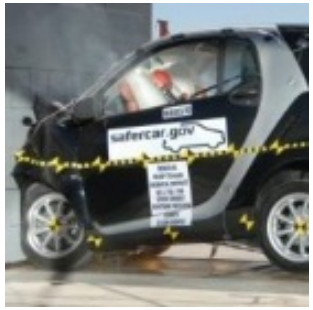

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Automation of Vehicle Safety Functions

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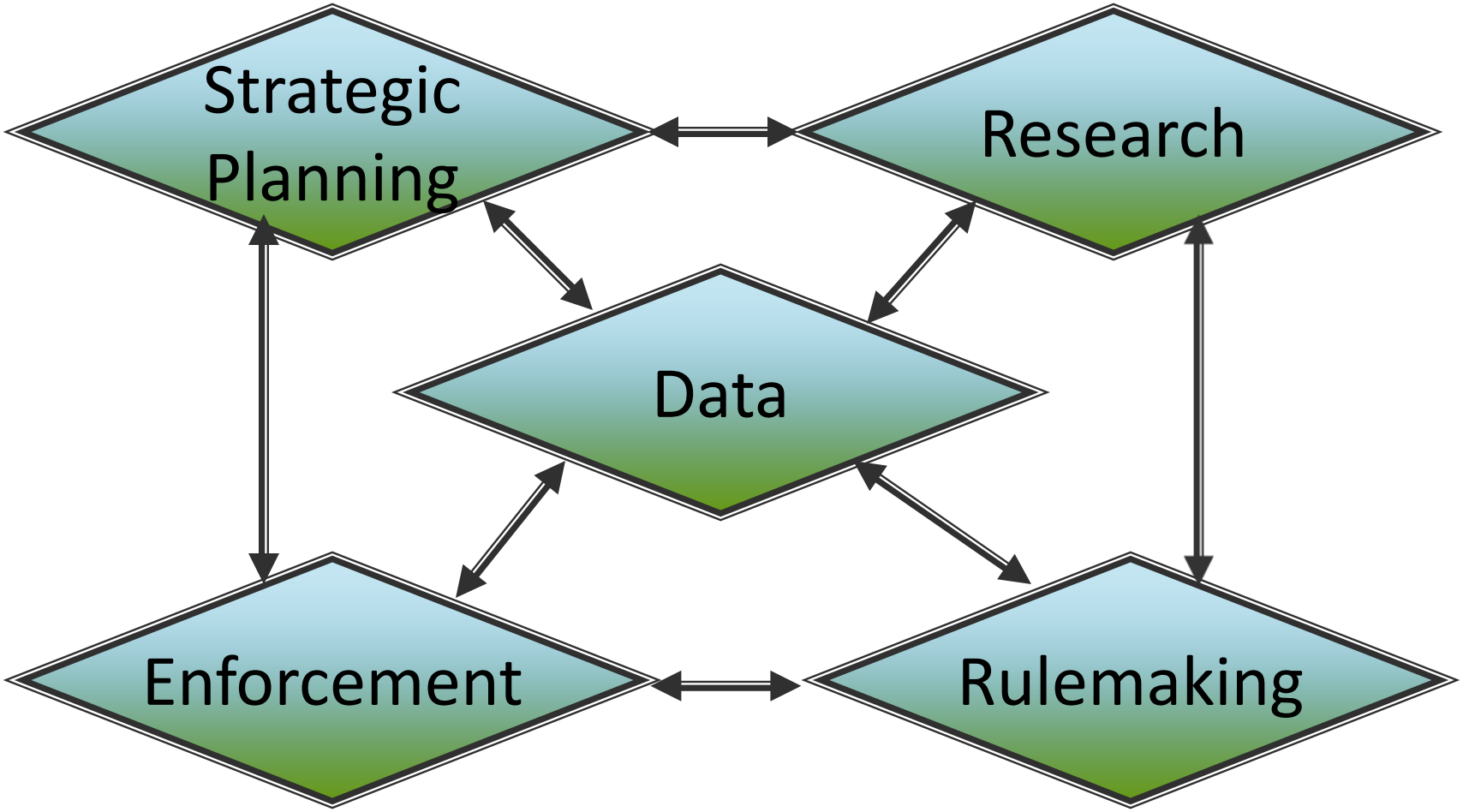
for Vehicle Safety

NHTSA's Office of Vehicle Safety (NVS)

- **National Center for Statistics and Analysis**
  - Data Acquisition, Traffic Records and Analysis, National Driver Register, Regulatory Analysis and Evaluation
- **Vehicle Safety Research**
  - Vehicle Research and Test Center, Vehicle Crashworthiness Research, Vehicle Crash Avoidance and Electronic Controls Research
- **Rulemaking**
  - Crashworthiness, Crash Avoidance, International Standards, Fuel Economy and Consumer Programs
- **Enforcement**
  - Defects Investigations, Compliance, Recalls, Odometer Fraud

