Operational Management Environments

Improved Solution Architectures for Multimodal Integrated Corridor Management

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Mobility Management Must be Integrated and Multimodal
What is Integrated Corridor Management (ICM)?

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.
When is ICM Appropriate

> 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
  > Parallel roadways,
  > Single-occupant vehicles,
  > Transit services.

> Facilities and services on a corridor are often independently operated.

Source: FHWA-HOP-17-027
Regional Mobility Management – Operational Systems

- Bridge and Tunnel Safety
- Smart Parking
- Transit
- Managed Lanes
- Commercial Vehicle Enforcement
- Arterial Management
- Freeway Management
- Tolling
Three Degrees of Integrated Mobility Management

**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.
How to Optimally Architect ICM Solutions

> Basic Integration
  > Some agencies share data (one-way, maybe two-way)
  > Limited cooperative response

> Optimal Integration
  > Full cooperative operations across all stakeholders
  > Open modular architecture
    > Easy to add new stakeholder systems and data sources
    > Avoiding vendor lock
  > Unlocking the potential of the data
    > Multi-source, multi-modal data integrated and fused for operations
    > Apps to derive value from data integration
Operational Silos
Each agency uses individual operational system without integration

- Stakeholders
  - State DOT
  - Municipal Ops
  - Law Enforcement
  - Towing
  - Fire/Rescue

- Types of Systems
  - Freeway Management
  - Signal Management
  - Dispatch
  - Asset Management
  - Lack of Command and Control System
Parallel Access

Duplicate workstation for one agency is installed in other centers

- No operational logic shared between systems
- Classic Example: TMC has 911/CAD station

Advantages
- Stakeholders have direct access to partner operational system

Disadvantages
- Often read-only access
- May be path of least resistance for increasing situational awareness
- Requires operators to learn and/or monitor another system
- Systems are not integrated, cannot combine data
- Very expensive to have staff monitor external partner systems
Shared Data Layer
Multiple Systems have Access to Common Data Store

Data from operational systems are integrated in an external, shared data platform that all systems can access.

Advantages
- Allows more stakeholder systems to participate
- No one system is dominant

Disadvantages
- Not much help for those without operational systems
- Still requires work within each operational system to use data
- Purely data sharing – does not unlock potential of the data
- Does not ensure coordinated operations
Shared Operational Functions

Logic for Shared Operations is Built into one of the Existing Systems

> Dominant operations system that drives the integrations both institutionally and operationally

> Advantages
  > Some direct systems integration
  > Allows for complex processes based on information sharing

> Disadvantages
  > Not much help for those without ops
  > Raises stakes on vendor lock
  > Creates implicit cross-agency dependencies and hierarchies
  > Hard to maintain one-off integrations
  > Expensive to architect additional integrations

Conway’s Law:
"Any organization that designs a system will inevitably produce a design whose structure is a copy of the organization's communication structure."
Shared Situational Awareness Systems
Additional User Interface Presents Data from Multiple Systems

Shared data layer + common way to view the data (Common GUI)

Advantages
- Allows all system operators to have same situational awareness view of the region
- Delivers information (not just data)
- Delivers value to stakeholders without operational systems
- Improved coordinate operations

Disadvantages
- Typically a read only system
- May require operators to interact with yet another system
Operational Management Environment

Shared Operational Logic is a Distinct Component

- Creating a layer of services and application logic to drive value from the shared data layer
  - Supports modeling, analytics and forecasting
  - Decision support
  - Coordinated response
  - Operational GUI to support stakeholders without system

- Advantages
  - Put intelligent, shared functions in their own layer
  - OME interacts with existing operational systems
  - Operators do not need to work with new system
  - Reduces risk of vendor dependency
Connected Mobility Platform with OME Applications

- Microservice Architecture
- Typical OME Applications
  - Decision Support Systems
  - Response Orchestration
  - Advanced Analytics
  - Notifications/Messaging
  - Performance Measures
  - Reporting

- Unlock potential of data
- Leverage industry standards
- Support open data and app development
Case Study – Hybrid System
Statewide Incident Management System (RTIMIS Virginia)

What is RTIMIS
- Statewide incident management information system
- Available to range of TMC and Law Enforcement stakeholders
- Provided shared data source for ATMS and CAD/911 users

Lessons Learned
- Some Regional TMCs received notices and regional data back through their primary ATMS (OME approach)
  - Became primary source for incident detection
  - Provided great value
- PSAPs and some regional TMCs used the separate web GUI
  - Users felt it was not worth the trouble of accessing a separate system
California I-210 ICM Architecture

Umbrella System Independent of Existing Operational Systems

ICM Components separate from operational systems

Modular architecture to enable mixing and matching components from different suppliers

Approach

Data from management systems feed data hub

Stand-alone Decision Support System provides response planning for all management systems

CMS provides operational GUI and tools for cooperative transportation management

Operators will use CMS to view the response plans, vote on plans, device status, create arterial events, view event status, etc.
## Comparison of Architectural Approaches

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<th>Parallel Access</th>
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<td>Two-way exchange</td>
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<td>Single operational Interface to access all data</td>
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<td>Avoids vendor lock</td>
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<td>Supports Coordinated Operations</td>
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<td>Extensible/ Scalable</td>
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Summary

> Multimodal Regional management requires coordinated operations and integrated systems
> There are several solution architectures options

> OME + Microservices Architecture offers stronger opportunities to
  > Unlock potential of data
  > Encourage open data and application development
  > Ensure not tied to a single vendor
  > Foster collaboration between agencies
Thank you

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