Step 5: Compile the KSA Text from the KSA Table (table B-2)

The position description for each KSA level is created by compiling the text for all of the KSA requirements, and eliminating redundancies. The text associated with the numbered KSA requirements is found in table B-2. KSAs should be listed in the order of general to specific, making the elimination of superseded requirements easier. To make a position description, however, more is needed than just the KSA lists. Task statements must be created to correspond to the KSAs; these task statements are used in the position description to describe the task and responsibilities.

Using the software tool, select the KSAs of interest to include in the position description. Select "Position Description" from the output list, select the position description fields to include, fill in the details, and the tool will generate the completed position description. When choosing the KSAs that should be changed into task statements for the position description, focus on the frequency and criticality of the KSA. If the KSA is very frequent, it should be included. If the KSA is infrequent but critical to the position, then it should also be included.

Based on the KSA list, the following outputs can be generated by the tool: position descriptions, a training program outline, and a list of testable skills.

6 TMOT TRAINING

The KSA descriptions used within this document establish the requirements for the TMOT to accomplish assigned tasks. In a perfect world, every position candidate will posses the full set of required capabilities and begin effective operations on the first day. Of course, this is not the case in the real world. If the candidate meets the ability requirements in terms of education and experience, there is a good possibility that the candidate will be able to obtain and use the required knowledge to function within the position. Training forms the bridge between the candidate's capabilities and the required KSAs.

6.1 Model TMOT Training Program

The model training program for the TMOT presented herein is based on an assumption that most existing TMOTs have completed high school and have limited traffic engineering training or less than one year of traffic management experience. This assumption is based upon the labor pool characteristics of the operators at today's TMCs in the United States. Most employees are hired into a developmental position and require on-the-job and formal training to advance to the full performance level. This model training program is designed to support such an approach.

There are a few examples of TMCs that have hired people highly skilled in another field, such as military or civil air traffic control experience, that permits a shorter time period of training before achieving full performance level.

Sections A through F of this model TMOT training program apply to the entry level TMOT who has just entered on duty, is learning the system requirements, and honing skills/abilities that would be necessary to move to the full performance level. Refresher training is also identified that would be provided to employees before and after they achieved the full performance level. It also needs to be recognized that if a particular traffic management information system is substantially revised, additional training needs to be provided to all TMOTs, no matter what their level of expertise. Also, some of the entry level requirements, like knowledge of the transportation system, will need to be addressed for someone hired into a full performance or advanced position from another region.

Section G on the Principles and Practices of Technical Traffic Engineering is aimed at the TMOT who is preparing to reach the full performance level; though it could be scheduled shortly after the employee has achieved the full performance level, depending upon the employee's background and experience.

Section H describes a certification program that should be available to TMOTs who have achieved the full performance level and have the potential to achieve the advanced level. The programs are aimed specifically at KSAs that we have identified in the KSA Matrix as requisites at the advanced level, though the curriculum could vary depending on the tasks assigned to an advanced TMOT. While certification programs could also be implemented as a pre-requisite to advancement to the full performance level, completion of specialized training programs is vital to demonstrate the high standards requisite to achieve the advanced level. Structured tests could

also be used to demonstrate completion of the certification program and as a pre-requisite to achieving the advanced level.

6.2 Model Program Description and Outline

The following outline identifies various levels (A through H) of TMOT training program:

A. **Orientation to the TMC**: Organizational structure. Applicable laws, regulations, and standards. Personnel policies. Pay practices. Shifts. Training opportunities. Work environment. Security. Evacuation procedures. Computer security. Introduction to senior managers.

Materials/Techniques: Provided by personnel office and supervisor. Handouts include organization charts, personnel documents, operating policies, pictures of staff. Information could be developed on a compact disc for ease in updating and to improve employee access.

Estimated hours: 2-4 hours on the first day, provided by the personnel office and the operations supervisor. Employee signs check list, acknowledging receipt of material/information.

B. **Nuts and Bolts of the Control Room**: Overview of staff roles and equipment. Discussion of various staff in the control room including dispatcher, traveler information operator, operator duties and differences. Purposes of the equipment used in the control room.

Materials/Techniques: Information provided by supervisor/trainer. Prepared charts. Direct observation/questions in control room.

Estimated hours: 2-4 hours on the first day, 1-hour refresher on second day.

C. **Knowledge of the Transportation System**: Orientation about area transportation system, including roads under control of the TMC and feeder roads, potential impediments to traffic flow, general familiarity with other agencies involved in traffic control which help make the system work, and other transportation modes affecting highways. While employees may have general knowledge of the road system, they may experience visual confusion between reality and highways observed through cameras; therefore, camera image processing is discussed and practiced.

Materials/Techniques: Maps, direct observation using closed circuit cameras. Interaction with emergency vehicles, road maintenance, highway helpers, police, ambulances, HAZMAT units, etc. Supervised driving on key highways, tunnels, and intersections that represent the most potential congestion. Test map interpretation through simulated exercises.

Estimated hours: 16 hours OJT during first week for new employees and 8 hours directed at specific areas, depending on observed needs (e.g., visual confusion vs. reality) during the next 6 months. Supervised driving on highways should be delayed beyond the first week until employee gains experience with message signs and traffic controls in order to recognize needs. Refresher training as system changes. Testing is based on supervisor observation.

D. **Knowledge of Transportation Management System**: Variable message signs (VMSs), ramp meters, intersectional traffic signals, lane controls, highway advisory radio (HAR), use of logs, and shift transfer procedures. Special attention is focused on incident management procedures, policies, or precedents for weather, ice, accidents, HAZMAT, road damage or hazards (e.g., potholes, dead animals, broken fences, oil/water spills). Need to learn and become operationally familiar with dispatching, contacting, and reporting processes “dos and don'ts.” Need to "build bridges with other partners in traffic management" such as law enforcement, fire protection, maintenance dispatchers, and highway helpers.

Materials/Techniques: Operational procedure manuals, technical terminology used in the center, and simulated exercises on detection and evaluation of various transportation incidents or congestion. These simulations should include a set of emergency drills. Supervised training. Testing is based on supervisor observation and testing of surprise emergency drills. Attends meetings at TMC with associated partner organizations. Recommend cross training, if possible, where operator spends one or two days with partners from the traffic management system to gain familiarity with their needs and operational problems.

Estimated hours: 16 hours OJT during first two weeks for new employee and 4 hours per month for the next 6 months. Employee needs to try out traffic control tools on various incidents. Use sample logs and develop trial logs based on cases. Review logs and road construction incidents from prior shifts and simulate initial responses. As part of this training, recommend 4-8 hours cross training with local public safety organization at their "Incident Command Center" and 4-8 hours on the road with emergency assistance personnel. Refresher training scheduled for 8 hours per year.

E. **Public/Media Interaction:** Respond to public/media Inquiries, maintaining composure under stress.

Materials/Techniques: Use guidelines on responses to different queries from public and/or media. Simulated role-playing exercises. Testing is based on supervisor observation.

Estimated hours: 4 hours OJT during first two weeks for new employees and 1 hour per month for next 6 months. Refresher training as needed.

F. **Software/Equipment** : How to startup, use, and shut down existing system, identify error messages, and report problems. Formal instruction provided by knowledgeable in-house personnel such as information systems analysts/programmers.

Materials/Techniques: Employee needs hands-on experience/training using existing or spare workstation in TMC. Use a spare message sign or other equipment for simulation, if possible. Know how to report problems or resolving very minor problems using available documentation, as required. If documentation is not available, additional verbal instruction may be required. This training should be scheduled during the first month with opportunity for refresher training as needed. Supervisor will review techniques with employee and request that he/she demonstrate abilities before advancing beyond the trainee level. The following are illustrative of the software/equipment operating techniques to be covered and will need to be customized by TMCs to the specific equipment and software in use.

1. Basic application software/operating system, wall maps, and graphical user interface (GUI) features: 2-4 hours depending on learning skills.

2. Ramp meters and traffic signals: 4-6 hours depending on learning skills.

3. VMSs: 2-4 hours depending on learning skills.

4. Video surveillance, two-way radio, loop detectors, automated weather stations, traffic sensors: 2-4 hours depending on learning skills.

5. Web site management: Technical capabilities and limitations of using the web site to provide information to the public. 1-2 hours depending on learning skills.

G. **Principles and Practices of Technical Traffic Engineering**: Fundamentals of traffic engineering theory and practices including queuing, capacity, etc. Formal instruction will supplement hands-on experience of the new operator, providing a framework for understanding why and how a traffic management system is designed.

Materials/Techniques: Provided by senior traffic engineer using descriptions of principles and case studies and/or visual slides.

Estimated hours: 8 hours to be performed between 6 months and 18 months after entrance-on-duty.

H. **Options for Advanced Training (Certification)**: These programs need to be conducted by traffic specialists or traffic software specialists from other units in the transportation department or outside professional instructors. The objective is to improve an employee's KSA so that he/she will be able to independently cope with complex traffic control problems. These programs will be available where these tasks/responsibilities are assigned only to specially trained TMOTs or to supervisors. Employees should be selected for this training by supervisors based on potential for

success. Completion of these training programs could be a pre-requisite to become a shift supervisor or advancement to the advanced operator level. However, there needs to be some selectivity because not all TMCs will require the subject matter expertise represented by these programs. Employees will be tested during the training program (except for creative problem solving and team building) and receive certificates to acknowledge that they have attained course objectives. Training will be conducted outside the control room environment during off peak hours. We estimate that 20 to 30 hours would be required to complete each of the following courses, except for overheight vehicle management.

1. Traffic Planning: Knowledge of traffic flow and intermodal processes to use for event planning such as Super Bowl, large conventions/meetings, etc. Will also focus on the different interests of various transportation organizations in considering traffic management issues. Analysis of incidents as case studies.

2. HAZMAT: Knowledge of various hazardous materials, codes, and appropriate emergency responses to these incidents. Analysis of incidents as case studies.

3. Ramp metering, traffic signal control timing selection plans, and traffic controls at railway intersections: Knowledge of ramp meters, capacities, and traffic signal control timing plans in TMC-controlled areas, railway intersections, and arterial roads. The focus is to improve coordination with the traffic management system to ensure better traffic system flow. Analysis of incidents as case studies. (This course could be offered in separate sections, covering the three topical areas, depending upon TMC needs.)

4. Creative problem solving: Exercises in analyzing optional responses to various major or atypical traffic crises such as severe snowstorms, floods, or hurricanes, or such events as planes needing to land on roads. Goal is to ensure that trainee is able to independently deal with incidents that have few or no precedents. Role playing of control room management of incidents.

5. Troubleshooting software/equipment problems: Exercises in recognizing various problems with the transportation management network operations and techniques for resolving the less complex problems without the assistance of specialized information systems personnel. Learn how to use available software documentation to recognize problem areas.

6. Team building and conflict resolution: Role-playing exercises in playing different leadership and participant roles in building constructive team work. Additional focus on how to motivate learning of less experienced staff.

7. Overheight vehicles: Presentation on the special traffic regulations and response plans for managing the traffic flow of these vehicles. Case studies would be used. (This material is expected to be covered in 8 hours.)

6.3 Relationship of Performance Level KSAs to Model Training Program

In the following series of generic activity group tables, a set of tasks is provided, along with the KSA requirements for accomplishing those tasks at each of the three performance levels. The letter, or combination of letter and number, in parentheses in each performance level column points to the outline section in the model training program of section 6.2. Note that KSAs listed for the entry level position also apply to the full performance and advanced levels, and those listed for the full performance level position also apply to the advanced level. An example of how the activity tables relate to the training program is as follows: Table 5 shows that advanced level TMOTs require knowledge of HAZMAT policies, procedures, and codes (G) and area emergency evacuation policies and procedures (D). The D and G refer back to section 6.2 and indicate that the person filling this role should have training in (D) knowledge of the transportation management system and (G) principles and practices of technical traffic engineering. Note that training will also be required on (F2) ramp meters and traffic signals, as that is a requirement for the full performance level operator performing the tasks identified at the top of the table. The specifics of those paragraphs in section 6.2 provide information that can be used to develop appropriate training materials.

Once the discrete tasks have been identified by the software tool user, the user can elect to generate a training program. The tool uses the data from appendix B and the generic activity group tables to customize the training program outline for the TMC characterized in the tool and for the three performance levels.

Table 3. Human resources: generic activity group I.

Monitors, classifies, assesses, and archives data and other inputs regarding traffic accidents, road surfaces, traffic density, weather, traffic signal operation/malfunctions, construction projects, major disasters, and special events to maintain constant awareness of traffic system operation.

	Entry Level	Full Performance	Advanced
Knowledge	• TMC metro area road system. • Use of common language/terms used to describe traffic conditions.	• Road locations that are critical to traffic safety and/or traffic flow. (C; D) • TMOT's manual, including policies and procedures. (D) • Traffic system terminology. (B; D) • Principles of technical traffic engineering (e.g. queuing, capacity). (D; G)	• Traffic signal timing selection plans. (D; F2; H3) • HAZMAT policies, procedures and codes. (H2) • Overheight vehicle control regulations and response plans. (D; H7) • Rail crossing traffic signal controls and response plans. (D; F2; H3)
Skills/Abilities	• Skill in visualizing map locations (i.e., map reading skill). • Skill in reading and listening to detailed or technical information. • Ability to communicate orally and in writing to provide information clearly and succinctly. • Ability to learn a body of material consisting of regulations, and/or procedures. • Demonstrated success in dealing with pressure situations.	• Ability to analyze multiple source data from equipment and people under time pressure. (D; G) • Ability to communicate effectively with transportation system audiences (e.g., police, highway helpers, public). (C, D)	• Ability to interpret conflicting or ambiguous traffic incident/congestion information. (C; G; H4) • Ability to make a disciplined and timely assessment of information on potential for major disasters and emergencies. (C; G; H4)

Table 4. Human resources: generic activity group II.

Selects, activates, and operates a variety of existing equipment and information systems, including computers, traffic signal timing plans, closed circuit cameras, dynamic message signs, two-way radios, ramp meters, traffic density detectors using various software. These systems are used to collect road and traffic information and transmit accurate and timely images, messages, or data on traffic conditions and incidents under the purview of the TMC, and are located at a workstation in a TMC. Notifies information systems support professionals about equipment/software performance problems and issues work orders.

	Entry Level	Full Performance	Advanced
Knowledge	• Computer equipment/software with Microsoft Windows or equivalent systems.	• Software programs / equipment capabilities and limitations used in TMC-operated systems. (F1-5)	• Techniques to respond to and correct minor equipment / software performance problems. (H5)
Skills/Abilities	• Demonstrated general automation skill by use of moderately complex software used in spreadsheets, word processing, databases, or internet applications. • Demonstrated ability to operate and integrate audio, video, or other moderately complex electronic equipment.	• Skill in operating software and equipment used by a TMC. (B; F1-5) • Ability to clearly communicate with ITS staff regarding how the equipment and software is performing. (B; F1-5)	• Ability to independently troubleshoot and correct minor performance problems with equipment and software. (H5) • Ability to train/mentor other operators about equipment and software capabilities. (H6) • Ability to recommend improvements to traffic information systems and network operations. (H5)

Table 5. Human resources: generic activity group III.

Evaluates data on the severity of traffic conditions and other factors affecting the traveling public and selects the appropriate response plan in order to ensure the best possible flow of traffic using TMC policies, procedures, and precedents. Takes the necessary steps to implement the response plan and ensures that the conditions and responses are recorded into the data system of the TMC. Track and evaluate performance measurement data for use in modifying operations or recommending traffic systems operational changes.

	Entry Level	Full Performance	Advanced
Knowledge	• English usage and grammar, demonstrated by successful completion of relevant high school courses. • In specific TMCs, conversational Spanish -- test or structured interview. • Mathematical concepts, demonstrated by successful completion of related high school courses in geometry, algebra, or trigonometry.	• Principles of technical traffic engineering (e.g., queuing, capacity, etc.). (D; G) • TMC operations manual including policies, precedents, and procedures. • Intelligent transportation measuring systems (e.g., heuristic). (F2)	• HAZMAT policies, procedures, and codes. (G) • Area emergency evacuation policies and procedures. (D)

	Entry Level	Full Performance	Advanced
Skills/Abilities	• Ability to solve problems (e.g., demonstrated good judgment about career and life situations). • Demonstrated success in dealing with stressful situations. • Apply quantitative skills such as percentages, numerical ratios, and speed and distance formulas.	• Ability to diagnose and assess the severity of traffic incidents. (D) • Ability to develop and implement effective and disciplined response plans within established policies under time pressures. (D) • Skill in timely and effectively addressing customer service needs. (B; C; D; E)	• Ability to recognize when to override/modify automated system generated plan. (C; G; H4) • Ability to make timely and independent decisions to respond in unprecedented situations or major disasters (e.g., plane landing on highway, atypical HAZMAT spills). (C; G; H4; H6) • Ability to independently develop traffic management plans for special events and/or other areas of potentially chronic congestion. (C; G; H1; H4) • Ability to independently evaluate meter queues and adjust timing of ramp meters. (F2; G; H3) • Ability to recommend systems operational changes. (C; G)

Table 6. Human resources: generic activity group IV.

Coordinates with and/or dispatches other traffic management personnel and organizations such as police, fire and rescue squads, emergency assistance personnel, transit services, highway patrol, or traffic signal repair crews to resolve traffic systems problems or repair parts of the transportation management system. Participates in transportation planning activities as required.

	Entry Level	Full Performance	Advanced
Knowledge	• English grammar and usage, demonstrated by successful completion of relevant high school courses.	• Traffic management terminology. (B; D)	• Traffic management systems for arterial roads. (C)
Skills/Ability	• Ability to speak / write in an understandable manner using detailed information or technical terms. • Ability to listen and understand detailed and technical information.	• Skill to communicate technical information clearly and succinctly to peers. (C; D) • Ability to listen and understand detailed and technical information and apply solutions that are within established guidelines. (D)	• Ability to independently resolve issues from the competing or conflicting needs or concerns of other traffic management entities. (C; H4; H6) • Ability to represent the TMC at meetings to develop special events plans. (C; G; H1; H4; H6)

Table 7. Human resources: generic activity group V.

Disseminate information to the public through message signs, advisory radio, web sites, and other media to improve the flow of traffic.

	Entry Level	Full Performance	Advanced Level
Knowledge	• English grammar and usage. • Conversational Spanish (optional to specific position where metropolitan area has large Spanish-speaking population).	• Traffic system terminology. (B; D) • Web site management. (F5)	• Not applicable.
Skills/Ability	• Ability to speak clearly and succinctly.	• Ability to clearly communicate technical information in layman's terms. (C; D) • Skill in displaying courtesy and sensitivity to the motorist and public needs. (E)	• Not applicable.

7 COMPARABLE TMOT JOB CLASSIFICATIONS

The creation of position descriptions outlined in section 5 is an important step in staffing a TMC. The next step requires classification of the position, which involves a comparison of the described job with similar jobs in related work environments. This document provides the first known comparable job classification effort looking at TMC operations from the national perspective. It provides TMC managers, and their human resource counterparts, with information that is helpful in determining appropriate job classification categories for TMOTs, including an estimated pay range based upon the Federal Job Classification system (http://www.opm.gov/), and more specifically, the Federal Factor Evaluation System (FES).

Because job classification encompasses all the functions and the many operator tasks that a TMOT may perform, the comparable job classification analyses are based on an assessment of all the requirements for a particular job. Therefore, the first step in this task is to identify job descriptions that are representative, or prototypical, of those for operator positions in many TMCs.

Three prototypical TMOT position descriptions, based upon three KSA requirement groupings that reflect generic entry level, full performance, and advanced TMOT positions are provided. These provide a description of the details that may be included in a position description; they do not serve as examples of actual position descriptions. These groupings were selected from the menu of functions and tasks identified in section 3, and represent typical TMC configurations known to be in common use and observed in the field. Some of the larger TMCs in North America have all three positions in place and filled at any given time, while smaller TMCs may have a subset consisting of only a full performance or advanced operator, utilizing an entry level position only during times of personnel change (turnover). These three groupings represent the range of typical operator requirements the project team has observed in the field. The degree of specificity inherent in the prototypical generic activity groups used in section 3 is sufficient to provide a meaningful comparable classification at this general level. In order to classify a specific position, the process described in section 5 should be followed and a specific comparison done that takes into account demographics, labor force, and union requirements and other local factors that will enter into the establishment of a specific compensation range for the TMOT position.

7.1 Benchmark Position Descriptions

The “benchmark” position descriptions herein contain these three prototypical KSA constellations for entry level, full performance, and advanced. These position descriptions are written in a common and standardized format recognizable to federal human resource professionals, and have been customized for the TMC domain. For each constellation, it has been determined how the position would be classified in the FES. The suggested classifications are consistent with the intent of the FES and with best industry practice.

The FES is a method used to assign grades to nonsupervisory positions under the General Schedule (GS) in the federal government. It is based on nine factors: knowledge required by the position, supervisory controls, guidelines, complexity, scope and effect, personal contacts, purpose of contacts, physical demands, and work environment. The benchmark positions provided here use the FES format.

Each benchmark position description is based upon a prototypical grouping of KSAs that reflect a configuration of staffing common to many TMCs. The following position descriptions include a brief introduction, definition of major responsibilities based upon the KSAs, identification of special requirements of the position, and a description of the job classification factors that fully describe the detailed position requirements.

7.2 TMOT: Entry Level Position Description

This position description is for the entry level, or trainee position, performing technical work in a TMC. The work involves operating a variety of equipment and information systems to monitor, evaluate, and direct traffic operations for a specific geographic area covered by the TMC.

7.2.1 The Typical TMC and the Entry Level TMOT

The typical TMC is established to provide more efficient and safer highway capacity through the application of advanced traffic management technology, primarily in high-traffic volume corridors. The prototypical categorical activity grouping of program responsibilities in any TMC, applicable to the entry level operator, are as follows:

- Congestion monitoring
- Incident management (utilizing service patrols, emergency responders, and other highway operations responders)
- Traffic management (i.e., manage freeways and often arterial traffic control)
- Information management (i.e., to collect, process, synthesize, and fuse real-time information on the transportation information management system)
- Traffic information dissemination (i.e., motorist information and guidance)

Many TMCs are engaged in providing some of the additional functions, such as traffic signal system control and ramp meter control, for which trainees (entry level) may or may not be assigned during this entry level stage, depending on the specific TMC operations.

The entry level operator is a developmental position that receives close and detailed supervision from the 1st level supervisor, or a higher level TMOT. At entry level, the TMOT receives intensive OJT. OJT assignments include work on traffic systems monitoring, incident/congestion management, record keeping, and communications with other TMOTs in the TMC. Employees undergo training to learn to operate state of the art computerized traffic management workstations designed to facilitate traffic flow and minimize traffic congestion.

7.2.2 Major Duties and Responsibilities

Most employees are hired into a TMOT developmental position, with a basic set of KSAs, but without specialized experience or subject matter knowledge required by a TMOT position. The position is the initial level (frequently referenced as Operator Level I) of a career ladder, with potential for advancement to the full performance level TMOT position in the TMC. The position requires successful completion of on-the-job and formal training in order to advance to the full performance level. The entry level TMOT is learning the system requirements and honing skills/abilities that will be necessary to advance to that level, or higher level advanced positions.

Under a formalized training plan, initial entry personnel gain training and on-the job assignments from a supervisor or higher level TMOT, in the following responsibilities:

1. Monitor and assess information on traffic flow and the external conditions affecting traffic flow;

2. Select and operate specific traffic management equipment at a workstation, to gain information in order to manage traffic flow;

3. Evaluate traffic incidents and formulate operational plans, using policies, procedures, and precedents;

4. Coordinate and plan with various TMOTs and supervisors, or other traffic management organizations, to resolve episodic and chronic traffic control congestion and problems; and

5. Disseminate information to the public and public media, through message signs, advisory radio, web sites and other media to improve the flow of traffic.

At the developmental level, examples of specific OJT assignments are as follows:

1. Monitor radios/police scanners, closed circuit television (CCTV) displays, and TMC GUI displays, including map based information, for traffic incidents;

2. Disseminate information to local radio and traffic monitoring media;

3. Monitor computer traffic signal and ramp metering activities (where applicable within the specific TMC);

4. Disseminate traffic signal malfunction information to appropriate personnel (e.g. emergency traffic patrols, emergency response units, or other highway operations response units), or to other traffic management jurisdictions;

5. Perform recordkeeping tasks, make keyboard entries, and generate daily reports.

The developmental TMOT works in conjunction with, and assists, higher level technicians in performing the above responsibilities, as part of an overall training plan, which is communicated to the employee at the beginning of his/her employment. The following is a summary of typical learning goals in a training plan for this position:

1. **Orientation to the TMC:** Includes understanding organizational structure; applicable laws, regulations, and standards; personnel policies; pay practices; shifts; formal training opportunities; work environment; security; evacuation procedures; computer security; and introduction to TMC operation and senior management.

2. **Control Room Operations:** Overview of staff roles including discussion of various staff responsibilities in the control room, including dispatcher, traveler information operator, and TMC technician; relationship of the control room to other TMC operations, and overall relationship to State transportation management system; customer service and accountability of operators/technicians; and TMC liabilities and information dissemination policies.

3. **Area Transportation System:** Understanding the area transportation system, other agencies involved in traffic control, and how the control room interfaces with those agencies, other transportation modes such as buses and light rail that affect road systems, and traffic laws as applicable to the State department of transportation (DOT) and other responders.

4. **Software and Equipment Used at the Workstation:** Understanding of how to startup, use, and shut down existing systems; identify error messages; how to report outages or problems; and how to resolve minor automation problems using available system documentation.

5. **TMC Traffic Management System:** This includes the functionality and use of variable/dynamic message signs, monitors, ramp meters, HOV lanes, intersection traffic signals, traffic signal timing selection plans, lane controls (including shut down processes), and HAR processes and procedures. The entry level TMOT must also understand other parts of the system, including the use of logs and shift transfer procedures; incident management procedures; dispatching, contacting, and reporting processes; coordination with other partners in traffic management (such as law

enforcement, fire protection, etc.); traffic surveillance and detection procedures; map interpretation; and radio console use and call signals.

7.2.3 Special Requirements of the Position

Employees in this position may be required to work rotating shifts on a 24/7 or 16/7 per week schedule, to include evenings, nights, holidays, and weekends. In the event of emergency highway conditions, the employee is subject to callback during scheduled off-hours. Depending on the policies, laws, and regulations based in local or state transportation code for the specific TMC, employees may also be subject to (or protected from) substance abuse testing, for use of illegal drugs or other substances. In cases where law enforcement officials are co-located in the TMC, background checks may be pre-requisite to employment.

7.2.4 Classification Factors

The developmental position is analyzed based on the accepted definitions for KSAs, and the descriptions and matrices established in sections 3 and 4. While each TMC will have to customize the KSAs to reflect their local needs, the following classification factors from the FES were based on the aforementioned position requirements most commonly in place at North American TMCs.

7.2.4.1 Factor 1, Knowledge Required by the Position

This factor defines the kind of KSAs required, and how the KSAs are used in doing the work described below. TMOTs are technical positions and require the exercise of judgment and discretion, which becomes even more critical at the full performance and advanced levels. Developmental employees will have to possess basic technical skills and aptitudes that will enable them to acquire more subject-specific KSAs, required to advance in a developmental position to a full performance level.

- Monitor and assess traffic flow: The TMOT must have a general awareness and understanding of the TMC area road system and be knowledgeable of common language/terms used to describe traffic conditions. The TMOT must demonstrate skill in visualizing map locations (i.e., map reading skill) using two dimensional representation of a three dimensional field of view, skill in reading and listening to detailed or technical information, ability to communicate orally and in writing and provide information clearly and succinctly, ability to learn a body of material consisting of regulations and procedures, and ability to deal with pressure or "crisis" situations.

- Select and operate specific traffic equipment, to gain Information in order to manage traffic flow: automation and electronic skills: Must have the ability and skill to operate a wide variety of electronic and other equipment. Incumbent must have skill in operating computer

hardware and software in a windowing applications environment. TMOT must be able to respond to system queries, use menus, and edit data fields.

- Evaluate data on traffic incidents and formulate operational response plans, using TMC policies, procedures, and precedents: Must have skill in English usage and grammar (verbal and written), as well as mathematical concepts, reflecting a basic understanding of the elements and processes of geometry and algebra. The TMOT must demonstrate an ability to solve practical problems, deal with stressful situations, and apply quantitative skills such as percentages, numerical ratios, and speed and distance formulas. Must be able to read, understand, and perform traffic control procedures specified in a systems operator manual.

- Coordinate with and dispatch other traffic management personnel as required; coordinate with other organizations, such as police, fire and rescue squads, etc.: Must understand emergency traffic procedures and roles of the various traffic management organizations. The TMOT must have skill in English grammar and usage, and ability to speak/write in an understandable manner using detailed information or technical terms, as well as an equal ability to listen and to understand detailed and technical information, which is being disseminated by other personnel/organizations.

- Disseminate traffic flow information to the public through message signs, advisory radio, web sites, and other media: Must understand and be able to apply English grammar correctly, and must demonstrate the ability to speak clearly and succinctly.

- Understand the legal framework controlling traffic management policies and procedures: As the developmental TMOT progresses, he/she must quickly understand the local traffic laws within the area covered by the TMC and the surrounding jurisdictions, and their impact on police and emergency assistance.

- "Sprinter Mentality": Must have a "sprinter mentality," described as an ability to adjust from a low to high level of activity quickly, to respond to immediate traffic management incidents or situations, and to make accurate and rapid judgments based on the data and information available.

7.2.4.2 Factor 2, Supervisory Controls

This factor describes how the work is assigned, the employee's responsibility for carrying out the work, and how the supervisor reviews the employee's work. The developmental TMOT:

- Is assigned work by the TMC supervisor with specific instructions and guidelines on the goals and objectives of the assignment, as well as the methodology or work processes to complete the assignment.

- Works under the direction of a more senior TMC TMOT. Gains experience and knowledge of TMC control room operations by assisting in the completion of the work. The employee

also receives formal training in the specific work areas, and has the responsibility to progress *on a continuum of on the job and formal* training to higher level work assignments, and within a reasonable period of time to achieve a higher level technician position. Incumbent is expected to work with greater independence as he/she progresses.

- Depending on employee's prior experience, may be assigned routine or less complex TMC operation assignments to complete independently, with only a general review being done by the supervisor, upon completion of the assignment.

- Is reviewed closely and regularly by the most senior TMOT or supervisor, and guidance and direction is given to the employee on a day-to-day basis in the completion of non-routine assignments. The employee's work is assessed regularly and feedback on progress and areas for improvement are regularly given to the employee as he/she progresses in the position.

7.2.4.3 Factor 3, Guidelines

This factor describes the nature of the guidelines (e.g. procedures and policies, regulations, law, and interpretations/precedents) for performing the work, and the judgment needed by the employee to apply the guidelines or develop new guidelines. These guidelines are:

- Usually encompassed in a book normally called the "TMC Operations Manual." This manual defines the specific goals and objectives of the TMC, and the operations of the TMC and the control room. The guidelines are very specific, reference the TMOT responsibilities and include: the State Operations Center (SOC) guidelines; guidelines for traffic operation facilities other than the SOC; radio communications; the traveler's advisory radio (TAR); VMS; CCTV; camera locations and utilization; incident management procedures and agencies to be contacted; description of equipment, facilities, and reporting systems within the TMC.

- Provided to the TMOT who is expected to follow specific instructions and guidelines exactly, and to complete work in accordance with the specific procedures and processes outlined in the TMC Operations Manual or other applicable guidelines established by other traffic management organizations and used by the TMC. There is limited room for discretion, and judgment is limited to following the procedural instructions exactly as written or communicated to the employee. However, the difficulty in this position is integrating the different procedural directions and policies quickly in order to make timely decisions that may have a major impact on traffic flow management. As the developmental TMOT progresses, he/she must exercise judgment in determining which guidelines to follow based on the specific traffic management situation(s), and must demonstrate the mental agility to react to a wide variety of traffic situations.

7.2.4.4 Factor 4, Complexity

The complexity of the position is based on the nature of the assignment, the tasks and methodology, as well as the difficulty in understanding what needs to be done, and how to accomplish the work. Complexity reflects the difficulty and originality required to perform the work which:

- Requires detailed application of specific procedures and processes to routine or non-complex assignments. The employee must apply specific instructions or guidelines to particular cases and demonstrate the capacity to follow those instructions in detail to the completion of the assignment.

- Is developmental in nature, and demands strict adherence to the procedure, and the instruction from a higher level technician. The assignments may limit originality or creativity, or broad discretion in determining the action to be taken, but the difficulty is in applying multiple procedures or instructions quickly and timely to specific traffic incidents demanding immediate judgments and actions. The complexity is in the application of specific instructions to real life traffic management cases that demand immediate determinations.

- Requires imposed deadlines that increase the pressure of the responsibilities. Tight time frames and the crisis of the incident frequently will cause stress and demand action within very narrow time frames to resolve immediate problems.

- Requires that the TMOT be able to rapidly "visualize" maps of streets and traffic flow based on computer screens and graphics. He/she must also recognize and utilize different parts of the traffic management system, human and technical, to alleviate the traffic congestion problem.

- Requires the coordination with other TMC technicians, and with other traffic management organizations, including police, fire and rescue personnel, and other emergency response units.

7.2.4.5 Factor 5, Scope and Effect

This factor defines the overall purpose of the work, or the ultimate goal, and the impact of the work product or service provided. The TMOT:

- Performs technical highway operations work, involving traffic systems control, incident/congestion management, and traffic management communications.

- Is assigned tasks and formal training in order to gain KSAs, in order to become a fully operational TMOT, and to complete assigned traffic management work independently.

- Assists higher level technicians in completing routine and less complex assignments on the control room floor, and to participate as a team member on TMC technical planning teams.

- Supports the TMC in facilitating traffic flow and minimizing traffic congestion on major roads and arterial roads, which is the major impact.

7.2.4.6 Factor 6, Personal Contacts; and
7.2.4.7 Factor 7, Purpose of Contacts

These factors evaluate the personnel, internal or external to the TMC, with whom the employee has regular contact, and the purpose of those contacts (i.e., give or exchange information, resolve problems, provide service, negotiate or persuade others, etc.). Contacts include:

- Internal staff, including higher level technicians, and supervisors or management personnel in the TMC. The purpose is to gain knowledge, including instruction, information, and guidance, and to practice skills and abilities in doing the higher level TMC technician position.

- Officials or representatives of other traffic management organizations, including the police, fire and rescue squads, and assigned emergency response units, as well as representatives from other TMCs that may be affected by his/her service provided.

- The traveling public and the traffic media under the guidance and direction of a higher level specialist.

7.2.4.8 Factor 8, Physical Demands; and
7.2.4.9 Factor 9, Work Environment

These factors evaluate the physical demands placed on the employee, including climbing, lifting, etc., and the physical surroundings or environment where the employee works. The employee works in a control room that:

- Includes only normal amounts of physical activity, including lifting and climbing as required on an occasional basis.

- Physical abilities to see and read displays and hear sounds as required to perform in a TMC.

- Has no specific safety or health restrictions or limitations, nor any recognized work environment hazards or HAZMAT.

