# Automated Vehicle Safety Consortium™
*A Program of SAE ITC*

**2020**

# Data Collection
# Best Practice Overview
## Sept 14th, 2020

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*For Informational Purposes*

**https://avsc.sae-itc.org/**

# SAE Group



**SAEITC**
An SAE International Affiliate
(PA not-for-profit Corp)
IRC 501(c)(6)

**Automated Vehicle Safety Consortium™**
A Program of SAE ITC

| | |
|---|---|
| ARINC IA | WMC/PIN |
| ASPQP | IAMTS |
| SAE AMS-AMDC | Mobility Data Collaborative |
| ExchangeWell | DATC |
| IBIS | Probitas |
| AESQ | HRCS |

**SAE INTERNATIONAL®**
(PA not-for-profit Corp)
IRC 501(c)(3)

Standards

Conferences

Publications

Professional Development

Pre-professional

Sections

**PRI**
PERFORMANCE REVIEW INSTITUTE
(PA not-for-profit Corp)
IRC 501(c)(6)

Process accreditation

| | |
|---|---|
| Nadcap | MedAccred |
| Quality Mgt | Registrar |
| Training | Bodies of Knowledge |

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# AVSC's Mission

**Vision:** Public acceptance of SAE L4/L5 automated driving systems as a safe and beneficial component of transportation through industry consensus.

**Mission:** The mission of the Automated Vehicle Safety Consortium is to **quickly** establish safety principles, common terminology, and best safety practices, **leading to standards** to **engender public confidence** in the safe operation of SAE L4/L5 light duty passenger/cargo on-road vehicles ahead of their widespread deployment.

