Lessons Learned, Benefits, and Strategies for Implementing ICM

ITS Canada Annual Meeting 2018
Niagara Falls
Tuesday June 19, 2018
Breakout Session T1 – Smart Cooperation ICM
What is Integrated Corridor Management (ICM)?
Coordinated Management and Operations

ICM is the coordination of individual transportation network operations of adjacent facilities across all government or other operations agencies that creates a unified, interconnected, and multimodal system capable of sharing cross-network travel management to safely and efficiently improve the movement of people and goods.
Approach to Integrated Corridor Management

- Manage a corridor as a multimodal system
- Make operational decisions for the benefit of the corridor as a whole.
  - Transportation corridors often contain underutilized capacity in the form of parallel roadways, single-occupant vehicles, and transit services.
  - Facilities and services on a corridor are often independently operated.

Growing congestion
High-volume corridors
High delay
Potential for integrated network cooperation to improve safety and mobility
Other alternative routes available for diversion
Multimodal capabilities

Source: FHWA-HOP-17-027
Viewing Assets through a Single Lens

Source: Federal Highway Administration
Sample Use Case – Major Freeway Incident Scenario

Source: I-210 Concept of Operations
Information Flow
Source: I-210 Concept of Operations
Lessons Learned

1. Integration and Capability Maturity
2. Planning for ICM
3. Performance Metrics
4. Technology Best Practices
5. Post-Deployment Maintenance, Evaluation, and System Enhancements
Lesson #1 - Three Degrees of Integration

Institutional

Coordination to collaboration between various agencies and jurisdictions that transcends institutional boundaries.

Operational

Multi-agency and cross-network operational strategies to manage the total capacity and demand of the corridor.

Technical

Sharing and distribution of information, and system operations and control functions to support the immediate analysis and response.
### ICM Capability Maturity Model

**Source:** ICM Scan Tour - NCHRP20-68A_12_02

<table>
<thead>
<tr>
<th><strong>Institutional Integration</strong></th>
<th><strong>Technical Integration</strong></th>
<th><strong>Operational Integration</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inter-agency Cooperation</strong></td>
<td><strong>Funding</strong></td>
<td><strong>Traveler Information</strong></td>
</tr>
<tr>
<td><strong>Level 1</strong> Silo</td>
<td><strong>Level 2</strong> Centralized</td>
<td><strong>Level 3</strong> Partially Integrated</td>
</tr>
<tr>
<td>Agencies do not coordinate their operations</td>
<td>Some agencies share data, but operate their networks independently</td>
<td>Agencies share data, and some cooperative responses are done</td>
</tr>
<tr>
<td><strong>Level 4</strong> Multimodal Integrated</td>
<td><strong>Level 5</strong> Multimodal Optimized</td>
<td></td>
</tr>
<tr>
<td>Agencies share data, and implement multi-modal incident response plans</td>
<td>Operations are centralized for the corridor with personnel operating the corridor cooperatively</td>
<td></td>
</tr>
<tr>
<td><strong>Level 2</strong> Centralized</td>
<td><strong>Level 3</strong> Partially Integrated</td>
<td></td>
</tr>
<tr>
<td>Single Agency</td>
<td>Coordinated funding through MPO</td>
<td></td>
</tr>
<tr>
<td>MPO tracks funding</td>
<td>Coopertively fund deployment projects</td>
<td></td>
</tr>
<tr>
<td><strong>Level 3</strong> Partially Integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static information on corridor travel modes</td>
<td>Static trip planning with limited real-time alerts</td>
<td></td>
</tr>
<tr>
<td>Multimodal trip planning and account based alerts</td>
<td>Location-based, on-journey multimodal information</td>
<td></td>
</tr>
<tr>
<td><strong>Level 4</strong> Multimodal Integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location-based, multimodal proactive routing</td>
<td><strong>Level 5</strong> Multimodal Optimized</td>
<td></td>
</tr>
<tr>
<td><strong>Level 1</strong> Silo</td>
<td><strong>Level 2</strong> Centralized</td>
<td><strong>Level 3</strong> Partially Integrated</td>
</tr>
<tr>
<td>Limited or Manual</td>
<td>Near real-time data for multiple modes</td>
<td>Integrated multi-modal data (one-way)</td>
</tr>
<tr>
<td>Near real-time data for multiple modes</td>
<td>Integrated multi-modal data (two-way)</td>
<td><strong>Level 4</strong> Multimodal Integrated</td>
</tr>
<tr>
<td><strong>Level 4</strong> Multimodal Integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-source multi-modal data integrated and fused for operations</td>
<td>Multi-modal performance measures in real-time</td>
<td></td>
</tr>
<tr>
<td><strong>Level 5</strong> Multimodal Optimized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual coordination of response</td>
<td>Pre-agreed incident response plans</td>
<td></td>
</tr>
<tr>
<td>Pre-agreed incident response plans</td>
<td>Model based selection of pre-agreed plans</td>
<td></td>
</tr>
<tr>
<td><strong>Level 4</strong> Multimodal Integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model based creation of incident response plans</td>
<td><strong>Level 5</strong> Multimodal Optimized</td>
<td></td>
</tr>
</tbody>
</table>
Lesson #2 – Proactive Planning for ICM

