

Decision Support Systems for Integrated Corridor Management

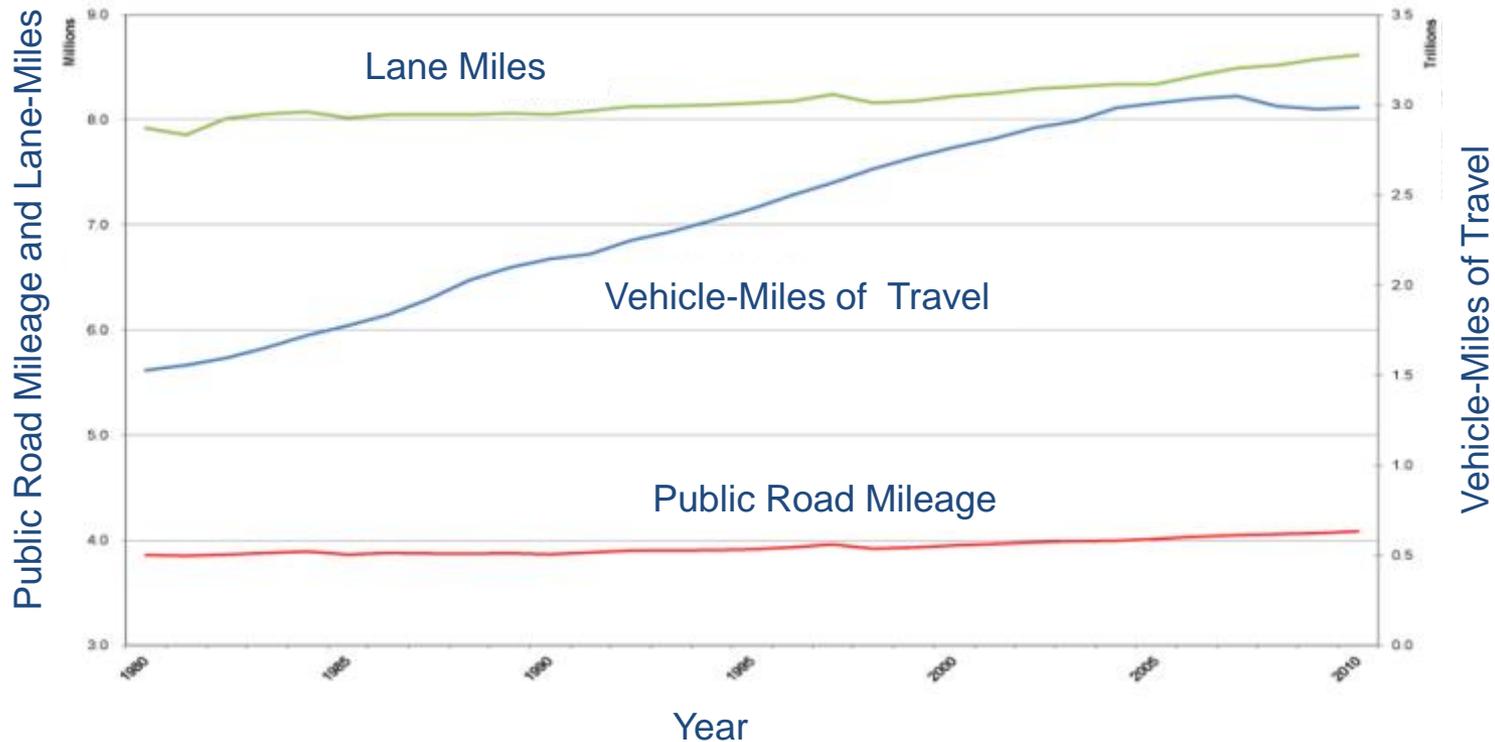
April 23, 2015

ICM Introduction

Robert Sheehan, ITS Joint Program Office

The Reality: Demand is Greater than Supply

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



The Reality: Operations Today:

