Transportation Operations Framework

Interim Report Tasks 1-4

Prepared for
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Transportation Research Board
of
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Contents

BACKGROUND

It is increasingly recognized that the lack of qualified professional and technical staff is the leading barrier to effective mainstreaming of systems operations and management. The relatively modest acquaintance of DOT general management with management and operations (M&O) is a significant handicap. The need for increased levels of training in transportation management and operations was highlighted during a meeting of the AASHTO Subcommittee on System Operations and Management (SSO), when representatives of several state DOTs, that had committed to greater emphasis on M&O, expressed their frustration with the absence of experienced professional-level personnel, to lead these activities. There were two activities that were a result of these discussions.

First, the University of Maryland (UMD), with the support of the I-95 Corridor Coalition, developed and launched a two-week total immersion Management and Operations program designated the Operations Academy, for senior level management personnel. The Operations Academy program was carefully developed to provide focused training, including classroom instruction, workshops, and field trips that emphasize the fundamental principles of operations. The Operations Academy is not intended to represent a complete solution to the transportation community's need for comprehensive M&O training. It has intentionally emphasized the training of senior management personnel on the premise that the introduction of training at this level will potentially have the greatest immediate impact on the transportation community. It is clear that the M&O field is extremely broad, and will require a comprehensive training program spanning many specialties and organizational levels, if the desired shift in emphasis is to be achieved. Thus, the Operations Academy must be viewed as a small first step in the creation of a training framework that deals with the entire functional scope of management and operations.

The second activity was the release of NCHRP 20-77 (this project) to develop a training and capacity building framework for transportation operations technicians, engineers, and managers. The major outcomes of the project are to determine: (1) what training is needed, (2) what training is currently available, (3) what are the gaps between what training is available and what is needed, and (4) what is the most effective way to deliver the training that is missing?

PROJECT DESCRIPTION

Tasks 1 and 2 of NCHRP 20-77 answer the questions: (1) what training is needed and (2) what training is currently available. In order to answer the first question, "What training is needed," the UMD team needed to define the detailed competencies that are required by personnel at various levels in an organization. Basically, the UMD team needed to fill in the blank cells shown in the table in Appendix A. The rows of the table represent a group of core functions required to carry out a state of the practice SSOM program ranging from broad policy down through technical development to field activities. Each column represents an agency position—from senior management to technician. The cell at the intersections of the rows and column define a set of competencies related to a position's role related to a core function. The competencies that were defined by the Project Advisory Committees (PAC) were used to develop the course subject matter required to answer the second question "What training is currently available?"

Task 3 answers the question, (3) "what are the gaps between what training is available and what is needed?" In order to answer this question, the results of Task 1, which identified individual knowledge requirements, were compared with the existing training that was gathered in Task 2. The difference between these two data sets represented the gaps in available training resources.

Tasks 4, 6 and 7 will answer the question, (4) "what is the most effective way to deliver the training that is missing?"

The University of Maryland began working on this project in September 2007. This interim report summarizes the activities and results of Tasks 1- 4.

TASK 1

Task Description:

> Define core transportation operations functions for use in this project. For each core function, describe key generic positions in transportation agencies and describe core competencies for those positions. Also describe positions and core competencies for operations management positions.

In order to accomplish the required results for Task 1, the UMD Team had several subtasks that were necessary. All of these subtasks are described below.

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A. Create Project Advisory Committees (PACs) - From UMD's response to comments and proposed modifications for this project, it was stated that four project advisory committees (PACs) would be developed to define functions, positions, and knowledge needs (or competencies) for each of the core functions that would be used as the basis for future training. Based on the seven core functions, UMD combined them to create four PACs. A draft list of the PACs and potential members was sent to the project review panel on November 5, 2007. The final list of members that for each PAC are shown in Appendix E.

   The Four PACs included:

   - Policy & Strategic Considerations and Program Planning,
   - Systems Development and Project Management,
   - Real-time Operations and Real-time Traveler Information, and
   - Specific Technical Specialties (ITS User Services).

B. Define Draft Core Functions and Position Descriptions – In order for the UMD Team, with the assistance of the PACs, to be able to fill in the cells of the blank Operations Framework (see Appendix A), it was necessary to develop draft versions of the core functions and position descriptions that could be discussed by four project advisory committees (PACs). Draft versions of both were forwarded to the project review panel on November 5, 2007 for their review and final draft versions were sent to the PAC members in preparation for their meetings. The draft core functions sent out to the PACs are shown in Appendix B and the position descriptions are shown in Appendix C.

C. Coordinate and Participate in PAC Meetings – The PAC meetings were scheduled for the morning and afternoon of Tuesday, December 18 and Wednesday, December 19, 2007; four separate committee meetings were held. The purpose of these meetings was to refine the list of core functions, review and refine the position descriptions and fill in the competencies by position. A copy of the agenda for each meeting is shown in Appendix D. Prior to the meetings, the UMD team decided which cells of the framework (or matrix) that each PAC would need to complete. The competencies that were identified by each of the PACs are shown in Appendices F, G, and H.

TASK 2

Task Description:

> Review the literature and conduct telephone interviews with selected transportation agencies to determine training that is available for each position identified in Task 1. Submit a working paper summarizing the results of Tasks 1 and 2. The NCHRP will make this paper widely available and the contractor will keep it up-to-date based on comments received.

In order to accomplish the required results for Task 2, the UMD Team had several subtasks that were necessary. All of these subtasks are described below.

A. Compile Course Subject Matter – In order to conduct a search of the existing courses available, the UMD project team met several times via phone to refine the list of core competencies that were identified by the PACs. There were several core competencies that were missing, some that were duplicated and some were worded in such a way that it was impossible to search for existing courses on the topic. The group agreed upon the list of course subject matter that is shown in Appendix I. It should be noted by Real-time Traveler Information is listed under Real-time Operations. The UMD team is doing their course search based on the topics in that list.

B. Develop Access Database – An access database was created to house all the information the UMD team gathered on existing courses available for the competencies identified. The fields contained in the database are shown in Appendix J. For sorting purposes, each competency has a name and a corresponding ID code.

