Document ADS-05-30
5th ADS-IWG session
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# ADS-IWG Phase 2
# Simulation credibility
## Requirements and assessment

ADS-IWG 5th session
Seoul - 09-13/12/2024

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# Summary

- 3 meetings since ADS-IWG 4th (London)
  - Further round of review on Phase 1 text
  - Brainstorming on assessment

✓ Completed the review of the draft provisions from ID (GRVA-20-36e)

- Most of requirements are direct transposition from ID
- Some "NEW" requirements albeit inspired by ID

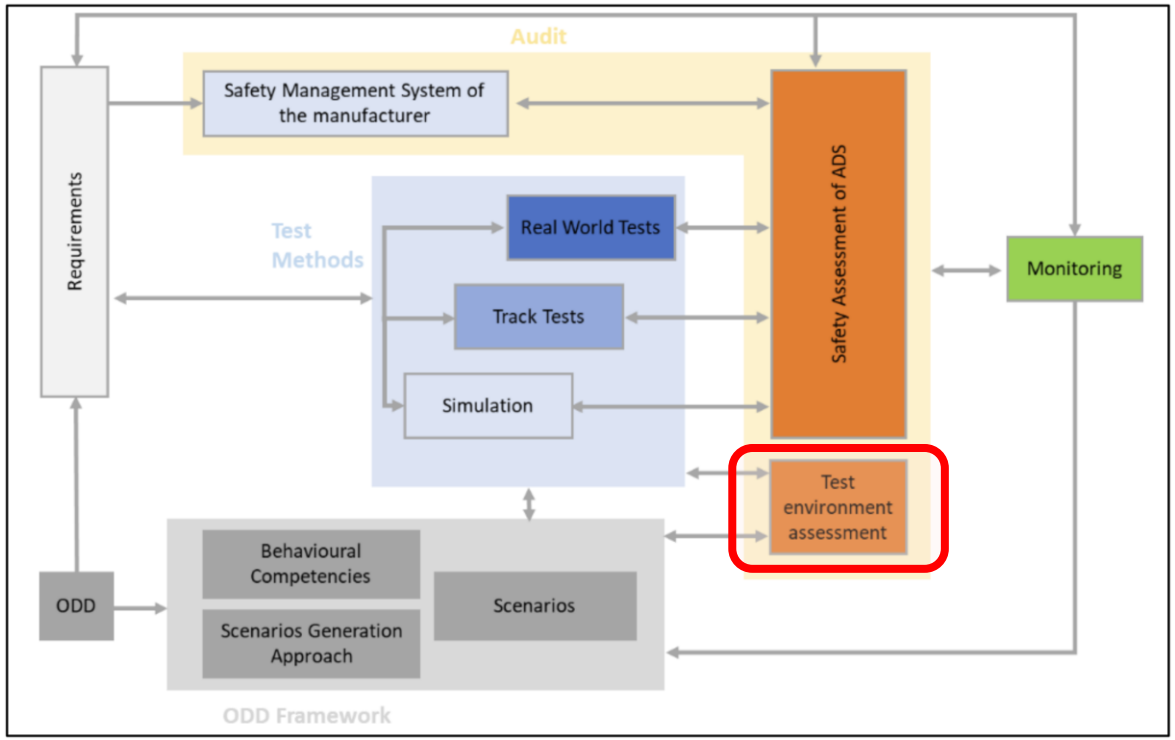
➢ Started the draft of assessment provisions (high-level requirements)

➢ Re-arranged in Table format with reference to ID (traceability)

