Enhancing Safety Through Automation

TRB Automated Vehicle Workshop, July 25, 2012

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NHTSA's Missions

- Safety

  Save lives, prevent injuries and reduce economic costs due to road traffic and non-traffic crashes through education, research, safety standards and enforcement activity.

- Consumer Programs

  Increase fuel economy, damageability protection, and theft protection, reduce odometer tampering, and provide consumer information.

The Problem!!!

Safety

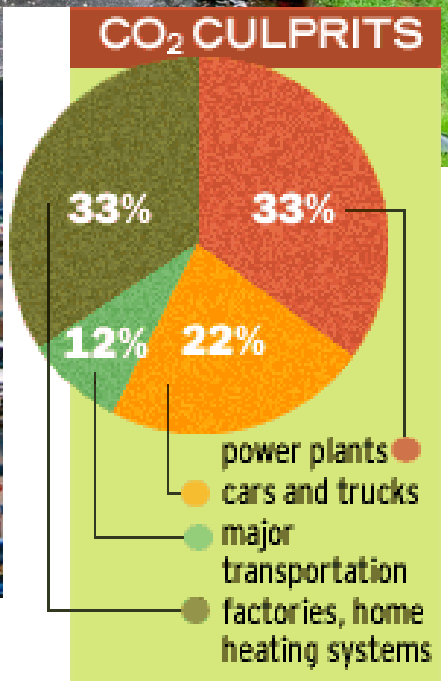
- 32,788 highway deaths in 2010
- 6,000,000 crashes/year
- Leading cause of death for ages 4 - 34

Mobility

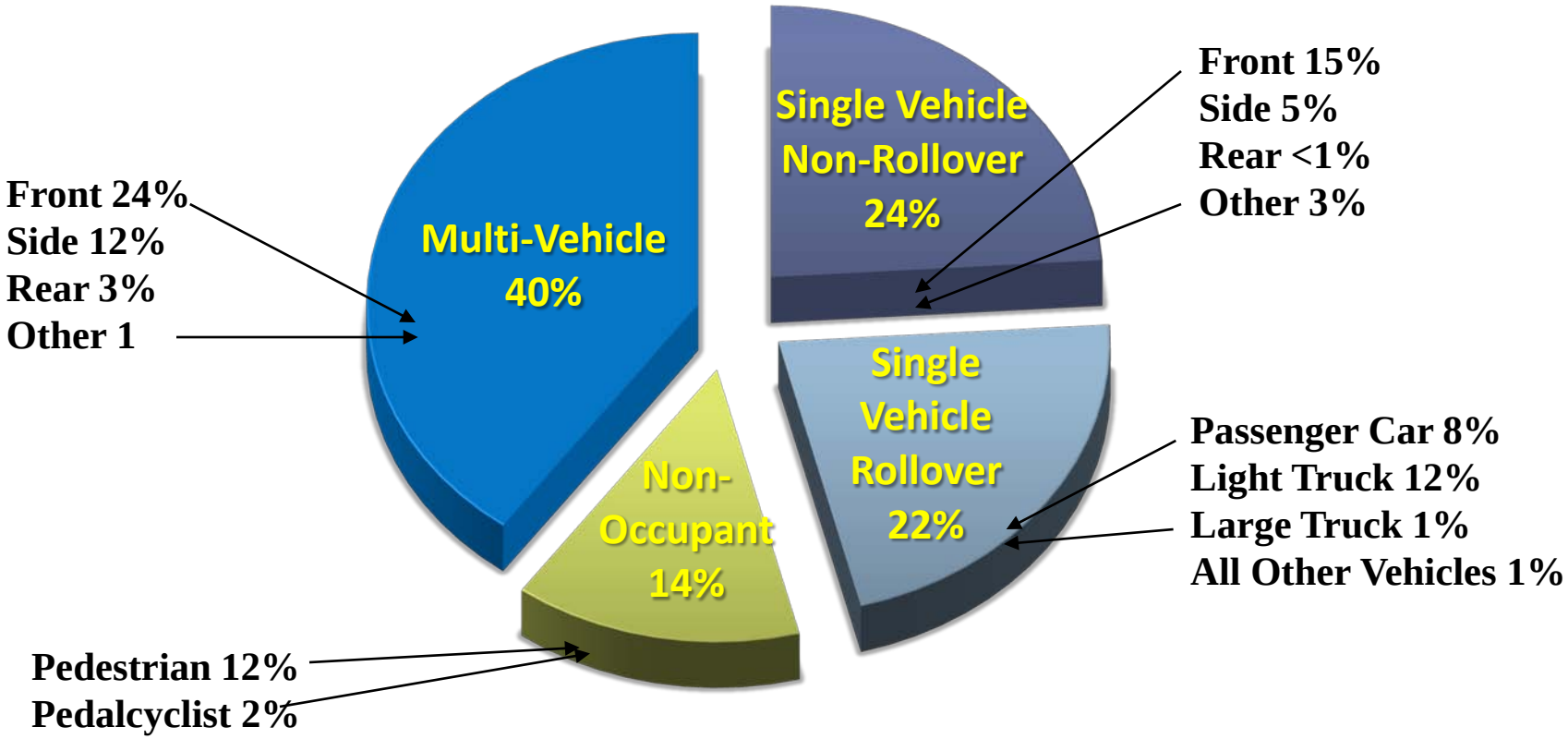
- 4,200,000,000 hours of travel delay
- $80,000,000,000 cost of urban congestion