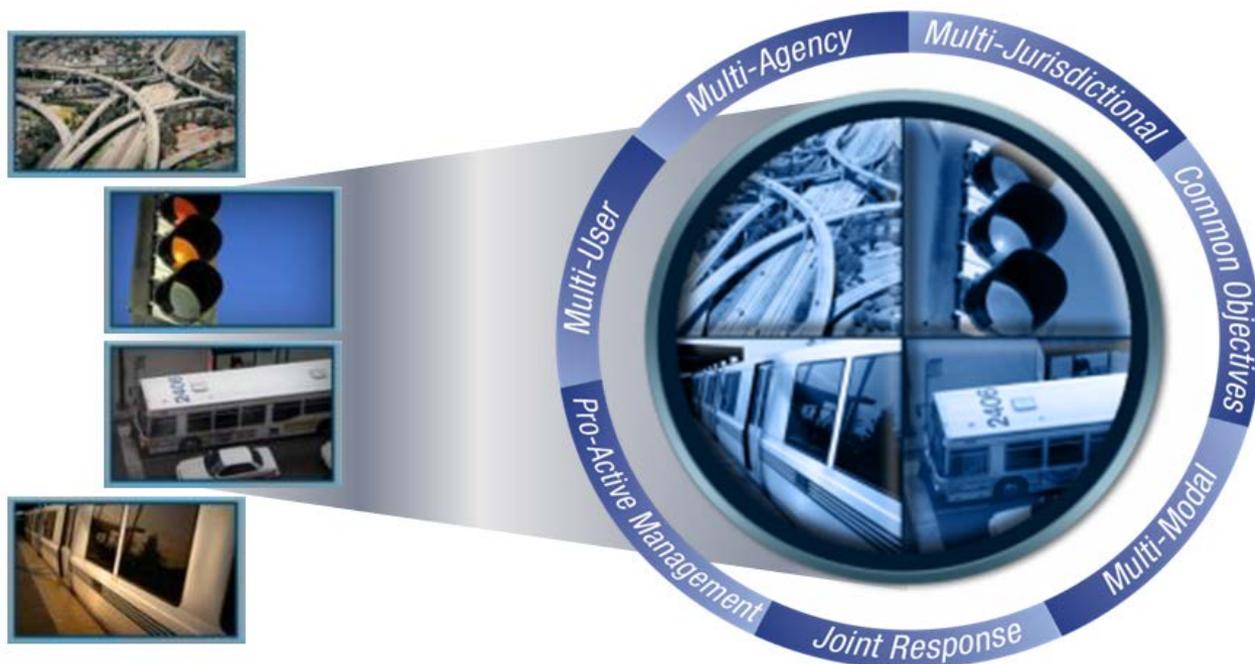
- Surface transportation systems are made up of several independent networks
 - Freeways, bus/rail transit, arterials, etc.
- Most efforts to reduce congestion have focused on optimization of individual networks
 - Agency/facility/mode – specific ITS systems & strategies
- Minimal cross-network management in response to increased demand / reduction in demand
- Output based performance measures

Corridor Transportation Opportunities

- Performance Management
- More efficient operations
- More productive systems
- More reliable travel
- Focus on “customer”
- Consider all users as stakeholders

ICM Vision

An opportunity exists to realize significant improvements in the efficient movement of people and goods through integrated and proactive management of major multimodal transportation corridors.



Integration

Institutional Integration

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

Operational Integration

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

Technical Integration

Sharing and distribution of information, system operations and control functions to support the immediate analysis and response.

ICM Operational Approaches

- Information Sharing/Distribution
- Improve Operational Efficiency at Network Junctions
- Accommodate (Passive)/Promote (Active) Cross Network Route and Modal Shifts
- Manage Capacity-Demand Relationship Within Corridor
 - Real-time"/Short-Term
 - Long Term

KEY: Implemented at a corridor-level, multi-jurisdictional, multi-modal fashion

Stakeholders

Who's here
today?
Who's missing?

