Introduction to Integrated Corridor Management (ICM) Deployment Workshop
WELCOME!

Introduction to Integrated Corridor Management (ICM) Deployment Workshop
Housekeeping

Cell phones off/silent
No texting
Restrooms
Emergency exits
Breaks
Ending times
The “Parking Lot”

Topics to be discussed later will be **“parked”** for later discussion.
Will review at the end to make sure they were answered.
Overview

- ITS Professional Capacity Building (PCB)
- Introduction to Integration Corridor Management
- ICM Knowledge and Technology Transfer
- What’s next?
ITS Professional Capacity Building (PCB)
ITS Professional Capacity Building Program

Vision: To develop an ITS profession that leads the world in innovative use of ITS technologies

Learn More: http://www.its.dot.gov/icms/
PCB Strategic Goals

Goal 1: Professional Development – Equip current and emerging ITS professionals with the knowledge, skills, and abilities to plan, design, deploy, and operate ITS solutions.

Goal 2: Leadership Outreach – Develop a network of ITS Leaders who promote the value of ITS.

Goal 3: Knowledge Exchange – Facilitate the exchange of knowledge and innovative solutions among ITS professionals.

Goal 4: Technology Transfer – Accelerate technology transfer to bring ITS research and solutions to the user community.
### Professional Capacity Building – New Program Content by Tier

#### Tier 1: Emerging Technologies
- Connected Vehicle:
  - V2V
  - V2I
- Safety Pilot
- Real Time Data Capture & Mgmt.
- DMA
- AERIS
- Road Weather
- Technology
- Policy

#### Tier 2: Current Research
- Short-term Intermodal Research
- Research Initiatives
  - ICM
  - MSAA
  - Clarus
  - IVBSS
  - EFM
  - Smart Roadside

#### Tier 3: Existing Technologies
- Arterial Management
- Freeway Management
- Crash Prevention & Safety
- Road Weather Management
- Roadway Ops & Maintenance
- 9 others

#### Tier 4: Cross-Cutting
- Standards
- ITS Architecture
- Systems Engineering
- Telecommunications
- DSRC
- Data Collection & Mgmt.
- Security
- Data Communications

Summary

- Refocused program with new content for:
  - Connected Vehicle audience – course offerings in FY 2012
  - Inter-modal audience
  - Early Adopters
  - Students
- Full range of Knowledge and Technology Transfer strategies, not just training
- Collaboration with Research Managers is critical
- Strategic use of partnerships to reach new audiences
- Use of Innovative delivery mechanisms
- Continuing efforts to enhance professional development through foundational courses that use new media
- Employ technology transfer strategy throughout the research and development lifecycle
ICM Knowledge and Technology Transfer

Learn More: http://www.its.dot.gov/icms/
Your Instructors
Workshop Goal

Introduce audiences to Integrated Corridor Management (ICM) and to the ICM Knowledge and Technology Transfer experience and resources available.
Intended Audience

Transportation leaders at all levels, from a heterogeneous mix of backgrounds and organizations, interested to improve the transportation system and seeking to learn about how to implement Integrated Corridor Management (ICM)
Integrated Corridor Management Workshop

1. ICM Introduction
2. ICM Fundamentals
3. ICM Lifecycle
4. ICM Guidance
Let’s Get Started!
Lesson 1: Introduction to Integrated Corridor Management (ICM)
Upon completing this lesson, learners will be able to:

- Describe the purpose of Integrated Corridor Management (ICM)
- Explain the US DOT ICM Initiative
- Explain the fundamentals of ICM
The Reality:
Contributing Causes of Congestion

- Bottlenecks: 40%
- Traffic Incidents: 25%
- Work Zones: 10%
- Bad Weather: 15%
- Poor Signal Timing: 5%
- Special Events: 5%
The Reality:
Demand Is Greater than Supply

Public Road Mileage, Lane Miles, and VMT, 1980 - 2010

- Lane Miles
- Vehicle-Miles of Travel
- Public Road Mileage
The Reality:
Unreliability (variability) of travel
The Reality:
Increasing Delay for All

![Bar chart showing hours of delay per traveler by population area size and year]

- **Very Large**: more than 3 million
- **Large**: 1 million to 3 million
- **Medium**: 500,000 to 1 million
- **Small**: Less than 500,000

**Population Area Size**

- **Small**
- **Medium**
- **Large**
- **Very Large**

**Years**

- **1982**
- **1995**
- **2005**

**Hours of Delay per Traveler**

- **60**
- **50**
- **40**
- **30**
- **20**
- **10**
- **0**
The Reality:
Quality of Life Impact
The Reality:
Recent Headlines (2010 and 2011)


“Rebounding areas pay price in gridlock”
“New study estimates for first time the public health costs of traffic congestion in U.S.: At least 2,200 premature deaths and $17.8 Billion”
“Expect to spend more time in traffic this year.”
“Vehicle crashes cost region $11.3 billion annually”
The Problem:
Past Transportation Management practices

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<tbody>
<tr>
<td>Independent Operations</td>
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<tr>
<td>Re-active approach</td>
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<tr>
<td>Lack of modal and facility integration</td>
</tr>
<tr>
<td>Lack of stakeholder or customer integration</td>
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<tr>
<td>Limited actionable information</td>
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<tr>
<td>Limited ability to monitor and manage</td>
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<tr>
<td>Travel Reliability not a core objective</td>
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</table>
What is Operations?

