Monash Institute of Railway Technology

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OPTIONS TO HARMONISE ROLLING STOCK TESTING AND TEST LOCATIONS – DISCUSSION PAPER

RESONSES PREPARED BY:

MONASH INSTITUTE OF RAILWAY TECHNOLOGY

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DISCLOSURE NOTICE

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PURPOSE:

The information contained in this submission responds to the *National Transport Commission 2026, Options to harmonise rolling stock testing and test locations – Discussion Paper.*

AUDIENCE:

The work described in this submission to the National Transport Corporation is for public circulation.

ASSUMPTIONS/QUALIFICATIONS:

All observations made in this submission are the opinions of the Monash Institute of Railway Technology (Monash IRT), located at Monash University in Victoria.

FURTHER INFORMATION:

Further information on this document can be obtained from Professor Ravi Ravitharan at the Monash Institute of Railway Technology (Monash IRT).

EXTERNAL SOURCE MATERIALS:

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EXECUTIVE SUMMARY

The Monash University's Institute of Railway Technology (Monash IRT) is pleased to respond to the National Transport Commission's, *Options to harmonise rolling stock testing and test locations – Discussion Paper*.

Monash IRT is Australia's premier track and vehicle railway research centre and has earned an international reputation for delivering 54 years of excellence in railway research. For twenty-six years Monash IRT has been based at Monash University.

The Monash IRT is one of the main technology service providers to heavy haul, freight, passenger, mass-transit and light-rail railway systems both nationally and around the globe and provides a "one-stop" technology access point for the international railway industry, having a client base of more than 170 global railway entities. The Institute has completed over 700 projects since 2000.

Monash IRT has developed a reputation nationally and globally for providing efficient and practical solutions to railway-related technical issues, and its solutions have been adopted by railway systems throughout the world. Its comprehensive and holistic approach to problem solving and program implementation delivered through the specialist expertise of its team of approximately seventy experienced engineers, scientists and technicians, have led to significant savings to its customers' operating and capital costs.

Monash IRT strongly supports the establishment of a National Rolling Stock Testing and Certification Capability centred on a versatile full-scale dynamic laboratory-based testing facility, capable of independently evaluating rolling stock subsystems and complete vehicles under representative Australian operating conditions. The capability should strengthen the engineering evidence supporting certification, registration and network approval, while improving the consistency and efficiency of rolling stock approvals across Australia.

The primary objective is not to replace existing certification or on-network dynamic testing, but to provide a nationally recognised mechanism for generating trusted engineering evidence that is objective, repeatable and reusable throughout the approval lifecycle of the rolling stock. By reducing engineering uncertainty before network testing, the capability enables on-network testing to focus on confirming expected performance and validating residual network-specific operational risks.

Unlike facilities developed around the characteristics of individual rail networks, the national capability should be sufficiently versatile to reproduce the range of infrastructure and operating conditions encountered across Australia. This includes representative variations in track geometry, wheel and rail conditions, vehicle loading, adhesion, curvature, operating speeds and maintenance conditions. Such versatility is essential to evaluate rolling stock performance consistently by the multiple Rail Infrastructure Managers (RIMs) located across Australia, and to support harmonisation of testing methodologies, and provide robust engineering evidence that can be recognised with confidence nationally.

The capability should integrate engineering simulation with controlled laboratory testing to evaluate critical network interface subsystems, including bogies, couplers, suspension systems and pantograph (power) systems, as well as the performance of the complete vehicles. The resulting engineering evidence should support certification by demonstrating compliance with nationally recognised testing methodologies and engineering requirements before necessary on-network testing is undertaken.

