



Impacts of dedicated CAV lanes on I-270 Maryland

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JACOBS[®]

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Presentation Outline

Impacts of CAV on Infrastructure

Previous Research

I-270 ICM Project

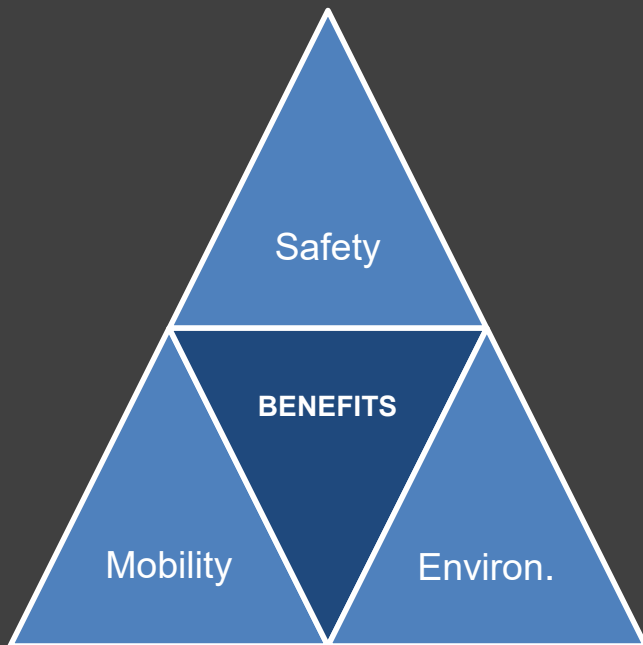
I-270 VISSIM Model

Analysis & Results

Conclusion & Next Steps

Questions

What is CAV (Connected & Automated Vehicle)



Transformative to our nation's surface transportation system

Automated vehicles can be Autonomous (self-driving) and/or Connected (V2V, V2i)

Connected vehicles communicate with each other and/or surrounding infrastructure

Autonomous vehicles take control of active driving functions

CAV & Future of Infrastructure

- As proportion of AV increases in the current fleet, future transportation needs will change significantly
- Many questions with many different answers
- We tested one – Impact on Roadway infrastructure due to capacity increase
- We assumed Level 2 and above for Automation and V2V and V2I communication

Infrastructure?

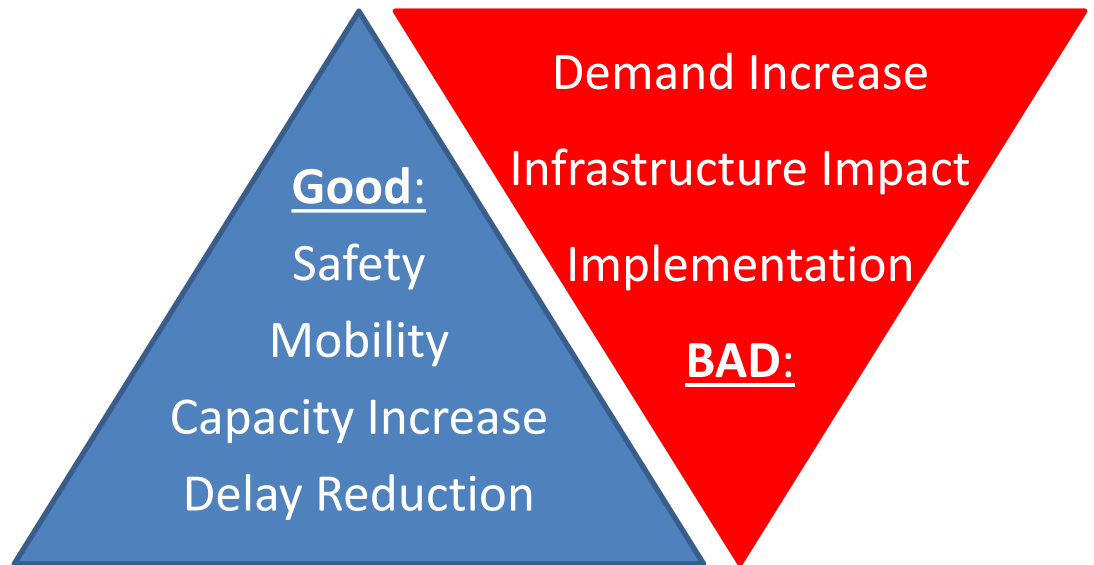
Vehicle
Ownership?