C. Search for Courses Available – The UMD team searched for existing courses available to address the identified competencies. The team found courses from the following types of sources: industry associations, federal government, universities, state departments of transportation, and private industry.

D. Populate Database - Once a course was found, all the relevant data was entered into the project database, including the course title, description, website, offeror, fees, CEUs, etc. Then, the competencies to which the subject matter of the course apply were identified. So far, there are almost 1,000 records in the database.

TASK 3

Task Description:

> Conduct a gap analysis to determine training efforts that are needed to improve skills within core functions, to improve leadership and communications skills, and to foster a broader understanding of systems operations and management. Identify gaps in available training.

In order to accomplish the required results for Task 3, the UMD Team had several subtasks that were necessary. All of these subtasks are described below.

A. Assign Levels of Training Required for Each Competency – UMD segmented the training required for each core competency into comprehensive, intermediate, and overview categories representing the importance of a particular subject to a specific job classification. This was necessary in order to match existing training courses to specific competencies since each existing course was assigned a field called "Level of Detail."

B. Develop Matrices of Existing Courses by Core Function and Competency – UMD developed a matrix of existing courses for each competency under the five core functions: Policy and Strategic Considerations (PSC), Program Planning (PP), Systems Development and Information Technology (SDIT), Project Management (PM), and Real-time Operations (RTO). Excel spreadsheets were developed for each Core Function and specific competencies within those core functions. Each spreadsheet contained three worksheets, one for each position type: Senior, Mid-level, and Technician. See Appendix M for a sample matrix developed.

C. Identify Gaps in Training – Using the matrices developed under B above, UMD was able to identify the gaps between existing training and the training needs. See Appendix L for the full Gap Analysis.

TASK 4

Task Description:

> Present creative and innovative concepts that support the advancement of operations in transportation agencies and are applicable to this project. These concepts could include a variety of delivery methods, messages, ways to improve awareness of training opportunities, and ways to facilitate shared use of training materials. Explore how these concepts could be expressed in the framework and implementation plan.

In order to accomplish the required results for Task 4, the UMD Team UMD researched a number of different types of training methods that could be used to effectively support operations and management training. A chart of eight different training methods was developed that provided the following: a definition of the training type, applicable categories of subject matter, students most likely to benefit, development and delivery costs, specialized skills required, and limitations. The results of this task are shown in Appendix N. This information will be used to prepare the recommended training packages under Task 6.

NEXT STEPS

This report represents the activities of Task 5. There is a conference call scheduled for October 8, 2008 to discuss Tasks 3 and 4 and also UMD moving to Task 6 before meeting face-to-face with the review committee. Following the call, UMD will make any edits to this report and/or the deliverable for Tasks 3 and 4. Following the October 8th call and with Review Committee approval, UMD plans to move forward with Task 6. This task consists of packaging the results of the previous tasks into programs that can be used by state and local agencies for the delivery of traffic management and operations training. Training packages will be defined for each cell of the matrix (see Appendix A) that contains a unique set of training requirements. Each training package will be comprehensively defined, to include all of the material required for the creation of a training program

APPENDIX A
BLANK OPERATIONS FRAMEWORK

CORE FUNCTIONS	POSITION						
	Senior Management		Mid-Level or Project Related (HQ or regional)			Technician/Field Personnel	
	Central Office Headquarters	Regional Management	Program Planning & Project Managers	Technical Specialists	Operations Managers	TMC (inside)	Field (Outside)
Policy and Strategic Considerations							
Program Planning							
Systems Development							
Project Management							
Real-time Operations							
Real-time Traveler Information							
Specific Technical Specialties (ITS user services)							

Note: *For each combination of core function and position there is a specific set of core competencies that are relevant, based on current best practices. The intersection of a core function (rows) and a role (column) defines a needed competency. Graphically speaking, each intersection "cell" in the matrix is a competency. Various roles require combinations of competencies. In addition, various functions require a combination of roles (positions).*

APPENDIX B

CORE FUNCTIONS

1. **Policy and Strategic Considerations**
   - Policy development
   - Strategic Planning
   - Performance Definition
2. **Program Planning**
   - Program definition, development & design
   - Budgeting
   - Organization & staffing
   - Data management & evaluation ConOps
   - PPP re operations & ETO
   - Interjurisdictional coordination & partnership development
   - Performance reporting
3. **Systems Development**
   - ConOps & architecture
   - Software development & systems integration
   - Information management
   - Hardware development (ITS, TMC & communications)
   - Procurement
   - Installation, construction supervision
4. **Project Management**
   - Coordination
   - Schedule
   - Budget
   - Rick Management
   - Procurement
   - Development oversight
   - Resource Management
   - Risk Management
5. **Real-time Operations**
   - TMC management & staff activities
   - Field Service Patrols
   - Incident Management, Field protocols & procedures
   - Safety
   - Maintenance
6. **Real Time Traveler Information**

7. Specific Technical Specialties (ITS User Services)

- Signals
- CVO
- Freeway Operations
- Architecture
- Standards
- Telecommunications
- Etc.

APPENDIX C

POSITION DESCRIPTIONS

Senior Management

Central Office/Headquarters – Top staff person with "Operations" in title. Division Chief for Operations (may report to Asst CEO for Operations and Maintenance or to CEO directly).

Broad responsibilities include all DOT policy and program activities focused on improving the efficiency, effectiveness and safety of the modal systems in light of both recurring and non-recurring congestion including congestion management, intelligent transportation systems (ITS), data management, traffic signals, and freight/people/good/services movement.

Develops, reviews, and evaluates proposed legislation and DOT (or Commission) polices pertaining to division activities. Responsible for representing SO&M in the overall statewide transportation policy, goals, objectives and strategy and for overseeing the conversion of SW policy into strategies appropriate to regions. Represents the DOT in discussions with the Administration and legislature regarding SO&M policy and resources. Represents the SO&M function in development of long-term and annual capital and Operating budgets, including staffing. Oversees the development of SO&M strategies and SO&M ;business plan including goals, standards, performance measures, programs and budgets for principal strategic initiatives such as IM, Freeway operations, traveler information and special initiatives. Monitor Regions and TMC compliance with central operations policies; evaluate and ensure the implementation of new work procedures, processes, products, equipment, and other actions that would improve the quality and efficiency of the division's programs.