• Inform AV pilot projects / deployments as they become more widespread

• Leverage safety expertise and culture of safety

• Publish our work to accelerate formal, global standards

• Consortium Members implement as appropriate within their organizations

# How We Work



**Technology neutral**

- Describe the "what" and leave the "how" for each organization to determine



**Complementary**

- Leverage and reference the good work of others

- Complement the work of others, avoiding duplication



**Common interest**

- Openly share current practices of common interest

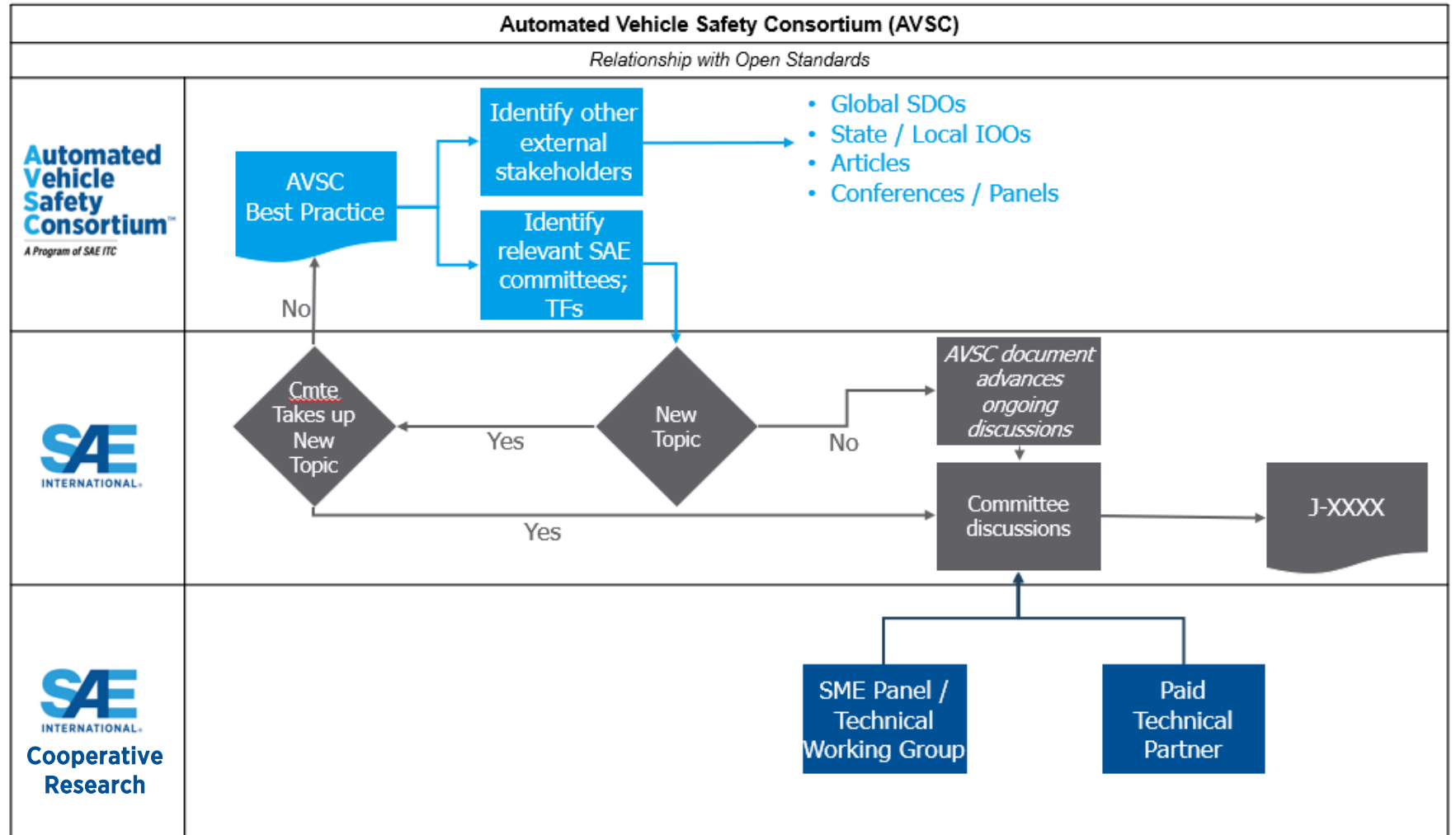- Describe challenges to consensus



**Accelerate standards**

- Introduce work to SAE and global SDOs

- Best practices are easily accessible

# Accelerate Standards Development

AVSC best practices introduced into committees for discussion, modification, and potential inclusion into SAE J-standards and / or other global standards development work

# Our Work Themes

- **Testing** - prior to and when operating AVs on public roads

- **Interaction** - between AVs, their users, and other road users

- **Data** – to reconstruct certain events and share lessons learned with industry

# Published Best Practices

*In-Vehicle Fallback Test Driver Selection, Training, and Oversight Procedures for Automated Vehicles Under Test*

**Published Nov 2019**

- Addresses the qualifications and training for on-board human oversight of testing for automated driving system (ADS)-operated vehicles.

  ➢ *Integrated in SAE J3018 (currently in ballot)*

*Describing an Operational Design Domain: Conceptual Framework and Lexicon*

**Published Apr 2020**

- Addresses a conceptual framework and lexicon manufacturers and developers can use in describing the ODD for their ADS-operated vehicles and communicating this with users and public.

- Provides an initial list of *potential* variables with definitions that manufacturers and developers can use in describing the ODDs.

  ➢ *New SAE work-in-progress pending*

# Published Best Practices

## *Passenger-Initiated Emergency Trip Interruption*

- Recommended processes for passenger-initiated emergency features in SAE level 4 and 5 fleet-managed ADS-DV operations.

- ADS-DVs should be equipped with a Passenger-initiated Emergency Stop (PES) feature, or a Passenger-initiated Emergency Call (PEC) feature, or both.

- Criteria and processes for passenger initiation of the features from inside a vehicle, communication with passengers, communication with fleet operations, enhanced diagnoses of situation, interaction outside the vehicle with other road users, and general post-stop actions.