Environment

- 2,900,000,000 gallons of wasted fuel



Fatalities in Motor Vehicle Traffic Crashes 2009



Human Error is Critical Reason for 93% of Crashes

	Crash Avoidance		Crashworthiness	
	NORMAL DRIVING	CRASH IMMINENT	CRASH EVENT	POST-CRASH
PASSENGER CARS/TRUCKS	• Driver Distraction • Driver Support Systems • Blind Spot Detection • Alcohol Detection • Drowsy Driver Detection •V2V & V2I •Human Factors/HMI •Automation	•Forward Crash Warning •Lane Departure Warning • Lane Keeping • Lane change/Blind Spot •Automatic Braking • Connected Vehicles [Vehicle-to-Vehicle (V2V) Communication]	• Dynamic Rollover • Oblique/Off-set Frontal • Adaptive Restraints • Child Side Impact • Elderly Occupants • ….	• Auto Crash Notification • Advanced ACN • Medical Outcome (CIREN) • First Responder Safety
HEAVY VEHICLES - Truck/Bus	• Driver Distraction • Drowsy Driver Detection • Enhanced Vision Systems • Blind Spot Detection •V2V & V2I •Human Factors/HMI •Automation	• ESC/RSC •Forward Collision Warning • Lane Change Warning • Automatic Braking • Lane Keeping •V2V	• Underride	
MOTORCYCLES	• Conspicuity •Automation?	• ABS/CBS • V2V	• Helmet Use • Airbags	• ACN
PEDESTRIANS	• Quiet Car Detection • Lighting Systems for Peds •Automation	• Pedestrian Warning • Automatic Braking • V2P	• GTR – Hoods / Bumpers	•ACN