Represents the operations perspective with other divisions in development of CWZM and winter management. Responsible for developing and maintaining formal relations and agreements with DOTs operational partners (PSAs and GPLG, MPOs and the private sector) at the state level and insuring related relationships are developed at the regional level. Develops and maintains appropriate organizational structure and staffing in C.O and insures appropriate staffing and training DOT-wide. Proposes and coordinate research which contributes to enhancing division's goals and objectives.

Regional Management – Top staff person with "Operations" in (may report to DE or to Asst DE for Operations and Maintenance).

Broad responsibilities include all Regional program activities focused on interpreting DOT operations policies in program terms as appropriate to the region. Represents the SO&M function in development of regional capital and Operating budgets, including staffing. Oversees the development of SO&M programs and projects including performance measures, programs and budgets for principal strategic initiatives. Accountable to C.O for compliance with central operations policies. Oversees project development and project management, including procurement, staffing and day to day operations -- work procedures, processes, products, equipment, and other actions that would improve the quality and efficiency of the region's operations programs.

Represents the operations perspective with other components of the Region in development of CWZM and winter management. Responsible for developing and maintaining formal relations and agreements with DOTs regional partners (PSAs and GPLG, MPOs and the private sector). Develops and maintains appropriate organizational structure and staffing and insures appropriate training DOT-wide.

Mid-Level or Project Related (HQ or regional)

Program Planning & Project Managers – Program Planning and Project Managers focus on M&O core functions related to, respectively, planning from a program-wide perspective or project (initiative) specific perspective. Program Planning Managers are responsible for developing M&O strategic and/or business plans including programmatic level budgeting, budget tracking, scheduling, resource management, performance tracking, and administration. Project Managers perform project specific management of M&O initiatives including budget development and tracking, scheduling, staffing, project performance monitoring, contract administration and sign-off of project deliverables. Program Planning and Project Managers generally are supervisory positions.

Technical Specialists – Technical Specialists use in-depth knowledge and skills to provide effective (sometimes innovative) problem-solving techniques within a specific core function of management and operations. Because of their particular expertise, a technical specialist may also conduct training. This type of position is generally non-supervisory and provides technical support to Program Planning and Project Managers as well as Operations Managers.

Operations Managers – An operations manager is responsible for managing transportation management center or field operations (sometimes both). Operations managers are experienced in M&O core functions relative to addressing recurring and non-recurring congestion from either a center or field perspective (sometimes both). Responsibilities include budget development and tracking, resource (staffing, equipment) management, performance monitoring, developing and administering standard operating procedures, and developing and maintaining interagency/discipline relationships. Operations managers may also perform TMC (inside) and Field (outside) functions (see below). This is a supervisory position.

Technician / Field Personnel

TMC (inside) – A traffic management center technician operates center based control software and communications systems for M&O core functions relative to addressing recurring and non-recurring congestion. Responsibilities include identify transportation system problems, dispatching field personnel, participating in management of transportation incidents, and conducting transportation studies and analyses. This could be a supervisory or non-supervisory position.

Field (outside) – Field personnel operate service patrol units for M&O core functions relative to addressing non-recurring congestion. Responsibilities include motorist assistance services, vehicle removal/relocation, setting up temporary traffic control, and participating in multi-agency/discipline response to transportation incidents. This could be a supervisory or non-supervisory position.

APPENDIX D

PROJECT ADVISORY COMMITTEE (PAC) MEETING AGENDA

TUESDAY, DECEMBER 18, 2007 OR WEDNESDAY, DECEMBER 19, 2007

9:00 AM – 12:00 PM OR 1:00 – 4:00 PM

9:00 AM Welcome and Introductions

9:05 AM Purpose of the Project and Objectives of the Meeting

9:20 AM Description of Operations Framework

9:30 AM Accuracy of Core Functions Identified

- Do the bullets under the core functions of Policy and Strategic Considerations and Program Planning accurately reflect the activities of those functions?
- Should anything be added or subtracted?

10:00 AM Accuracy of Position Descriptions

- Are the two position descriptions under Senior Management accurate? Central Office Headquarters and Regional Management
- Should anything be added or deleted?

10:30 AM Discussion of Required Competencies

- This group will identify competencies for the core functions of:
  Policy and Strategic Considerations
  Program Planning
- The focus will be on positions under Senior Management. If time allows, we will identify competencies for positions under Mid-Level or Project Related if applicable.

11:45 AM Next Steps and Wrap Up

12:00 PM Adjourn

APPENDIX E

PROJECT ADVISORY COMMITTEE (PAC) MEMBERS

The members of each of the four PACs are shown in the table below:

Member	Agency/Organization
PAC 1 – Policy & Strategic Considerations and Program Planning	
Kathleen Frankle	University of MD
Regina McElroy	FHWA
Bob Pento	Pennsylvania DOT
George Schoener	I-95 Corridor Coalition
Eileen Singleton	Baltimore Metropolitan Counsel
Dick Steeg	Virginia DOT
Phil Tarnoff	University of MD
John Wolf	CalTrans
PAC 2 – Systems Development and Project Management	
Rick Dye	Maryland SHA
Leslie Fowler	Kansas DOT
Kathleen Frankle	University of MD
Tom Jacobs	University of MD
Chris Hill	Mixon/Hill
Shari Hilliard	Kansas DOT
Paul Olson	FHWA
Tom Phillips	Virginia DOT
Phil Tarnoff	University of MD
Mike Weaver	Pennsylvania DOT
PAC 3 – Real-time Operations and Real-time Traveler Information	
Tom Batz	TRANSCOM
Scott Cowherd	Virginia DOT
Leslie Fowler	Kansas DOT
Kathleen Frankle	University of MD
Shari Hilliard	Kansas DOT
Tom Jacobs	University of MD
Todd Kell	PBS&J
Chris Leight	Montgomery County TMC
Ling Li	Virginia DOT
Alvin Marquess	Maryland SHA
Doug Noble	ITE
John Riehl	Montgomery County TMC
Phil Tarnoff	University of MD
Greg Windham	Montgomery County TMC
PAC 4 – Specific Technical Specialties (ITS User Services)	
Steve Cummins	Lexington
Richard Easley	E-Squared
Anne Ferro	Maryland Motor Truck Assoc.
Kathleen Frankle	University of MD
David Helman	FHWA
Tom Jacobs	University of MD
Bob Jordan	MD Transit Authority
Alvin Marquess	Maryland SHA
Michael Pack	UMD – Center for Advanced Transportation Technology