**Roadway
Agencies**

**Planning
Organizations**

**Private
Sector**

**Transit
Agencies**

**Activity
Centers**

**Fleet
Operations**

**Public
Safety**

**Other agency
departments**

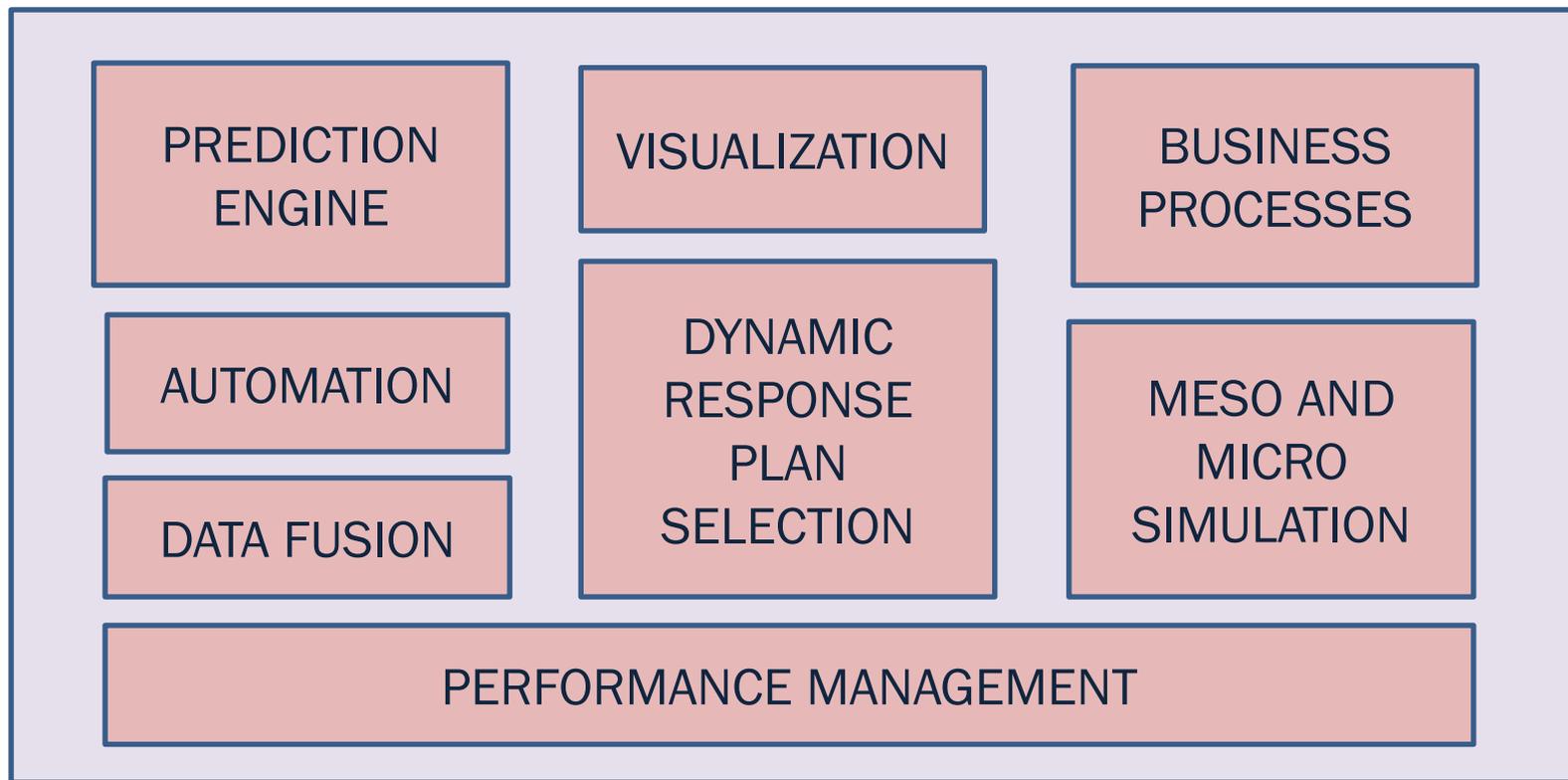
Traveler

ICM Decision Support Systems

Decision Support Systems

- Assist managers in the process of collaboratively managing a multimodal transportation network
- Objective driven
- Information systems
- Support multimodal, transportation operational decision-making in real time.
- Interactive, software-intensive system
- Multiple real-time data sources and knowledge-bases.
- Models, processes or analyses to implement context-specific actions and recommendations

Real-Time Decision Support Systems



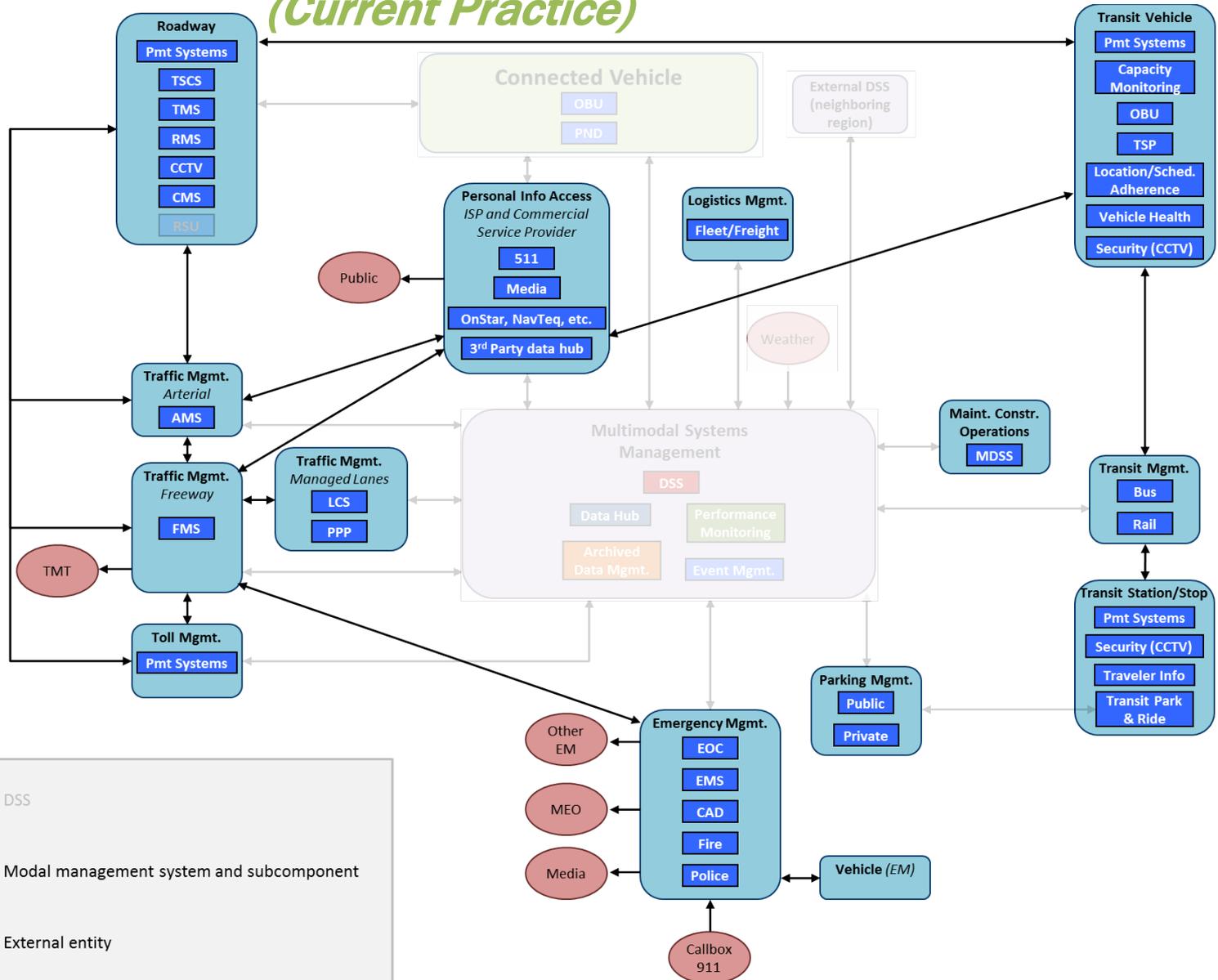
PERFORMANCE MONITORING → RECALIBRATION OF DSS

