

Submitted by the expert from France

Informal document **GRVA-15-20**  
15th GRVA, 23-27 January 2023  
Provisional agenda item 7



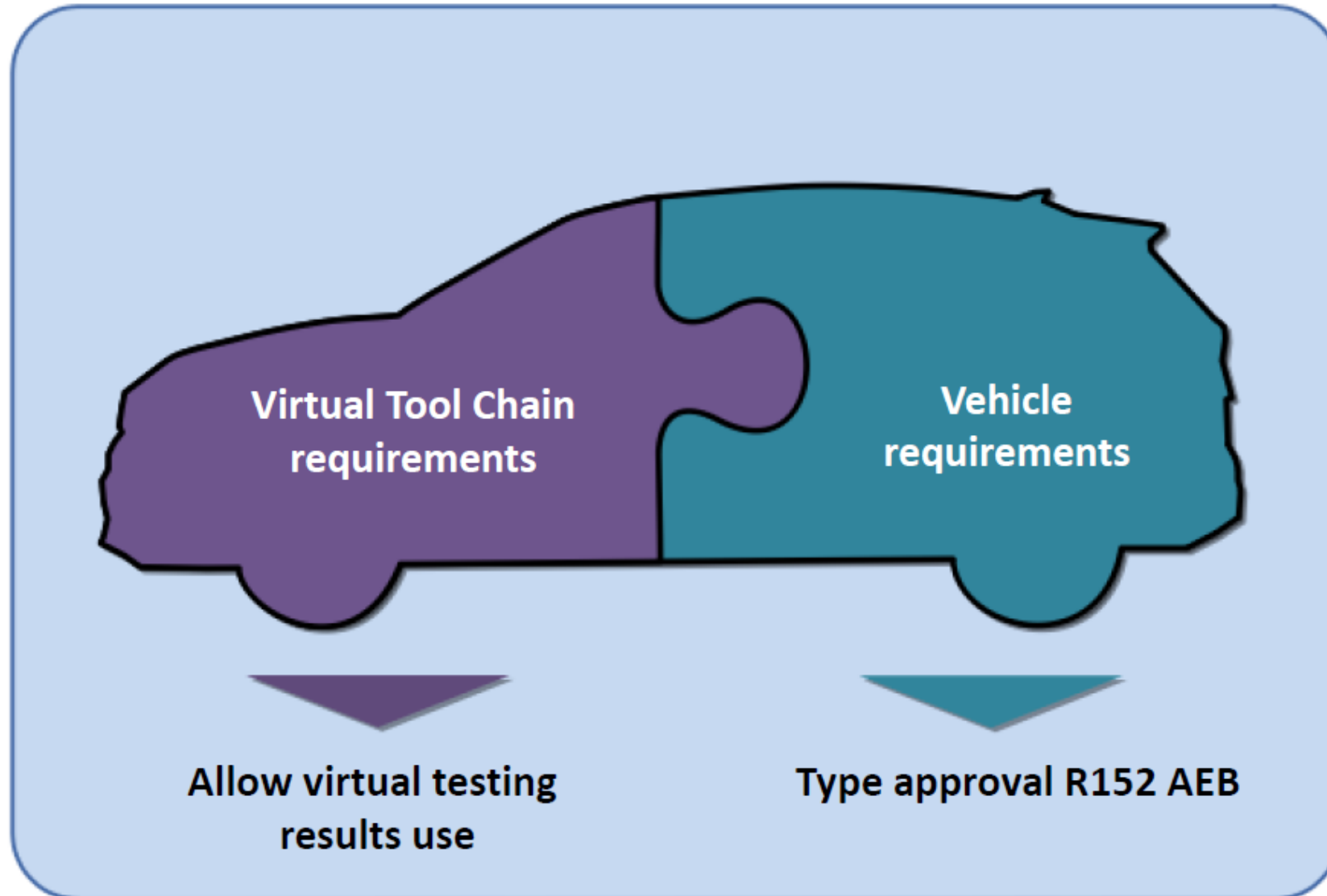
## Virtual testing method Use case application



