



# Primer for *Handbook for Developing a TMC Operations Manual*

 TMC  
Pooled-Fund Study

- ▶ ***The shift from structure focus to customer focus***



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## Primer for **HANDBOOK FOR DEVELOPING A TMC OPERATIONS MANUAL**

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The purpose of a TMC operations manual is to formalize and document the policies, plans, procedures, and other support activities that are performed to achieve a TMC's mission, goals, and objectives.

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## TRAFFIC AND TRANSPORTATION MANAGEMENT SYSTEMS

### What is a traffic and/or transportation management system?

A traffic and/or transportation management system (TMS) is a system of field-located transportation devices capable of data collection and motorist communication. These devices are electronically linked to a transportation management center (TMC) where operator interfaces enable control and monitoring of the transportation infrastructure through the use of video and electronic communications. Control may be applied through devices that manage roadway traffic through traffic signal operation, freeway ramp metering, and management of high occupancy vehicle (HOV) facilities.

### What kinds of data are measured and collected?

The functionality of a transportation management system varies based on the requirements of the region and the age of the system. Typical data that can be collected include traffic flow rates, travel times, and speeds; traffic signal status; roadway collisions and other incidents; transit vehicle locations; and other information useful in managing vehicular traffic and

providing travel information to the traveling public.

### How do transportation management systems benefit the traveling public?

By providing up-to-date traffic conditions, the operators of a system can effect changes in the system to respond to normal and abnormal traffic conditions, such as changing traffic signal timing, rerouting transit vehicles, and providing traffic condition information to travelers before they leave home or work or even during their trip so that they can make informed decisions as to trip scheduling, route planning, and modal choice.

### Are TMS a new development?

TMS have existed for well over fifty years, but in the last few years high-speed computer and data transmission systems and other modern technologies have enhanced their efficiency and effectiveness. Termed ITS (intelligent transportation systems), these technologies and services have provided TMC operators with more improved tools to manage traffic and transportation infrastructure.



Cabling used for video processing in a TMC.

**Transportation management systems have existed for over fifty years.**

## WHAT IS A TRANSPORTATION MANAGEMENT CENTER?

A transportation management center (TMC) is the nerve center or focus of the management task. Electronic



monitoring equipment with operator interfaces – keyboards, touch screens, voice communications, and other devices – allow the TMC

staff to monitor traffic conditions and respond to roadway events, both predictable (normal traffic) and unpredictable (such as roadway collisions, load spills, and vehicle stalls).

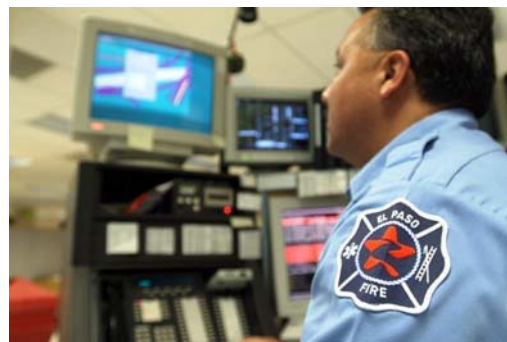
### Institutional Considerations

Few traffic management systems can operate in a vacuum: that is, without some interaction among area transportation agencies. That interaction will come about for better or worse, whether it is planned or intrinsic. A single city may include traffic, enforcement, emergency medical services (EMS),

transit, and state highway elements that all intermingle. In an urban area with multiple jurisdictions, that mixture is compounded. Travelers usually do not care through which jurisdictions the travel takes place as long as they arrive at their destination in a safe, efficient manner; in other words, jurisdictional boundaries should be transparent. Collocating



agencies in a TMC or providing high-speed communication among TMCs can enhance the overall trip experience for the traveler.



Collocating agencies in a TMC or providing high-speed communications among TMCs can enhance overall trip experiences for the traveler.

## What is a TMC Manual?



### Guide to Daily Operations

- Traffic management
- Emergency contacts
- Security policies
- Job responsibilities
- Public contacts
- Interagency coordinator

### A Console Fixture

- Resides on each console for ready access
- The quick “go-to” guide to daily operations
- A training aid for new operators

### Not a Detailed Computer or Software Manual

The manual will guide the user to the appropriate person or documentation in the event that procedures outside the scope of the TMS Operations Manual are required.



