Submission feedback on Options to harmonise rolling stock testing and test locations

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I am not responding to every consultation question. My comments focus on the areas where I can provide practical experience from German high-speed rolling stock modernisation, fleet type responsibility and vehicle-side technical authority for ICE 1 and ICE 2.

My background is in rolling stock electronics, onboard IT, passenger information systems, onboard communication networks, train-to-ground communication, software, cybersecurity-related vehicle interfaces and retrofit integration in German high-speed fleets.

My experience is mainly from passenger high-speed rolling stock rather than Australian freight wagons and locomotives. However, I believe several principles are directly transferable: standards-based assurance, clear configuration baselines, risk-based change assessment, staged testing, avoidance of duplicated evidence and clear separation between vehicle conformity, network compatibility and operational approval.

My main point is simple:

The objective should not be to reduce testing for the sake of reducing testing. The objective should be to avoid duplicated testing and duplicated documentation where the same technical question has already been answered for a controlled vehicle configuration.

For modified rolling stock, the key questions should always be:

- What has changed?
- Which interfaces are affected?
- Which existing evidence remains valid?
- Which tests are genuinely required to close the risk introduced by the change?

General comment on inefficiency and duplicated testing

From my experience, delays in rolling stock approvals are often not caused by the physical test itself. They are often caused by unclear evidence expectations, inconsistent documentation formats, late agreement on test scope, unclear responsibilities between operator, supplier, maintainer and infrastructure manager, and limited recognition of existing evidence.

For mature fleets, retesting the entire vehicle after every modification is not efficient and is not always risk-based. The focus should be on the delta introduced by the modification.

A good approval process should distinguish between:

1. vehicle-type evidence that should follow the vehicle configuration
2. modification-specific evidence linked to a controlled baseline
3. network-specific evidence linked to infrastructure compatibility
4. operational evidence linked to route, rules, degraded modes and local constraints

This distinction was essential in my work with ICE 1 and ICE 2. Without it, the process becomes document-driven. With it, the process becomes risk-driven.

Question 2: Are there particular types of tests or approvals where harmonisation would be most effective?

Yes. Harmonisation would be most effective where the technical intent is common and the remaining differences are mainly due to historic, organisational or local interpretation rather than genuine technical risk.

From a European perspective, this is an important point. Europe still has Technical Specifications for Interoperability (TSI) and National Notified Technical Rules (NNTR). However, the long-term direction is clear. The aim is not to create more special rules for every country. The aim is to work towards a common technical framework, with national deviations only where they are technically justified and clearly documented.

I believe Australia could apply a similar principle.

The long-term target should be a common national baseline for rolling stock testing and evidence. RIM-specific variations should only remain where there is a real network-specific technical reason. These variations should be documented, risk assessed and visible to industry.

The strongest early harmonisation opportunities are not necessarily the most complex dynamic tests. The strongest starting point is the evidence structure.

Good early candidates for harmonisation include:

- common evidence index
- common test report template
- common configuration baseline sheet
- common change impact assessment template
- common interface control document structure
- common supplier evidence checklist
- common software and firmware baseline record
- common installation verification checklist
- common open point and deviation register
- common regression test logic
- common rules for when previous evidence can be reused
- common rules for when a modification triggers new tests

For onboard systems and vehicle IT modifications, a standard evidence package should include:

- scope of modification
- affected vehicle type and vehicle configuration
- system architecture before and after the change
- affected interfaces
- applicable standards
- supplier evidence
- installation drawings
- software and firmware versions
- hardware configuration
- lab test results

- simulation or emulation results where used
- vehicle test results
- regression evidence
- open points and deviations
- operational restrictions
- maintenance impact
- cybersecurity impact where relevant
- final handover evidence

In my view, this would create immediate benefit. It would allow RIMs, RSOs, manufacturers and assessors to review evidence using the same structure.

More difficult areas such as dynamic ride behaviour, braking performance, signalling interaction and radio coverage may still require network-specific assessment. However, even in these areas, the methodology, minimum data set, report structure, instrumentation requirements and decision logic could be harmonised.

