Document FRAV-09-03
9th FRAV session, 12 January 2021

9th Session Status Review and Session Orientation

Web Conference

12 January 2021

FRAV

Today's Agenda

1. Adoption of the agenda
2. Adoption of the reports of the previous sessions
3. FRAV status and consensus to date
4. ADS level of safety
5. Elaboration of the five starting points
6. Updates to Documents 4 and 5
7. Highlights from the 8th GRVA session
8. Next steps and deliverables

Adoption of the Agenda

Agenda item		Documentation
1. Adoption of the agenda	12:30-12:35	FRAV-09-01
2. Adoption of the reports of the previous sessions	12:35-12:40	FRAV-07-02 FRAV-08-02
3. FRAV status and consensus	12:40-12:45	FRAV-09-03 (Co-chairs)
4. ADS level of safety 4.1. Guiding principle 4.2. Research needs	12:45-13:05	
5. Elaboration of ADS safety requirements 5.1. Consideration of subtopic list (additions, if any) 5.2. Consideration of "drive safely" subtopics	13:05-14:15	FRAV-08-09 (Co-chairs) FRAV-09-07 (Japan)
6. Documents 4 and 5 updates	14:15-14:30	FRAV-09-05 (Secretary) FRAV-09-06 (SAE)
7. Highlights of the 8th GRVA session 7.1. FRAV deliverables (AV Framework Document) 7.2. Integration of FRAV and VMAD output 7.3. Artificial intelligence	14:30-14:50	
8. Next Steps and Deliverables	14:50-15:00	

Adoption of the Reports

1. Adoption of the agenda
2. Adoption of the reports of the previous sessions
   - FRAV-07-02 (confirmation of adoption)
   - FRAV-08-02 (request for comments, if any)
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Review of FRAV Points of Consensus (1/2)

1. "*Automated Driving System*" (ADS) means the hardware and software that are collectively capable of operating a vehicle on a sustained basis.
2. FRAV requirements specifically regard the ADS and its performance in the operation of a vehicle.
3. Operational Design Domain (ODD) refers to the operating conditions under which an ADS is designed to function.
4. ADS may be designed to function under more than one discrete set of operating conditions (i.e., more than one ODD).
5. "*(ADS) feature*" means an application of ADS hardware and software designed specifically for use within an ODD.
6. An ADS may have one or more features as defined by their unique ODD.
7. "*Operational Design Domain*" means the operating conditions under which an ADS feature is specifically designed to function.
8. In operation, the ADS continuously controls the vehicle motion, monitors the vehicle environment, interacts with other road users, and determines responses to road and traffic conditions (collectively known as the Dynamic Driving Task (DDT)).
9. The ADS has functions that collectively perform the entire DDT while the ADS is in use.
10. The ADS monitors the functions and safely manages failure modes when detected.
11. The ADS functions enable the features to operate the vehicle within the ODD of the feature.
12. An ADS feature may use all or some of the functions of the ADS.
13. ADS features may share ADS functions.
14. An ADS should be assessed based on its intended use(s) and limitations on the use of its features.
15. ADS requirements should be technology-neutral and performance-based.

Review of FRAV Points of Consensus (2/2)

16. ADS requirements should be applicable across the anticipated diversity of configurations (i.e., features and functions).
17. ADS assessments require information specific to the configuration of the ADS (i.e., features, functions, ODD, other usage specifications).
18. Manufacturers provide the information specific to the ADS design and intended uses.
19. FRAV will define mandatory requirements for ADS descriptions (i.e., ODD elements, other usage specifications).
20. The manufacturer description of the ADS provides a means to determine the application of the ADS performance requirements.
21. The NATM process should begin with a review of the ADS description to verify fulfillment of the mandatory description requirements and to determine the application of the performance requirements.
22. The ADS requirements should be derived from the following safety perspectives:
    - The ADS should drive safely.
    - The ADS should interact safely with the user.
    - The ADS should manage safety-critical situations.
    - The ADS should safely manage failure modes.
    - The ADS should maintain a safe operational state.