7.3 TMOT: Full Performance Level Position

This position is the full performance level, or journeyman level position, performing technical work in a TMC. The work involves operating a variety of equipment and information systems to monitor, evaluate, and direct traffic operations for a specific geographic area covered by the TMC. It requires experience, expertise, and skills in automation software and applications.

7.3.1 Introduction

The typical TMC is established to provide more efficient and safer utilization of highway capacity through the application of advanced traffic management technology, primarily in high-traffic volume corridors. The prototypical program responsibilities of any TMC, applicable to the full performance TMOT, are as follows:

- Congestion monitoring
- Incident management (utilizing service patrols, emergency responders, and other highway operations responders)
- Traffic management (i.e., manage freeways and often arterial traffic control)
- Information management (i.e., to collect, process, synthesize, and fuse real-time information on the transportation information management system)
- Traffic information dissemination (i.e., motorist information and guidance)

It should be noted that different TMCs nationwide may have a number of additional functions, such as signal control and ramp meter control, and in those locations full performance technicians will be assigned these responsibilities upon completion of the developmental training, and dependent upon the specific TMC operations.

The full performance technician operates independently and through advanced systems training and more complex assignments on the job; the incumbent works towards the advanced technician level. At this journeyman level, the TMC technician operates with only general direction and guidance from the TMC 1st level supervisor, but makes immediate technical decisions independently. The TMC technician has specific responsibilities for traffic systems control, incident/congestion management, the facility communications network and systems, and traffic information dissemination. At this level, employees receive training and on-the job experience in state of the art software and automated traffic management workstations. The technician has responsibility to use these most advanced automated tools to facilitate traffic flow, minimize traffic congestion, and manage difficult traffic incidents that may involve public safety risks.

The role of the journeyman TMC technician is evolving rapidly as the role of the TMC evolves. TMCs are becoming active partners in area-wide and regional transportation management systems, and must be more integrated and multi-modal to implement these more complex transportation systems. TMCs will move far beyond the current focus on highway operations and surface street signal systems, to linking all transit system operations in a broad geographical area or center. This multi-jurisdictional and multi-modal operation of TMCs is expected to result in the further linking of TMCs in major metropolitan areas in more complex, hierarchical,

and hybrid TMC architectures. Wide-area advanced traveler information system databases are anticipated to develop and provide a seamless flow of multi-modal travel information.

7.3.2 Major Duties and Responsibilities

At the full performance level, the TMC technician has complete responsibility for the major functions or tasks of the TMC. He/she has gained the specialized experience and subject matter knowledge in traffic systems control, incident/congestion management, automated communications networks and systems, and the accomplished techniques and strategies of traffic information dissemination. The TMC Technician has the following overall responsibilities:

1. Monitor and assess information on traffic flow and the external conditions affecting traffic flow;

2. Select and operate specific traffic management equipment at a computer workstation, to gain information in order to manage traffic flow;

3. Evaluate traffic incidents and formulate operational plans, using policies, procedures, and precedents;

4. Coordinate and plan with various TMOTs and supervisors, or other traffic management organizations, to resolve episodic and chronic traffic control congestion and problems; and

5. Disseminate information to the public and public media, through message signs, advisory radio, web sites, and other media to improve the flow of traffic.

The specific areas of major operational responsibilities for which the independent full performance technician is accountable are multiple and varied. Every technician does perform a substantial number, though not necessarily all, of the following responsibilities:

1. Surveillance of traffic flow (traffic management): Uses detection and visual and vehicle probe techniques to conduct surveillance;

2. Incident management: Performs tasks related to incident detection, response, and monitoring;

3. Public and private information dissemination: Sends traffic data and other travel-related information to private and public organizations;

4. Interagency information sharing: Shares data and travel condition information among agencies involved or interested in TMC operations (incumbent may also use information for traffic data synthesis and analysis);

5. Environmental monitoring: Conducts observation and detection of air quality, noise, and weather conditions;

6. Special event management: Performs control, surveillance, and monitoring, and has responsibility for responses to traffic conditions, or incidents during special events;

7. Emergency Management and Coordination with Emergency Agencies: Coordinates, communicates, and dispatches personnel and emergency vehicles to respond to traffic incidents or congestion. In the case of natural catastrophes or disasters, technician has responsibility for dispatch and the direct involvement of TMC personnel dedicated for on-site emergencies.

8. HAZMAT management: Responds to traffic incidents involving hazardous materials, and communicates with or dispatches appropriate personnel to that incident;

9. HOV operations: Activates traffic surveillance and collects data on HOV operations, including bus priority or exclusive bus lane operations;

10. Planned lane track closure management: Coordinates and monitors scheduled maintenance and construction activities related to the maintenance and protection of traffic or transit operations;

11. Data fusion: Integrates various data sources (collected by the TMC and by sources outside the TMC), in order to perform traffic data synthesis and analysis tasks;

12. Ramp metering: Controls ramp metering devices for highways, HOV facilities, or even toll approaches (not at toll plazas);

13. At-grade rail intersection management: Monitors, controls, modifies, or preempts surface street traffic signals in response to changing traffic conditions, and may include actual control access to a railroad track crossing through signs and signaling operations;

14. Lane control signals: Controls, modifies, or sets emergency priority operations of lane use signals on streets and highways in response to traffic conditions, construction, or emergency or reversible lane usage.

Other responsibilities which are not in every technician position may include: monitoring toll operations tunnels or bridges; managing risk/liability, lowering risks and the potential for traffic liabilities, or lowering risks in response to traffic incidents; and taking calls from, and responding directly, to the public requesting or providing information.

7.3.3 Special Requirements of the Position

Employees in this position may be required to work rotating shifts on a 24/7 or 16/7 per week schedule, to include evenings, nights, and weekends. In the event of emergency highway conditions, employee is subject to callback during scheduled off-hours. Depending on the policies, laws, and regulations based in local or state transportation code for the specific TMC, employees may also be subject to substance abuse testing, for use of illegal drugs or other substances. In cases where law enforcement officials are co-located in the TMC, background checks may be pre-requisite to employment

7.3.4 Classification Factors

The full performance position was analyzed based on the accepted definitions for KSA descriptions and matrices established in Task Report C of the Phase 1 effort. While each TMC may customize these KSAs at the full performance level to meet their local needs, the following classification factors were based on the aforementioned position requirements most commonly in place at TMCs.

7.3.4.1 Factor 1, Knowledge Required by the Position

This factor defines the kind of KSAs required and how the KSAs are used in doing the work described above. TMC technicians require the exercise of judgment and discretion that is critical to successful accomplishment of the TMC mission. The technician must:

- Operate a standard computer workstation in a windows application environment, and understand and apply real time automated device control and command execution. The technician must navigate between multiple open application windows, and use available macros to accelerate editing of data fields. The incumbent must execute single control commands for either single or multiple automation devices.

- Have an in-depth knowledge of the TMC traffic management systems. This includes the functionality and use of variable/dynamic message signs, ramp meters, HOV lanes, intersectional traffic signals, traffic signal timing selection plans, lane controls (including shut down processes), and HAR processes and procedures.

- Understand and apply consistently the use of TMC logs and shift transfer procedures; incident management procedures; dispatching, contacting, and reporting processes; coordination with other partners in traffic management (such as law enforcement, fire protection, etc.); traffic surveillance and detection procedures; map interpretation; and radio console use and call signals.

- Listen to and correctly interpret multiple information feeds, coming in rapid-fire fashion from diverse callers, including police dispatchers, other TMC operations, and the public. Incumbent must convey important information clearly and succinctly, and switch quickly between lines without losing calls, utilizing speed and multi-channel dialing. In order to

coordinate functions and responsibilities within the TMC, the Technician must effectively communicate with other TMOTs and supervisors. The incumbent at the full performance level must consistently communicate at a high level, capturing and conveying important information while minimizing superfluous verbiage, slang, and lost data.

- Understand traffic information from visual sources in a frequently complex transportation schematic. Incumbent demonstrates "journeyman" knowledge of highway maps, outdoor and indoor video image displays, graphical text data, icons, and transportation modes and symbols.

- Quickly and accurately understand and communicate visual or graphic information from the TMC display wall, and match video orientation with static images. This requires an advanced map reading level based on skills and abilities, enhanced by in-depth experience in the TMC. The incumbent must have the skill to read character text information, within a matter of seconds, and effectively and timely note the changed and unusual traffic management conditions based on emergency graphic icons.

- Have a working knowledge of traffic flow characteristics, such as high speed, velocity, volume, average speed, density and percent of highway occupancy, traffic demand, and capacity. Technician must determine if the traffic data viewed is abnormal, anomalous, or within applicable thresholds.

- Have knowledge of the likely duration for emergency responders to respond to incidents and time frames for clean up of incident based on incident type. Incumbent must have the knowledge/skill to use data fusion methods to create standardized ATIS message sets. If radio console use is required, incumbent must have knowledge of radio call signs and required protocols.

- Know traffic law and incident management policies for the State DOT and the emergency responders, including police agencies. Incumbent must understand the relationships between local law enforcement jurisdictions, in terms of their impact on traffic management and incident response.

- Understand the theory and practice of traffic device operation.

- Regulatory device operation responsibilities (e.g. adjust traffic signal timings, activate lane use signals) including: transition and safety measures; a knowledge of split, cycle, offset, detectorization, and coordination; traffic signal selection timing plans; zones; master/slave concepts; saturation; transition cycles; capacity utilization and flow characteristics; and queuing principles and practices. In terms of the impact on traffic flow, the incumbent must know the theory of operation for variable speed limit, lane closure, ramp closure, and/or road closure for highways, tunnels, and bridges.

- Have the knowledge and skill, based on visual input from CCTV (traffic cameras), to establish the precise traffic location data, determine the revised lane configuration, and clearly classify incidents as property damage, injury, spilled load, HAZMAT, fire, type and number of vehicles, or overturned trucks. Incumbent must have the writing skill to complete the initial incident form clearly through a handwritten log or data entry.

- Possess working level knowledge of state and federal principles of public transportation policy, and demonstrate an understanding of customer service principles, transportation regulations, and principles of enforcement, liability, accountability, responsibility, and information dissemination.

7.3.4.2 Factor 2, Supervisory Controls

This factor describes how the work is assigned, the employee's responsibility for carrying out the work, and how the supervisor reviews the employee's work. The technician:

- Receives only general guidance from the 1st level TMC supervisor, and the supervisor may outline the outcomes expected or overall priorities in traffic management for the TMC. The technician performs the responsibilities independently.

- Is reviewed by the supervisor only upon completion of assignment or project, or by just a general review of the incumbent's achievement of the overall TMC objectives. Incumbent does not receive regular day-to-day, or week-to-week reviews on either routine or complex responsibilities. The full performance technician has accountability for completion of day to day work in a timely and successful manner.

- Performs responsibilities independently and seeks guidance only on the most complex issues, or issues that may be controversial for the State DOT or controversial in terms of normal TMC operations. For both routine and complex responsibilities, technician is accountable for successful completion of the assignments, without technical guidance or direction from the 1st level supervisor.

7.3.4.3 Factor 3, Guidelines

This factor describes the nature of the guidelines (e.g. procedures and policies, regulations, law, and interpretations/precedents) for performing the work, and the judgment needed by the employee to apply the guidelines or develop new guides. These guidelines are:

- Usually encompassed in the TMC operations manual. This manual defines the specific goals and objectives of the TMC, and the operations of the TMC and the control room. The guidelines reference the TMOT responsibilities and include: the SOC guidelines; guidelines for traffic operation facilities other than the SOC; radio communications; TAR or HAR; VMSs; CCTV; camera positioning and utilization; incident management procedures and agencies to be contacted; and description of equipment, facilities, and reporting systems

within the TMC. Guidelines may also include State transportation policies and procedures, as well as the policies and procedures of police agencies, and emergency responder units within the area/facilities covered by the TMC.

- Provided to the TMC technician who must know and understand the information in-depth. The technician gains extensive experience with precedent setting traffic management cases and issues that provide to the incumbent the broad technical background to make the difficult TMC operation judgments. At this level, there is a requirement for experienced discretion and judgment on individual cases or incidents, and the incumbent must frequently interpret and apply the guidelines based on his/her judgment.

7.3.4.4 Factor 4, Complexity

The complexity of this position is based on the nature of the assignment, the tasks and methodology, as well as the difficulty in understanding what needs to be done, and how to accomplish the work. Complexity reflects the difficulty and originality which:

- Requires the integration of different procedural directions and policies quickly in order to make timely decisions that may have a major impact on traffic flow management throughout the TMC area. The full performance technician must exercise judgment in determining which guidelines to follow based on the specific traffic management situation(s), and must demonstrate the mental agility to react to a wide variety of traffic management complications.

- Requires detailed application of specific procedures and processes to highly complex, as well as routine, traffic management assignments. The TMC technician must understand the specific TMC manual guidelines and procedures, and be able to apply those policies/procedures in a real time environment to particular traffic incidents or broader traffic management crises. The technician's decisions and methodology must not only be in conformance with the applicable guidelines, but must also reflect journeyman level judgment to ensure the safety and security of the traveling public, and concurrently, the effective facilitation of traffic flow to particular cases. The technician must demonstrate the capacity to follow those instructions in detail to the completion of the assignment.

- Involves the selection and application of various approaches and strategies to resolve the issues from traffic incidents or congestion quickly and safely. Those strategies and approaches must conform to the TMC policies and procedural requirements, as well as meet State DOT regulations and procedures.

- Gathers and synthesizes reliable data from various field video devices, as well as through radio and telephone communications with other transportation management agencies, and the public. Incident detection information synthesized by TMC technicians is frequently gathered by sources outside of, and not controlled by, the TMC, which adds to the complexity of the technician verification and coordination responsibility. These outside

sources include radio communications, phone calls, and fax transmissions with other agencies or private organizations.

- Involves working under imposed deadlines that increase the pressure of the responsibilities on this position. Tight time frames and the crisis of the incident frequently will cause stress on the incumbent and require extensive coordination with other TMC personnel, staff and supervisors, as well as other traffic management organizations. The coordination and the decisions by the incumbent demand action within very narrow time frames to resolve immediate problems.

- Operates and modifies or adapts advanced automation hardware and software in order to synthesize and transmit information to end-users, and to achieve a quicker response to incidents and to aid in the mitigation of recurring peak travel conditions.

- Rapidly "visualizes" maps of streets and traffic flow based on computer screens and graphics. He/she must also recognize and utilize different parts of the traffic management system, human and technical, to alleviate the traffic congestion problem, both safely and effectively to meet time constraints and alleviate traffic congestion. The incumbent must reflect the safety and security of the traveling public, the emergency responders, and the appropriate police personnel responding, in making both complex and potentially controversial traffic management decisions.

- Coordinates information analysis and dissemination with other TMC technicians, and with other traffic management organizations, including police, fire and rescue squads, and other emergency response units. This is the overriding complexity element in this position.

7.3.4.5 Factor 5, Scope and Effect

This factor defines the overall purpose of the work, or the ultimate goal, and the impact of the work product or service provided within and outside the organizations, as well as the impact on the public. The technician:

- Gathers, synthesizes, and disseminates traffic and travel condition information on a real-time basis. These are core functions. The overall purpose of the work of the TMOT is to perform highway operations monitoring involving traffic systems control, incident/congestion management, and traffic management communications. The scope of these responsibilities are broad because the efficiency and effectiveness of the overall transportation systems, including the safe efficient flow of traffic, depends on how well this technician performs and coordinates these three core functions.

- Collects data in a variety of congestion or incident indicators. This "data" becomes usable "information," updated on a real-time basis by the technician. Without the technician, the response to a traffic incident or information on the deterioration of traffic conditions would be delayed and not received in a usable format on a real-time mode. However, the

technician's impact is in synthesis, analysis, and transmission of information immediately, in order to achieve a quicker response to incidents, and to aid in the mitigation of recurring peak travel congestion.

- Monitors incident-related traffic conditions, as well as normal or "abnormal" traffic patterns. When incidents occur, technicians play a significant role in the three basic incident management functions: detection, response, and monitoring. The impact or effect of the work is to fully support the TMC in facilitating traffic flow and minimizing traffic congestion on major highways and arterial roads.

- Use the collected data to adjust ramp metering controls, prepare VMS messages, generate graphical displays (for the TMC and the public/media use), and present "information" on the real time traffic conditions in text form to transportation officials.

- Influences the operation of emergency incident responders, police agencies, other traffic management "partners" within the TMC area, and the successful work of the complete staff of the TMC, including traffic engineers, supervisors, and TMC management officials.

7.3.4.6 Factor 6, Personal Contacts; and
7.3.4.7 Factor 7, Purpose of Contacts

These factors evaluate the personnel, internal or external to the TMC, with whom the full performance technician has regular contact, and the purpose of those contacts (i.e., give or exchange information, resolve problems, provide service, negotiate or persuade others, etc.). However, frequently the TMC technician must persuade or convince other traffic management staff in outside transportation organizations, emergency responders, or police agency contacts of the necessity for specific real time actions based on the technician's synthesis and analysis of the data input into the TMC multiple systems. This technician expertise is based on a broad experience and skill base in traffic management operations. Contacts include:

- Officials or representatives of other traffic management organizations, including the police, fire and rescue squads, and assigned emergency response units, as well as representatives from other TMCs that may be affected by the service provided by the incumbent.

- The traveling public and traffic media, which are provided information upon request. The technician must be sensitive and astute in providing accurate, objective information.

Occasional contacts with high level State transportation management officials in order to resolve a difficult or dangerous transportation congestion problem which may affect a complete regional traffic operation, or specific traffic incidents that have created substantial traffic safety issues on major highways. The technician again must use persuasion and negotiation to convince the State DOT officials on the proper course(s) of action to ensure public safety and the minimization of traffic congestion.

7.3.4.8 Factor 8, Physical Demands; **and**
7.3.4.9 Factor 9, Work Environment

These factors evaluate the physical demands placed on the employee, including climbing, lifting, etc., and the physical surroundings or environment where the employee works. The technician works in a control room that:

- Includes normal amounts of physical activity, including lifting and climbing as required on an occasional basis.
- Physical abilities to see and read displays and hear sounds as required to perform in a TMC.
- Has no specific safety or health restrictions or limitations, nor any recognized work environment hazards or HAZMAT.

7.4 TMOT: Advanced Level Technician

This position is the advanced level technician in the TMC. The advanced level has the responsibility for the highest-level technician work in a TMC. The work involves operating a variety of equipment and information systems to monitor, evaluate, and direct traffic operations for a specific geographic area covered by the TMC. This position requires senior level experience, expertise and skills in automation software and applications.

7.4.1 Introduction

The typical TMC is established to provide more efficient and safer highway capacity through the application of advanced traffic management technology, primarily in high-traffic volume corridors. TMCs are able to process and synthesize the integration of measurable traffic and transportation evaluation data (e.g. traffic volume, queue lengths, average delay, headways, weather, etc.) gathered from multiple data collection systems in a continuous and real time flow of information. The prototypical program responsibilities of any TMC are as follows:

- Congestion monitoring
- Incident management (utilizing service patrols, emergency responders, and other highway operations responders)
- Traffic management (i.e., manage freeways and often arterial traffic control)
- Information management (i.e., to collect, process, synthesize, and fuse real-time information on the transportation information management system)
- Traffic information dissemination (i.e., motorist information and guidance)

It should be noted that TMCs nationwide may have a number of additional functions, such as signal control and ramp meter control, and in those locations advanced level technicians are generally assigned these higher level responsibilities

The role of the advanced TMC technician is evolving rapidly as the role of the TMC evolves. The TMCs are becoming active partners in area-wide and regional transportation management systems, and must be more integrated and multi-modal to implement these more complex transportation systems. TMCs will move far beyond the current focus on highway operations and surface street signal systems, to linking all transit system operations in a broad geographical area or center. This multi-jurisdictional and multi-modal operation of TMCs is expected to result in the further linking of TMCs in major metropolitan areas in more complex, hierarchical, and hybrid TMC architectures. Wide-area advanced traveler information system databases are anticipated to develop and provide a seamless flow of multi-modal travel information.

The advanced level TMC technician role is critical to the future success of each of the local TMCs nationwide.

7.4.2 Explanation of Differences between Advanced and Full Performance Levels

The differences between the full performance level technician and the advanced level are based on the individual employee's increasing in-depth expertise and ability at the higher level, and the reliance on the advanced level technician's expertise by first level supervisors and senior TMC management. At this level, the technician independently conducts TMC assignments (duties and responsibilities) without direct supervision or guidance, and frequently provides direction and guidance, or OJT, to full performance level technicians and developmental TMOTs in the completion of more difficult or complex assignments. The advanced technician may be the team lead on TMC wide projects, or frequently represent the TMC in negotiations and dialogue with other traffic management operations in the overall geographic area.

To advance to this level, the technician has individually made an impact on his/her position (impact of person on the job) and usually has two or more years of high level skill and ability as a full performance technician before achieving eligibility for advancement. Therefore a number of the advanced technician assignments or on-going responsibilities may be the same as those for the full performance technicians, but the individual's completion of those assignments is significantly different in terms of the level of responsibility, supervisory controls, guidelines, and frequently, the accountability to represent the TMC outside the center.

7.4.3 Major Duties and Responsibilities

At the advanced level, the TMC technician has complete responsibility for the major functions or tasks of the TMC. He/she has gained the specialized experience and subject matter knowledge in traffic systems control, incident/congestion management, automated communications

networks and systems, and the accomplished techniques and strategies of traffic information dissemination. The TMC technician has the following overall responsibilities:

1. Monitor and assess information on traffic flow and the external conditions affecting traffic flow;

2. Select and operate specific traffic management equipment at a computer workstation to gain information in order to manage traffic flow;

3. Evaluate traffic incidents and formulate operational plans using policies, procedures, and precedents;

4. Coordinate and plan with various TMOTs and supervisors, or other traffic management organizations, to resolve episodic and chronic traffic control congestion and problems; and

5. Disseminate information to the public and public media, through message signs, advisory radio, web sites, and other media to improve the flow of traffic.

The specific areas of major operational responsibilities for which the advanced technician is accountable are multiple and varied. At the advanced level, the technician must demonstrate the capability to perform almost all of the following responsibilities:

1. Surveillance of traffic flow (traffic management): Uses detection and visual and vehicle probe techniques to conduct surveillance;

2. Incident management: Performs tasks related to incident detection, response and monitoring;

3. Public and private information dissemination: Sends traffic data and other travel related information to private and public organizations;

4. Interagency information sharing: Shares data and travel condition information among agencies involved or interested in TMC operations (incumbent may also use information for traffic data synthesis and analysis);

5. Environmental monitoring: Conducts observation and detection of air quality, noise, and weather conditions;

6. Special event management: Performs control, surveillance, and monitoring, and has responsibility for responses to traffic conditions or incidents during special events;

7. Emergency management and coordination with emergency agencies: Coordinates, communicates, and dispatches personnel and emergency vehicles to respond to traffic incidents or congestion. In the case of natural catastrophes or disasters, technician has

responsibility for dispatch and the direct involvement of TMC personnel dedicated for on-site emergencies.

8. HAZMAT management: Responds to traffic incidents involving hazardous materials, and communicates with, or dispatches appropriate personnel to that incident;

9. HOV operations: Activates traffic surveillance and collects data on HOV operations, including bus priority or exclusive bus lane operations;

10. Planned lane closure management: Coordinates and monitors scheduled maintenance and construction activities related to the maintenance and protection of traffic or transit operations;

11. Data fusion: Integrates various data sources (collected by the TMC and by sources outside the TMC) in order to perform traffic data synthesis and analysis tasks;

12. Ramp metering: Controls ramp metering devices for highways, HOV facilities, or even toll approaches (not at toll plazas);

13. At-grade rail intersection management: Monitors, controls, modifies, or preempts surface street traffic signals in response to changing traffic conditions, and may include actual control access to a railroad track crossing through signs and signaling operations;

14. Lane control signals: Controls, modifies, or sets emergency priority operations of lane use signals on streets and highways in response to traffic conditions, construction, or emergency or reversible lane usage.

Other responsibilities which may be specifically assigned to the advanced level include: monitoring toll operations tunnels or bridges; risk/liability management focused on lowering risks and the potential for traffic liabilities, or lowering risks in response to traffic incidents; and taking calls from, and responding directly to, the public or media sources requesting or providing real time information.

7.4.4 Special Requirements of the Position

Employees in this position may be required to work rotating shifts on a 24/7 or 16/7 per week schedule, to include evenings, nights, and weekends. In the event of emergency highway conditions, employee is subject to callback during scheduled off-hours. Depending on the policies, laws, and regulations based in local or state transportation code for the specific TMC, employees may also be subject to substance abuse testing, for use of illegal drugs or other substances. In cases where law enforcement officials are co-located in the TMC, background checks may be pre-requisite to employment.

7.4.5 Classification Factors

The advanced level position was analyzed based on the accepted definitions for KSAs. While each TMC may customize these KSAs at the advanced level to meet their local needs, the following classification factors were based on the aforementioned position requirements most commonly in place at TMCs.

7.4.5.1 Factor 1, Knowledge Required by the Position

This factor defines the kind of KSAs required and how the KSAs are used in doing the work described above. TMC advanced level technicians require the exercise of high level judgment and discretion that is critical to successful accomplishment of the TMC mission. The technician must:

- Operate a standard computer workstation in a windows application environment, and understand and apply real time automated device control and command execution. The technician must navigate between multiple open application windows, and use available macros to accelerate editing of data fields. The incumbent must execute single control commands for either single or multiple automation devices.

- Have an in-depth knowledge of the TMC traffic management systems. This includes the functionality and use of variable/dynamic message signs, monitors, ramp meters, HOV lanes, intersectional traffic signals, traffic signal timing selection plans, lane controls (including shut down processes), and HAR processes and procedures.

- Understand and apply consistently the use of TMC logs and shift transfer procedures; incident management procedures; dispatching, contacting, and reporting processes; coordination with other partners in traffic management, such as law enforcement, fire protection, etc.; traffic surveillance and detection procedures; map interpretation; and radio console use and call signals.

- Listen to and correctly interpret multiple-information feed coming in rapid-fire fashion from diverse callers, including police dispatchers, other TMC operations, and the public. Incumbent must convey important information clearly and succinctly, and switch quickly between lines without losing calls, utilizing speed and multi-channel dialing. In order to coordinate functions and responsibilities within the TMC, the advanced level technician must effectively communicate with other TMOTs and supervisors. The incumbent at the advanced level must consistently communicate at a high level, capturing and conveying important information while minimizing superfluous verbiage, slang, and lost data.

- Understand traffic information from visual sources in a frequently complex transportation schematic. Incumbent demonstrates high-level expertise in understanding and applying highway maps, outdoor and indoor video image displays, graphical text data, icons, and transportation modes and symbols.

- Quickly and accurately understand and communicate visual or graphic information from the TMC display wall, and match video orientation with static images. This requires an advanced map reading level based on skills and abilities, enhanced by in-depth experience in the TMC. The incumbent must have the skill to read character text information, within a matter of seconds, and effectively and timely note the changed and unusual traffic management conditions based on emergency graphic icons.

- Have a working knowledge of traffic flow characteristics, such as high speed, velocity, volume, average speed, density and percent of highway occupancy, traffic demand, and capacity. Technician must determine if the traffic data viewed is abnormal, anomalous, or within applicable thresholds. Such determinations are frequently based on the advanced technician's experience in the TMC.

- Have knowledge of the likely duration for emergency responders to respond to incidents and time frames for clean up of incident based on incident type.

- Incumbent must have the knowledge/skill to use data fusion methods to create standardized ATIS message sets. If radio console use is required, incumbent must have knowledge of radio call signs and required protocols.

- Know traffic law and incident management policies for the State DOT and the emergency responders, including police agencies. Incumbent must understand the relationships between local law enforcement jurisdictions, in terms of their impact on traffic management and incident response.

- Understand the theory and practice of traffic device operation.

- Regulatory device operation responsibilities (e.g. adjust traffic signal timings, activate lane use signals), including: transition and safety measures; a knowledge of split, cycle, offset, detectorization, and coordination; traffic signal selection timing plans; zones; master/slave concepts; saturation; transition cycles; capacity utilization and flow characteristics; and queuing principles and practices. In terms of the impact on traffic flow, the incumbent must know the theory of operation for variable speed limit, lane closure, ramp closure, and/or road closure for highways, tunnels, and bridges.

- Have the knowledge and skill, based on visual input from CCTV, to establish the precise traffic location data, determine the revised lane configuration, and clearly classify incidents as property damage, injury, spilled load, HAZMAT, fire, type and number of vehicles, or overturned trucks. Incumbent must have the writing skill to complete the initial incident form clearly through a handwritten log or data entry.

- Possess working level knowledge of state and federal principles of public transportation policy, and demonstrate an understanding of customer service principles, transportation

regulations, and principles of enforcement, liability, accountability, responsibility, and information dissemination.

7.4.5.1.1 Specific Advanced Level Knowledge and Abilities

Specific knowledge that may be required at the advanced level includes:

- Traffic signal planning;
- HAZMAT policies, procedures and codes;
- Automation techniques to respond to and correct minor equipment or software failures;
- Ramp metering technology;
- Geographic area emergency evacuation policies and procedures;
- Capabilities and limitations of advanced intelligent transportation measuring systems (e.g. heuristic); and
- Traffic management systems for arterial roads.

7.4.5.1.2 Specific Abilities at the Advanced Technician Level

- Ability to train/mentor other TMOTs at lower levels (both entry and full performance) and expertise to conduct OJT;
- Ability to make decision/responses in unprecedented situations (e.g. non-standard messages or atypical HOV lane changes);
- Ability to interpret conflicting or ambiguous data in incident management;
- Ability to recognize and understand when to override automated response systems;
- Ability to resolve problems created by competing/conflicting need or concerns of other traffic management entities;
- Ability to develop comprehensive traffic management plans for special events;
- Ability to motivate/persuade others to achieve consensus in such functions as special event planning, congestion management, traffic control methods, etc.; and
- Demonstrate senior level knowledge and abilities by passing advanced TMOT certification test (if applicable at the local TMC).

Employees at the advanced level should possess a substantial number of KSAs defined above, but not necessarily possess every KSA.

7.4.5.2 Factor 2, Supervisory Controls

This factor describes how the work is assigned, the employee's responsibility for carrying out the work, and how the supervisor reviews the employee's work. The advanced technician:

- Receives only general direction or guidance from the manager of the TMC or the 1st level supervisor on overall TMC priorities. For both routine and the most complex responsibilities, the advanced level technician is accountable for successful completion of the assignments, without technical guidance or direction from the 1st level supervisor. The outcomes expected, priorities, and deadlines are determined by existing instructions or are outlined by the supervisor.

- Incumbent's decision making is independent, including decisions on the override of the automated system, discretion in determining specific traffic messages(s) or decisions on methodology to correct automated system errors, and decisions on dispatch of emergency response technicians. Incumbent seeks guidance only on the most complex issues, or issues that may be controversial for the State DOT or controversial in terms of normal TMC operations or setting precedents for future TMC operations.

- Work is reviewed by TMC manager or supervisor only upon completion of assignments or projects, or by a general review of the incumbent's achievement of the overall TMC objectives;

7.4.5.3 Factor 3, Guidelines

This factor describes the nature of the guidelines, e.g. procedures and policies, regulations, law and interpretations/precedents for performing the work, and the judgment needed by the employee to apply the guidelines or develop new guidelines. These guidelines are:

- Usually encompassed in the TMC operations manual. This manual defines the specific goals and objectives of the TMC, and the operations of the TMC and the control room. The guidelines reference the TMOT responsibilities and include: the SOC guidelines; guidelines for traffic operation facilities other than the SOC; radio communications; the TAR or HAR; VMSs; CCTV; camera positioning and utilization; incident management procedures and agencies to be contacted; description of equipment, facilities, and reporting systems within the TMC. Guidelines may also include State transportation policies and procedures, as well as the policies and procedures of police agencies, and emergency responder units within the area/facilities covered by the TMC.

- The advanced TMC technician is the senior expert, who both understands and interprets the guidelines in application to real time situations and traffic management. The advanced technician has gained extensive experience with precedent-setting traffic management cases and issues that provide to the incumbent the broad technical background to make the difficult TMC operation judgments. The incumbent exercises experienced discretion, and judgment on individual cases or incidents, and frequently guides and directs lower level TMOTs or technicians in interpreting and applying the guidelines in real-time situations and crises.

7.4.5.4 Factor 4, Complexity

The complexity of this position is based on the nature of the assignment, the tasks and methodology, as well as the difficulty in understanding what needs to be done, and how to accomplish the work. Complexity reflects the difficulty and originality, which the incumbent must use in accomplishing the following:

- As a TMC team lead, the advanced technician has the responsibility for specific projects affecting the Center's operations and procedures; the incumbent will provide technical direction to lower level TMOTs/technicians assigned to these projects.

- The advanced level technician also mentors developmental TMOTs or technicians, performs OJT, and conducts certification examinations for TMOTs/technicians

- The advanced technician must integrate different procedural directions and policies quickly in order to make timely decisions that may have a major impact on traffic flow management throughout the TMC area. The advanced technician must exercise judgment in determining which guidelines to follow based on the specific traffic management situation(s), and must demonstrate the mental agility to react to a wide variety of traffic management complications, in rapid-fire fashion.

- Position requires detailed application of specific procedures and processes to highly complex, as well as routine traffic management assignments. The TMC advanced technician must understand the specific TMC manual guidelines and procedures, and be able to apply those policies/procedures in a real time environment to particular traffic incidents or broader traffic management crises. The technician's decisions and methodology must not only be in conformance with the applicable guidelines, but must also reflect the senior level TMC judgment to ensure the safety and security of the traveling public, and concurrently the effective facilitation of traffic flow.

- Requires senior level judgment and discretion, in order to guide and direct lower level TMOTs and technicians at the TMC, to ensure they follow the specific traffic management instructions in detail and accurately to the completion of the assignment.

- Involves the selection and application of various approaches and strategies to resolve the issues from traffic incidents or congestion quickly and safely. Those strategies and

approaches must conform to the TMC policies and procedural requirements, as well as meet State DOT regulations and procedures.

- Requires the gathering and synthesis of reliable data from various field video devices, as well as through radio and telephone communications with other transportation management agencies, and the public. Incident detection information synthesized by the advanced TMC technician is frequently gathered by sources outside of, and not controlled by, the TMC, which adds to the complexity of the technician verification and coordination responsibility. These outside sources include radio communications, phone calls, and fax transmissions with other agencies or private organizations.

- Involves working under imposed deadlines that increase the pressure of the responsibilities on this position. Tight time frames and the crisis of the incident frequently will cause stress on the incumbent and require extensive coordination with other TMC personnel, staff, and supervisors, as well as other traffic management organizations. The coordination and the decisions by the incumbent demand action within very narrow time frames to resolve immediate problems.

- The automation complexity of TMC operations expands the complexity of the advanced technician position. The incumbent is the senior technician expert in operating and modifying or adapting advanced automation hardware and software in order to synthesize and transmit information to end-users, and to achieve a quicker response to incidents and to aid in the mitigation of recurring peak travel conditions.

- In terms of traffic management responsibilities, the advanced technician must rapidly "visualize" maps of streets and traffic flow based on computer screens and graphics. He/she must also recognize and utilize different parts of the traffic management system, human and technical, to alleviate the traffic congestion problem, both safely and effectively to meet time constraints and alleviate traffic congestion. The incumbent must reflect the safety and security of the traveling public, the emergency responders, and the appropriate police personnel responding, in making both complex and potentially controversial traffic management decisions.