• Influence travel demand (how much, when, where)
• Effectively manage traffic that results
• Anticipate and respond to planned and unplanned events
• Provide travelers with high quality traffic and weather information
• Ensure that the unique needs of the freight community are considered and included in all of the above
Why do we do Operations?

• To reduce / manage impacts of congestion
• To improve the safety of the highway system
• To keep people and commerce moving
  – *A healthy economy needs a reliable transportation system*
• To make more cost effective investment of limited resources
• To support a sustainable transportation system
• To improve quality of life
How is Operations done?

• Pro-active management
• Integration across system elements, jurisdictions, and modes
• State of the art technologies and strategies
• Measuring / monitoring performance
• Real-time and forecasted information
• Good analytical foundation / tools
• An organization and workforce capable of managing all of the above
Integrated Corridor Management
ICM Program Roadmap

Stakeholder working group

Phase 1 – Foundational Research

Phase 2 – Corridor tools, strategies and integration

Phase 2 Feedback:
Tool development, guidance, planning

ConOps & SyRS

Phase 3 – Pioneer Sites

Analysis, Modeling, and Simulation

Demonstration

Phase 3 - Evaluation

Pre-deployment | Post-

Phase 4: Knowledge and Technology Transfer

Awareness | Understanding | Equip practitioners | Long term

FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16

Learn More: http://www.its.dot.gov/icms/
ICM Pioneer Sites

Seattle

Minneapolis

Oakland

San Diego

Montgomery County

Dallas
San Antonio
Houston

Learn More: http://www.its.dot.gov/icms/
Integrated Corridor Management

Freeway Systems

Integrates Operations

Arterial Signal Systems

Freight & Service providers

Rail Systems

Parking Systems

Bus Systems

Learn More: http://www.its.dot.gov/icms/
Integrated Corridor Management

“ICM provides the opportunity to proactively improve and maximize the performance of the transportation system by serving as an alternate to traditional major infrastructure investments which may be more expensive or constrained by environmental issues.”

Alex Estrella, ICM Manager, San Diego Association of Governments

Learn More:  http://www.its.dot.gov/icms/
Basic ICM Concepts

• Corridor modes of operation
• Strategic areas for ICM
• Conceptual Levels within the corridor
• ICM environment
Operational Conditions

- Normal
- Planned Event
- Unplanned Event
- Transition
Integrated Corridor Management

MULTI-JURISDICTIONAL
MULTI-AGENCY
MULTI-USER
COMMON OBJECTIVES
MULT-MODAL
PRO-ACTIVE MANAGEMENT
JOINT RESPONSE

ONE SYSTEM

Learn More: http://www.its.dot.gov/icms/
Integration and Breakfast?
ICM Strategic Areas of Operation
ICM Approaches/Focus Areas

ICM

- Mode Shift
- Juncitons & Interfaces
- Information Distribution
- Route Shift
- Long Term Capacity/Demand
- Short Term Capacity/Demand
- Time Shift
ICM Operations

- ACTIONS
- DECISION SUPPORT
- INTEGRATED DATA
- JOINT OPERATIONS, RESPONSE & ACTION PLANS
- PROJECTS, STRATEGIES, TACTICS
- CORRIDOR NETWORKS: ROADWAY, TRANSIT, and FREIGHT

Learn More: http://www.its.dot.gov/icms/
ICM Pioneer Sites & Major Stages

Stage 1
Concept of operations and requirements
- Dallas, TX
- Houston, TX
- Minneapolis, MN
- Montgomery County, MD
- Oakland, CA
- San Antonio, TX
- San Diego, CA
- Seattle, WA

Stage 2
Analysis, modeling, and simulation
- Dallas, TX
- Minneapolis, MN
- San Diego, CA

Stage 3
Demonstration and evaluation
- Dallas, TX
- San Diego, CA

Learn More:  http://www.its.dot.gov/icms/
ICM Analysis, Modeling, and Simulation Sites

US-75, Dallas, TX

I-394, Minneapolis, MN

I-15, San Diego, CA

Learn More: http://www.its.dot.gov/icms/
ICM Demonstration Sites

I-15, San Diego, CA

US-75, Dallas, TX

Learn More:  http://www.its.dot.gov/icms/
ICM Program Roadmap

Stakeholder working group

- Phase 1 – Foundational Research
- Phase 2 – Corridor tools, strategies and integration
- Phase 2 Feedback: Tool development, guidance, planning
- Phase 3 – Pioneer Sites
  - ConOps & SyRS
  - Analysis, Modeling, and Simulation
  - Demonstration
  - Phase 3 - Evaluation
    - Pre-deployment
    - Post-
- Phase 4: Knowledge and Technology Transfer
  - Awareness
  - Understanding
  - Equip practitioners
  - Long term

Learn More: http://www.its.dot.gov/icms/
ICM Demonstration

<table>
<thead>
<tr>
<th>• Build ICM System</th>
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<tbody>
<tr>
<td>• Deploy supporting systems</td>
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<td>• Integrate data</td>
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<tr>
<td>• Develop joint operations plans</td>
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<tr>
<td>• Make data available</td>
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<td>• Operate Differently</td>
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ICM Evaluation

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<th>The Implementation of ICM will:</th>
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<tbody>
<tr>
<td>• Improve Situational Awareness</td>
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<td>• Enhance Response and Control</td>
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<td>• Better Inform Travelers</td>
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<tr>
<td>• Improve Corridor Performance</td>
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<tr>
<td>• Have Benefits Greater than Costs</td>
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<tr>
<td>• <em>Be enhanced through Decision Support Systems</em></td>
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The implementation of ICM will have a positive or no effect on:

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<td>• Air Quality</td>
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<tr>
<td>• Safety</td>
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ACTIVE or INTEGRATED or Both?