APPENDIX F

PAC #1 – COMPENTENCIES BY CORE FUNCTION AND POSITION

PAC 1 – Policy and Strategic Considerations and Program Planning

The first priority for this PAC was to define the detailed core functions of Policy and Strategic Considerations and Program Planning for Senior Management at the Central Office HQ and Regional Management levels. The PAC 1 meeting yielded the following detailed core functions:

CORE FUNCTIONS	POSITION	
	Senior Management – Priority #1	
	Central Office Headquarters	**Regional Management**
Policy and Strategic Considerations	Policy Development Operating Practices Standards Vision Development Strategic Thinking (focus and direction for vision) Performance Management (goals, objectives, scorecard Creative/Innovative Understanding Risk Management Business Process Management - Including Organizational Change Management Change Management Private Sector Relationships Interjurisdictional Coordination (Goals, etc.) Communications/Interpersonal Skills (dumb it down) Results Driven - Decision-Making with Limited/Incomplete Information Understanding of Organizational Culture Driving Change/Leading Change Coalition Building Outreach/Marketing Customer Service Consensus Building	Operating Practices Vision Development Think Strategically, Act Tactically Performance Management (goals, objectives, scorecard Creative/Innovative Understanding Risk Management Business Process Management - Including Organizational Change Management Change Management Interjurisdictional Coordination (Goals, etc.) Communications/Interpersonal Skills (dumb it down) Results Driven - Decision-Making with Limited/Incomplete Information Understanding of Organizational Culture Driving Change/Leading Change Coalition Building Outreach/Marketing Customer Service Consensus Building

Program Planning	Program definition, development & design Budgeting, Funding Administration Organization & staffing Data management & evaluation ConOps Performance Management (3 or 4 metrics) Knowledge of & how to work with the planning process - Including relationship to operations Coalition Building (eg. Coordination & partnerships) Link between operations & planning Impacts of Policy and Plans on Operations Linkage between politics and the planning process (Overcoming the Barriers, Influence Dynamics of Process)	Program definition, development & design Budgeting, Funding Administration Organization & staffing Data management & evaluation ConOps Performance Management (3 or 4 metrics) Knowledge of & how to work with the planning process - Including relationship to operations Coalition Building (eg. Coordination & partnerships) Link between operations & planning Impacts of Policy and Plans on Operations Linkage between politics and the planning process (Overcoming the Barriers, Influence Dynamics of Process)

APPENDIX G

PAC #2 – COMPENTENCIES BY CORE FUNCTION AND POSITION

PAC 2 – Systems Development & Project Planning

The top priority for the PAC 2 meeting was defining the detailed core functions of Systems Development and Project Management for Mid-Level or Project-Related (HQ or Regional) Management. The positions for which core functions were defined included Program Planning & Project Managers, Technical Specialists, and Operations Managers. The group also contributed to the detailed core functions of Systems Development and Project Management for Senior Management as they perceived them.

CORE FUNCTIONS	**POSITION**	
	Senior Management	
	Central Office Headquarters	**Regional Management**
Systems Development	Business Case (initiation) Cross Departmental Coordination Legislative/Budgetary Authorization Budget Allocation/Management	Business Case (initiation) Interdepartmental Coordination Budget Allocation/Management
Project Management	In-house/Outsourcing Performance Measures (Development and Operational) Policy, legal and institutional issues	In-house/Outsourcing Performance Measures (Development and Operational) Policy, legal and institutional issues

CORE FUNCTIONS	**Mid-Level or Project Related – Priority #1 (HQ or regional)**		
	Program Planning & Project Managers	**Technical Specialists**	**Operations Managers**
Systems Development	Business Case (PM Charter Document) Concept of Operations Planning Requirements Analysis Design Development Integration and Testing Implementation Operations and Maintenance Disposition (of old stuff)	Planning Requirements Analysis Design Development Integration and Testing Configuration Management	Concept of Operations Requirements Analysis Integration and Testing Implementation Operations and Maintenance

Project Management	Coordination Schedule Budget Procurement Development oversight Resource Management Risk Management Stakeholder Collaboration/Coordination Asset and Configuration Management Quality Assurance Performance Measures (Development and Operational) Contract Administration Policy, legal and institutional issues	Coordination Asset and Configuration Management Quality Assurance Performance Monitoring	Coordination (Internal/External) Human Resource Planning Resource Management Risk Management Operational Performance Measures Legal and institutional issues

APPENDIX H

PAC #3 – COMPENTENCIES BY CORE FUNCTION AND POSITION

PAC 3 – Real-time Operations and Real-time Traveler Information

Priority #1 for PAC 3 was defining the detailed core functions of Real-time Operations and Real-time Traveler Information for Mid-Level or Project-Related (HQ or Regional) Management. The positions for which core functions were defined included Program Planning & Project Managers, Technical Specialists, and Operations Managers.

Priority #2 for this group was to define the detailed core functions of Real-time Operations and Real-time Traveler Information for Technician/Field Personnel including TMC (inside) and Field (outside) personnel.