- As the senior technician in the TMC, incumbent coordinates information analysis and dissemination with other TMC technicians, and with other traffic management organizations, including police, fire and rescue squads, and other emergency response units.

- May be assigned responsibility for specific inter-agency or inter-TMC center projects, which require senior level expertise and an ability to work effectively with other transportation management agencies in achieving common goals.

7.4.5.5 Factor 5, Scope and Effect

This factor defines the overall purpose of the work, or the ultimate goal, and the impact of the work product or service provided within and outside the organizations, as well as the impact on the public. The advanced technician:

- Gathers, synthesizes, and disseminates traffic and travel condition information on a real-time basis. These are core functions. The overall purpose of the work of the TMC advanced technician is to perform, or guide and direct other technicians in performing, highway operations monitoring involving traffic systems control, incident/congestion management, and traffic management communications. The scope of these responsibilities are broad because the efficiency and effectiveness of the overall transportation systems, including the safe, efficient flow of traffic, depends on how well this technician performs and coordinates these three core functions.

- Collects data from a variety of congestion or incident indicators. This "data" becomes usable "information," updated on a real-time basis by the advanced technician. Without the technician, the response to a traffic incident or information on the deterioration of traffic conditions would be delayed and not received in a usable format on a real-time mode. However, the technician's impact is in synthesis, analysis, and transmission of information immediately, in order to achieve a quicker response to incidents and to aid in the mitigation of recurring peak travel congestion.

- Monitors incident-related traffic conditions, as well as normal or "abnormal" traffic patterns. When incidents occur, advanced technician plays a significant role in the three basic incident management functions: detection, response, and monitoring. The impact or effect of the work is to fully support the TMC in facilitating traffic flow and minimizing traffic congestion on major highways and arterial roads.

- Use the collected data to adjust ramp-metering controls, prepare VMS messages, generate graphical displays (for the TMC and the public/media use), and present "information" on the real time traffic conditions in text form to transportation officials.

- Influences the operation of emergency incident responders, police agencies, other traffic management "partners" within the TMC area, and the successful work of the complete staff of the TMC, including traffic engineers, supervisors, and TMC management officials.

- As a senior technician at the TMC, may be called on to represent the center in joint inter-agency conferences and in the development of joint traffic management plans for a geographic area. Impact of responsibilities may go well beyond the immediate center, and influence traffic management policies/procedures in a broad geographic area, or even statewide.

7.4.5.6 Factor 6, Personal Contacts; and
7.4.5.7 Factor 7, Purpose of Contacts

These factors evaluate the personnel, internal or external to the TMC, with whom the full performance technician has regular contact, and the purpose of those contacts (i.e., give or exchange information, resolve problems, provide service, negotiate or persuade others, etc.).

Frequently the TMC advanced technician must persuade or convince other traffic management staff in outside transportation organizations, emergency responders, or police agency contacts, of the necessity for specific real time actions based on the technician's synthesis and analysis of the data input into the TMC multiple systems. This technician's senior expertise is based on a broad experience and skill base in traffic management operations. Contacts include:

- Officials or representatives of other traffic management organizations, including the police, fire and rescue squads, and assigned emergency response units, as well as representatives from other TMCs that may be affected by the service provided by the incumbent.

- The traveling public and traffic media, which are provided information upon request. The advanced technician must be sensitive and astute in providing accurate, objective information.

- Regular contacts (as a TMC representative) with high level State transportation management officials in order to resolve a difficult or dangerous transportation congestion problem which may affect a complete regional traffic operation, or specific traffic incidents that have created substantial traffic safety issues on major highways. The advanced technician again must use persuasion and negotiation to convince the State DOT officials on the proper course(s) of action to ensure public safety and minimize traffic congestion.

7.4.5.8 Factor 8, Physical Demands; **and**
7.4.5.9 Factor 9, Work Environment

These factors evaluate the physical demands placed on the employee, including climbing, lifting, etc., and the physical surroundings or environment where the employee works. The technician works in a control room that:

- Includes normal amounts of physical activity, including lifting and climbing as required on an occasional basis.

- Physical abilities to see and read displays and hear sounds as required to perform in a TMC.

- Has no specific safety or health restrictions or limitations, nor any recognized work environment hazards or HAZMAT.

7.5 Evaluation Approach for Identification of Comparable Job Classifications

7.5.1 General Schedule (GS) Work Classification

In reviewing the TMOT position, it was determined that there were no federal positions which were perfect matches.

However, the federal classification system is broad enough to permit an accurate evaluation of TMOT positions in terms of federal classification standards.

The first step was to determine the broad type of work performed by TMOTs. The federal GS covers professional, administrative, technical, and clerical work, and these types of work are defined in the federal classification system as follows:

Professional work requires knowledge in a field of science or learning characteristically acquired through education or training equivalent to a bachelor's or higher degree with major study in or pertinent to the specialized field, as distinguished from general education. Work is professional when it requires the exercise of discretion, judgment, and personal responsibility for the application of an organized body of knowledge that is constantly studied to make new discoveries and interpretations, and to improve data, materials, and methods (e.g., mathematics or engineering). Normally only applicants with a bachelor's degree or higher may enter a professional position.

Administrative work involves the exercise of analytical ability, judgment, discretion, and personal responsibility, and the application of a substantial body of knowledge of principles, concepts, and practices applicable to one or more fields of administration or management. While these positions do not require specialized education, they do involve the type of skills (e.g., analytical, research, writing, judgment) typically gained through a college level education, or through progressively responsible experience. Administrative work may be performed as a part of the principal mission or program of an agency or subcomponent, or it can be performed as a service function, which supports the agency's mission or program. Employees engaged in administrative work are concerned with analyzing, evaluating, modifying, and developing the basic programs, policies, and procedures which facilitate the work of federal agencies and their programs. They apply knowledge of administrative analysis, theory, and principles in adapting practice to the unique requirements of a particular program.

Technical work is typically associated with and supportive of a professional or administrative field. It involves extensive practical knowledge, gained through experience and/or specific training less than that represented by college graduation. Work in these occupations may involve substantial elements of the work of the professional or administrative field, but requires less than full knowledge of the field involved. Technical employees carry out tasks, methods, procedures, and/or computations that are laid out either in published or oral instructions and covered by established precedents or guidelines. Depending upon the level of difficulty of the work, these procedures often require a high degree of technical skill, care, and precision.

Clerical occupations involve structured work in support of office, business, or fiscal operations. Clerical work is performed in accordance with established policies, procedures, or techniques, and requires training, experience, or working knowledge related to the tasks to be performed. Clerical work typically involves general office or program support duties such as preparing, receiving, reviewing, and verifying documents; processing transactions; maintaining office records; locating and compiling data or information from files; keeping a calendar and informing others of deadlines and other important dates; and using keyboards to prepare typewritten material or to store or manipulate information for data processing use. The work requires knowledge of an organization's rules, some degree of subject matter knowledge, and skill in carrying out clerical processes and procedures.

The TMOT position does not meet the definition for a professional position because although incumbents perform highly complex duties requiring the exercise of judgment and discretion, particularly at the full performance and advanced levels, a bachelor's degree in a specific field of study is not required for entrance into the position. TMOTs do not have to apply a body of knowledge in a field such as mathematics or engineering, which is constantly being studied in order to come up with new discoveries and interpretations.

The TMOT is not an administrative position. Administrative positions are primarily concerned with developing, analyzing, or evaluating agency policies or programs or providing services to support an agency's missions. Even though TMOTs may have some involvement with the development of procedures used at centers, this would not be the primary responsibility.

TMOT positions are not clerical because clerical work is primarily concerned with receiving and reviewing documents and processing transactions. TMOTs do not perform this type of work as their primary function.

TMOTs are technical positions and therefore, are titled as technicians at the full performance level and advanced level in this study. Incumbents must have a significant amount of experience and training. They perform tasks which require a high degree of skill, care, and precision.

7.5.2 Classification Standards

Following the determination that TMOTs are technical positions, the next step was to determine which classification standards would be used to evaluate the positions in terms of federal grades.

It was determined that two standards would be used. They are the standard for engineering technician positions and the Primary Classification Standard.

The Engineering Technician series is not an exact match for TMC TMOT/technician positions. However, the work performed by TMOTs is comparable in complexity and difficulty to the work performed by engineering technicians, and it requires application of similar knowledge and abilities such as the ability to operate a wide variety of electronic and other equipment, the

ability to use computer hardware and software, and the ability to gather data and use it to make decisions.

The Primary Classification Standard is a general classification standard, which can be used for any position. The concepts which it contains are contained in most other classification standards. The Primary Standard is suggested for use to confirm a determination made under another classification standard when there is not a perfect match between the position being evaluated and the classification standard being used. Since there is not a perfect match between the TMC TMOT position and the Engineering Technician Standard, the Primary Standard was used to test conclusions reached with the Engineering Technician Standard. In addition, these standards were used because one uses a narrative evaluation system, and the other uses the FES. These are the two systems used in the federal government, and it was felt that it was important to ensure that the grade determined to be appropriate was not dependent on the system used.

The Engineering Technician Standard uses narrative descriptions for the classification criteria. For each grade level, there are descriptions of the nature of the assignments and the level of responsibility.

Nature of assignment includes the scope and difficulty of the project and the skills and knowledge required to complete the assignment. For example, at lower grade levels, selection and application of techniques and methods are significant; at intermediate levels, minor modification, interpretation, and analysis enters the picture; and, at higher levels, project complexity may be comparable to that of professional engineering assignments and may require considerable knowledge of specialized engineering practice.

Level of responsibility includes consideration of the nature and purpose of person-to-person work relationships, and supervision received in terms of intensity of review of work, as well as guidance received during the course of the work cycle.

The personal contacts that the TMC TMOT/technician maintains with others, and the extent to which his/her technical judgments are relied upon without detailed review are important considerations in determining the level of responsibility.

The Primary Standard uses the FES. The standard describes several levels for the nine factors. A level and corresponding point value is assigned for each factor. The final grade is determined by comparing the total points for all the factors to a grade conversion table in the standard. Factor 1, Knowledge Required by the Position, consists of nine levels, ranging from little or no previous training or experience to mastery of the field to generate and develop new hypotheses and theories. Factor 2, Supervisory Controls, has five levels, ranging from closely controlled work to independent work. Factor 3, Guidelines, has five levels, ranging from specific detailed guidelines covering all aspects of an assignment to broadly stated guidelines open to interpretation. Factor 4, Complexity, has six levels, ranging from clear-cut related tasks to broad functions and processes requiring extensive analysis for decision making. Factor 5, Scope and Effect, has six levels, ranging from performance of specific, routine operations with little impact

outside the work unit to planning and development of programs which impacts the entire organization. Factor 6, Personal Contacts, has four levels, ranging from contact with employees in the immediate organization and/or with the general public in highly structured situations to contact with high ranking officials outside the organization. Factor 7, Purpose of Contacts, has four levels, ranging from obtaining, clarifying, and giving information to settling matters involving controversial issues. Factor 8, Physical Demands, has three levels, ranging from sedentary to strenuous physical exertion. Factor 9, Work Environment, has 3 levels, ranging from everyday risks or discomforts to high risks with exposure to potentially dangerous or unusual environmental stressors. In the position descriptions described below, the level of each factor is described which was determined to best fit each of the three performance levels.

The FES uses many of the same concepts used in narrative classification standards, such as the Engineering Technician Standard, but the factors give more specificity to the concepts since each factor has been separately described in the position description.

7.5.3 Grade Level Determination and Pay Range

The federal classification system is called the General Schedule. There are 15 grades ranging from GS-1 to 15. The entry level for technician positions is either GS-4 or 5, and the full performance or journeyman level for most technician positions is either GS-6 or 7. Advanced level technicians are usually at GS-8 or 9.

Each grade in the federal government has 10 steps, which represent a range in salary from bottom to top of approximately 30 percent. In addition, the pay for a position is augmented depending on where the position is located. The lowest salary range is for positions in what is called Rest of United States. This is for positions for which a separate locality pay area has not been established. In 2002, the highest salary range is for positions in the San Francisco Locality Pay area.

The following sections show how the grade level is determined for each of the three performance levels of a TMC operator. For each position, the appropriate level of each of the nine factors is determined. Each level has a point assignment, as described in *Introduction to the Position Classification Standards*. The total points are added up for each of the nine factors, and that total is compared to the grade conversion table from the position classification standards. The GS grade level is determined from the total point assignment, from which pay ranges can then be determined. The conversion table is in Table 8.

Table 8. GS grade conversion table.

GS Grade	Point Range
1	190-250
2	255-450
3	455-650

GS Grade	Point Range
4	655-850
5	855-1100
6	1105-1350
7	1355-1600
8	1605-1850
9	1855-2100
10	2105-2350
11	2355-2750
12	2755-3150
13	3155-3600
14	3605-4050
15	4055-up

7.5.4 Developmental Level or Entry Level TMOT

7.5.4.1 Engineering Technician Standard

7.5.4.1.1 Nature of Assignments

Engineering Technicians GS-5 carry out operations in variable sequences that are not completely standardized or prescribed as at grade GS-4. The GS-5 technician uses a variety of standard references, guides, and precedents to obtain needed information and to select and adapt methods and procedures. GS-5 technicians apply a background of knowledge and understanding of engineering practice based on a background of substantial training and experience in the specialty field. At grade GS-4 the work involves primarily application of established practices; GS-5 employees are typically required to select and adapt methods and procedures.

The work differs from similar work at grade GS-4 in that the GS-5 technician applies judgment and knowledge in selecting sources, evaluating data, and adapting methods in tasks such as the following types of illustrative situations:

(1) Extracting data from a variety of sources (e.g., field notes, design manuals, laboratory reports, and handbooks), requiring knowledge of the applicability and use of the data and the characteristics of the sources (at grade GS-4, sources are normally prescribed);

(2) Recognizing and reporting errors, inconsistencies, and other deficiencies in the technical data. This requires knowledge of the methods by which the data are derived and the possible sources of error;

(3) Selecting the method for presenting the data for internal use where the work requires use of statistical and graphical methods of curve fitting and curve smoothing (e.g., logarithmic, rectilinear, and polar coordinates).

At first look, it would appear that entry level TMOTs are performing duties equivalent only to the GS-4 engineering technician because they are usually hired with limited specific knowledge, and at the very beginning of their employment, they exercise very little judgment. However, the position must be viewed as a continuum.

The entry level TMOTs are expected to gain sufficient knowledge to perform a variety of ongoing functions, which require the exercise of some judgment. They assist higher level employees to perform more complex duties. They must quickly become cognizant of the legal framework of traffic management and in particular traffic laws in TMC and surrounding jurisdictions. For example, local traffic laws may differ on how directive police or emergency assistance can be. Also, there may be variations on what information can be released to the public.

Based on the developmental nature of the position and the fact that as the TMOT progresses, he/she must quickly acquire a body of knowledge and must perform more complex duties requiring more judgment, it has been determined that the position meets the criteria for nature of assignment described at the GS-5 level.

7.5.4.1.2 Level of Responsibility

The level of responsibility at grade GS-5 is characterized by the following:

a. Work assignments, which involve concepts and nonstandard methods familiar to the TMOT, are made in terms of the objectives to be achieved and without explicit instructions as to work methods. At grade GS-4 instructions normally cover nonstandard work methods.

b. Non-routine technical problems of the type previously encountered by the TMOT in the course of the work are typically resolved independently, but may be referred to others in unusual cases.

c. Assistance in solving technical problems involving unfamiliar methods or concepts is provided by the supervisor. At grade GS-4 specific instructions are usually provided in such cases.

d. The methods applied and technical adequacy of the completed work are reviewed or checked. Narrative assignments are typically not revised in process as at grade GS-4.

The developmental TMOT is expected to work with greater independence as he/she progresses. Once an assignment becomes familiar to him/her, he/she is expected to accomplish it and similar assignments with greater independence. Because of the developmental nature of the position, the level of responsibility must be looked at as a continuum, and although when first hired, the TMOT probably works under closer supervision than is described at this level, he/she is

expected to progress to the level described here. Therefore, it is determined that level of responsibility matches the criteria described for GS-5.

Since both nature of assignment and level of responsibility match the criteria described for GS-5, the developmental TMOT position is determined to be equivalent to GS-5 when evaluated under the Engineering Technician Standard.

7.5.4.2 Primary Standard

7.5.4.2.1 Factor 1, Knowledge Required by the Position

At level 1-4, positions require practical knowledge of standard procedures in a technical field, requiring extended training or experience, to perform such work as adapting equipment when this requires consideration of the functioning characteristics of equipment; interpreting results of tests based on previous experience and observations (rather than directly reading instruments or other measures); or extracting information from various sources when this requires considering the applicability of information and the characteristics and quality of the sources.

As was the case when evaluating the position under the Engineering Technician Standard, it would first appear that TMOTs in developmental positions would not meet this level because when they first enter the position, they don't have the specific body of knowledge envisioned here. However, as they progress within the developmental position, they are expected to acquire the level of knowledge and exercise the judgment described here. Therefore, the appropriate level for this factor is 1-4, 550 points.

7.5.4.2.2 Factor 2, Supervisory Controls

At level 2-2, the supervisor provides continuing or individual assignments by indicating generally what is to be done, limitations, quality and quantity expected, deadlines, and priority of assignments. The supervisor provides additional, specific instructions for new, difficult, or unusual assignments, including suggested work methods or advice on source material available.

The employee uses initiative in carrying out recurring assignments independently without specific instruction, but refers deviations, problems, and unfamiliar situations not covered by instructions to the supervisor for decision or help.

The supervisor assures that finished work and methods used are technically accurate and in compliance with instructions or established procedures. Review of the work increases with more difficult assignments if the employee has not previously performed similar assignments.

This is exactly the manner in which the developmental TMOT is expected to operate. He/she performs routine or familiar assignments independently but receives greater supervision and assistance on unfamiliar or difficult assignments. Therefore, the appropriate level for this factor

is 2-2, 125 points. The fact that the TMOT often must work under tight deadlines and time pressures is another factor that justifies the assignment of this level.

7.5.4.2.3 Factor 3, Guidelines

At level 3-2, procedures for doing the work have been established and a number of specific guidelines are available.

The number and similarity of guidelines and work situations require the employee to use judgment in locating and selecting the most appropriate guidelines, references, and procedures for application and in making minor deviations to adapt the guidelines to specific cases. The employee may also determine which of several established alternatives to use. Situations to which the existing guidelines cannot be applied, or significant proposed deviations from the guidelines, are referred to the supervisor.

The TMOT must follow a wide variety of guidelines such as the TMC operator manual, which contain instructions for accomplishing the work. Particularly at the beginning of the TMOT's employment, he/she exercises very limited judgment. However, as he/she progresses, there will be a greater need for judgment in such areas as knowing which of several guidelines to follow or knowing when to bring discrepancies between the guideline and the real situation to the supervisor. Also, the TMOT must increase his/her ability to react quickly and to develop and implement responses to various traffic situations within guidelines. Because of the expectation that the TMOT will have to exercise more judgment and react quickly to a wide variety of traffic situations as he/she progresses, the appropriate level for this factor is 3-2, 125 points.

7.5.4.2.4 Factor 4, Complexity

At level 4-2, the work consists of duties that involve related steps, processes, or methods. The decision regarding what needs to be done involves various choices that require the employee to recognize the existence of, and differences among, a few easily recognizable situations. Actions to be taken or responses to be made differ in such things as the source of information, the kind of transactions or entries, or other differences of a factual nature.

This position requires detailed application of specific procedures and processes to routine or non-complex assignments. The employee must apply specific instructions or guidelines to particular cases, and demonstrate the capacity to follow those instructions in detail to the completion of the assignment.

Most of the assignments at this level are developmental in nature, and demand strict adherence to the procedure, and the instruction from a higher level technician. In the beginning, the assignments severely limit any originality or creativity, or individual discretion in determining the action to be taken, but as the employee progresses, he/she will encounter greater complexity in such areas as information sources, and the alternative actions which may be taken.

Some assignments at this level may be complex because of the demand for the employee's immediate action, and the stress in accomplishing the task within tight time frames.

An additional complexity element is the requirement to coordinate with other TMC TMOTs/technicians, and with other traffic management organizations, including police, fire and rescue squads, and other emergency response units.

Complexity is also increased by the need for the TMOT to be able to visualize incidents in the context of a map of traffic flow at different times of the day and night, and the requirement to recognize and utilize different parts of the traffic management system, human and technical, to alleviate the problem.

Because of the various sources of information, the alternative actions, which may have to be taken, and the requirement for coordination in and out of the TMC, the appropriate level for this factor is 4-2, 75 points.

7.5.4.2.5 Factor 5, Scope and Effect

At level 5-2, the work involves the execution of specific rules, regulations, or procedures and typically comprises a complete segment of an assignment or project of broader scope.

The work product or service affects the accuracy, reliability, or acceptability of further processes or services. The incumbent follows a body of procedures and other requirements, and the work enables him/her to become a full performance TMOT. The work also assists higher level TMOTs to perform more complex duties. The work has an impact on the service, which the TMC provides.

Because the work involves following established procedures and requirements, and because it has an impact on the service that the TMC provides, the appropriate level for this factor is 5-2, 75 points.

7.5.4.2.6 Factor 6, Personal Contacts

At level 6-1, the personal contacts are with employees within the immediate organization, office, project, or work unit, and in related or support units.

At level 6-2, there are additional contacts outside the immediate organization. The primary contacts for the TMC TMOT at the developmental level are internal, including higher level technicians, and supervisors or management personnel in the TMC. However, the TMOT does have significant contacts outside the TMC such as with other traffic management organizations.

Therefore, the appropriate level for this factor is 6-2, 25 points.

7.5.4.2.7 Factor 7, Purpose of Contacts

At level 7-1, the purpose of contacts is to obtain, clarify, or give information.

The primary purposes of the developmental TMOT's contacts are to either obtain or give information. Therefore, the appropriate level for this factor is 7-1, 20 points.

7.5.4.2.8 Factor 8, Physical Demands

Since the work is primarily sedentary, the appropriate level for this factor is 8-1, 5 points.

7.5.4.2.9 Factor 9, Work Environment

Since the work is performed in a facility that is properly lighted and ventilated, the appropriate level for this factor is 9-1, 5 points.

7.5.4.2.10 Summary of Factor Level Determinations

Factor Level	*Point Assignment*
1-4	550
2-2	125
3-2	125
4-2	75
5-2	75
6-2	25
7-1	20
8-1	5
9-1	5
Total=	1005

Referring to Table 8, the grade conversion table, 1005 points is in the range for GS-5.

7.5.4.3 Final Classification: TMOT Entry Level

Since the evaluation of this position under both the Engineering Technician and Primary Standards results in the same grade, it is determined that this position equates to GS-5 in the Federal Service.

7.5.4.4 Pay Range

In 2002, the pay range for GS-5 in the Rest of United states was $24,701 to $32,113, and the range in San Francisco was $27,066 to $35,187.

7.5.5 Journeyman or Full Performance Level TMC Technician

7.5.5.1 Engineering Technician Standard

7.5.5.1.1 Nature of Assignments

Engineering technicians GS-6 carry out non-routine assignments of substantial variety and complexity. The work is more complex than that typical of grade GS-5 in that GS-6 employees apply a background of knowledge based on intensive training and diversified experience in the particular specialty field and, in addition, knowledge of engineering practice in related fields.

Engineering technicians GS-6 applies and adapts a wide variety of established methods of computation and analysis under a variety of circumstances. The work is more demanding than at grade GS-5 in terms of breadth of required knowledge and judgment required to evaluate and interpret data.

Engineering technicians GS-7 apply initiative and resourcefulness in planning non-routine assignments of substantial variety and complexity. GS-7 technicians select appropriate guidelines to resolve operational problems not fully covered by precedents. At grade GS-6, precedents have more specific applicability. Engineering technicians GS-7 are required to develop revisions to standard work methods and procedures; modify parts, instruments, and equipment; and take actions or make recommendations based on preliminary interpretation of data or results of analysis.

Judgment, initiative, resourcefulness, and knowledge based on experience is required in:

(1) The analysis and extraction of pertinent data from a variety of sources including journals, engineer hand-books, manufacturers' catalogs, agency publications, precedent designs, standard and guideline specifications, and other references;

(2) The selection of alternatives and development of designs and/or specifications, which will satisfy specific criteria and requirements;

(3) Devising of means to overcome problems such as space and weight limitations and interference; and

(4) Analysis of adequacy of designs and specifications for conformance to specific requirements.

Positions at grade GS-6 concerned with design and specifications typically involve a lesser degree of responsibility for design, and are concerned primarily with the collection, documentation, and communication of design information rather than the performance of design.

Journeyman TMC technicians are expected to perform the full range of both routine and complex assignments. As discussed in the position description, they are involved in most, if not all, of the major TMC functions. The journeyman technician gathers data and, based on the data, guidelines, and precedents, and his/her experience and training, takes definitive action to resolve problems related to such issues as traffic congestion, special events, or emergency situations.

A primary difference between the GS-6 and 7 engineering technician is that at the GS-7 level, there is a greater emphasis on taking definitive actions based on the data which are gathered. The journeyman TMC technician certainly has the responsibility to act in most situations based on the available data. A second difference is that, at the GS-7 level, precedents have less applicability than they do at the GS-6 level where they usually provide specific guidance.

The journeyman TMC technician certainly has extensive guidelines and available precedents to rely on. However, he/she is expected to be able to make decisions quickly and in a wide variety of situations where there is not always the time or opportunity to research available precedents. Therefore, this position meets the GS-7 level for nature of assignment.

The classification standard also mentions that at the GS-7 level, the engineering technician is involved in developing revisions to work methods or procedures. Although the journeyman TMC technician usually would not be required to do this very often, this does not weaken the determination of the proper level for nature of assignment.

7.5.5.1.2 Level of Responsibility

The level of responsibility for GS-6 engineering technicians is characterized by the following:

a. Work assignments, which involve concepts and nonstandard methods familiar to the technician, are made in terms of the objectives to be achieved, and without explicit instructions as to work methods.

b. Technical problems, including some not previously encountered by the technician, and involving concepts and methods for which agency guides and precedents are applicable, are resolved independently. At grade GS-5 technical problems solved independently are typically of the type previously encountered.

c. Supervisor provides assistance in solving unfamiliar technical problems involving methods or concepts not covered in agency guides or precedents.

d. Completed work is reviewed for technical adequacy. The methods applied by the technician are not normally reviewed as at grade GS-5.

GS-7 engineering technicians perform assignments, which require initiative and resourcefulness in planning and/or execution. GS-7 technicians independently select, interpret, and apply engineering technical guidelines in situations where precedents are not fully applicable.

By comparison, GS-6 engineering technicians independently select, interpret, and apply guidelines where precedents are applicable.

When new or significantly changed assignments are made, GS-7 engineering technicians receive instructions and information or reference material, which includes information on unfamiliar practices and problems, and closer than normal guidance is provided. When the work assigned is similar to that previously accomplished by the technician, he/she is relied upon to select the appropriate guidelines and complete the assignment without explicit instructions as to work methods.

GS-7 engineering technicians may demonstrate or explain their work to others and have frequent contacts with professionals, technicians, mechanics, and others within their organization in connection with specific assignments. They represent their organization at meetings and conferences to provide factual information.

As at grade GS-6, new and significantly changed work aspects are intensively reviewed for technical adequacy. Recurring aspects of work are occasionally observed and subject to only occasional spot checks for technical adequacy. Assignments falling between these extremes are subject to normal review.

As explained above, journeyman TMC technicians are expected to perform the full range of assignments independently, even when there is no time or opportunity to research applicable precedents.

Journeyman TMC technicians have frequent contacts with organizations outside the TMC, such as law enforcement agencies. The technician is speaking for the TMC in most of these situations. These would be comparable to the contacts described in the Primary Standard.

Because of the independence with which the journeyman TMC technician works on both routine and complex assignments, the position is equivalent to GS-7 for level of responsibility.

Since both nature of assignment and level of responsibility match the criteria described for GS-7, the full performance or journeyman TMC technician position is determined to be equivalent to GS-7 when evaluated under the Engineering Technician Standard.

7.5.5.2 Primary Standard

7.5.5.2.1 Factor 1, Knowledge Required by the Position

At level 1-4, positions require practical knowledge of standard procedures in a technical field, requiring extended training or experience, to perform such work as adapting equipment when this requires consideration of the functioning characteristics of equipment; interpreting results of tests based on previous experience and observations (rather than directly reading instruments or other measures); or extracting information from various sources when this requires considering the applicability of information and the characteristics and quality of the sources.

In addition to the practical knowledge of standard procedures in Level 1-4, level 1-5 requires practical knowledge of technical methods to perform assignments, which involve use of specialized complicated techniques.

The journeyman TMC technician must have an extensive body of knowledge and must apply it to complicated functions. For example, he/she must be able to use advanced map reading techniques to make real time determinations concerning traffic flow. He/she must understand traffic management concepts such as capacity utilization and flow, and must be able to determine their impact on real world situations.

Because of the large number of complicated theoretical and practical concepts and techniques which journeyman technicians must apply, the appropriate level for this factor is 1-5, 750 points.

7.5.5.2.2 Factor 2, Supervisory Controls

At level 2-2, the supervisor provides continuing or individual assignments by indicating generally what is to be done, limitations, quality and quantity expected, deadlines, and priority of assignments. The supervisor provides additional, specific instructions for new, difficult, or unusual assignments, including suggested work methods or advice on source material available.

The employee uses initiative in carrying out recurring assignments independently without specific instruction, but refers deviations, problems, and unfamiliar situations not covered by instructions to the supervisor for decision or help.

The supervisor assures that finished work and methods used are technically accurate and in compliance with instructions or established procedures. Review of the work increases with more difficult assignments if the employee has not previously performed similar assignments.

At level 2-3, the supervisor makes assignments by defining objectives, priorities, and deadlines, and assists the employee with unusual situations that do not have clear precedents.

The employee plans and carries out the successive steps and handles problems and deviations in the work assignment in accordance with instructions, policies, previous training, or accepted practices in the occupation.

Completed work is usually evaluated for technical soundness, appropriateness, and conformity to policy and requirements. The methods used in arriving at the end results are not usually reviewed in detail.

Once the supervisor sets the work objectives, the journeyman technician performs ongoing assignments with a high degree of independence. Although the technician is expected to make a wide variety of decisions independently, these decisions are made within quality and quantity requirements established by the supervisor. The supervisor provides assistance on controversial or unusually complex situations, or situations which have not been encountered by the journeyman and don't fall within his/her experience base.

Because the technician carries out assignments with a high degree of independence, the appropriate level for this factor would first appear to be 2-3. However, that level envisions discrete projects with distinct requirements for which the employee is responsible as opposed to ongoing assignments. In the FES, similar ongoing assignments are considered to require less supervision than discrete projects, and for this reason, the supervisory controls factor is weakened when the primary work of a position consists of ongoing assignments.

Therefore, the appropriate level for this factor is 2-2, 125 points.

It is noted that the same level was assigned for the developmental position. This would first appear to be inconsistent. However, each factor level represents a range. Level 2-2, can cover a range that extends from developmental to full performance positions.

7.5.5.2.3 Factor 3, Guidelines

At level 3-2, procedures for doing the work have been established and a number of specific guidelines are available.

The number and similarity of guidelines and work situations require the employee to use judgment in locating and selecting the most appropriate guidelines, references, and procedures for application, and in making minor deviations to adapt the guidelines to specific cases. The employee may also determine which of several established alternatives to use. Situations to which the existing guidelines cannot be applied, or significant proposed deviations from the guidelines, are referred to the supervisor.

At level 3-3, guidelines are available, but are not completely applicable to the work or have gaps in specificity.

The employee uses judgment in interpreting and adapting guidelines such as agency policies, regulations, precedents, and work directions for application to specific cases or problems. The employee analyzes results and recommends changes.

There are a wide variety of guidelines. The journeyman technician must know and understand these guidelines in depth and must be able to apply them quickly and accurately. He/she must use judgment to interpret the guidelines. As previously explained, there may not always be time for the TMOT to research guidelines or precedents, so he/she must exercise judgment which would be equivalent to situations where guidelines or precedents were not available or applicable.

Because of the wide variety of guidelines and the need for the TMOT to make quick and accurate judgments without always having the opportunity to conduct extensive research, the appropriate level for this factor is 3-3, 275 points.

7.5.5.2.4 Factor 4, Complexity

At level 4-3, the work includes various duties involving different and unrelated processes and methods.

The decision regarding what needs to be done depends upon the analysis of the subject, phase, or issues involved in each assignment, and the chosen course of action may have to be selected from many alternatives.

The work involves conditions and elements that must be identified and analyzed to discern interrelationships.

The journeyman technician has responsibility for a wide variety of functions at the TMC. He/she must use different parts of the traffic management system to resolve problems, and he/she may be required on the fly to come up with solutions.

Assignments at this level are also complex because of the demand for the employee's immediate action, and the stress in accomplishing the task within tight time frames.

An additional complexity element is the requirement to coordinate with other TMC technicians, and with other traffic management organizations, including police, fire and rescue squads, and other emergency response units.

Complexity is also increased by the need for the TMOT to be able to visualize incidents in the context of a map of traffic flow at different times of the day and night, and the requirement to

recognize and utilize different parts of the traffic management system, human and technical, to alleviate the problem.

Because of the various sources of information, the wide variety of functions for which the journeyman technician has independent responsibility, the analysis of alternative actions which may have to be taken, and the requirement for coordination in and out of the TMC, the appropriate level for this factor is 4-3, 150 points.

Note: Level 4-3 is usually considered to be the top level that should be assigned for technician positions.

7.5.5.2.5 Factor 5, Scope and Effect

At level 5-3, the work involves treating a variety of conventional problems, questions, or situations in conformance with established criteria.

The work product or service affects the design or operation of systems, programs, or equipment; the adequacy of such activities as field investigations, testing operations, or research conclusions; or the social, physical, and economic well being of people.

The journeyman technician gathers, synthesizes, and disseminates a wide variety of complex data. His/her work improves the flow of traffic and helps to ensure the safety and well being of the public. Although the technician certainly uses judgment and discretion, most of the work is performed in conformance with established criteria. The technician is not involved with developing new criteria, formulating projects, or assessing program effectiveness, which would be required for the next higher level in this factor.

Therefore, the appropriate level for this factor is 5-3, 150 points.

7.5.5.2.6 Factor 6, Personal Contacts

At level 6-1, the personal contacts are with employees within the immediate organization, office, project, or work unit, and in related or support units.

At level 6-2, there are additional contacts outside the immediate organization. Most contacts are moderately structured so that parties understand their respective roles.

In addition to contacts throughout the TMC, the technician has significant contacts outside the TMC, such as with other traffic management or law enforcement organizations. In most situations, parties understand their respective roles. Occasionally there may be contacts with high-level transportation officials, but these are not frequent enough to affect the level for this factor.

Therefore, the appropriate level for this factor is 6- 2, 25 points.

7.5.5.2.7 Factor 7, Purpose of Contacts

At level 7-1, the purpose of contacts is to obtain, clarify, or give information.