No comments received since the last session.

If there are reservations, concerns, or questions regarding these points, please convey them to the FRAV secretary. FRAV will address the issues at a future session.

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   - Document 5, para. 3.2.
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Overall Level of Safety

ADS performance should be consistent with safe human driving behaviors while avoiding human recognition, decision, and performance errors and the introduction of unreasonable ADS-specific risks.

Table 2. Driver-Related Critical Reasons

Critical Reason	Estimated (Based on 94% of the NMVCCS crashes) Number	Percentage* ± 95% conf. limits
Recognition Error	845,000	41% ±2.2%
Decision Error	684,000	33% ±3.7%
Performance Error	210,000	11% ±2.7%
Non-Performance Error (sleep, etc.)	145,000	7% ±1.0%
Other	162,000	8% ±1.9%
Total	2,046,000	100%

*Percentages are based on unrounded estimated frequencies
(Data Source: NMVCCS 2005–2007)

"consistent" means compatible with human-dominated traffic and within parameters derived from safe driving data.

- ✓ "Careful and competent human driver"
  - Build out data on human responses to traffic situations
- ✓ "State-of-the-art" based on technological feasibility
  - Define technical parameters within range of optimal human behaviors
- ✓ "Safety envelope"
  - Mathematical formulas based on technical parameters and conditions
- ✓ Statistical "positive risk balance"
  - Optimal human behaviors omitting human errors

Implications of Safety Principle: Research

- Safe human driving behaviors
  - Human driver actions or maneuvers in navigating traffic
  - Human driver performance (e.g., perception, decision, action, response ranges)
- Crash causation factors
  - Further breakdown of recognition, decision, performance, and non-performance errors
- ADS capabilities related to elimination of crash causation factors
  - Parameters where needed to ensure safe responses
- ADS-specific needs (→ Safety topic discussions)
  - Human use safeguards, ODD conditions/boundaries, etc.

Implications of Safety Principle: Validation

- Improve road transport: Contribute to road transport safety and efficiency
- Performance based: Define minimum performance thresholds/ranges
- Technology neutral: Avoid design/technology specifications
- Measurable: Objectively verifiable or measurable
- Feasibility: Reasonably attainable given the current state of ADS technologies
- Social acceptance: Yield performance that meets public expectations

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   - Document 5, Section 5 "ADS Performance Requirements"
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FRAV Discussion Topics

- Agreed to a “top-down approach” to defining safety requirements
- Agreed to five “starting points” from which to derive specifics
- Agreed to 34 “discussion topics” derived from:
  - Five starting points
  - FRAV “common functional requirements” based on OICA/CLEPA work
  - 142 candidates gathered across all stakeholders
  - Input from stakeholders during sessions 3-7
- Agreed to proceed through each of the discussion topics individually
  - Further define stakeholder interests and aims for ADS safety
  - Identify options for describing desired outcomes in measurable/verifiable terms

Performance Requirement Starting Points

1. ADS should drive safely. (Ensure safe behavior of the ADS as “the driver”)
2. ADS should interact safely with the user. (Ensure safe use of ADS and safe interactions with the user such as transfers of control, user override, etc.)
3. ADS should manage safety-critical situations. (Differentiate between normal driving and emergency situations to ensure safe responses to the latter)
4. ADS should safely manage failure modes. (Ensure safe responses to system malfunction, physical damage, etc.)
5. ADS should maintain a safe operational state. (Ensure safety throughout the useful life of the ADS, such as safety critical updates, response to obsolescence)

