Integrated Corridor Management

Joint ITE Workshop
San Juan Capistrano, CA
March 8, 2019

By Ellison Alegre, SANDAG
Integrated Corridor Management

- **2005**
  - I-15 Express Lanes Development (2003-2012)
  - IMTMS / RTMS / RAMS / A-PeMS / T-PeMS

- **Stage 1: ConOps & SysReqs**
- **Stage 2: Analysis, Modeling & Simulation**
- **Stage 3: Pilot Implementation**

- **Application & Award**

- **ICMS Operations**
ICM Program Evolution

San Diego, CA (I-15)
Oakland, CA
Minneapolis, MN
San Antonio, TX
Houston, TX
Dallas, TX (US 75)
Montgomery County, MD
Seattle, WA

Source: FHWA “Integrated Corridor Management” presentation
ICM In Review: Toolbox for managing transportation system

- Proactively Manage Congestion
- Provide Choices
- Maximize System Capacity
- Improve Coordination/Interoperability
- Manage and Operate Across Modes and Agencies

- **Commitment** - collaboration between various agencies, modes, and jurisdictions that transcends institutional boundaries
- **All inclusive customer focus** - Joint operational objectives and strategies to manage and balance the total capacity and demand of the corridor
- **Sharing and distribution** - of information and system operations control functions to support the analysis and immediate response
ICM Corridor

• Unique facility in the U.S.
• “Freeway within a freeway”
• 20 miles long
• 10 general purpose lanes
• 4 reconfigurable lanes with 16 miles of moveable barrier
• 20 CMS, 49 Way-Finding Signs, 220 signals, 35 ramp meters, 15 CCTVs
• Multiple entry/exit points and Direct Access Ramps
• Integrated with new BRT service
• Smart Parking
ICM is about management of a corridor. Management implies more than monitoring. Management implies planning for, and responding to, what is happening across all networks.
Project need: Institutional

Multiple Modes
Multiple Jurisdictions
Core Understanding Only
Lack of Operational Visibility
Limited Procedural Awareness
Desire to cooperate, but lacked vehicle
I-15 Integrated Corridor Management

Why ICM: Asset/Management System Rich *but* System Management and Operations Deficient

- Lacked decision quality
- Lacked procedural awareness
- Lacked repeatability
- Lacked standardized exchange
- Lacked knowledge of availability
- Lack of cross-boundary performance monitoring
- *Had desire to work and cooperate, but lacked vehicle*
What are I-15 ICM Strategies

- First to Implement Multi-Modal Active Traffic Management (ATM):
  - Active Decision Support System (First In Nation)
  - Coordinated congestion management
  - Freeway coordinated ramp metering
  - Actionable traveler information (en-route and pre-trip via changeable message signs (CMS), new 511 app, and other commercial sources)
  - Coordinated traffic signals with ramp meters (new traffic signal coordination timings, responsive traffic signal control)
  - Active arterial routing
  - Provides corridor awareness – Transit Operators
What are the ICM Management Assets:
What are the ICM Network Assets:

- Main Lanes
- Express Lanes
- DAR
- Transit
- Rapid Transit Station
- Arterial Network
What are the ICM Operational Assets:

**Traveler Information**
- No change
- Notify operators of event
- Notify public of event on freeway
- Notify public of event on arterial
- Direct traffic to use alternative routes
- Direct traffic to specific routes or transit usage

**Traffic Signal Timing**
- No action
- Inbound Shoulder
- Inbound Peak
- Inbound Step Up
- Inbound Flush
- Outbound Shoulder
- Outbound Peak
- Outbound Step Up
- Outbound Flush

**Ramp Metering**
- No action
- Meter Off
- Max
- Min

**Transit**
- No change
- Notify transit dispatcher of event
- Provide transit dispatcher w/recommended transit user message
- Provide dead-head re-routing recommendation
- Provide in-service re-routing recommendation
- Recommend deployment of stand-by transit vehicles

**Express Lanes**
- No change
- Open to all Vehicles
- Northbound 3
- Southbound 1
- Southbound 3
- Northbound 1
- Closed to vehicles (segment)
ICM DSS: How Does Work?