At level 7-2, contacts are to resolve operational problems by influencing or motivating individuals to take a particular action. In most cases, parties are working cooperatively toward mutual goals.

In addition to providing and obtaining information, the journeyman technician may have to convince officials, such as those in law enforcement organizations, to take a particular action in response to a problem. In most situations, organizations are working toward the same goal.

Therefore, the appropriate level for this factor is 7-2, 50 points.

7.5.5.2.8 Factor 8, Physical Demands

Since the work is primarily sedentary, the appropriate level for this factor is 8-1, 5 points.

7.5.5.2.9 Factor 9, Work Environment

Since the work is performed in a facility that is properly lighted and ventilated, the appropriate level for this factor is 9-1, 5 points.

7.5.5.2.10 Summary of Factor Level Determinations

Factor Level	*Point Assignment*
1.5	750
2-2	125
3-3	275
4-3	150
5-3	150
6-2	25
7-2	50
8-1	5
9-1	5

Total= 1535

Referring to Table 8, the grade conversion table, 1535 points is in the range for GS-7.

7.5.5.3 Final Classification: Full Performance Operator

Since the evaluation of this position under both the Engineering Technician and Primary Standards results in the same grade, it is determined that this position equates to GS-7 in the Federal Service.

7.5.5.4 Pay Range

In 2002, the pay range for GS-7 in the Rest of United states was $30,597 to $39,779, and the range in San Francisco was $33,526 to $43,586.

7.5.6 Advanced Level TMC Technician

7.5.6.1 Engineering Technician Standard

7.5.6.1.1 Nature of Assignments

Engineering technicians GS-8 independently plan and conduct a block of work which is a complete project of relatively conventional and limited scope or a portion of a large project with diverse components. Assignments require analyses of several possible courses of action, techniques, general layouts, or designs, and selection of the most appropriate. They generally require consideration of numerous precedents and some adaptation of previous plans and techniques. However, assignments require to only a limited degree the coordination and integration of diverse phases carried out by others. The more complex and critical aspects of problem exploration, evaluation of approaches, and development of new solutions are referred to others.

Engineering technicians GS-9 typically perform a variety of work relating to the area of specialization that requires the application of a considerable number of different basic, but established, methods, procedures, and techniques. Assignments usually involve independent responsibility for planning and conduct of a block of work, which is a complete conventional project of relatively limited scope, or a portion of a larger and more diverse project. Assignments require study, analysis, and consideration of several possible courses of action, techniques, general layouts, or designs, and selection of the most appropriate. They generally require consideration of numerous precedents and some adaptation of previous plans or techniques. Often changes or deviations must be made during progress of an assignment to incorporate additional factors requested after commencement of the project, or to adjust to findings and conclusions which could not be predicted accurately in the original plans.

Assignments of engineering technicians GS-9 typically require coordination of several parts, each requiring independent analysis and solution. When other groups or personnel outside the organizational unit complete project components or specific details, the technician reviews, analyzes, and integrates their work. In addition, assignments at this level require a good understanding of the effect that recommendations made, or other results of the assignment, may have on an item, system, or process and its end-use application.

Assignments performed by GS-9 engineering technicians are more complex than those typical of grade GS-8. The assignments also differ from those typical of grade GS-8 by the lesser need at GS-8 to coordinate separate activities and to deal extensively with representatives of other organizations in resolving issues.

Advanced level TMC technicians perform the full range of complex assignments at the TMC. They must have expert knowledge in all of the center's functions. In addition to responsibility for complex actions, they may be given responsibility for TMC wide projects, which would be comparable to, or even slightly exceed, the projects referenced in the standard.

The advanced level TMC technician must apply precedents and must also know when it is necessary to deviate from precedents. The standard refers to making changes once a project has begun. The advanced technician must do this, and often the changes which are required must be made on a real time basis.

Advanced technicians may be expected to lead full performance level technicians and coordinate their work. They also may have extensive dealings with organizations outside the TMC and coordinate the input received from those organizations. These functions are comparable to the functions described in the standard at the GS-9 level. In fact, one of the key differences between GS-8 and 9 is the greater need for coordination and integration at the GS-9 level, and the advanced level TMOT is expected to perform these functions in the manner described at the GS-9 level.

Based on the extensive knowledge required at the advanced level, the responsibility for TMC wide projects, the need to lead the work of full technicians, and the need to coordinate with representatives from organizations outside the TMC, the position is comparable to the GS-9 level for nature of assignment.

7.5.6.1.2 Level of Responsibility

The degree of supervision received by GS-8 engineering technicians is similar to that at grade GS-7, in that, the engineering technician receives guidance and instructions in dealing with unfamiliar practices and problems. On familiar types of assignments, the GS-8 engineering technician is relied upon to select and adapt appropriate guidelines and complete assignments without explicit instructions as to work methods and precedents. Problems not covered by

guides may be solved independently, but are typically referred to higher grade employees for prior review. Significant deviations from guides require approval.

Engineering technicians GS-9 typically work with less supervisory guidance and a greater degree of independence than at grade GS-8. In assigning work, the supervisor outlines requirements, provides information on any related work being performed, and furnishes general instructions as to the scope of objectives, time limitations, priorities, and similar aspects. The supervisor is available for consultation and advice where significant deviations from standard engineering practices must be made, and the supervisor gives more detailed instructions when distinctly new criteria or new techniques are involved. (At grade GS-8, such instructions are usually provided for unfamiliar problems. Also at grade GS-8, the supervisor is typically consulted on problems not covered by guides.)

The supervisor observes the work of the GS-9 engineering technician for progress and for coordination with work performed by other employees or other sections, and for adherence to completion and cost schedules. Standard methods employed are seldom reviewed, but review is made for adequacy and for conformance with established policies, precedents, and sound engineering concepts and usage.

Personal work contacts typically are more frequent and demanding than at grade GS-8. They are primarily to resolve mutual problems and coordinate the work with that of personnel in related activities. Some contacts are made with using agencies for whom work is done, and with contractors and architect-engineer firms. The contacts are made, for example, to clear up doubtful points, to advise as to discrepancies found in meeting contract terms, to consider recommendations for acceptable substitutes, and to promote adherence to agency standards and concepts of good engineering.

One of the key differences between the full performance and advanced level TMC technicians is the manner of supervision. These differences parallel the difference described in the standard between the GS-9 and the GS-7 and 8 levels. The advanced level TMC technician works with a high degree of independence on routine and complex issues and receives guidance only on the most controversial matters. He/she has wide latitude in dealing with persons outside the TMC and resolving work problems with them.

Because of the high degree of independence with which the advanced level TMOT is expected to operate on the full range of actions and projects, the position is comparable to the GS-9 level for level of responsibility.

Since both nature of assignment and level of responsibility match the criteria described for GS-9, the advanced TMC technician position is determined to be equivalent to GS-9 when evaluated under the Engineering Technician Standard.

7.5.6.2 Primary Standard

7.5.6.2.1 Factor 1, Knowledge Required by the Position

At level 1-4, positions require practical knowledge of standard procedures in a technical field, requiring extended training or experience, to perform such work as adapting equipment when this requires consideration of the functioning characteristics of equipment; interpreting results of tests based on previous experience and observations (rather than directly reading instruments or other measures); or extracting information from various sources when this requires considering the applicability of information and the characteristics and quality of the sources.

In addition to the practical knowledge of standard procedures in Level 1-4, level 1-5 requires practical knowledge of technical methods to perform assignments, which involve use of specialized or complicated techniques.

For technician positions, level 1-6 requires practical knowledge of a wide range of technical methods, principles, and practices similar to a narrow area of a professional field, and skill in applying this knowledge to such assignments as the design and planning of difficult projects with precedents.

The advanced level TMC technician must have expert knowledge in the full range of TMC functions. He/she must be able to lead and/or train full performance TMOTs. He/she must be able to deal with the most difficult situations, and at times he/she must be able to deal with unprecedented events.

The expert technical knowledge which the position requires clearly meets level 1-6. Because at times the technician must deal with unprecedented situations, and the factor level description referred to projects with precedents, level 1-7 was reviewed to determine whether the position fully met that level. However, to meet level 1-7, the position must be involved with the development of new methods, approaches, or procedures. The work of a TMC is such that at the advanced level, the technician would not be routinely involved with the development of new methods, approaches, and procedures.

Because of the expert technical knowledge which the position requires, the appropriate level for this factor is 1-6, 950 points.

7.5.6.2.2 Factor 2, Supervisory Controls

At level 2-3, the supervisor makes assignments by defining objectives, priorities, and deadlines, and assists the employee with unusual situations that do not have clear precedents.

The employee plans and carries out the successive steps and handles problems and deviations in the work assignment in accordance with instructions, policies, previous training, or accepted practices in the occupation.

Completed work is usually evaluated for technical soundness, appropriateness, and conformity to policy and requirements. The methods used in arriving at the end results are not usually reviewed in detail.

The advanced level technician operates in the manner described at this level. The supervisor sets the overall objectives, and except for the most controversial situations which could set a precedent, the technician works independently. The advanced level technician has greater responsibility for broad projects than is the case for the full performance level technician, and these projects are performed with a high degree of independence.

Because of the high degree of independence with which the advanced level technician accomplishes individual actions and projects, the appropriate level for this factor is 2-3, 275 points.

Because the advanced level technician works with a high degree of independence, level 2-4 was reviewed to determine whether the position meets that level. At that level, one of the key features is that the employee and supervisor in consultation develop the projects, deadlines, and work to be done. In most cases at a TMC, the work and deadlines are known and defined by existing policies or by the supervisor, and the technician and supervisor would not be consulting to determine them.

7.5.6.2.3 Factor 3, Guidelines

At level 3-2, procedures and guidelines for doing the work have been established.

The number and similarity of guidelines and work situations require the employee to use judgment in locating and selecting the most appropriate guidelines, references, and procedures for application and in making minor deviations to adapt the guidelines to specific cases. The employee may also determine which of several established alternatives to use. Situations to which the existing guidelines cannot be applied, or significant proposed deviations from the guidelines, are referred to the supervisor.

At level 3-3, guidelines are available, but are not completely applicable to the work or have gaps in specificity.

The employee uses judgment in interpreting and adapting guidelines such as agency policies, regulations, precedents, and work directions for application to specific cases or problems. The employee analyzes results and recommends changes.

The advanced level technician has a wide variety of guidelines available to him/her, but he/she is expected to use judgment and discretion to interpret and adapt them to the specific situation. As

with the full performance level technician, often decisions must be made quickly without the luxury of thoroughly reviewing the applicable guidelines.

Because of the high level of required judgment, the appropriate level for this factor is 3-3, 275 points.

The position does not meet level 3-4 because at that level, guidelines are broad policies or legislation, and have limited applicability to specific situations. The TMC operations manual, for example, provides more specificity than is envisioned at level 3-4.

7.5.6.2.4 Factor 4, Complexity

At level 4-3, the work includes various duties involving different and unrelated processes and methods.

The decision regarding what needs to be done depends upon the analysis of the subject, phase, or issues involved in each assignment, and the chosen course of action may have to be selected from many alternatives.

The work involves conditions and elements that must be identified and analyzed to discern interrelationships.

The advanced level technician has responsibility for a wide variety of functions at the TMC. He/she must use different parts of the traffic management system to resolve problems, and he/she may be required on the fly to come up with solutions.

Assignments at this level are also complex because of the demand for the employee's immediate action, and the stress in accomplishing the task within tight time frames.

An additional complexity element is the requirement to lead or coordinate the work of full performance level technicians, and coordinate with other traffic management organizations, including police, fire and rescue squads, and other emergency response units.

Complexity is also increased by the need for the TMOT to be able to visualize incidents in the context of a map of traffic flow at different times of the day and night, and the requirement to recognize and utilize different parts of the traffic management system, human and technical, to alleviate the problem.

Because of the various sources of information, the wide variety of functions for which the advanced level technician has independent responsibility, the analysis of alternative actions which may have to be taken, and the requirement for coordination in and out of the TMC, the appropriate level for this factor is 4-3, 150 points.

Note: Level 4-3 is usually considered to be the top level that should be assigned for technician positions. Level 4-4 involves many varied and unrelated processes related to an administrative or professional field, and this is beyond even the advanced level TMOT position.

7.5.6.2.5 Factor 5, Scope and Effect

At level 5-3, the work involves treating a variety of conventional problems, questions, or situations in conformance with established criteria.

The work product or service affects the design or operation of systems, programs, or equipment; the adequacy of such activities as field investigations, testing operations, or research conclusions; or the social, physical, and economic well being of people.

The advanced level technician gathers, synthesizes, and disseminates a wide variety of complex data. His/her work improves the flow of traffic and helps to ensure the safety and well being of the public. Although the technician certainly uses judgment and discretion, most of the work is performed in conformance with established criteria. The technician does not have the extensive involvement with developing new criteria, formulating projects, or assessing program effectiveness, which would be required for the next higher level in this factor.

Therefore, the appropriate level for this factor is 5-3, 150 points.

7.5.6.2.6 Factor 6, Personal Contacts

At level 6-1, the personal contacts are with employees within the immediate organization, office, project, or work unit, and in related or support units.

At level 6-2, there are additional contacts outside the immediate organization. Most contacts are moderately structured so that parties understand their respective roles.

In addition to contacts throughout the TMC, the technician has significant contacts outside the TMC, such as with other traffic management or law enforcement organizations. There may be contacts with high-level transportation officials.

In most cases, contacts are relatively structured in that parties understand their respective roles.

Therefore, the appropriate level for this factor is 6-2, 25 points.

7.5.6.2.7 Factor 7, Purpose of Contacts

At level 7-2, contacts are to resolve operational problems by influencing or motivating individuals to take a particular action. In most cases, parties are working cooperatively toward mutual goals.

At level 7-3, the purpose is to influence, motivate, interrogate, or control people or groups. The people contacted may be fearful, skeptical, uncooperative, or dangerous. Therefore, the employee must be skillful in approaching the individual or group in order to obtain the desired effect, such as gaining compliance with established policies and regulations by persuasion or negotiation, or gaining information by establishing rapport with a suspicious informant.

Although the purpose of the contacts is similar to the contacts made by the journeyman technician, the advanced level technician has greater authority to speak for the TMC. The technician may have to convince other organizations to take major steps, and it is his/her credibility as a technical expert, which may lead to agreement. In other words, where an official may be reluctant to take action based on contact with a journeyman technician, he/she is more likely to proceed based on the contact with the advanced level technician.

Because the advanced level technician may more often speak for the TMC and may have his/her recommendation more readily accepted, the appropriate level for this factor is 7-3, 120 points.

7.5.6.2.8 Factor 8, Physical Demands

Since the work is primarily sedentary, the appropriate level for this factor is 8-1, 5 points.

7.5.6.2.9 Factor 9, Work Environment

Since the work is performed in a facility that is properly lighted and ventilated, the appropriate level for this factor is 9-1, 5 points.

7.5.6.2.10 Summary of Factor Level Determinations

Factor Level	*Point Assignment*
1-6	950
2-3	275
3-3	275
4-3	150
5-3	150
6-2	25
7-3	120
8-1	5

9-1 5

Total= 1955

Referring to Table 8, the grade conversion table, 1955 points is in the range for GS-9.

7.5.6.3 Final Classification: Advanced TMOT

Since the evaluation of this position under both the Engineering Technician and Primary Standards results in the same grade, it is determined that this position equates to GS-9 in the Federal service.

7.5.6.4 Pay Range

In 2002, the pay range for GS-9 in the Rest of United states was $37,428 to $48,652, and the range in San Francisco was $41,010 to $53,310.

7.6 Comparable Job Classification Conclusions

The classification material and position descriptions for TMC TMOTs provide TMC managers with information that is helpful in determining appropriate job classification categories for TMC TMOTs. The job classifications encompass all the functions and the many TMOT tasks that a TMOT may perform, based on an assessment of all the requirements for these jobs. The job descriptions are representative of those for TMOT positions in many TMCs.

The three prototypical TMC TMOT position descriptions are based upon three KSA requirement groupings that reflect entry level, full performance, and advanced TMOT positions.

The three prototypical KSA constellations are included in the "benchmark" position descriptions for entry level, full performance, and advanced. These position descriptions are written in a common and standardized format recognizable to human resource professionals. For each constellation, it has been determined how the position would be classified under the FES. The suggested classifications are consistent with the intent of the FES and with best industry practice.

The recommended minimum grade and salary levels for TMC technicians (operators) are equivalent to the federal classifications of GS-5 for Entry Level, GS-7 for Full Performance, and GS-9 for Advanced.

The requirements for special functions and customized position descriptions will be additive to these minimum levels. Requirements for four year technical degree, or requirements that the TMOT has sufficient experience to handle events where life safety is at stake, will increase the required compensation level.

Appendix A contains a listing of the actual position description titles reviewed for this analysis.

8 LIST OF ACRONYMS

AD	Archived Data
APTS	Advanced Public Transportation Systems
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
AVSS	Advanced Vehicle Safety Systems
CCTV	closed circuit television
CHART	Chesapeake Highway Advisories Routing Traffic
CV	commercial vehicle
CVO	Commercial Vehicle Operations
DMS	dynamic message sign
DOT	Department of Transportation
EM	Emergency Management
EMS	emergency management system
EMT	Emergency Medical Technician
ETTM	Electronic Toll and Traffic Management
F	function
FAA	Federal Aviation Administration
FES	Factor Evaluation System
FHWA	Federal Highway Administration
G	general
GS	General Schedule
GUI	graphical user interface
HAR	highway advisory radio
HAZMAT	hazardous materials
HOT	Highway Operations Technician
HOV	high occupancy vehicle
HR	human resources
HRI	highway-rail intersection
HTML	Hyper Text Markup Language
ICS	incident command system
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
KSA	knowledge, skill, and ability
MCO	Maintenance and Construction Management
MKV	mouse, keyboard, video monitor
MTBF	mean time between failure
OJT	on-the-job training
OPM	Office of Personnel Management
PTZ	pan, tilt, zoom
RWIS	roadway weather information systems
S	special

SCADA	surveillance, control and data acquisition
SOC	State Operations Center
SOP	standard operating procedure
T	task
TAR	traveler's advisory radio
TCC	Train Control Center
TMC	Transportation Management Center
TMOT	Transportation Management Operations Technician
TSC	traffic signal control
TTI	Texas Transportation Institute
U.S.	United States
VMS	variable message sign
WPM	words per minute

APPENDIX A: POSITION DESCRIPTIONS REVIEWED

Appendix to Benchmark Position Descriptions
Listing of Position Descriptions Reviewed In Development of Benchmarks

This appendix provides additional information relative to section 7 of the report.

Position Descriptions in State TMCs:

INFORM - New York Center

- Operator I (Entry level)
- Operator II (Traffic Management position under direct-moderate supervision)
- Operator III (Senior Level Shift Operator; moderate to light supervision)
- Operator IV (Trainee Level Position towards Operations Supervisor)
- Operations Supervisor (Professional level responsible for daily operations)

City of Las Vegas TMC Office

- Traffic Communication Technician I and II
- Traffic Systems Engineering Supervisor
- Senior Traffic Signal Technician
- Traffic Signal Technician I and II
- Network Systems Technician
- Senior Intelligent Transportation Systems Technician

Maryland Chart, Statewide Operations Center

Descriptions:

- Highway Operations Technician I, Salary Grade 9 ($23,722-$36,541)
- Highway Operations Technician II, salary Grade 11 ($26,958-$41,641)
- Highway Operations Technician III, Salary Grade 12 ($28,749-$44,453)
- Highway Operations Technician IV, Salary Grade 14 (Supervisor) ($32,715-$50,700)

- Emergency Response Technician, Salary Grade 11
- Emergency Response Technician, Salary Grade 12

Position Evaluation Statements:

- HOT I, Entry Level Highway Operations Technician
- HOT II, 2ND Developmental Highway Operations Technician
- HOT III, Full Performance Level Highway Operations Technician, Team Leader
- HOT IV, 1st Level Supervisor for HOT I, HOT II and HOT III Technicians

State of Georgia, Transportation Department, Transportation Management Center (TMC)

- TMC Operations Manager
- Transportation Management Engineer (Supervisor on-the-floor)
- Transportation Management Center Console Operator, Grade 10
- Transportation Management Center Console Operator, Trainee, Grade 8

Utah Department of Transportation

- Operator Trainee
- Operator I (2nd Developmental Level)
- Operator II (Full Performance Level)
- Operator III (Responsible to coordinate day-to-day operations)

Minneapolis, DOT, Traffic Management Center

- Student Worker-Paraprofessional, Operations Intern
- Transportation Program Specialist 1, Individual Contributor Position
- North Operator (Traffic Management Center)
- South Operator (Traffic Management Center)
- Weekend Operator (Traffic Management Center)

- Dispatcher
- Traveler Information Operator
- Broadcaster

Occupations, Series and Positions Reviewed in the Federal Classification System:

U.S. Office of Personnel Management (OPM) Occupational Series Definitions and Factor Evaluation Guides for:

- Computer Operation Series, GS-332
- Computer Clerk and Assistant Series, GS-335
- Management and Program Clerical and Assistance Series, GS-344
- Telecommunications Processing Series, GS-390
- Telecommunications Series, GS-391
- Administrative Work in the Information Technology Group, GS-2200

OPM Occupational Series Descriptions and Definitions for:

- Air Traffic Control Series, GS-2152 (Federal Aviation Administration)
- Electrical Engineering Series, GS-850
- Computer Engineering Series, GS-854
- Electronics Technician Series, GS-856
- Engineering Technician Series, GS-802
- Equipment Specialist Series, GS-1670

Position Descriptions from the Office of Information Resources Management, Indian Health Service, the National Institutes of Health and the FAA:

- Computer Operator, GS-332-9
- Telecommunications Assistant, GS-394-9
- Computer Systems Analyst, GS-334-12

- Computer Systems Analyst, GS-334-12 (Help Desk)
- Computer Specialist, GS-334-12(Network Administration)
- Computer Systems Analyst, GS-334-13

Position Descriptions from the Federal Aviation Administration:

- Air Traffic Systems Control Specialist (Automated Flight Service Stations), GS-2152-9
- Air Traffic Systems Control Specialist (Automated Station), GS-2152-11
- Telecommunications Specialist, FAA, GS-391-5/7

Other Reference Documents:

1. Chesapeake Highway Advisories Routing Traffic (CHART) Operations Manual, prepared by the Maryland State Highway Administration. Manual includes: Chart Overview and Objectives, Radio Communications, TAR (Traveler Advisory Radio); VMS (Variable Message Signs); Cameras, SOC (State Operations Center) Guidelines; Chart Operational Facilities other than the SOC, Directional Guidelines (Traffic Management)

2. Guidelines for Training New Employees at CHART

3. Bridgeport, Conn. Operations Center Functional Statement

APPENDIX B: TMOT REQUIREMENTS MATRICES

Table B- 1 lists the 16 selected functions and identifies the number of discrete tasks for each function, for a total of 1060 discrete tasks.

Table B- 1. List of functions and associated discrete task count.

TMC Task Integral Function	No. of Tasks
F-1. Provide Travel Information	30
F-2. Records Management	37
F-3. Congestion Management	121
F-4. Failure Management	171
F-5. Incident Management	121
F-6. Special Event Management	108
F-7. Traffic Flow Monitoring	45
F-8. Emergency Management	34
F-9. Provide/Coordinate Service Patrols	45
F-10. Reversible and HOV Lane Management	52
F-11. Traffic Signal System Management	104
F-12. Transit Vehicle Monitoring	35
F-13. APTS System Management	62
F-14. Environmental and RWIS Monitoring	17
F-15. Overheight Vehicle Management	13
F-16. Rail Crossing Management	65
Total Tasks	**1060**

Table B- 2 lists the two types of KSAs identified for TMOT specific activities. The two types are "General," numbered G-1 through G-6 in the dark green cells, and "Special," numbered S-10 through S-230 in the light green cells and spaced in increments of 10 to allow for future expansion. These are used in conjunction with the remaining tables to identify the KSAs specific to the discrete tasks which are performed in a TMC.

Table B- 2. General and special KSAs.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
G-1	Utilize GUI at mouse, keyboard, video monitor (MKV) workstation.	Operation of a standard computer workstation in a windowing applications environment. Response to system queries and messages. Use of menus. Data entry and standard field editing. Understanding of real-time device control and command execution.	Navigate between four or more multiple open application windows. Data entry of X words per minute (WPM) with X% accuracy (40 WPM is minimum, 50 is recommended. Accuracy must be 97% or higher). Use of available macros to accelerate editing of data fields. Execute single control command for a single, or up to X multiple devices (default for number of devices depends on ATMS software).	Comprehend and read English as demonstrated by successful completion of X grade English course (default = 10th grade). Windowing software mastery, specifically the X operating system (default = Microsoft Windows). Minimum of high school education with X years of on-the-job experience using computers (recommend 2 years) or 4-year college degree.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
G-2	Utilize multi-channel telephone and radio headset.	Operation of hold, transfer, speak, listen, speed dial, and other standard business telephone headset features. Operation of channelized two way radio headset with selectable frequencies.	Listen to, and correctly interpret, information from callers, including police dispatchers, other TMC operators, and the public. Ability to convey important information succinctly with minimal verbiage. Quickly switch between lines without lost calls, utilize speed and multi-channel dialing.	Comprehend and read English as demonstrated by successful completion of X grade English course (default = 10th grade). Ability to articulate and speak clearly. Ability to articulate and speak clearly as demonstrated by X years of job experience using a multi-channel business telephone set (default = 2 years).
G-3	Obtain visual information from display wall.	Use of highway maps, outdoor and indoor video image displays, graphical text data, icons, and transportation.	Match CCTV video camera orientation with static images to determine the orientation of the roadway in the field of view. Read character text information. Note changed, unusual conditions or appearance of emergency icons within X seconds (default = 15 seconds).	Understand traffic information from visual sources in a transportation schematic. Ability is demonstrated by X years of experience on X roadway system(s) (default = 4 years experience on 1 roadway system), advanced map reading level as demonstrated by experience as X (default = either emergency medical technician (EMT) driver or US Army Private First Class), and 20/X correctable vision (default = 20).

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
G-4	Read, understand, and act in accordance with agency policies and procedures.	Know public policy principles including customer service, regulation, enforcement, liability, accountability, responsibility, information dissemination, controlled conduct.	Perform duties consistent with agency policies. Can correctly identify situations not conforming to these policies and notify supervisor within X minutes (default = 2 minutes). Remember or find reference material on policies within X minutes (default = 2 minutes).	Memorize X pages of bulleted text material on policies related to job duties (default = 3 pages). X years experience (default = 4 years) on-the-job in position requiring adherence to policy and procedure or 4-year college education.
G-5	Read, understand, and perform procedures in system operator manual.	Know GUI procedures. Understand operating system, application, and database levels.	Implement error free procedures within X attempts (default = 2).	Comprehend and read English as demonstrated by successful completion of X grade English course (default = 10^{th} grade). Ability to read and interpret technical data related to computers and software. Ability to follow written instructions with minimal supervision under time pressure.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
G-6	Verbally communicate to coordinate activities with other TMC operators and supervisors.	Knowledge of appropriate language and interpersonal communication (listening and speaking) used to conduct commonly used, business-related oral communications.	Communicate effectively, capturing and conveying important information while minimizing superfluous verbiage, slang, and lost data.	Work closely and cooperatively with others in a professional business environment as demonstrated by X years participating in goal directed teams (default = 2 years). Ability to perform under pressure, including when communications are recorded for third party review.
S-10	View traffic data.	Traffic flow characteristics such as speed, velocity, volume, average speed, density, percent occupancy, demand, and capacity.	Determine if data viewed is abnormal, anomalous, within or outside a range or threshold.	Correctly interpret data assembled in a two-dimensional array format as demonstrated by successful completion of X grade high school mathematics (default = 10^{th} grade), and completion of college level course material on highway capacity, National Highway Institute training, or specialized training in freeway flow. Alternatively, a 4-year engineering degree in Transportation, Civil (w/transportation courses), or Traffic Engineering. Alternatively, 2 years experience in a TMC utilizing traffic flow parameters, and demonstrated ability.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-20	View video images.	Stationary and moving object recognition in a two (2) dimensional representation of a three (3) dimensional field of view.	Determine if image objects viewed are abnormal, anomalous, and reflect any danger to safe and efficient transportation. Daytime and nighttime operation skills required. Demonstrated skill level to detect a single event in X images (default = 6 images), in X seconds (default = 10 seconds).	Scan multiple monitors and note changes over time to objects and images as demonstrated by X years experience in a multi-monitor environment (default = 2 years), or demonstrated ability.
S-30	View weather data.	Impact of adverse weather on transportation systems, including wind, precipitation, temperature extremes, and airborne particulates including smog, fog, smoke, and precipitation.	Anticipate safety and traffic flow implications of weather fluctuations and events. Recognize values out of acceptable ranges.	Understand how weather systems function as demonstrated by successful completion of courses of general or earth science at the X grade level (default = 10^{th} grade), combined with RWIS vendor training in weather systems, or 4-year engineering degree.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-40	View emissions data.	General air quality principles regarding particulate content in parts per million. Familiarity with common airborne toxins.	Anticipate safety and traffic flow implications of emissions fluctuations and events. Recognize values out of acceptable ranges.	Understand how emissions, fog, and smoke impair air quality as demonstrated by successful completion of courses of Chemistry or Biology sciences at the X level (default = undergraduate 4-year college).
S-50	Detect events. Examples: Note events in video images. Note events from audible sources (radio monitoring, telephone notification). Note events from ATMS generated incident detection alarms (audible and/or visible).	Roadway geometry and lane configuration, direction, coordinates, links, nodes, zones, sections, mileposts, station numbering. General surveillance, control, and data acquisition (SCADA) alarm principles.	Work two consecutive hours with sufficient focus to respond to all alarms received in less than 10 seconds for each alarm. Work two consecutive hours with 100% accuracy taking note of randomly recurring events, at the rate of at least 20 events per hour.	X years experience on-the-job with automated alarms in a SCADA work environment, dispatch center, or similar facility (default = 2 years), and demonstrated skill level. Alternatively, 2 weeks of ATMS software training on simulator with 2-hour focus periods, and/or a 4-year engineering degree.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-60	Verification using CCTV. Examples: Establish precise location data. Determine revised lane configuration. Classify as property damage, injury, spilled load, HAZMAT, fire, type and number of vehicles, overturned truck, etc. Complete initial incident form (handwritten log or data entry). Clear if false alarm.	Camera locations and orientation. Pan, tilt, zoom (PTZ) camera controls. Knowledge of pre-sets, iris functions, and white balance.	Select camera, locate, and zoom in on incident in 360-degree field of view with dome type PTZ in 12 seconds or less. Select camera, locate, and zoom in on incident in 360-degree field of view with rotating enclosure drive type PTZ in 30 seconds or less.	X years experience on-the-job with CCTV systems in TMC or security or broadcast media work environment, dispatch center, or similar facility (default = 2 years), or 4-year education.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-70	Event response. Examples: Knowledge of narrowcasting incident data to required responders based upon event classification. Establish or confirm system generated duration estimate based upon knowledge of typical event durations. Implement ITS advisory roadside devices (dynamic message sign (DMS), HAR) and sub-systems to improve responder safety and mitigate travel. Provide service patrols with incident information.	Knowledge of likely duration for response and cleanup of incidents by classification type. Data fusion methods to create standardized message sets related to the event.	Complete initial required response to multiple minor incidents within 10 minutes, a major incident within 5 minutes. Complete entire response action to any roadway vehicular accident within an additional 5 minutes. Take precautions to prevent secondary incidents within an additional 5 minutes.	X years experience on-the-job with incident management in an emergency response, police, fire, service patrol, or military work environment, dispatch center, or similar facility (default = 2 years). Alternatively, advanced EMT training or 4-year education with major coursework in transportation or emergency preparedness and response.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-80	Coordinate with interagency traffic management personnel during confirmed incidents.	If radio console use is required, knowledge of radio call signs and protocols is required. Traffic law and incident management policies for DOT and responders including police agencies. Local political jurisdictions and institutional relationships. Knowledge of incident command system (ICS) in use.	Memorize all required call signs and policies. Low violation rate of protocols.	If co-located with police, security clearance and background check is required, no felony convictions.
S-90	Regulatory device operation: Activate ramp meters or lane use signals in response to incident.	Theory of operation, including transition and safety measures.	Skill in using regulatory devices is based upon safety, and devices must be used in a safe manner. Unsafe use of regulatory devices can increase the probability of vehicular accidents at the site of the device.	Utilization of regulatory devices requires a four year college degree in a technical or scientific field, or X years experience in traffic control with a government agency (default = 10 years).

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-100	Regulatory device operation: Adjust traffic signal timings in response to incident.	Theory of operation, including transition and safety measures. Split, cycle, offset, detectorization and coordination, timing plans, zones, master/slave concepts, saturation, transition cycles. Capacity utilization and flow characteristics, queuing. Selection of traffic signal timing plans.	Skill in using regulatory devices is based upon safety, and devices must be used in a safe manner. Unsafe use of regulatory devices can increase the probability of vehicular accidents at the site of the device.	Utilization of traffic signal regulatory devices requires a four year college degree in a technical or scientific field with a concentration in Traffic Engineering, or X years experience in traffic control with a government agency or traffic control equipment vendor (default = 10 years).
S-110	Regulatory device operation: Activate regulatory DMS in response to incident, or to support reversible or HOV operation. Open/close gates.	Theory of operation for variable speed limit, lane closure, ramp closure, and/or road closure for highways, tunnels, and bridges.	Skill in using regulatory devices is based upon safety, and devices must be used in a safe manner. Unsafe use of regulatory devices can increase the probability of vehicular accidents at the site of the device.	Utilization of traffic signal regulatory devices requires a four year college degree in a technical or scientific field with a concentration in Traffic Engineering, or X years experience in traffic control with a government agency or traffic control equipment vendor (default = 10 years).