The PAC 3 meeting yielded the detailed core functions listed below for each position:

CORE FUNCTIONS	**POSITION**		
	Mid-Level or Project Related – Priority #1 (HQ or regional)		
	Program Planning & Project Managers	**Technical Specialists**	**Operations Managers**
Real-time Operations	Planning for Incident Management, Field protocols & procedures (FITM Plans) Safety Planning/Funding for Maintenance and Asset Management (devices, systems software, computers, telecommunications, life cycle) Work Zone /Traffic Control Planning/Funding Customer Service Planning - Interjurisdictional Coordination NIMS/ICS (Incident Command System) – a requirement Contract Administration Traffic Engineering Principles Plan Review of construction documents for operations considerations (public & private) Security – critical infrastructure Legal and Institutional issues	Safety Maintenance (asset management, devices, systems software, computers, telecommunications, life cycle) IT Hardware/Software Work Zone /Traffic Control NIMS/ICS (Incident Command System) Statistical Analysis Traffic Engineering Signal Timing ITS Devices – CCTV (installation, policy on use)/DMS/HAR/Meters/Detectors Plan Review of construction documents for operations considerations (public & private) Security – critical infrastructure	TMC management & staff activities Field Service Patrols Implementation of Incident Management, Field protocols & procedures (FITM Plans) Safety (incident scene, TMC, coop planning) Work Zone /Traffic Control Budget Control Contract Administration Implementation - Interjurisdictional Coordination NIMS/ICS (Incident Command System) Situational Analysis - Interpretation Traffic Engineering Principles Signal Timing Legal and Institutional Issues Special Event Management

Real-time Traveler Information	Continuity of Operations 511(Real Time) Travel Times Private Sector Agreements (exclusivity rights) Data Performance Measures Funding – Resources ? Customer Service – Public Relations - Marketing Legal and Institutional Issues Strategic Development	Continuity of Operations 511(Real Time) Archived Data Travel Times Devices/Media to convey Info – Distribution Channels Data Performance Measures Marketing	Continuity of Operations Media Coordination Distribution Devices Planned Events – Scheduled Incident Travel Times Data Performance Measures Coordination Public Relations

CORE FUNCTIONS	**POSITION**	
	Technician/Field Personnel – Priority #2	
	TMC (inside)	**Field (Outside)**
Real-time Operations	Situational Analysis - Interpretation Traffic Engineering Use of ITS Devices/Tools/Applications Customer Service Relationship Building Follow Standard Operating Procedures (SOP) NIMS/ICS Hazmat Awareness Computer Skills Map Reading Skills Communications/Radio Etiquette Departmental Knowledge (who to call) Knowledge of MUTCD Security – critical infrastructure System Troubleshooting Special Event Management Crisis Management Dedication – willing to go the extra mile	Work Zone /Traffic Control Incident Traffic Control Situational Analysis - Interpretation Customer Service NIMS/ICS Quick Clearance Techniques Hazmat Awareness Computer Skills Communications/Radio Etiquette Relationship Building Multiagency Coordination First Aid/CPR Blood Borne Pathogen Training Knowledge of MUTCD Inspections - construction Security Portable device deployment/programming/trouble shooting
Real-time Traveler Information	Media Coordination Distribution Devices Software for Controlling DMS Travel Times Reliability – clear and concise Devices/Media to convey Info – Distribution Channels Public Affairs Coordination (SOP)	Travel Times Reliability Public Relations

APPENDIX I

COURSE SUBJECT MATTER

1. Policy and Strategic Considerations (PSC)

A. Policy Development

- Strategy Development (mission, vision, strategy objectives)
- Public/Decisionmaker/Stakeholder Outreach

B. Organizational Change Management

2. Program Planning (PP)

A. Business Process Management
- Program definition, Concepts of operation (Conops)
- Data management & evaluation
- Performance management, accountability
- Performance measurement, dashboards, reporting (3 or 4 metrics)
- Partnership development (Interjurisdictional coordination [goals, etc], coalition building [coordination & partnerships)
- In-house vs. outsourcing

B. Partnerships
- Public-public partnerships (definition and examples, managing/coordinating, outreach/marketing, consensus-building)
- Public-private partnerships (types of partnerships, managing/coordinating) outreach/marketing, consensus-building)

C. Organization & Staffing
- Organizational architecture (cross-departmental coordination)
- Staff development (core capacities: recruiting, training, job specifications)
- Staff management (incentives, performance monitoring, innovation, …)

D. Link between Operations and Planning
- Integrating operations into the planning process
  - Impacts of policy and plans on ops
  - Linkage between political process and the planning process
  - Overcoming barriers, influence, dynamics of process
  - Knowledge of and how to work with the planning process
  - Planning Interjurisdictional coordination
- Transportation Modeling/Simulation – operations planning emphasis

3. Systems Development/Information Technology for ITS and Operations (SDIT)

- Systems Engineering process/methods
- Systems Architecture
- Database Management for Ops (including real-time data)
- Programming languages and technologies (web apps, etc.)
- Visualization (off-line and online)
- Network Security

4. Project Management (PM)

- Contract management (types)
- Outsourcing contract management
- Procurement
- In-house project management
  - Legislative/budgetary authorization
  - Budget allocation/management
  - Policy, legal, institutional issues
  - Interdepartmental coordination

- Risk Management

5. Real-time Operations (RTO)

A. Operations Strategies
- Planning for Incident Management, field protocols and procedures (FITM Plans)
  - Implementation of Incident Management, Field Protocols and Procedures (FITM plans)
  - NIMS/ICS (Incident Command System)
  - Required laws and regulations
  - Interagency agreements (with PSAs)
  - Field service patrols
  - Agreements and memoranda of understanding (towing, law enforcement, other agencies, etc.
- Work Zone/Traffic Control
- Ramp metering
- Road weather management
- Freeway management and operations
- Arterial operations
- Active traffic management (speed and flow control)
- Transportation Modeling/Simulation (operations emphasis)
- Value (Congestion) Pricing Strategies
- TMC Development (staffing, technology, relationships)
- Real-time Traveler Information
  - Media Coordination (devices/media to convey info – distribution channels)
  - 511 (devices/media to convey info – distribution channels)
  - Distribution devices
  - Coordination
  - Travel Times (including 511)
- Archived Data
- Special Event Management (planned events)
- Traffic Signal Systems
  - Signal Timing
- Traffic Engineering