“ACTIVE”  “INTEGRATED”
Path to Desired End State – Pro-active

Traffic Management

Knowing

Guiding

Pro-Active

Predicting

Informing

Re-Active

Traffic Knowledge
Path to Desired End State - Integrated

- Independent
- Multipe
- Joint
- Integrated

Objectives/Response vs. Facilities/ Stakeholders
The ACTIVE and INTEGRATED Continuum

- Active, But Not Integrated
- Early in Active and/or Integrated Operations
- Integrated, But Not Active
- DESIRED END STATE: Active and Integrated

Learn More: http://www.its.dot.gov/icms/
ICM Program Roadmap

FY06  FY07  FY08  FY09  FY10  FY11  FY12  FY13  FY14  FY15  FY16

Stakeholder working group

- Phase 1 – Foundational Research
- Phase 2 – Corridor tools, strategies and integration
- Phase 2 Feedback: Tool development, guidance, planning
- ConOps & SyRS
  - Phase 3 – Pioneer Sites
    - Analysis, Modeling, and Simulation
    - Demonstration
    - Phase 3 - Evaluation
      - Pre-deployment
      - Post-
- Phase 4: Knowledge and Technology Transfer
  - Awareness
  - Understanding
  - Equip practitioners
  - Long term

Learn More:  http://www.its.dot.gov/icms/
Lesson 1 Review

- Describe the purpose of Integrated Corridor Management (ICM)
- Explain the US DOT ICM Initiative
- Explain the fundamentals of ICM
Activity 1: The Active and Integrated Scale: Where are you today?

Purpose: To help students understand the difference between what it means for corridor operations to be “active” and “integrated” and consider where their agency or a corridor in their region currently fits on the active-integrated scale.
The ACTIVE and INTEGRATED Continuum

- Active, But Not Integrated
- Early in Active and/or Integrated Operations
- Integrated, But Not Active
- DESIRED END STATE: Active and Integrated
Lesson 2:
Overview of Integrated Corridor Management (ICM) Lifecycle
Upon completing this lesson, learners will be able to:

- List the seven phases of the ICM Implementation process
- Describe the AMS worksteps
- Describe the ICM Implementation Guide
- Voice your biggest potential stumbling blocks to implementing ICM
7-Phase ICM Lifecycle

1. Get Started
2. Establish Goals

3. Plan for Success
   - 3.1 PMP
   - 3.2 SEMP
   - 3.3 Con Ops

4. Specify & Design
   - 4.1 Architecture
   - 4.2 Requirements
   - 4.3 Detailed Design

5. Build & Test

6. Operate & Maintain

7. Retire/Replace

Continuous Improvement (the “Virtuous Circle”)

Learn More: http://www.its.dot.gov/icms/
Analysis, Modeling and Simulation Worksteps

1. Develop Analysis Plan
2. Develop Data Collection Plan and Collect Data
3. Model Setup and Calibration
4. Alternatives Analysis and Documentation
5. Continuous Improvement

ICM AMS Approach Worksteps

Conduct Analysis Modeling & Simulation of ICM Strategies and Scenarios of Interest

Learn More:  http://www.its.dot.gov/icms/
Structure of the Implementation Guide

• Chapter 1: Introduction to the ICM Guide
• Chapter 2: Understanding Integrated Management of Transportation Corridors
• Chapter 3: ICM Implementation Guidance and Lessons Learned (7-Phase ICM Implementation Process)
• Appendix A: Conceptualizing Integrated Corridor Management
• Appendix B: Defining the ICMS Decision Support System
• Appendix C: ICM Walkthroughs
• Appendix D: List of Acronyms and Abbreviations
Manage for Quality

- Resources
- Highlights
- Questions to answer
- Lessons learned
- Pioneer site examples
Generic Structure Diagram
The ICM Implementation Guide will help you...

- Use the applicable steps and deliverables
- Focus on measures and benefits, including performance monitoring and performance management
- Understand ICM operations and maintenance (O&M)
- Adhere to existing FHWA/FTA rules, policy, and guidance
- Find other guidebooks for more detail
What Other Resources Are Available?