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-120	Monitor incident. Examples: Observe traffic data and video images and update response plan as lane configurations and incident site conditions change. Observe the queue to detect secondary incidents. Update response duration estimate as appropriate. Initiate secondary notifications if observed conditions change (i.e., coroner, HAZMAT, contractor, fire, DOT engineers for structural damage). Hand off incident if shift change occurs. Recover roadway and clear incident: Observe traffic data and video images to determine roadway recovery and clear response plan as appropriate.	Camera locations and orientation. PTZ camera controls. Knowledge of pre-sets, iris functions, and white balance. Knowledge of ICS in use. Knowledge of response plan generation and traffic management.	Select camera, locate, and zoom in on incident in 360-degree field of view with dome type PTZ in 12 seconds or less. Select camera, locate, and zoom in on incident in 360-degree field of view with rotating enclosure drive type PTZ in 30 seconds or less.	X years experience on-the-job with incident management in an emergency response, police, fire, service patrol, or military work environment, dispatch center, or similar facility (default = 2 years). Alternatively, advanced EMT training or 4-year education with major coursework in transportation or emergency preparedness and response.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-130	Acknowledge detected failures, diagnose failures, implement repairs, dispatch/notify traffic signal repair technician(s).	Theory regarding automatic retry of devices, data communications errors and error checking algorithms, MTBF data, and diagnostic codes.	The skills required for failure management include classifying failure events as repeated alarms for the same failed device, grouping similar events, determining if device failures are local device or communication failures, etc. The measure of skill is to maintain a high number of operational devices, and only issue proper work orders to maintainers.	Two-year technical college degree in electronics, or 4-year college education in a technical or scientific field covering electronics, or four years of experience in a SCADA type work environment where monitored points issue failure alarms, or 2 years prior experience in a TMC having automated failure management.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-140	Utilize DMSs in a system.	Texas Transportation Institute (TTI) and FHWA guidelines for creation of VMS text messages. Standard spell check routines.	Select DMS, or a group of DMS, and select database messages for display within 2 minutes. Compose messages in the TTI/FHWA format quickly without spelling, syntax, or timing errors.	Demonstrated work experience in a position requiring compliance with policies for X years (default = 2 years), without adverse incident. Work history indicating emotional stability, trustworthiness, and consistent performance in an increasingly responsible position without adverse incident. Message text formulation requires 4-year engineering degree in Civil/Transportation Engineering with concentration in Traffic Engineering.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-150	Record HAR or 511 messages.	KSA G-2, with emphasis on diction.	Select HAR, or a group of HARs, and record accurate and understandable voice messages for broadcast within 5 minutes.	Demonstrated work experience in a position requiring compliance with policies for X years (default = 2 years), without adverse incident. Work history indicating emotional stability, trustworthiness, and consistent performance in an increasingly responsible position without adverse incident. Message text formulation requires 4-year engineering degree in Civil/Transportation Engineering with concentration in Traffic Engineering, or advanced training in HAR message generation.
S-160	Utilize ATIS.	KSAs G-1 through G-6, and data fusion methodology.	KSAs G-1 through G-6, keep messages timely and accurate. Refresh multiple message sets on an X minute cycle (default = 5 minutes).	X years experience on-the-job with ATIS systems in TMC or broadcast media work environment, dispatch center, or similar facility (default = 2 years), or 4-year education.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-170	Utilize APTS, notify travelers of transit locations and headways.	Public transit operational criteria including scheduling, route selection, headways, and ridership. Traffic flow characteristics such as speed, velocity, volume, average speed, density, percent occupancy, demand, and capacity.	Provide effective route information to aid the transit user in reaching destination in a courteous and professional manner. Complete response to inquiries in less than three minutes.	Vendor training on APTS and specialized training in transit operations. Alternatively, a 4-year engineering degree in Transportation, Civil (w/transportation courses) or Traffic Engineering. Alternatively, 2 years experience in a TMC utilizing traffic flow parameters, and demonstrated ability.
S-180	Meter ramps (including adjustment of metering rates).	Highway capacity for freeways, metering rate selection, queue detection and monitoring, corridor metering strategy dynamic rate selection.	Select ramp, or a group of ramps, and select metering rate strategies. Implement metering in a safe fashion and monitor queue backup onto arterial streets, adjust meter rates based upon meter performance.	Four-year engineering degree in Civil/Transportation Engineering with concentration in Traffic Engineering.

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-190	Respond to public inquiries: Examples are taking cell phone calls for travel assistance directly from travelers.	KSAs G-1 through G-6, and customer service practices. Origins and destinations in the covered areas, knowledge of the roadway network, and travel conditions by time of day.	Provide effective route information to aid motorist in reaching destination in a courteous and professional manner. Complete response to inquiries in less than 3 minutes.	X years experience on-the-job with ATIS systems or in TMC or broadcast media work environment, dispatch center, or similar facility (default = 2 years), or 4-year education. Customer service training requisite for information service provider industry.
S-200	Respond to media inquiries. Examples: Radio interviews during traffic events, broadcast television requests for live broadcasts from TMC or incident site.	KSAs G-1 through G-6, and customer service practices. Knowledge of media practices.	Present transportation information in a positive light, with appropriate language in the proper context, while not exposing the operating agency to any liability, legal or otherwise.	X years experience on-the-job in public relations, media relations or agency communications, in both a TMC and broadcast media work environment (default = 4 years), and 4-year education with concentration in business communications. Customer service training requisite for information service provider industry.
S-210	Update Web site with ATIS Information.	KSAs G-1 through G-6 and KSA S-160, and hyper text markup language (HTML) or Web editing software.	Keep information timely and accurate. Edit static and dynamic fields and some formatting.	In addition to KSA S-160, X years experience on-the-job with Web site development, maintenance, and editing (default = 2 years).

KSA Designator	TMOT Activity Type	Knowledge	Skill	Ability
S-220	Acknowledge TMC software failures, look up error codes and diagnose failures, warm and cold restarts of systems, dispatch/notify computer hardware technician(s) when appropriate.	In addition to KSA G-1, specific knowledge in operating systems software in use, networking at the system administrator level, database and server maintenance.	The skills required for failure management include classifying failure events as repeated alarms for the same failed device, grouping similar events, determining if device failures are local device or communication failures, etc. The measure of skill is to maintain a high number of operational devices, and only issue proper work orders to maintainers.	Two year technical college degree in networking and computer software and 4 years experience, or 4-year college education, in a technical or scientific field covering software and systems, or 4 years of experience in a TMC work environment with integrated ITS subsystems.
S-230	Life-safety event handling, regulatory device operation to prevent accidental loss of life. Activate regulatory device in response to incident. Open/close gates, portals, on active lanes.	Detailed theory of operation for overheight vehicles, rail grade crossing equipment, variable speed limit, lane closure, ramp closure, and/or road closure for highways, tunnels and bridges.	Skill in using regulatory devices is based upon safety, and devices must be used in a safe manner. Unsafe use of regulatory devices can increase the probability of vehicular accidents at the site of the device.	Utilization of traffic signal regulatory devices requires a 4-year college degree in a technical or scientific field with a concentration in traffic engineering, and X years experience in life safety systems operation with a government agency or military (default = 10 years).

Tables B-3 through B-18 characterize each of the 16 functions. These tables are used to identify the specific performance KSAs required for each function. The first column in the table, labeled "Composite Task Name," displays the name of the composite task that each set of discrete TMOT tasks is associated with. Each composite task is assigned a number (e.g., F-3, T-1, meaning Function 3, Task 1). The discrete TMOT tasks appear in three columns, and this group of three columns is labeled "Discrete TMOT Tasks." The text in these columns is justified within the column to make the text more readable.

The next column lists the Generic HR KSA for the task. The Generic HR KSAs are described in Section 6.3. The next column assigns a number to each discrete TMOT task within the associated composite task. The tasks are numbered consecutively within a composite task, and the column heading lists the total number of discrete TMOT tasks for the function.

The next six columns display the general KSAs, G-1 through G-6, that form the base level tasks required for a TMOT to participate in delivery of any of the 16 Task Integral TMC functions; these general KSAs are identified by the dark green entries in Table B- 2. If the general KSA is required to perform a discrete task, a box appears in the cell for that general KSA. For each function, a percentage is provided at the top of each of the general KSA columns that indicates the total percentage of all the tasks in the function that require each general KSA.

The next three columns are collectively labeled "TMOT KSA Level," and the individual columns are labeled "Entry Level," "Full Performance," and "Advanced Only." Boxes appear in the cells to indicate the position level(s) at which the task is expected to be performed. (By definition, any task performed by a lower-level TMOT can also be performed by a higher-level TMOT.) For each function, a percentage is provided at the top of each of the performance level columns that indicates the total percentage of all the tasks in the function at each performance level.

The next three columns are collectively labeled "Special KSAs Required," and up to three special KSAs may be required for each discrete TMOT task. The special KSAs, S-10 through S-230, are defined in the light green entries in Table B- 2.

Table B- 3. Characterization of Function 1 - Provide Travel Information.

Tasks	Num	Discrete TMOT Tasks (30)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-1, T-1: Collect Traveler Information	1	Analyze sensor data for speeds and delays for traveler information update	I	G-1,G-3, G-4,G-5	10	Entry Level
	2	Receive automated incident information for traveler information update	I	G-1,G-3		Entry Level
	3	Receive diversion route information for traveler information update	I	G-1,G-2, G-3,G-4,G-5		Entry Level
	4	Receive automated transit schedule information for traveler information update	I	G-1		Entry Level
	5	Receive automated tunnel/bridge monitoring information for traveler information update	I	G-1	20	Entry Level
	6	Receive cellular call-ins for traveler information update	I	G-1,G-2,G-4		Entry Level
	7	Contact (receive automated info) from areawide TMCs for traveler information update	I	G-1,G-2, G-4,G-6		Entry Level
	8	Contact (receive automated info) from transit control centers for traveler information update	I	G-1,G-2, G-4,G-5,G-6	80	Full Performance
F-1, T-2: Update and Post (Disseminate) Traveler Information	1	Contact (receive automated info) from media outlets for traveler information update	I	G-1,G-2,G-6		Entry Level

Tasks	Num	Discrete TMOT Tasks (30)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Record/note all traveler information update	I	G-1,G-4,G-5		Entry Level
	3	Selectively keep record of traveler information request	I	G-1,G-3, G-4,G-5		Full Performance
	4	Update traveler information archived data	I	G-1,G-4,G-5		Full Performance
	5	Post traveler information to database	V	G-1,G-4,G-5		Full Performance
	6	Post traveler information to ATIS	V	G-1,G-4,G-5	70	Advanced
	7	Post traveler information to World Wide Web	V	G-1,G-4,G-5	70	Advanced
	8	Regularly update traveler information to World Wide Web	V	G-1,G-4,G-5	70	Advanced
F-1, T-3: Provide Travel Information Inquiry/Update Service	1	Acknowledge traveler information request	I	G-1,G-2, G-4,G-5		Entry Level
	2	Determine location(s) where traveler information is requested	I	G-1,G-2, G-4,G-5		Entry Level
	3	Record/Enter details for the person requesting traveler information	I	G-1,G-2, G-4,G-5		Entry Level
	4	Ensure real-time traveler information is provided	V	G-1,G-2, G-3,G-4,G-5		Entry Level

Tasks	Num	Discrete TMOT Tasks (30)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	5	Provide real-time traveler information	V	G-1,G-4,G-5		Full Performance
F-1, T-4: Create Fused Data Set (Operator Decision)	1	Add DMS information to fused traveler information messages	III	G-1,G-3, G-4,G-5	110	Full Performance
	2	DMS information fused traveler information messages	V	G-1,G-3, G-4,G-5	110	Full Performance
	3	Add HARs with rused traveler information messages	V	G-1,G-3, G-4,G-5	70	Full Performance
	4	Summarize various sources into standard format for the fused traveler information messages	V	G-1,G-3, G-4,G-5		Full Performance
	5	Update traffic information services with fused traveler information messages	V	G-1,G-3, G-4,G-5		Full Performance
F-1, T-5: Create, Record, and Post 511 Messages	1	Match fused traveler information to links	III	G-1,G-2		Full Performance
	2	Determine if fused traveler information meets 511 criteria	V	G-2,G-4,G-5		Full Performance
	3	Record the fused traveler information for each link	V	G-1,G-2, G-4,G-5		Full Performance

Tasks	Num	Discrete TMOT Tasks (30)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Post updated link by linking fused traveler information to 511 system	V	G-1,G-2, G-4,G-5	70	Full Performance

Table B- 4. Characterization of Function 2 - Records Management.

Composite Tasks	Num	Discrete TMOT Tasks (37)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-2, T-1: Manage Freeway Management/Incident Data	1	Archive/retrieve recorded traffic sensor data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded freeway reversible lane/HOV data	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded incident management data	I	G-1,G-4,G-5		Entry Level
	4	Archive/retrieve recorded emergency phone calls (audio)	I	G-1,G-4,G-5		Entry Level
	5	Archive/retrieve recorded emergency services coordination data	I	G-1,G-4,G-5		Entry Level
	6	Archive/retrieve recorded incident data (video)	I	G-1,G-4,G-5		Entry Level
F-2, T-2: Manage Special Event Management Data	1	Archive/retrieve recorded special event data (no. of events, data, type, etc.)	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded special event traffic operations data	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded special event parking data	I	G-1,G-4,G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (37)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-2, T-3: Manage Transit Management Data	1	Archive/retrieve recorded automated vehicle location data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded transit schedule compliance/non-compliance data	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded transit maintenance data	I	G-1,G-4,G-5		Entry Level
F-2, T-4: Manage Toll System Management Data	1	Archive/retrieve recorded toll traffic counts, axles, occupancy, and operations data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded toll violation/enforcement data	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded toll violation/enforcement (video)	I	G-1,G-4,G-5		Entry Level
	4	Archive/retrieve recorded toll administration/revenue data	I	G-1,G-4,G-5		Entry Level
	5	Archive/retrieve recorded ETTM data	I	G-1,G-4,G-5		Entry Level
F-2, T-5: Manage Arterial Management Data	1	Archive/retrieve recorded signal system data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded parking management data	I	G-1,G-4,G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (37)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Archive/retrieve recorded arterial reversible lane/HOV data	I	G-1,G-4,G-5		Entry Level
F-2, T-6: Manage Environment and Emissions Data	1	Archive/retrieve recorded emissions sensors data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded causative action data (closure of tunnel, etc.)	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded EM standards non-attainment data	I	G-1,G-4,G-5		Entry Level
F-2, T-7: Manage Failure Management Data	1	Archive/retrieve recorded failure logs (device, comm. etc.)	I	G-1,G-4,G-5		Entry Level
F-2, T-8: Manage Railroad Management Data	1	Archive/retrieve recorded train sensor data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded train schedule compliance/non-compliance data	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded HRI data	I	G-1,G-4,G-5		Entry Level
	4	Archive/retrieve recorded HRI incident data	I	G-1,G-4,G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (37)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-2, T-9: Manage Overheight Vehicle Management Data	1	Archive/retrieve recorded overheight incident data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded warning compliance/non-compliance data	I	G-1,G-4,G-5		Entry Level
F-2, T-10: Manage Commercial Vehicle Management Data	1	Archive/retrieve recorded CV type, counts, and axle data	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded CV cargo type - non-HAZMAT	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded CV cargo type - HAZMAT	I	G-1,G-4,G-5		Entry Level
	4	Archive/retrieve recorded CV electronic processing data	I	G-1,G-4,G-5		Entry Level
F-2, T-11: Manage Emergency Management Data	1	Archive/retrieve recorded emergency phone calls (audio)	I	G-1,G-4,G-5		Entry Level
	2	Archive/retrieve recorded emergency phone logs (data)	I	G-1,G-4,G-5		Entry Level
	3	Archive/retrieve recorded incident data (video)	I	G-1,G-4,G-5		Entry Level

Table B- 5. Characterization of Function 3 - Congestion Management.

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-1: Respond to an ATMS Detected Congestion Event	1	Acknowledge congestion alarm	II	G-1,G-5	50	Entry Level
	2	View congestion data	II	G-1,G-3,G-5	10	Entry Level
	3	Determine congestion location	II	G-1,G-3,G-5		Entry Level
	4	Select camera at congestion location	II	G-1,G-3,G-5		Entry Level
	5	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Entry Level
	6	Classify congestion alarm as false/true	II	G-1,G-4,G-5		Entry Level
	7	Record/enter congestion conditions	II	G-1,G-5		Entry Level
	8	Provide congestion notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	9	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	10	View/create/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	11	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	12	Monitor/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	13	Clear congestion alarm	III	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-2: Note Congestion Event in ATMS Flow Map Visual Data and Respond	1	Notice congestion condition on flow map	II	G-3	50	Entry Level
	2	Evaluate congestion data	III	G-1,G-3,G-4, G-5	10	Entry Level
	3	Determine congestion location	II	G-3,G-5		Entry Level
	4	Select camera at congestion location	II	G-1,G-3,G-5		Entry Level
	5	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Entry Level
	6	Record/enter congestion conditions	II	G-1,G-4,G-5		Entry Level
	7	Provide congestion notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	8	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	9	View/create/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	10	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	11	Monitor/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-3: Note Congestion Event in CCTV Image and Respond	1	Notice congestion condition in CCTV image	II	G-3	50	Entry Level
	2	Determine congestion location	II	G-1,G-3,G-5		Entry Level
	3	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Entry Level
	4	Record/enter congestion conditions	II	G-1,G-4,G-5		Entry Level
	5	Provide congestion notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	6	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	7	View/create/modify congestion response scenario	III	G-1,G-3,G-4, G-5		Full Performance
	8	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	9	Monitor/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
F-3, T-4: Note Congestion Event Heard on Police Radio Monitor (Aural) and Respond	1	Listen to congestion information	II	G-2,G-6	50	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine congestion location from police	II	G-2,G-4,G-6		Full Performance
	3	Check for and view congestion data	II	G-1,G-3,G-5	10	Full Performance
	4	Select camera at congestion location	II	G-1,G-3,G-5		Full Performance
	5	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Full Performance
	6	Record/enter congestion conditions	II	G-1,G-3,G-4, G-5		Full Performance
	7	Provide congestion notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	8	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	9	View/create/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	10	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	11	Monitor/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-5: Respond to Police Notification (Aural) of Congestion Event	1	Receive call and note congestion information	II	G-2,G-6	50	Full Performance
	2	Determine congestion location from police	II	G-2,G-6		Full Performance
	3	Select camera at congestion location	II	G-1,G-3,G-5		Full Performance
	4	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Full Performance
	5	Record/enter congestion conditions	II	G-1,G-4,G-5		Full Performance
	6	Provide congestion notifications	III	G-1,G-4,G-5, G-6		Full Performance
	7	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	8	View/create/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	9	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Monitor/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-6: Respond to APTS Driver Notification by Radio of Congestion Event	1	Receive call and note congestion information	II	G-2,G-6	50	Full Performance
	2	Determine congestion location from driver	II	G-2,G-6		Full Performance
	3	Select camera at congestion location	II	G-1,G-3,G-5		Full Performance
	4	Operate camera for congestion verification	II	G-1,G-3,G-5	20	Full Performance
	5	Record/enter congestion conditions	II	G-1,G-4,G-5	10	Full Performance
	6	Provide congestion notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	7	Enact congestion response	III	G-1,G-4,G-5, G-6		Full Performance
	8	View/create/modify congestion response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	9	Enable congestion response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Monitor/modify congestion sesponse scenario	IV	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-7: Generate and Implement Response Plan for Congestion Event	1	Evaluate severity of congestion delays	III	G-1,G-3	10	Full Performance
	2	Determine devices available for congestion management	III	G-1,G-3,G-5		Full Performance
	3	Resolve conflicting priorities with other congestion sites	IV	G-1,G-3,G-4, G-5,G-6		Advanced
	4	Check device status (failed?) for congestion response plan	III	G-1,G-3,G-5	10	Full Performance
	5	Select DMSs for congestion messaging	II	G-1,G-3,G-4, G-5		Full Performance
	6	Determine (or create) appropriate DMS congestion messages	II	G-1,G-4,G-5		Full Performance
	7	Determine appropriate HARs for congestion response	II	G-1,G-3,G-4		Full Performance
	8	Record HAR congestion messages	II	G-1,G-2,G-4, G-5,G-6		Full Performance
	9	Activate HARs with congestion messages	II	G-1,G-4,G-5		Full Performance
	10	Determine if ramp metering will mitigate congestion in vicinity (upstream)	II	G-1,G-3,G-4		Advanced
	11	Determine appropriate ramp metering rates to mitigate congestion in vicinity (upstream)	II	G-1,G-4		Advanced

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	12	Determine if arterial diversion is occuring or warranted for congestion management	III	G-1,G-4		Advanced
	13	Seek jurisdictional approval for utilizing congestion diversion signal plan	III	G-1,G-4		Advanced
	14	Select traffic signal timing plan for congestion diversion	II	G-1,G-3,G-4, G-5,G-6		Advanced
	15	Record and implement response plan for the congestion event	II	G-1,G-4,G-5, G-6		Advanced
	16	Evaluate effectiveness and adjust congestion response plan if necessary	II	G-1,G-3,G-4, G-5		Advanced
F-3, T-8: Devise and Implement Advanced Techniques for Congestion Management	1	Develop customized DMS messages for traffic flow classified as non-recurring congestion	V	G-1,G-3,G-4		Full Performance
	2	Implement DMS messages based on traffic flow classification	V	G-1,G-3,G-4		Full Performance
	3	Develop response plan for traffic flow classified as non-recurring congestion	V	G-1,G-3,G-4		Full Performance
	4	Implement congestion management strategies to improve traffic flow conditions	IV	G-1,G-3,G-4		Full Performance
	5	Implement parking strategies based on observed traffic flow conditions	IV	G-1,G-3,G-4		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	6	Implement ramp metering strategies to improve traffic flow if available	IV	G-1,G-3,G-4		Full Performance
	7	Devise and program a scheduled event to improve traffic flow if available	IV	G-1,G-3,G-4		Full Performance
F-3, T-9: Devise and Schedule Advanced Techniques for Recurring Congestion	1	Develop customized DMS messages for traffic flow classified as recurring congestion	V	G-1,G-3,G-4		Full Performance
	2	Implement DMS messages based on traffic flow classification	V	G-1,G-3,G-4		Full Performance
	3	Develop response plan for traffic flow classified as recurring congestion	V	G-1,G-3,G-4		Full Performance
	4	Implement congestion management strategies to improve traffic flow conditions	IV	G-1,G-3,G-4		Full Performance
	5	Implement parking strategies based on observed traffic flow conditions	IV	G-1,G-3,G-4		Full Performance
	6	Implement ramp metering strategies to improve traffic flow if available	IV	G-1,G-3,G-4		Full Performance
	7	Devise and program a scheduled event to improve traffic flow if available	IV	G-1,G-3,G-4		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-3, T-10: Devise and Implement a Ramp Metering Response to a Non-Recurring Congestion Event	1	Check and record current status of congestion backups on ramps and freeways	II	G-1,G-3,G-5	10	Full Performance
	2	Determine the extent of congestion backups and delays	II	G-1,G-3,G-5		Full Performance
	3	Select ramps to implement ramp metering for congestion management	II	G-1,G-3,G-4		Full Performance
	4	Check current status of ramp meters designed to reduce congestion severity	II	G-1,G-3,G-5		Full Performance
	5	Seek permission to activate ramp meters to reduce congestion severity	IV	G-2,G-4,G-6		Full Performance
	6	Determine the best algorithm for congestion management (if required)	IV	G-1,G-4		Advanced
	7	Activate ramp meters to reduce congestion severity	V	G-1,G-4,G-5		Full Performance
	8	Monitor status of activated ramps meters to reduce congestion severity	II	G-1,G-3,G-4, G-5		Full Performance
	9	Select camera(s) to monitor ramp meters activated to reduce congestion severity	II	G-1,G-3,G-5		Full Performance
	10	Operate camera for congestion monitoring after activating ramp meters	II	G-1,G-3,G-5	20	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	11	Check freeway/ramp sensors for congestion monitoring	II	G-1,G-5		Full Performance
	12	Check and record current status of congestion delays	I	G-1,G-3,G-4, G-5		Full Performance
	13	Deactivate ramp meter when congestion delays are below threshold	V	G-1,G-5		Full Performance
	14	Select camera(s) to monitor ramp meters deactivated for congestion management	II	G-1,G-3		Full Performance
	15	Operate camera for congestion monitoring after deactivating ramp meters	II	G-1,G-3,G-5	20	Full Performance
F-3, T-11: Devise and Implement a Ramp Metering Response to a Recurring Congestion Event	1	Check historical status of congestion delays	I	G-1,G-5	10	Advanced
	2	Check and record current status of congestion backups on ramps and freeways	II	G-1,G-3,G-5		Advanced
	3	Determine the extent of congestion backups and delays	II	G-1,G-3		Advanced
	4	Ensure activation of ramp meters to reduce congestion severity - through event scheduler	V	G-1,G-4,G-5		Advanced
	5	Monitor status of activated ramp meters to reduce congestion severity	II	G-1,G-3,G-5		Advanced

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	6	Select camera(s) to monitor ramp meters activated to reduce congestion severity	II	G-1,G-3		Full Performance
	7	Operate camera for congestion monitoring after activating ramp meters	II	G-1,G-3,G-5	20	Full Performance
	8	Check freeway/ramp sensors for congestion monitoring	I	G-1,G-3,G-5		Full Performance
	9	Check and record current status of congestion delays	I	G-1,G-3,G-4, G-5		Full Performance
	10	Ensure deactivation of ramp meters for congestion management - through event scheduler	V	G-1,G-3,G-4		Advanced
	11	Select camera(s) to monitor ramp meters deactivated for congestion management	II	G-1,G-3,G-5		Full Performance
	12	Operate camera for congestion monitoring after deactivating ramp meters	II	G-1,G-3,G-5	20	Full Performance

Table B- 6. Characterization of Function 4 - Failure Management.

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-4, T-1: Record ATMS Detected Device Failure	1	Acknowledge roadside device failure alarm	II	G-1,G-5	50	Entry Level
	2	View roadside device failure data	II	G-1,G-3,G-5	10	Entry Level
	3	Determine roadside device failure location	II	G-1,G-3,G-5		Entry Level
	4	Attempt roadside device failure reset	II	G-1,G-3,G-5		Entry Level
	5	Operate camera for DMS roadside device failure verification/diagnosis	II	G-1,G-3,G-5	20	Entry Level
	6	Classify roadside device failure alarm as false/true	II	G-1,G-4,G-5		Entry Level
	7	Record/enter roadside device failure type	II	G-1,G-5		Entry Level
	8	Issue roadside device failure notification	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	9	Provide roadside device failure notifications	III	G-1,G-4,G-5, G-6		Full Performance
	10	Enact roadside device failure response	IV	G-1,G-3,G-4, G-5		Full Performance
F-4, T-2: Report ATMS Failed Device	1	Notice roadside device failure condition	II	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Evaluate roadside device failure data	III	G-1,G-3,G-4, G-5		Full Performance
	3	Determine roadside device failure location	II	G-1,G-4,G-5		Full Performance
	4	Record/enter roadside device failure conditions	II	G-1,G-4,G-5	130	Advanced
	5	Provide roadside device failure notifications	III	G-3	50	Entry Level
	6	Enact roadside device failure response	IV	G-1,G-3,G-4, G-5	10	Entry Level
	7	View/create/modify roadside device failure records	I	G-3,G-5		Entry Level
	8	Enable roadside device failure repair actions	II	G-1,G-3,G-5		Entry Level
F-4, T-3: Record ATMS Software Failure	1	View failure message text for roadside device failure and see SOP for information	II	G-1,G-3,G-5	20	Entry Level
	2	Create roadside device failure service repair order	IV	G-1,G-4,G-5		Entry Level
	3	Notify maintenance personnel of critical roadside device failure immediately	IV	G-1,G-2,G-4, G-5,G-6		Full Performance
	4	Verify roadside device failure with system diagnostic	II	G-1,G-4,G-5, G-6		Full Performance
	5	Determine if system operates with roadside device failure prior to repair	II	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-4, T-4: Record ATMS Communication Failure	1	Determine roadside device failure and run system communication test	II	G-1,G-4,G-5		Full Performance
	2	Determine location of roadside device failure and run system communication test to nearest device	II	G-1,G-3,G-4, G-5		Full Performance
	3	Verify that with roadside device failure system can still operate	II	G-1,G-3,G-4, G-5	130	Advanced
	4	Notify system administrator of roadside device failure and create service repair order	IV	G-3	50	Entry Level
	5	Contact maintenance personnel about roadside device failure and notify of type of failure	IV	G-1,G-3,G-5		Entry Level
	6	Verify roadside device failure and start system diagnostic	II	G-1,G-3,G-5	20	Entry Level
	7	Acknowledge communications device failure alarm	II	G-1,G-4,G-5		Entry Level
F-4, T-5: Record ATMS Multiple Sequential Device Failures	1	View communications device failure data	II	G-1,G-2,G-4, G-5,G-6		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine communications device failure location	II	G-1,G-4,G-5, G-6		Full Performance
	3	Attempt communications device failure reset	II	G-1,G-3,G-4, G-5		Full Performance
	4	Classify communications device failure alarm as false/true	II	G-1,G-4,G-5		Full Performance
	5	Record/enter communications device failure type	I	G-1,G-3,G-4, G-5		Full Performance
	6	Issue communications device failure notification	III	G-1,G-3,G-4, G-5	130	Advanced
	7	Provide communications device failure notifications	III	G-2,G-6	50	Entry Level
	8	Enact communications device failure response	IV	G-2,G-4,G-6		Full Performance
	9	Notice communications device failure condition	II	G-1,G-3,G-5	10	Full Performance
	10	Assess impact of communications device failure on roadside devices	IV	G-1,G-3,G-5		Full Performance
F-4, T-6: Record Central Device Failures	1	Acknowledge TMC central device failure alarm	II	G-1,G-3,G-5	20, 220	Full Performance
	2	View TMC central device failure data	II	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Determine TMC central device failure location	II	G-1,G-2,G-4, G-5,G-6		Full Performance
	4	Attempt TMC central device failure reset	II	G-1,G-4,G-5, G-6	220	Advanced
	5	Classify TMC central device failure alarm as false/true	II	G-1,G-3,G-4, G-5	220	Advanced
	6	Record/enter TMC central device failure type	I	G-1,G-4,G-5	220	Advanced
	7	Issue TMC central device failure notification	III	G-1,G-3,G-4, G-5	220	Advanced
	8	Provide TMC central device failure notifications	III	G-1,G-3,G-4, G-5	130, 220	Advanced
	9	Enact TMC central device failure response	IV	G-2,G-6	50, 220	Advanced
	10	Notice TMC central device failure condition	II	G-2,G-6	220	Advanced
	11	Assess impact of TMC central device failure on roadside devices	IV	G-1,G-3,G-5	220	Advanced
F-4, T-7: ATIS Detected Device Failure	1	Acknowledge roadside device failure alarm	II	G-1,G-3,G-5	20	Full Performance
	2	View roadside device failure data	II	G-1,G-4,G-5		Full Performance
	3	Determine roadside device failure location	II	G-1,G-4,G-5, G-6		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Attempt roadside device failure reset	II	G-1,G-4,G-5, G-6		Full Performance
	5	Operate camera for roadside device failure verification/diagnosis	II	G-1,G-3,G-4, G-5		Full Performance
	6	Classify roadside device failure alarm as false/true	II	G-1,G-4,G-5		Full Performance
	7	Record/enter roadside device failure type	I	G-1,G-3,G-4, G-5		Full Performance
	8	Issue roadside device failure notification	III	G-1,G-3,G-4, G-5	130	Advanced
	9	Provide roadside device failure notifications	III	G-2,G-6	50	Full Performance
	10	Enact roadside device failure response	IV	G-2,G-6		Full Performance
F-4, T-8: ATIS Failed Device Report	1	Notice roadside device failure condition	II	G-1,G-3,G-5		Full Performance
	2	Evaluate roadside device failure data	III	G-1,G-3,G-5	20	Full Performance
	3	Determine roadside device failure location	II	G-1,G-4,G-5	10	Full Performance
	4	Record/enter roadside device failure conditions	I	G-1,G-2,G-4, G-5,G-6		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	5	Provide roadside device failure notifications	III	G-1,G-4,G-5, G-6		Full Performance
	6	Enact roadside device failure response	IV	G-1,G-3,G-4, G-5		Full Performance
	7	View/create/modify roadside device failure records	I	G-1,G-4,G-5		Full Performance
	8	Enable roadside device failure repair actions	II	G-1,G-3,G-4, G-5		Full Performance
F-4, T-9: ATIS Software Failure	1	View failure message text for roadside device failure and see SOP for information	II	G-1,G-3	130, 220	Advanced
	2	Create roadside device failure service repair order	IV	G-1,G-3	10, 220	Full Performance
	3	Notify maintenance personnel of critical roadside device failure immediately	IV	G-1,G-3,G-5	220	Full Performance
	4	Verify roadside device failure with system diagnostic	II	G-1,G-3,G-4, G-5,G-6	130, 220	Advanced
	5	Determine if system operates with roadside device failure prior to repair	II	G-1,G-3,G-5	10, 220	Full Performance
F-4, T-10: ATIS Communication Failure	1	Determine roadside device failure and run system communication test	II	G-1,G-3,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine location of failure roadside device failure and run system communication test to nearest device	II	G-1,G-4,G-5		Full Performance
	3	Verify that with roadside device failure system can still operate	II	G-1,G-3,G-4		Full Performance
	4	Notify system administrator of roadside device failure and create service repair order	IV	G-1,G-2,G-4, G-5		Full Performance
	5	Contact maintenance personnel of roadside device failure and notify of type of failure	IV	G-1,G-4,G-5, G-6		Full Performance
	6	Verify roadside device failure and start system diagnostic	II	G-1,G-3,G-4	130, 220	Advanced
F-4, T-11: ATIS Multiple Sequential Device Failures	1	Acknowledge communications device failure alarm	II	G-1,G-4	130, 220	Advanced
	2	View communications device failure data	II	G-1,G-4	130, 220	Advanced
	3	Determine communications device failure location	II	G-1,G-4	130, 220	Advanced
	4	Attempt communications device failure reset	II	G-1,G-3,G-4, G-5,G-6	130, 220	Advanced
	5	Classify communications device failure alarm as false/true	II	G-1,G-4,G-5, G-6	130, 220	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	6	Record/enter communications device failure type	I	G-1,G-3,G-4, G-5	130, 220	Advanced
	7	Issue communications device failure notification	III		130, 220	Advanced
	8	Provide communications device failure notifications	III	G-1,G-4,G-5	130, 220	Advanced
	9	Enact communications device failure response	IV	G-1,G-4,G-5	130, 220	Advanced
	10	Notice communications device failure condition	II	G-1,G-4,G-5	130, 220	Advanced
	11	Assess impact of communications device failure on roadside devices	IV	G-1,G-4,G-5	130, 220	Advanced
F-4, T-12: APTS Detected Device Failure	1	Acknowledge roadside device failure alarm	II	G-1,G-4,G-5	130	Advanced
	2	View roadside device failure data	II	G-1,G-4,G-5	130	Advanced
	3	Determine roadside device failure location	II	G-1,G-4,G-5	130	Advanced
	4	Attempt roadside device failure reset	II		130	Advanced
	5	Operate camera for roadside device failure verification/diagnosis	II		130	Advanced
	6	Classify roadside device failure alarm as false/true	II	G-1,G-4,G-5	130	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	7	Record/enter roadside device failure type	I	G-1,G-4,G-5	130	Advanced
	8	Issue roadside device failure notification	II	G-1,G-4,G-5	130	Advanced
	9	Provide roadside device failure notifications	III	G-1,G-4,G-5	130	Advanced
	10	Enact roadside device failure response	IV	G-1,G-4,G-5	130	Advanced
F-4, T-13: APTS Failed Device Report	1	Notice roadside device failure condition	II	G-1,G-4,G-5	130	Advanced
	2	Evaluate roadside device failure data	III	G-1,G-4,G-5	130	Advanced
	3	Determine roadside device failure location	II		130	Advanced
	4	Record/enter roadside device failure conditions	I		130	Advanced
	5	Provide roadside device failure notifications	III	G-1,G-3,G-5	10	Full Performance
	6	Enact roadside device failure response	IV	G-1,G-3,G-5		Full Performance
	7	View/create/modify roadside device failure records	I	G-1,G-3,G-4		Full Performance
	8	Enable roadside device failure repair actions	IV	G-1,G-3,G-5		Full Performance
F-4, T-14: APTS Software Failure	1	View failure message text for roadside device failure and see SOP for information	II	G-2,G-4,G-6	220	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Create roadside device failure service repair order	IV	G-1,G-4	220	Advanced
	3	Notify maintenance personnel of critical roadside device failure immediately	IV	G-1,G-4,G-5	220	Full Performance
	4	Verify roadside device failure with system diagnostic	II	G-1,G-3,G-4, G-5	220	Full Performance
	5	Determine if system operates with roadside device failure prior to repair	II	G-1,G-3,G-5	220	Full Performance
F-4, T-15: APTS Communication Failure	1	Determine roadside device failure and run system communication test	II	G-1,G-3,G-5	20	Full Performance
	2	Determine location of roadside device failure and run system communication test to nearest device	II	G-1,G-5		Full Performance
	3	Verify that with roadside device failure system can still operate	II	G-1,G-3,G-4, G-5		Full Performance
	4	Notify system administrator of roadside device failure and create service repair order	IV	G-1,G-5		Full Performance
	5	Contact maintenance personnel about roadside device failure and notify of type of failure	IV	G-1,G-3,G-5		Full Performance
	6	Verify roadside device failure and start system diagnostic	II	G-1,G-3,G-5	20	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-4, T-16: APTS Multiple Sequential Device Failures	1	Acknowledge communications device failure alarm	II			Advanced
	2	View communications device failure data	II	G-1,G-5	10	Advanced
	3	Determine communications device failure location	II	G-1,G-3,G-5		Advanced
	4	Attempt communications device failure reset	II	G-1,G-3		Advanced
	5	Classify communications device failure alarm as false/true	II	G-1,G-4,G-5		Advanced
	6	Record/enter communications device failure type	I	G-1,G-3,G-5		Advanced
	7	Issue communications device failure notification	III	G-1,G-3		Full Performance
	8	Provide communications device failure notifications	III	G-1,G-3,G-5	20	Full Performance
	9	Enact communications device failure response	IV	G-1,G-3,G-5		Full Performance
	10	Notice communications device failure condition	II	G-1,G-3,G-4, G-5		Full Performance
	11	Assess impact of communications device failure on roadside devices	IV	G-1,G-3,G-4	130	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-4, T-17: TSC Detected Device Failure	1	Acknowledge intersection device failure alarm	II	G-1,G-3,G-5		Full Performance
	2	View intersection device failure data	II	G-1,G-3,G-5	20	Full Performance
	3	Determine intersection device failure location	II	G-1,G-3,G-5	130	Advanced
	4	Attempt intersection device failure reset	II	G-1,G-3,G-5	130	Advanced
	5	Operate camera for intersection device failure verification/diagnosis	II	G-1,G-3,G-5	130	Advanced
	6	Classify intersection device failure alarm as false/true	II	G-1,G-3,G-5	130	Advanced
	7	Record/enter intersection device failure type	I	G-1,G-3,G-5	130	Advanced
	8	Issue intersection device failure notification	III	G-1,G-3,G-5	130	Advanced
	9	Provide intersection device failure notifications	III	G-1,G-3,G-5	130	Advanced
	10	Enact intersection device failure response	IV	G-1,G-3,G-5	130	Advanced
F-4, T-18: TSC System Failed Device Report	1	Notice intersection device failure condition	II	G-1,G-3,G-5	130	Advanced
	2	Evaluate intersection device failure data	III	G-1,G-3,G-5	130	Advanced
	3	Determine intersection device failure location	II	G-1,G-3,G-5	130	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Record/enter intersection device failure conditions	I	G-1,G-3,G-5	130	Advanced
	5	Provide intersection device failure notifications	III	G-1,G-3,G-5	130	Advanced
	6	Enact intersection device failure response	IV	G-1,G-3,G-5	130	Advanced
	7	View/create/modify intersection device failure records	I	G-1,G-3,G-5	130	Advanced
	8	Enable intersection device failure repair actions	IV	G-1,G-3,G-5	130	Advanced
F-4, T-19: TSC System Software Failure	1	View failure message text for intersection device failure and see SOP for information	II	G-1,G-3,G-5	220	Advanced
	2	Create intersection device failure service repair order	IV	G-1,G-3,G-5	220	Advanced
	3	Notify maintenance personnel of critical intersection device failure immediately	IV	G-1,G-3,G-5	220	Advanced
	4	Verify intersection device failure with system diagnostic	II	G-1,G-3,G-5	220	Advanced
	5	Determine if system operates with intersection device failure prior to repair	II	G-1,G-3,G-5	220	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-4, T-20: TSC System Communication Failure	1	Determine intersection device failure and run system communication test	II	G-1,G-3,G-5	130	Advanced
	2	Determine location of intersection device failure and run system communication test to nearest device	II	G-1,G-3,G-5	130	Advanced
	3	Verify that with intersection device failure system can still operate	II	G-1,G-3,G-5	130	Advanced
	4	Notify system administrator of intersection device failure and create service repair order	IV	G-1,G-3,G-5	130	Advanced
	5	Contact maintenance personnel about intersection device failure and notify of type of failure	IV	G-1,G-3,G-5	130	Advanced
	6	Verify intersection device failure and start system diagnostic	II	G-1,G-3,G-5	130	Advanced
F-4, T-21: TSC System Multiple Sequential Device Failures	1	Acknowledge communications device failure alarm	II	G-1,G-3,G-5	130	Advanced
	2	View communications device failure data	II	G-1,G-3,G-5	130	Advanced
	3	Determine communications device failure location	II	G-1,G-3,G-5	130	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (171)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Attempt communications device failure reset	II	G-1,G-3,G-5	130	Advanced
	5	Classify communications device failure alarm as false/true	II	G-1,G-3,G-5	130	Advanced
	6	Record/enter communications device failure type	I	G-1,G-3,G-5	130	Advanced
	7	Issue communications device failure notification	III	G-1,G-3,G-5	130	Advanced
	8	Provide communications device failure notifications	III	G-1,G-3,G-5	130	Advanced
	9	Enact communications device failure response	IV	G-1,G-3,G-5	130	Advanced
	10	Notice communications device failure condition	II	G-1,G-3,G-5	130	Advanced
	11	Assess impact of communications device failure on roadside devices	III	G-1,G-3,G-5	130	Advanced

