UNITED STATES
DEPARTMENT OF TRANSPORTATION

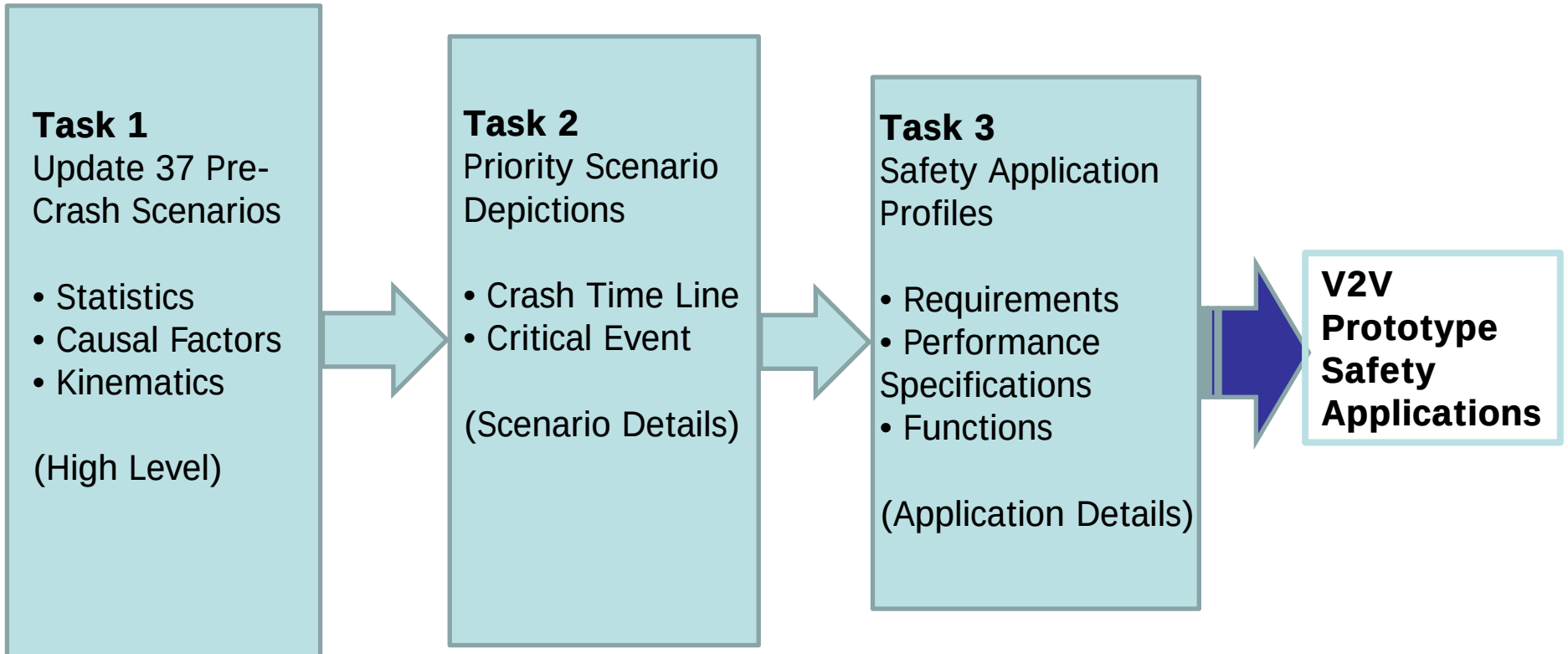
Crash Scenario Framework (Track 1) and Benefits Assessment (Track 3)