Guidance and Reports
- ICM Implementation and AMS Guides (for Managers)
- Evaluation Plans
- ICM AMS Methodology and Results Summaries

Example Documentation from the ICM Pioneer Sites
- Project Charters, MOU/MOAs, CONOPS, Requirements, AMS Plans and Results, System Design Documents and more

Outreach Materials
- Fact Sheets, Newsletters, Articles, Presentations, Information Briefs coming soon on ICM and related operations topics such as TIM, Freight, and ATDM

Systems Engineering Guidebook for Intelligent Transportation Systems, Version 3.0
Activity 2: Getting It All Out On the Table – Biggest ICM Questions

Purpose: To provide students with the opportunity to voice their biggest questions related to ICM or what they see as the biggest potential stumbling blocks to implementing ICM.
Lesson 2 Review:

- List the seven phases of the ICM Implementation process
- Describe the AMS worksteps
- Describe the ICM Implementation Guide
- Voice your biggest potential stumbling blocks to implementing ICM
Lesson 3:
Phase 1: Get Started
ICM Strategic Areas of Operation
ICM Environment

• Stakeholders
  – Stakeholder Communication
  – Stakeholder Coordination
• Integrated Corridor Management Systems
  – Operational Needs
  – Networks
  – Architecture
ICM Stakeholders

• Travelers and other transportation network users
• Government entities
• Transportation network operators and their staff
• Incident responders
• Emergency responders
• Commercial entities
• Private sector information providers
• Other service providers
ICM System

Integrated Corridor Management System (ICMS)

• An integrated corridor management system is a tool to help the corridor’s transportation network keep their networks operating at optimal levels.

• In discussing the ICMS, we will cover two major aspects:
  – Operational needs of an ICMS
  – System architecture for an ICMS (discuss later)
ICM System – Operational Needs

Operational needs are the highest level “requirements” or needs.
Examples are an attempt to abstract, needs for an ICMS.
- Need for active and passive communication with transportation network users
- Need to manage the supply of services to match demand
- Need to collect and process data in real-time or near real-time
- Need to monitor the effectiveness of control tactics implemented in the corridor
- Need for corridor performance measures
- Need for impact assessment tool
ICM System – Networks

• A corridor can have several types of networks.
  – Roadway networks – Freeways and Arterial
  – Transit networks - Bus, Heavy and Light Rail, and Commuter Rail
  – Freight networks – Long Haul and Short Haul trucks, Freight rail

• Optimal performance of the corridor must be considered when optimizing and managing the facilities

• Optimizing the corridor, however, requires the ability to collect, process, and evaluate the information from each of the individual networks in a consolidated fashion.
ICM Goals Objectives (examples)

1. Increase corridor throughput
2. Improve incident management
3. Ensure traveler safety
4. Enable inter-modal travel decisions.
5. Provide viable alternatives to road users
6. Keep travelers informed
7. Prevent catastrophic incidents that strand road users
8. Improve operational efficiency
9. Improve system productivity
10. Improve system and trip reliability
Phase 1: Get Started

Constraints
FHWA Final Rule
FTA Policy

Inputs
Regional ITS Architecture(s)
Proposed list of Stakeholders
Corridor Performance Data
Planning Model Forecast(s)

Activities
Foster Champions and Organize Stakeholders
Coordinate with Planning Process
Interface with the Regional ITS Architecture

Outputs
Approved Project Charter
Capabilities and Availability of the Agencies
Inventory of Corridor Resources

Enablers
Regional Operations Group(s)
Stakeholder Involvement

Learn More: http://www.its.dot.gov/icms/
Organize Stakeholders

Cast a wide net early in the process.

Inter-jurisdictional: DOT, MPO, Local
• Multimodal: Rail, Bus, Freeway, Arterial, Freight
• Public Safety Services: Police, Fire & Rescue, Safety Service Patrol
• Support Services: Parking, Traveler Information Systems/511 Providers, Commuter/Rideshare Organizations, Media

Who’s here today? Who’s missing from our group?
Organize Stakeholders

- Determine the **Lead Agency and Points of Contact (POCs)**
- Determine the **mission, activities, and operating procedures**
- Determine the **relationship with existing processes and groups**
Foster Champions

Good leadership includes imparting the vision of the project:

- Why it is needed?
- How it will help solve current problems?
- How it will benefit each of the stakeholder groups?
Dallas ICM Example: Get Started

- North Texas Council of Governments
- Regional Transportation Council
- ITS Steering Subcommittee
- US 75 Corridor Steering Subcommittee
- TxDOT
- City of Dallas
- City of Richardson
- City of Plano
- DART
- NTTA
- City of University Park
- Town of Highland Park
Activity 3: Ingredient List

Purpose: To draw on personal experience and learn from those of their peers to brainstorm ways to ensure effective stakeholder organization and engagement.
Approach to Planning for ICM

- Regional Goals
- Operations Objectives
- Performance Measures
- M&O Strategies
- Investment and Implementation
- Monitoring and Evaluation
Planning for Operations

New Publications

Operations Benefit/Cost Analysis Desk Reference

The Operations Benefit/Cost Analysis Desk Reference is intended to meet the needs of a wide range of practitioners looking to conduct benefit/cost analysis of operations strategies. The guidance provided in the Desk Reference includes basic background information on benefit/cost analysis, including basic terminology and concepts, intended to support the needs of practitioners just getting started with B/C analysis, who may be unfamiliar with the general process.