Beyond strengthening individual rolling stock approvals, the capability would provide broader strategic benefits to the Australian rail industry by:

- supporting nationally consistent engineering measures, testing methodologies and reporting;
- generating robust engineering evidence that can be recognised and reused across multiple RIMs;
- reducing duplication of type testing and engineering assessment across jurisdictions;
- reducing engineering risk through earlier identification and resolution of technical issues;
- supporting Australian small to medium enterprises (SME) and Original Equipment Manufacturers (OEM) and researchers to develop, validate and commercialise innovative railway technologies;
- providing validated physical datasets to support engineering simulation and digital engineering; and
- strengthening Australia's long-term capability in railway engineering, interoperability and innovation.

Monash IRT considers that the long-term value lies not simply in establishing a national testing facility, but in creating a nationally recognised engineering assurance framework.

The National Rolling Stock Testing and Certification Capability should become the trusted source of engineering evidence for the Australian rail industry, enabling evidence to be generated once, interpreted consistently and reused throughout certification, registration and network approvals. This approach supports the objectives of the National Pathway by reducing duplication, improving interoperability and maintaining robust safety assurances.

A nationally recognised engineering assurance framework could be applied by a network of certified testing providers across Australia. Facilities should be recognised according to their demonstrated testing capability, including the tests they are accredited to perform, the representative operating conditions they can reproduce and the applicable standards and methodologies they can support. Over time, these facilities should operate under the governance of the National Rolling Stock Testing and Certification Capability, ensuring engineering evidence generated anywhere within the network of certified testing centres remains consistent, comparable and trusted by all RIMs.

Monash IRT considers that harmonisation of testing requirements should be treated as one of the highest priorities within the National Pathway because it establishes the engineering foundation upon which certification, registration and network approvals are based. The priority should not simply be to harmonise individual tests, but to standardise the engineering assurance process used to demonstrate compliance.

Monash IRT considers that harmonisation would be most effective for Network Interface Standards (NIS). The interface compliance tests are linked to the NIS which define the technical and operational requirements of rail vehicles for safe and effective operations on a network. The harmonisation of the NIS for rolling stock components that directly interface with the rail network include bogie, coupler, signalling and pantograph subsystems. Developing nationally accepted harmonised subsystem compliance tests and specifications for these critical interfaces, would lead to a more consistent approach for demonstrating compliance by all RIMs to the NIS.

Monash IRT considers having nationally accepted harmonised subsystem interface tests would assist with compliance evaluation using a laboratory based full scale dynamic testing rig for the subsystems. This approach with clear assessment criteria and engineering evidence, would reduce ambiguity and improve confidence in the outcomes and minimise dynamic on track testing requirements. Monash IRT strongly recommends an independent, evidence-based technical approach to testing and outcomes, once the harmonised standards are developed.

Monash IRT considers that international experience demonstrates that the greatest long-term value comes from developing an integrated engineering assurance framework rather than implementing individual reforms in isolation. Australia should investigate four key learnings from international practice, while tailoring them to the unique characteristics of the Australian rail network. The four key learnings are:

Learning 1 – Develop a nationally coordinated testing and certification capability
Learning 2 – Adopt validated simulation as a complement to physical testing
Learning 3 – Ensure engineering evidence follows the vehicle
Learning 4 – Strengthen national engineering capability

Monash IRT considers that Australia should not simply replicate overseas testing facilities but instead adopt the underlying principles that have made them successful. An integrated testing and certification capability that combines versatile laboratory-based testing, validated simulation, nationally recognised engineering evidence and ongoing research capability would provide greater long-term value than isolated investments in individual facilities or processes. Such an approach would strengthen the National Pathway by improving interoperability, reducing duplication, supporting Australian innovation and maintaining robust safety assurance.

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1. INTRODUCTION

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Monash IRT has supported accredited standards development organisations, including Standards Australia, Rail Industry Safety and Standards Board (RISSB) and now the Australian Railway Industry Standards Organisation (ARiSO). Monash IRT also undertakes railway component testing according to the various standards' requirements.

2. POSITION STATEMENT

Monash IRT strongly supports the establishment of a National Rolling Stock Testing and Certification Capability centred on a versatile full-scale dynamic laboratory-based testing facility, capable of independently evaluating rolling stock subsystems and complete vehicles under representative Australian operating conditions. The capability should strengthen the engineering evidence supporting certification, registration and network approval, while improving the consistency and efficiency of rolling stock approvals across Australia.