Emily Nodine

Volpe Center

August 2, 2011

Crash Scenario Framework

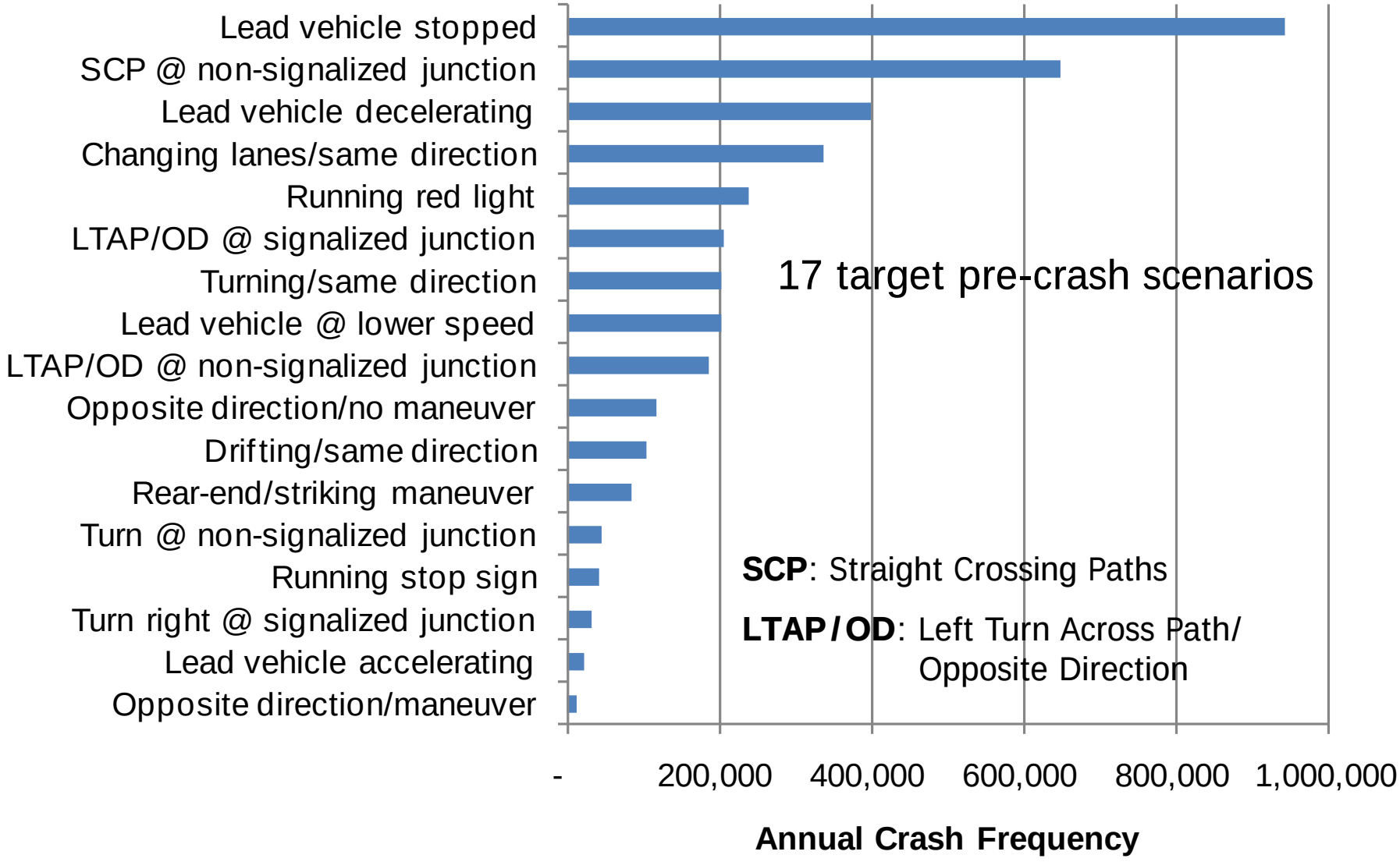


Identify and describe crash problems

Connect scenarios to V2V-based countermeasures

Define functions/performance requirements

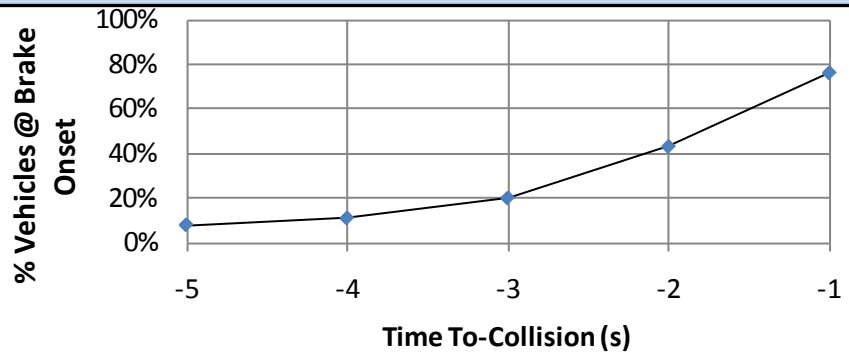
Target V2V Crash Scenarios



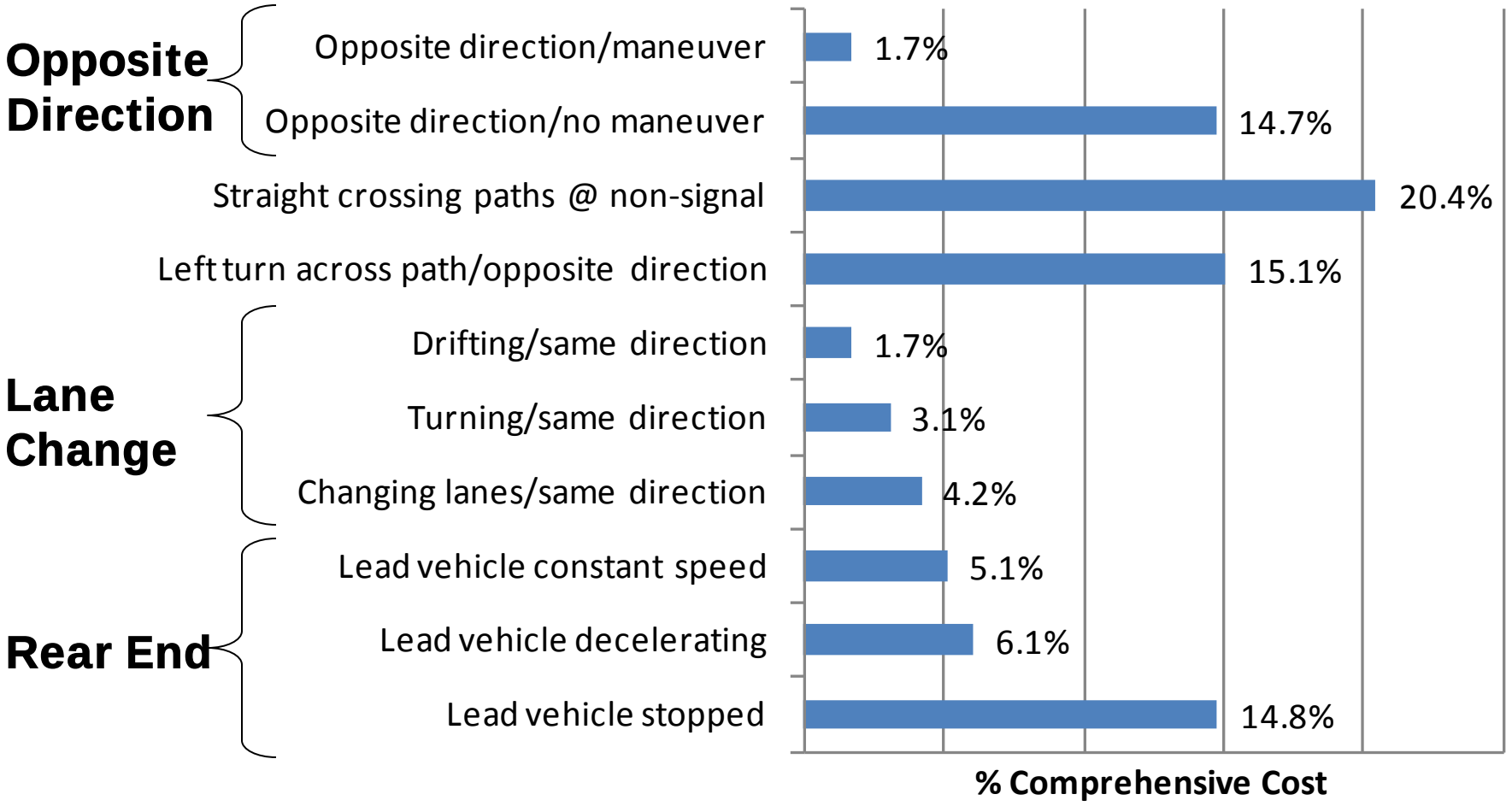
Crash Scenario Statistics

General Estimates System
Roadway Alignment
Roadway Surface Condition
Atmospheric Conditions
Relation to Junction
Traffic Control Device
Lighting Condition
Speed Limit
Driver Age
Driver Gender
Alcohol Involvement
Drug Involvement
Physical Impairment
Violations Charged
Speed Related
Driver Vision Obscured By
Driver Distracted By
Vehicle Contributing Factors

National Motor Vehicle Crash Causation Survey
Critical Reason for Critical Precrash Event
Driver Fatigue
Driver Inattention
Driver Conversing
Driver Inadequate Surveillance
Other Driver Recognition Factor
Misjudgement of Distance/Speed of Other Vehicle
False Assumption of Other Road User's Action
Following Too Closely
Other Driver Decision Factor
Event Data Recorder