Creating an Effective Program to Advance Transportation System Management and Operations: Primer

The purpose of the Creating an Effective Program to Advance Transportation System Management and Operations (TSM&O) activities. The Primer provides high-level guidance focused on key program, process, and organizational capabilities that are essential to the development of more effective TSM&O strategy applications. It is aimed at program and activity-level managers responsible for TSM&O related activities in State, regional, and local transportation agencies.

Applying a Regional ITS Architecture to Support Planning for Operations: A Primer

Applying a Regional ITS Architecture to Support Planning for Operations: A Primer offers transportation planners and operations managers a menu of opportunities for applying the regional ITS architecture to enhance planning for operations.
ICM Planning Questions to Consider

• What data is available?
• What are the gaps, problems, and issues for region?
• What transportation corridors are best suited for ICM?
• What ICM strategies are available (or possible)?
• How can we effectively integrate ICM strategies?
• How can we define ICM program in terms of functional requirements and operations concepts?
Other Key Points to Consider

- Approved transportation planning process
- Leverage planning data
- Specify goals and objectives
- Incremental deployment of ICM
- Relationships to others
- Performance measures to track progress
- Regional ITS Architecture
Applying a 
REGIONAL ITS ARCHITECTURE 
TO SUPPORT PLANNING FOR OPERATIONS

A PRIMER

EXECUTIVE SUMMARY
1 CHAPTER 1: Introduction
1.1 The Motivation
1.2 How to Use This Primer
5 CHAPTER 2: Planning for Operations and Architecture – A Quick Tutorial
2.1 Operations and ITS – A Unified View
2.2 What is Planning for Operations?
2.3 What is a Regional ITS Architecture?
2.4 Making the Connections
21 CHAPTER 3: Opportunities for Architecture Use
3.1 Establishing Collaboration and Coordination
3.2 Developing Goals, Operations Objectives, and Performance Measures
3.3 Determining Operations Needs
3.4 Identifying, Evaluating, and Selecting M&O Strategies
3.5 Defining Programs and Projects
3.6 Selecting and Prioritizing Projects
3.7 Implementation and System Operations
3.8 Monitoring and Evaluation
49 CHAPTER 4: Creating a Planning-Supportive Architecture
4.1 Making the Architecture Connections to Planning Explicit
4.2 Keeping it Planner-Friendly
4.3 Adding the Planning Context – ITS/Operations Plans
4.4 Scheduling Updates to Optimize Use
67 CHAPTER 5: Your Action Plan for More Productive Architecture Use
5.1 Establish Support
5.2 Organizational readiness
5.3 Planning
5.4 Design
5.5 Adoption
5.6 Evaluation

Federal Highway Administration
Interface with Regional ITS Architecture

- Scope
- Stakeholders
- Roles and Responsibilities
- Interfaces
- Services
- Project Sequencing
- Agreements
Activity 4: List questions to answer as part of Get Started Phase

Purpose: To brainstorm what students think must be accomplished to start an ICM initiative.
Lesson 3 Review

- List fundamentals of ICM and an ICM System
- Describe factors to consider to foster champions and organize stakeholders
- List key points to consider in planning for ICM
- Explain how ICM relates to “planning for operations”
- Define a “Regional ITS Architecture”
Lesson 4:
Phase 2: Establish Goals
Upon completion of this lesson, the learners will be able to:

- Describe the purpose of the Concept Exploration Working Group
- List the factors that the Concept Exploration Working Group should consider when selecting a candidate corridor
- List four major strategic areas of ICM
- Describe factors to consider when assessing feasibility
- Explain the difference between systems engineering and systems integration

Learn More: http://www.its.dot.gov/icms/
Phase 2: Establish Goals

Inputs
- Approved Project Charter
- Capabilities and Availability of the Agencies
- Current Corridor Conditions
- Inventory of Corridor Resources
- Inventory of Available Corridor Data

Constraints
- Regional ITS Architectures
- System Access and Permissions Reports

Outputs
- Corridor Boundaries
- Project Needs Assessment
- Project Goals and Objectives
- Preliminary Project Constraints
- Feasibility Assessment
- Corridor Data Collection Needs
- Regional ITS Architecture Assessment
- Initial Stakeholder Agreements

Activities
- Explore the ICM Concept
- Develop Goals, Measureable Objectives, and Data Collection Needs
- Analyze System Problems and Identify System (User) Needs
- Conduct Feasibility Assessment
- Identify Development Support Resources

Enablers
- Concept Exploration Working Group
- Stakeholder Involvement

Learn More: http://www.its.dot.gov/icms/
Explore the ICM Concept

Establish an ICM Concept Exploration Working Group to:
1. Select and define a candidate corridor for ICM
2. Identify transportation problems/issues
3. Determine data needed to assess the potential impact (see *ICM AMS Guide*)
4. Review the Regional ITS Architecture
How ICM concepts address problems?
ICM Approaches/Focus Areas

- TIME SHIFT
- ROUTE SHIFT
- MODE SHIFT
- JUNCTIONS & INTERFACES
- INFORMATION DISTRIBUTION
- LONG TERM CAPACITY/DEMAND
- SHORT TERM CAPACITY/DEMAND
Should I Implement ICM?