System Integration



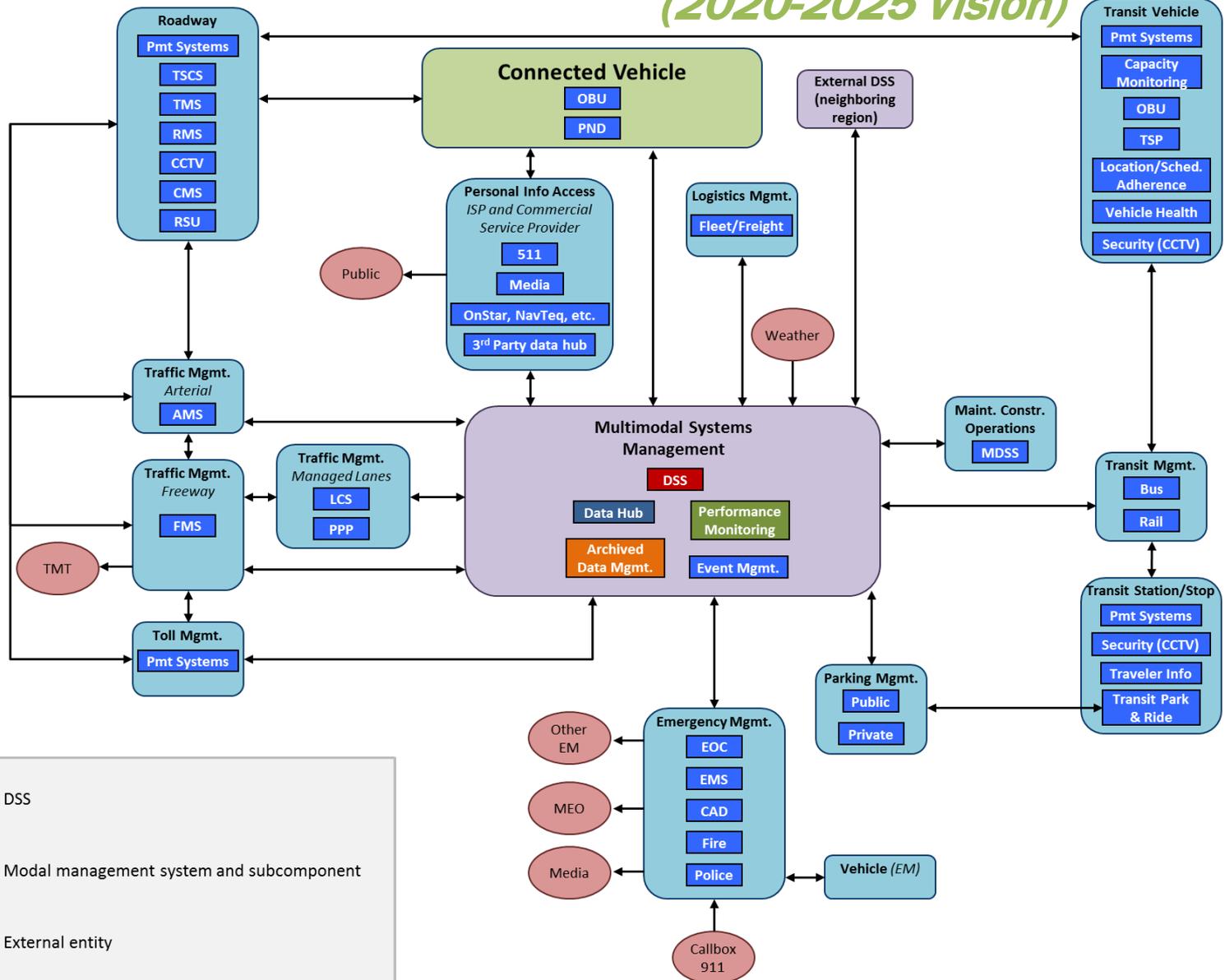
Real-Time Multimodal DSS Informational Flow Diagram