1. Inventory + Prediction
2. Business Rules Engine
3. Event Response Suite
4. Multi-level Analysis Tools Provide Comprehensive Insight
   - Regional patterns and mode shift, transit analysis capability
   - Traveler information, HOT lanes, congestion pricing and regional diversion patterns
   - Traffic control strategies such as ramp metering and arterial traffic signal control
5. Corridor MOE
   \{0.00, -13.28, 11.14, 1.19, 7.81, 2.2\}
6. Response Plan Sent to Field
I-15 Integrated Corridor Management

How Does ICM Work

Inventory + Prediction

Event Response Suite

Business Rules Engine

Corridor MOE

{0.00, -13.28, 11.14, 1.19, 7.81, 2.2}

Recommended Response Plan
### Proposed Change List

**Diversion**: Exit at Mira Mesa to Black Mountain South and re-enter at Kearny Villa on ramp.

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Current</th>
<th>Proposed</th>
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<tbody>
<tr>
<td>Caltrans.120</td>
<td>1-15 @ MIRA MESA BLVD</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>SanDiego.390</td>
<td>BLACK MTN @ KEARNY VILLA RD</td>
<td>Free</td>
<td>2A</td>
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<tr>
<td>SanDiego.389</td>
<td>BLACK MTN @ MAYA LINDA</td>
<td>1A</td>
<td>2A</td>
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<td>SanDiego.388</td>
<td>BLACK MTN @ CARROLL CYN</td>
<td>1A</td>
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<tr>
<td>SanDiego.387</td>
<td>BLACK MTN @ GOLD COAST</td>
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<td>SanDiego.439</td>
<td>BLACK MTN @ MIRAMAR COLLEGE DRWY</td>
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<tr>
<td>SanDiego.183</td>
<td>MIRA MESA @ WESTVIEW</td>
<td>Transition</td>
<td>1A</td>
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</table>

### Notes:

Data observed during response plan period, noted a decrease in travel time along freeway segment of approx. 45% when compared to a typical Thursday (27 vs. 39 minutes). Also observed an increase flow on particular arterial of approx. 950 vehicles during response period.
DSS Response Plans

- The DSS has the ability to recommend up to 15 response plans at any given time, giving operators more time to change any necessary field elements (e.g., implement recommended signal timing plans).

- 156 available routes for coordination
- 260 local arterial intersections
- 18 ramp metered interchanges
- 20 CMS

- 5 BRT stations
- 20 miles Express Lanes
- 30 miles traffic-responsive
- 511 message sets
- 14 available active arterial routes

= Billions of potential response plans
Vision to Implementation: Institutional

MOUs

Management Framework

Technical Memorandum


Stage 1

Stage 2

Stage 3

Deployment

Concept Development and Draft Reqs. – Partnership Commitment

Implementing Vision

Corridor Management and Operations in Practice

Beyond
I-15 Integrated Corridor Management

What is Happening Now

- **Operational review meetings**
  - Venue to check in and review system operations
  - Events and response plans occurring in past period
  - Performance statistics associated with events
  - Expectations regarding event identification and appropriate responses
  - Corridor configuration parameters (particularly congestion score, congestion event finder, congestion thresholds)

- Aim to foster an on-going process for discussing, reviewing, assessing, and ultimately modifying ICM system settings and response plans

<table>
<thead>
<tr>
<th>Stage</th>
<th>Date(s)</th>
<th>Meetings</th>
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<tbody>
<tr>
<td>1st Stage</td>
<td>2/4/2014, 6/30/2014</td>
<td>Weekly Meetings</td>
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<tr>
<td>2nd Stage</td>
<td>7/1/2014, 9/30/2014</td>
<td>Monthly Meetings</td>
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<tr>
<td>3rd Stage</td>
<td>10/1/2014, Ongoing</td>
<td>Quarterly Meetings</td>
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ICM Highlights: System Operations Continues