Target V2V Scenario Prioritization

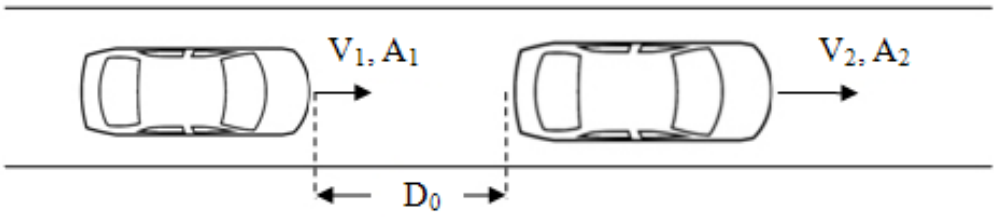


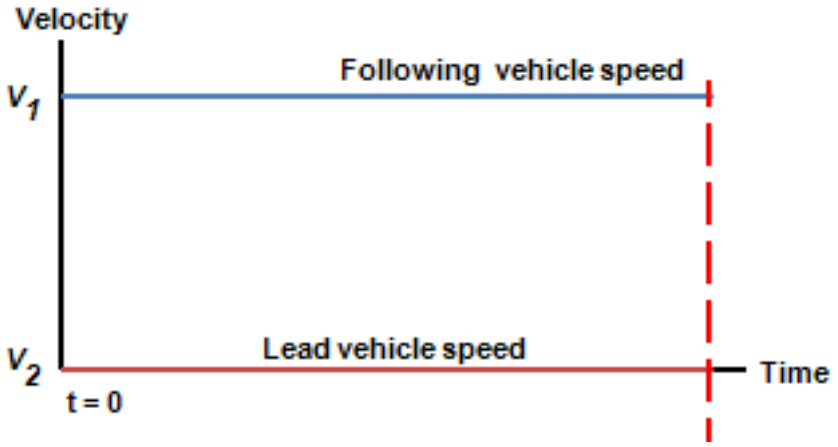
Priority V2V Scenario Depiction

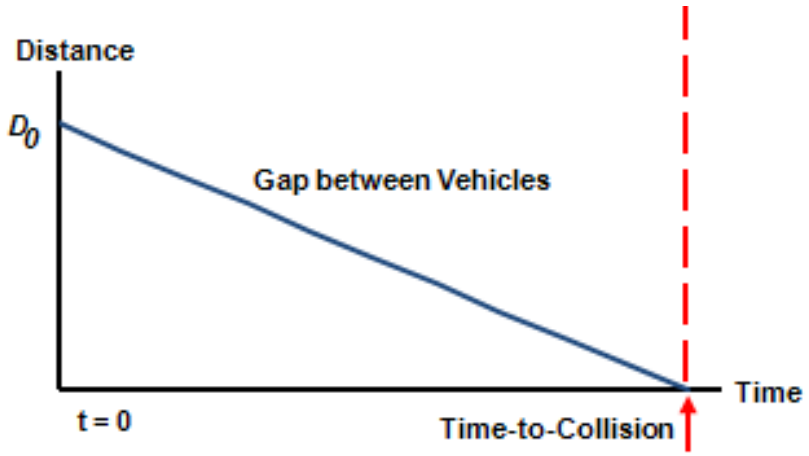
Rear-End/Lead Vehicle Stopped

$$ttc = \frac{D_0}{V_1}$$

ttc = Time-to-collision
D_0 = Distance between vehicles
V_i = Vehicle i speed







V2V Countermeasure Needs

Information Needs	Pre-Crash Scenario Group				
	Rear-End	Opposite Direction	LTAP/OD	SCP @ Non Signal	Lane Change
Relative Position	✓	✓	✓	✓	✓
Velocity	✓	✓	✓	✓	✓
Longitudinal Acceleration	✓	✓	✓	✓	✓
Lateral Acceleration	✓	✓	✓	✓	✓
Heading	✓	✓	✓	✓	✓
Yaw rate			✓		✓
Range Rate	✓	✓	✓	✓	✓
Position in Lane	✓	✓			✓
Other: Wiper state, temperature, turn signal status, throttle, brake, etc.	✓	✓	✓	✓	✓