FRAV Subtopics

1. The ADS should drive safely
    1. The ADS should perform the entire Dynamic Driving Task.
        1. The ADS should control the longitudinal and lateral motion of the vehicle.
        2. The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s).
        3. The ADS should detect, recognize, classify, and prepare to respond to objects and events in the traffic environment.
    2. The ADS should respect traffic rules.
    3. The ADS should interact safely with other road users.
    4. The ADS should adapt its behavior in line with safety risks.
    5. The ADS should adapt its behavior to the surrounding traffic conditions.
        1. The ADS should not disrupt the flow of traffic (ref. string stability)
    6. The ADS behavior should not be the critical factor in causation of a collision.
2. The ADS should interact safely with the user
3. The ADS should manage safety-critical situations
4. The ADS should safely manage failure modes
5. The ADS should maintain a safe operational state

FRAV Subtopics

1. The ADS should drive safely
2. The ADS should interact safely with the user
    7. Activation of an ADS feature should only be possible when the conditions of its ODD have been met.
    8. The ADS should signal when conditions indicate a probable ODD exit.
    9. The user should be permitted to override the ADS to assume full control over the vehicle.
    10. The ADS should safely manage transitions of control to the user.
        1. Prior to a transition of control to the user, the ADS should verify the availability of the user to assume control.
        2. Pursuant to a transition, the ADS should verify full control of the vehicle by the user prior to deactivation.
    11. The ADS should tolerate user input errors.
    12. The ADS should provide feedback to the user on its operational status.
    13. The ADS should warn the user of failures to fulfill user roles and responsibilities.
    14. The user should be provided with information regarding user roles and responsibilities for the safe use of the ADS.
    15. ADS vehicles that may operate without a user-in-charge should provide means for occupant communication with a remote operator.
    16. Upon completion of an MRM, a user may be permitted to assume control of the vehicle.
3. The ADS should manage safety-critical situations
4. The ADS should safely manage failure modes
5. The ADS should maintain a safe operational state

FRAV Subtopics

1. The ADS should drive safely
2. The ADS should interact safely with the user
3. The ADS should manage safety-critical situations
    17. The ADS should recognize and respond to road-safety agents.
    18. The ADS should mitigate the effects of road hazards.
    19. The ADS should execute a safe fallback response as conditions warrant.
    20. In the absence of a fallback-ready user, the ADS should automatically achieve a Minimal Risk Condition (MRC).
    21. The ADS should place the vehicle in an MRC in the event of a failed transition of full control to the user.
    22. The ADS should achieve a Minimal Risk Condition (MRC) prior to deactivation.
    23. The ADS should signal its intention to place the vehicle in an MRC.
    24. The ADS should safely manage short-duration ODD exits.
    25. Pursuant to a collision, the ADS should stop the vehicle and deactivate.
4. The ADS should safely manage failure modes
5. The ADS should maintain a safe operational state

FRAV Subtopics

1. The ADS should drive safely
2. The ADS should interact safely with the user
3. The ADS should manage safety-critical situations
4. The ADS should safely manage failure modes
   26. The ADS should detect system malfunctions and abnormalities.
   27. The ADS should execute a safe fallback response upon detection of a failure that compromises performance of the DDT.
   28. Provided a failure does not compromise ADS performance of the entire DDT, the ADS should respond safely to the presence of a fault in the system.
   29. The ADS should signal faults and resulting operational status.
5. The ADS should maintain a safe operational state
   30. The ADS should be permanently disabled in the event of obsolescence.
   31. Pursuant to a collision and/or a failure detected in DDT-related functions, ADS activation should not be possible until the safe operational state of the ADS has been verified.
   32. The ADS should signal required system maintenance to the user.
   33. The ADS should be accessible for the purposes of maintenance and repair to authorized persons.
   34. ADS safety should be ensured in the event of discontinued production/support/maintenance.

“Drive safely” subtopics

5.1.1. The ADS should perform the entire Dynamic Driving Task.

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5.1.2. The ADS should respect traffic rules.

5.1.3. The ADS should interact safely with other road users.

5.1.4. The ADS should adapt its behavior in line with safety risks.

5.1.5. The ADS should adapt its behavior to the surrounding traffic conditions.

5.1.5.1. The ADS driving behavior should not disrupt the flow of traffic.

5.1.6. The ADS behavior should not be the critical factor in the causation of a collision.

What are the desired performance outcomes?