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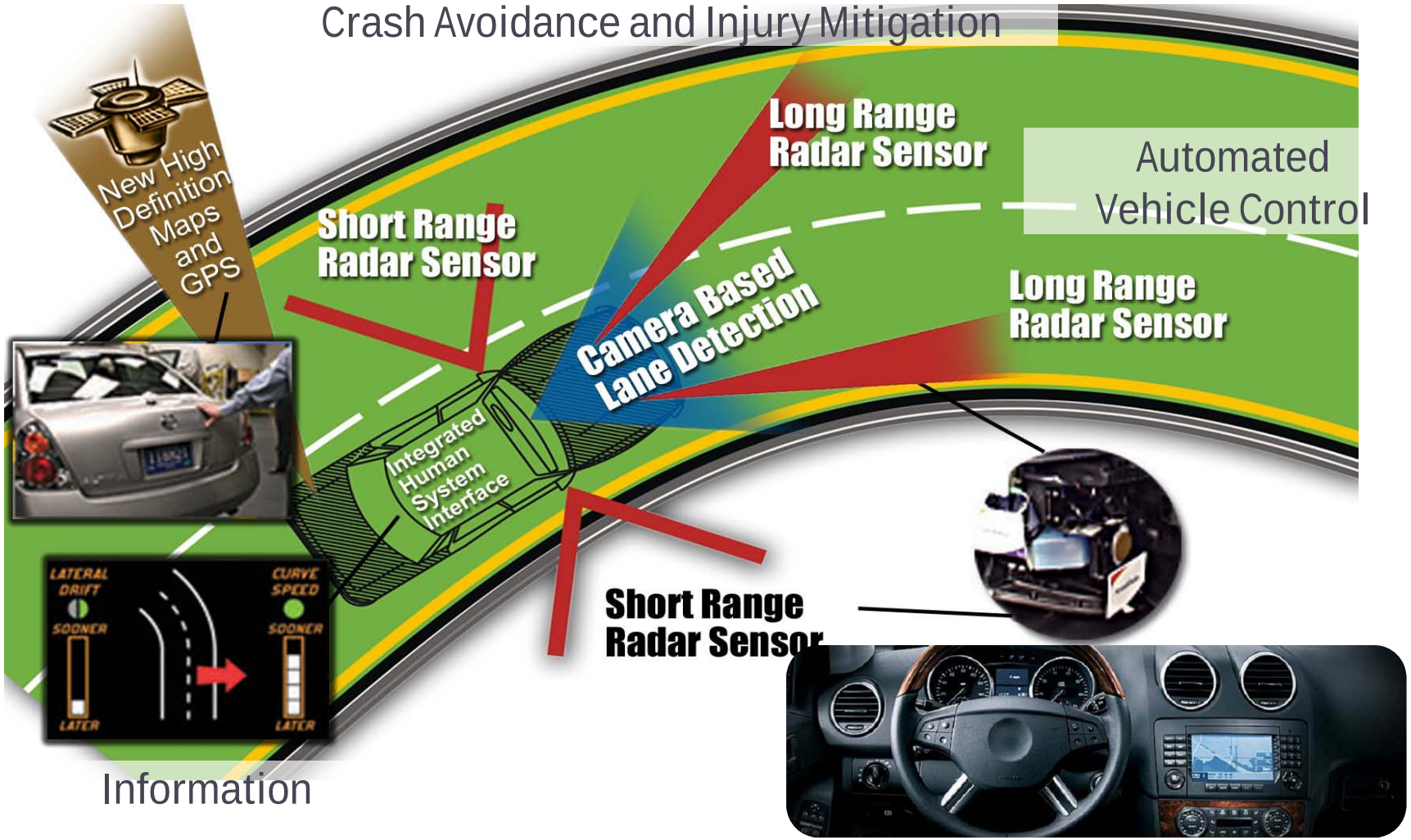
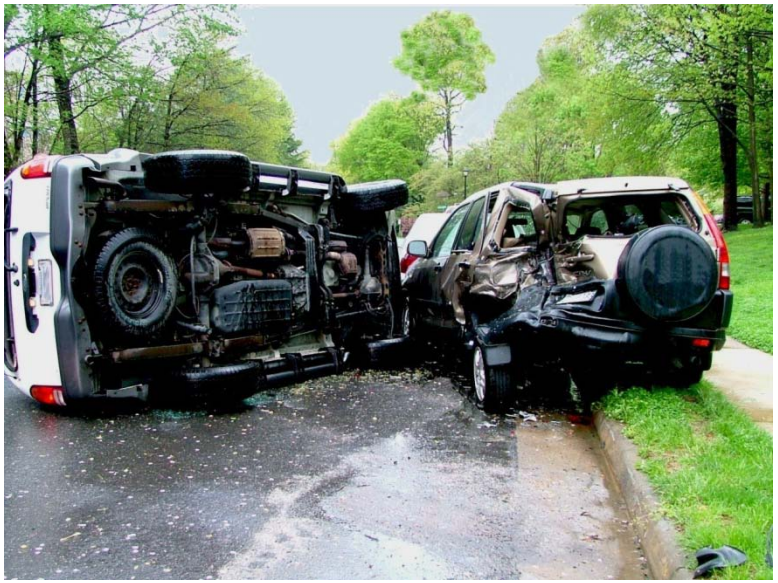
Evolution of Vehicle Electronics