  ➤ *New SAE work-in-progress pending - joint effort between Driving Automation Systems Committee and On-Road Automated Driving Committee*
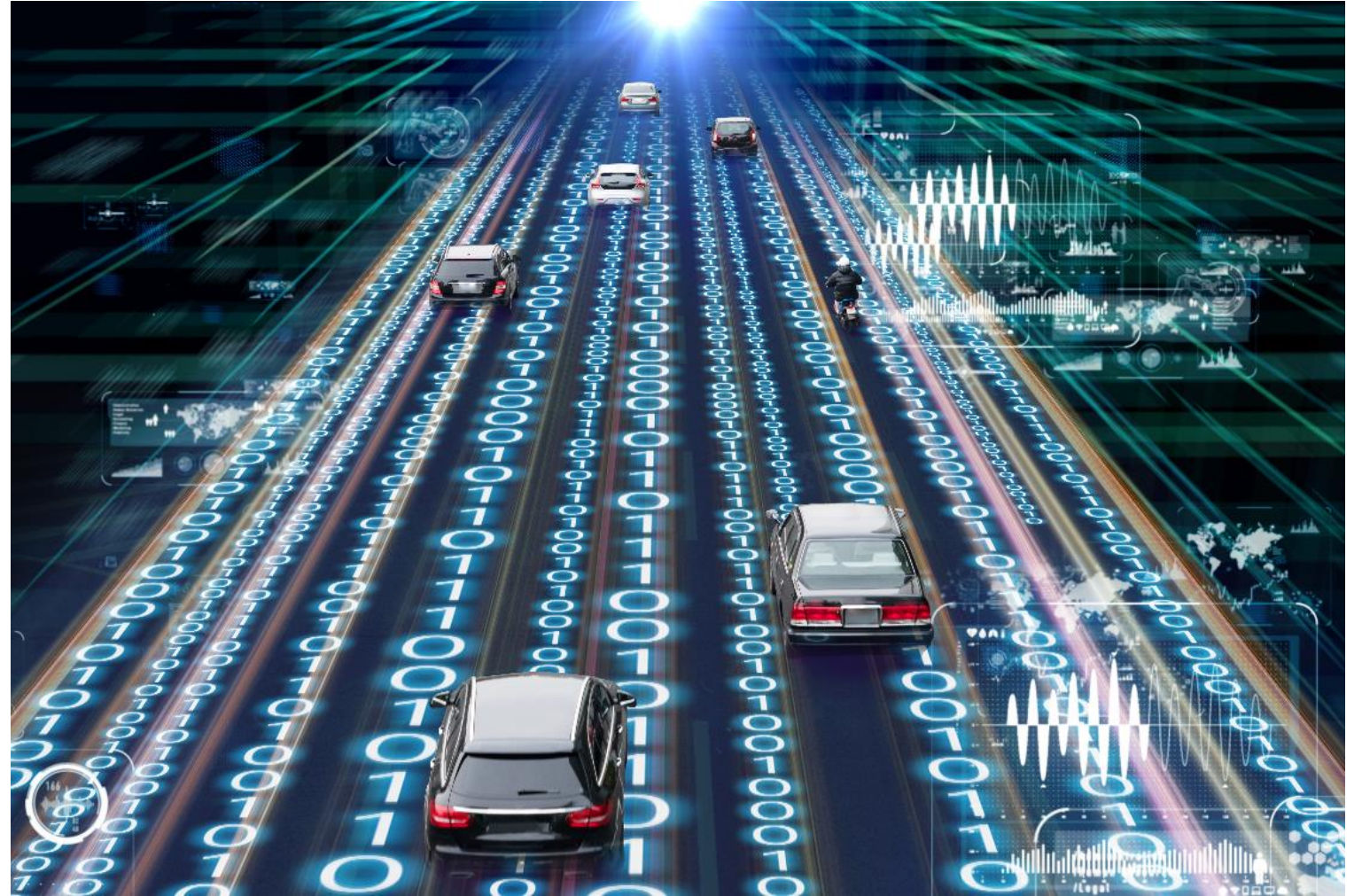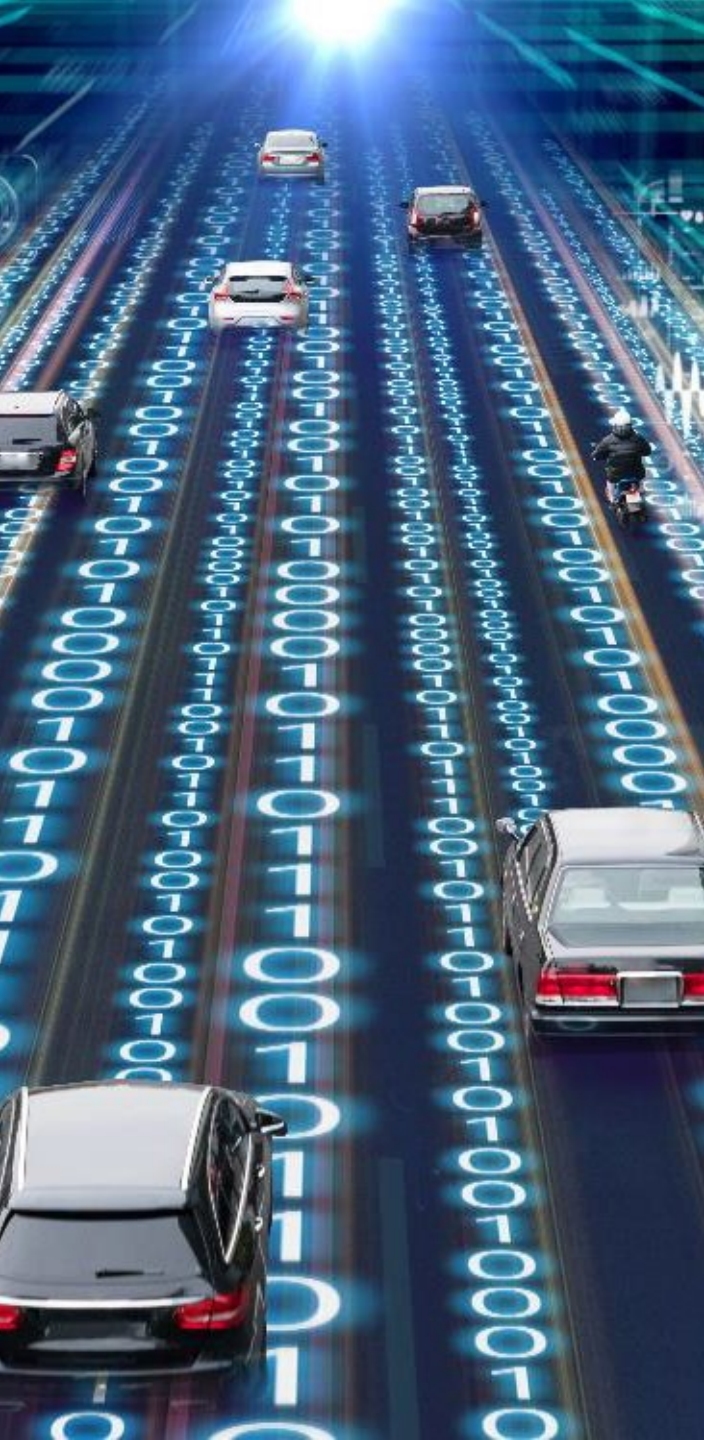
**Published Jun 2020**