SCP: Straight Crossing Paths

LTAP/OD: Left Turn Across Path/Opposite Direction

Mapping to Safety Applications

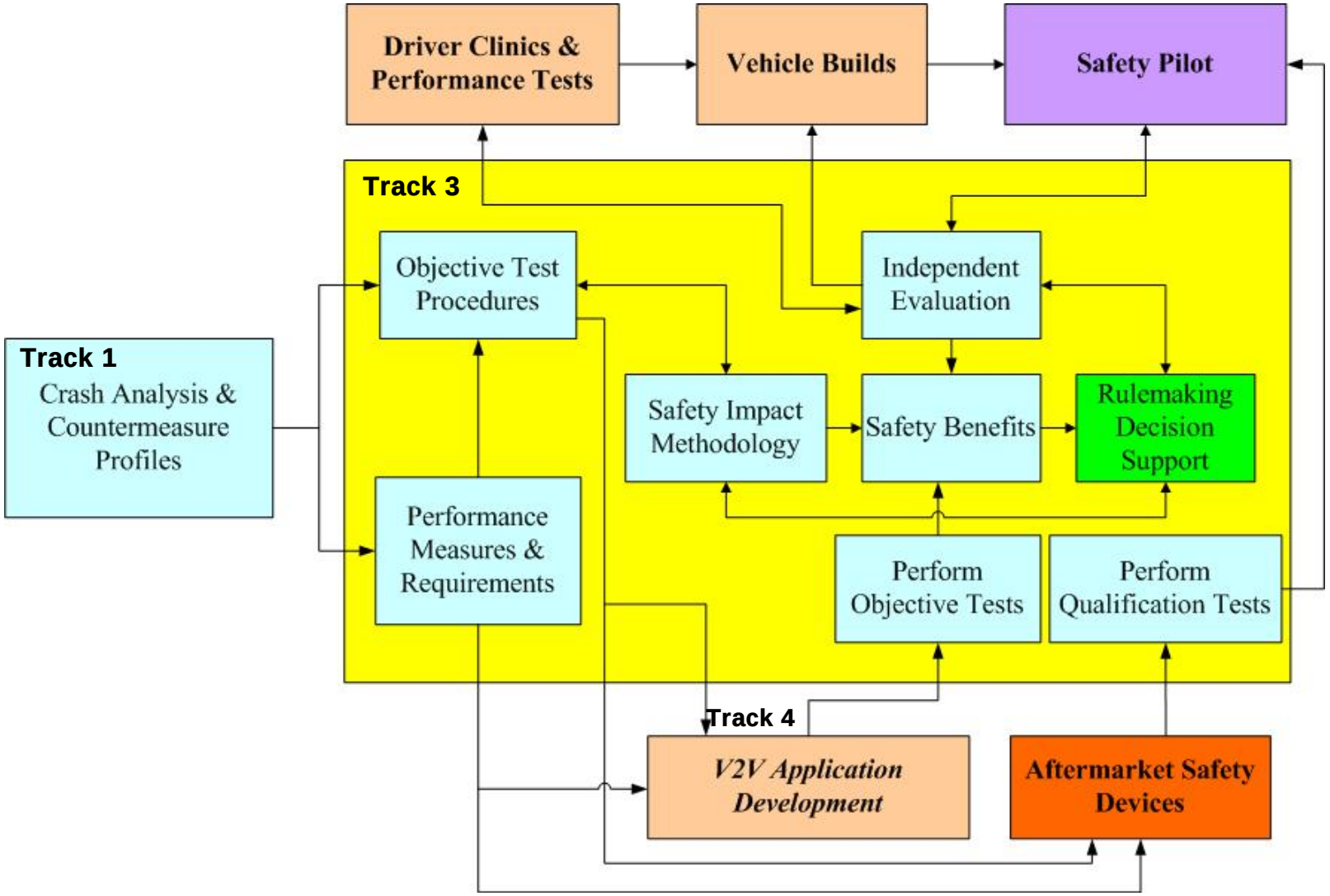
Target Pre-Crash Groups and Scenarios		V2V Safety Applications				
		EEBL	FCW	IMA	DNPW	BSW+LCW
Rear-End	Lead Vehicle Stopped		✓			
	Lead Vehicle Moving		✓			
	Lead Vehicle Decelerating	✓	✓			
Junction Crossing	SCP @ Non Signal			✓		
LTAP/OD	LTAP/OD					
Opposite Direction	Opposite Direction/No Maneuver					
	Opposite Direction/Maneuver				✓	
Lane Change	Changing Lanes/Same Direction					✓
	Turning/Same Direction					✓
	Drifting/Same Direction					✓

EEBL: Electronic Emergency Brake Light **FCW**: Forward Crash Warning
IMA: Intersection Movement Assist **DNPW**: Do Not Pass Warning
BSW: Blind Spot Warning **LCW**: Lane Change Warning