Design
Standards?

Travel Patterns?

Parking
Infrastructure?

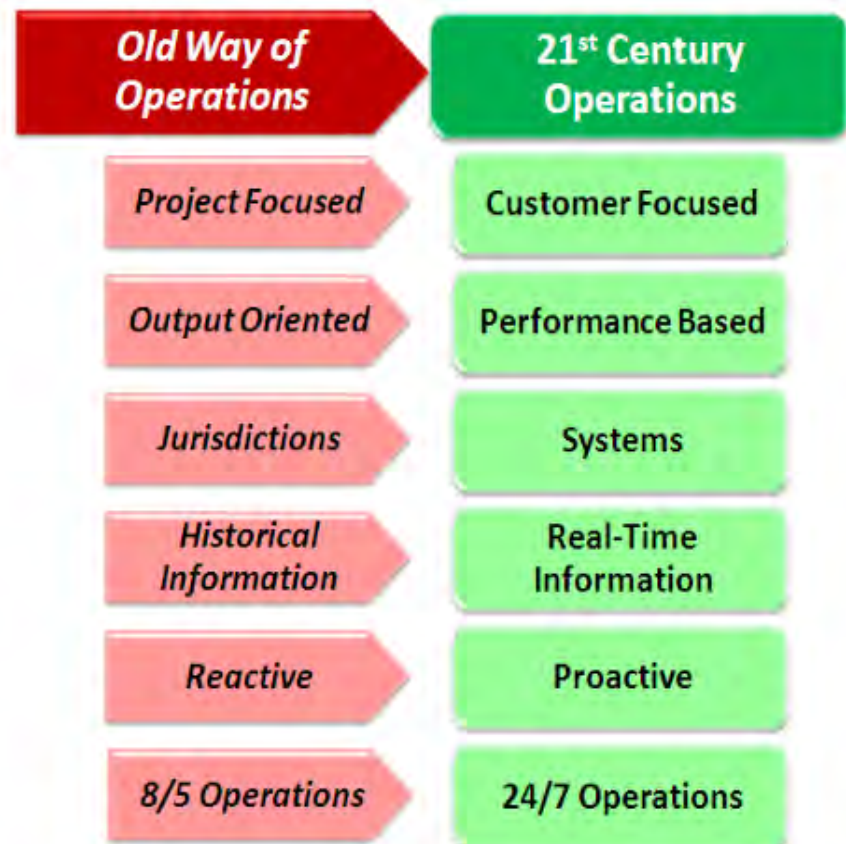
Other Unknowns?