# Data Collection for Automated Driving System-Dedicated Vehicles to Support Event Analysis

# Data Collection for ADS-DVs to Support Event Analysis

Why -

- Data recording important for crash reconstruction, system performance investigations and event analysis to improve industry-wide safety

- Data recording needs are evolving
    - ➤ Automated driving system takes the place of a human driver
        - o Perceives the environment
        - o Handles vehicle motion control, i.e., the dynamic driving task

- Current definition of impact based on triggers no longer sufficient to capture collisions traditionally detected by humans

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# Data Collection for ADS-DVs to Support Event Analysis

## What -

- Addresses common data collection practices for SAE L4/L5 AVs, for the **purpose of event analysis and producing lessons learned**

- **Compliments current motor vehicle event data collection standards** (including SAE J1698-1 and SAE J3197) and clarifies areas specific to ADS-DVs

- Provides definition of data elements, considerations for data prioritization, retrievability, survivability, storage, and traceability

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# Definition of event

- *Event* defined as collision or collision-like situation

- Lack of consensus for what constitutes a collision for event reporting makes it challenging for ADS-DVs to determine
  - State reporting requirements vary
  - Criteria described in terms of dollar value
  - Impacts with domesticated but not undomesticated animals

- In addition to triggering conditions specified in SAE J1698 family of standards:
  - Deployment of a non-reversible restraint, such as airbags
  - Change in vehicle velocity that equals or exceeds 8 km/h within a 150 ms interval
  - Events causing failures that result in the ADS performing DDT fallback
  - Other events

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# Data Elements

**Thirty-nine (39) data elements** recommended for ADS-DVs to collect to support event analysis

- **Fourteen (14) new data elements** specific to ADS-DVs
- Twenty-five (25) identified from previously defined or legacy data collection standards

*Breakdown of data elements by relation to other SAE data collection standards*

| New data elements | Adapted from SAE J3197 (different) | Adapted from SAE J1698 (different) | From SAE J3197 (used "as is") | From SAE J1698 (used "as is") |
|---|---|---|---|---|
| 14 | 8 | 8 | 4 | 5 |

# Data Element Categories

- Vehicle control – "What the ADS did"

- Saliency – "What the ADS thought was important"

- Sensing- "What the sensors saw"

- "General parameters"

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# Vehicle Control
## "What the ADS did"