## WHY DEVELOP A TMC OPERATIONS MANUAL?

There are many outcomes associated with the development of a TMC operations manual including the following.



- Creating a training mechanism for new personnel;
- Promoting continuity in management and the application of employee related decisions;
- Providing an objective framework for comparisons toward meeting the goals and objectives of the TMC; and
- Reminding “old hands” of policies and procedures.

A TMC operations manual also defines the roles and relationships with other stakeholders. This is especially important for co-located operations and connections to other transportation-related systems like enforcement, fire, and Emergency Management Services (EMS).

- Formalizing and documenting operational, maintenance, data collection, and warehousing procedures.
- Reflecting the concept of operations (COO) for the system;
- Providing uniform standards, policies, procedures, and expectations for employees;
- Capturing and identifying standard operating procedures, techniques, and experiences;



### Benefits of a TMC Manual:

- Enable interagency and interjurisdictional relationships
- Improve resource utilization
- Improve transportation system performance

## GETTING STARTED

The following procedural steps should be addressed prior to beginning the operations manual development.

### Define Development Process

- Identifying a Manual Development Leader
  - Must have managerial (people) skills as well as technical skills
  - Must have support from managers above and from line employees
  - Should be assigned to the task throughout the process
- Establishing a Manual Development Team
  - Must be representative of all stakeholders in the Transportation Management System, whether housed in TMC building or not
  - Should be committed to the task throughout the development
- Designating an Advisory Group
  - Upper level managers from all stakeholder constituencies to review, coordinate, and “champion” the effort is essential for system buy-in and support

- Identifying an Independent Reviewer
  - A reviewer from outside the affected agencies and jurisdiction who has experience with Transportation Management Systems can help ensure consistency and comprehensiveness of the manual
- Collecting and Assembling Relevant System Documents
  - System plans and specifications as well as the COO document are essential in developing the manual; similar information for existing systems will also be helpful in developing the manual. Other relevant items include equipment inventories and locations, mapping, and plans and specifications of existing systems.
- Collecting and Assembling Regional Agreements and ITS Plans
  - Existing agreements and plans are essential to define roles, responsibilities, and communication lines.

- Establishing a Schedule and Assigning Responsibilities
  - A work plan must be developed to ensure that the operations manual is developed in a timely manner.

### Define Management Structure

There are multiple ways the management system may be structured. The *Handbook for Developing a TMC Operations Manual* provides advantages and disadvantages of each including:

- Geographic Area
  - Single Jurisdiction
  - Multiple Jurisdictions
  - Regional
  - Statewide
- Number and Type of Agencies Involved
  - Single Agency
  - Multiple Transportation Agencies
  - Multiple Agency and Disciplines
- Operating Mechanism
  - Agency Staffed and Operated
  - Private Contract Operation

## SIX STEP PROCESS FOR DEVELOPING A TMC OPERATIONS MANUAL

Throughout its life, a TMC may experience multiple technology generations.

The process on the next page is structured from the viewpoint of the development leader that manages the effort to write and/or update the TMC Operations Manual. Note that the process is continuous - few systems are static. Therefore, new processes, strategies, policies, hardware, and software must be incorporated into the manual on an ongoing basis.

Frequently, the leader and most of the team will be technically versed in transportation system operation. If not, it may be necessary to get them up to speed on the “state-of-the-practice” in system operation. Numerous resources are available for self - study or group study.

The *Handbook* provides a resource for the process of developing an operations manual.

Although many preparatory steps proceed it, Step 1 of the manual development will be to identify a team leader. The team leader can use the first three chapters as a guideline prior to forming the team - Step 2 on the diagram at the right. The team can be

assembled and the *Handbook* can provide a resource for their work - Steps 3 and 4.

The next activities are for the team to identify the components of the

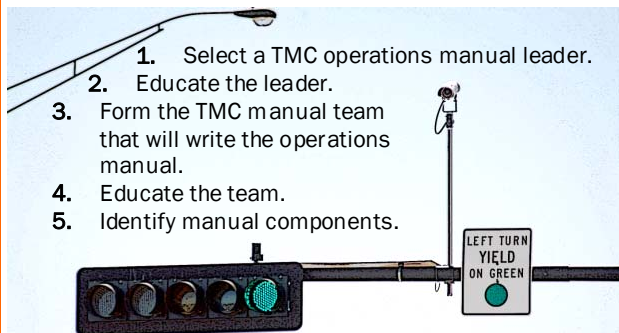


operations manual applicable for their TMC and develop the manual throughout the TMC life cycle - Steps 5 and 6.