B. Systems and Technologies
- Traffic Monitoring/Surveillance (detectors, probes)
  Data characteristics (volume, speed, occupancy, travel time, latency, accuracy, etc.)
- Telecommunications (voice, data, wireless, video, process vs. devices, media, protocols)
- ITS Devices
  - CCTV (installation, policy on use)
  - DMS
  - HAR
  - Meters
  - Detectors
  - RWIS
- Planning/Funding for Maintenance and Asset Mgmt
  - Devices
  - Systems software
  - Computers
  - Telecommunications
  - Life cycle
- Electronic Payment Systems
  - Electronic Toll Collection (ETC) Systems
- Automatic Vehicle Location/Identification (AVL/AVI)
  - License plate recognition/reader systems
- Parking Management Systems
- Commercial Vehicle Systems and Technologies

- Electronic Clearance
- Roadside Safety Inspections
- Administrative Processes (e-credentialing)
- Truck parking

C. Safety
- Road Safety Audits
- Automated Enforcement (red-light running)

D. Security
- Emergency Mgmt Procedures
- Evacuation Planning and Tools
- Critical infrastructure
- Continuity of Operations

E. Management of RTO Systems
- Customer Service
- Plan Review of Construction Documents for Ops Considerations (pubic and private)
- Legal and Institutional Issues
- Funding-Resources

APPENDIX J

FIELDS IN THE ACCESS DATABASE

- CourseID
- CourseName
- Provider
- Content
- Level of Detail
- Duration
- Presentation
- Website (URL)
- Restrictions
- Location
- Frequency
- CEUs
- Competency ID
- Competency Name
- Audience
- Contact(s)

APPENDIX K

SAMPLE RECORD IN THE ACCESS DATABASE

Course Name	ITS Telecommunications Overview (FHWA-NHI-137005)
Provider	National Highway Institute (NHI)
Content	This course provides a broad introduction to telecommunications technologies, the associated issues, and practical lessons learned in the applications for such technologies of intelligent transportation systems (ITS). It is part of the core ITS curriculum established by the ITS Professional Capacity Building (PCB) program.
Level of Detail	Overview
Duration	1 day
Presentation Style	Classroom
Website	http://www.nhi.fhwa.dot.gov/training/course_detail.aspx?num=FHWA-NHI-137005&cat=t&key=&num=137&loc=&sta=&tit=&typ=&lev=&ava=&str=&end=&drl=
Restrictions	20-student min/30-student max
Location	On-site
Frequency	Upon Request
CEU's	0.6
Fee	$200
Audience	Public and private sector transportation professionals, including project planners, engineers, managers, and senior technicians, involved in ITS transportation planning and ITS deployment, such as MPOs transit agencies, municipalities, State highway agencies, FHWA Division and Resource Center offices, FTA personnel, and systems integrators.
Contacts	William Cribbs, (703) 235-0526
Competency Type	RTO-ST-2 Telecommunications (voice, data, wireless, video, process vs. devices) RTO-ST-3 ITS Devices

APPENDIX L

GAP ANALYSIS

The gap analysis defines additional developments required for the assembly of a comprehensive curriculum. In this document, the results of Task 1, which identified individual knowledge requirements, were compared with the existing training that was gathered in Task 2. The difference between these two data sets represents the gaps in available training resources.

Available training is identified using a code that references the database of available training programs and courses. In addition, the training required in each category has been segmented into comprehensive, intermediate, and overview categories representing the importance of a particular subject to a specific job classification.

The set of matrices contained herein make for an ideal starting point for identifying gaps. The gaps are categorized according to (1) areas with NO available training, (2) areas with some available training, and (3) areas with available training that does not cover the subject adequately.

There are five Core Functions for which available training was researched:

- Policy and Strategic Considerations (PSC)
- Program Planning (PP)
- Systems Development and Information Technology (SDIT)
- Project Management (PM)
- Real-time Operations (RTO)

Under each Core Function, there is a set of core competencies. The attached matrices are arranged by core function and competency. The competencies for which no available training was found include:

- RTO-Operations Strategies-Real-time Traveler Information: Coordination (overview)
- RTO-Operations Strategies: Archived data (overview)
- RTO-Operations Strategies: Special event management (comprehensive)
- RTO-Systems Technologies: Electronic Payment Systems (overview)
- RTO-Management of RTO Systems: Plan Review of Construction Documents for Ops Considerations (overview)

The competencies for which very little training or inadequate/incomplete training is available include:

- PSC-Business Process Mgmt: Program definition, conops (intermediate, comprehensive)
- PSC-Business Process Mgmt: In-house vs. Outsourcing (overview, comprehensive)
- PSC-Business Process Mgmt: Performance measurement (comprehensive)
- PSC-Business Process Mgmt: Partnership development (overview, comprehensive)
- PSC-Organizational Change Management (intermediate, comprehensive)
- PP-Organizational architecture (intermediate)
- PP-Staff Development (intermediate)
- PM: Contract Management (overview)
- PM: Outsourcing Contract Management (overview)
- RTO-Operations Strategies: Road Weather Management (overview, intermediate)
- RTO-Operations Strategies: Value (Congestion) Pricing Strategies (overview, intermediate & comprehensive)
- RTO-Operations Strategies-Real-time Traveler Information (overview, intermediate, comprehensive)