Focus on Safety

- Automation should be focused first on safety
- Not enough to be “as safe” as human drivers
- Automated car goal: “crash-less”



Definitions are Important

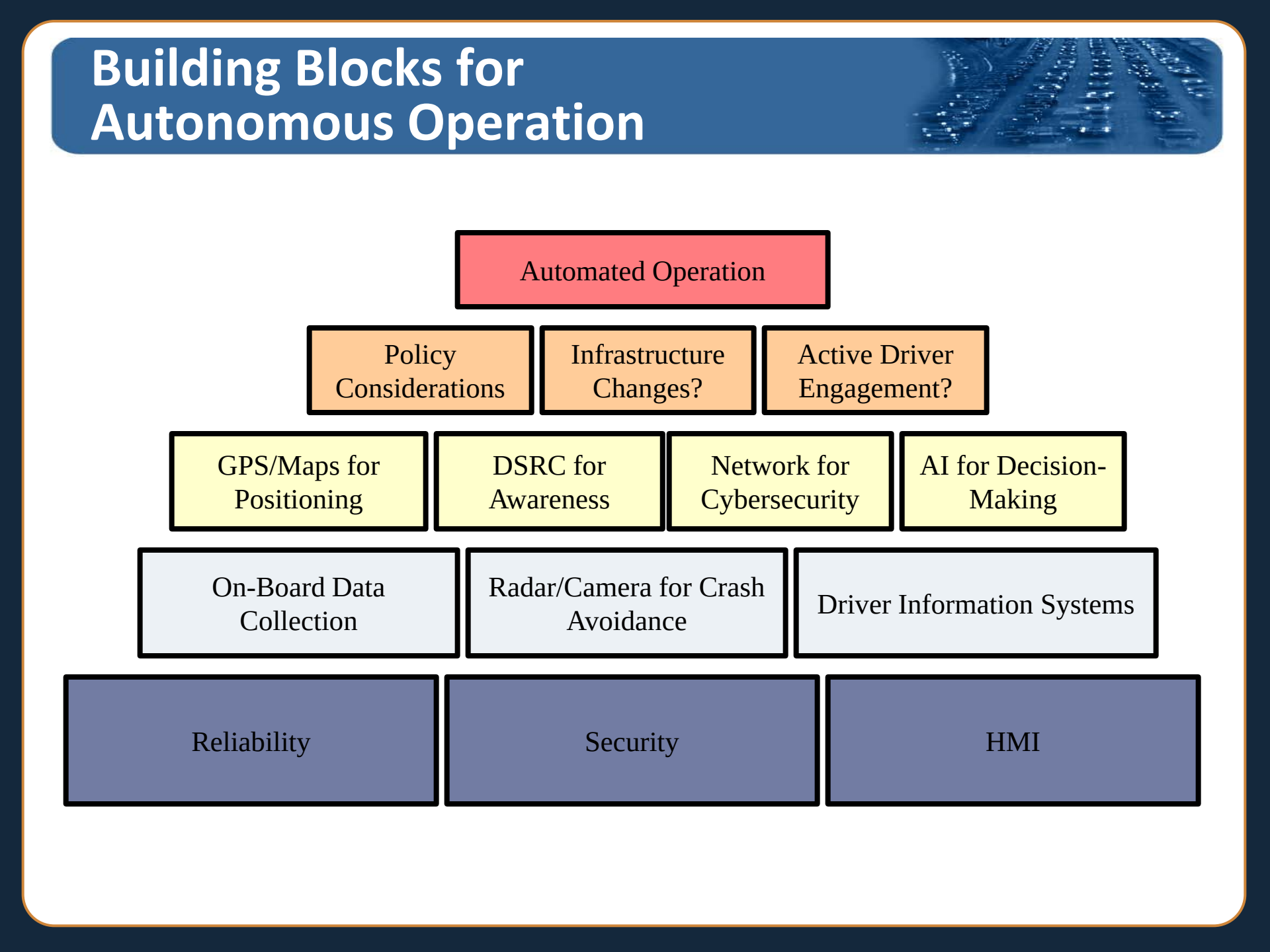
- **Autonomous**
  - "not subject to control from outside; independent" *
  - "undertaken or carried on without outside control" #
- **Automated**
  - "automatically controlled operation of an apparatus, process or system by mechanical or electronic devices that take the place of human labor" #
- **Cooperative**
  - "acting together for a common purpose or benefit" *