- Increasing congestion and unreliable travel times?
- Existing infrastructure/systems that can be integrated?
- Infrastructure devices/systems provide real-time or near real-time data?
- Alternative routes/modes?
- Existing transportation systems fully optimized?
- Agency agreements to coordinate operations and management?
- All relevant agencies on board?
Example Goals

- Increase Corridor Throughput
- Improve accessibility to travel options and attain an enhanced level of mobility for corridor travelers.
- Employ an integrated approach through a corridor-wide perspective to resolve problems.
- Improve System and Travel Time Reliability
- Improve operational efficiency
- Improve system productivity
- Improve Incident Management
- Enable Intermodal Travel Decisions
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<tr>
<th>Goal</th>
<th>Stakeholder</th>
<th>Example Objectives</th>
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| Increase Corridor throughput| Transit     | • Increase transit mode share by X percent by year Y.  
• Increase transit mode share by X percent by year Y during peak periods. |
|                             | State DOT   | • Decrease the buffer index for (specific travel routes) by X percent over the next Y years.  
• Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.  
• Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y. |
|                             | State DOT/Freeway | • Reduce the daily hours of recurring congestion on major freeways from X to Y by year Z. |
|                             | State DOT/Arterial | • Reduce the share of major intersections operating at LOS Z by X percent  
• by year Y. |
# Activity 5 – Goals and Objectives

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<th>Stakeholder</th>
<th>Example Objectives</th>
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<td>State DOT</td>
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<td>State DOT/Freeway</td>
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<tr>
<td>State DOT/Arterial</td>
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Analyze System Problems and Identify System (User) Needs

- Gaps in the capabilities of the existing system
- New desired capabilities that the existing systems don’t satisfy
- Data collection capabilities required to support the measurement of objectives and goal attainment
- Upgrades desired in existing facilities/systems
ICM System

• Integrated Corridor Management System (ICMS)
• An integrated corridor management system is a tool to help the corridor’s transportation network keep their networks operating at optimal levels.
• In discussing the ICMS, we will cover two major aspects:
  – Operational needs of an ICMS
  – System architecture for an ICMS
ICM System – Operational Needs

Operational needs are the highest level “requirements” or needs.
The following examples are an attempt to abstract, at the highest level, the overall needs for an ICMS.

- Need for active and passive communication with transportation network users
- Need for transportation system operators and public safety organizations to coordinate
- Need to manage the supply of services to match demand
- Need to collect and process data in real-time or near real-time
- Need to monitor the effectiveness of control tactics implemented in the corridor
- Need for corridor performance measures
- Need for impact assessment tools
Conduct Feasibility Assessment

Feasibility is assessed in three ways:

1. Benefit that a capability will provide must eclipse the cost
2. Investment required must be within budgetary constraints
3. Investment has to be technically feasible
Engineering vs. Integration

System Engineering - *Designer*
System Integration - *Builder*
Activity 6: Case Study

Purpose: To develop a set of questions to determine whether a corridor is a viable candidate for ICM.
Lesson 4 Review

- Describe the purpose of the Concept Exploration Working Group
- List the factors that the Concept Exploration Working Group should consider when selecting a candidate corridor
- List four major strategic areas of ICM
- Describe factors to consider when assessing feasibility
- Explain the difference between systems engineering and systems integration
Lesson 5:
Plan for Success
Upon completing this lesson, learners will be able to:

- Describe the purpose of Project Management Plan
- Identify features of the PMP
- Describe the purpose of the System Engineering Management Plan
- Identify features of the SEMP
7-Phase ICM Lifecycle

1. Get Started
2. Establish Goals
3. Plan for Success
   - 3.1 PMP
   - 3.2 SEMP
   - 3.3 Con Ops
4. Specify & Design
   - 4.1 Architecture
   - 4.2 Requirements
   - 4.3 Detailed Design
5. Build & Test
6. Operate & Maintain
7. Retire/Replace

Continuous Improvement (the “Virtuous Circle”)

Learn More: http://www.its.dot.gov/icms/
Phase 3: PMP

Inputs
- Project Goals and Objectives
- Capabilities and Availability of the Agencies
- Feasibility Studies
- Analysis, Modeling, and Simulations
- Draft Data Sharing Agreements

Outputs
- Project Management Plan
- Assigned Roles and Responsibilities

Enablers
- PMP Development Team
- Stakeholder Involvement

PMP Activities
- Assess Project Management Activities
- Determine Roles and Responsibilities
- Initiate Procurement Discussions
- Prepare Project Management Plan and supporting plans (as needed)

Constraints
- MOUs
- Agency Agreements
- Applicable State, Local, and Federal Laws

Learn More: http://www.its.dot.gov/icms/
PMP Highlights

- Communication management;
- Change management;
- Quality management;
- Resource management;
- Cost and schedule management;
- Monitoring and control;
- Roles and responsibilities;
- Project organization chart; and
- Expertise/qualifications needed to complete the project.
Pioneer Site Example

Figure 10. Dallas ICM Example: Risk Management Process

- Start Risk Management Cycle
- Ad Hoc Risk Identified
- Identify Risks
  - Surface, list, and locate areas of potential risk
- Monitor & Control
  - Execute plans and correct deviations from risk mitigation activities
- Analyze & Quantify
  - Evaluate and convert risk data into decision-making information
- Communicate
- Plan
  - Develop/implement risk mitigation plan
- Prioritize
  - Rank risks
  - Top "N" Risk List
  - Watch List