- RTO-Operations Strategies-Real-time Traveler Information: 511 (overview, intermediate, comprehensive)
- RTO-Operations Strategies-Real-time Traveler Information: Distribution Devices (overview, intermediate, comprehensive)
- RTO-Operations Strategies-Real-time Traveler Information: Travel Times (overview)
- RTO-Operations Strategies-Real-time Traveler Information: Coordination (comprehensive)
- RTO-Operations Strategies: Ramp metering (overview, comprehensive)
- RTO-Operations Strategies: Arterial operations (intermediate)
- RTO-Operations Strategies: Active traffic management (intermediate)
- RTO-Operations Strategies: Archived data (intermediate, comprehensive)
- RTO-Operations Strategies: Special event management (intermediate)
- RTO-System Technologies: Planning/Funding for Maintenance and Asset Mgmt (overview, intermediate)
- RTO-System Technologies: Electronic Payment Systems (overview)
- RTO-System Technologies: AVL/AVI (overview)
- RTO-System Technologies: Parking Management (overview)
- RTO-System Technologies: CVO (overview, intermediate, comprehensive)
- RTO-System Technologies: Electronic Payment Systems (comprehensive)
- RTO-System Technologies: Traffic Monitoring & Surveillance (intermediate, comprehensive)
- RTO-System Technologies: Telecommunications (intermediate, comprehensive)
- RTO-System Technologies: Parking management systems (overview, intermediate comprehensive)
- RTO-Safety: Road Safety Audits (overview, intermediate)
- RTO-Safety: Automated Enforcement (overview, intermediate, comprehensive)
- RTO-Management of RTO Systems: Customer Service (overview)
- RTO-Management of RTO Systems: Legal and Institutional Issues (overview, comprehensive)
- RTO-Management of RTO Systems: Funding-Resources? (overview)
- RTO-Management of RTO Systems: Plan Review of Construction Documents for Ops Considerations (comprehensive)

APPENDIX M

SAMPLE MATRIX USED TO DEVELOP GAP ANALYSIS

Competencies	Position	
	Senior Management	
	Central Office Headquarters	Regional Management
PP-BPM-1: Program definition, concepts of operation (Conops) (4)	Course 297, 298 Introduction to Systems Engineering Course 299 Advanced Systems Engineering for Advanced Transportation Projects Course 339 Risk Management Course 439 Transportation Policy Planning Course 441 Urban Transportation Planning & Modeling Course 446 Transportation Policy and Environmental Limits Course 452 Logistical and Transportation Planning Methods Course 456 Transportation, Transit, and Land-Use Policy and Planning Course 462 Urban and Regional Transportation Planning Course 470 Urban Transportation Planning Course 675 Transportation II Course 676 Transportation Systems Management Course 817 Transportation Policy Course 819 Advanced Transportation Planning Course 820, 824, 837 Transportation Planning Course 821 Introduction to Metropolitan Transportation Planning Course 849 Effective Transportation Planning Practice in California Course 841 Advanced Transportation Planning Course 863 Leadership Skills for Planners Course 869 Road Ecology, Integrating Transportation and the Natural Environment	Course 297, 298 Introduction to Systems Engineering Course 299 Advanced Systems Engineering for Advanced Transportation Projects Course 339 Risk Management Course 439 Transportation Policy Planning Course 441 Urban Transportation Planning & Modeling Course 446 Transportation Policy and Environmental Limits Course 452 Logistical and Transportation Planning Methods Course 456 Transportation, Transit, and Land-Use Policy and Planning Course 462 Urban and Regional Transportation Planning Course 470 Urban Transportation Planning Course 675 Transportation II Course 676 Transportation Systems Management Course 817 Transportation Policy Course 819 Advanced Transportation Planning Course 820, 824, 837 Transportation Planning Course 841 Advanced Transportation Planning Course 849 Effective Transportation Planning Practice in California Course 869 Road Ecology, Integrating Transportation and the Natural Environment

APPENDIX N

INNOVATIVE CONCEPTS AND DELIVERY METHODS

Applicable Categories of Subject Matter	Students Most Likely To Benefit from Methodology	Development Costs	Cost of Delivery	Specialized Skills	Limitations
Live Topic Lecture (real-time interaction) *Description:* In-person lecture supported with PowerPoint presentation.					
Appropriate for all subject areas	Those who learn best in a structured, instructor/learner style environment. Students, employees or other affinity groups that are already geographically close and/or already using classrooms for related activities	In general, 35-40 hrs of development time translates into 1 hour of classroom time. ($$ to $$$)	Cost of delivery for the presenting organization includes salaries, classroom assignment/designation, books and other materials for distribution, etc. The presenting organization must either have classrooms of their own to use, lease classrooms, or offer on-site training or training close to client locations. ($$) Cost to students includes tuition, purchase of books and other materials, travel expenses and time away from work. ($ to $$)	Instructor must have good presentation, interpersonal and interaction skills	Limitations on class size will be dictated by classroom availability, size and location.
Online Distance Learning (limited interaction) *Description:* Course delivered completely by the Internet. Access to instructor via e-mail or online discussion forums only. Some contact with other students if discussion forum available. Taken at students' own pace.					
Appropriate for most subject areas, except those requiring hands-on activities.	Students most likely to benefit from online learning are independent learners, or	It is generally thought that 100-130 hours of development time results in 1 hour of	The cost of development for the presenting organization can be quite high. However, the	The presenting organization must either have web developers and instructional	There are usually very high or no limitations in terms of class size and no limitations on

	students who are geographically dispersed, or students who need to learn on schedules of their own choosing.	instructional time. This is considerably more than the development time (35-40 hours) for an hour of live topic lecture training. The benefit is the fact that more students will have access to the training (no geographical restrictions or travel required). ($$$ to $$$$)	development cost can be spread over a larger number of students since the course is available through the internet. The cost to students includes Internet access fees, tuition, and materials. ($)	designers on staff or outsource to a company specializing in web-based training development.	location. Students must have a computer and internet access to participate.
Blended Learning *Description*: Combination of online learning and live topic lecture and includes the best features of both. Students interact with the instructor and other students via live teleconference and/or discussion forums. Flexibility of reviewing online material at their own pace (within a specific time window), and delivery of exercises/workshops via discussion forums.					
Appropriate for all subject areas, including those requiring hands-on activities.	Most students would likely benefit from blended learning because this methodology combines the social benefits of live topic lecture with the individualized benefits of online learning.	It is generally thought that 100-130 hours of development time results in 1 hour of instructional time. This is considerably more than the development time (35-40 hours) for an hour of live topic lecture training. The benefit is the fact that more students will have access to the training (no geographical restrictions or travel required). ($$$ to $$$$)	It costs less to implement than 100% live topic lecture, provides greater flexibility and, because of the ability to access web-based courses for just-in-time learning, improves your retention and sustains your performance over a longer time period. ($-$$ if course already developed and only paying instructor). The cost to students includes Internet access fees, tuition, and materials. ($)	The presenting organization must either have web developers and instructional designers on staff or outsource to a company specializing in web-based training development.	There is a maximum number of students (40) per offering if there is to be true interaction between students and instructor. Students must have a computer and internet access to participate.
Real-time Live Participatory Workshops *Description*: Students attend at same location and are provided with problems to be solved either individually or, usually, as part of a group.					
Appropriate for subject areas in which hands-on	Workshop training is most appropriate for	Developing a workshop costs much less than	The costs associated with presenting a workshop		Based on the amount of interaction involved by