The primary key to a successful program is simply to get started!

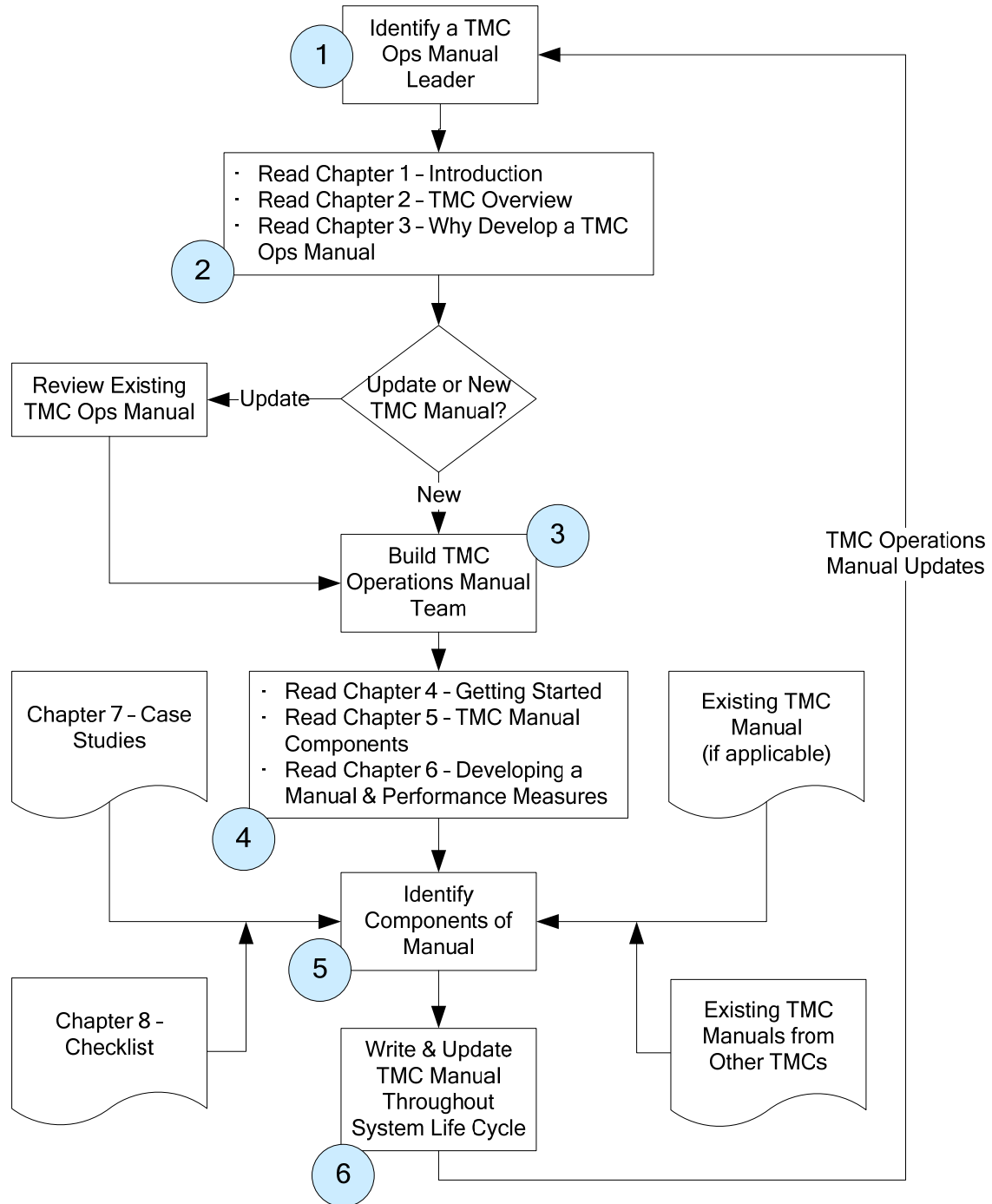
### Six Step Summary of Process to Develop a TMC Operations Manual

1. Select a TMC operations manual leader.
2. Educate the leader.
3. Form the TMC manual team that will write the operations manual.
4. Educate the team.
5. Identify manual components.
6. Write the TMC operations manual throughout the life cycle of the system.





