



Virtual testing within certification

ACOUTRAIN Final Conference
Maria Starnberg, DB – WP5 Leader
Estelle Bongini, SNCF – WP1 Leader

7th November 2014, Brussels



Forewords - Where do we stand now?

ESSENTIAL REQUIREMENTS

1. The TSI limit value is set for predefined operational and environmental conditions as well as receiver positions. These conditions should be identical for the new virtual test procedure.
2. The output result from both procedures should be equivalent. It is a prerequisite that the choice of test procedure should not affect the decision to accept or reject a vehicle.
3. The reliability or the standard uncertainty of both procedures should be comparable.

OUTCOMES FROM ACOUTRAIN

1. Calculations can be computed for representative propagation effects, with receivers located according to TSI requirements. However, some parameters (such as track parameters) have to be fixed for virtual testing (not only max value)
2. For instance, the equivalence between real tests results and virtual tests results could not be demonstrated in ACOUTRAIN: no complete set of input data (regarding virtual testing needs) is available
3. Reliability of real testing has never been fully quantified. Little information about the input uncertainty for the VT implementation: the standard uncertainty of VT procedure is therefore not assessed.

Forewords - Where do we stand now?

ACOUTRAIN project has allowed defining the requirements that are implied when we say « as reliable as... » . But a degree of acceptable uncertainty has not yet been fixed.

It will then be needed to pass the degree of precision required for the output on all the inputs:

- Noise sources characterization
- Noise source modelling
- Numerical tool process

All the requirements declined for the different inputs will have to be addressed before testing the VT process.

Therefore , what is presented hereafter are **PROPOSALS**.

For turning these **proposals into procedures**, we need **several practical cases -real test measurements carried out according to virtual testing needs-** to:

- 1- precisely defined what is “accurate enough”
- 2- validate our proposals



Preliminary concepts for the proposals

VT is based on the building of virtual vehicle which has to be representative of the real vehicle.

The building of such a VV requires a lot of effort and time (particularly concerning the noise sources characterization and the integration effect assessment) to be sufficiently precise and reliable.

To skip this step of VV complete building, a VV already built for another vehicle could be used provided that:

- The 2 vehicles are similar enough
- The VV previously built is fully validated i.e. declared as reference vehicle

In case we have a reference VV similar enough, then we can perform an EoA

In case we don't, then we have to build the VV corresponding to the new vehicle under certification and validate it (with real test measurement). This is the hybrid approach.

Let's go into the details of this procedure...



I have a new vehicle that has to be certified....

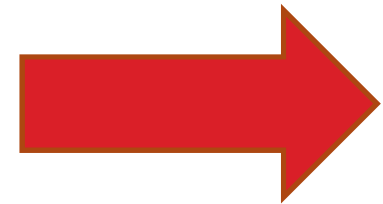
Do I have an existing similar vehicle?
(family part, same design)

Are they similar enough?

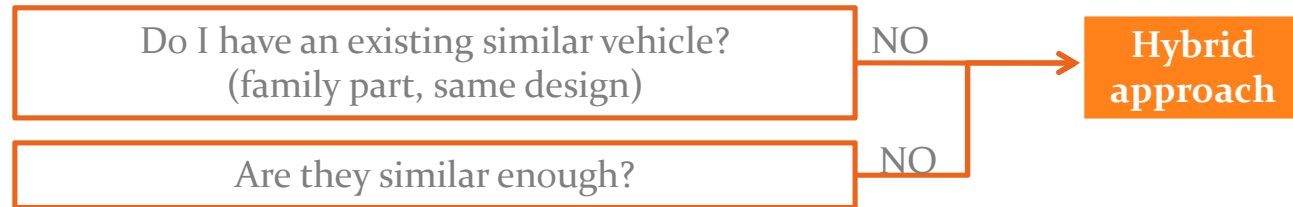
I have a new vehicle that has to be certified....

Do I have an existing similar vehicle?
(family part, same design)

Are they similar enough?