• Over 28K Response Plans
• Over 2 million Events
• Continued Work with I-15 ICM Team for ICM System Monitoring (System Performance and System Enhancements):
  – Established System Procedures for Major Event
  – Signal Subsystem Transition
  – Ramp Metering 2070 Firmware
  – DSS Modeling Upgrades
  – **Assessment of Corridor Score Algorithm** – Recently Implemented New Response Plan Triggering Threshold/MOE
  – On-going system maintenance
https://www.youtube.com/watch?v=CsA3OaHpND4
Performance Since ICM activation (April 2014- Feb 2019)

• System is triggered: 1-2 times a month
• Automatic adjustment of signals and ramp meters
• Decrease in travel times: 3-9%
• Increase in Travel Speed: 2-10%
• Diversion to the Arterials (passive): 9-20%
• Expect % Diversion to go up with Active Re-routing
On-Going/Next Steps ICM Efforts

- Continued Work with I-15 ICM Team for ICM System Monitoring (System Performance and System Enhancements) –
- Strategic Planning Efforts for future ICMs
- Development of Regional Transportation System Management and Operations (TMS&O) Strategy

Lessons Learned supported:
- Establishment of the I-15 Corridor Management Team (CMT)
- Completion of 805 ATDM Concept Optns.
- Initiation of 805 TSMO Plan - March
ICM: Toolbox for managing transportation system

- Proactively Manage Congestion
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Project Need: Technical integration

ICMS

- Ramp Meter Information System
- Freeway Mgmt System
- Regional Event Mgmt. System
- Congestion Pricing System
- Regional Transit Mgmt System
- Smart Parking System
- Network Prediction System
- Real-Time Simulation System
- Weather NWS
- Arterial Travel Time System
- Lane Closure System
- Regional Arterial Mgmt System
- 511

SANDAG
Project Need: Operational

**Demand**
- **Light**
  - Weekends
  - Holidays
- **Moderate**
  - Off-peak weekday
  - Minor weekend special event
- **Heavy**
  - Peak-hour weekday traffic

**Response Posture**

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<th>Conservative</th>
<th>Moderate</th>
<th>Aggressive</th>
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<tr>
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<td>Moderate</td>
<td>Aggressive</td>
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**Event Impact**

- **Low**
  - Incident closing freeway shoulder or one lane
  - Construction closing one lane of primary arterial
  - Breakdown of transit vehicle

- **Medium**
  - Incident closing 1 freeway lane
  - Closure of Express Lanes
  - Construction on Pomerado reducing NB and SB to one lane each direction

- **High**
  - Major incident at intersection of primary arterials
  - Closure of two or more lanes of the freeway
  - Combination of low and medium incidents
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ICM System Assets
Integrated Corridor Management Concept

1. Smart Intersections
2. Smart ramp motors
3. Real-time transit
4. Multi-modal transit station
5. Active arterial muting
6. Congestion pricing - managed lanes
7. Active traffic management
8. Dynamic parking management
9. Incident management
Vision To Implementation

- Propose who and what would be involved
- Discuss approach for responding to recurring & non-recurring congestion
- Identify performance measures for operations.
- Drive Common Operational Multi-Agency Philosophy
Vision to Implementation: Institutional

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Phase 2
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• Strategic Planning Efforts for future ICMs via ATDM Program
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Lessons Learned from I-15 ICM

Federal Pilot Project (2006-2013)

• Importance of Con Ops
  • Set expectations, vision, goals
  • Lack of set roadmap to take highly conceptual strategy to actual implementation

• Importance of “executive-level” project sponsor/champion
  • Focus on technical complexity and overall project implementation
  • Breaking new ground in multi-modal operations / Degree of uncertainly/learning as we go
Lessons Learned from I-15 ICM

ICMS Operations (2013-current)

• A LOT data / Data rich & Information Poor
• Continuous level of engagement with Caltrans and local agencies (Trust-building)
• ICM is about People, Processes and tools