Stakeholder Collaboration and Concept of Operations

- Full commitment of regional partners and stakeholders
  - Project Champion and Project Leader
  - Identify critical resources
  - Prepare regional agreements and policies in advance
  - Agreement for long-term funding and O&M

- Systems Engineering-Centric Process
  - Analyze Issues to Identify Corridor Needs
  - Define Vision to Address Needs
  - Determine Goals to meet Vision
  - Develop Objectives based on Vision
Lesson #3 – Performance Driven Approach

- Define Performance Measures that are easily calculated
- Provide Success thresholds
- Revisit Performance Measures as system evolves

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Performance Measure Success Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time Index</td>
<td>Reduce Index by 2% per year</td>
</tr>
<tr>
<td>Corridor Throughput</td>
<td>Increase overall throughput – increase person/trips per hour by 2%</td>
</tr>
<tr>
<td>Clearance time for an Incident (based on Jurisdiction and Corridor)</td>
<td>Emergency Responder Training - 75% of agencies trained on Incident Management response.</td>
</tr>
<tr>
<td>Response time</td>
<td>Response to incidents - target is consistent response between jurisdictions (within 5 minutes)</td>
</tr>
<tr>
<td>Parking Lot Volume at Transit locations</td>
<td>Parking Lot Capacity – 90% utilization</td>
</tr>
<tr>
<td>Ridership per vehicle (Transit)</td>
<td>Increase of ridership – 2% (year to year increase)</td>
</tr>
<tr>
<td>Provide ATIS Information to public on incident</td>
<td>Information to Regional 511 System – 10 minutes of Incident entered into SmartNET</td>
</tr>
<tr>
<td>Public Perception</td>
<td>Public Perception – Awareness of ICM and perceived benefits (survey based)</td>
</tr>
<tr>
<td>ICM Response Plan deployment</td>
<td>ICM Response Plan activated - 95% of plans were deployed correctly</td>
</tr>
</tbody>
</table>
Lesson #4 – Open, Modular Architecture

Basic Components of an ICM
- Integrated Data Exchange
- Decision Support System
- Business Intelligence
- Forecasting & Prediction (Simulation)

Practical Considerations
- Standards-based data interfaces
- Open, modular architecture
- Extensible platform
Integrated Data Exchange (IDE) / Data Hub

- Open
  - Standards based
  - Enable center-to-center data exchange as well as open data portal for external users

- Secure
  - Access-controlled

- Managed
  - Requirements driven
  - Scalable to expand capacity over time

- Governed
  - Data governance
  - Cloud-based so it is easily accessible by all stakeholders
Select Performance Measures that are meaningful to your Operation and you have the Data.

Consider standard performance measures:

- **Travel Time Index** – The ratio of the actual travel rate to the ideal travel rate
- **Total Delay** – The excess travel used on a trip, facility, or freeway segment beyond what would occur under ideal conditions
- **Buffer Index** – The difference between the 95th percentile travel time and the average travel time, normalized by the average travel time
- **Planning Time Index** – The 95th percentile travel time
- **Number and duration of Incidents**
Decision Support System