Question 4: Are there additional learnings or approaches from international jurisdictions that should be investigated?

A useful learning from German and European rolling stock modification practice is the discipline of linking approval evidence to the vehicle type, the controlled configuration baseline and the specific modification package.

In my work on ICE fleet modifications, approval readiness depended on a structured chain of evidence:

- requirements
- interface descriptions
- supplier evidence
- installation documentation
- configuration baseline
- test procedures
- lab results
- pilot train commissioning records
- regression evidence
- open point management
- final handover documentation

This approach is particularly useful for harmonisation because it separates generic vehicle conformity evidence from network-specific compatibility evidence. It also supports mutual recognition, because another reviewer can understand exactly what was tested, on which configuration, under which assumptions and with which limitations.

I strongly support a standards-based approach.

In my German high-speed rolling stock experience, standards such as EN 50155, EN 50121, EN 50126, EN 50128, EN 50129 and EN 50716 provided a very useful engineering framework. Their value is not only in the technical requirements, but in the discipline they create around lifecycle thinking, configuration control, verification, validation, software change management, traceability, documentation and evidence-based acceptance.

Australia should not simply copy the European regulatory system. However, the mindset is useful: common recognised standards, controlled deviations and clearly documented network-specific variations.

From a vehicle-side technical authority perspective, that type of framework helps separate what belongs to vehicle conformity, what belongs to network compatibility and what belongs to operational approval. That separation is essential if duplicated testing is to be reduced without weakening safety assurance.

Question 5: To what extent is there a need for a national testing facility in Australia, and how could it deliver value to the industry?

A national test facility in Australia would be worth considering, especially if it is independent and nationally recognised.

A useful reference point from Europe is a facility like Siemens Wildenrath in Germany. For Australia, I would not recommend a manufacturer-specific model. I would recommend an independent facility that supports operators, suppliers, RIMs and assessors under the same recognised conditions.

In my vehicle IT work, we used a staged integration approach. A change did not go directly to the train. It was first specified, reviewed with suppliers, tested in lab environments, then tested through an overall integration test before going onto the vehicle for commissioning and further testing.

A similar concept could be scaled up for rolling stock approvals.

A national facility could provide:

- common test conditions
- common acceptance criteria
- repeatable test processes
- standardised measurement and data capture
- reduced disruption to operational networks
- better preparation before on-network trials
- validation of simulation and emulation
- early integration testing of new technology
- better mutual recognition of evidence

However, a national test facility should not be seen as the only solution. It could be expensive and may not replicate every network-specific condition.

Some benefits could also be achieved through:

- strong risk management
- recognised lab testing
- realistic simulation
- emulation of counterpart systems
- standardised subsystem tests
- an approved test location register
- targeted real-world tests only where necessary

A practical model would be staged:

1. lab testing, simulation and emulation
2. controlled integration testing at a recognised facility

3. physical vehicle testing
4. network-specific testing only where the network interface genuinely requires it

This would reduce risk before a vehicle enters the operational network.

Question 7: Are there specific acceptance criteria or documentation requirements that could be quickly harmonised to deliver immediate benefits?

Yes. The quickest improvements are likely to come from harmonised documentation and evidence requirements before attempting to harmonise every technical test limit.

Modern rolling stock is increasingly software-based. Even traditional vehicle modifications often include software, firmware, networks, cybersecurity, diagnostics or data interfaces.

For that reason, I believe EN 50716-style thinking is very useful, even where the system is not purely safety-critical software.

The important principles are:

- clear requirements
- architecture control
- configuration management
- version control
- traceability
- verification
- validation
- change impact assessment
- regression testing
- structured release evidence
- controlled supplier documentation

In my experience, many approval difficulties arise when the physical installation is documented, but the software state, firmware state, interface version or configuration baseline is not controlled well enough.

For Australia, I would recommend that harmonised documentation requirements include software and firmware baseline records as standard evidence for any modern onboard system.