CAV & Changing Emphasis in Operations

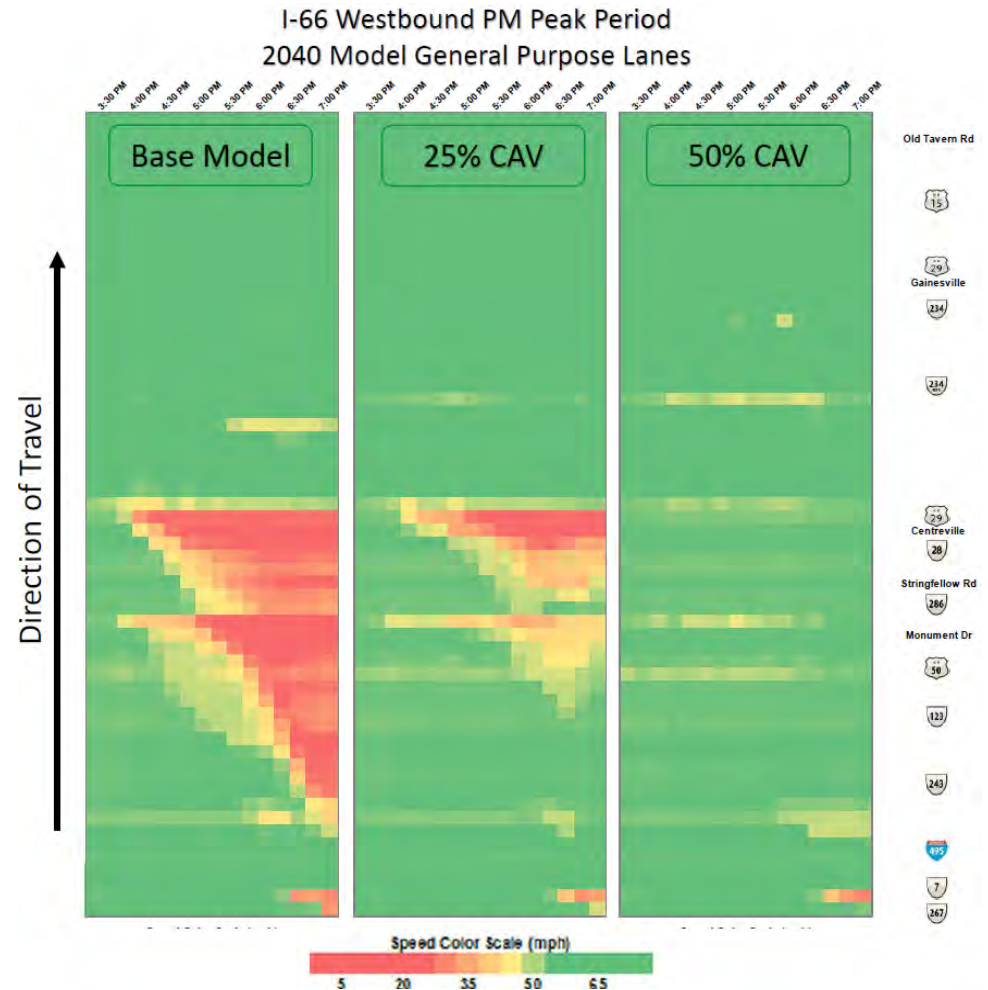
- One of the key recommendations for adapting to technology changes is to focus on having a “Nimble Service-Oriented Program Mindset.”

“effectively addressing the congestion problem will hinge on the ability to reshape traditional transportation organizations into 21st century operations agencies using 21st century technologies” – FHWA Guidance



Previous Research – Transform I-66 CAV analysis

- 35+ mile corridor in Northern Virginia
- VISSIM models used to evaluate 2040 conditions
- 25% and 50% CAV in fleet evaluated
- CAV increased capacity, reduced congestion, improved TT and Speeds
- More CAV = Better results