- ADS Action
  - ADS Requested Hazard Flasher
  - ADS Requested Headlights
  - ADS Requested Turn Signals
- Vehicle Indicated
  - Hazard Flasher Status (from SAE J1698-1)
  - Headlight Status (adapted from SAE J1698-1)
  - Turn Signal Status (from SAE J1698-1)

- ADS Mode (adapted from SAE J1698-1)
- ADS Action – ADS Requested Pedestrian Communication Device
- Failure Mitigation Strategy Activated
- (from SAE J1698-1)

- ADS Determined – Reference Vehicle Speed (adapted from SAE J1698-1)
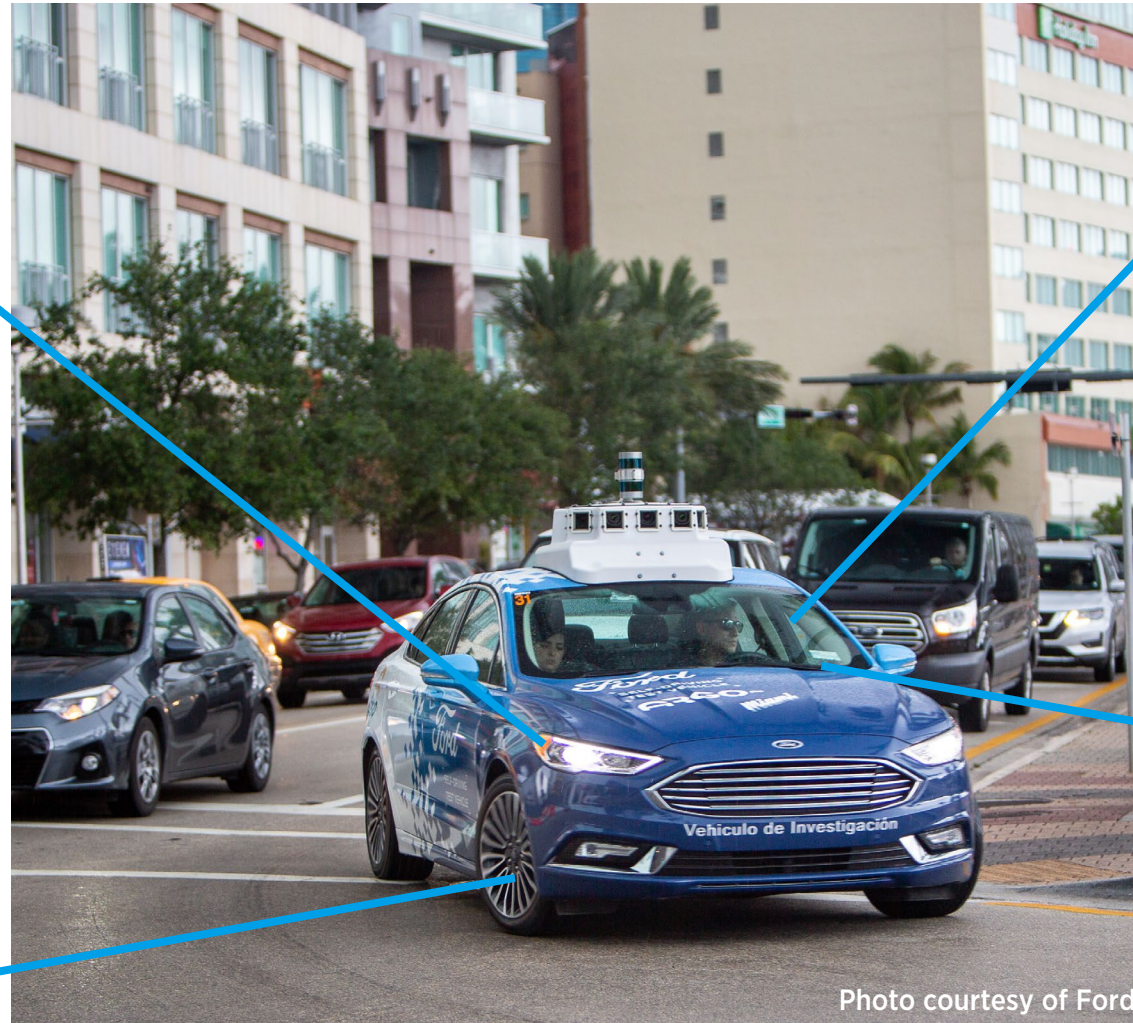- Vehicle Indicated – Speed (adapted from SAE J1698-1)