Example of impact on Document 5

5.3.6. The ADS should manage short-duration transitions between ODD ➔ safely manage short-duration ODD exits.

5.3.6.1. The duration of an ODD exit may be known (navigating ramps from one highway to another) or unknown (encountering a weather condition such as fog that may be brief or extended).

5.3.6.2. The ODD exit may be planned or unplanned.

5.3.6.3. In principle, the response to an ODD exit should be a transfer of control to the user.

5.3.6.4. Transfers in response to ODD exits could involve a period of cooperation between the user and the ADS until the ADS can verify that the user is in full control of the vehicle.

5.3.6.5. In some cases, the ODD exit may require execution of an MRM.

5.3.6.6. It may be beneficial to permit the ADS to resume control if the duration of the ODD exit is known or proves to be short-lived.

5.3.6.7. FRAV should consider whether an ODD exit is definitive (always resulting in a complete transfer of control to the user) or may be partial in some cases (the ADS may interrupt the transfer and resume control).

5.3.6.8. Based on discussions of transfers in response to planned and unplanned ODD exits, user interactions and communications, and other related topics, FRAV should reach conclusions regarding instances where an ODD exit may be short-lived (possibly including a maximum permissible limit during which an ADS may interrupt a transition and resume control).

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   - FRAV-08-04: Document 4 status
   - FRAV-08-05/FRAV-09-05: Document 5 status
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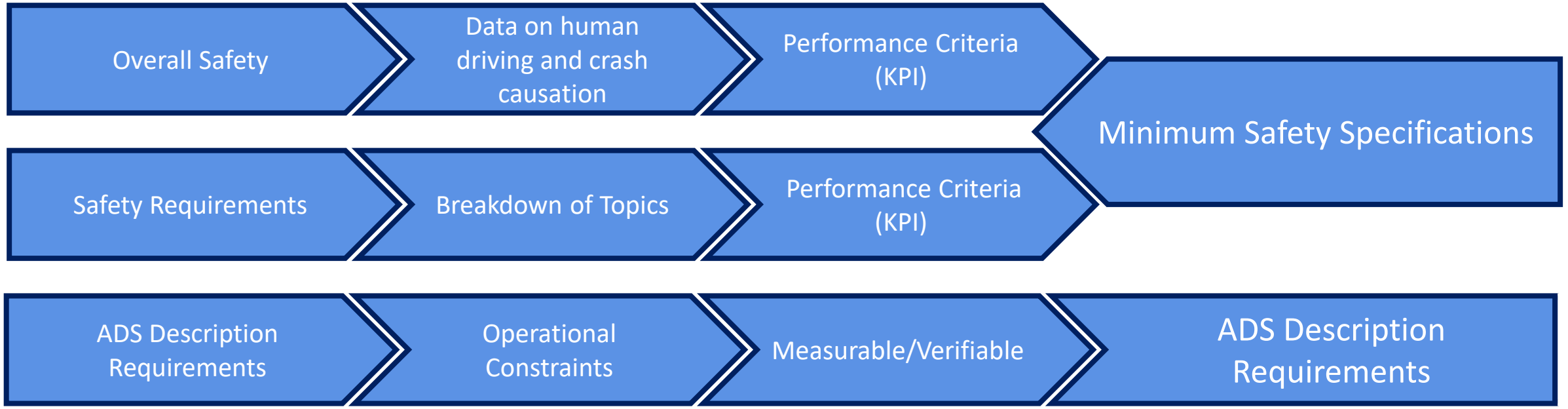
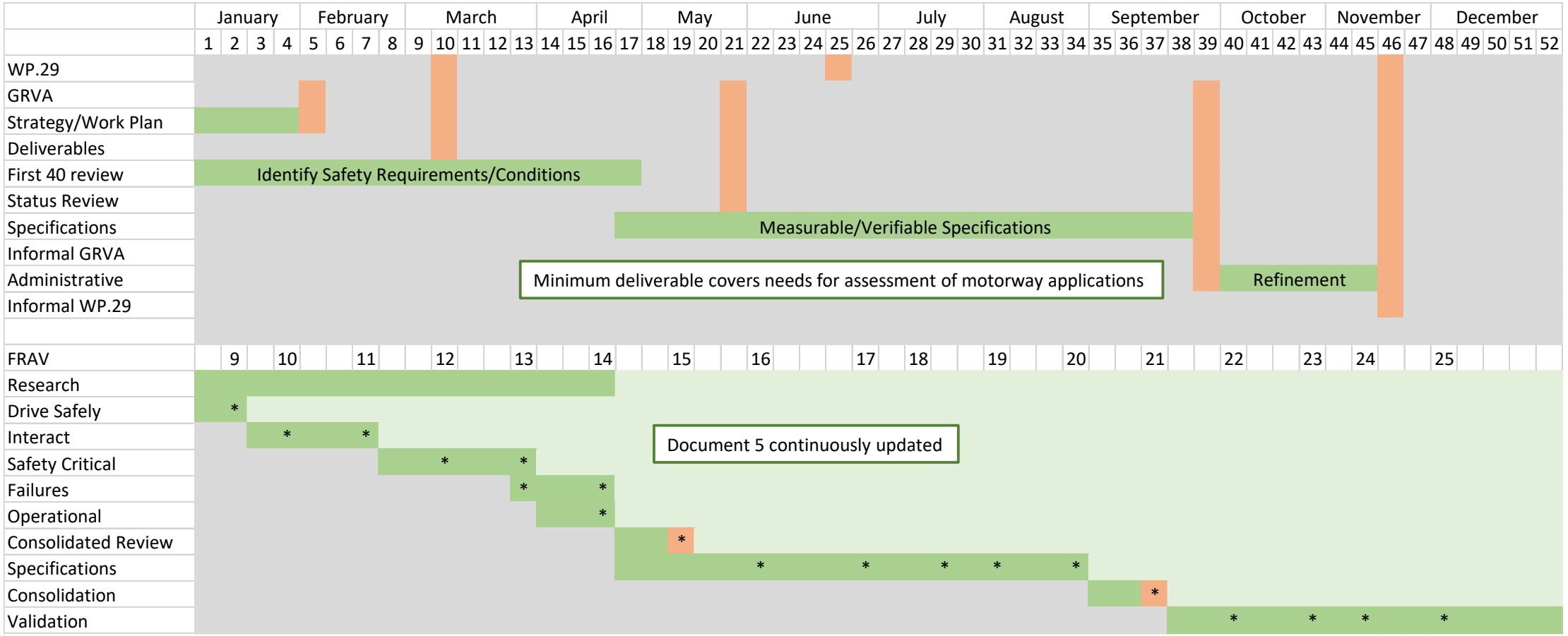
Work streams

Proposal for three parallel and complementary work streams.