➢ Consolidated text since summer with only minor amendments

# What is “credibility”

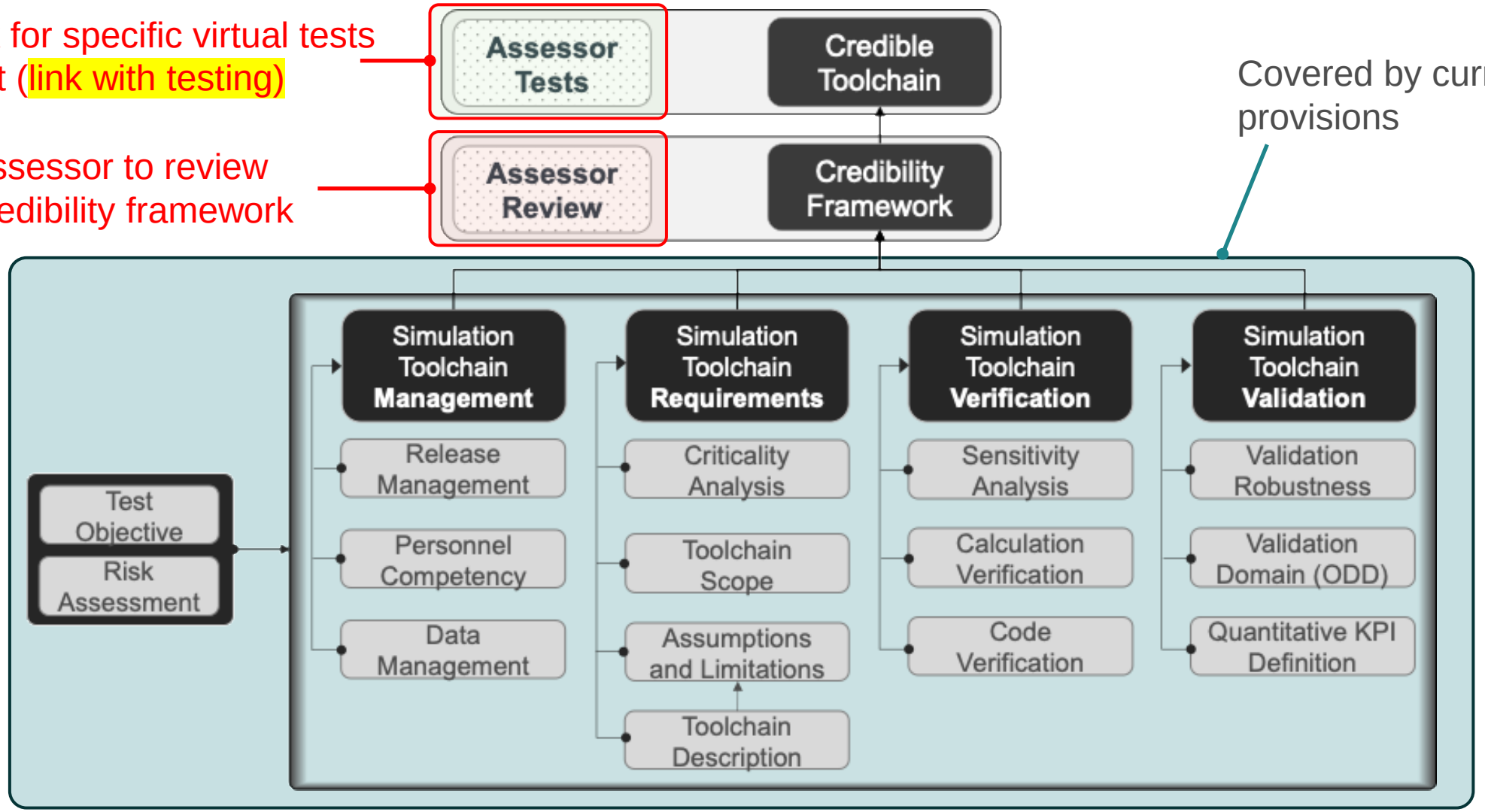
- Qualify a testing toolchain (virtual/physical/mixed) to provide trustable results
- Concept derived from NASA STD7009A/B as part of VMAD SG2
- Other sectors/industries started to use similar approach
- Main idea: **move beyond validation** (i.e. sim results match real data)
- Adapted to fit multipillar approach



# Status of work

Assessor to ask for specific virtual tests to be carried out (link with testing)

Assessor to review credibility framework



# Text structure

- **Section 3:** Definitions:
  - *4 entries: 2 unchanged since London, 1 modified, 1 new*
- **Section 4:** General requirements:
  - *3 entries: unchanged since London*
- **Section 5:** Manufacturer requirements:
  - *54 entries: minor changes since London*
- **Section 6:** Assessment requirements:
  - *3 entries: unchanged since London*