Quick wins could include:

- common evidence index
- common change impact assessment template
- common configuration baseline template
- common interface control document template
- common software and firmware version record
- common supplier evidence checklist
- common installation verification checklist
- common commissioning checklist
- common regression test template
- common open point and deviation register
- common final handover record

The goal should be that an RSO, RIM, manufacturer or independent reviewer can open an evidence package and immediately understand:

- what changed
- which vehicle configuration is affected
- which interfaces are affected
- which evidence is reused
- which evidence is new
- which tests were performed
- which deviations remain
- which restrictions apply

This would deliver immediate value even before all technical standards are fully harmonised.

Question 9: Is simulation testing a viable alternative to physical trials and, if so, what protocols would need to be adopted?

Simulation and emulation should be used more, but with realistic expectations.

In one of my projects, we introduced a TCMS security gateway. We created a technical specification, and manufacturers such as Siemens, Bombardier / Alstom and Talgo developed gateway solutions based on that specification.

The first step was simulation and emulation. We used this to test behaviour against defined counterpart systems and expected interface conditions.

This was extremely valuable. It reduced risk, stabilised the technical concept, supported supplier alignment and made later vehicle testing more efficient.

However, it did not fully replace vehicle testing.

On older rolling stock, a simulation can never perfectly represent all real-world conditions. In the real train, we saw effects that were not fully predictable in the simulation. These can come from legacy systems, timing behaviour, cable lengths, grounding, older software states, installation conditions, vehicle-specific interfaces and operational edge cases.

My conclusion is:

Simulation is gold for risk reduction, but it must not be treated as proof that the real vehicle will behave exactly the same.

Another example is roof antennas on high-speed rolling stock. Even where simulations were performed using current standards, the real world still produced unexpected conditions. Tunnel entry, pressure waves, passing trains and aerodynamic effects at around 300 km/h can create scenarios that are difficult to fully capture in a model.

Simulation is highly suitable for:

- early risk reduction
- design comparison
- interface verification
- software and communication behaviour
- emulation of counterpart systems
- regression testing

- kinematic and clearance assessments
- structural calculations
- preparation of physical tests

Simulation should be used with more caution for:

- older rolling stock with legacy interfaces
- complex dynamic behaviour
- aerodynamics
- antenna and radio behaviour
- tunnel pressure effects
- real installation conditions
- signalling and communication interfaces
- safety-relevant interfaces with incomplete input assumptions

For simulation to be accepted, the protocols should be clear:

- model description
- model version
- model owner
- configuration baseline
- input parameters
- assumptions
- limits of validity
- validation against real test data
- sensitivity analysis
- traceability to requirements
- independent review where required
- acceptance criteria
- clear statement of what the simulation proves
- clear statement of what still requires physical testing

Simulation should not be treated as a simple replacement for physical testing. It should be part of a staged evidence strategy. It is ideal for reducing risk before physical vehicle testing. Final integration, especially on mature rolling stock and complex interfaces, still needs verification on the real vehicle and, where required, in the relevant operating environment.

Comment on testing location register

A test location register would be useful if it is more than just a list of tracks.

It should define which location is suitable for which type of test.

The register should include:

- approved test types
- track gauge
- track geometry
- curves and gradients
- available speed range
- electrification
- signalling and train control environment

- radio and communication environment
- access conditions
- measurement equipment
- calibration requirements
- data format
- responsible organisation
- validity period
- limitations and exclusions

A test performed at an approved location using an agreed method should be accepted by participating RIMs unless there is a clearly documented network-specific reason not to accept it.

Overall recommendation

My recommendation is to create a harmonised approval and testing framework that combines:

- a national test requirements matrix
- common evidence templates
- a clear split between vehicle conformity, network compatibility and operational approval
- controlled configuration baselines
- mutual recognition of equivalent vehicle-side evidence
- common documentation for software and firmware states
- recognised test locations
- validated simulation and emulation protocols
- documented RIM-specific variations only where technically justified

The key is not to remove safety assurance. The key is to make safety assurance more consistent, more transparent and less repetitive.

From my experience with ICE fleet modernisation, the most efficient approval process is one that asks the right engineering question:

What is the actual risk introduced by this change, and what is the minimum robust evidence needed to close that risk?

That mindset would help Australia reduce duplication while keeping strong safety assurance.