**MINISTÈRE  
DE LA TRANSITION  
ÉCOLOGIQUE  
ET DE LA COHÉSION  
DES TERRITOIRES**

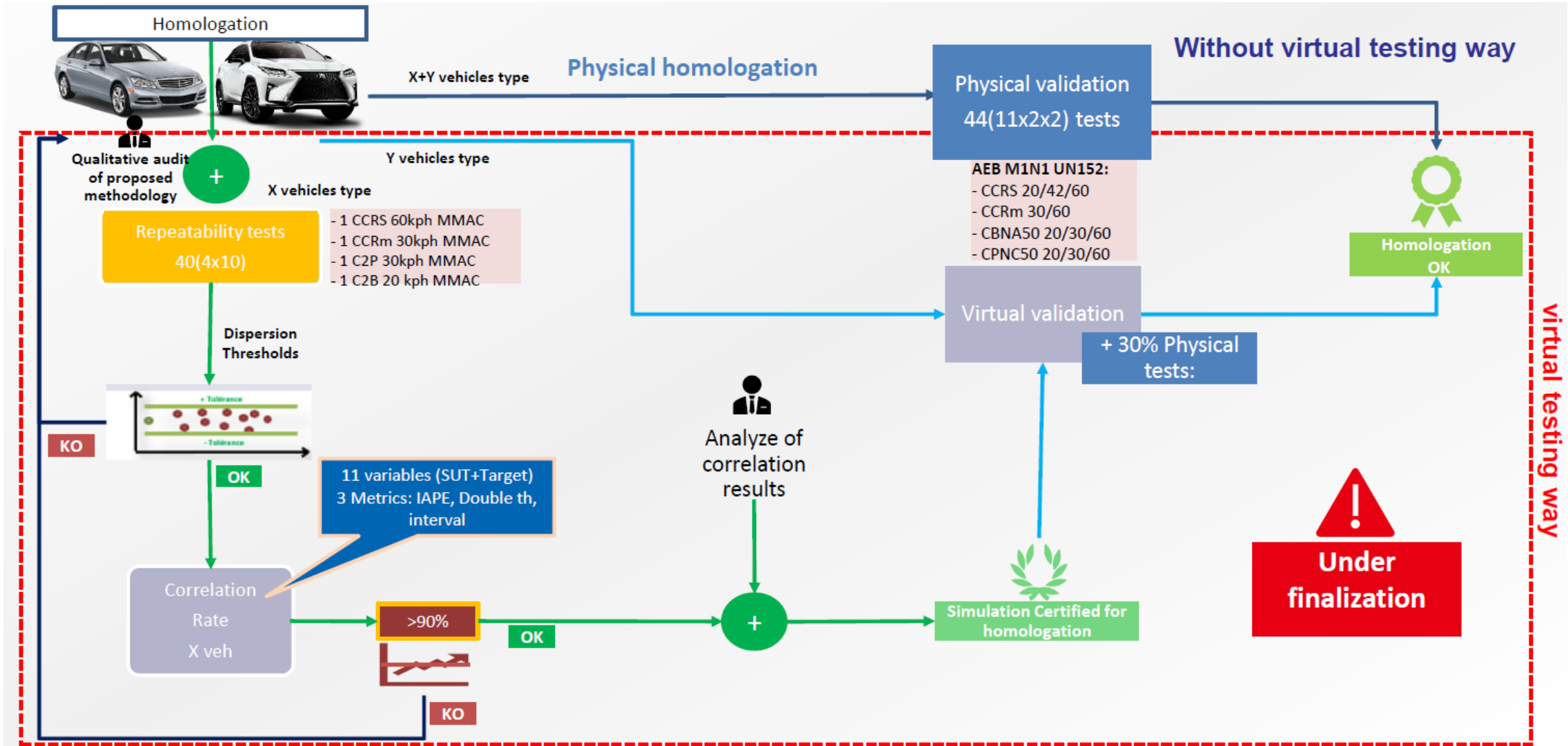
*Liberté  
Égalité  
Fraternité*





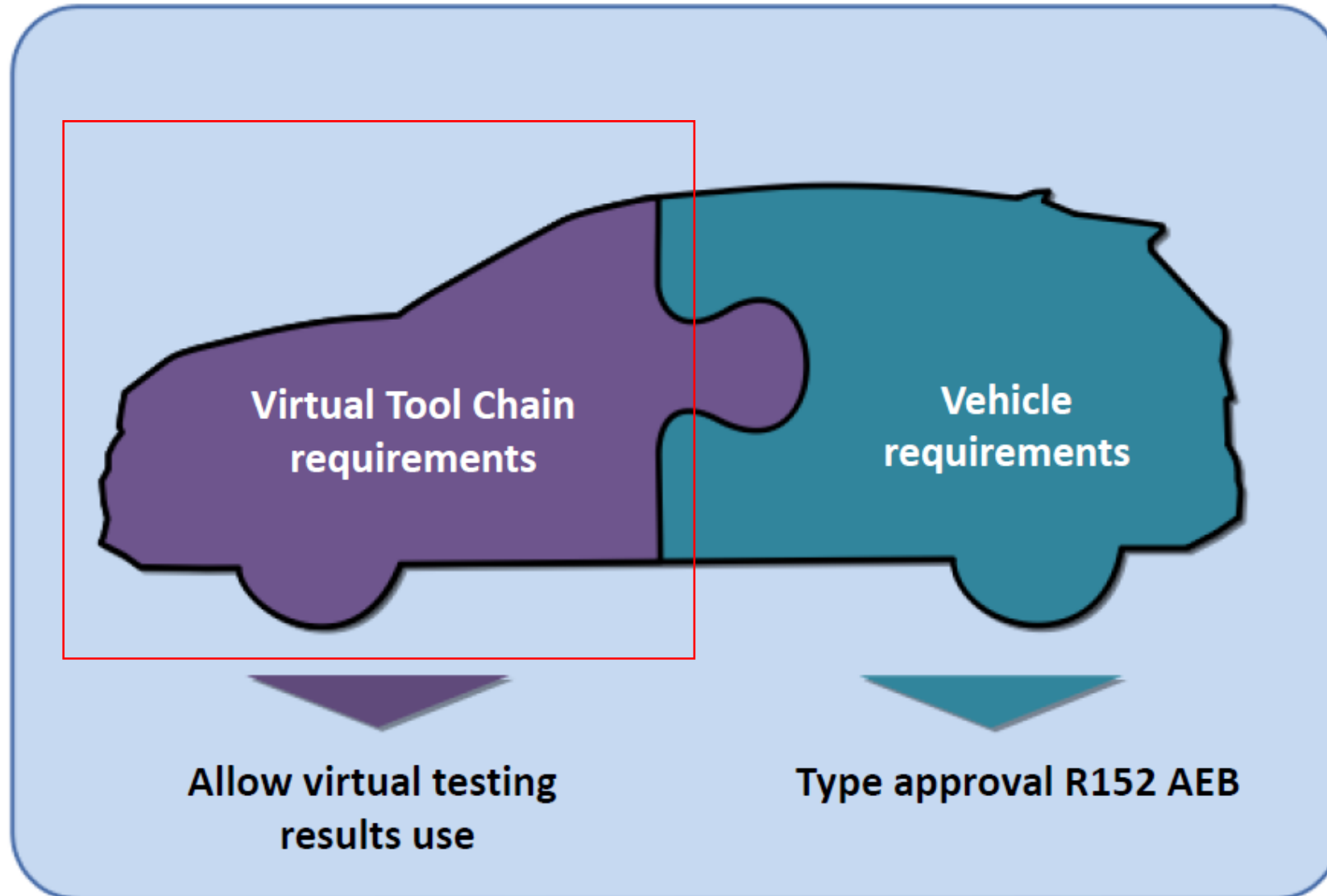
# AEBS on virtual testing

## Global overview



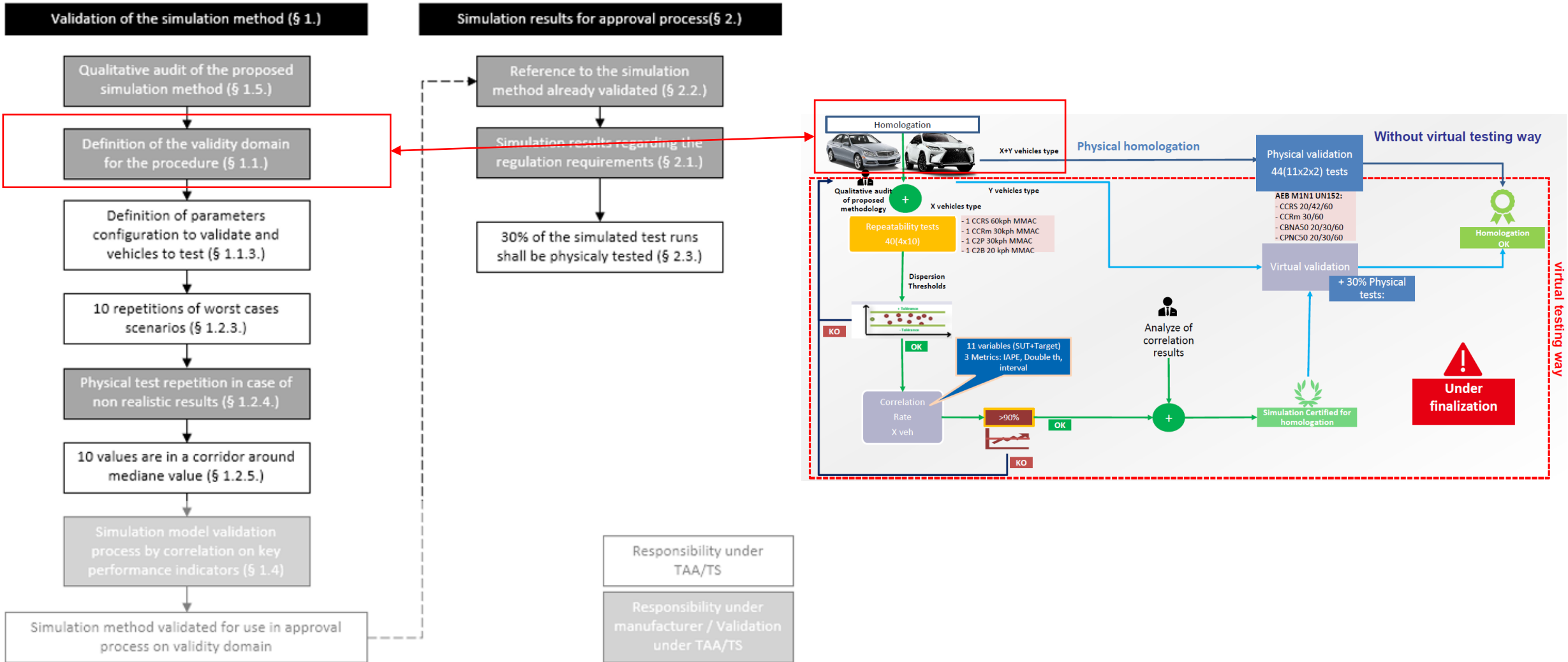
# AEBS on virtual testing

*2 separate assessment*



# AEBS on virtual testing


## Example of application



# AEBS on virtual testing

## #1 : validity domain

- OEM defines validity domain for virtual testing with TAA/TS (example) :
  - Vehicle types definitions to be covered including variability having impact on AEBS (mass, braking systems, ...)
  - Scenarios to be covered
  - Speed range
  - [...]



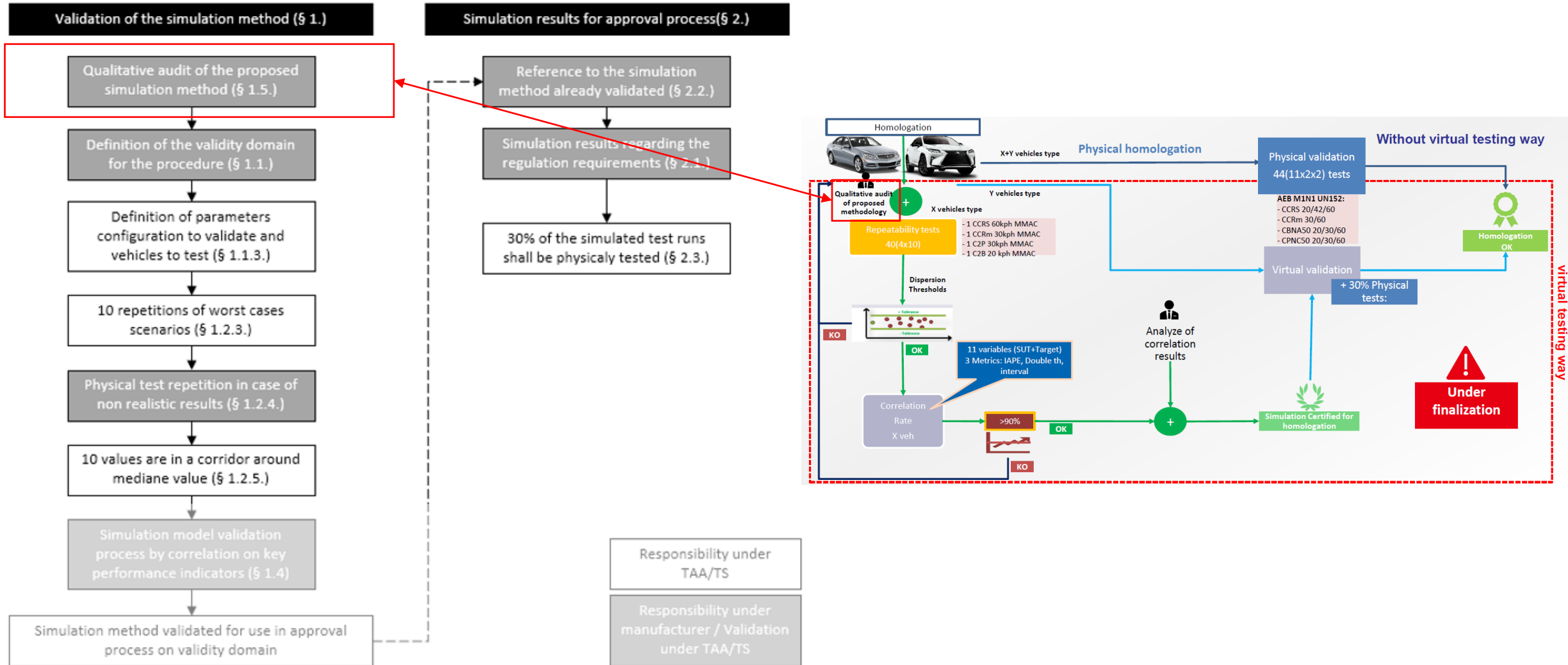
R152 AEB tests requested to be covered by using  
The virtual method in the validity domain defined  
(Yellow color)

| Vehicle               | Version               | Mass (kg)<br>VODM | Mass (kg)<br>MMAC | CCRs |      |      |      |      |      | CCRm |      |      |      | CBNA |      |      |      |      |      | CPNC |      |      |      |      |      |
|-----------------------|-----------------------|-------------------|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                       |                       |                   |                   | 100% |      |      |      |      |      | 100% |      |      |      | 50%  |      |      |      |      |      | 50%  |      |      |      |      |      |
|                       |                       |                   |                   | 20   |      | 42   |      | 60   |      | 30   |      | 60   |      | 20   |      | 30   |      | 60   |      | 20   |      | 30   |      | 60   |      |
|                       |                       |                   |                   | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM | MMAC | VODM |
| Vehicle 1 "City"      | Standard              | 1100              | 1600              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Convertible           | 1250              | 1750              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Vehicle 2 "Compact"   | Standard              | 1200              | 1800              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Convertible           | 1300              | 1900              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Station wagon         | 1500              | 2100              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Two doors             | 1150              | 1600              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | SUV                   | 1450              | 2200              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Vehicle 3 "Executive" | Standard              | 1800              | 2400              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Convertible           | 1950              | 2200              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Station wagon         | 2100              | 2600              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | OffRoad station wagon | 2200              | 2600              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Vehicle 4 "Van"       | Standard              | 1600              | 3000              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                       | Long body             | 1800              | 3500              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |



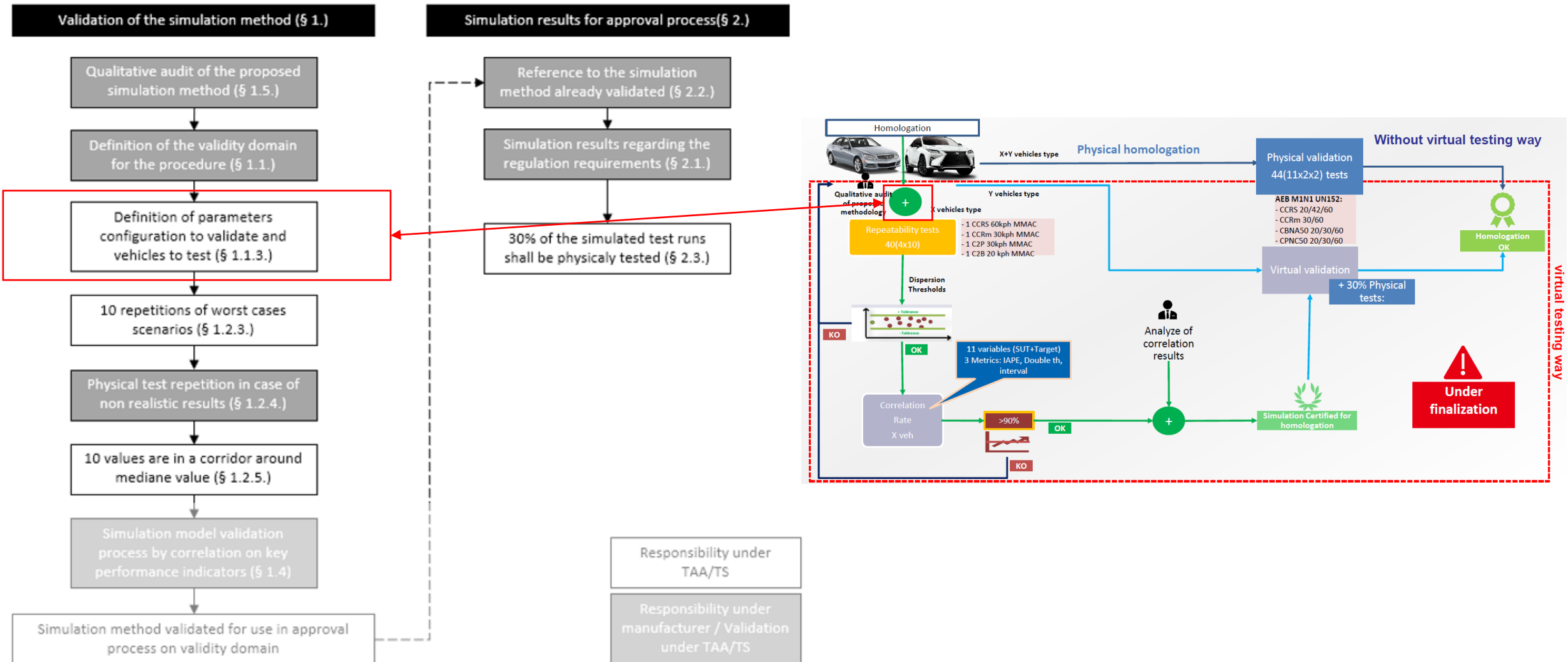
# AEBS on virtual testing

## Example of application



# AEBS on virtual testing

## Example of application

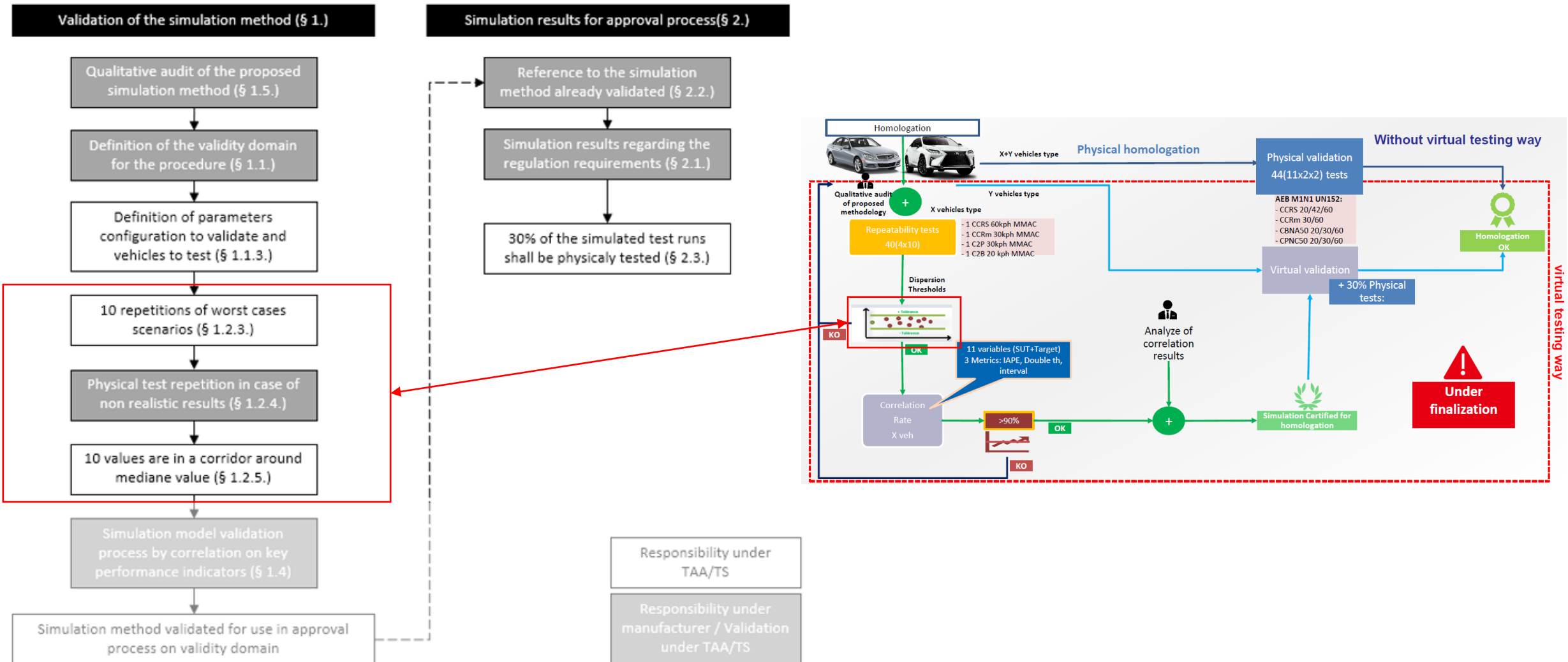






# AEBS on virtual testing

## Example of application

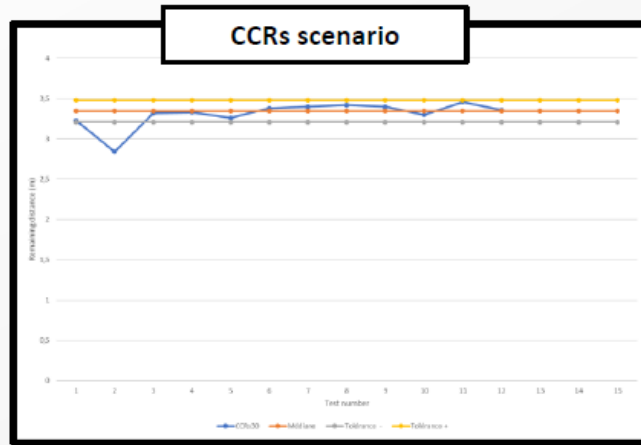