# Definitions

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|---|---|---|---|---|
| 3.1.33. | "*Simulation*" means the imitation of the operation of a real-world process or system over time. | 3.34. | "*Simulation*" means the imitation of the operation of a real-world process or system over time **utilizing a software implementation for some (or all) of the models, tools or test environment.** | **OPI:** not changed from London |
| 3.1.34. | "*Simulation toolchain*" means a combination of simulation tools that are used to support the validation of an ADS. | 3.35. | "*Simulation toolchain*" means **a simulation tool** or a combination of simulation tools that are used to **generate evidence supporting the manufacturer's safety case's claims** | **OPI:** not changed from London |
| 3.1.44. | "*Virtual testing*" means the process of testing a system using one or more simulation models. | 3.44. | "*Virtual testing*" means a type of testing that uses a simulation toolchain**(s)** to ~~assess the performance of the ADS~~ **generate evidence supporting the manufacturer's safety case's claims** | **OPI 7/11/2024**: revised definition to avoid referring to "*ADS' performance*" but to the "*safety case's claims*" |
| **NEW (Adapted from UN-R 155)** | | 3.XX. | "*Post-production phase*" means the period in which an ADS vehicle is no longer produced until the end-of-life of all ADS vehicles of the same type. The phase ends when there are no longer any operational ADS vehicles of a specific ADS type. | **OPI 21/11/2024**: added definition to support 5.8.1.3.3.1. and avoid referring to "*decommissioning*" |

# General requirements

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|---|---|---|---|
| **NEW** | 4.6. | The manufacturer shall demonstrate that the approach to testing is suitable for the demonstration of the safety case and the compliance with performance/functional requirements | |
| **NEW** | 4.6.1. | The manufacturer shall demonstrate that the physical testing (proving ground and/or public road) facilities and environment are suitable for the tests that are being conducted. | |
| **NEW** | 4.6.2. | The manufacturer shall demonstrate that the simulation toolchain(s) is suitable for conducting virtual tests. The requirements for the simulation toolchain(s) are listed in 5.8.1. | **OPI**: to check cross reference after structure is established |

Consider to move these requirements in Safety Case section 5.4.1:

The manufacturer shall provide a safety case that includes:[…]
4) **Demonstration of credibility and suitability of test tool used in generating evidence**

# Document overview

https://wiki.unece.org/download/attachments/254181423/ADS-05-07.docx?api=v2

# Manufacturer requirements 1/1

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|---|---|---|
| Annex 5 – Appendix 1 – 8. The M&S lifecycle is a dynamic process with frequent releases that should be monitored and documented. As a result, it is recommended that management activities should be established to support the M&S through typical product management processes. Relevant information on the following aspects should be included in this section. | 5.8.1.3.3.1. The manufacturer shall manage and support the simulation toolchain(s) used for virtual testing throughout **the** lifecycle **of the simulation toolchain(s). This management and support shall also continue until the end of the post-production phase of the ADS.** | **OPI 21/11/2024**: revised definition following meeting.<br>Avoid use of "decommissioning".<br>Avoid use of unclear pronoun "its" |
| Annex 5 – Appendix 1 – 43 (c). The ADS manufacturer should define the logical scenarios used for virtual testing toolchain validation. They should be able to cover, to the maximum possible extent, the ODD of virtual testing for ADS validation | 5.8.1.4.1.3.3. The manufacturer shall demonstrate that the test selection ~~for simulation toolchain(s) validation~~ is sufficient to **justify the claim** ~~demonstrate~~ that **the simulation toolchain(s)** ~~it will perform effectively~~ **can be used** within the defined scope. | **OPI 21/11/2024**: rephrased to avoid referring to the "validation" in scope section |
| Annex 5 – Appendix 1 – 30. The simulation models and the simulation tools used in the overall toolchain should be investigated in terms of their impact in case of a safety error in the final product. | 5.8.1.4.1.4.1. The manufacturer shall review the **error estimates of the** simulation toolchain(s) to assess the**ir** criticality ~~of prediction errors~~ and the effect these would have on the manufacturer's claims about their safety case. | **OPI 7/11/2024**: rephrased to avoid using unclear "prediction error" statement |