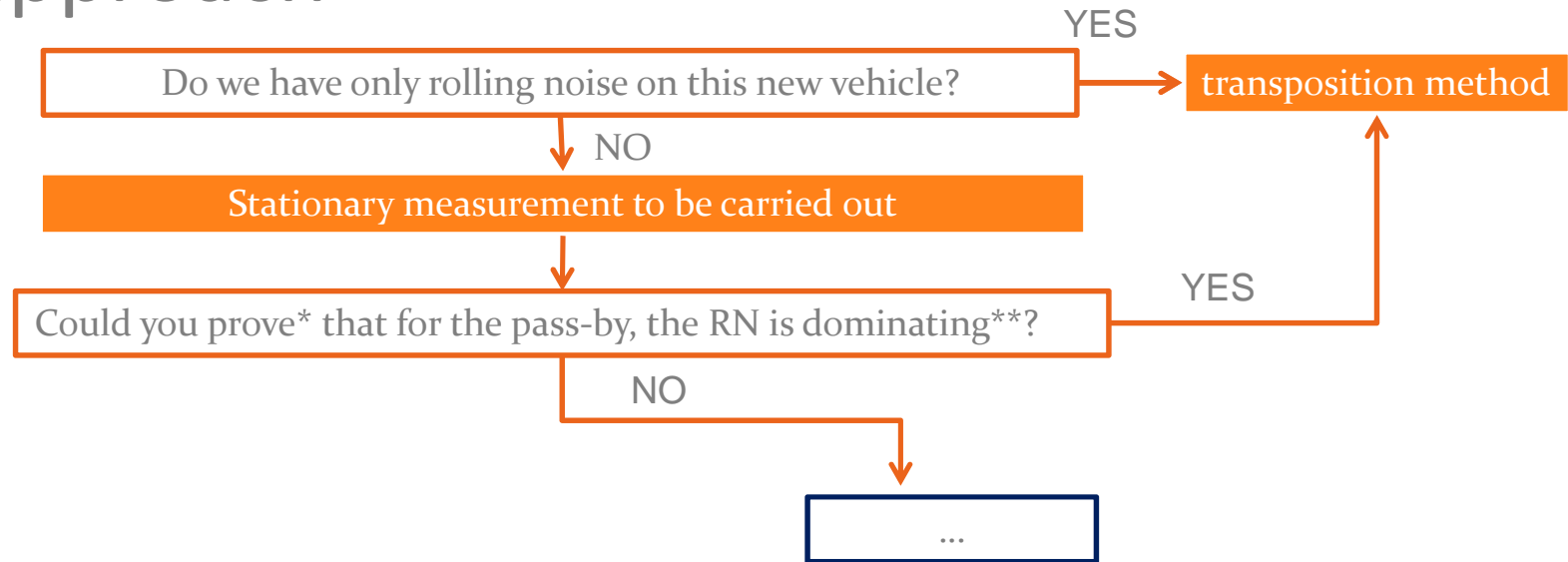
I have a new vehicle that has to be certified....



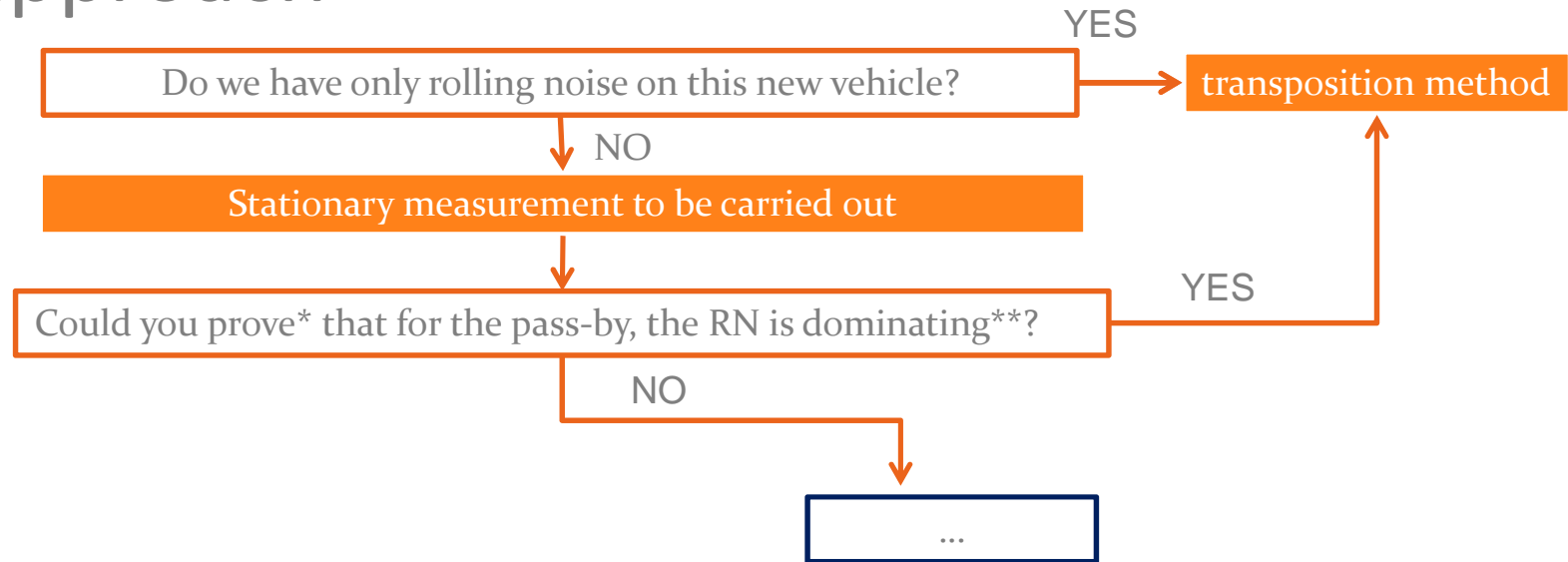
Hybrid approach implementation

- Within Acoutrain, we have defined the hybrid approach as a combination of real tests and virtual tests: the certification will then be partially done with virtual tests.
- Moreover, in the Hybrid approach real tests implementation will be required to validate your virtual test
- Typically, stationary measurements will be used on the same time:
 - For stationary certification
 - And for the limited validation of your virtual vehicle that could be used for pass-by simulation
- The main cases for using hybrid approach are the measurement at standstill to derive the pass-by while moving, and the transposition of measurements from non-TSI track to TSI-track