# AEBS on virtual testing

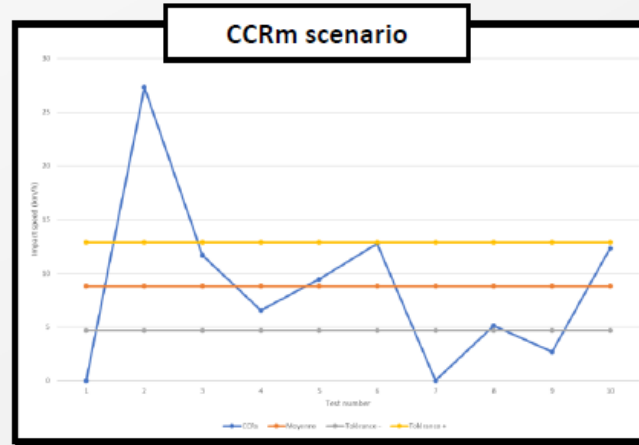
## #3 : physical repeatability testing

Vehicle 1

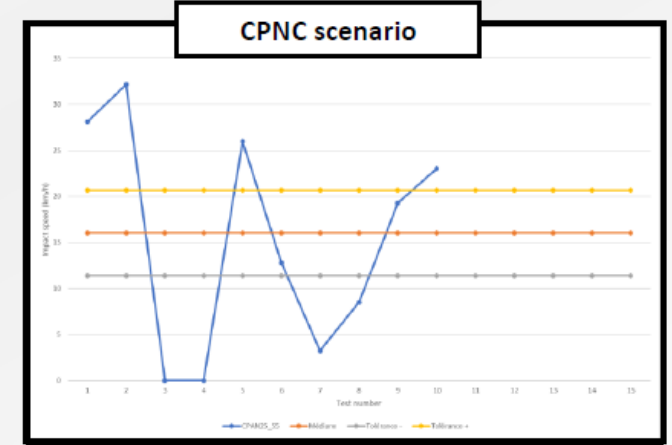
PASS



FAIL

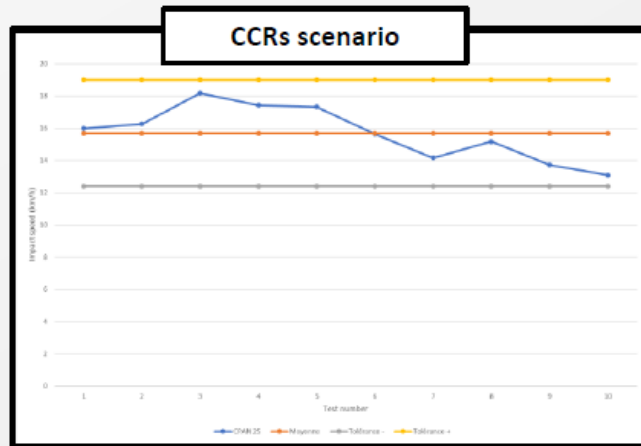


FAIL

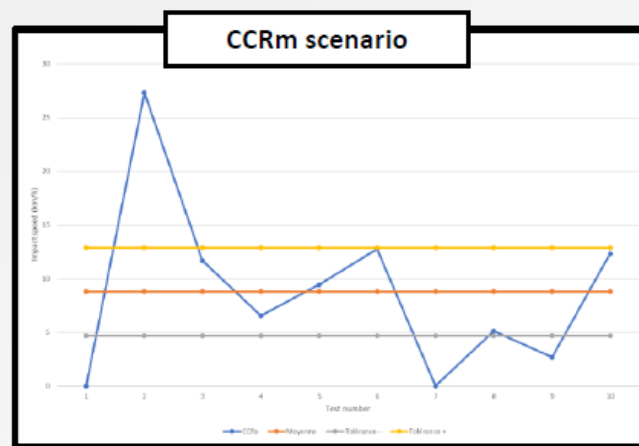


Vehicle 3

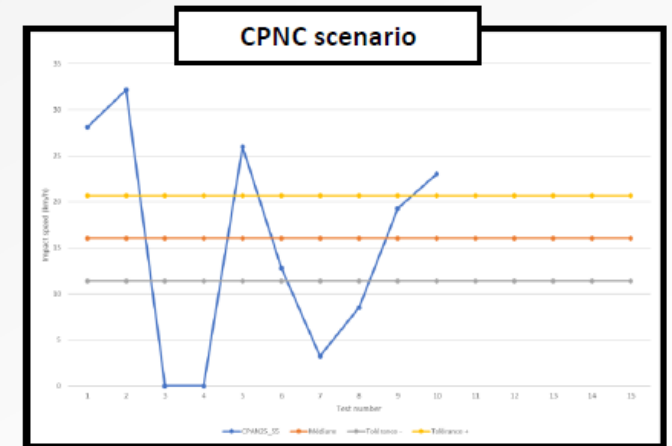
PASS