The primary objective is not to replace existing certification or on-network dynamic testing, but to provide a nationally recognised mechanism for generating trusted engineering evidence that is objective, repeatable and reusable throughout the approval lifecycle. By reducing engineering uncertainty before network testing, the capability enables on-network testing to focus on confirming expected performance and validating residual network-specific operational risks.

Unlike facilities developed around the characteristics of individual rail networks, the national capability should be sufficiently versatile to reproduce the range of infrastructure and operating conditions encountered across Australia. This includes representative variations in track geometry, wheel and rail conditions, vehicle loading, adhesion, curvature, operating speeds and maintenance conditions. Such versatility is essential to evaluate rolling stock performance consistently by the multiple Rail Infrastructure Managers (RIMs) located across Australia, and to support harmonisation of testing methodologies, and provide robust engineering evidence that can be recognised with confidence nationally.

The capability should integrate engineering simulation with controlled laboratory testing to evaluate critical network interface subsystems, including bogies, couplers, suspension systems and pantograph (power) systems, as well as the performance of the complete vehicles. The resulting engineering evidence should support certification by demonstrating compliance with nationally recognised testing methodologies and engineering requirements before necessary on-network testing is undertaken.

Beyond strengthening individual rolling stock approvals, the capability would provide broader strategic benefits to the Australian rail industry by:

- supporting nationally consistent engineering measures, testing methodologies and reporting;
- generating robust engineering evidence that can be recognised and reused across multiple RIMs;
- reducing duplication of type testing and engineering assessment across jurisdictions;
- reducing engineering risk through earlier identification and resolution of technical issues;
- supporting Australian small to medium enterprises (SME) and Original Equipment Manufacturers (OEM) and researchers to develop, validate and commercialise innovative railway technologies;
- providing validated physical datasets to support engineering simulation and digital engineering; and
- strengthening Australia's long-term capability in railway engineering, interoperability and innovation.

Monash IRT considers that the long-term value lies not simply in establishing a national testing facility, but in creating a nationally recognised engineering assurance framework. The National Rolling Stock Testing and Certification Capability should become the trusted source of engineering evidence for the Australian rail industry, enabling evidence to be generated once, interpreted consistently and reused throughout certification, registration and network approvals. This approach supports the objectives of the National Pathway by reducing duplication, improving interoperability and maintaining robust safety assurances.

A nationally recognised engineering assurance framework could be applied by a network of certified testing providers across Australia. Facilities should be recognised according to their demonstrated testing capability, including the tests they are accredited to perform, the representative operating conditions they can reproduce and the applicable standards and methodologies they can support. Over time, these facilities should operate under the governance of the National Rolling Stock Testing and Certification Capability, ensuring engineering evidence generated anywhere within the network of certified testing centres remains consistent, comparable and trusted by all RIMs.

3. QUESTIONS AND RESPONSES

Monash IRT has reviewed the Discussion Paper published by National Transport Commission (NTC) in June 2026: *Options to Harmonise Rolling Stock Testing and Test Locations* and provide the following responses to the questions raised:

3.1 Question 1

To what extent do current rolling stock testing requirements and practices contribute to inefficiency and delay in certification and registration. How should efforts to address testing requirements be prioritised relative to other rolling stock approval elements of the National Pathway?

***Monash IRT Response**:*

Monash IRT considers that current rolling stock testing requirements and practices are a significant contributor to inefficiencies and delays in rolling stock certification and registration. While testing is only one element of the approval process, it provides the engineering evidence relied upon throughout certification, registration and network approval. Consequently, improving the consistency, quality and recognition of engineering evidence should be treated as one of the highest priorities within the National Pathway.