(Current Practice)



Real-Time Multimodal DSS Informational Flow Diagram

(2020-2025 Vision)



ITS AMERICA

State of the Practice: Decision Support Systems for Integrated Corridor Management



April 23, 2015





Outline

- Project goals and activities
- Fundamental DSS requirements
- Lessons Learned
 - Institutional
 - Technical
 - External
- Gauging the DSS Market
- Readiness Criteria



Project Goals and Activities

- Summarize state of the practice and suggest institutional and technical readiness criteria for deploying DSS for ICM
- Produce white paper on DSS
- Conducted stakeholder meetings
 - Dallas, TX – Feb 2014, San Diego, CA – Aug 2014
- Gathered external perspectives
 - Outside ICM
 - And outside transportation
- Conducted a small-scale industry survey



Common DSS Attributes

- **Institutional Commitment**
 - Agency leadership, adoption, and support for data-driven approach incorporating the knowledge of agency staff
- **Data Policies**
 - Clear policies for the collection and use of data within agency's jurisdictional boundaries
 - Security, privacy, and liability



Common DSS Attributes

- **Performance Metrics**
 - Gauge the need for and application of response plans recommendations
 - Set thresholds for normal and stressed system operating conditions
- **Inventory Management System**
 - Processes and procedures for maintaining a well-documented record of deployed assets
 - Situational awareness of assets in real-time



Common DSS Attributes

- **Situational Awareness**

- Instrumented and communicative infrastructure
- Incorporating information from external parties
- Fully understanding the state of the affected transportation system

- **Data Warehousing**

- Rigorous and disciplined data acquisition, storage, and archiving



Common DSS Attributes

- **Asset Control**
 - Ability to control infrastructure assets and actively manage the transportation system
- **Closed-loop Process**
 - Means of confirming awareness and action taken to mitigate anomalies
 - Essential for reviewing actions taken as part of any response plan



Common DSS Attributes

- **Recording of Response Plan Actions**
 - Recording all actions taken by the DSS
 - Recording of the steps leading up to the decision made by the system
 - Recording of the results of the actions
- **Review of Response Plan**
 - Review of anomalies and actions taken
 - Did the action itself or timeliness of the action achieve the goals of the system?



Part I - Lessons Learned from ICM Demonstrations and External Perspectives



Lessons Learned

- Dallas ICM site
- San Diego ICM site



Lessons Learned – Institutional

- Establish trust and synergism within your stakeholders
- Consider the effort as a path
- Identify a common language platform
- Tailor your DSS needs to your corridor
- **Proceed with operations and maintenance in mind**
- Remain patient and stay flexible



Lessons Learned – Technical

- Data, data, data
- **Identify individual modal and other system impacts early**
- Utilize multiple dissemination and feedback methods
- **Systems engineering is only a starting point**
- Understand the complexity of systems and data



Lessons Learned – Technical

- Maintenance of the system and assets are just as important
- **Obtain hands-on testing experience**
- Consider future requirements



External Perspectives

- Laurence Abcede of Sempra Utilities
 - San Diego Gas & Electric's Outage Management System/Distribution Management System (OMS/DMS)
- Dave Jackson of CH2M Hill
 - Transit Operations Decision Support Systems (TODSS) tested with Pace Suburban Bus Service
- Tony McClellan of Indiana DOT
 - Maintenance Decision Support System (MDSS)
- Mansooreh Mollaghasemi of Productivity APEX
 - Freight Advanced Traveler Information System (FRATIS) deployment in south Florida



San Diego Gas & Electric

- **Goal:** More efficiently identify outages and manage distribution of electric power
- **Previously:** existing response plans agreed on, but... manual processes and a lot of paperwork



San Diego Gas & Electric

- Went live with Outage Management System/
Distribution Management System (OMS/DMS)
Sept 2012
 - Operators able to obtain situational awareness through smart meters, CAD/AVL and SCADA
 - Immediate notifications of power off alarms (every 3 min) [smart meters]
 - Remotely controlling circuit switches and re-routing power around downed equipment (SCADA), potentially restoring power before the arrival of ground crews
 - Operators able to visualize the status of grid devices and electricity flow using GIS



Lessons Learned - San Diego Gas & Electric

- Come to agreement across the organization on desired capabilities of the system
- Strong IT staff
 - Technicians and business people
- Co-locate key team members
 - Facilitates strong teamwork
- Conduct extensive training across the organization
 - Operators helped write training material, re-wrote policies, and trained their peers during a 6-week training period
- Don't rush to implement a system before it has been tested thoroughly by users
 - Simulated live scenarios



TODSS

- **Goal:** effectively and efficiently handle service disruptions for fixed route service
- **Previously:** Multiple service disruption notifications without context and priorities. Dispatchers overwhelmed