- ADS Determined – Reference Vehicle Steering Position
- Vehicle Indicated – Steering Position Actual (adapted from SAE J1698-1)

- Vehicle Indicated – Gear Position (from SAE J1698-1)
- ADS Action
  - ADS Requested Gear (from SAE J3197)
  - ADS Requested Lateral Vehicle Motion Control (adapted from SAE J3197)
  - ADS Requested Longitudinal Vehicle Motion Control (adapted from SAE J3197)



Photo courtesy of Ford

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# Saliency
## "What the ADS thought was important"



Salient Object(s) Detected
– Vehicle Backup Light Status
– Vehicle Brake Lights Status
– Vehicle Emergency Light Status
– Vehicle Hazard Flasher Status
– Vehicle Turn Signal Status

Salient Object(s) Detected
– Classification
– Identification Number (ID)

Salient Object(s) Detected
– Relative Position (from SAE J3197)
– Relative Velocity
  (adapted from SAE J3197)

Salient Object(s) Detected – Traffic Control Device State
(adapted from SAE J3197)

Salient Emergency Vehicle Warning(s) Detected
(from SAE J3197)

Salient Object(s) Detected – Lane Delineation and Channelization

Photo courtesy of Ford

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# Sensing and General Parameters
## "What the sensors saw"



- Visual Representation (adapted from SAE J3197)
- Other Sensor and Input Data

- Time of day (adapted from SAE J3197)
- Vehicle Location (adapted from SAE J3197)

Passenger-Initiated Emergency Trip Interruption Activation (adapted from SAE J3197)

Vehicle Identification Number (VIN) (from SAE J1698-1)

- ADS Relevant Health Status (adapted from SAE J1698-1)
- Data Record Trigger Type (adapted from SAE J3197)

Photo courtesy of Ford

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# Data Element Prioritization

**Priority 1 -** Likely to be most relevant to ADS-related event analysis. Most important to recover from a vehicle.

**Priority 2 -** Secondary value to ADS-related event analysis. Important to recover from a vehicle, as long as recording of Priority 1 data elements is not negatively impacted.

**Priority 3 -** Tertiary value to ADS-related event analysis. Important to recover, as long as recording of Priority 1 and 2 data elements is not negatively impacted.

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# Recording Considerations

- Recommend **recording interval of 5 seconds prior to time zero**

- Recommended frequency based on needs of event analysis

- Recording system should be capable of recording at least one event

- Should have a method for synchronization and correlation

# Data Handling

- Retrievability
  - Support industry standard tools
  - Compliant with industry data security standards (ISO/SAE 21434 and SAE J3061)

- Survivability
  - Current technology may not meet current requirements
  - Goal is to reach similar survivability CFR Part 563.10

- Storage
  - Recording may include off-board systems for storage and processing

- Traceability
  - ADS-DV should be uniquely identified with Vehicle Identification Number (VIN)

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# 2020 Topics

- **Data collection (September 2020)**

- **1st Responder interaction**

- **ADS Safety Assurance**
  - ➢ Phase 1: Metrics & methods
  - ➢ Phase 2: Behavioral competencies

- **Safety management system (SMS)**

# Contact Us

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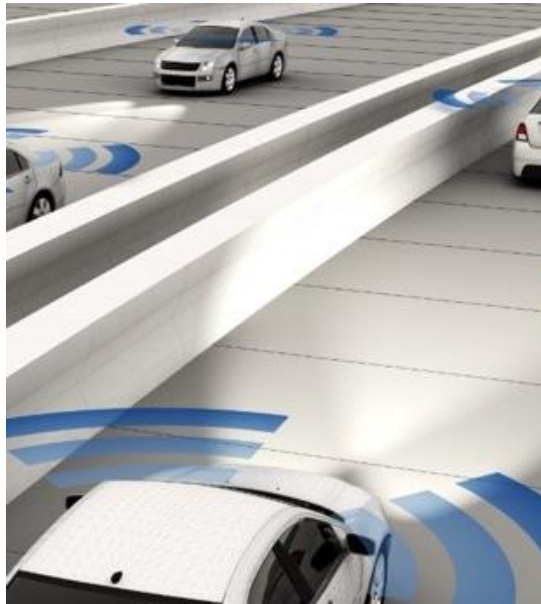amy.chu@sae-itc.org

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# AVSC Best Practice: Data Collection for ADS-DVs to Support Event Analysis

## THANK YOU

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