## FLOWCHART FOR SIX STEP TMC MANUAL DEVELOPMENT PROCESS



## TMC OPERATIONS MANUAL COMPONENTS

### DAILY OPERATIONS

- Emergency and Other Contact Numbers
- TMC Emergency Plan
- General Policies
- General System Operation
- Malfunction Response

### INVENTORY

- Area of Coverage
- Functions
- Services Provided
- Field-Located Traffic Control Devices
- Highway Construction Plans
- TMC Components
- Stakeholders



### TMC MAINTENANCE PROCEDURES

- Routine Maintenance
- Preventative Maintenance
- Spare / Backup Equipment
- Emergency Procedures
- Agency Maintenance
- Contract Maintenance

### OPERATIONAL CONCEPTS

#### Goals of the Traffic Management System

- Interagency and Inter-Jurisdictional Coordination
- Traffic Monitoring
- Traffic Response
- Field Devices
- Control System Operation Procedures
- System Start-Up Procedures
- System Shut Down Procedures
- Operator Interface
- Incident Management Procedures

## TMC OPERATIONS MANUAL COMPONENTS

### SYSTEM OPERATIONS LOGS

- Incidents and Events
- Operations
- Maintenance
- Citizen Requests



### SYSTEM REPORTS

- Traffic Data Collection and Storage
- Risk Management
- System Documentation



### ORGANIZATIONAL SETTING WITHIN THE TMC

- Potential Agencies in TMC
- Operating Agreements
- Roles and Responsibilities



### PERFORMANCE MONITORING

- Performance Measures
- Continuity
- Documentation

## DEVELOPING A TMC OPERATIONS MANUAL FROM SCRATCH

### Concept of Operations

An operations manual defines not only the environment within a TMC, but also how it operates, who operates it, and their responsibilities and specific tasks. A starting point for an operations manual is often the COO document. In general, a COO defines what a center will accomplish and how it accomplishes those steps.

By comparison, an operations manual will generally go into greater detail about each step, providing specific instructions, contact names, job functions, agency contacts and interface information

### Who Develops the Manual?

An operations manual can be developed via two main methods: in-house or using an outside consultant. Using an in-house group may promote more “buy-in” and support from the employee base, but generally takes longer to accomplish and may require significant additional effort above and beyond the normal operating activities of the agency. Using an outside consultant may bring significant experience to the task, but will require commitment of

monetary resources to accomplish. However, it will free up agency personnel to handle other related tasks.

### Engendering Ownership

Regardless of the mechanism used for creating an operations manual, a critical factor is ownership. Before starting on any aspect of the manual, the key constituents and stakeholders must be identified. This generally includes the member agencies in the TMC as well as external agencies which may coordinate activities with the TMC. This committee, or group, will function as the primary mechanism for overseeing the manual development, whether it is done in-house or through the use of a consultant.

### Integrating the Manual into Training & Operation

Once complete, it is important that training be utilized to not only discuss and present the manual, but also to teach, train, and help employees integrate the manual and the information therein into their daily jobs.

Critical factors for developing a successful operations manual are:

- Oversight
- Ownership
- Cheerleading
- Training

- Updates should be accomplished using a committee or multi-jurisdictional approach.
- Updates should be accomplished when agency operations change.

## UPDATING A TMC OPERATIONS MANUAL

### A Continuous Process

Once an operations manual is created, the task is not complete. Most successful agencies have an ongoing evaluation and update mechanism in place to keep the operations manual a viable part of the agency, not only from the standpoint of documentation and employee job requirements, but also from the standpoint of agency operations.

### Who Updates the Manual?

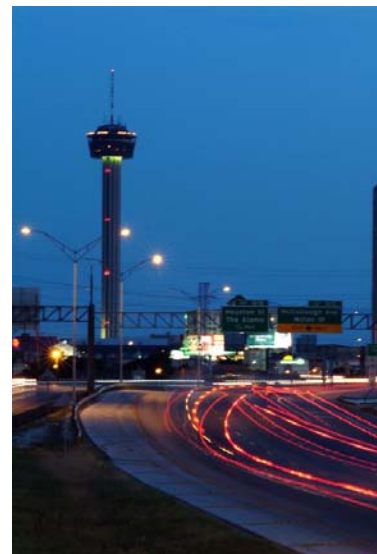
With the initial development complete, it is far more typical for an agency to accomplish updates in-house. Often, the development of updates is easier, as the existing material serves as a good reference or template for creating new components and materials.