TODSS

- Challenge: effectively and efficiently handling service disruptions for fixed route service
 - Dispatchers faced with so much data coming in via the AVL system during the course of a shift
 - Virtually impossible (without support) to parse the volume of data in order to consistently identify and respond to problems
- 60-day test with Pace Bus in Chicago, IL
- Archival capability for performance assessment of individuals and systems



TODSS

- **Goal:** effectively and efficiently handle service disruptions for fixed route service
- **Previously:** Multiple service disruption notifications without context and priorities. Dispatchers overwhelmed
- **Lessons Learned**
 - Real-time asset management and control
 - Situational awareness
 - Identify and prioritize what to focus on
 - Performance assessment management



Maintenance DSS (MDSS) - Indiana DOT

- **Goal:** Winter weather in northern states present a variety of road conditions to which transportation agencies must respond.
- **Previously:** operators and supervisors used mainly their knowledge and experience to clear roadways



Maintenance DSS (MDSS) - Indiana DOT

- The first winter of statewide MDSS implementation (FY09) saved Indiana DOT approx. \$11M as compared to prior year
- Building trust across departments and managing expectations
 - Improved communications between maintenance units, and between garages;
 - Accountability of resources expended during snow and ice operations;
 - Scientifically driven vs. experience driven



Maintenance DSS (MDSS) - Indiana DOT

- **Lessons Learned:**
 - Plan big, but start small
 - Plan smart and integrate into other plans
 - Accurately communicate the benefits of ICM to decision makers
 - Create internal support team to help with buy-in
 - **Accurately communicate the benefits of ICM to agency staff**
 - **Manage the expectations and benefits of ICM to decision makers**
 - **Gain stakeholders and partners' trust**



Lessons Learned – FRATIS

- **Goal:** Generates the most efficient operations plan for executing the freight pickups and deliveries
- **Previously:** Operators used their knowledge and experience to route trucks and freight traffic



FRATIS

- Generates the **most efficient operations plan** for executing the freight pickups and deliveries
- Real-time information regarding freight routing, such as: facility wait times, traffic conditions, incidents, **routing restrictions**, and speed limits
- Provides dynamic routing for freight vehicle operators while also monitoring performance indicators for fleet managers



Lessons Learned – FRATIS

- **Lessons Learned:**

- System trust through trusted data, better information and performance metrics
 - Some dispatchers and vehicle operators expressed discomfort with or resistance to using FRATIS-generated operations plans
- Training and acceptance by dispatchers was key
 - Operators may have felt a loss of control over the daily process, since they typically have control over the plan for the day's operations



External Perspectives

- Real-time asset management and control
- Situational awareness
- Trust in the system
 - Training and acceptance at all levels
- Performance metrics



Part II - Gauging the DSS Market



Survey Background – Public

- Purpose
 - Investigated public sector demand for DSS
 - Aimed to get a sense of the current state of private sector offerings
- Respondents
 - 22 public respondents
 - 10 state DOTs, 7 regional, 3 local, 1 transit agency, 1 unknown
 - 13 private respondents in total
 - 8 with DSS offerings specifically intended for use in transportation systems management, 5 from outside the transportation sector