FAIL

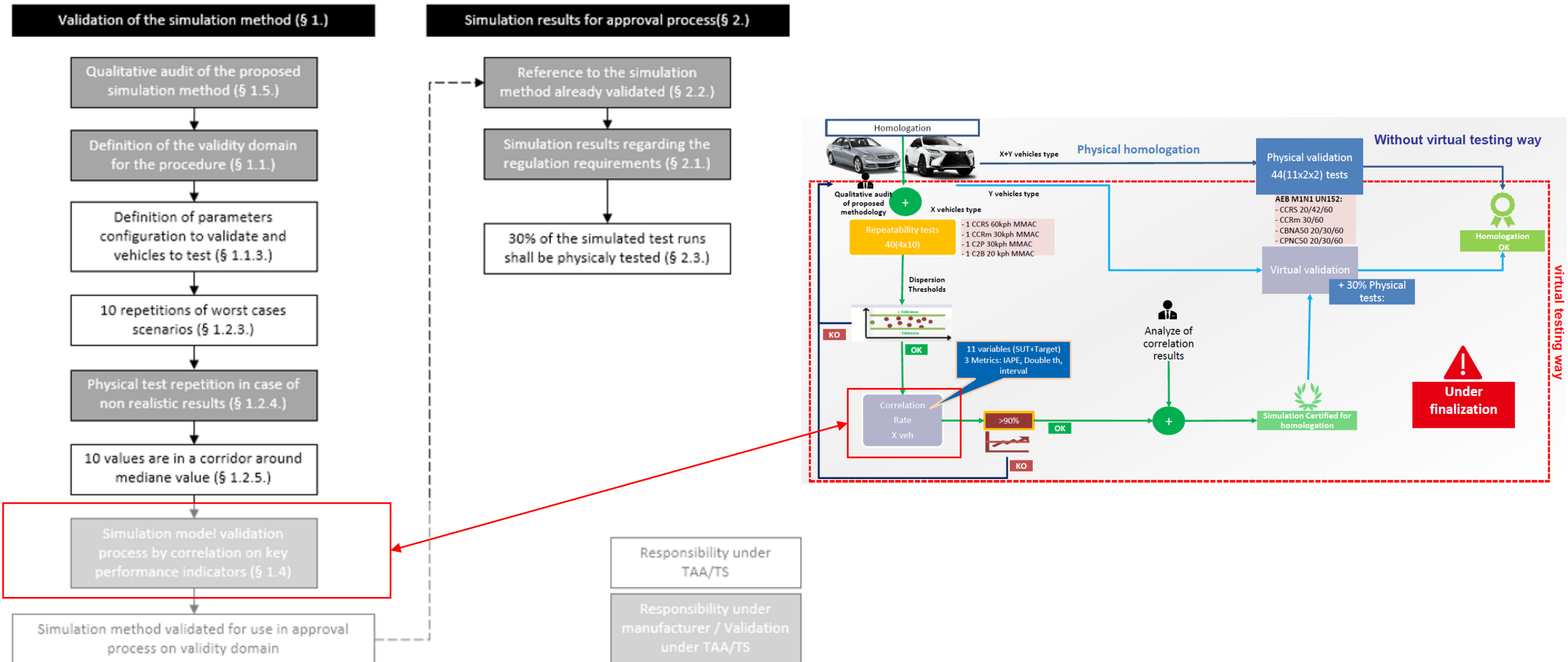


FAIL



# AEBS on virtual testing

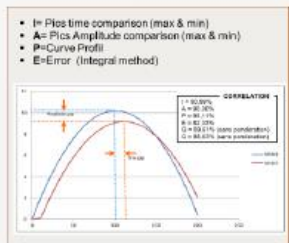
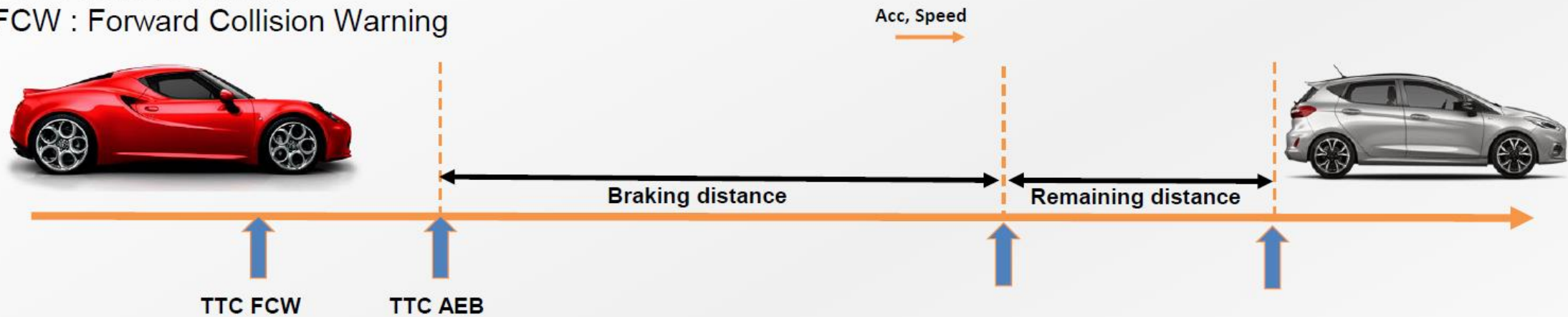
## Example of application



# AEBS on virtual testing

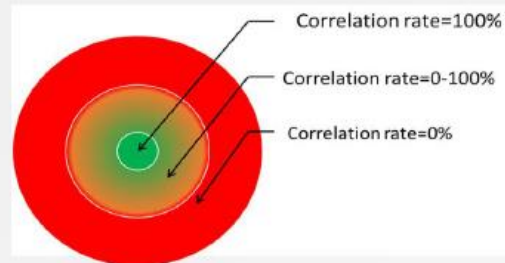
## #4 : assessing physical and virtual results