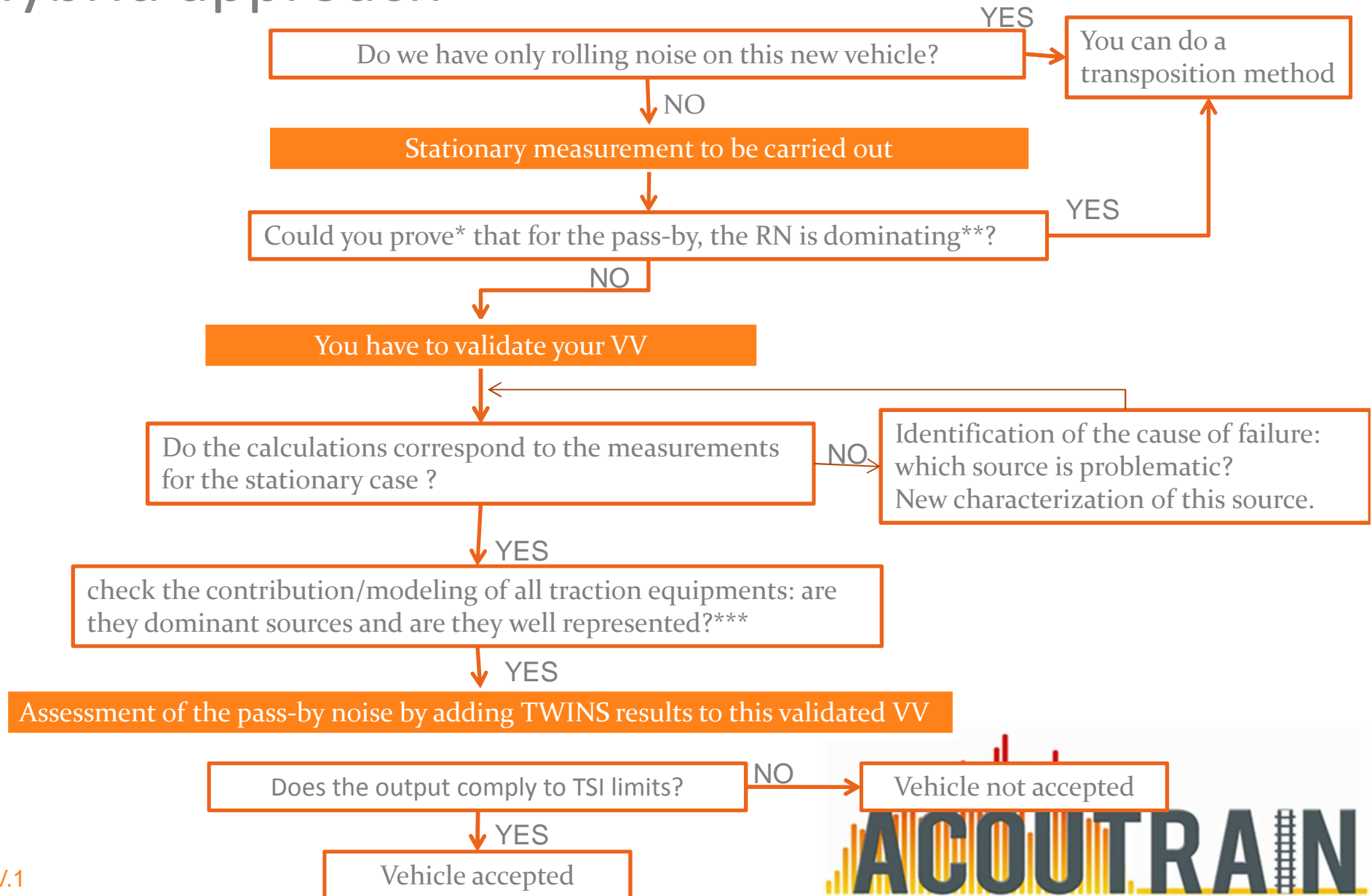
Hybrid approach



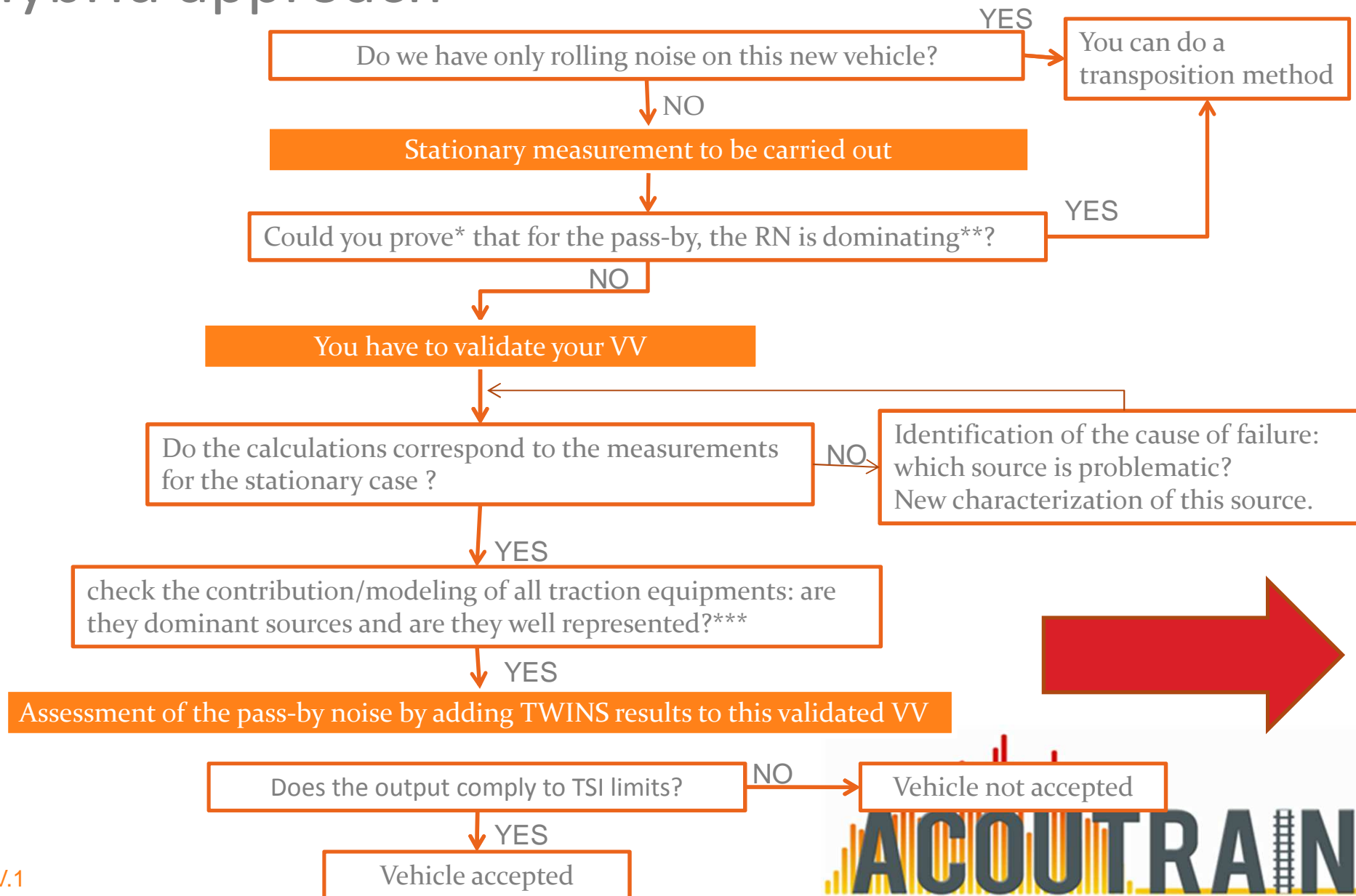
Hybrid approach



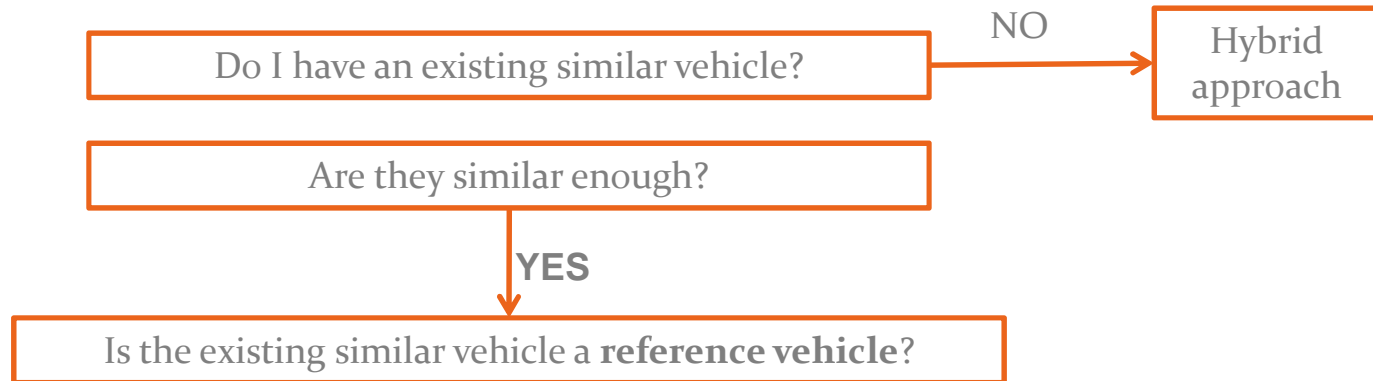
Hybrid approach