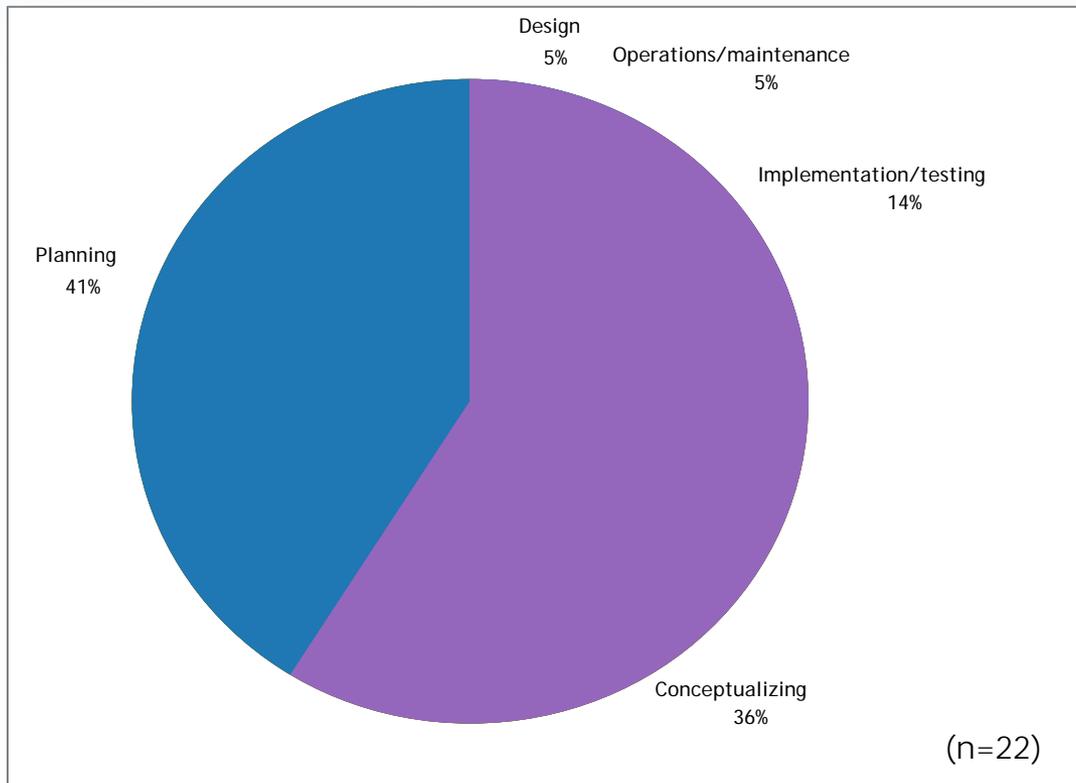
Gauging the DSS Market – Public

- 19 respondents indicated they have a project either underway or planned
 - Remaining 3 respondents indicated corridor with a need, but no champion
- Identified a total of 31 projects across the 19 surveyed agencies
 - 2 agencies had 4 projects within their jurisdiction



Gauging the DSS Market – Public

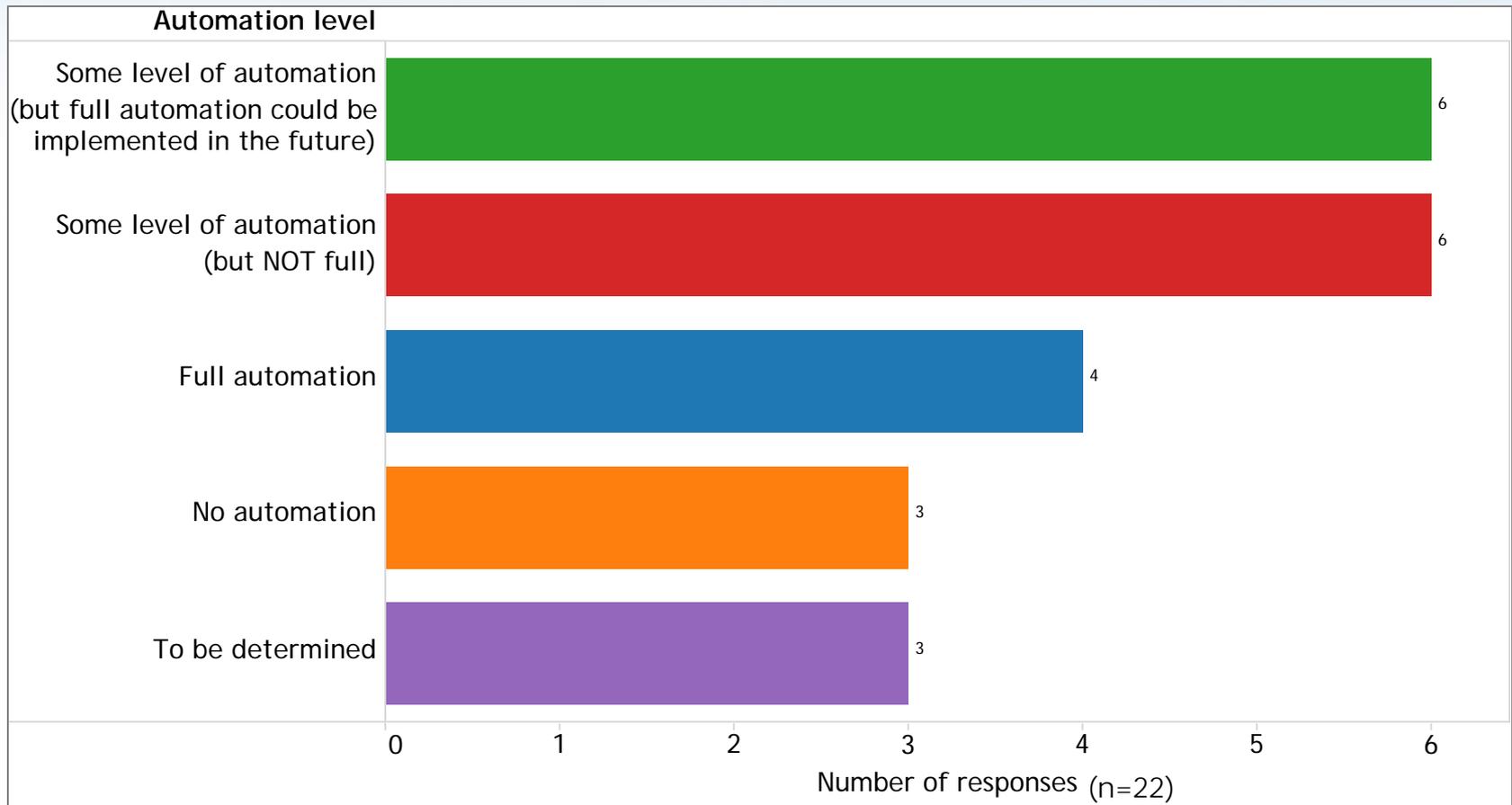
- Current project status



The implication for decision support systems is that the level of automation of the DSS to be implemented on these systems is still, for the most part, to be determined.