activities are essential.	group learning, especially where team ownership is essential and one plan amongst many must be established. Workshops allow the attendees to be exposed to constructive alternatives for doing the work. They also tend to get maximum participation from the attendees.	developing a full course. ($$ to $$$)	include travel expenses for the instructor(s), material production costs, facility rental, etc. ($$ to $$$) The costs for students are usually comparable to live topic lecture instruction. ($ to $$)		the participants, there are limitations to the number of students that can participate per offering. There are also limitations based on course location and participants required to make the workshop successful. Geographic location of potential audience Most are group-scheduled
Virtual Reality Participatory Workshops *Description*: Students are presented with computer-generated scenarios that represent realistic, life-like situations. They participate in the scenario(s) as a member of the team in the virtual reality environment.					
Virtual reality training is best suited, but not limited to, the incident and emergency management subject areas.	This is ideal training for first responders who can work together to clear a realistic display of an incident.	The costs associated with developing and delivering a virtual reality environment are extremely high and include, software development, hardware acquisition, facilities management, developer salaries, etc. ($$$$)	The cost to students varies according to the presenting organization. Some government-funded training is offered at low cost and some is even provided for no fee at all. ($)	The virtual reality development team must have advanced software programming and systems development skills.	To date, virtual reality systems require extremely expensive hardware and software and are confined mostly to research laboratories. Must be group-scheduled
Simulation-Based Task Training *Description*: A form of online training in which individual students are provided with displays similar to those they would use in the real world.					
Simulation-based training is most useful for training in the application of software products and systems	Students most likely to benefit from this type of training include TOC operators, and/or those requiring training in the	The development costs of this type of training are comparatively high, close to the costs associated with virtual	As with virtual reality training, the cost to students varies according to the presenting organization. Some	The development team for simulation-based training must have specific, advanced software programming	The most important limitation of this type of training is that simulation is extremely difficult because most

requiring user entry of data, such as TOC operator training, and/or training in the use of simulation and signal timing software.	use of simulation and signal timing software.	reality participatory workshops training development. ($$$$)	government-funded training is offered at low cost and some is even provided for no fee at all. ($ to $$)	and systems development skills.	natural phenomena are subject to an almost infinite number of influences.
Hardware/Software In-the-Loop Task Training Description: Integration of hardware and software into a system that can be used to train operators and technicians in the use of particular devices and systems.					
Hardware/software in-the-loop training is most useful in providing technician personnel with training in applications such as signal system maintenance and/or the entry of signal timing parameters into signal controllers.	Students most likely to benefit from this type of training include technical personnel for applications such as signal system maintenance and/or the entry of signal timing parameters into signal controllers.	Due to the inclusion of the "real" component, development of this type of training is extremely complex. In turn, the costs are comparatively high. ($$$$)	The cost to students is more difficult to measure. Since this type of training is so complex, it s usually government-funded. Therefore, the cost to students is mostly likely relatively low. ($ to $$)	It is a form of real-time simulation. Hardware/Software In-the-Loop differs from pure real-time simulation by the addition of a "real" component in the loop such as a traffic signal.	
Case Study Training *Description*: A critical analysis of the facilities and/or activities of existing organizations.					
A case study is most useful for reinforcing principles presented during live topic lectures or online study. Therefore, it is a supplemental, not a primary form of instruction. Any of the subject areas in question would benefit from case study presentation.	All students would likely benefit from case study presentation.	The costs of developing a case study are usually negligible compared to the other methods presented here. ($ to $$)	The costs associated with presenting a case study have to do with paying someone to do the research into the subject at hand and write the case study, producing the written document, and presenting it to students. There may also be trips to the location of the case study. If so, the costs would increase and there would be limitations in the availability of the case	The only specialized skills required for case study development presentation is expertise in the subject matter and "case" being studied.	Limitations may come into play if field trips are planned.

		study. ($$) The cost to students is relatively low. ($ to $$)		
Total Immersion Training *Description*: A relatively new phenomenon in the educational vernacular. This training method encourages deep mental involvement in a subject area and uses a mix of classroom instruction, workshops, and analysis of existing systems to ensure the retention of the principles being presented. There are usually opportunities to practice and internalize the principles learned, which is not possible in traditional classes and short courses.				
Can be appropriate for all subject areas, including those requiring hands-on activities.	This type of training can be useful, but perhaps not practical for all types of students, especially at the technician level. It is most often used in management and executive training areas.	The costs to develop and present such an experience fall somewhere in between the high-tech training methods (simulation, hardware/software in-the-loop, virtual reality) and the more traditional training methods (live topic lecture, online, workshops). ($$$) Since students reside on-site for one week or more, the cost to students is more than traditional live topic lecture training. Cost will vary based on the length pf the program. Travel costs are also required. ($$)	There are no specialized skills required, per se, but because this type of training usually involves a number of different topic areas, experts in those subject areas must be employed. Requires high level of logistical coordination for program coordinator(s).	The limitations center around securing a facility that is conducive to this type of training environment.

Key:

$ = Up to $1,000

$$ = Between $1,000 and $10,000

$$$ = Between $10,000 and $100,000

$$$$ = Over $100,000