[Source: Dallas ICM PMP, version 2.5, December 15, 2010, unpublished.]
Phase 3: SEMP

Inputs
- Project Goals and Objectives
- Capabilities and Availability of the Agencies
- Feasibility Studies
- Analysis, Modeling, and Simulations
- Draft Data Sharing Agreements

Constraints
- MOUs
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Outputs
- Project Management Plan
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- Assess Project Management Activities
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- Initiate Procurement Discussions
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Learn More: http://www.its.dot.gov/icms/
SEMP Highlights

- Task Identification
- Technical Planning and Control Processes
- Risk Management
- Engineering Program Integration
- Systems Engineering Process
- Specialty Engineering Plans and Procedures
- Configuration Management
- Performance monitoring
Activity 7

Discuss PMP and SEMP benefits and challenges?
Lesson 5 Review

- Describe the purpose of Project Management Plan
- Identify features of the PMP
- Describe the purpose of the System Engineering Management Plan
- Identify features of the SEMP
Lesson 6:
Concept of Operations, and
System Requirements
Upon completing this lesson, learners will be able to:

- Describe the purpose of the ConOps
- Describe system needs and provide examples
- Describe purpose of system architecture
- List types of inputs, processing, and outputs
- Describe the purpose of system requirements
- Provide characteristics of well-written requirements
7-Phase ICM Lifecycle

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Continuous Improvement (the “Virtuous Circle”)
Phase 3: ConOps

• Inputs
  - Project Goals and Objectives
  - Recommended System Concept
  - Preliminary Needs Assessment
  - Feasibility Assessment
  - Preliminary Project Constraints
  - Draft Interagency MOUs and Data Sharing Agreements
  - Draft Analysis, Modeling and Simulation report

• Outputs
  - Concept Selection
  - Concept of Operations

• ConOps Activities
  - Define/Refine Project Vision, Goals and Objectives
  - Explore Project Concepts
  - Develop Operational Scenarios
  - Develop and Document Project Concept of Operations
  - Define System Boundaries

• Enablers
  - ConOps Development Team
  - Stakeholder Involvement

Learn More: http://www.its.dot.gov/icms/
Concept of Operations

- Stakeholders vision and expectations
- Corridor problems and how they are addressed now
- Envision how problems can be resolved
- Identify and collect information
- Operational scenarios
- System (needs and functionality)
ICM Strategic Areas of Operation
ICM Stakeholders

- Travelers and other transportation network users
- Government entities
- Transportation network operators and their staff
- Incident responders
- Emergency responders
- Commercial entities
- Private sector information providers
- Other service providers
ICM Goals Objectives (examples)

1. Increase corridor throughput
2. Improve incident management
3. Ensure traveler safety
4. Enable inter-modal travel decisions.
5. Provide viable alternatives to road users
6. Keep travelers informed
7. Prevent catastrophic incidents that strand road users
8. Improve operational efficiency
9. Improve system productivity
10. Improve system and trip reliability
ICM System – Networks

- A corridor can have several types of networks.
  - Roadway networks – Freeways and Arterial
  - Transit networks - Bus, Heavy and Light Rail, and Commuter Rail
  - Freight networks – Long Haul and Short Haul trucks, Freight rail
- Optimal performance of the corridor must be considered when optimizing and managing the facilities
- Optimizing the corridor, however, requires the ability to collect, process, and evaluate the information from each of the individual networks in a consolidated fashion.
ICM System

• Integrated Corridor Management System (ICMS)
  • An integrated corridor management system is a tool to help the corridor’s transportation network keep their networks operating at optimal levels.
  • In discussing the ICMS, we will cover two major aspects:
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- Need to monitor the effectiveness of control tactics implemented in the corridor
- Need for corridor performance measures
- Need for impact assessment tools
“The ConOps is an essential tool for capturing corridor needs and translating them into system needs. This phase of the project should not be underestimated. A well-developed ConOps is key to successfully guiding system development and ensuring that project and stakeholder goals are met.”

Koorosh Olyai
Assistant Vice President
Mobility Programs Development
Dallas Area Rapid Transit
Activity 8 Discussion

- Concept of Operation discussion
Phase 3: Architecture

4.1 Architecture

Activities
- Develop, Decompose, and Evaluate Project Architecture Alternatives
- Identify and Evaluate Internal and External Interfaces
- Evaluate Industry Standards and Identify Standards Gaps
- Select and Document the High Level Design
- Perform Preliminary Design Review (PDR)
- Conduct a Traceability Review

Constraints
- PMP/SEMP
- ITS Standards
- Regional ITS Architecture

Inputs
- Concept Selection
- Concept of Operations
- Regional ITS Architecture Products
- System Requirements Iterations

Outputs
- High-Level Design (Project Architecture)
- Internal and External Interface Specifications
- Selected Industry Standards

Enablers
- Architecture Development Team
- Stakeholder Involvement

Learn More: http://www.its.dot.gov/icms/
Architecture Highlights

- Identify system constraints
- Consider requirements of the regional ITS architecture?
- Identify System boundaries
- Include the functionality and flows discussed in the ConOps?
- Is the logical architecture traceable?
- Traceability to a system output
ICM System – Architecture - Inputs