### When Should It Be Updated?

The key point for when to update the manual is when any change occurs in the agency operations. If new tasks are to be undertaken, a comprehensive addition to the operations manual should support those tasks. If existing tasks are changed, by using new equipment, additional data, different analyses, or software tools, procedures should be updated with the new methods.

### Implementing the Updated Manual

Regardless of the type of updates, getting that information back into the hands of the employees remains a high priority for ensuring consistent operations and making sure everyone is on the same page. A mechanism for tracking manual update, such as an update tracking sheet, should be placed at the front of the manual.



## URBAN, RURAL, AND MATURITY CONSIDERATIONS

### Urban/Rural Issues

All TMCs are not created equal. These differences are not bad or even problematic; they simply exist and must be recognized. The concept that one size fits all, or that one solution is the right solution, is not valid when discussing TMCs. Each TMC must evolve to serve their stakeholders and accomplish their particular mission.

Urban TMCs are typically focused on freeway management, traffic signal management, and/or transit operations. Incident detection, response, and management are at the heart of their systems and mission. Keeping the freeways and major arterials moving is critical to their success. As a general rule, urban TMCs are typically larger and more developed than their more rural counterparts. Urban TMCs may also have established a number of working relationships with other agencies such as traffic operators, transit services, and police or emergency dispatchers which may be co-located in the same building or control room.

By comparison, rural TMCs are generally smaller facilities and may cover a wider geographic area. There may not be an expansive infrastructure and the focus of the agency may be different. While urban TMCs focus on freeway management, signal systems, urban transit, and mobility, rural TMCs may

focus on emergency services and rural transit service.

Despite the differences, both urban and rural TMCs can benefit from the *Handbook*. It can be a valuable tool and asset for any TMC, no matter how small or large, rural or urban.

### TMC Complexity and Maturity

The concepts detailed in the *Handbook* apply to any TMC, urban or rural, mature or new. However, the level of detail or applicability of each particular section may be different. The key is to use the *Handbook* to find out what value can be added to your TMC and your existing processes. If you are an existing and mature TMC, the information contained in this handbook may simply help you to refine the steps and procedures you already perform and their supporting documentation. If you are a new TMC, these *Handbook* chapters will help you lay out a developmental roadmap, addressing not only the important steps along your evolution, but also the processes, procedures, and documentation that can help you develop as you move along the growth path.

**All TMCs are not created equal. They differ in multiple ways including:**

- **Area of coverage**
- **Hours of operations**
- **Size**
- **Physical location**
- **Physical facilities**
- **Staffing and resources**
- **Operating characteristics**
- **Stakeholders**
- **Organizational structure**

## PERFORMANCE MEASUREMENT

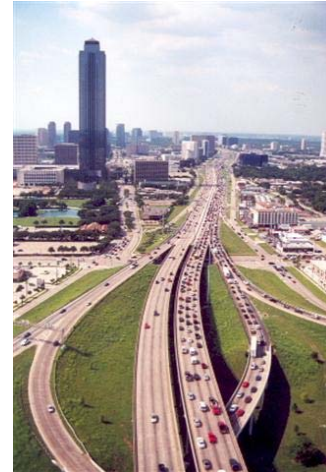
The *Handbook* provides an overview of the need for, the benefits of, and the uses of performance measures in the system operation task. While the day-to-day TMC operations personnel may not be the end user of data leading to performance measures, they must understand the importance of accurate and complete data collection. The *Handbook* provides an overview of the process as follows:

- Identify the critical activity.
- Identify the goals and objectives of the activity.
- Develop a set of candidate performance measures.
- Identify performance targets.
- Identify uses of performance measures and potential audiences.
- Identify data needs and requirements for analytical tools.
- Establish data collection and evaluation procedures.
- Compare actual performance to targeted goals.
- Determine corrective actions or progress needed to achieve goals.