Total Travel Time

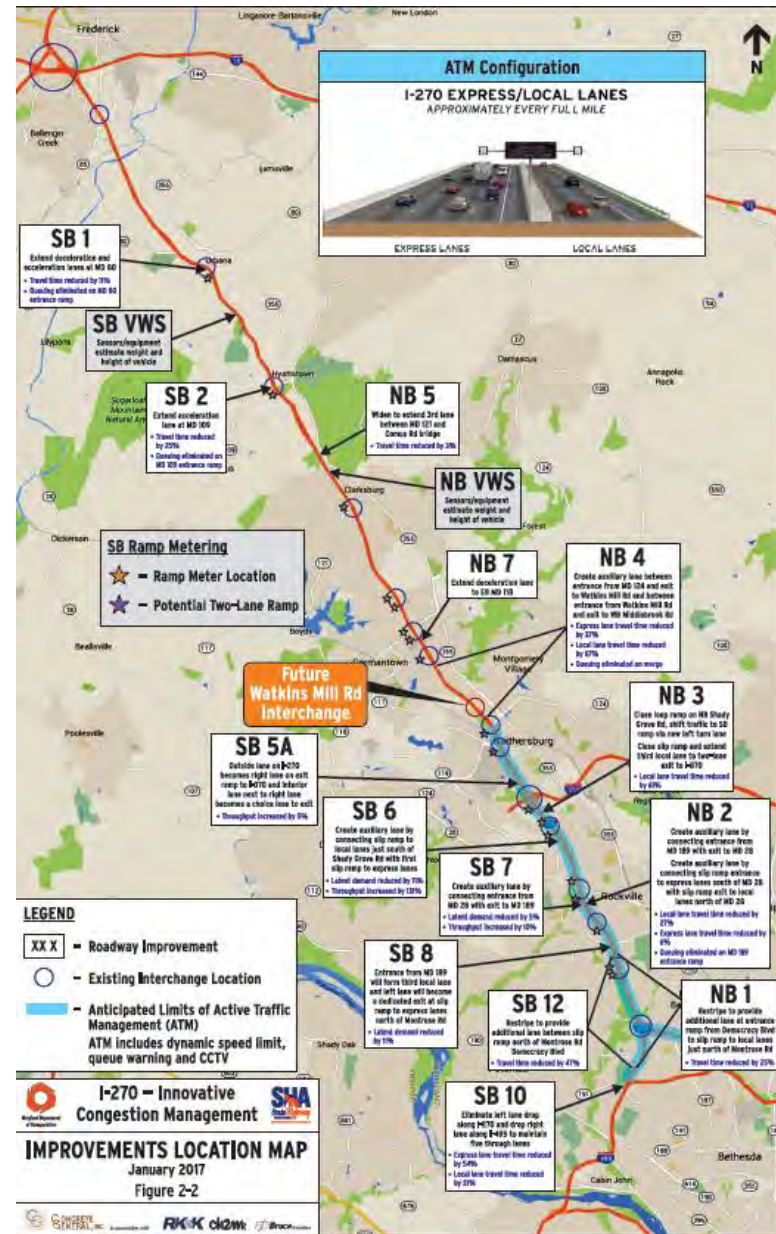
- Free Flow: 10.5 min
- Base: 20 min
- 25% CAV: 14 min
- 50% CAV: 11 min

Percent Reduction in Delay

- 60% for 25% CAV
- 88% for 50% CAV

I-270 Innovative Congestion Management project

- 32+ mile corridor
- HOV-only lane, Express lanes & Local lanes
- One of the most congested corridors in the nation.
- Proposed 14 roadway and technology improvements including ATM and Ramp Metering
- VISSIM model for corridor analysis



Assumptions

Calibrated VISSIM Models

Base + 3 Scenarios for CAV-Only Lane

0%, 15%, 30% & 40% CAV Scenarios

VISSIM Version 9

Demand, OD, Analysis period kept same

New Vehicle Type – CAV

Updated Driver Behavior from PTV

Vehicle Type & Composition

- New Vehicle Type = CAV
- Updated Vehicle Composition

Vehicle Compositions / Relative Flows (2)

Select layout...

Cou	No	Name	Count	VehType	DesSpeedDistr	RelFlow
7	7003	6% Trucks 40MPH	1	100: Car	100: 65 mph	0.760
8	7004	6% Trucks 45MPH	2	200: HOV	100: 65 mph	0.090
9	7005	6% Trucks 50MPH	3	700: CAV	100: 65 mph	0.150
1	7006	8% Trucks 40MPH				
1	7007	7% Trucks 50MPH				
1	7008	7% Trucks 40MPH				
1	7009	7% Trucks 45MPH				
1	7010	4% Trucks 40MPH				
1	7011	8% Trucks 30MPH				
1	7012	8% Trucks 40MPH				
1	7013	8% Trucks 45MPH				
1	7014	8% Trucks 50MPH				
1	7015	8% Trucks 65MPH				
2	7016	7% Trucks 54% HOV 65 MPH				
2	7017	7% Trucks 65MPH				
2	7018	2% Trucks 40MPH				
2	7019	7% Trucks 5% HOV 50 MPH				
2	7020	7% Trucks 5% HOV 40 MPH				
2	7021	7% Trucks 5.4% HOV 40 MPH				
2	7022	7% Trucks 12.8% HOV 45 MPH				
2	7023	4% Trucks 40MPH				
2	7024	9% Trucks 65MPH				
2	7025	7% Trucks 13% HOV 45MPH				
3	7026	7% Trucks 54% HOV SURGE 65 MP				

Vehicle Compositions / Relative Flows Vehicle Compositions / Relative Flows (2)