# Manufacturer requirements 2/2

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| Annex 5 – Appendix 1 – 41. The ADS manufacturer should demonstrate that robust calibration procedures have been adopted and that this has identified and calibrated the most critical parameters leading to an increase in the credibility of the developed toolchain. | 5.8.1.5.4.2. The manufacturer shall demonstrate that robust calibration procedures have been adopted for assigning appropriate value(s) to ~~the most critical~~ **all the simulation** parameters **whilst ensuring that special attention is taken for the most critical parameters. This is** to ensure that the simulation toolchain(s) ~~imitates~~ **can be used to emulate the relevant real-world** ~~the physical~~ system. | **OPI 21/11/2024**: rephrased to make sure there is no "unrobust" procedures but parameters might be treated differently depending on the sensitivity analysis outcome |
| Annex 5 – Appendix 1 – 43. The quantitative process of determining the degree to which a model or a simulation is an accurate representation of the real world from the perspective of the intended uses of the M&S. It is recommended that the following items be considered when assessing the validity of a model or simulation: | 5.8.1.6.1. The manufacturer shall **perform a validation analysis to** ~~quantitatively~~ determine the degree to which the simulation toolchain(s) is an accurate representation of the real-world system ~~by means of a validation analysis~~. **The validation analysis shall be based on quantitative metrics.** | **OPI 7/11/2024**: rephrased following UK comment |

# Assessment requirements 1/2

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|---|---|---|
| Annex 5 – Appendix 1 – 4. […] The assessor should investigate the documentation and evidence supporting credibility during the audit phase. It is understood that the actual validation tests will take place once there is sufficient evidence that a simulation tool or toolchain produces credible results. | 6.4.1. The assessor shall review the manufacturer's credibility framework to determine whether the simulation the toolchain(s) is suitable to undertake virtual testing. | |
| **NEW** | 6.4.2. The assessor shall review the documentation and evidence supporting the manufacturer's claims.<br>a) A successful outcome of the assessment will be a confirmation that the claims of the manufacturer about the capability of the simulation toolchain(s), including its scope, are correct and that it can be used to perform the virtual testing as part of the ADS assessment.<br>b) The simulation toolchain(s) can only be used to undertake virtual testing once the credibility of the same has been established. | |

# Assessment requirements 2/2

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|---|---|---|---|
| Annex 5 – Appendix 1 – 43 (g). The assessor should audit the documentation provided by the manufacturer and may carry out tests of the complete integrated tool. If the output of the virtual tests does not sufficiently replicate the output of physical tests, the assessor may request that the virtual and/or physical tests to be repeated. The outcome of the tests will be reviewed and any deviation in the results should be reviewed with the manufacturer. Sufficient explanation is required to justify why the test configuration caused deviation in results. | 6.4.3. | The assessor shall audit the information provided by the manufacturer and may request or carry out additional tests of the simulation toolchain(s) or physical tests. The outcome of the tests shall be reviewed and any concerns or discrepancies shall be raised and reviewed with the manufacturer.<br><br>The manufacturer shall provide an explanation of the discrepancies in the results. If the results from the simulation toolchain(s) do not sufficiently replicate the output of physical test or does not have sufficient scope the assessor shall inform the manufacturer.<br><br>The manufacturer shall conduct extra validation activity and resubmit their information for further assessment. | |

# Open items

- Link between Credibility & SMS (5.8.1.3.X *Management activities*)
- Link between Credibility & Safety Case (4.6 *General Requirements*)
- Level of detail in Assessment:
  - ✓ Option 1: high-level requirements
  - ➢ Option 2: middle-level requirements
  - ➢ Option 3: low-level requirements (is it useful to double manufacturer requirement for the assessor?)
  - ➢ Option 4: Alternate approach (Maturity Level)

# Work ahead

- To complete Assessment provisions (in collaboration with **testing** subgroup)
- To provide provisions on “Documentation Structure” (a.k.a. simulation handbook, guidance from ID)

# Thank you