Hybrid approach



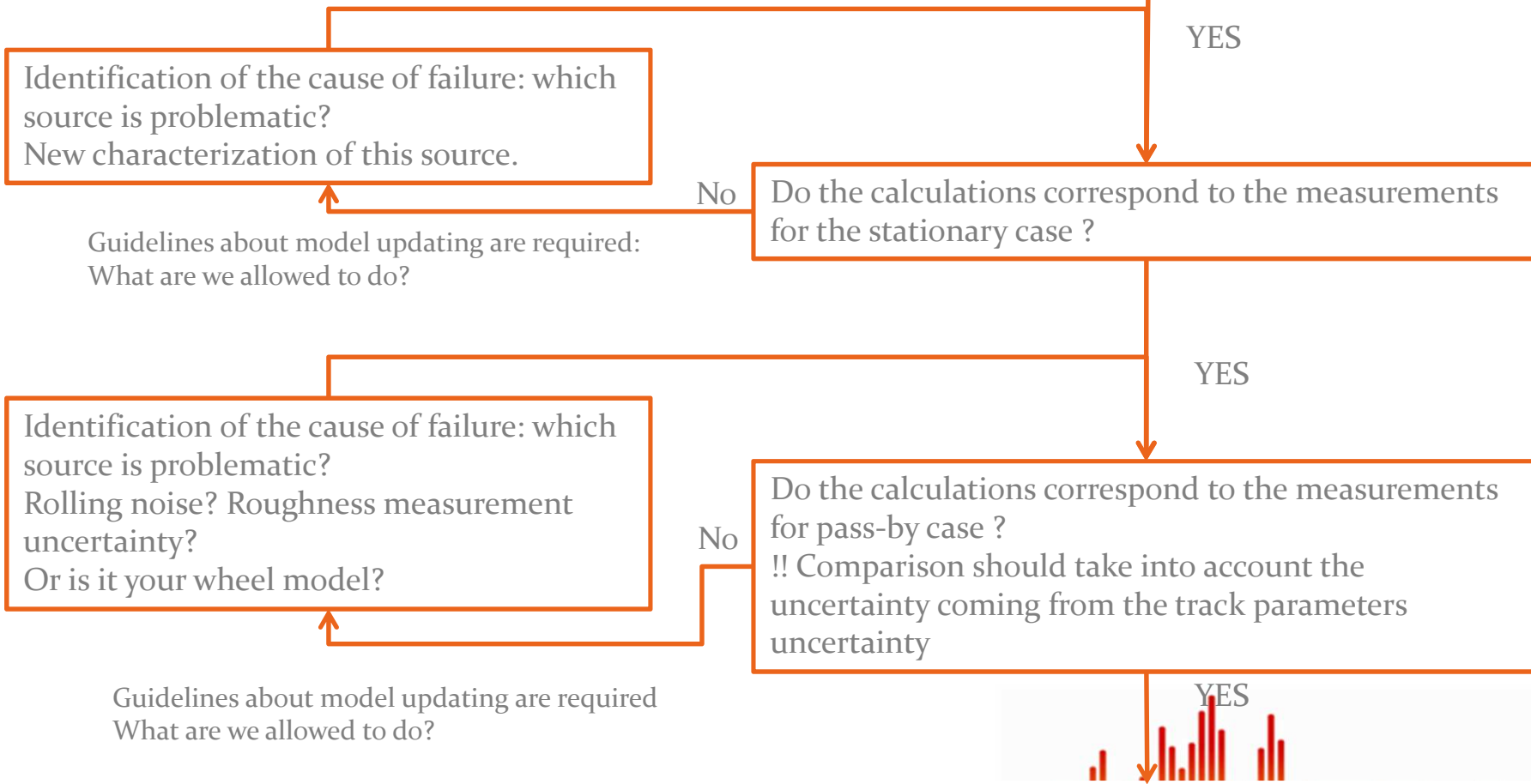
I have a new vehicle that has to be certified....



Reference vehicle – complete validation

Reference vehicle: validated at stationary and pass-by

Pre-requisites: for this existing similar vehicle, we have or make a VV model, measurements at stationary and measurements at pass-by