The National Pathway seeks to streamline rolling stock approvals by improving consistency across certification, registration and network approval while maintaining robust safety assurance. Within this context, harmonisation of testing methodologies to reach desired outcomes, should not be considered in isolation, but as a foundational element that supports the broader objectives of consistent engineering assessment, mutual recognition of evidence and more efficient approval processes.

Key issues

Monash IRT considers that the current testing framework presents three key issues.

Firstly, engineering evidence is often generated and assessed differently across Rail Infrastructure Managers (RIMs). Differences in testing methodologies, engineering measures, documentation requirements, interpretation of technical evidence and acceptance criteria, creates uncertainty for Rolling Stock Operators (RSOs) and frequently results in the need for repeated engineering assessments, additional requests for further evidence and long and protracted technical discussions before approval decisions can be made.

Secondly, engineering evidence generated during certification is not consistently reusable across multiple networks. Rolling stock transferred between networks, or even between owners, may require significant portions of the assessment to be repeated despite no change to the vehicle itself. This duplication increases cost and delays while providing limited additional engineering value.

Thirdly, there is limited capability to independently validate the integrated dynamic performance of rolling stock before on-network testing**.** While static testing demonstrates compliance of individual components through engineering calculations and delivers the required documentation, it provides limited evidence of how the complete vehicle will perform dynamically under representative operating conditions. This can result in uncertainty regarding the interpretation and adequacy of the static test results, leading to additional engineering reviews, requests for further evidence and a more cautious approach before permission is granted for on-network dynamic testing. Where issues are subsequently identified during network testing, engineering investigations, modifications and repeat testing can further delay the approval process.

Addressing the root causes

To address the issues outlined related to testing requirements, Monash IRT believes there is a need for these to be prioritised according to their ability to improve the consistency, transparency and reuse of engineering evidence across the approval process. Within the broader objectives of the National Pathway, the priority should be to establish a nationally consistent engineering assurance process before introducing additional testing capability or infrastructure.

The first priority should be to establish nationally agreed engineering measures, testing methodologies, documentation requirements and simulation validation protocols. Standardising the process to be applied to demonstrate compliance is more important than immediately harmonising acceptance thresholds as genuine differences in performance requirements may remain due to infrastructure characteristics, operating environments and operational risk. This work should also identify where different testing methodologies exist and determine, through engineering studies where necessary, whether they produce equivalent engineering outcomes or whether network-specific approaches remain justified.

The second priority should be to establish nationally recognised approaches for interpreting and accepting engineering evidence. Once testing methodologies and documentation are standardised, engineering evidence should be assessed consistently by all RIMs. This will reduce repeated technical reviews, minimise requests for additional evidence and improve the reuse of engineering evidence throughout certification, registration and network approval.

The third priority should be to strengthen the technical assurance supporting the approval process through a nationally recognised testing and certification capability. This capability should provide independent testing, validated simulation and controlled assessment using nationally agreed methodologies to generate engineering evidence that is trusted by all RIMs.

Importantly, this capability is intended to complement rather than replace on-network dynamic testing. By providing greater confidence in the integrated performance of rolling stock before network testing, it reduces engineering uncertainty entering the network approval stage, allowing on-network testing to focus on confirming expected performance and validating residual network-specific operational risks.

For RSOs, the greatest benefit is that engineering evidence can be generated once and it can be reused throughout the approval lifecycle of the rolling stock. Where rolling stock is intended to operate across multiple networks, or subsequently transferred to another operator or network, the RSO should only need to demonstrate the incremental requirements associated with the receiving network rather than repeating common engineering assessments. This reduces duplication, provides greater certainty during project planning and significantly simplifies the process of obtaining approvals by all RIMs.

Together, these priorities establish a logical progression for the National Pathway: first standardise how compliance is demonstrated, then standardise how engineering evidence is interpreted and recognised, and finally strengthen how the evidence is generated. This approach addresses the underlying causes of approval inefficiency while maintaining robust safety assurance and supporting greater consistency across Australian rail networks.