• There are six major types of inputs that an ICMS will use:
  – Continuous input data
  – Sample data
  – Continuous sample data
  – Analytical data
  – Geometric data
  – Geographic data
ICM System – Architecture - Processing

• Process lies at the heart of the ICMS.
• The types of processes that an ICMS contains include:
  – Demand volume processing
  – Travel time processing
  – Facility capacity usage
  – Predictive and/or forecasting
  – Decision support systems
  – Control
  – Archive
ICM System – Architecture - Outputs

• The outputs of an ICMS are all designed to be used to manage corridor networks.
• There are five major types of outputs:
  – Continuous output
  – Analytical output
    • Operational plans
    • Long-range plans
  – Event-driven response output
  – Automated feedback
  – Archived data
Activity 9

- Architecture discussion
Phase 3: Requirements

**Inputs**
- Concept Selection
- Concept of Operations
- Regional ITS Architecture Products
- System Architecture Iterations
- System Verification Plan
- Industry Standards

**Outputs**
- Requirements Specifications: System and Subsystems
- Requirements Traceability and Verification Matrix

**Constraints**
- PMP/SEMP
- ITS Standards
- External Interface Control Documents

**4.2 Requirements**

**Activities**
- Develop Requirements
- Write and Document Requirements
- Review for Completeness
- Analyze, Refine, and Decompose Requirements
- Manage Requirements
- Technical Reviews
- Perform Preliminary Design Review (PDR)

**Enablers**
- Requirements Development Team
- Stakeholder Involvement
Requirements lessons learned

- Keep requirements concise
- Action word definitions
- Compound requirements
- Avoid confusing terms
- System requirements focus
- Review user needs
Activity 10

- System Requirements discussion
Detailed Design
Build and Test

Inputs
- Detailed Design Document
- Component Design
- Detailed Design
- Selected COTS Products and Applications
- Component/Unit Verification Plans

Outputs
- Verified System
- Project Approval
- Operations Manual
- Maintenance Manual
- Training Manuals and Plans
- Trained Staff

Enablers
- Development & Implementation Team
- Stakeholder Involvement

Build and Test Activities
- Perform Component Development
- Purchase Commercial Off-The-Shelf (COTS) Products and Applications
- Integrate System Components, Products and Applications
- Conduct a Traceability Review
- Develop Operations, Maintenance, and Training Manuals and Plans
- Conduct Training

Constraints
- PMP/SEMP
- ITS Standards
- External & Internal Interface Control Documents

Learn More: http://www.its.dot.gov/icms/
Lesson 6 Review

- Describe the purpose of the ConOps
- Describe system needs and provide examples
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Closing
Resources and Next Steps
ICM Implementation Guide

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6. Operate & Maintain
7. Retire/Replace

Conduct Analysis Modeling & Simulation of ICM Strategies and Scenarios of Interest

Continuous Improvement (the “Virtuous Circle”)
Structure of the Implementation Guide

- Chapter 1: Introduction to the ICM Guide
- Chapter 2: Understanding Integrated Management of Transportation Corridors
- Chapter 3: ICM Implementation Guidance and Lessons Learned (7-Phase ICM Implementation Process)
- Appendix A: Conceptualizing Integrated Corridor Management
- Appendix B: Defining the ICMS Decision Support System
- Appendix C: ICM Walkthroughs
- Appendix D: List of Acronyms and Abbreviations
# ICM AMS Guide

<table>
<thead>
<tr>
<th>What?</th>
<th>• Step-by-step approach to implementation of ICM AMS methodology, with lessons learned from its application to three ICM Pioneer sites and a test corridor.</th>
</tr>
</thead>
</table>
| Who?  | • Technical and/or program managers who may oversee implementation of ICM and/or an ICM/AMS initiative.  
• Helpful reference for all stakeholders involved in AMS. |
| Why?  | • Help corridor stakeholders implement the ICM AMS methodology successfully and effectively |
Structure of the AMS Guide

Section 1.0 – Introduction and Background
Section 2.0 – Overview of Recommended Approach
Section 3.0 – AMS Worksteps (1-5)
Section 4.0 – Lessons-Learned
Appendix A – USDOT Guidance on Performance Measures
Appendix B – San Diego Data Collection Plan
Closing: What’s Next for My Corridor?
Activity 12: Next Steps—Moving Forward

Purpose: To develop actionable next steps students can take to advance ICM in their region.
ICM Technology Transfer

Guidance
- ICM Implementation Guide
- Analysis Modeling, and Simulation (AMS) Guide

Technical Support
- Short courses
- Technical development workshops

Resources
- Pioneer site CONOPs and Requirements Documents, and Lessons Learned
- AMS Reports
- Data Gap Technical Resources
- Demonstration site Design, Build, and Test reports

Learn More: http://www.its.dot.gov/icms/
Learn More

• Search it up:
  • “ICM, FHWA”, “ICM, JPO”, “ICM, ITS”

• Bookmark the ICM Knowledgebase -
  http://www.its.dot.gov/icms/knowledgebase.htm

• Sign up for the ICM Newsletter
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Final Thoughts