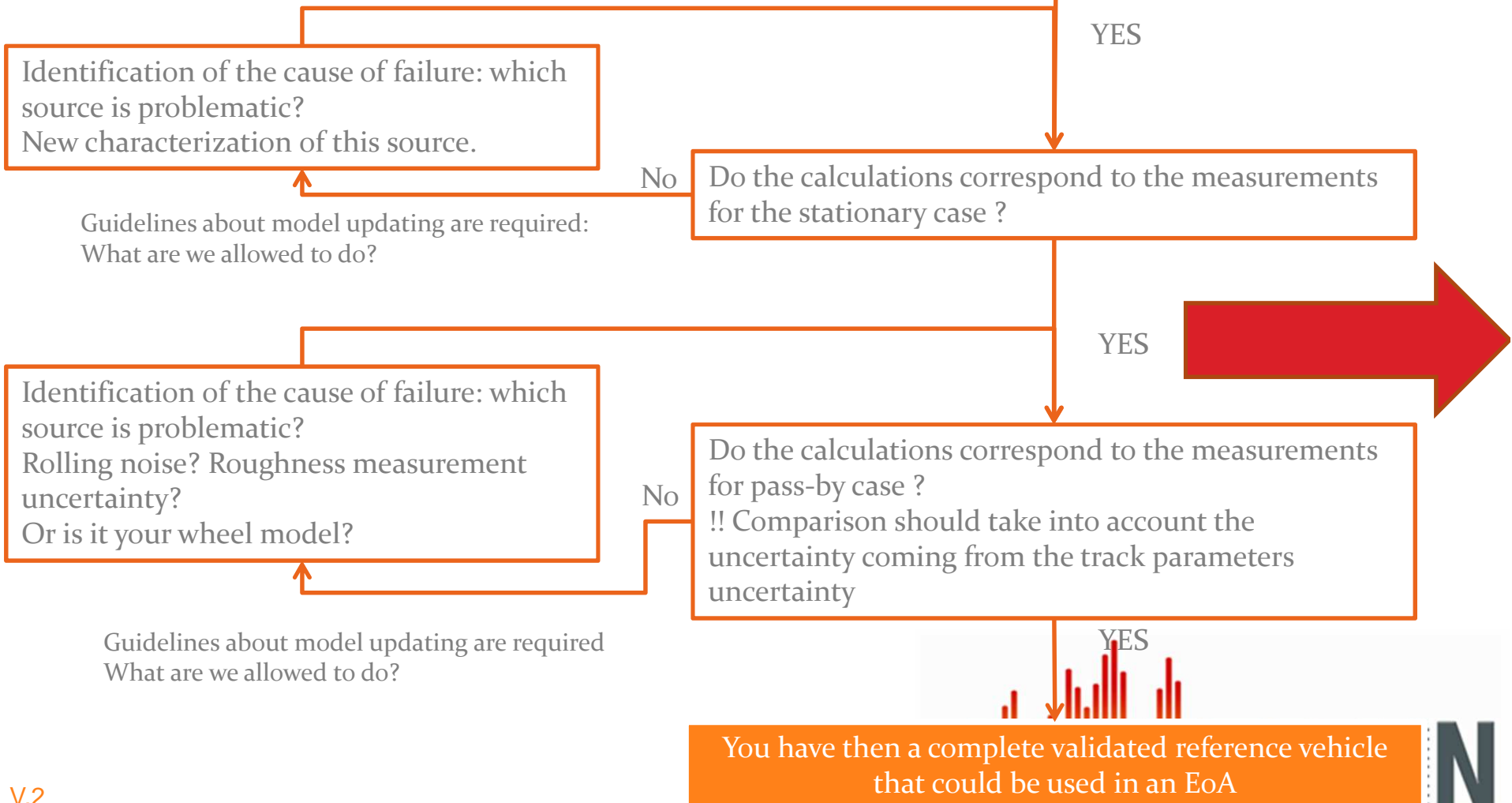


You have then a complete validated reference vehicle that could be used in an EoA

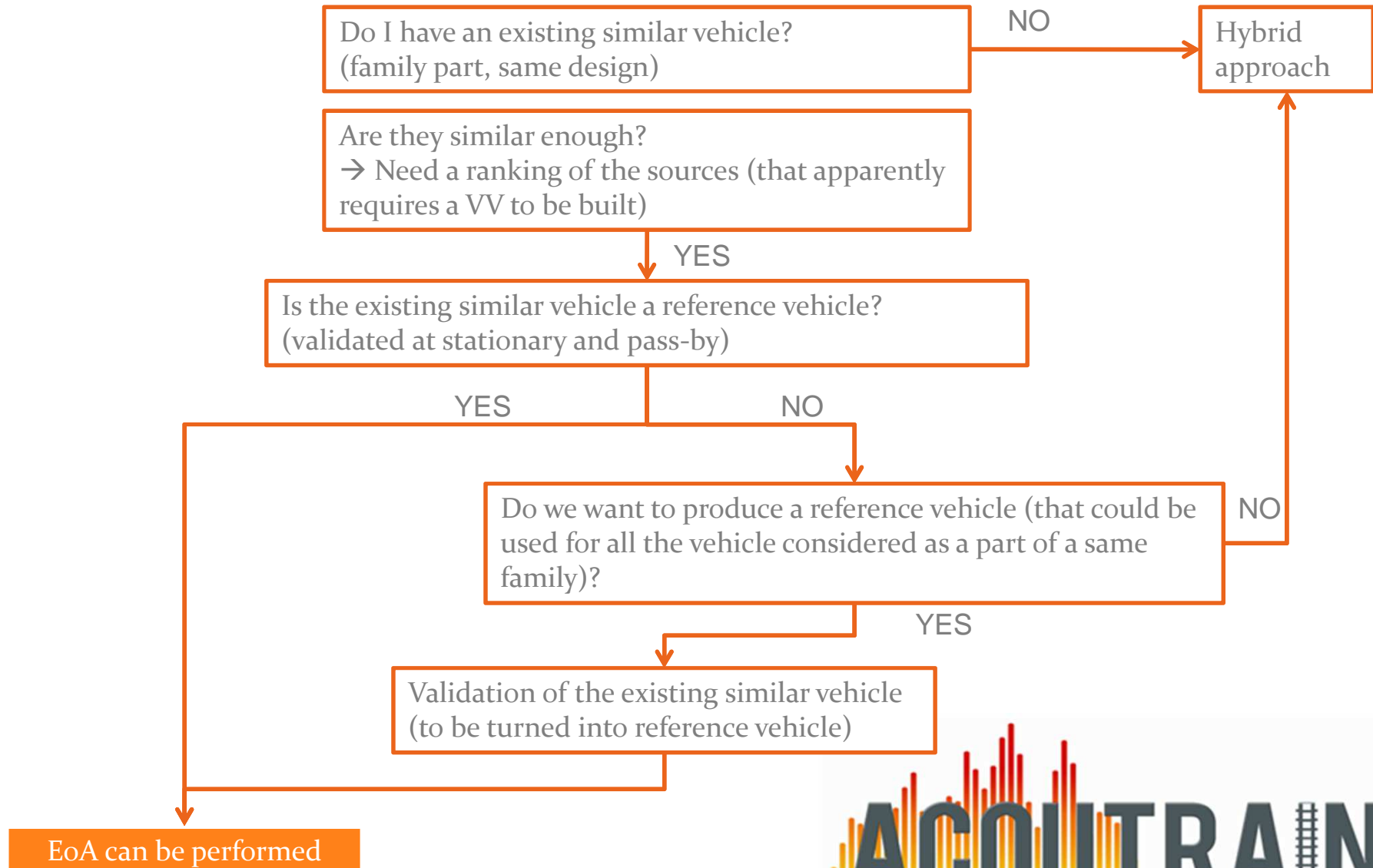
Reference vehicle – complete validation (come-back)