Table B- 7. Characterization of Function 5 - Incident Management.

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-5, T-1: Respond to an ATMS Detected Incident Alarm	1	Acknowledge incident alarm	II	G-1		Entry Level
	2	View incident data	II	G-1	10	Entry Level
	3	Determine incident location	II	G-1,G-3		Entry Level
	4	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	6	Classify incident alarm as false/true	II	G-1,G-4,G-5		Entry Level
	7	Record/enter incident conditions	I	G-1,G-4,G-5		Full Performance
	8	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	9	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	10	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	12	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	13	Clear incident alarm	II	G-1		Entry Level
F-5, T-2: Note Incident in ATMS Flow Map Visual Data	1	Notice incident condition	II	G-1,G-3		Entry Level
	2	Evaluate incident data	III	G-1	10	Full Performance
	3	Determine incident location	II	G-1,G-3		Entry Level
	4	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	6	Record/enter incident conditions	I	G-1,G-4,G-5		Entry Level
	7	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	8	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-5, T-3: Note Incident in CCTV Displayed Image and Respond	1	Determine incident location	I	G-1,G-3		Entry Level
	2	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	3	Record/enter incident conditions	I	G-1,G-4,G-5		Entry Level
	4	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	5	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	6	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	7	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	8	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-5, T-4: Note Incident Heard on Police Radio Monitor (Aural) and Respond	1	Listen to incident information	I	G-1,G-2		Entry Level
	2	Determine incident location from police	I	G-1,G-2,G-6		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Check for and view incident data	II	G-1,G-3	10	Entry Level
	4	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	6	Record/enter incident conditions	I	G-1,G-4,G-5		Entry Level
	7	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	8	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-5, T-5: Respond to Police Notification (Aural) of Incident	1	Receive call and note incident information	I	G-1,G-2		Entry Level
	2	Determine incident location from police	I	G-1,G-2,G-6		Entry Level
	3	Select camera at incident location	II	G-1,G-3		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide incident notifications	III	G-1,G-4,G-5		Entry Level
	7	Enact incident response	III	G-1,G-4,G-5		Full Performance
	8	View/create/modify incident response scenario	IV	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
F-5, T-6: Respond to Direct Cell Phone Call-In of Incident	1	Receive call and note incident information	I	G-1,G-2		Entry Level
	2	Check for and view incident data	II	G-1	10	Entry Level
	3	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	5	Record/enter incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	7	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	8	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	9	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify incident response scenario	IV	G-1,G-3,G-4, G-5	120	Full Performance
F-5, T-7: Respond to Motorist Aid Call Box Alert	1	Receive alert and note incident information	I	G-1,G-2		Entry Level
	2	Check for and view incident data	II	G-1	10	Entry Level
	3	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter incident conditions	I	G-1,G-3,G-4, G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	6	Provide incident notifications	III	G-1,G-4,G-5		Full Performance
	7	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	8	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	9	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify incident response scenario	IV	G-1,G-3,G-4, G-5	120	Full Performance
F-5, T-8: Respond to APTS Driver Notification by Radio of Incident	1	Receive call and note incident information	I	G-1,G-2		Entry Level
	2	Determine incident location from driver	I	G-1,G-2,G-6		Entry Level
	3	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide incident notifications	III	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	7	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	8	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	9	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-5, T-9: Respond to Roadside Call Box Activation of Incident	1	Acknowledge incident call box activation	I	G-1		Entry Level
	2	Determine incident location	I	G-1,G-2,G-3		Entry Level
	3	Select camera at incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Classify incident call as false/true	I	G-1,G-3,G-4, G-5		Entry Level
	6	Record/enter incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	7	Provide incident notifications	III	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	8	Enact incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	View/create/modify incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Enable incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Monitor/modify incident response scenario	IV	G-1,G-3,G-4, G-5	120	Full Performance
	12	Clear incident alarm	II	G-1		Entry Level
F-5, T-10: Generate and Implement Incident Response Plan	1	Evaluate severity of incident delays	III	G-1		Full Performance
	2	Determine devices available for incident management	II	G-1,G-3		Entry Level
	3	Resolve conflicting priorities with other incident sites	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	4	Check device status for incident response plan	II	G-1,G-3		Entry Level
	5	Activate DMSs with incident messages	V	G-1,G-3,G-4, G-5	140	Full Performance
	6	Activate HARs with incident messages	V	G-1,G-3,G-4, G-5	140	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	7	Activate ramp metering in incident vicinity (upstream)	III	G-1,G-3,G-4, G-5	180	Full Performance
	8	Select traffic signal timing plan for incident diversion	III	G-1,G-3,G-4, G-5	100	Full Performance
	9	Update traffic information on Web site due to incident conditions	V			Advanced
F-5, T-11: Respond to a Confirmed Major Incident	1	Determine number and configuration of incident lanes blocked	II	G-1,G-2,G-3, G-6		Entry Level
	2	Monitor number and configuration of incident lanes blocked	II	G-1,G-2,G-3, G-6		Entry Level
	3	Evaluate, determine, query responders if incident involves personal injuries	III	G-1,G-2,G-3, G-4,G-5	70, 80	Full Performance
	4	Confirm dispatch of ambulance to incident involving injury	IV	G-1,G-2,G-3, G-4,G-5	70	Full Performance
	5	Evaluate, determine, query responders if incident involves fatality	IV	G-1,G-2,G-3, G-4,G-5	70, 80, 200	Full Performance
	6	Confirm notification of coroner of incident involving fatality	IV	G-1,G-2,G-3, G-4,G-5	70, 200	Full Performance
	7	Evaluate, determine, query responders if incident involves spilled load/material	IV	G-1,G-2,G-3, G-4,G-5,G-6	70, 80, 200	Full Performance
	8	Evaluate, determine, query responders if spill involves flammable material	IV	G-1,G-2,G-3, G-4,G-5,G-6	70, 80, 200	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (121)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	9	Evaluate, determine, query responders if spill involves hazardous material	IV	G-1,G-2,G-3, G-4,G-5,G-6	70, 80, 200	Full Performance
	10	Confirm notification of HAZMAT responder of incident involving fatality	IV	G-1,G-2,G-3, G-4,G-5	70, 80, 200	Full Performance
	11	Determine location of DOT resources based on incident location	III	G-1,G-2,G-6	70	Entry Level
	12	Evaluate, based on experience, and estimate the likely incident duration	III	G-1,G-2,G-6	70	Full Performance
	13	Update response plans based upon likely incident duration	IV	G-1,G-2,G-3, G-4,G-5,G-6	120	Full Performance
F-5, T-12: Terminate Response Plan for Cleared Incident	1	Confirm incident clearance	IV	G-1,G-2,G-3, G-6		Entry Level
	2	Terminate incident response plan	IV	G-1		Entry Level
	3	Terminate incident delay mitigation plan	IV	G-1,G-6		Entry Level
	4	Enter incident clearance in software/records	II	G-1		Entry Level

Table B- 8. Characterization of Function 6 - Special Event Management.

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-6, T-1: Respond to Special Event Data	1	Program special event location	II	G-1,G-3		Entry Level
	2	Enter special event schedule	II	G-1		Entry Level
	3	Create special event incident response	IV	G-1,G-3,G-4, G-5		Full Performance
	4	Plan possible diversion routes due to special event incident conditions	III	G-1,G-3,G-4, G-5		Full Performance
	5	Plan alternate parking options due to special event conditions	III	G-1,G-4,G-5		Full Performance
	6	Determine cameras to be activated during special event conditions	II	G-1,G-3,G-4, G-5		Full Performance
	7	Create library for DMS messages for special event incident conditions	II			Advanced
	8	Create library for DMS messages for special event normal conditions	II			Advanced
	9	Determine emergency response plan during special event conditions	IV	G-1,G-2,G-3, G-4,G-5,G-6	80	Full Performance
	10	Develop incident management plan for special event incident conditions	III	G-1,G-2,G-3, G-4,G-5,G-6	80	Full Performance
	11	Store archived data for special event conditions	I	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-6, T-2: Respond to ATMS Detected Incident Alarm	1	Acknowledge special event incident alarm	II	G-1,G-3		Entry Level
	2	View special event incident data	II	G-1	10	Entry Level
	3	Determine special event incident location	II	G-1		Entry Level
	4	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	6	Classify special event incident alarm as false/true	II	G-1,G-4,G-5		Full Performance
	7	Record/enter special event incident conditions	I	G-1,G-2,G-3, G-4,G-5,G-6		Entry Level
	8	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	9	Enact special event incident response	III	G-1,G-2,G-4, G-5		Entry Level
	10	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	11	Enable special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	12	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	13	Clear special event incident alarm	II	G-1		Entry Level
F-6, T-3: Respond to ATMS Flow Map Visual Data	1	Notice special event incident condition	II	G-1,G-3		Entry Level
	2	Evaluate special event incident data	III	G-1	10	Full Performance
	3	Determine special event incident location	II	G-1,G-3		Entry Level
	4	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	6	Record/enter special event incident conditions	I	G-1,G-4,G-5		Entry Level
	7	Provide special event incident notifications	III	G-1,G-2,G-3, G-4,G-5,G-6	50	Full Performance
	8	Enact special event incident response	III	G-1,G-4,G-5		Advanced
	9	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Enable special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Monitor/modify special event incident response scenario	IV	G-1,G-3,G-4, G-5	120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-6, T-4: Note Incident in CCTV Displayed Image and Respond	1	Determine special event incident location	II	G-1,G-3		Full Performance
	2	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20	Full Performance
	3	Record/enter special event incident conditions	I	G-1,G-4,G-5		Full Performance
	4	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	5	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	6	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	7	Enable special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	8	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-6, T-5: Note Incident Heard on Police Radio Monitor (Aural) and Respond	1	Listen to special event incident information	I	G-1,G-2		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine special event incident location from police	I	G-1,G-2,G-6		Entry Level
	3	Check for and view special event incident data	II	G-1,G-3	10	Entry Level
	4	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	6	Record/enter special event incident conditions	I	G-1,G-4,G-5		Entry Level
	7	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	8	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Enable special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-6, T-6: Respond to Police Notification (Aural) of Incident	1	Receive call and note special event incident information	I	G-1,G-2		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine special event incident location from police	I	G-1,G-2,G-6		Entry Level
	3	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter special event incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	7	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	8	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	9	Enable special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-6, T-7: Respond to Direct Cell Phone Call-In of Incident	1	Receive call and note special event incident information	I	G-1,G-2		Entry Level
	2	Check for and view special event incident data	II	G-1	10	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter special event incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	7	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	8	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	9	Enable special event incident response scenario	IV	G-1,G-4,G-5	70	Full Performance
	10	Monitor/modify special event incident response scenario	IV	G-1,G-3,G-4, G-5	120	Full Performance
F-6, T-8: Respond to APTS Driver Notification by Radio of Incident	1	Receive call and note special event incident information	I	G-1,G-2		Entry Level
	2	Determine special event incident location from driver	I	G-1,G-2,G-6		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Select camera at special event incident location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Record/enter special event incident conditions	I	G-1,G-3,G-4, G-5		Entry Level
	6	Provide special event incident notifications	III	G-1,G-4,G-5		Entry Level
	7	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Entry Level
	8	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	9	Enable special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-6, T-9: Respond to Roadside Call Box Activation of Incident	1	Acknowledge special event incident call box activation	II	G-1		Entry Level
	2	Determine special event incident location	II	G-1,G-2,G-3		Entry Level
	3	Select camera at special event incident location	II	G-1,G-3,G-4,G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Operate camera for special event incident verification	II	G-1,G-3,G-4, G-5	20, 60	Entry Level
	5	Classify special event incident call as false/true	II	G-1,G-3,G-4, G-5		Entry Level
	6	Record/enter special event incident conditions	I	G-1,G-4,G-5		Entry Level
	7	Provide special event incident notifications	III	G-1,G-4,G-5		Full Performance
	8	Enact special event incident response	III	G-1,G-2,G-4, G-5,G-6	50	Full Performance
	9	View/create/modify special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Enable special event incident response scenario	IV	G-1,G-4,G-5		Full Performance
	11	Monitor/modify special event incident response scenario	IV	G-1,G-4,G-5	120	Full Performance
	12	Clear special event incident alarm	II	G-1,G-3		Entry Level
F-6, T-10: Generate and Implement Response Plan	1	Evaluate severity of special event incident delays	III	G-1,G-3		Full Performance
	2	Determine devices available for special event incident management	IV	G-1,G-3		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (108)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Resolve conflicting priorities with other special event incident sites	IV	G-1,G-2,G-4, G-5,G-6		Full Performance
	4	Check device status for special event incident response plan	IV	G-1,G-3		Entry Level
	5	Activate DMSs with special event incident messages	V	G-1,G-2,G-4, G-5,G-6	110	Full Performance
	6	Activate DMS for parking options due to special event incident diversion	V	G-1,G-3,G-5, G-6	110	Full Performance
	7	Activate HARs with special event incident messages	V	G-1,G-5,G-6	70	Full Performance
	8	Activate HAR for parking/diversion route due to special event incident conditions	V	G-1,G-3,G-5, G-6	70	Full Performance
	9	Activate ramp metering in special event incident vicinity (upstream)	V	G-1,G-3,G-5, G-6	180	Full Performance
	10	Select traffic signal timing plan for special event incident diversion	V	G-1,G-5,G-6	100	Full Performance
	11	Select traffic signal timing for alternate parking due to special event incident conditions	V	G-1,G-3,G-5, G-6	100	Full Performance
	12	Update traffic/parking information on Web site due to special event incident conditions	V	G-1,G-3,G-5, G-6		Advanced

Table B- 9. Characterization of Function 7 - Traffic Flow Monitoring.

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-7, T-1: Monitor Real-Time Traffic Flow Data from ATMS	1	Visually monitor ATMS GUI for traffic flow characteristics	II	G-1,G-3		Entry Level
	2	Evaluate differentials between normal conditions by time and link with traffic flow observed	III	G-1,G-3,G-4, G-5	10	Full Performance
	3	Identify traffic flow problem links	III	G-1,G-3,G-4, G-5		Full Performance
	4	Evaluate traffic flow average speeds	III	G-1	10	Entry Level
	5	Evaluate traffic flow volumes	III	G-1	10	Entry Level
	6	Evaluate traffic flow densities	III	G-1	10	Entry Level
	7	Monitor and record current status of traffic flow at freeways and arterials	I	G-1,G-3,G-4, G-5		Entry Level
	8	Analyze freeway/ramp sensors for traffic flow monitoring	III	G-1	10	Full Performance
	9	Determine traffic flow hotspots	II	G-1,G-2,G-4, G-5		Full Performance
	10	Determine traffic flow pockets of congestion	II	G-1,G-2,G-4, G-5		Full Performance
	11	Determine cause of traffic flow delays	III	G-1,G-2,G-4, G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	12	Classify real-time traffic flow as normal or congested flow	III	G-1,G-4,G-5		Full Performance
	13	Classify real-time traffic flow recurring or non-recurring congestion	III	G-1,G-4,G-5		Full Performance
F-7, T-2: Monitor Real-Time Traffic Flow Data from ATIS	1	Visually monitor ATIS GUI for traffic flow characteristics	II	G-1,G-3		Entry Level
	2	Evaluate differentials between normal conditions by time and link with traffic flow observed	III	G-1,G-3,G-4, G-5	10	Full Performance
	3	Identify traffic flow problem links	III	G-1,G-3,G-4, G-5		Full Performance
	4	Evaluate traffic flow average speeds	III	G-1,G-3	10	Entry Level
	5	Evaluate traffic flow volumes	III	G-1	10	Entry Level
	6	Monitor and record current status of traffic flow at freeways and arterials	I	G-1,G-4,G-5	10	Entry Level
	7	Determine traffic flow hotspots	II	G-1,G-2,G-3, G-4,G-5		Full Performance
	8	Determine traffic flow pockets of congestion	II	G-1,G-2,G-4, G-5		Full Performance
	9	Determine cause of traffic flow delays	III	G-1,G-2		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	10	Classify real-time traffic flow as normal or congested flow	III	G-1,G-4,G-5		Full Performance
	11	Classify real-time traffic flow recurring or non-recurring congestion	III	G-1,G-4,G-5		Full Performance
F-7, T-3: Monitor Real-Time Traffic Flow Data from APTS	1	Visually monitor APTS GUI for transit vehicle flow characteristics	II	G-1,G-3		Entry Level
	2	Evaluate differentials between normal conditions by time and link with transit vehicle schedules	III	G-1,G-3,G-4, G-5		Full Performance
	3	Identify transit vehicle problem links	III	G-1,G-3,G-4, G-5		Full Performance
	4	Evaluate transit vehicle average speeds	III	G-1,G-3	10	Entry Level
	5	Evaluate fluctuations in transit vehicle travel times	III	G-1	170	Full Performance
	6	Determine traffic flow hotspots	II	G-1,G-2,G-4, G-5		Full Performance
	7	Determine traffic flow pockets of congestion	II	G-1,G-2,G-3, G-4,G-5		Full Performance
	8	Determine cause of traffic flow delays	III	G-1,G-2		Full Performance
	9	Classify real-time traffic flow as normal or congested flow	III	G-1		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	10	Classify real-time traffic flow recurring or non-recurring congestion	III	G-1,G-4,G-5		Full Performance
F-7, T-4: Monitor Traffic Flow Using Video Images	1	Evaluate tour of video feeds for traffic flow monitoring	II	G-1,G-3	20	Full Performance
	2	Observe obstructions, bottlenecks, incidents, or events that are causing traffic flow obstructions	III	G-1,G-2,G-3, G-4,G-5		Full Performance
	3	Rotate cameras in downstream direction of traffic flow toward obstructions	III	G-1,G-3,G-4, G-5	20	Entry Level
	4	Evaluate frequency of brakelight occurrence to identify traffic flow delays	III	G-1,G-3		Full Performance
	5	Approximate traffic flow average speeds	III	G-1	10	Entry Level
	6	Select camera(s) to monitor traffic flow at freeways and arterials	II	G-1		Entry Level
	7	Determine traffic flow hotspots	II	G-1,G-2,G-3, G-4,G-5		Full Performance
	8	Determine traffic flow pockets of congestion	II	G-1,G-2,G-4, G-5		Full Performance
	9	Determine cause of traffic flow delays	III	G-1,G-2		Full Performance
	10	Classify real-time traffic flow as normal or congested flow	III	G-1		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	11	Classify real-time traffic flow recurring or non-recurring congestion	III	G-1,G-4,G-5		Full Performance

Table B- 10. Characterization of Function 8 - Emergency Management.

Composite Tasks	Num	Discrete TMOT Tasks (34)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-8, T-1: Provide Support for Emergency Management Functions	1	Coordinate with EM officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	2	Coordinate with EM officials for signal malfunctions	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	3	Coordinate with police officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	4	Coordinate with police officials for signal malfunctions	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	5	Coordinate with other fire and rescue officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	6	Coordinate with EMS officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	7	Coordinate with private towing agencies during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	8	Coordinate with private towing agencies during normal conditions for disabled vehicles	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	9	Coordinate with private information service agencies during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	10	Coordinate with incident management teams on EM response	IV	G-1,G-2,G-3, G-4,G-5,G-6	70	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (34)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	11	Implement/monitor preemption priority for emergency vehicles (if applicable)	V	G-1,G-2,G-6		Full Performance
	12	Analyze incident location to provide signal preemption	III	G-1,G-2,G-3, G-6	100	Full Performance
	13	Store archived data on EM functions	I	G-1		Entry Level
F-8, T-2: Evaluate Emergency Vehicle Movement Information (to Provide Traffic Signal Preemption)	1	Verify if signal preemption needed for optimal operation	III	G-1,G-2,G-4, G-5,G-6	100	Entry Level
	2	Determine optimal incident location route	III	G-1,G-2		Entry Level
	3	Classify event/incident as incident/emergency/special event	III	G-1,G-3,G-4, G-5		Entry Level
	4	Record/enter preemption priority type	II	G-1,G-2,G-4, G-5		Entry Level
	5	Provide signal preemption along the optimal route	II	G-1,G-4,G-5	100	Full Performance
	6	Monitor/evaluate signal preemption operations	III	G-1,G-2,G-4, G-5		Full Performance
	7	Activate camera (if applicable) to view signal preemption operations	II	G-1,G-4,G-5	20	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (34)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	8	Disable (if applicable) signal preemption upon passage of emergency vehicles	III	G-1,G-4,G-5	100	Full Performance
	9	Monitor/modify EM response scenario	IV	G-1,G-2,G-4, G-5,G-6	70	Full Performance
F-8, T-3: Utilize ATMS to Monitor Signal Preemption	1	Display preemption priority signals	II	G-1,G-3		Entry Level
	2	Record/enter preemption priority signals	I	G-1		Entry Level
	3	Determine real-time status of preemption priority signals	II	G-1,G-3,G-4, G-5		Entry Level
	4	Select camera at preemption priority signals	II	G-1,G-3,G-4, G-5		Entry Level
	5	Operate camera for preemption priority signal verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	6	Record end of preemption priority upon passage of emergency vehicles	I	G-1		Entry Level
F-8, T-4: Generate and Implement Response Plan (to Preempt Traffic Signals)	1	Evaluate severity of event/incident delays	III	G-1		Full Performance
	2	Determine devices available for event/incident management	IV	G-1,G-2		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (34)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Check signal timings at intersections near the event/incident location	II	G-1,G-2,G-3, G-4,G-5	100	Full Performance
	4	Evaluate delays/queue at preempted signals due to event/incident management	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	5	Coordinate with police to manage traffic due to event/incident at select location(s)	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	6	Evaluate delays/queue at preempted signal due to event/incident management after normal timings are restored	III	G-1		Full Performance

Table B- 11. Characterization of Function 9 - Provide/Coordinate Service Patrols.

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-9, T-1: Respond to CCTV Displayed Image	1	Determine service need location	II	G-1,G-3		Entry Level
	2	Operate camera for service need verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	3	Record/enter service need conditions	I	G-1		Entry Level
	4	Notify service patrol of service need and circumstances	III	G-1,G-2,G-4, G-5,G-6		Entry Level
	5	Determine if lane blockage is resulting from service need response	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	6	View/create/modify service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	7	Enable service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	8	Monitor/modify service need response scenario	IV	G-1,G-2,G-4, G-5	120	Full Performance
F-9, T-2: Note Service Need Heard on Police Radio Monitor (Aural) and Respond	1	Listen to service need information	I	G-1,G-2,G-4		Full Performance
	2	Determine service need location from police	I	G-1,G-2,G-4		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Check for and view service need data	II	G-1,G-4,G-5, G-6	20	Entry Level
	4	Select camera at service need location	II	G-1		Entry Level
	5	Operate camera for service need verification	II	G-1,G-3,G-5		Entry Level
	6	Notify service patrol of service need and circumstances	III	G-1,G-2,G-3, G-5,G-6		Entry Level
	7	Determine if lane blockage is resulting from service need response	III	G-1,G-2,G-5		Full Performance
	8	Record/enter service need conditions	I	G-1,G-5		Entry Level
	9	Provide service need notifications	III	G-1,G-2,G-3, G-5		Full Performance
	10	Enact service need response	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	11	View/create/modify service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	12	Enable service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	13	Monitor/modify service need response scenario	IV	G-1,G-4,G-5	120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-9, T-3: Respond to Police Notification (Aural) of Service Need	1	Receive call and note service need information	I	G-1,G-2		Entry Level
	2	Determine service need location from police	I	G-1,G-2,G-3, G-6		Entry Level
	3	Select camera at service need location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for service need verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	5	Notify service patrol of service need and circumstances	III	G-1,G-2,G-3		Entry Level
	6	Determine if lane blockage is resulting from service need response	III	G-2,G-3,G-4, G-5		Full Performance
	7	Record/enter service need conditions	I	G-1		Entry Level
	8	Provide service need notifications	III	G-1,G-2		Full Performance
	9	Enact service need response	III	G-1,G-2,G-3, G-4,G-5		Full Performance
	10	View/create/modify service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	11	Enable service need response scenario	IV	G-1,G-4,G-5	70	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	12	Monitor/modify service need response scenario	IV	G-1,G-4,G-5	120	Full Performance
F-9, T-4: Respond to Direct Cell Phone Call-In Requesting Service	1	Receive call and note service need information	I	G-1,G-2		Entry Level
	2	Check for and view service need data	II	G-1		Entry Level
	3	Select camera at service need location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for service need verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	5	Notify service patrol of service need and circumstances	III	G-1,G-2,G-3		Entry Level
	6	Determine if lane blockage is resulting from service need response	III	G-1,G-2,G-3, G-4,G-5		Full Performance
	7	Record/enter service need conditions	I	G-1		Entry Level
	8	Provide service need notifications	III	G-1,G-2,G-4, G-5		Full Performance
	9	Enact service need response	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	10	View/create/modify service need response scenario	IV	G-1,G-4,G-5	70	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (45)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	11	Enable service need response scenario	IV	G-1,G-4,G-5	70	Full Performance
	12	Monitor/modify service need response scenario	IV	G-1,G-4,G-5	120	Full Performance

Table B- 12. Characterization of Function 10 - Reversible and HOV Lane Management.

Composite Tasks	Num	Discrete TMOT Tasks (52)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-10, T-1: Activate Reversible Lane Operation (Congestion/Schedule Based Operation)	1	Check suitability of reversible lane operation for congestion management	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	2	Check and record current status of arterial/freeway for initiation of reversible lane operation	III	G-1,G-3		Entry Level
	3	Notify personnel on reversible lane operation initiation time	III	G-1,G-2,G-4, G-5,G-6		Entry Level
	4	Begin placing cones/barriers (if applicable) for reversible lane operation	III	G-1,G-4,G-5		Entry Level
	5	Check current status of peak traffic prior to initiation of reversible lane operation	III	G-1,G-2,G-3, G-6		Entry Level
	6	Seek permission/notify all concerned prior to activating reversible lane operation	IV	G-1,G-2,G-4, G-5		Entry Level
	7	Activate DMSs with reversible lane operation messages	V	G-1,G-3,G-4, G-5	140	Entry Level
	8	Activate HARs with reversible lane operation messages	V	G-1,G-3,G-4, G-5	150	Entry Level
	9	Select traffic signal timing plan for arterial reversible lane operation	V	G-1,G-3,G-4, G-5	100	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (52)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	10	Update traffic information on Web site due to reversible lane operation conditions	V	G-1,G-4,G-5	160, 210	Advanced
	11	Activate reversible lane operation at the onset of peak hour	V	G-1,G-2,G-3, G-4,G-5,G-6		Entry Level
	12	Monitor status of activated reversible lane operation	II	G-1,G-2,G-3, G-4,G-5		Entry Level
	13	Select camera(s) to monitor reversible lane operation	II	G-1,G-3,G-4, G-5		Full Performance
	14	Operate camera for reversible lane operation monitoring	II	G-1,G-3,G-4, G-5	20	Full Performance
	15	Check freeway/ramp sensors for reversible lane operation monitoring	I	G-1,G-4,G-5	10	Full Performance
	16	Check arterial sensors for reversible lane operation monitoring	I	G-1,G-4,G-5	10	Full Performance
	17	Check and record current status of reversible lane operation	I	G-1,G-2,G-4, G-5		Entry Level
	18	Notify personnel on reversible lane operation deactivation	III	G-1,G-2,G-3		Entry Level
	19	Begin placing cones/barriers (if applicable) for normal lane operation	IV	G-1,G-4,G-5		Entry Level
	20	Deactivate reversible lane operations and initiate normal lane operation	V	G-1,G-2,G-3, G-4,G-5		Entry Level
	21	Activate DMSs with normal lane operation messages	V	G-1,G-3,G-4, G-5	140	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (52)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	22	Activate HARs with normal lane operation messages	V	G-1,G-3,G-4, G-5	150	Entry Level
	23	Select traffic signal timing plan for normal lane operation	V	G-1,G-3,G-4, G-5	100	Full Performance
	24	Update traffic information on Web site due to normal lane operation conditions	V	G-1,G-4,G-5	160, 210	Advanced
	25	Select camera(s) to monitor normal lane operation	II	G-1,G-3,G-4, G-5		Entry Level
	26	Operate camera for normal lane operation	II	G-1,G-3,G-4, G-5	20	Entry Level
F-10, T-2: Activate HOV Lane Operation (Congestion/Schedule Based Operation)	1	Check suitability of HOV lane operation for congestion management	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	2	Check and record current status of arterial/freeway for initiation of HOV lane operation	III	G-1,G-3		Entry Level
	3	Notify personnel on HOV lane operation initiation time	III	G-1,G-2,G-4, G-5,G-6		Entry Level
	4	Begin placing cones/barriers (if applicable) for HOV lane operation	III	G-1,G-4,G-5		Entry Level
	5	Check current status of peak traffic prior to initiation of HOV lane operation	III	G-1,G-2,G-3, G-6		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (52)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	6	Seek permission/notify all concerned prior to activating HOV lane operation	IV	G-1,G-2,G-4, G-5		Entry Level
	7	Activate DMSs with HOV lane operation messages	V	G-1,G-3,G-4, G-5	140	Entry Level
	8	Activate HARs with HOV lane operation messages	V	G-1,G-3,G-4, G-5	150	Entry Level
	9	Select special traffic signal timing plan for arterial HOV lane operation	V	G-1,G-3,G-4, G-5	100	Full Performance
	10	Update traffic information on Web site due to HOV lane operation conditions	V	G-1,G-4,G-5	160, 210	Advanced
	11	Activate HOV lane operation at the onset of peak hour	V	G-1,G-2,G-3, G-4,G-5,G-6		Entry Level
	12	Monitor status of activated HOV lane operation	II	G-1,G-2,G-3, G-4,G-5		Entry Level
	13	Select camera(s) to monitor HOV lane operation	II	G-1,G-3,G-4, G-5		Entry Level
	14	Operate camera for HOV lane operation monitoring	II	G-1,G-3,G-4, G-5	20	Entry Level
	15	Check freeway/ramp sensors for HOV lane operation monitoring	I	G-1,G-4,G-5	10	Full Performance
	16	Check arterial sensors for HOV lane operation monitoring	I	G-1,G-4,G-5	10	Full Performance
	17	Check and record current status of HOV lane operation	I	G-1,G-2,G-4, G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (52)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	18	Notify personnel on HOV lane operation deactivation	III	G-1,G-2,G-3		Entry Level
	19	Begin placing cones/barriers (if applicable) for normal lane operation	IV	G-1,G-4,G-5		Entry Level
	20	Deactivate HOV lane operations and initiate normal lane operation	V	G-1,G-2,G-3, G-4,G-5		Entry Level
	21	Activate DMSs with normal lane operation messages	V	G-1,G-3,G-4, G-5	140	Entry Level
	22	Activate HARs with normal lane operation messages	V	G-1,G-3,G-4, G-5	150	Entry Level
	23	Select traffic signal timing plan for normal lane operation	V	G-1,G-3,G-4, G-5	100	Full Performance
	24	Update traffic information on Web site due to normal lane operation conditions	V	G-1,G-4,G-5	160, 210	Advanced
	25	Select camera(s) to monitor normal lane operation	II	G-1,G-3,G-4, G-5		Entry Level
	26	Operate camera for normal lane operation	II	G-1,G-3,G-4, G-5	20	Entry Level

Table B- 13. Characterization of Function 11 - Traffic Signal System Management.