Gauging the DSS Market – Public





Concerns, Challenges, Obstacles to Automation

- 13 responses (free response)
 - 4 cited cost or funding issues
 - 3 cited concerns about relinquishing control of facilities



Other Existing DSS Applications in Use Today

- 7 responses (free response)
 - Ramp metering
 - Travel time estimates
 - Response plan generation for TMC operators
 - Dynamic pricing for HOT lanes
 - Adaptive arterial signal control



Survey Background – Private

- Aimed to get a sense of the current state of private sector offerings
- 13 respondents in total
 - 8 with DSS offerings specifically intended for use in transportation systems management
 - 5 from outside the transportation sector



Gauging the DSS Market – Private

Capabilities (n=8)		Companies with Transportation- Focused DSS (n=8)	Companies outside Transportation (n=3)
Web hosting		8	3
Database or library interface		7	3
Real-time data		7	3
Field device control system interface		5	3
Simulation software interface		4	2



Gauging the DSS Market – Private

- Multi-modal integration capability for companies with transportation DSS offerings

Type of Mode or Facility (n=5)

Transit	5
Arterials	4
Freeways	4
Freight	4
Parking	4
Bicycles	2



Survey Summary

- Public sector
 - Identified 31 projects across 19 agencies with ICM projects planned or in the works
 - 3 agencies who did not have a project in the works cited lack of a champion
 - Most projects at the conceptual or planning stage
 - All but 3 projects anticipate some level of automation
- Private sector offerings
 - Of 8 companies identified in transportation space, X...
 - All do web hosting
 - Most handle real-time data and interfacing with databases and field devices
 - Half can interface with traffic simulation software
 - Most capable of handling alternate modes at some level



Part III - Readiness Criteria



Technical Readiness Criteria - General

- Assessment Area
- Description of Assessment Area
- Level of readiness
 - Not Prepared
 - Minimally prepared
 - Somewhat prepared
 - Prepared



Technical Readiness Criteria

Criteria Number	Assessment Area	Description of Assessment Area	Not prepared (1)	Minimally prepared (2)	Somewhat prepared (3)	Prepared (4)
1	Level of asset coverage	What is the level of asset coverage for the assets that are intended to be used for the project (i.e., data on operating characteristics of key roadways/key systems)?	Very few of the assets that are anticipated to be used are present.	Some of the assets are present but there are many missing segments.	Most of the assets are present but there are a few missing segments.	All assets that are intended to be used are present with sufficient coverage to achieve the goals of the project.
2	Level of connectivity and control with assets	What is the level of real-time connection and control with the assets intended to be used for the project?	No real-time connection to the assets is available.	Some assets have real-time connections.	Most assets have real-time connections.	All assets have real-time connections.
3	Level of asset maintenance	What is the level of conformity of maintenance practices for...	Rate of critical failures is high.	Rate of critical failures is medium to high and is decreasing at...	Rate of critical failures is medium to low and is decreasing at...	Rate of critical failures is low and maintenance practices are...



DSS for ICM Technical Readiness Criteria (criteria 1-6)

1. Level of asset coverage
2. Level of connectivity and control with assets
3. Level of asset maintenance
4. Level of interagency data sharing
5. Level of policy and control to manage cybersecurity risk
6. Level of partner agency agreement on big picture goals for desired level of automation



DSS for ICM Institutional Readiness Criteria (criteria 7-11)

7. Existence of champions within partner agencies
8. Existence of an external champion
9. Level of involvement from necessary departments within partner agencies
10. Level of inter-agency coordination in the area of operations
11. Level of partner agency agreement on big picture goals



DSS for ICM Institutional Readiness Criteria

- Criteria Number 2:
 - Level of connectivity and control with assets

This criterion establishes whether or not any of the partner agencies may need to invest in providing real-time connections at the beginning of the project, allowing the agencies to more accurately determine necessary resources.



DSS for ICM Institutional Readiness Criteria

- Criteria Number 5:
 - Level of policy and control to manage cybersecurity risk

Defense in depth

- *Constructive strategies*
- *Operational strategies*
- *Reactive strategies*



DSS for ICM Institutional Readiness Criteria

- Criteria Number 6:
 - Level of agency agreement on big picture goal of desired level of automation

The level of automation considers what the system will do potentially requiring TMC operators and managers to verify the recommended response scenario, or allowing the system to implement the recommended response scenario without human verification.



DSS for ICM Institutional Readiness Criteria

- Criteria Number 7:
 - Existence of champions within partner agencies

Current organizational and institutional structures in transportation agencies benefit from having a champion within the partner agencies to advocate and bring together the necessary decision makers and key players to move the project forward.



DSS for ICM Institutional Readiness Criteria

- Criteria Number 9:
 - Level of involvement from necessary departments within partner agencies

Some departments to consider are:

- Traffic operations;
- Maintenance;
- Planning;
- Towing and Recovery or Freeway Service Patrol;
- First responders; and
- IT departments.



Questions?

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