Reference vehicle: validated at stationary and pass-by

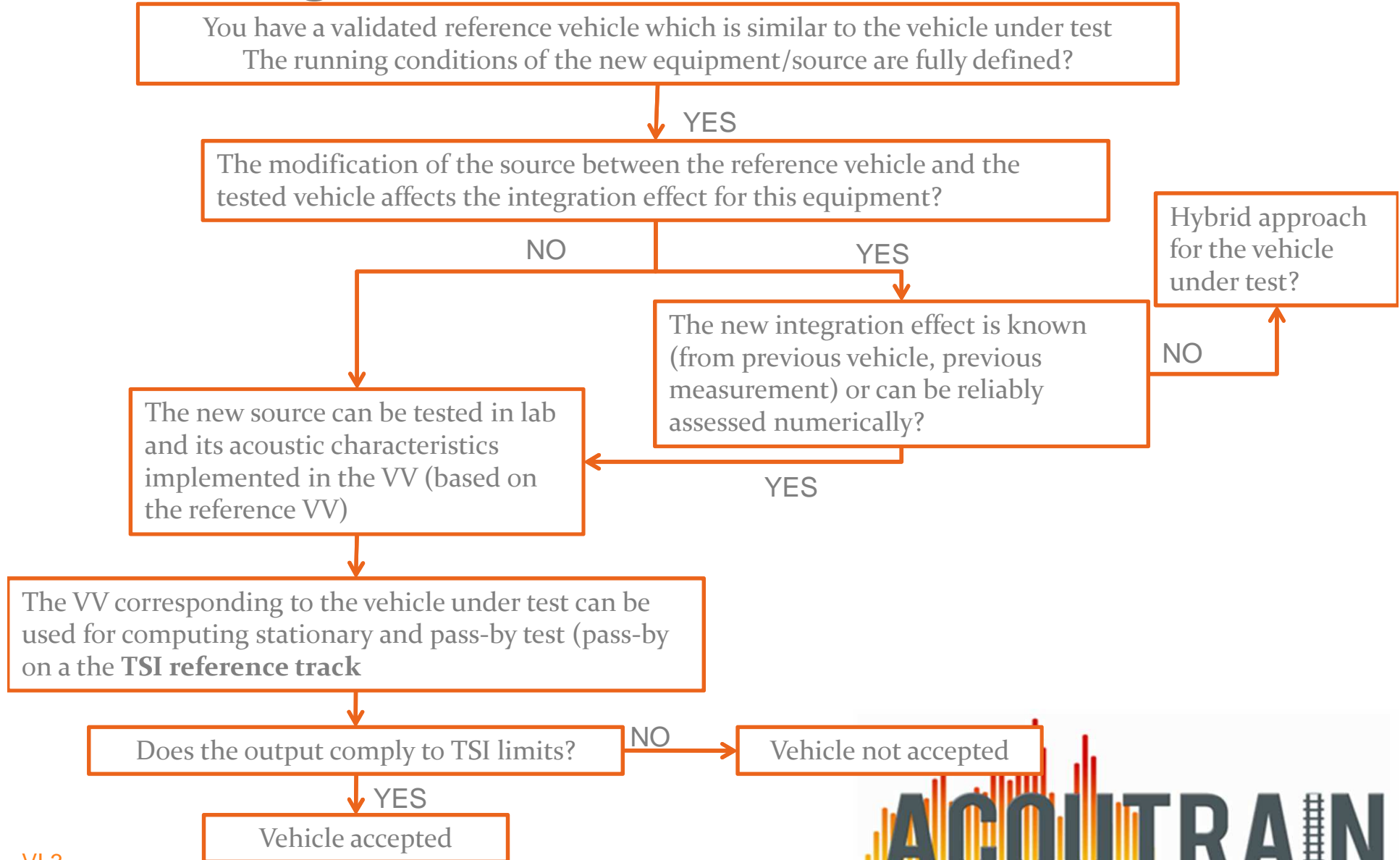
Pre-requisites: for this existing similar vehicle, we have or make a VV model, measurements at stationary and measurements at pass-by