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-11, T-1: Monitor and Evalute ATMS Signal Functions	1	Monitor signal system data	I	G-1		Entry Level
	2	Monitor signal system map graphics	I	G-1,G-3		Entry Level
	3	Monitor/evaluate signal system coordination strategies	III	G-1,G-3,G-4, G-5		Full Performance
	4	Monitor/evaluate signal system time-space diagrams	III	G-1,G-3		Full Performance
	5	Monitor/evaluate signal system control strategies - isolated or coordinated	III	G-1,G-3,G-4, G-5		Full Performance
	6	Monitor/evaluate signal system traffic responsive operations	III	G-1,G-3		Full Performance
	7	Monitor/evaluate signal system adaptive control	III	G-1,G-3		Advanced
	8	Monitor/evaluate signal system malfunctions	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	9	Program signal system for special event conditions	II	G-1,G-4,G-5, G-6		Full Performance
	10	Incorporate/consider signal system timing for special events	III	G-1,G-3,G-4, G-5		Full Performance
	11	Coordinate with other signal system operators for traffic progression along boundaries	IV	G-2,G-3,G-4, G-5,G-6	80	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	12	Coordinate with other signal system system operators during incidents	IV	G-2,G-3,G-4, G-5,G-6	80	Full Performance
	13	Store archived data for signal system operations, incident management, and response	I	G-1,G-3,G-4, G-5		Entry Level
F-11, T-2: Provide Emergency/Special Event/Transit Vehicle Movement Information (to Coordinate Traffic Signals)	1	Acknowledge emergency/special event/transit vehicle notification	III	G-1	50	Entry Level
	2	Determine emergency/special event/transit vehicle location	II	G-1	10	Entry Level
	3	Operate camera (if applicable) for emergency/special event/transit vehicle verification	II	G-1,G-3,G-4, G-5	60	Entry Level
	4	Classify emergency/special event/transit vehicle incident/emergency/special event	II	G-1,G-4,G-5		Entry Level
	5	Record/enter emergency/special event/transit vehicle type	I	G-1,G-4,G-5	20	Entry Level
	6	Issue emergency/special event/transit vehicle notification	III	G-1,G-2,G-4, G-5,G-6		Entry Level
	7	Provide emergency/special event/transit vehicle notifications	III	G-1,G-2,G-4, G-5,G-6		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	8	Enact emergency/special event/transit vehicle response	III	G-1,G-4,G-5, G-6		Advanced
	9	View/create/modify emergency/special event/transit vehicle response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	10	Enable emergency/special event/transit vehicle response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	11	Monitor/modify emergency/special event/transit vehicle response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
F-11, T-3: Verify Arterial Incident/Signal Malfunction Through Central Software	1	Acknowledge arterial incident/signal malfunction alarm	II	G-1,G-3	50	Entry Level
	2	View arterial incident/signal malfunction data	II	G-1,G-3		Entry Level
	3	Determine arterial incident/signal malfunction location	II	G-1,G-3		Entry Level
	4	Attempt arterial incident/signal malfunction reset	II	G-1,G-3		Entry Level
	5	Operate camera for arterial incident/signal malfunction verification	II	G-1,G-4,G-5	20	Full Performance
	6	Classify arterial incident/signal malfunction alarm as false/true	II	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	7	Record/enter arterial incident/signal malfunction type	I	G-1,G-3,G-4, G-5		Full Performance
	8	Issue arterial incident/signal malfunction notification	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	9	Provide arterial incident/signal malfunction notifications	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	10	Enact arterial incident/signal malfunction response	III	G-1		Advanced
	11	View/create/modify arterial incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5	50	Full Performance
	12	Enable arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance
	13	Monitor/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5	10	Full Performance
F-11, T-4: Verify Arterial Incidents/Signal Malfunctions Through Visual Maps	1	Notice arterial incident/signal malfunction type	II	G-1	20	Full Performance
	2	Evaluate arterial incident/signal malfunction data	III	G-1		Full Performance
	3	Determine arterial incident/signal malfunction location	II	G-1		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	4	Select camera at arterial incident/signal malfunction location	II	G-1,G-3,G-4, G-5	20	Full Performance
	5	Operate camera for arterial incident/signal malfunction verification	II	G-1,G-3,G-4, G-5	20	Full Performance
	6	Record/enter arterial incident/signal malfunction conditions	I	G-1,G-4,G-5		Full Performance
	7	Provide arterial incident/signal malfunction notifications	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	8	Enact arterial incident/signal malfunction response	III	G-1,G-4,G-5		Advanced
	9	View/create/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5	50	Full Performance
	10	Enable arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance
	11	Monitor/modify arterial incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
F-11, T-5: Verify Incident/Signal Malfunction Calls Received Through Cell Phone Call-Ins	1	Receive call and note arterial incident/signal malfunction information	I	G-1,G-2		Entry Level
	2	Check for and view arterial incident/signal malfunction data	II	G-1,G-3		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Select camera at arterial incident/signal malfunction location	II	G-1,G-4,G-5	20	Full Performance
	4	Operate camera for arterial incident/signal malfunction verification	II	G-1,G-3,G-4, G-5	20	Full Performance
	5	Record/enter arterial incident/signal malfunction type	I	G-1,G-4,G-5		Full Performance
	6	Provide arterial incident/signal malfunction notifications	III	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	7	Enact arterial incident/signal malfunction response	III	G-1,G-4,G-5		Advanced
	8	View/create/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5	50	Full Performance
	9	Enable arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Monitor/modify arterial incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
F-11, T-6: Verify Incident/Signal Malfunctions Calls from Police Radio Monitor (Aural)	1	Listen to arterial incident/signal malfunction information	I	G-1,G-2	10	Entry Level
	2	Determine arterial incident/signal malfunction location from police	I	G-1,G-2,G-6		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Check and view arterial incident/signal malfunction data	II	G-1,G-3,G-6		Entry Level
	4	Select camera at arterial incident/signal malfunction location	II	G-1,G-3,G-4, G-5	20	Entry Level
	5	Operate camera for arterial incident/signal malfunction verification	II	G-1,G-3,G-4, G-5	20	Entry Level
	6	Record/enter arterial incident/signal malfunction type	I	G-1,G-4,G-5		Entry Level
	7	Provide arterial incident/signal malfunction notifications	III	G-1,G-2,G-4, G-5,G-6		Entry Level
	8	Enact arterial incident/signal malfunction response	III	G-1,G-4,G-5	10	Full Performance
	9	View/create/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance
	10	Enable arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Advanced
	11	Monitor/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5	10	Full Performance
F-11, T-7: Verify Incident/Signal Malfunction Calls from Police Notification (Aural)	1	Receive call and note arterial incident/signal malfunction information	I	G-1,G-2,G-4, G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine arterial incident/signal malfunction location from police	I	G-1,G-4		Entry Level
	3	Select camera at arterial incident/signal malfunction location	II	G-1,G-2,G-3, G-4,G-5,G-6		Entry Level
	4	Operate camera for arterial incident/signal malfunction verification	II	G-1,G-3,G-4, G-5		Entry Level
	5	Record/enter arterial incident/signal malfunction type	I	G-1,G-4		Entry Level
	6	Provide arterial incident/signal malfunction notifications	III	G-1,G-2,G-4, G-6		Full Performance
	7	Enact arterial incident/signal malfunction response	III	G-1,G-4		Full Performance
	8	View/create/modify arterial incident/signal malfunction response scenario	IV	G-1,G-2,G-4		Full Performance
	9	Enable arterial incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5		Full Performance
	10	Monitor/modify arterial incident/signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-11, T-8: Verify Incident/Signal Malfunction Information Received Through APTS Driver Notification (Radio)	1	Receive call and note signal malfunction information	I	G-1,G-2		Entry Level
	2	Determine signal malfunction location from driver	I	G-1		Entry Level
	3	Select camera at signal malfunction location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for signal malfunction verification	II	G-1,G-3,G-4, G-5		Entry Level
	5	Record/enter signal malfunction type	I	G-1,G-4,G-5		Entry Level
	6	Provide signal malfunction notifications	III	G-1,G-2,G-4, G-5,G-6		Full Performance
	7	Enact signal malfunction response	III	G-1,G-4,G-5		Full Performance
	8	View/create/modify signal malfunction response scenario	IV	G-1,G-4,G-5		Full Performance
	9	Enable signal malfunction response scenario	IV			Full Performance
	10	Monitor/modify signal malfunction response scenario	IV			Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-11, T-9: Generate Response Plan to Arterial Incidents (Operator Decision)	1	Evaluate severity of arterial incident delays	III	G-1		Full Performance
	2	Determine devices available for arterial incident management	IV	G-1		Full Performance
	3	Evaluate possible detour plans to divert from arterial incident location	III	G-1,G-4,G-5		Full Performance
	4	Consider/implement special timing plans for arterial incident diversion route	V	G-1,G-4,G-5	100	Advanced
	5	Activate DMS (if applicable) with arterial incident messages	V	G-1,G-4,G-5	110	Advanced
	6	Activate HARs with arterial incident messages	V	G-1,G-4,G-5	70	Advanced
	7	Check signal timings at intersections near the arterial incident location	II	G-1,G-3,G-4, G-5	100	Advanced
	8	Evaluate diversion route intersections around arterial incident location	III	G-1,G-3,G-4, G-5	100	Advanced
	9	Revert to original timing plans after arterial incident clearance	V	G-1,G-3,G-4, G-5		Advanced
F-11, T-10: Generate Response Plan to Signal Malfunctions (Operator Decision)	1	Evaluate severity of signal malfunction delays	III	G-1		Advanced

Composite Tasks	Num	Discrete TMOT Tasks (104)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Determine devices available for signal malfunction management	IV	G-1,G-3		Advanced
	3	Coordinate with police to manage traffic due to signal malfunction at select location(s)	IV	G-1,G-2,G-4, G-5,G-6		Advanced
	4	Activate DMS/HAR (if applicable) to warn of signal malfunction at select location(s)	V	G-1,G-3,G-4, G-5	70	Advanced
	5	Communicate with police officers posted at signal malfunction site(s)	IV	G-1,G-2,G-4, G-5,G-6	100	Advanced
	6	Change signal timing plans near the signal malfunction area to expedite traffic flow	II	G-1,G-3		Advanced

Table B- 14. Characterization of Function 12 - Transit Vehicle Monitoring.

Composite Tasks	Num	Discrete TMOT Tasks (35)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-12, T-1: Monitor APTS Transit Vehicles	1	Monitor transit vehicle data	I	G-1,G-3,G-5	10	Entry Level
	2	Monitor transit vehicle map graphics	I	G-1,G-3,G-5		Entry Level
	3	Monitor/evaluate transit vehicle schedule	I	G-1,G-3,G-5	170	Entry Level
	4	Monitor/evaluate transit vehicle location	II	G-1,G-3,G-5	170	Entry Level
	5	Monitor transit vehicle fleet	II	G-1,G-3,G-5	170	Entry Level
	6	Monitor/evaluate transit vehicle origin-destination	II	G-1,G-4,G-5	170	Entry Level
	7	Monitor/evaluate transit vehicle control strategies - runcutting	III	G-1,G-4,G-5	170	Full Performance
	8	Monitor/evaluate transit vehicle operations	III	G-1,G-2,G-4, G-5	170	Full Performance
	9	Monitor/evaluate transit vehicle passenger capacity (if applicable)	III	G-1,G-5	170	Entry Level
	10	Monitor/evaluate transit vehicle preemption need/transit priority	III	G-1,G-3,G-4, G-5	170	Full Performance
	11	Implement/monitor preemption priority to transit vehicles	III	G-1,G-4,G-5	170	Full Performance
	12	Store archived data transit vehicle/preemption priority for future needs	III	G-1,G-4,G-5		Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (35)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-12, T-2: Provide APTS - Transit Vehicle Movement Information for Transit Priority	1	Analyze incident location to provide diversion to transit vehicles	III	G-1,G-3,G-5		Entry Level
	2	Determine optimal incident diversion transit route	III	G-1,G-3,G-5		Entry Level
	3	Classify incident/event special event/incident/construction	III	G-1,G-3,G-4, G-5		Entry Level
	4	Record/enter transit priority type - diversion or runcutting (schedule adherence)	III	G-1,G-3,G-4, G-5	170	Entry Level
	5	Request transit priority to signals along the diversion route	III	G-3,G-5	170	Entry Level
	6	Monitor/evaluate signal preemption operations	III	G-1,G-3,G-5	170	Full Performance
	7	View intersection signal preemption operations	III	G-1,G-3,G-5	170	Full Performance
	8	Disable (if applicable) signal preemption upon passage of emergency vehicles	III	G-1,G-5	170	Full Performance
	9	Monitor/modify EM response scenario	IV		120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (35)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-12, T-3: Generate APTS Operator Response Plan to Provide Transit Priority	1	Evaluate severity of transit vehicle schedule non-adherence	IV	G-1,G-3,G-4, G-5	170	Entry Level
	2	Determine devices available for transit vehicle management	IV	G-1,G-3,G-4, G-5	170	Entry Level
	3	Check signal timings at intersections near the transit vehicle location	II	G-1,G-3,G-4, G-5	170	Entry Level
	4	Evaluate delays/queue at preempted signal due to transit vehicle priority	III	G-1,G-3,G-4, G-5	170	Full Performance
	5	Coordinate with police to manage traffic due to transit vehicle priority at high traffic location(s)	III	G-1,G-3,G-4, G-5	170	Full Performance
	6	Evaluate delays/queue at preempted signal due to transit vehicle priority management after normal timings are restored	III	G-1,G-3,G-4, G-5	170	Full Performance
	7	Evaluate delays/queue at preempted signal due to transit vehicle management after normal timings are restored	III	G-1,G-3,G-4, G-5	170	Full Performance
F-12, T-4: Determine Transit Delay Using APTS Map Visual Data	1	Display transit vehicle location	II	G-1,G-3,G-4, G-5	10, 170	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (35)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	2	Display transit vehicle location with respect to corridor (i.e. Arterial or freeway)	III	G-1,G-3,G-4, G-5	170	Entry Level
	3	Determine real-time status of transit priority vehicles and signals	III	G-1,G-3,G-4, G-5	170	Entry Level
	4	Select camera (if applicable) to observe transit priority vehicle and signals	III	G-1,G-3,G-4, G-5	20, 170	Entry Level
	5	Operate camera for transit priority signal verification	III	G-1,G-3,G-4, G-5	20	Entry Level
	6	Record/enter transit priority vehicle and signals	III	G-1,G-3,G-4, G-5		Entry Level
	7	Evaluate severity of transit vehicle delays	III	G-1,G-3,G-4, G-5	170	Full Performance

Table B- 15. Characterization of Function 13 - APTS System Management.

Composite Tasks	Num	Discrete TMOT Tasks (62)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-13, T-1: Manage APTS System Functions	1	Monitor transit vehicle data, location, signal priority, schedule, fleet	III	G-1,G-2,G-3	10, 170	Entry Level
	2	Monitor transit vehicle operations	III	G-1,G-3	10, 170	Entry Level
	3	Monitor/evaluate transit vehicle malfunctions	III	G-1,G-3	10, 170	Entry Level
	4	Monitor/evaluate transit vehicle security	IV	G-1,G-3	10, 170	Entry Level
	5	Monitor/evaluate transit vehicle fuel efficiency	III	G-1	10, 170	Entry Level
	6	Monitor/evaluate transit vehicle maintenance record	IV	G-1,G-4,G-5	10, 170	Entry Level
	7	Program special routes for transit vehicle during special event operations/conditions	III	G-1,G-3,G-4, G-5	170	Full Performance
	8	Coordinate with other transit vehicle system operators for connecting service	II	G-1,G-2,G-3, G-4,G-5,G-6	80, 170	Full Performance
	9	Coordinate with transit vehicle system operators during incidents	II	G-1,G-2,G-3, G-4,G-5,G-6	80, 170	Full Performance
	10	Coordinate with other tmcs officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6	80, 170	Full Performance
	11	Coordinate with police officials during arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6	80, 170	Full Performance
	12	Coordinate with police officials for signal malfunctions	IV	G-1,G-2,G-3, G-4,G-5,G-6	80, 170	Full Performance

	13	Coordinate with private information service providers agencies during freeway/arterial and freeway incidents	IV	G-1,G-2,G-3, G-4,G-5	80, 170	Full Performance
	14	Implement/monitor preemption priority to transit vehicles	V	G-1,G-3,G-4, G-5	170, 120	Full Performance
	15	Analyze incident location to provide diversion to transit vehicles	III	G-1,G-3,G-4, G-5	170	Full Performance
	16	Provide real-time update in transit vehicle stations for the next bus information	V	G-1,G-3,G-4, G-5	170	Entry Level
	17	View camera images of transit transit/transit vehicle stations for security and schedule adherence	III	G-1,G-3,G-5	170	Entry Level
	18	Store archive data transit vehicle/transit vehicle stations data, location, signal priority, schedule, fleet	III	G-1,G-4,G-5	170	Entry Level
F-13, T-2: Monitor/Evalaute APTS Transit Vehicle Functions	1	Monitor transit vehicle data	I	G-1,G-3,G-5	170	Entry Level
	2	Monitor transit vehicle map graphics	I	G-1,G-3,G-4, G-5	170	Entry Level
	3	Monitor/evaluate transit vehicle schedule	I	G-1,G-2,G-3, G-4,G-5,G-6	170	Entry Level
	4	Monitor/evaluate transit vehicle location	I	G-1,G-3,G-4, G-5,G-6	170	Entry Level
	5	Monitor/evaluate transit vehicle fleet	I	G-1,G-3,G-4,	170	Entry Level

				G-5		
	6	Monitor/evaluate transit vehicle origin-destination	I	G-1,G-3,G-4, G-5	170	Entry Level
	7	Monitor/evaluate transit vehicle control strategies - runcutting	III	G-1,G-3,G-4, G-5	170	Full Performance
	8	Monitor/evaluate transit vehicle operations	III	G-1,G-3	170	Full Performance
	9	Monitor/evaluate transit vehicle passenger capacity (if applicable)	III	G-1,G-3	170	Entry Level
	10	Monitor/evaluate transit vehicle preemption need/transit priority	III	G-1,G-3,G-4, G-5	170	Full Performance
	11	Determine optimal incident diversion transit route	III	G-1,G-3,G-4, G-5	170	Full Performance
	12	Classify incident/event special event/incident/construction	III	G-1,G-3,G-4, G-5	170, 60	Full Performance
	13	Record/enter transit priority type - diversion or runcutting (schedule adherence)	III	G-1,G-2,G-3, G-4,G-5,G-6	170	Full Performance
	14	Request transit priority to signals along the diversion route	III	G-1,G-3,G-4, G-5,G-6	170	Full Performance
	15	Monitor/evaluate signal preemption operations	III	G-1,G-3,G-4, G-5	170, 120	Full Performance
	16	View intersection signal preemption operations	III	G-1,G-3,G-4, G-5	170	Full Performance
	17	Disable (if applicable) signal preemption upon passage of emergency vehicles	III	G-1,G-2,G-4, G-5	170	Full Performance
	18	Monitor/modify EM response scenario	IV	G-1,G-2,G-3,	170	Full

				G-4,G-5		Performance
F-13, T-3: Monitor APTS - Transit Vehicles Through Map Visual Data	1	Display transit vehicle location	I	G-2,G-6	170, 50	Entry Level
	2	Display transit vehicle location with respect to corridor (i.e. arterial or freeway)	I	G-2,G-4,G-6	170	Full Performance
	3	Determine real-time status of transit priority vehicles and signals	III	G-1,G-3,G-5	170, 10	Full Performance
	4	Select camera (if applicable) to observe transit priority vehicle and signals	III	G-1,G-3,G-5	170	Full Performance
	5	Operate camera for transit priority signal verification	III	G-1,G-3,G-5	170, 20	Full Performance
	6	Record/enter transit priority vehicle and signals	III	G-1,G-3,G-4, G-5	170	Full Performance
F-13, T-4: Generate APTS Operator Response Plan to Provide Transit Priority	1	Evaluate severity of transit vehicle delays	III	G-1,G-2,G-4, G-5,G-6	170	Full Performance
	2	Evaluate severity of transit vehicle schedule non-adherence	III	G-1,G-4,G-5, G-6	170	Full Performance
	3	Determine devices available for transit vehicle management	IV	G-1,G-3,G-4, G-5	170	Full Performance
	4	Check signal timings at intersections near the	III	G-1,G-4,G-5	170,	Full

		transit vehicle location			100	Performance
	5	Evaluate delays/queue at preempted signal due to transit vehicle priority	III	G-1,G-3,G-4, G-5	170	Full Performance
	6	Coordinate with police to manage traffic due to transit vehicle priority at high traffic location(s)	III		170	Advanced
	7	Evaluate delays/queue at preempted signal due to transit vehicle priority management after normal timings are restored	III	G-2,G-6	170, 50	Full Performance
	8	Evaluate delays/queue at preempted signal due to transit vehicle management after normal timings are restored	III	G-1,G-3,G-5	170	Full Performance
F-13, T-5: APTS Next Bus Monitoring Functions	1	Monitor transit vehicle data	I	G-1,G-3,G-5	170, 20	Full Performance
	2	Monitor transit vehicle map graphics	I	G-1,G-4,G-5	170	Full Performance
	3	Monitor transit vehicle schedule	I	G-1,G-4,G-5, G-6	170	Full Performance
	4	Monitor transit vehicle location	I	G-1,G-4,G-5, G-6	170	Full Performance
	5	Monitor/evaluate transit vehicle origin-destination	I	G-1,G-3,G-4, G-5	170	Full Performance
	6	Request real-time calculation for a transit vehicle time to reach next bus stop	II	G-1,G-4,G-5	170	Full Performance
	7	Post next bus information for a transit vehicle on DMS	V	G-1,G-3,G-4, G-5	170	Full Performance

	8	Monitor/evaluate transit vehicle time schedule	II		170	Advanced
	9	Update transit vehicle next bus information on DMS (if needed)	II	G-2,G-6	170, 50	Full Performance
	10	Monitor/evaluate transit vehicle passenger reaction to bus schedule	III	G-2,G-6	170	Full Performance
	11	Determine schedule delay (if any) for transit vehicle to provide priority	III	G-1,G-3,G-5	170	Full Performance
	12	Provide transit vehicle priority	III	G-1,G-3,G-5	170, 20	Full Performance

Table B- 16. Characterization of Function 14 - Environmental and RWIS Monitoring.

Composite Tasks	Num	Discrete TMOT Tasks (17)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-14, T-1: Monitor Environmental and RWIS Functions	1	Monitor environmental/RWIS monitoring data from TMC	II	G-1,G-2,G-3, G-4,G-5,G-6		Entry Level
	2	Environmental/RWIS monitoring locations on map display	I	G-1,G-3,G-5		Entry Level
	3	Monitor environmental/RWIS monitoring snowfall	I	G-1,G-3,G-5	30	Entry Level
	4	Monitor environmental/RWIS monitoring rainfall	I	G-1,G-3,G-5	30	Entry Level
	5	Monitor environmental/RWIS monitoring sub-surface temperature	I	G-1,G-3,G-5	30	Entry Level
	6	Monitor/evaluate environmental/RWIS monitoring salt applications - number, roadway, section, date, and time	I	G-1,G-5		Entry Level
	7	Monitor environmental/RWIS monitoring for sensor data error	II	G-1,G-3,G-5	30	Entry Level
	8	Monitor/evaluate environmental/RWIS monitoring operations	II	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	9	Program environmental/RWIS monitoring for proper communication baud rates	II	G-1,G-5	30	Advanced
	10	Check data upload/download of environmental/RWIS monitoring data for proper operation	II	G-1,G-5	30	Advanced

Composite Tasks	Num	Discrete TMOT Tasks (17)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	11	Coordinate with other local agencies for environmental/RWIS monitoring sensor placement and possible data sharing	III	G-1,G-3,G-5		Full Performance
	12	Coordinate with environmental/RWIS monitoring system operators during malfunctions	II	G-1,G-3,G-4, G-5		Full Performance
	13	Coordinate information on environmental/RWIS monitoring data with other TMCs	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	14	View camera images (if applicable) of environmental/RWIS monitoring locations in real time	III	G-1,G-3,G-5	10, 20	Full Performance
	15	Post advisory weather messages on DMS based on environmental/RWIS monitoring sensor data	V	G-1,G-3,G-5	110	Entry Level
	16	Monitor/evaluate environmental/RWIS monitoring sensor maintenance records	IV	G-1,G-3,G-4, G-5		Entry Level
	17	Store/monitor archived data environmental/RWIS monitoring sensor location, rainfall, snowfall, subsurface temperature, and salt applications details	III	G-1,G-3,G-4, G-5		Entry Level

Table B- 17. Characterization of Function 15 - Overheight Vehicle Management.

Composite Tasks	Num	Discrete TMOT Tasks (13)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-15, T-1: ATMS Detected Overheight Vehicle Alarm	1	Acknowledge overheight vehicle alarm	II	G-1,G-5	50	Full Performance
	2	View overheight vehicle data	II	G-1,G-3,G-5	10	Full Performance
	3	Determine overheight vehicle location	II	G-1,G-3,G-5		Full Performance
	4	Select camera at overheight vehicle location	II	G-1,G-3,G-5		Full Performance
	5	Operate camera for overheight vehicle verification	II	G-1,G-3,G-5	20	Full Performance
	6	Classify overheight vehicle alarm as false/true	II	G-1,G-4,G-5		Advanced
	7	Record/enter overheight vehicle conditions	I	G-1,G-5		Advanced
	8	Provide overheight vehicle notifications	III	G-1,G-2,G-4, G-5,G-6		Advanced
	9	Enact overheight vehicle response	III	G-1,G-4,G-5, G-6	230	Advanced
	10	View/create/modify overheight vehicle response scenario	IV	G-1,G-3,G-4, G-5	230	Advanced
	11	Enable overheight vehicle response scenario	IV	G-1,G-4,G-5	230	Advanced
	12	Monitor/modify overheight vehicle response scenario	IV	G-1,G-3,G-4, G-5		Advanced

	13	Clear overheight vehicle alarm	II			Advanced

Table B- 18. Characterization of Function 16 - Rail Crossing Management.

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
F-16, T-1: Provide ATMS Railroad Crossing Functions	1	Monitor train control system data from train company	I	G-1	10	Entry Level
	2	Monitor train control system data from TCC	I	G-1,G-2,G-4, G-5,G-6	10	Entry Level
	3	Monitor train schedule	I	G-1	10	Entry Level
	4	Monitor train passage time(s) through HRI	I	G-1,G-3	10	Entry Level
	5	Monitor train type (commuter, goods, etc.)	I	G-1,G-3	10	Entry Level
	6	Monitor train speeds through HRI	I	G-1,G-3	10	Entry Level
	7	Monitor train sensors near HRI	I	G-1,G-3	10	Entry Level
	8	Monitor train tracks (condition) in the vicinity of the HRI	I	G-1,G-3		Full Performance
	9	Monitor TCC communications/reliability	I	G-1,G-3	130	Advanced
	10	Monitor HRI incident frequency	I	G-1,G-3		Entry Level
	11	Monitor/evaluate HRI incident response and clearance plans	III	G-1,G-3,G-4, G-5	120	Full Performance
	12	Monitor railroad signal system map graphics from TMC	I	G-1,G-3,G-4, G-5	120	Entry Level
	13	Monitor/evaluate railroad signal system coordination strategies at railroad crossings	III	G-1,G-3,G-4, G-5	120	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	14	Monitor/evaluate railroad signal system time-space diagrams for railroad crossings	III	G-1,G-4,G-5	120	Full Performance
	15	Monitor/evaluate railroad signal system control strategies - isolated or coordinated	III	G-1,G-4,G-5	120	Full Performance
	16	Monitor/evaluate railroad signal system traffic responsive operations, if any	III	G-1,G-4,G-5		Full Performance
	17	Monitor/evaluate railroad signal system adaptive control operations, if any	III	G-1,G-4,G-5	100	Advanced
	18	Monitor/evaluate railroad signal system malfunctions at HRI crossings	III	G-1,G-3,G-4, G-5		Full Performance
	19	Coordinate with other railroad signal system operators for traffic progression along HRI	IV	G-1,G-2,G-3, G-4,G-5,G-6	80	Full Performance
	20	Coordinate with other signal system operators during incidents	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	21	Store archived data for railroad signal system operations, train data, and incident response	I	G-1		Entry Level
F-16, T-2: Respond to ATMS - Map Visual Data - Highway-Railroad Incidents and Signal Malfunctions	1	Notice highway-railroad incident/signal malfunction type	II	G-1		Entry Level
	2	Evaluate highway-railroad incident/signal malfunction data	III	G-1		Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Determine highway-railroad incident/signal malfunction location	II	G-1		Entry Level
	4	Record/enter highway-railroad incident/signal malfunction conditions	I	G-1,G-3,G-4, G-5		Entry Level
	5	Provide highway-railroad incident/signal malfunction notifications	III	G-1		Full Performance
	6	Coordinate with TMC for highway-railroad incident/signal malfunction verifications	IV	G-1,G-2,G-3, G-4,G-5,G-6	80, 60	Full Performance
	7	Enact highway-railroad incident/signal malfunction response	III	G-1,G-2,G-3, G-4,G-5,G-6	230	Full Performance
	8	View/create/modify highway-railroad incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5	70, 230	Full Performance
	9	Enable highway-railroad incident/signal malfunction response scenario	IV	G-1,G-4,G-5	70, 230	Full Performance
	10	Monitor/modify highway-railroad incident/signal malfunction response scenario	IV	G-1,G-4,G-5	120, 230	Full Performance
F-16, T-3: Process Direct Cell Phone Call-In (Incident/Malfunction Calls)	1	Receive call and note highway-railroad incident/signal malfunction information	I	G-1,G-2		Entry Level
	2	Check for and view highway-railroad incident/signal malfunction data	II	G-1,G-3	10	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	3	Coordinate with TMC for highway-railroad incident/signal malfunction verification	IV	G-1,G-2,G-3, G-4,G-5,G-6	80, 60	Full Performance
	4	Record/enter highway-railroad incident/signal malfunction type	I	G-1,G-3		Entry Level
	5	Provide highway-railroad incident/signal malfunction notifications	III	G-1,G-4,G-5		Full Performance
	6	Enact highway-railroad incident/signal malfunction response	III	G-1,G-2,G-3, G-4,G-5,G-6	230	Full Performance
	7	View/create/modify highway-railroad incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5	70, 230	Full Performance
	8	Enable highway-railroad incident/signal malfunction response scenario	IV	G-1,G-3,G-4, G-5	70, 230	Full Performance
	9	Monitor/modify highway-railroad incident/signal malfunction response scenario	IV	G-1,G-4,G-5	120, 230	Full Performance
F-16, T-4: Provide Notification in Case of Signal Malfunctions	1	Receive call and note railroad crossing signal malfunction information	I	G-1,G-2		Entry Level
	2	Determine railroad crossing signal malfunction location from driver	I	G-1,G-2		Entry Level
	3	Select camera at railroad crossing signal malfunction location	II	G-1,G-3,G-4, G-5		Entry Level
	4	Operate camera for railroad crossing signal malfunction verification	II	G-1,G-3,G-4, G-5	20, 60, 80	Entry Level

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	5	Record/enter railroad crossing signal malfunction type	I	G-1		Entry Level
	6	Provide railroad crossing signal malfunction notifications	III	G-1,G-4,G-5		Full Performance
	7	Enact railroad crossing signal malfunction response	III	G-1,G-2,G-3, G-4,G-5,G-6	230	Full Performance
	8	View/create/modify railroad crossing signal malfunction response scenario	IV	G-1,G-3,G-4, G-5	70, 230	Full Performance
	9	Enable railroad crossing signal malfunction response scenario	IV	G-1,G-4,G-5	70, 230	Full Performance
	10	Monitor/modify railroad crossing signal malfunction response scenario	IV	G-1,G-4,G-5	120, 230	Full Performance
F-16, T-5: Develop and Implement Response Plan (to Highway-Railroad Incident)	1	Evaluate severity of highway-railroad incident delays	III	G-1	20	Full Performance
	2	Determine devices available for highway-railroad incident management	IV	G-1		Entry Level
	3	Evaluate possible detour plans to divert from highway-railroad incident location	III	G-1		Full Performance
	4	Consider/implement special timing plans for highway-railroad incident diversion route	V	G-1,G-3,G-4, G-5	20	Full Performance

Composite Tasks	Num	Discrete TMOT Tasks (65)	Generic HR KSA	General KSAs	Special KSAs	TMOT KSA Level
	5	Activate DMS (if applicable) with highway-railroad incident messages	V	G-1,G-3,G-4, G-5	140	Full Performance
	6	Activate HARs with highway-railroad incident messages	V	G-1,G-4,G-5	150	Full Performance
	7	Check signal timings at intersections near the highway-railroad incident location	III	G-1,G-2,G-3, G-4,G-5,G-6	100	Full Performance
	8	Evaluate diversion route intersections around highway-railroad incident location	III	G-1,G-4,G-5		Full Performance
	9	Revert to original timing plans after highway-railroad incident clearance	V	G-1,G-4,G-5	100	Full Performance
F-16, T-6: Generate Response Plan (Malfunction)	1	Evaluate severity of signal malfunction delays	III	G-1		Full Performance
	2	Determine devices available for signal malfunction management	IV	G-1,G-3		Entry Level
	3	Coordinate with police to manage traffic due to signal malfunction at select location(s)	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	4	Activate DMS/HAR (if applicable) to warn of signal malfunction at select location(s)	V	G-1,G-3,G-4, G-5	140, 150	Entry Level
	5	Communicate with police officers posted at signal malfunction site(s)	IV	G-1,G-2,G-3, G-4,G-5,G-6		Full Performance
	6	Change signal timing plans near the signal malfunction area to expedite traffic flow	V	G-1,G-4,G-5	100	Full Performance

APPENDIX C: DEFINITIONS DEVELOPMENT

The following descriptions regarding how the definitions were developed are not necessary for the reader who is interested in simply writing position descriptions for TMC staffing. The information necessary to create position descriptions is found in Sections 4 and 5.