### Types of Performance Measures

The *Handbook* provides a discussion of what makes a successful performance program and typical examples of performance measures such as:

- Trip Character
  - Average travel time
  - Average trip length
  - Modal splits
- Mobility
  - Vehicle miles of travel by congestion level
  - Travel time under congested conditions
  - Delay per vehicle mile of travel
  - Delay due to incidents
  - Lost time due to congestion
  - Annual hours of delay
  - Increase in system reliability
- Economic Development
  - Jobs supported
  - Jobs created
  - Economic cost of accidents
- Quality of Life
  - Perceived satisfaction with commute times
  - Perceived improvements in safety
  - Lost time due to congestion
  - Change in vehicle emissions
  - Accidents per vehicle miles traveled



A performance measurement system is an ongoing process, not a one-time event.

Performance measurement keeps a TMC focused on their primary goal.

- Ease of connections to inter-modal transfer points
- Environmental and Resource Conservation
  - Tons of pollutants emitted
  - Fuel consumption per vehicle miles traveled
  - Air quality rating
  - Modal splits
- Safety
  - Fatalities per vehicle mile traveled
  - Number of highway fatalities
  - Crash rate
  - Average duration of incidents
  - Average incident detection time
  - Average incident response time
- Operational Efficiency
  - Customer perception of system safety
  - Public expenditures on transportation system
  - Savings to taxpayers from incident management

**Data for Performance Measurement**

The following table is excerpted from the *Handbook* and shows typical information sources for performance measurement data.

**Other Performance Data Issues**

Methods of collecting performance data as well as guidelines for reporting and presenting such measures are provided in the *Handbook*.

**Typical Information Sources for Performance Measurement Data**

Travel Times	Speeds	Densities	Capacities
Corridor Facility Average Regional Peak vs. off-peak	Average Estimated Corridor By vehicle type	By lane By facility By time of day Incident vs. non-incident	By section By facility Incident vs. non-incident
Queues	Throughput	Incident Characteristics	Other Sources
Length Speed Duration Rate of growth	By facility By vehicle type By time of day	Detection time Duration Response measures Extent	Weather Work zones Staffing Expenditures Customer satisfaction



## BEST PRACTICES CASE STUDIES

The *Handbook* includes two case studies of currently operating TMCs.

### NORTHERN VIRGINIA SMART TRAFFIC CENTER CASE STUDY

The Northern Virginia (NoVA) District of the Virginia Department of Transportation (VDOT) operates one of the department's three existing Smart Traffic Centers (STC). The STC is similar to a Traffic Management Center concept, and is situated in a very urbanized and congested area of metropolitan Washington, focused on management of the interstate route freeways, overseeing more than 100 miles of roadway. It operates on a 24 hour/7 day a week schedule. The NoVA STC operations include: congestion mitigation with extensive reversible HOV lane operations, incident management, and traffic planning.

#### Contents of Manual

The TMC Operations Manual used for the NoVA STC is called the "Standard Operating Procedures" (SOP). The manual is very comprehensive with 157 pages. Contents for the manual are listed in sufficient detail that the reader (or manual developer) will find

guidance and assistance from a real-world environment.

#### Overview of Manual Effectiveness

In developing the case study, the manager of the system was interviewed and provided unique insights into the many aspects of the effectiveness of the manual.

#### Summary (Summarized from *Handbook*)

The NoVA STC SOP, or operations manual, is very comprehensive, incorporating most elements identified by the Institute of Transportation Engineers (ITE) Annotated Outline as key items (though presented in a different order).

The operational concepts provided in the SOP are very comprehensive, yet not too lengthy. This section should serve as an excellent model for other TMCs. If this information is too long, it may likely not be read or forgotten. While sufficiently detailed, it is right to the point. The SOP includes a good description of the overall system, including an inventory of the elements. It also has an effective date on the cover.

#### Conclusions (Summarized from *Handbook*)

The NoVA STC is a very busy operation, and it requires additional resources to focus on updating and maintaining manual. Clearly, the VDOT NoVA STC recognizes the need, importance, and value of an operations manual. The management is aware of how to effectively integrate the use of an operations manual into their daily activities, procedures, policies, and programs. As relationships continue to grow with regional partners, it is expected that the requirements in the SOP will increase.

The *Handbook* presents two detailed case studies for two operational Transportation Management Centers.