Sources: * http://dictionary.reference.com
http://www.merriam-webster.com/dictionary

Levels of Automation (NHTSA Draft)

	Monitoring Roadway	Active Control	Responsibility for Safe Operation	Driver/Occupant Availiability
Level 0 - Non-Automated	D	D	D	Y
Level 1 - Automated-Assisted	D	D and R	D	Y
Level 2 - Monitored Automation	D	R	D	Y
Level 3 - Conditional Automation	R	R	R?	Y
Level 4 - Full Automation	R	R	R?	N
D= Driver				
R= Robot				

Building Blocks for Autonomous Operation



Automation Challenges Include:

- **Human Factors (Driver Engagement/Re-engagement)**
- **Sensor Performance**
- **Artificial Intelligence Decision-Making Capability**
- **Electronic Control Systems Safety**
- **Cybersecurity**
- **Testing and Evaluation Methodology**
- **Regulatory Approaches:**
  - Performance requirements/objective testing for various levels of automation.
  - Standardization - Are different concepts for achieving automation compatible on the roadway?
- **Operating environment - operating in mixed traffic and on public roads?**
- **Infrastructure modifications**
- **Liability**
- **etc…….**

Motor Vehicle Automation Research Roadmap

<u>Goal:</u> to improve motor vehicle safety by investigating the requirements for automated driving that is:

- **Operational only to the extent granted by the driver**
  - Including override capability
- **Electronically Reliable and Secure**
  - Functionally safe w/appropriate data storage/diagnostics/prognostics
  - Secure from malicious external control and tampering
- **Operationally intuitive for drivers**
  - under diverse driving conditions
  - within limits understood by the driver
- **<u>Focused on reducing crashes!</u>**

Motor Vehicle Automation Research Roadmap

Objectives

1. **Support policy decisions on emerging system concepts (Level 2 and Level 3 systems)**
   - Near production concepts are already here
2. **Facilitate development/deployment of safety enhancing automated systems**
   - Defining concepts of automated operation including the integration of safety systems [safety enhancing concepts]
   - Developing technical requirements and associated performance tests
   - Assess safety benefits & system performance

Motor Vehicle Automation Research Roadmap

Efforts

1	2	3	4	5	6
Support Policy Decisions	Program Planning/ Knowledge Base	Develop System Performance Requirements	Address Electronic Control Systems Safety	Improve Driver Awareness & Response	Evaluate System Operability
Complete human factors studies to evaluate emerging concepts	Evaluate critical issues. Synthesize findings to define critical research gaps	Performance requirements for automation levels and associated system concepts	Reliability and cybersecurity requirements	Driver-Vehicle Interface (DVI) criteria and guidelines Driver Training & Licensing req'ts	• Develop obj. tests • Define safety and perf. metrics • Complete Evaluation studies • Estimate Benefits

Outcomes

Automation Challenges Can be Met

- **The goal is a worthy one**
- **Great potential for improving vehicle safety**
  - And other transportation goals
- **NHTSA establishing a comprehensive research plan**
- **Will require collaboration**
  - product developers,
  - insurers,
  - academia,
  - state and federal governments,
  - and many others…..

THANK YOU!

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