C.1 Development of the TMOT Definition

Since the first North American freeway management centers opened in the late 1960s, transportation professionals have referred to people who worked at these "control centers" simply as "operators". Unfortunately, in the human resource circles of the information processing industry at large, the term "operator" is most commonly used to describe primarily clerical positions such as computer operators for data entry and keypad operators. When a TMC supervisor asks a human resources expert to classify a "TMC Operator", the base level of knowledge, skill, ability, education, and related compensation level is likely to be underestimated. The result is a TMC that does not achieve its objectives due to an under-compensated and under-qualified staff.

Attempts to resolve this problem in the past have lead to TMC managers utilizing titles such as "Transportation Management Technician," and specialty titles such as "Traffic Information Coordinator". Those who have utilized these titles report having succeeded in obtaining a better qualified and compensated staff. A good example is the Montgomery County, Maryland, TMC, where the transportation supervisor at the time, Mr. Gene Donaldson, advocated the "Traffic Management Technician" titles. These titles are useful, and could serve as a general title for the purpose of this document. The Traffic Management Technician title is an improvement on "TMC Operator," even though the word "technician" may imply to the human resources professional more of a "hardware" installation, troubleshooting, or repair KSA capability set than may be required to perform in the typical TMC operations position.

The title of TMOT was developed for these this document to connote that the technical capabilities required are to be applied to operational tasks in a traffic management setting, rather than maintenance tasks. Adopting the TMOT nomenclature in the transportation community may result in more consistent communication of staffing needs to human resources and civil service officials.

C.2 Development of the TMC Function Definition

A search of existing research literature related to TMC operations shows that there is no consistently utilized definition of the term "function" contained in the TMC related transportation research literature. In fact, practitioners use the words "function" and "task" quite loosely.

The general definition of the word "function" is "the action for which a person or thing is specially fitted or used or for which a thing exists: Purpose".[3] There are two key words in this literal definition that will aid in the development of a contextual definition for TMC function: 1. "Action," and 2. "Purpose". In TMC operations, implied action and purpose in describing functions is very common.

According to the literal definition, the characterization of an activity, or group of activities, as a function should contain two parts, a verb that conveys action being taken, and a word or phrase that conveys the purpose of the action. A good example of common action verbs used to describe TMC functions are contained in the following table:

Table C- 1. Action verbs used in representative research on functions.

Publication Number FHWA-RD-95-181	DTFH61-92-C-00094 Paper G.1
Detect, sense, receive, verify, assess, anticipate, identify, predict, select, determine, monitor, post, control, provide, formulate, issue, transmit, store, retrieve, perform, implement, maintain, and coordinate.	Assess, select, identify, determine, receive, provide, control, perform, store, predict, monitor, verify, transmit, store, post, issue, implement, verify, maintain, develop, anticipate, and retrieve.

The similarity of these lists is attributable to commonality in the way researchers characterize activities of human interaction with real-time operational computer systems.

The "purpose" portion of a function's description is a more difficult to identify correctly. Incident management is a TMC function. The function could be more correctly identified as "Perform Incident Management". Another good example of terminology being somewhat inaccurate, albeit readily accepted, is to say that "ramp metering" is a function. Most transportation engineers know that the purpose of metering ramps is to improve mainline flow conditions and reduce accidents; however, this purpose is not literally conveyed by the description. "Meter Freeway Entrance Ramps" is a function description that is more precise. Unfortunately, "ramp metering" is not just a function, it is also a TMC sub-system or market package in the ITS industry. Precision is frequently sacrificed for brevity, especially when the functions are described in tabular text format, which is most often the case. "Traffic Signal Control" is essentially the same as "Control Traffic Signals to Prevent Collisions and Minimize Delay".

An example of this kind of abbreviation of function descriptions appears in Traffic Management Center Functions, NCHRP Report 270, June 1998. Table 4 on page 30 lists the TMC functions under consideration as follows:

[3] "Function" Merriam-Webster Online: Collegiate Dictionary. 2001. http://www.merriam-webster.com/dictionary.htm (29 Nov. 2001).

Table C- 2. NCHRP 270 TMC function descriptions.

Surveillance	Incident Management	Public Information Dissemination
Private Information Dissemination	Interagency Information Sharing	Environmental Monitoring
Special Event Management	Coordination with Emergency Agencies	HAZMAT
Emergency Management	HOV Operations	Planned Track/Lane Closure
Ramp Metering	Traffic/Track Signal Control	Lane Signal Control
Toll Management	Risk/Liability Management	Data Fusion

The connection between these functions and the purpose, being the overall objectives or mission of the center, is supplied by the reader, and not described, even implicitly, in these function descriptions. In most instances, this is not a problem. In the development of the TMOT Requirements Matrices for this report, definitions were needed to test whether an activity was a function, or a task, to properly describe the activity in the matrices. Traffic Management Center Functions, NCHRP Report 270, on page 22 states as follows:

"Transportation Management Centers perform three basic functions: gathering, synthesizing, and disseminating traffic and travel condition information."

This classic definition is the most basic elemental functional description, and is common to almost all ITS system and TMC design processes. There is no need to change it. This definition is consistent with the definition of TMC function, as defined in this document, as it reflects input, process, and output. The definitions used in this report are an expansion upon this basic theme, to provide a way to capture the distinctions between functions and tasks. It is not necessary for practitioners in the transportation industry to start referring to ramp metering as "Meter Freeway Entrance Ramps". The context in which a term like this is used will provide the distinction as to whether a system or a function is being described.

C.3 Development of the TMOT Task Definition

A dictionary definition of the word "task" is "a usually assigned piece of work often to be finished within a certain time".[4] There are three key phrases in this literal definition that will aid in the development of a contextual definition for TMC TMOT Tasks: 1. "usually assigned," 2. "piece of work," and 3. "finished within a certain time". Lists of TMC operator tasks readily found in existing transportation research literature are generally not consistent with this or any other definition, and too often the terms "function" and "task" are used interchangeably. The key distinction between functions and tasks can be derived from the task definition. By

[4] "Task" Merriam-Webster Online: Collegiate Dictionary. 2001. http://www.merriam-webster.com/dictionary.htm (29 Nov. 2001).

definition, a “function” is an on-going process, where as a “task” is a discrete entity, with a beginning and an end. Literally, the function is the “work” and the task is the “piece of work”.

Operator task descriptions rely very heavily upon the same action words, especially “receive,” “assess,” “monitor,” “transmit,” “issue,” and “select”. The task descriptions almost always include the “thing” involved, namely the item acted upon (e.g., traffic detector data).

The state of the practice in definition of operator tasks is also highly inconsistent and arbitrary, in that review of any extensive list will lead to exceptions to this rule. Task descriptions can easily be found that are too general “monitor traffic conditions” or too specific “override restrictive metering rate at saturated ramp”.

In the context of developing operator tasks upon which to base knowledge, skill, and ability assessments for operators, a determination must be made as to the appropriate level of specificity required. Every function described for use in the study must have at least one task, and every task must contribute to at least one, and quite possible more than one, function.

Some of the Operator tasks identified in this document will differ from those commonly found in the literature regarding TMC Operations. As an example, the knowledge, skill and ability required to control a pan, tilt, and zoom video camera remotely through a software interface, and to understand the orientation of the image viewed and the content thereof, should be a required TMOT capability. However, it is rarely, if ever, described in existing operator position descriptions. This is partly because “Video Surveillance” is not a popularly referenced function, and should not be defined as such because the sole purpose is to support other functions such as incident management or the metering of ramps (for visual queue monitoring). The ability to compose a Dynamic Message Sign message using a user interface, and to understand the implications of sending the message to the sign, is very common in TMCs, but rarely included in position descriptions for the same reason. The ability to master and utilize technologies in these centers is absolutely critical to meeting TMC objectives, but is very frequently not identified in position descriptions. These activities are defined herein as TMOT tasks.

Adopting these definitions provides some structure to the discussion of functions and tasks central to developing TMC operator requirements matrices on which to develop position descriptions or aid in TMC design. These definitions will, however, eventually lead to changes in how we talk about TMC operations. As an example, it sounds perfectly reasonable to say, “An operator performs certain functions within the TMC”. Using the literal definitions in this document, this statement becomes incorrect! A function is an on-going purpose. An operator performs tasks (not functions) congruent with this purpose. The reason it is important to make this distinction is to provide a conceptual hierarchy by which to “break down” a TMC operation into small enough descriptions of activities so that the staffing requirements can be developed based upon what the operator will really be asked to do as part of his or her job.

C.4 Human Resource Related Definitions

The definitions of knowledge, skill, and ability, and the use of the terminology of “entry level” and “full performance” are generally consistent with definitions accepted by human resources professionals.

APPENDIX D: SELECTION OF THE 16 TMC FUNCTIONS

D.1 Adopted Definitions

The definitions adopted for use are as follows:

TMC Function. **The on-going purpose for which a set of related activities are conducted in the TMC.** Function definitions will include a macroscopic action descriptor such as "provide," "manage," and "monitor". Function definitions will also include complex macroscopic operational entities such as "incidents," traffic conditions," "traveler information," etc.

TMC Operator Task. **A discrete work element conducted by a TMC TMOT that contributes to a function**. Task descriptions will always include a discrete action statement and an item to be acted upon, and may also include an output descriptor as well as a defined beginning and end.

D.2 Identification and Selection of TMC Functions

Review of the TMC related source documentation reveals that the most commonly referenced groups of functions are as follows:

Traffic monitoring
Control of ITS devices
Maintenance, repair, and troubleshooting
Disseminate information
Personnel management
Data analysis
Interface with media and public
Plan, recommend, implement system and procedural upgrades
Coordination with incident response agencies
Coordination with other local and regional transportation agencies

The functions of a TMC include activities not necessarily carried out by the TMOTs. This document deals only with TMOT requirements, and therefore the set of TMC functions from the literature was narrowed to only those functions that involve actions by the TMOT. As an example, "Plan, recommend, implement system and procedural upgrades" is not considered a TMOT supported function because it represents a management and supervisory function that is **normally** not performed by TMOTs.

D.2.1 Concept of Operations and TMC Function Selection

The concept of operations describes how a TMC is operated to perform functions related to the highway environment and the highway users. Highway TMCs have a similar structure at the highest level. The entire set of activities within a Highway TMC will generally fall into the categories of operations or maintenance.

The basic activity categories that define the purposes of a TMC, and the further breakdown the "Operations" category with which this document is concerned, are presented in Figure D- 1.

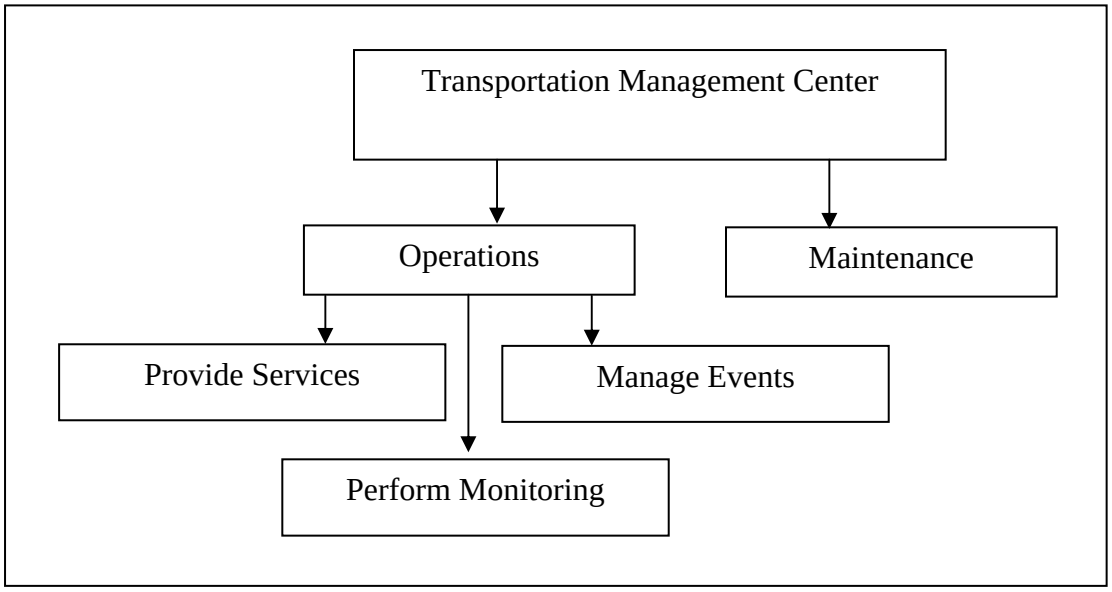

Figure D- 1. Typical concept of operations diagram for a highway TMC.

The operational activity categories of providing services, managing events, and performance of monitoring are essential to formulation of the TMC functions. Using the definition of a TMC function, these represent a grouping of activities that become functions when a purpose statement is applied.

D.2.1.1 Perform Monitoring

One of the most common activities undertaken by the TMOTs in a TMC is to monitor the transportation facilities that are part of TMC's domain. Monitoring is normally visual and can also be aural. It is common to monitor conditions through the use of a computer workstation graphic display environment. The TMOT uses displays of video images and computer generated graphics, radio broadcast information (i.e. a police band radio scanner) and operational data reports. Monitoring is not a function by definition, as it requires further definition to convey a purpose. Monitoring is a very common part of the activities involved with delivering and performing many of the functions described herein. The definition of monitoring is:

"To watch, keep track of, or check usually for a special purpose". [5]

Monitoring is an action verb that is used as an integral part of many of the task descriptions included in the this document; however, it would be a mistake to conclude that every TMOT action is the result of monitoring. Most TMCs have repetitive activities required of the TMOTs as part of the normal work of their shift. These are often "check-list" based activities. A "maintenance" example would be a requirement to obtain a system generated failure report, or to list all failed devices over which the TMC has control once per day or once per shift. An "operations" example would be to initiate the opening or closing of a reversible lane facility at the same time every day according to procedural requirements. These are examples of required activities that are not a result of monitoring.

D.2.1.2 Manage Events

If the definition of monitoring is to "watch, keep track of, or check usually for a special purpose," then the observation or detection of an "event" is certainly one of the most common reasons to monitor. Events can be either randomly occurring or planned/scheduled phenomena. Events are a broad category that includes the "incidents" that trigger incident management in a TMC. An incident is always an event, although an event is not always an incident, and certainly not always a vehicular accident. For example, a failed ITS roadside device, or the commencement of a parade is an event that is not an accident. The following types of events are managed:

> Randomly Occurring Events. The number one event type that concerns most TMCs is the vehicular accident. Although certain factors may increase the probability of accidents occurring, such as the onset of rainfall during a peak travel period, they are essentially random. There are many other types of events including vehicle breakdowns, debris on the highway, weather related events, etc., that will draw the attention of a monitoring TMOT. Accidents have many classifications that indicate the type and severity of the accident, plus special circumstances that may require special TMOT action, such as fire, spilled loads, hazardous materials, injuries, or fatalities. Events can also be "system generated," meaning that a computerized system has detected a state change or other electronically monitored phenomena that constitutes an event. System generated events may be brought to the TMOT's attention through displays of the data, or in some cases through an audible alarm.
>
> Planned Events. A planned event is an expected event for which a schedule has been established. It is most frequently an event that is expected to have a measurable and significant impact on the transportation system. The reality of TMC operations is that planned events (often called "special events" in transportation jargon) such as a professional or college football game or other sporting event, a parade or motorcade, a

[5] "monitor" Merriam-Webster Online: Collegiate Dictionary. 2001. http://www.merriam-webster.com/dictionary.htm (08 Dec. 2001).

lane closure for construction, etc., rarely occur at a precise planned time, and sometimes occur significantly early, late, or not at all. Therefore, from the standpoint of the TMC TMOT, the occurrence of a planned event outside of the TMOT's control is still something that may require monitoring to detect, and once detected is likely to require further monitoring as it progresses.

Recurring Random Events. An important type of event, which contributes to functional definitions of TMC activities, is the "recurring random event". Transportation engineers often separate "congestion" (meaning the degradation of traffic flow due to traffic volume demand in excess of capacity) into two categories: Recurring congestion, and Non-recurring congestion. Recurring congestion is usually associated with the excess demand that is likely to occur at a predictable time, location, and severity, especially in urban and suburban areas where there is a clearly defined "peak" travel period associated normally with work generated trips. Non-recurring congestion is generally accepted to be associated with "incidents". The "recurring random event" includes recurring congestion as defined above. At some TMCs, managing recurring random events to reduce delay is a major function. Activation of dynamic message signs with "congestion" type messages and ramp meters to manage mainline traffic flow would fall into this category. The paradigm change inherent in the adoption of this definition is the inclusion of recurring congestion management activities into the general category of "manage events". Since the onset of congestion due to excess demand is expected but not precise, it will be considered an event that may be cause for monitoring and other system or TMOT actions.

D.2.1.3 Provide Services

Some TMC functions provide services to their constituency on the highways on such a regular basis that these services fall outside of the category of event management. The utilization of ATIS within a TMC may very likely include functions that are service oriented. The provision of traveler information, both event related and non-event related, is considered a service. As an example, the TMC in Atlanta, Georgia, currently provides a service to motorists by responding to incoming telephone calls from the public for requests related to highway conditions, delays, accidents, or best routes for them to take to get to a specific destination. Many TMCs now participate in the provision of traveler information through a "511" telephone dial-in service. Another example of this type of function is the provision of service patrols, to aid motorists with events such as breakdowns and "out of gas" events.

D.2.2 TMC Support

The category of "TMC Support" is not included in Figure 1 because support activities that facilitate the operation of the TMC tend to be more "institutional" than operational. The activities of hiring, managing, training, record keeping, interpersonal and interagency

communications, and the general upkeep and improvement of the TMC are essential to the operation, but generally are incidental to real time operation.

D.2.3 Use of Intelligent Transportation Systems

Since the early 1990's, the Intelligent Transportation Society of America has supported the categorization of ITS into four basic system types:

- Advanced Transportation Management Systems (ATMS)
- Advanced Traveler Information Systems (ATIS)
- Advanced Public Transportation Systems (APTS)
- Commercial Vehicle Operations (CVO)

These systems are normally operated from a TMC environment. These systems, and the equipment used to create these systems, are not "functions" as defined in this report. Rather, these systems are "tools," or created capabilities, used to accomplish the functions of a TMC. Much of the operator activity in most TMCs involves interaction with this type of system in the course of doing their job. The listing of these general categories of systems is a "check" to help determine if the TMC functions identified are inclusive of the types of functions supported by these systems. Activities such as monitoring traffic signal control systems (a type of ATMS), locating a transit vehicle in distress (a capability of some APTS), activating a highway advisory radio system (a capability of some ATIS and ATMS), all point to overriding purpose, or function for which these systems are put in place.

D.3 Summary of Functions

Table D- 1 shows the common TMC functions for which TMOT tasks were developed. The relationships have to be established to objectively define TMC functions. Table D- 1 depicts the relationships between the TMC functions, operational concepts, source of the function, systems, actions, and purposes in tabular format. The two columns of "Purpose" and "Action" provide the two essential components of a function. The "Source" column in Table D- 1 contains one or more numbers between one and four, to indicate that the source of the function was:

(1) Published Research Literature.
(2) TMC Pooled Fund Study Participants.
(3) Site Visit Observations.
(4) Study Team Experience.

The summary of functions in Table D- 1 is sufficient to generate representative TMOT tasks for which knowledge, skills, and abilities are to be defined. As an example, if a TMOT has to be able to operate a CCTV camera remotely and evaluate the images for the desired content, the knowledge, skill, and ability required would be very similar regardless of whether a TMOT is verifying an incident or determining if a ramp meter queue is excessive. More obscure functions

found in only a small set of TMCs are of little value here unless they pertain to accident prevention (as in the case of overheight vehicle management) or other life-safety or regulatory issues that may require special skills to accomplish. Table D- 1 is, for the large part, consistent with common practice; however, some of the findings represent a change in the common conventions. The definition of operation concepts into three categories of monitoring, event management, and services are intuitive, and provide a consistent framework for activities and functions. One change in convention documented in Table D- 1 regards incident detection. There is a widely accepted convention that the function of "incident management" is made up of detection, verification, response, and clearance. In Table D- 1, incident detection (detect events) is a monitoring activity rather than a part of incident management. This common sense approach is intuitively obvious (you cannot manage an incident until it is detected); however, it defies convention. Similarly, the definition of event being broadened to include the onset of "randomly recurring congestion" is a significant departure, as the convention is to treat recurring congestion as a static rather than dynamic phenomena. The main goal is to define operator requirements in a consistent way, regardless of convention.

Table D- 1. Summary of TMC functions.

Operations Concept	Type	Purpose	Activities	TMC Function(s)	Source	Notes
Perform Monitoring	Delays	Evaluate Real Time Travel Conditions for Impediments	View Traffic Data	Traffic Flow Monitoring	1,2,3,4	• RWIS = Roadway Weather Information Systems
			View Video Images			
	Hazards		View Weather Data	Environmental and RWIS Monitoring		
			View Emissions Data	Transit Vehicle Monitoring		
			Detect Events			
Manage Events	Random Events	Mitigate Impact of Incidents by Management	Acknowledge Detection	Incident Management	1,2,3,4	• CCTV = Closed Circuit Television Cameras • Lane Signals = Regulatory Lane Control, or Lane Use Signals • Traffic Signal Timings can be adjusted to facilitate improved traffic flow on an arterial diversion route • DMS = Dynamic Message Signs • HAR = Highway Advisory Radio • ATIS = Advanced Traveler Information Systems • ATMS = Advanced Transportation Management Systems • Incident Response includes a complex set of actions.
			Verify (CCTV)	Emergency Management		
			Respond			
			Coordinate with interagency traffic management personnel.			
			Recover			
		Control Traffic Flow to Improve Safety, Reduce Travel Time	Activate Lane Signals			
			Adjust Traffic Signal Timings			
			Utilize Ramp Meters		2,3	
		Respond to and repair equipment failures.	Acknowledge Detected Failures	Failure Management	1,2,3,4	
			Diagnose Failures			
			Implement Repairs			
	Recurring Events	Mitigate Delay Propagation on	Use DMS and HAR	Congestion Management	1,2,3,4	
			Utilize ATIS			

Operations Concept	Type	Purpose	Activities	TMC Function(s)	Source	Notes
Manage Events (cont.)	Recurring Events (cont.)	Highway Segments	Meter Ramps	Congestion Management (cont.)		
			Toll Plaza Ops.			
		Reduce Demand on Congested Segments	Utilize ATMS			
	Scheduled Events	Mitigate Impact of Special Event Demand on Traffic Flow	Utilize ATIS	Special Event Management	1,2,3,4	
			Respond to public inquiries			
Provide Services	Traveler Information	Enhance Travel by Providing Trip Information Directly to Travelers	Utilize ATIS	Provide Travel Information	1,2,3,4	• APTS = Advanced Public Transportation Systems, a type of Intelligent Transportation System (ITS) • Overheight Vehicle Control is a Service, because it is intended to prevent an incident. When an overheight accident happens, it is part of incident management. • Some reversible and HOV lane gates are controlled by TMC operators, but the norm
			Utilize ATMS			
			Utilize Parking Management Systems			
			Respond to media inquiries		1	
	Broadcast Media Information	Providing Trip and Event Information Directly to Media Outlets for Re-broadcast	Prepare event information for periodic dissemination		2,4	
			Provide Service Patrols with incident Information			

Operations Concept	Type	Purpose	Activities	TMC Function(s)	Source	Notes
Provide Services (cont.)	Service Patrols	Respond to Minor Incidents Such as Vehicle Breakdown		Provide/Coordinate Service Patrols	1,2,3,4	is for field control of gates, and visual sweeps of CCTV views prior to reversal. • Most TMCs do not receive signal malfunction calls, however there are enough important exceptions to warrant inclusion in this table.
	Traffic Signal Control	Coordinate Traffic Signals to Optimize Arterial Street Traffic Flow	Determine appropriate jurisdiction Select and implement appropriate timing plans	Traffic Signal System Management	1,2,3,4	
		Respond to Signal Malfunction Reports/calls	Dispatch/notify traffic signal repair technician(s)			
			Notify Travelers of Transit Locations and Headways			
	Public Transit	Provide Transit Information to Improve Service to Users	Utilize APTS	APTS System Management	1,3,4	
			Utilize ATIS			
	Reversible Lane and HOV	Manage Reversible Lane(s) to manage capacity	Visually verify status, open/close gates	Reversible and HOV Lane Management	1,2,4	
			Utilize DMS			
	At-Grade Rail	Manage At-Grade Rail	Utilize any control equipment (signals and gates).	Rail Crossing Management	1	

Operations Concept	Type	Purpose	Activities	TMC Function(s)	Source	Notes
	Crossings	Crossings to improve safety	Notify rail operator of compromised crossing			
	Overheight Vehicle Control	Prevent Facility Damage and Accidents	Acknowledge Detection	Overheight Vehicle Management	4	
			Implement Response			
			Manage Delay			
TMC Support	Human Resources Staffing	Provide staff to accomplish TMC mission	Train New TMOTs	Human Resource Management	2,3,4	
	Human Resources Training	Provide training to establish the needed capabilities	Train TMOTs on New Capabilities		2,4	
	Record Keeping and Reporting	Document Operations and Maintenance activities as required by policies	Keep manual records	Records Management	2,3,4	
			Enter Data into Systems			
			Print or store reports.		2,3,4	
			Facilitate Data Warehousing		2,3,4	
					1	
	System	Keep	Routine Maintenance	Maintenance Management	2,3,4	

	Type	Purpose	Activities	TMC Function(s)	Source	Notes
	Maintenance Monitoring	equipment and systems operational	Preventive Maintenance Monitor Current System Configuration	Configuration Management		

The selected TMC Functions serve as the basis for development of TMOT tasks important to the definition of knowledge, skill, and ability descriptions essential to defining TMOT requirements. The 19 defined TMC Functions, extracted from Table D- 1, are, in alphabetical order:

- APTS System Management
- Configuration Management
- Congestion Management
- Emergency Management
- Environmental and RWIS Monitoring
- Failure Management
- Human Resource Management
- Incident Management
- Maintenance Management
- Overheight Vehicle Management
- Provide/Coordinate Service Patrols
- Provide Travel Information
- Rail Crossing Management
- Records Management
- Reversible and HOV Lane Management
- Special Event Management
- Traffic Flow Monitoring
- Traffic Signal System Management
- Transit Vehicle Monitoring

It is doubtful that any list generated in an industry as broad and complex as the transportation industry will be comprehensive and inarguably complete; however, this list captures the essential functions identified in a very extensive volume of source material associated with TMC operations and management.

D.4 Generality Across TMCs

Table D- 2 provides an indication of how common, or general, the 19 functions are across today's existing North American TMCs.

Table D- 2. Generality of TMC functions.

Universal: Almost all TMCs have this function. (90 to 99% of TMCs)	Prevalent: A majority of TMCs have this function. (75 to 90% of TMCs)	Common: A significant number of TMCs have this function. (50 to 75% of TMCs)	Sporadic: A relatively small number of TMCs have this function) (50% or less of TMCs)
Human Resource Management	Configuration Management	Emergency Management	APTS System Management
Maintenance Management	Congestion Management	Provide/Coordinate Service Patrols	Environmental and RWIS Monitoring
Provide Travel Information	Failure Management	Reversible and HOV Lane Management	Overheight Vehicle Management
Records Management	Incident Management	Traffic Signal System Management	Rail Crossing Management
	Special Event Management	Transit Vehicle Monitoring	
	Traffic Flow Monitoring		

These classifications in Table D- 2 are subjective, based upon the author's experience. Commonality is not necessarily synonymous with operational importance in this case, especially since sporadically used functions are likely to require advanced knowledge, skill and ability of the TMOT.

D.5 Determination of Task Integral Functions

The 19 TMC Functions are evaluated in Table D- 3 to determine which functions are "Task Integral" for the typical TMC. In this context, "Task Integral" means that the function can be broken down into tasks collectively forming the function, and that these tasks will be performed by the TMOT in the TMC.

Table D- 3 is a decision matrix by which each TMC function is evaluated to determine if it meets the criteria for being classified as a task integral function.

Table D- 3. "Task integral" TMC functions.

TMC Function	Task Integral?	TMC Function	Task Integral?
1. Human Resource Management	No. The typical TMOT has no actions related to this function.	11. Emergency Management	Yes.
2. Maintenance Management	No. The TMOT plays a role in maintenance, with tasks supporting Failure Management (7.)	12. Provide/Coordinate Service Patrols	Yes.
3. Provide Travel Information	Yes.	13. Reversible and HOV Lane Management	Yes.
4. Records Management	Yes. TMOTs are required to keep records.	14. Traffic Signal System Management	Yes.
5. Configuration Management	No. Configuration management is typically performed by engineering or supervisor personnel	15. Transit Vehicle Monitoring	Yes.
6. Congestion Management	Yes.	16. APTS System Management	Yes.
7. Failure Management	Yes.	17. Environmental and RWIS Monitoring	Yes.
8. Incident Management	Yes.	18. Overheight Vehicle Management	Yes.
9. Special Event Management	Yes.	19. Rail Crossing Management	Yes.
10. Traffic Flow Monitoring	Yes.		

The result of the "Task Integral" filter applied to the TMC functions produces the following ordered list for task differentiation:

1. Provide Travel Information
2. Records Management
3. Congestion Management
4. Failure Management
5. Incident Management
6. Special Event Management
7. Traffic Flow Monitoring
8. Emergency Management

9. Provide/Coordinate Service Patrols
10. Reversible and HOV Lane Management
11. Traffic Signal System Management
12. Transit Vehicle Monitoring
13. APTS System Management
14. Environmental and RWIS Monitoring
15. Overheight Vehicle Management
16. Rail Crossing Management

These 16 TMC functions will be differentiated to determine the associated TMC TMOT Tasks.

APPENDIX E: TMOT OPERATIONS TERMINOLOGY

The following definitions are essential to understanding and using *TMC Operator Requirements and Position Descriptions.*

E.1 Transportation Management Operations Technician (TMOT)

A TMOT is a person who is capable of working a typical shift, normally eight hours per day, in a TMC. Many TMCs use part time operations staff, who also are considered TMOTs if they are capable of working the various conditions that may be encountered in a typical full shift. A typical shift may include operation under congested, non-congested, incident and non-incident conditions. The TMOT's work will usually consist of direct, "hands-on" accomplishment of tasks necessary to deliver one or more accepted TMC functions. Typically, TMOTs work their entire shift sitting at a console in the center, and do not have a desk or office elsewhere in the TMC facility. Engineers, supervisors, and managers who support the operation but also have other responsibilities in the organization, even though they may work part time in operations, are not TMOTs as defined in this section. The knowledge, skills, and abilities of operations personnel other than TMOTs are not described in this report.

E.2 TMC Function

A TMC function is defined as the on-going purpose for which a set of related activities is conducted in the TMC. Function descriptions will include a macroscopic action descriptor such as "provide," "manage," and "monitor". TMC Function descriptions include complex macroscopic operational entities such as "incidents," traffic conditions," and "traveler information".

E.3 TMOT Task

A TMOT task is defined as a discrete work element conducted by a TMOT that contributes to a function. Task descriptions used in this document will normally include a discrete action statement and an item to be acted upon, and may also include an output descriptor. In this context, "discrete" implies that a TMOT task has a distinct beginning and end, unlike the on-going continuous nature of TMC functions.

E.4 TMOT Knowledge, Skill, and Ability (KSA)

KSA descriptions are commonly found in human resource literature and practice. The KSA is a standardized way of expressing the capabilities required to perform in a specific position. The following definitions are used in this document:

- TMOT knowledge is defined as the intellectual possession and command of information necessary to (1) qualify for the TMOT position (entry level), and (2) the information that must be acquired after assuming a position in order to perform TMOT tasks. The knowledge of a TMOT or TMOT position candidate may be assessed by measuring the accuracy of responses to a set of TMC operations related questions.

- TMOT skill is defined as an assessment of the level of proficiency in exercising knowledge and/or performing TMOT tasks. Skill of a TMOT may be assessed by task performance time and accuracy assessments.

- TMOT ability is defined as the basic intellectual and physical capacities necessary to successfully perform in a TMOT position, acquire the necessary skills, and apply the necessary knowledge. The ability of a TMOT or TMOT position candidate may be assessed by aptitude tests or may be assumed based on level of education and job history.

E.5 TMOT Full Performance KSA Level

The "Full Performance" KSA level is defined as the set of KSAs required for a TMOT to carry out his or her responsibilities with a minimum of supervision, guidance, and direction. The full performance KSA level is often referred to as a "journeyman" position in the federal sector. The full performance TMOT is not a TMC supervisor by definition; however, there could be supervisory judgment capabilities inherent in the full performance KSAs. On-the-job training and experience are required to qualify for this level. TMC organizations will have to customize full performance KSAs based on the specific TMC functions and TMOT tasks characteristic of their TMC.

E.6 TMOT Entry KSA Level (Entry level)

The entry level is defined as the set of TMOT KSAs that a candidate must possess to be hired for training and work in a TMC TMOT position. Candidates with no direct TMC experience being considered for hire will not have much specific TMOT knowledge. Possession of basic abilities will permit the entry level TMOT to acquire more subject-specific knowledge and skills required to advance in a developmental, or trainee position to eventually qualify for the full performance KSA level.

E.7 TMOT Advanced KSA Level

The advanced KSA level is defined as the set of KSAs required for a TMOT to perform independently as an expert in the majority of functions at a TMC. Attainment of this level is measured by combining extensive experience and training leading to advanced knowledge and measurable skills beyond that expected of the full performance TMOT. Attainment of the

Advanced Level is also reflective of more permissive management controls applied by the supervisor, providing the opportunity for more discretion and judgment to be exercised by the TMOT in meeting the objectives of TMC functions. Mastery of the automated systems used at the TMC, and the knowledge of remedial measures required to correct or work around system failures, are likely to be expected of the Advanced TMOT.

E.8 Development of Definitions

Use of a common terminology was seen to be advantageous in bridging the gap between transportation and human resource professionals in creating the TMOT Requirements Matrices. Different connotations for commonly used terms can lead to misclassification of the positions required to operate the TMC. The net result can be a TMC being operated by inadequate, under qualified or overqualified staff. Development of the definitions for this report is documented in Appendix C: Definitions Development.