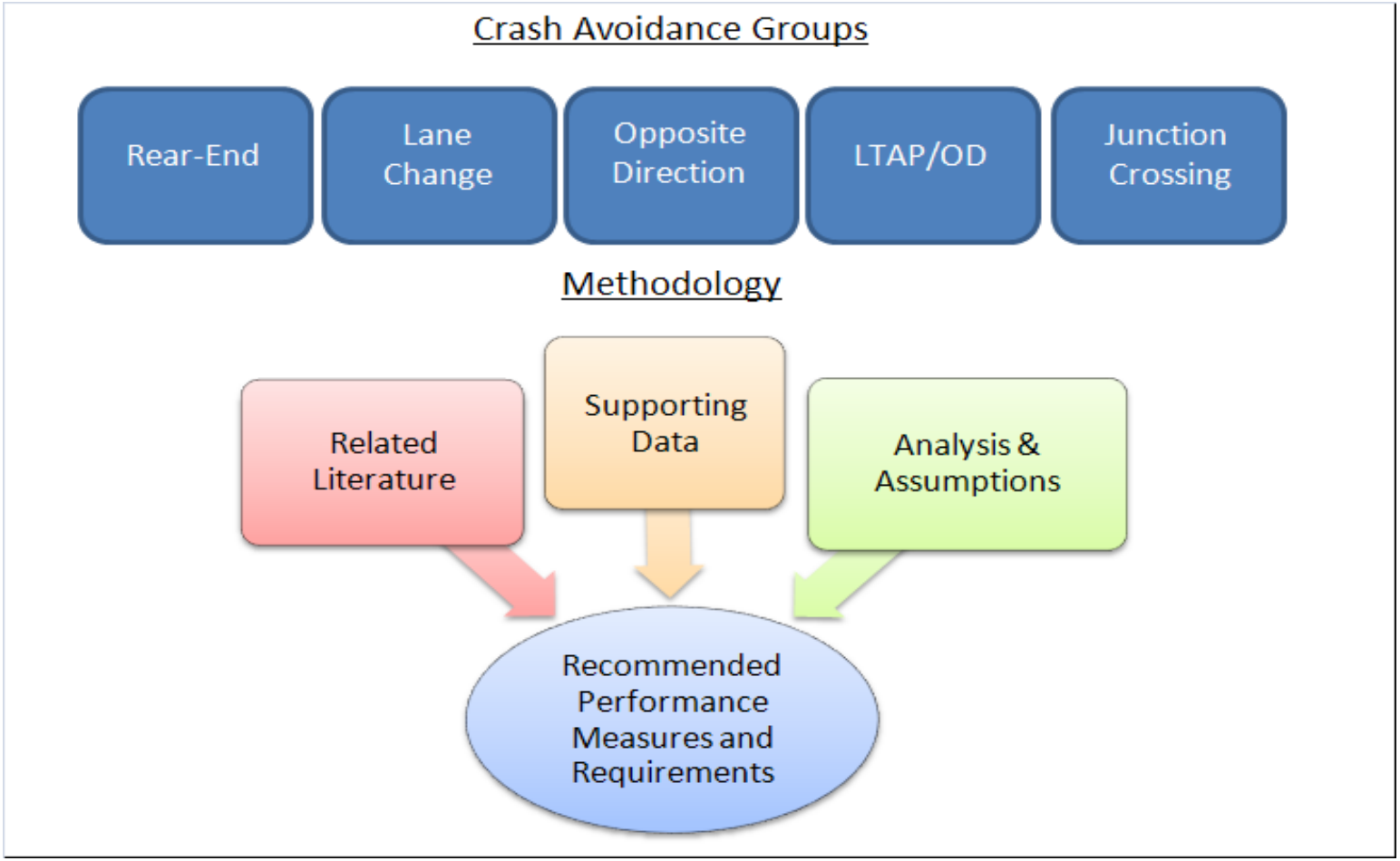
Countermeasure Functions

- **Sensing and Perception**
  - Monitor vehicle
  - Perceive roadway
  - Perceive obstacles
- **Situation Characterization and Threat Assessment**
  - Determine road conditions
  - Integrate data: vehicle, target, roadway, and road conditions
  - Assess threats
  - Arbitrate threats
  - Determine driver conditions
  - Identify false alarms
- **Presentation of Crash-Avoidance Information**
  - Commands to vehicle
  - Cues and displays to driver
- **System Management**
  - Driver inputs
  - Data integrity, diagnostics, raw data
  - System status messages