TTC : Time to collision  
 FCW : Forward Collision Warning



### IAPE Method

- Vehicle Speed
- Acceleration



### Double thresholds method

- Remaining distance
- Impact Speed
- TTC AEB
- TTC FCW

If  $A < X < B \rightarrow 100 \%$   
 Else  $\rightarrow 0 \%$

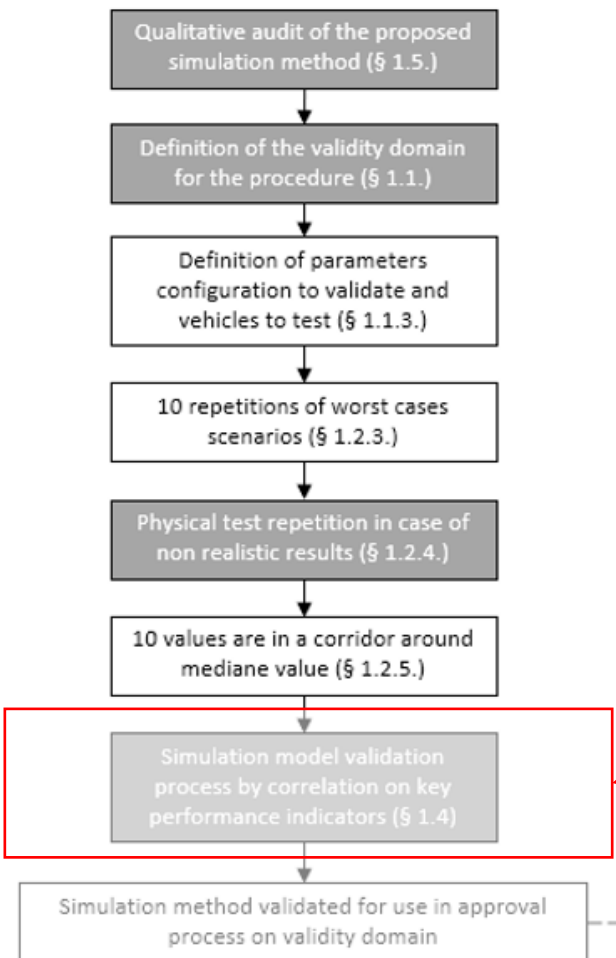
### Interval Method

- Lateral distance
- Relative distance

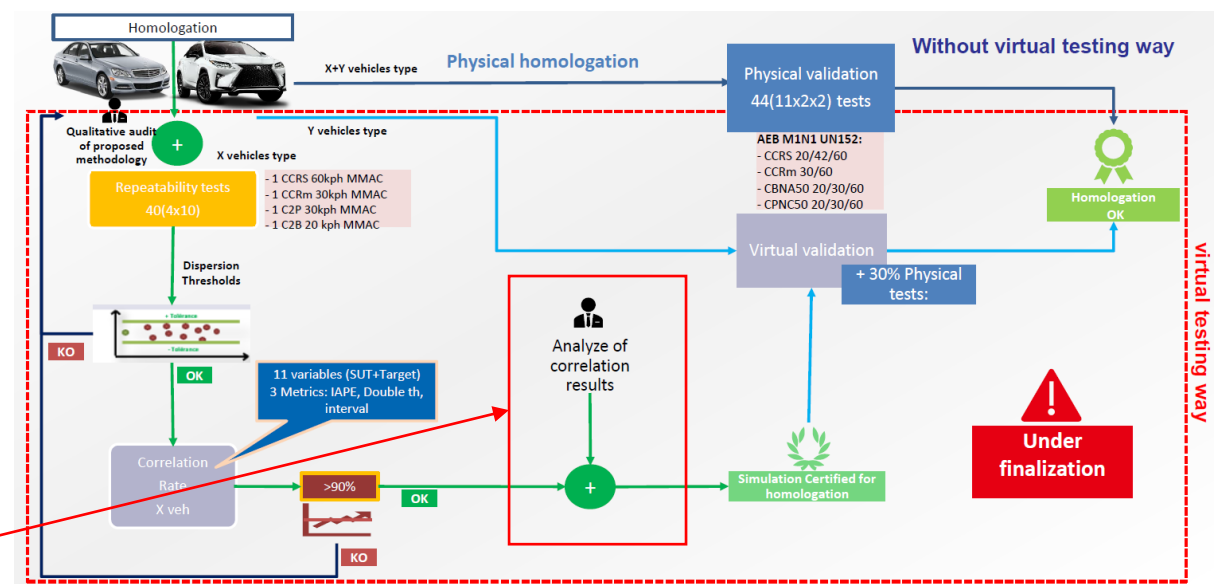
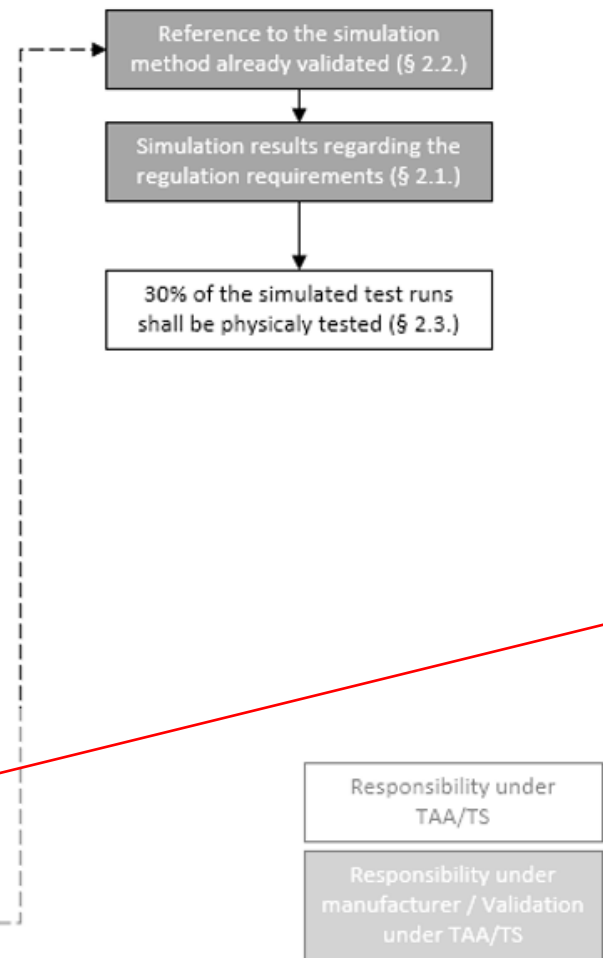
# AEBS on virtual testing