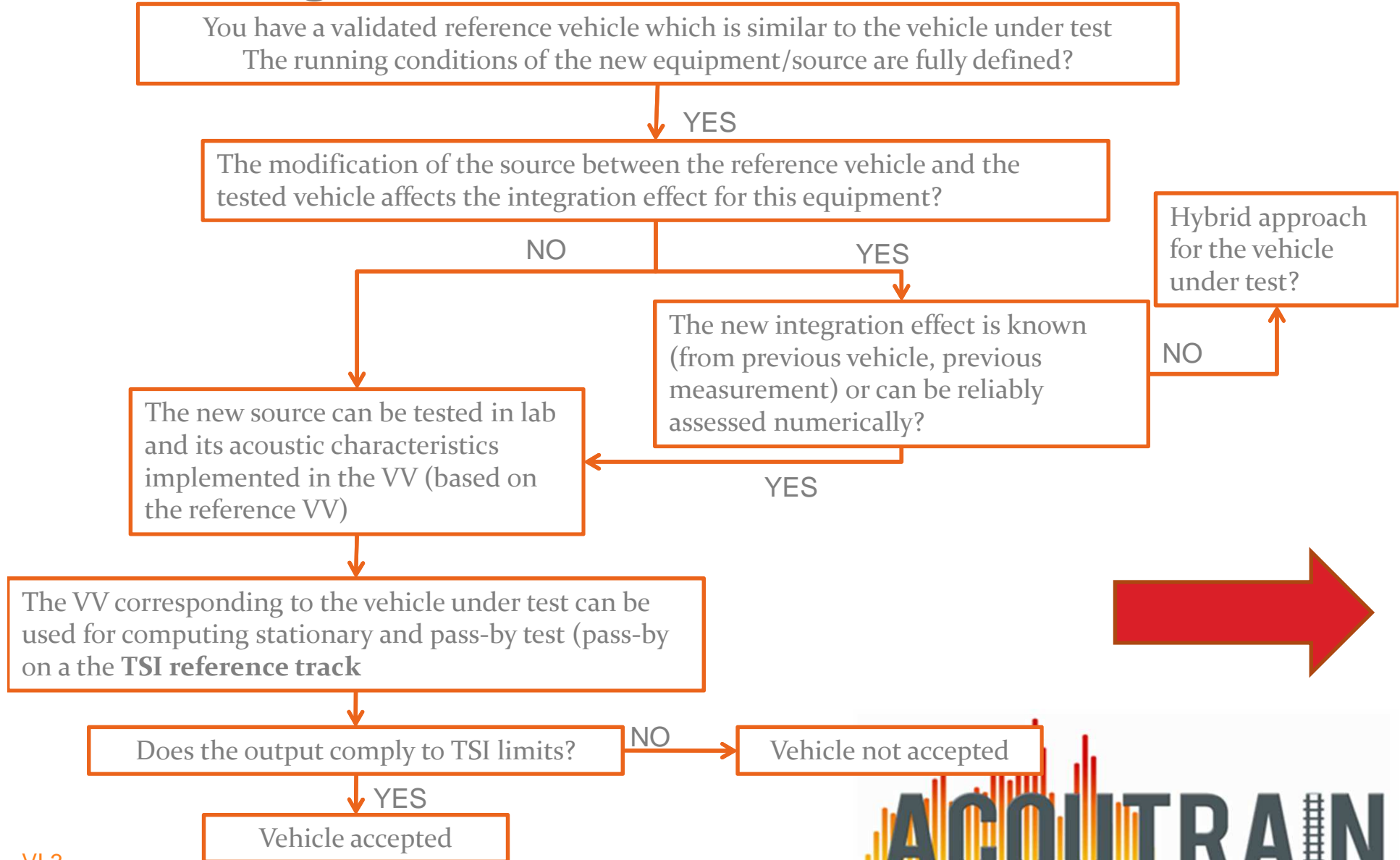
I have a new vehicle that has to be certified....



EoA: change of a source



EoA: change of a source



How to communicate with NoBo?

- Information to be exchanged with NoBo:

Hybrid approach

- Tool certification report
- Some information about sources characterization: measurement reports, integration effect assessment
- VV validation report (at stationary)
- Virtual testing report (comparison with limit values – compliance with TSI requirements)

Extension of Approval

- Tool certification report
- Validation report for the reference vehicle
- Similarity evidence between the reference vehicle and the vehicle to be tested
- New source characterization: measurement report
- Virtual testing report (comparison with limit values – compliance with TSI requirements)



Time for questions!



How to communicate with NoBo?

- Information to be exchanged with NoBo:

All these information / reports should be sufficiently explicit to be considered by a non-expert in acoustics

- We have to work on FORMALISING our requirements, particularly for the following concepts and practices:

- Similarity
- Validation and update model loops

- Guidelines are required to define good practices, requirements and limits for these steps in a virtual testing process.
- These guidelines could only be written if we gain in VT experience: tests on several data sets are necessary to assess the impact of similarity limits and model update on the process reliability.

How to accredit someone for VT?

- For instance, virtual testing needs to be further studied and worked out before an official implementation in a certification process. This is the job of railway acoustic experts, from manufacturers and operators.
- Once the VT procedure fully defined and validated, accreditation for VT users should be managed by an EAC entity (European Accreditation committee). An accreditation procedure would therefore be required, that would cover:
 - Accreditation for measurements to be carried out in all the VT process: for sources characterization (lab measurements, integration effect measurements) and for validation step (stationary and pass-by measurements, track characterization, ground impedance measurement)
 - Accreditation for using numerical process: integration effect numerical assessment , noise sources modelling, virtual vehicle creation in a numerical tool