## BEST PRACTICES CASE STUDIES

### ORLANDO TMC CASE STUDY

The City of Orlando TMC and its staff are responsible for the operation and maintenance of a Regional Computerized Signal System (RCSS).

The RCSS is a multi-jurisdictional traffic signal control system which coordinates 384 traffic signals within the borders of Orange County, Florida.

The City of Orlando staffs and operates the TMC and thereby provides some inter-agency coordination in order to provide the motorist with a seamless transition when crossing jurisdictional boundaries. The TMC is in operation 24 hour/ 7 day per week. The Florida DOT District 5 provides video feeds from its Closed Circuit Television (CCTV) cameras and information on diverted traffic from I-4. The City can develop signal control plans and adjust signal timings to accommodate the traffic diversions.



### Contents of Manual

The operations manual used by the City of Orlando TMC is a composite of customized instruction sheets from the system vendor and Standard

Operating Procedures.

Contents for the manual are listed in sufficient detail that the reader (or manual developer) will find guidance and assistance from a real-world environment.

### Overview of Manual Effectiveness

In developing the case study, the manager of the system was

interviewed and provided unique insights into the many aspects of the effectiveness of the manual.

### Summary (Summarized from *Handbook*)

The TMC manual provides an extensive number of call lists. Its detail of daily operations and control system operational procedures can serve as an excellent model for other TMCs, especially those that operate traffic signal systems.

*Continued on next page*

<http://tmcps.ops.fhwa.dot.gov/> The TMC Pooled-Fund program provides a rich resource for sharing among operating agencies.

## BEST PRACTICES CASE STUDIES

It is apparent the use of figures and diagrams make the procedures simpler to follow, versus just using text descriptions. There are several maintenance fault monitoring and some simple trouble-shooting procedures identified in the manual.

While there is not specific mention of a concept of operations, or a separate description of the system, it can be inferred that much of this information is documented elsewhere. Additionally, most of this information can certainly be derived from the manual contents.

### Conclusions

The standard manual developed by the original software system developer was not sufficient as an operations manual for the City. It did not cover every situation an operator encounters. Usually, these are written from the software programmer's point-of-view, and that is not sufficient for an operator.

Clearly, the City of Orlando TMC recognizes the need, importance, and value of an operations manual. This is exemplified by the 24 hour 7 day a week operation of the TMC. The management is aware of how to effectively integrate the use of an operations manual into their daily activities, procedures, policies, and programs.



**Operations affect outcomes. With more effective operations there is more effective system performance.**



## TMC OPERATIONS MANUAL CHECKLIST

The checklist provides a comprehensive list of topics for a TMS/TMC manual. Sections are cross-referenced to discussions in Section 5 of the *Handbook*. Relevant headings in this chapter are followed in

parentheses by the applicable section in Chapter 5. Examples of this cross-referencing system are excerpted from the *Handbook* and shown below.

### Daily Operations (*Section 5.3*)

Components of an operations manual to support daily operations

#### Emergency and Other Contact Numbers (*Section 5.3.1*)

Quick reference for emergency situations:

- Police, fire, EMS, motorist assistance patrols, PSAP
- Street maintenance, freeway maintenance
- Private information providers, media
- Other

#### TMC Emergency Plan (*Section 5.3.2*)

Quick reference for emergency action in the control room (not related to traffic management or homeland security issues)

#### Traffic Monitoring (*Section 5.4.4*)

Description of traffic monitoring devices such as:

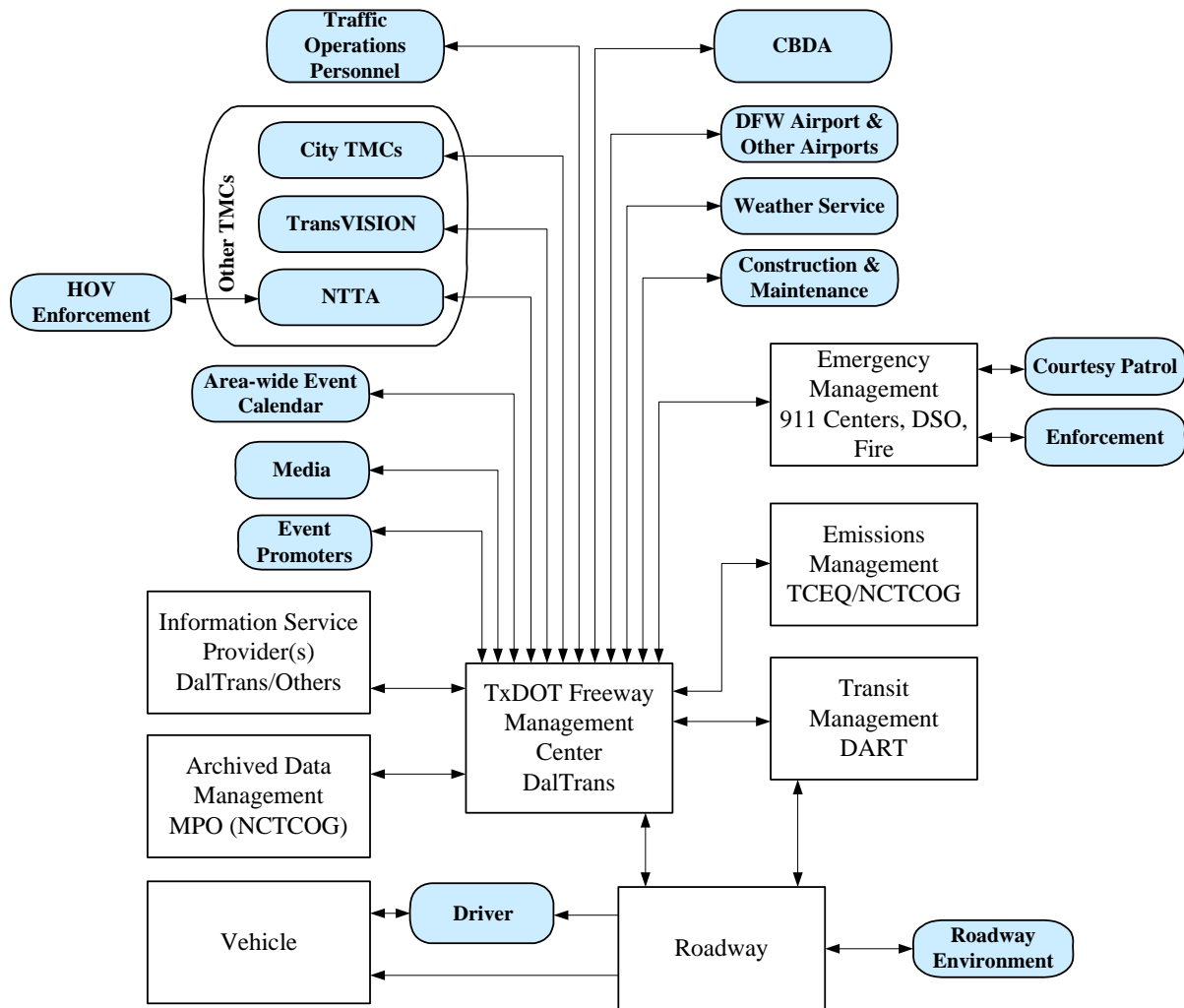
- Speed detector monitoring and response
- Closed circuit television (CCTV)
- Recording video images
- Road construction monitoring
- Highway maintenance activity

#### Traffic Response (*Section 5.4.5*)

Response to planned or unplanned events

## MULTIJURISDICTIONAL, MULTIAGENCY RELATIONSHIPS IN A LARGE URBAN AREA

The need for an effective TMC operations manual is also evident in regions and along corridors where significant integration and cooperation are essential to delivery of the customer-based focus that is the goal of system management and operations. The illustration below depicts a high level view of the integration that is targeted for the Dallas / Fort Worth region. This representation was developed as a part of the concept of operations documentation for the Texas Department of Transportation DalTrans Transportation Management System deployed in the Dallas region.



"We're here to talk about taking system management and operations to the next level. To move to what we at FHWA refer to as '21<sup>st</sup> century operations.' Operations that are more proactive, more performance-based, more effective, on a continuous 24/7 basis, regional, and intermodal.

For the most part, our transportation system is developed. Our monumental Interstate System is built. My message to ITE is: We need to focus more of our attention to operating the system -- to maximizing its capabilities. We need to shift from structure focus to customer focus."

FHWA Administrator  
Mary Peters,  
ITE 2005 Technical Conference  
February 28, 2005, Las Vegas, Nevada



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