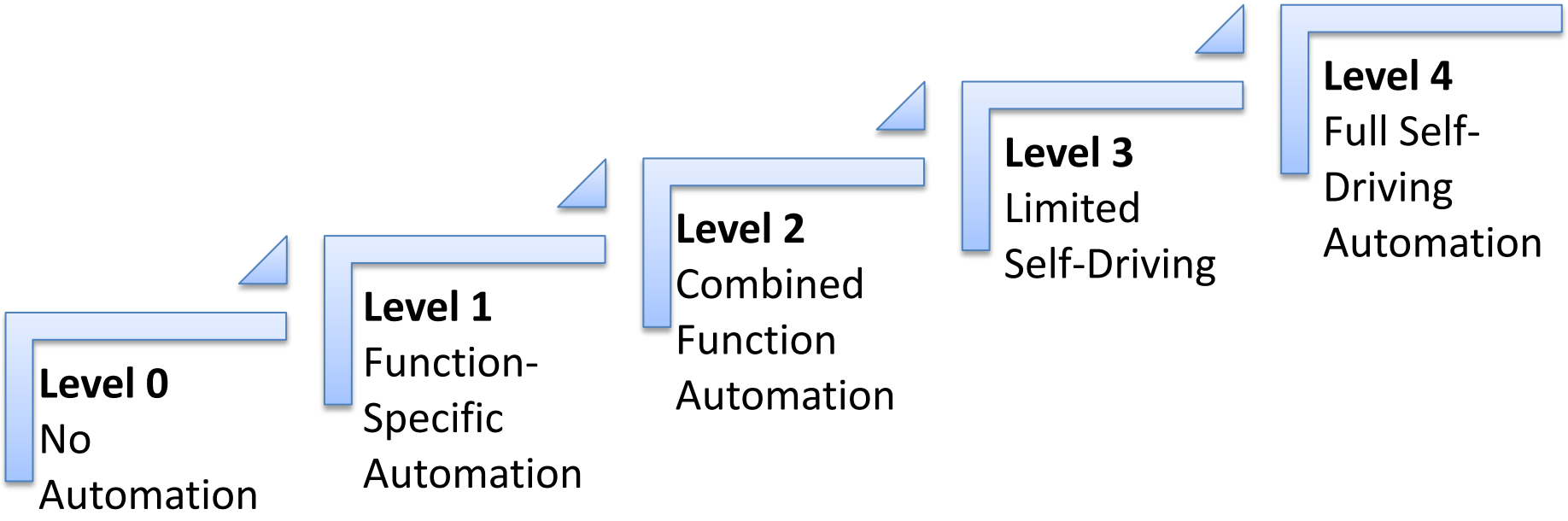
NVS Process and Organizational Relationship



Streams of Vehicle Innovation

- **Crash avoidance systems**
  - Warnings: blind spot, lane departure, forward collision
  - Active control: automatic braking, lane keeping
- **Self-driving vehicles**
  - Active control of safety functions, automatic route following
- **Vehicle-to-vehicle communications (V2V)**
  - May complement any level of warning and automation by providing data from nearby vehicles

Levels of Automation



LEVELS OF AUTOMATION: NHTSA'S SUGGESTED DEFINITIONS

Level 0 (No automation):

- The human is in complete and sole control of safety-critical functions (brake, throttle, steering) at all times.

Level 1 (Function-specific automation):

- The human has complete authority, but cedes limited control of certain functions to the vehicle in certain normal driving or crash imminent situations.
- Examples: adaptive cruise control, ESC, automatic braking (but not in combination so as to enable hands-off-steering wheel/foot-off-pedal operation)

LEVELS OF AUTOMATION: NHTSA'S SUGGESTED DEFINITIONS

Level 2 (Combined function automation)

- Automation of at least two control functions designed to work in harmony (e.g., adaptive cruise control and lane centering) in certain driving situations.
- Enables hands-off-wheel and foot-off-pedal operation.
- Driver still responsible for monitoring and safe operation and expected to be available at all times to resume control of the vehicle.

LEVELS OF AUTOMATION: NHTSA'S SUGGESTED DEFINITIONS

Level 3 (Limited self-driving)

- Vehicle controls all safety functions under certain traffic and environmental conditions.
- Human can cede monitoring authority to vehicle, which must alert driver if conditions require transition to driver control.
- Driver expected to be available for occasional control.

LEVELS OF AUTOMATION: NHTSA'S SUGGESTED DEFINITIONS

Level 4 (Full self-driving automation)

- Vehicle controls all safety functions and monitors conditions for the entire trip.
- The human provides destination or navigation input but is not expected to be available for control during the trip.
- Responsibility for safe operation rests solely on the automated system.

NHTSA'S ROLE

- Others will develop vehicle automation technologies
- NHTSA will determine how to ensure safety benefits are widely enjoyed and potential safety risks addressed
- Research plan on automation aims to
  - Ensure safe shared vehicle control between the driver and automated driving modes (driver-vehicle interface requirements)
  - Develop performance requirements for emerging automation vehicle concepts to ensure safe operation in mixed traffic/public roads
  - Develop methods to comprehensively test automated vehicles
  - Ensure electronic control systems safety and cybersecurity