Benefits Assessment



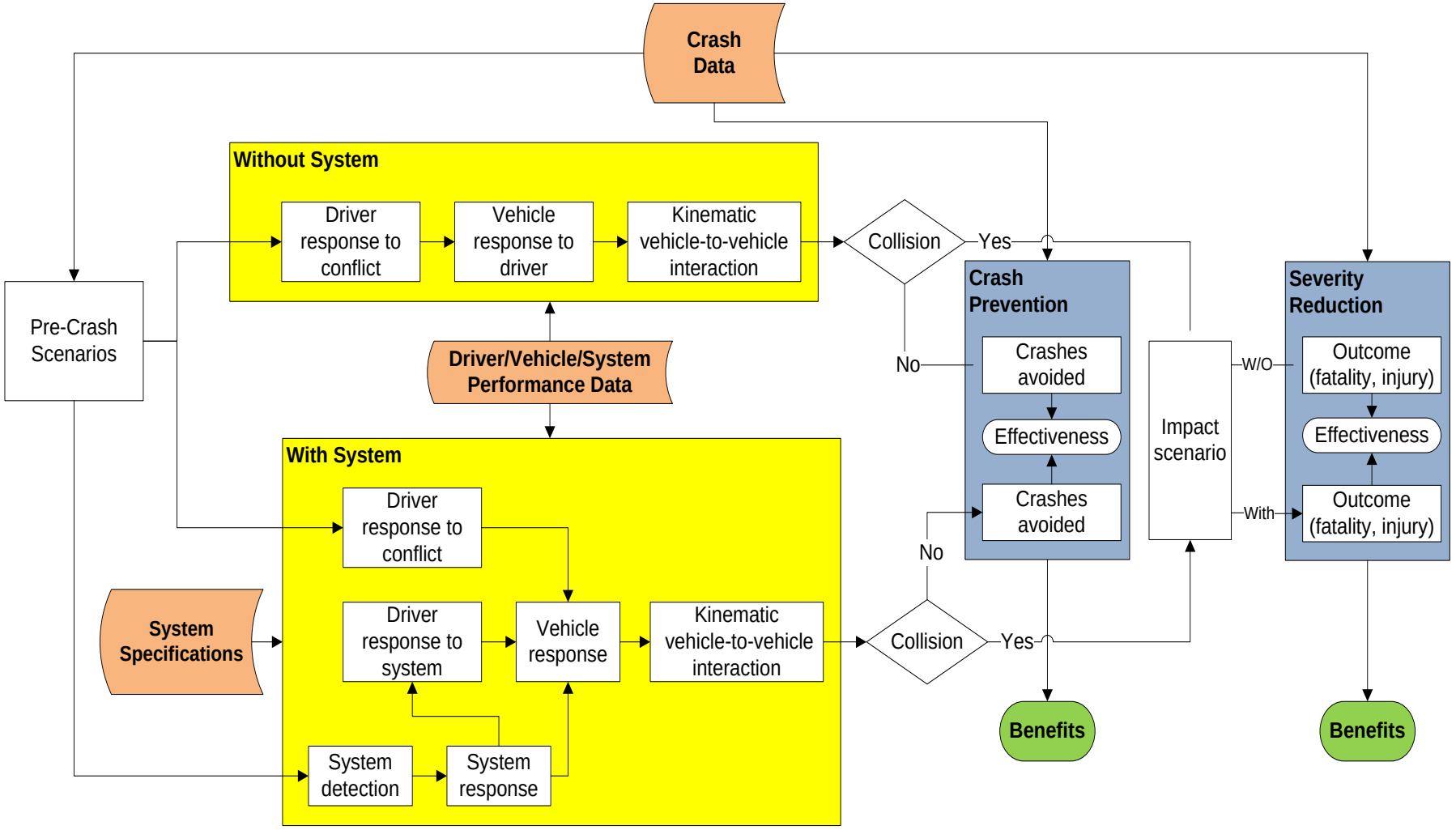
Performance Measures & Requirements



Objective Test Procedures

- Produce guidelines for objective tests
- Develop test procedures:
  - Aftermarket safety devices
  - Track 4 systems
- Conduct tests:
  - Qualification – aftermarket safety devices
  - Characterization – Track 4 systems

Safety Impact Methodology



Independent Evaluation of Safety Pilot

- Assess the safety impact of DSRC-based safety applications:
  - Overall driving behavior
  - Exposure and response to near crashes
  - Driver attention
  - Impact of deployment rate
- Determine driver acceptance:
  - Ease of use
  - Usefulness
  - Ease of learning
  - Willingness to use/Advocacy
  - Privacy
- Characterize system performance and capability:
  - Accuracy
  - Interoperability
  - Security
  - Alert logic
  - Driver-vehicle interface