## Example of application

### Validation of the simulation method (§ 1.)

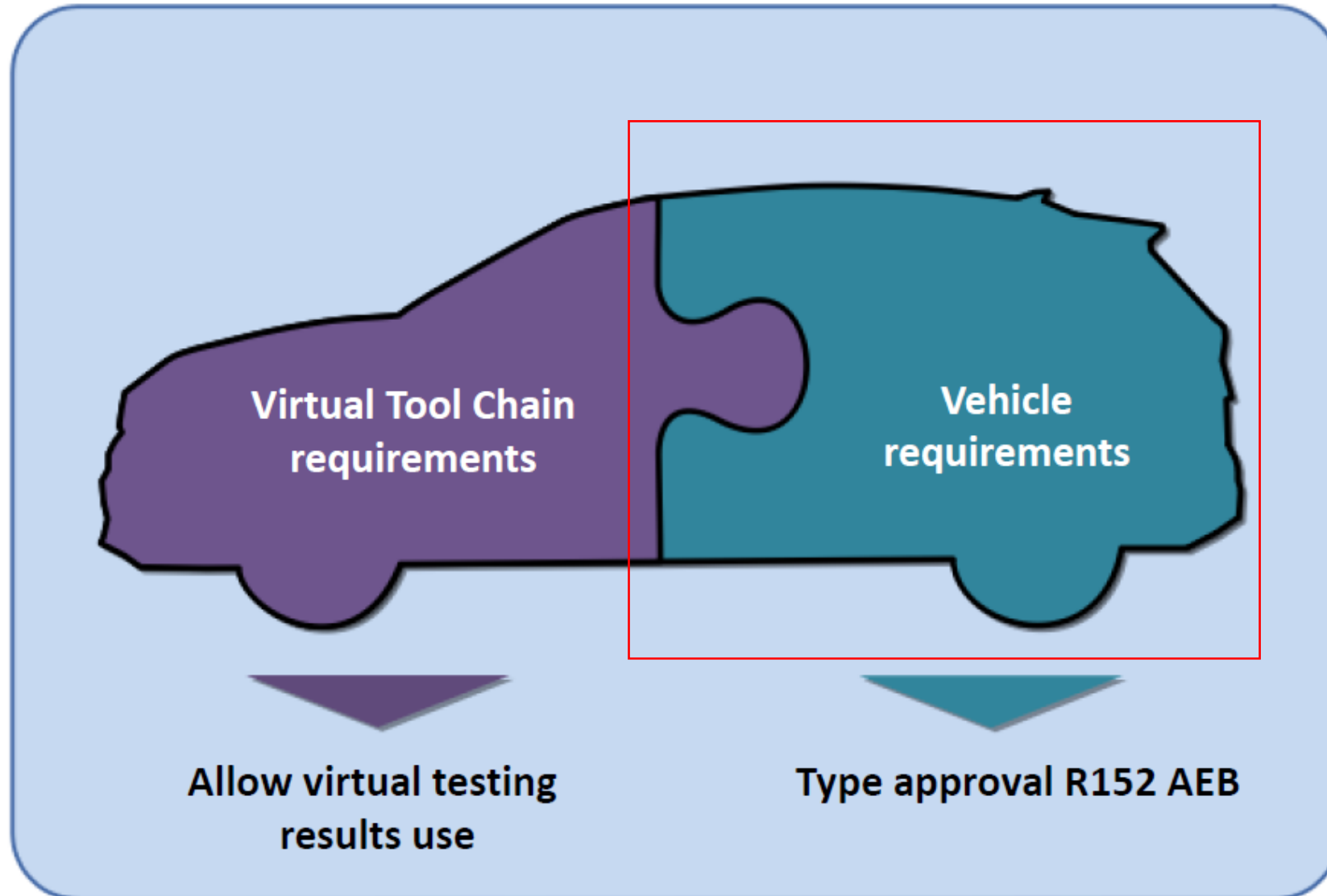


### Simulation results for approval process (§ 2.)









# AEBS on virtual testing

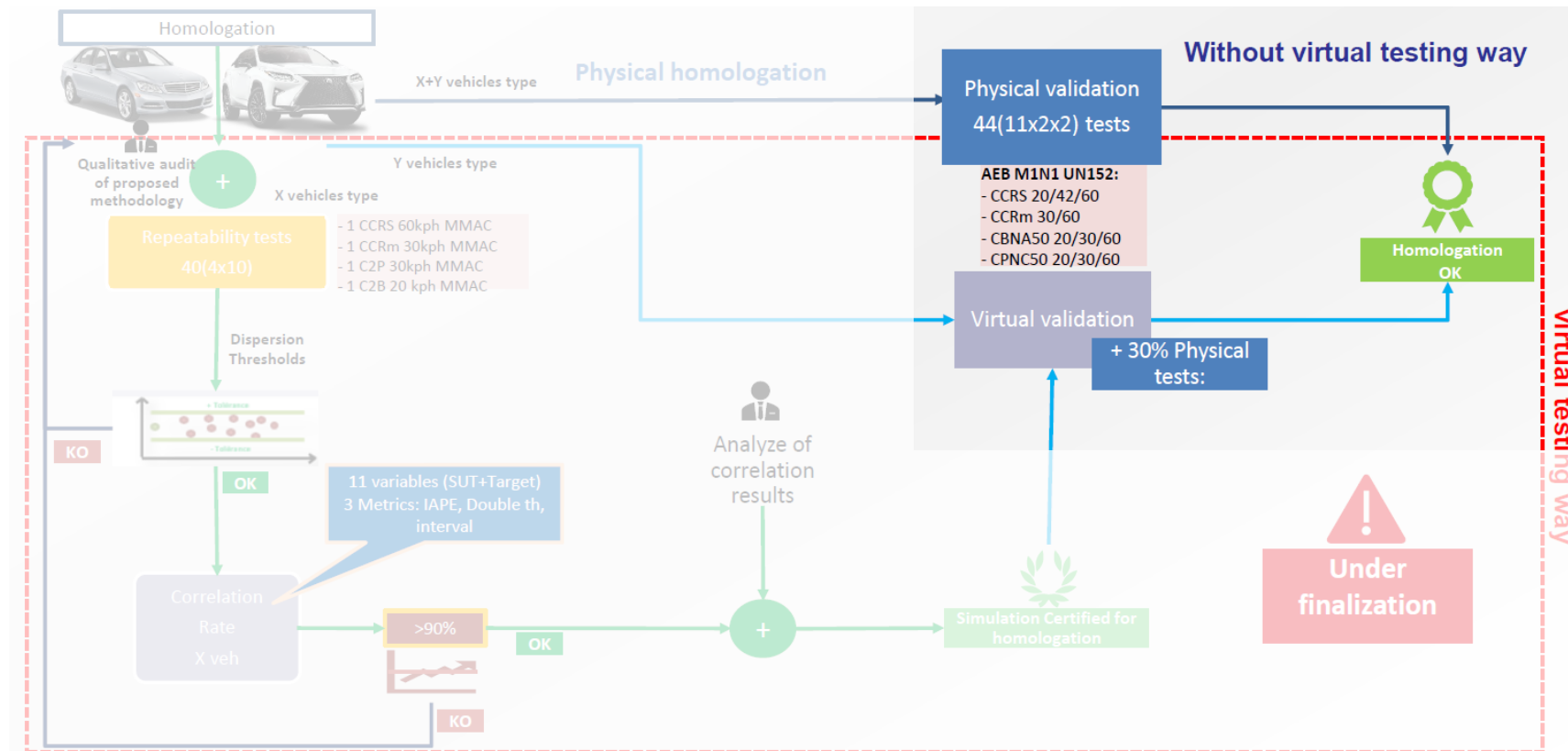
## Global overview

- For each type approval, OEM is able to use alternatively

- Full physical evaluation

OR

- Virtual testing results within the validity domain + 30% physical tests within the validity domain + physical tests outside the validity domain if any





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