Source: I-210 Concept of Operations
### Response Plans

#### Strategies

<table>
<thead>
<tr>
<th>Incident Type</th>
<th>No. Affected Lanes</th>
<th>Speed (m/s)</th>
<th>Queue Length (m)</th>
<th>Speed Frontage Road (m/s)</th>
<th>Speed Diversion Road (m/s)</th>
<th>Park &amp; Ride Utilization</th>
<th>Light Rail Transit Utilization</th>
<th>Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor Incident: Short Diversion to Frontage Road (FR)</td>
<td>≥ 1</td>
<td>&lt; 30</td>
<td>0.5 &lt; Q &lt; 1</td>
<td>&gt; 20</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Major Incident: Long Diversion to FR</td>
<td>≥ 1</td>
<td>&lt; 30</td>
<td>Q ≥ 1</td>
<td>&gt; 20</td>
<td>N/A</td>
<td>(1)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Major Incident: Diversion to FR and Greenville Avenue (GV), Transit</td>
<td>≥ 2</td>
<td>&lt; 30</td>
<td>Q ≥ 1</td>
<td>&lt; 26</td>
<td>&gt; 26</td>
<td>(1)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Major Incident: Diversion to FR and GV, Transit</td>
<td>≥ 2</td>
<td>&lt; 30</td>
<td>Q ≥ 1</td>
<td>&lt; 20</td>
<td>&gt; 26</td>
<td>(1)</td>
<td>&lt; 85%</td>
<td>&lt; 85%</td>
</tr>
<tr>
<td>Major Incident: Diversion to FR and GV, Transit</td>
<td>≥ 2</td>
<td>&lt; 30</td>
<td>Q ≥ 1</td>
<td>&lt; 20</td>
<td>&gt; 26</td>
<td>(1)</td>
<td>&gt; 85%</td>
<td>&gt; 85%</td>
</tr>
<tr>
<td>Return to Normal</td>
<td>&lt; 1</td>
<td>&gt; 30</td>
<td>Q ≤ 0.5</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

#### Integrated Corridor Management (ICM) Decision Support System (DSS)

**The Process**

- An incident occurs on US 75 and is entered into SmartNET by agency staff.
- SmartNET relays the incident information to DSS.
- DSS evaluates the incident and communicates alternatives using expert rules.
- DSS recommends solutions to multiple operating agencies.
- SmartNET reevaluates solution based on roadway conditions and incident status.

**The Benefits**

- Improved travel time reliability for commuters
- Enhanced decision making support for operating agencies
- Achieves a 20:1 return ($276.4 million) on the project's cost over 10 years

**Figure 10. Diagram. Decision support process used by Dallas Area Rapid Transit.**

(Source: Miller et al. 2015, Final Report-Dallas Integrated Corridor Management (ICM) Demonstration Project)
Analysis and Prediction

Predict near-term changes in traffic with and without response plans

Application
- Congestion monitoring
- Response plan selection
- Response plan evaluation

Techniques
- Simulation
- Machine Learning/AI
- Historical trend analysis
Lesson #5 – Post-Deployment Calibration

➢ System Verification:
  ▪ Verify requirements with acceptance testing

➢ System Validation
  ▪ Validate ConOps against real-world
  ▪ Soft Launch
ICM System Enhancements

- Assess and evaluate ICM against performance measures
- Continually seek to refine and expand the ICM
  - Geographic
  - Systems
  - Agencies
  - Applications
- Secure funding to support O&M
  - Adding new stakeholders
  - Incorporating new data
  - Calibrating the simulation and decision support system
  - Data mining and analytics
Summary

- ICM is a tool to facilitate cooperative, holistic traffic management
- Opportunities for small to medium regional areas, not just limited to large corridors
- Prioritize needs and implement incrementally
- Be driven by performance measures
- Obtain full commitment of regional partners and stakeholders.
- Design ICM outside of standard operational systems – it is a shared system
- Follow system engineering best practices
- Adhere to standards and best practices for open architecture
- Secure funding for Design/Build and O&M
Kapsch ICM Activities

➢ Consulting
  ▪ NCHRP ICM Scan
  ▪ FDOT D5 – Orlando Regional ICM System ConOps & Requirements
  ▪ Dallas ICM ConOps & Requirements
  ▪ Montgomery County MD ICM ConOps & Requirements
  ▪ Northern VA East-West Travel Shed ICM Planning Grant
  ▪ I95/395 ICM Implementation Plan

➢ System Design
  ▪ FDOT D5 – Orlando ICM DSS / Response Plan Development

➢ Systems Integrator
  ▪ Dallas ICM Demonstration Project
  ▪ MDX (Miami) Information Exchange Network
  ▪ NCTCOG Data Connectivity
Jeffrey Adler, PhD PE
VP, ITS & Solution Consulting

Kapsch TrafficCom North America

1390 Piccard Drive, Suite 200
Rockville, MD 20850
Phone: +1 571 225 2918    E-Mail: jeff.adler@kapsch.net

www.kapsch.net