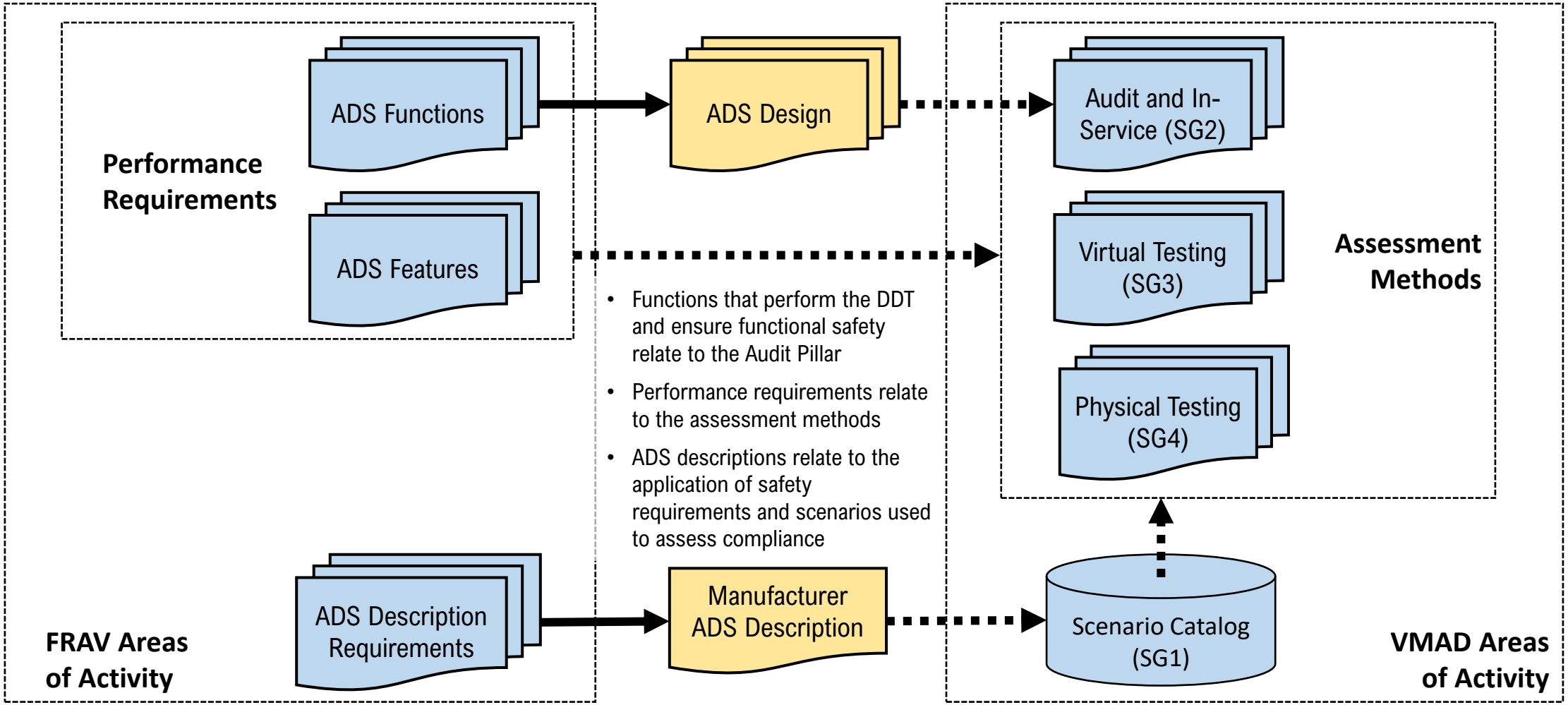


FRAV 2021 deliverables



WP.29 and GRVA wish to update the AV Framework Document with deliverables for 2021-22. FRAV should provide its views for the February GRVA session. "Motorway ADS" has been proposed as a "proof of concept".

FRAV Interfaces with VMAD



Artificial Intelligence

- Definition of AI?
- Harmonized view of AI and machine-learning as applicable to our work?
- What aspects would be applicable?
- How does this fit into regulations (i.e., government action to regulate AI-related technologies)?
- Should ADS safety requirements address AI?
- Would an AI application make changes to the ADS software?
- ITU: Extreme caution should be used in allowing active AI in vehicle (as opposed to AI used to develop and then freeze production software package).
- Impact of AI on users of ADS?

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Next session

- Next session 27 January
  - Review FRAV submission(s) to GRVA
  - Review updates introduced in FRAV-10-05
    - Synthesis of FRAV-09 safety topic discussion
  - Consider input on human driving, crash causation, etc.
  - Continue discussion of safety topics
- Provide submissions by 20 January to facilitate 10th session preparations
- Proposal for 11th FRAV session on [17] February

Next session preparation requests

- Comments on FRAV-09-05
  - Further comments on “drive safely” topics
  - Input on “interact safely with the user” topics
- Input on typical driving maneuvers (VMAD SG1 scenarios?)
- Input on crash causation
- Deadline for written submissions: 20 January