Driver Behavior Changes

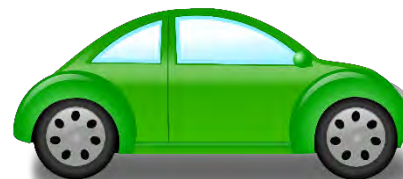
Wiedemann 99 (Freeways):

- Standstill Distance
- Headway Time
- Lane Changing

Wiedemann 74 (Arterials):

- Signal Control – Reaction Time
- Car Following Model Parameters

Minimum Gap



Following Vehicle



Lead Vehicle

Reaction Time



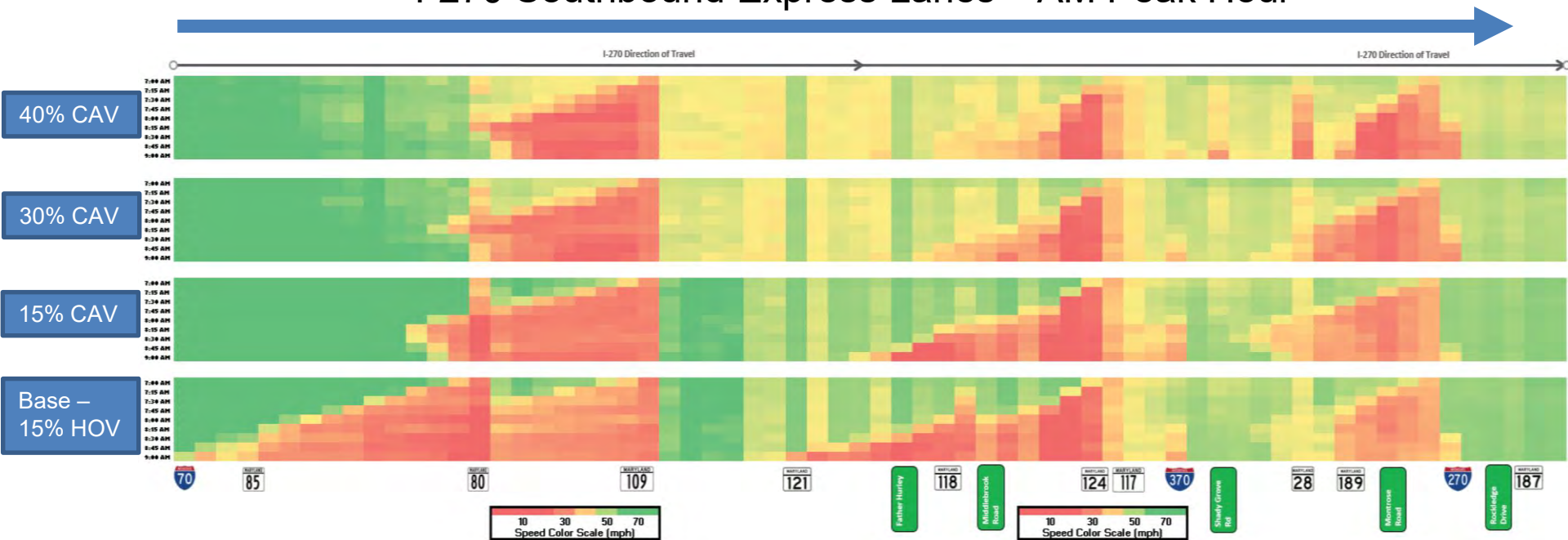
Vehicle at Signal



Traffic Signal

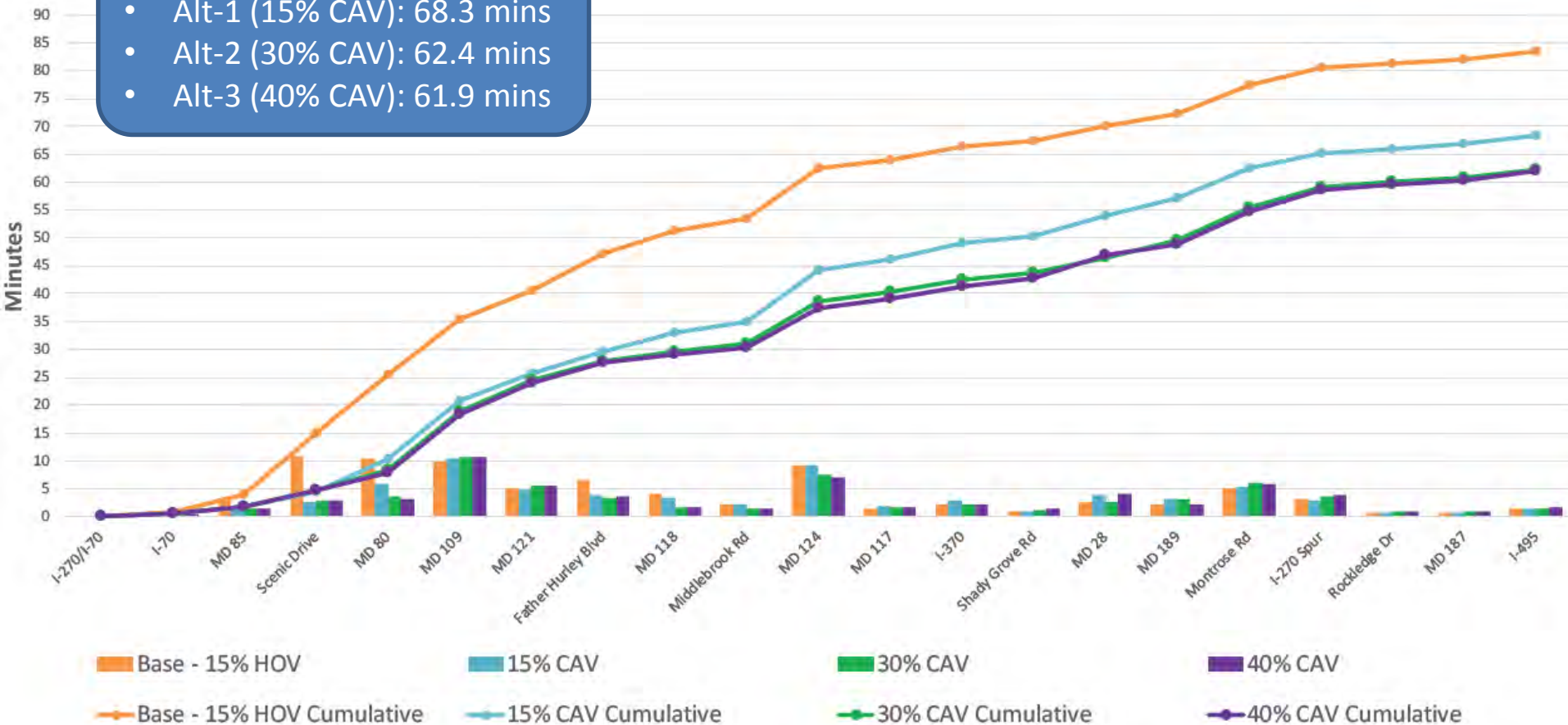
Speed/Congestion along Corridor

I-270 Southbound Express Lanes – AM Peak Hour



Travel Time along Corridor

- Base (15% HOV): 83.6 mins
- Alt-1 (15% CAV): 68.3 mins
- Alt-2 (30% CAV): 62.4 mins
- Alt-3 (40% CAV): 61.9 mins



Throughput along Corridor

- With the reduction in congestion there is also an increase in throughput along the corridor.
- Near the southern end of the corridor:

Scenario	Throughput	% Increase
Base (15% HOV)	9,350	-
Alt-1 (15% CAV)	9,900	6 %
Alt-2 (30% CAV)	10,190	8 %
Alt-3 (40% CAV)	10,230	9 %

CAV-only Lanes: Challenges & Opportunities

Microsimulation models were developed for a different study – this required model adjustments.

Study assumed real-life corridor & existing constraints were considered in conceptualizing the CAV-only lane.

CAV-only lane was not barrier-separated. Providing a physically separated CAV-only lane can result in greater benefits.

CAV-only Lanes: Framework & Conclusions

Does not need to be designed to specs of normal ML.

Provides greater return on investment.

Higher capacity from reduced-width dedicated CAV lane.