Overall

Monash IRT considers that harmonisation of testing requirements should be treated as one of the highest priorities within the National Pathway because it establishes the engineering foundation upon which certification, registration and network approvals are based. The priority should not simply be to harmonise individual tests, but to standardise the engineering assurance process used to demonstrate compliance.

By first establishing nationally consistent testing methodologies, engineering measures and documentation requirements, then aligning the interpretation and recognition of engineering evidence, and finally supporting this through a nationally recognised testing and certification capability, Australia can significantly reduce duplication and improve consistency in rolling stock approvals. This approach provides greater certainty for RSOs by clearly defining what engineering evidence is required, how it will be assessed and how it can be reused by all RIMs. Rather than repeatedly demonstrating common aspects of rolling stock performance for each network, operators should only be required to address the incremental requirements associated with the receiving network. In parallel, RIMs can focus their assessment on genuine network-specific operational risks (reducing time taken for testing on network) rather than re-evaluating engineering evidence that has already been independently generated and verified (in an accredited independent dynamic testing laboratory).

Together, these reforms provide a practical pathway towards a more efficient, transparent and nationally consistent approval framework that reduces unnecessary duplication, improves interoperability and maintains robust safety assurance.

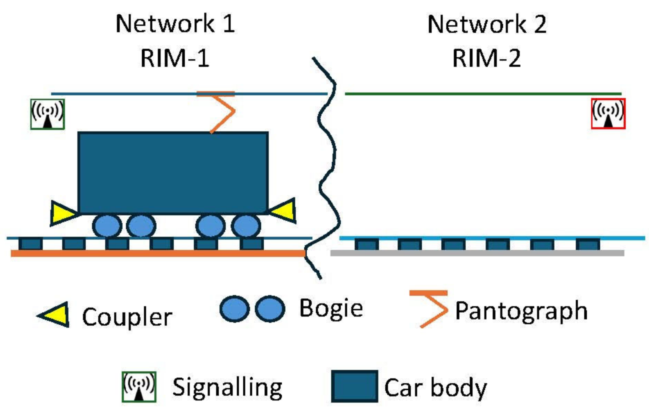
3.2 Question 2

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

***Monash IRT Response**:*

Monash IRT considers that harmonisation would be most effective for Network Interface Standards (NIS). The interface compliance tests are linked to the NIS which define the technical and operational requirements of rail vehicles for safe and effective operations on a network. Currently the testing methodologies, interpretation of risk and acceptance criteria can vary from one RIM to another. Planning and executing interface compliance testing can be complex, time consuming and expensive, especially when multiple networks are involved. Minimising uncertainty through harmonised network interface compliance tests would be most effective. This would reduce complexities, and the time and money required for repeat testing. Nationally accepted criteria to be used by all RIMs will provide greater confidence, quality assurance and consistency in outcomes for implementation of rolling stock on networks.

The figure below demonstrates the key rolling stock components that generally interface with the network infrastructure. During the dynamic testing phase, the focus will be on these interfaces for testing for compliance.



As illustrated, the harmonisation of the NIS for rolling stock components that directly interface with the rail network include bogie, coupler, signalling and pantograph subsystems. Developing nationally accepted harmonised subsystem compliance tests and specifications for these critical interfaces, would lead to a more consistent approach for demonstrating compliance by all RIMs to the NIS.

Monash IRT considers having nationally accepted harmonised subsystem interface tests would assist with compliance evaluation using a laboratory based full scale dynamic testing rig for the subsystems. This approach with clear assessment criteria and engineering evidence, would reduce ambiguity and improve confidence in the outcomes and minimise dynamic on track testing requirements.

Monash IRT strongly recommends an independent, evidence-based technical approach to testing and outcomes, once the harmonised standards are developed which will instil greater confidence to overcome the very conservative current RIMs certification approach. Technical evidence generated through independent and approved testing should be recognised as part of the requirements in the approval lifecycle. This approach would generate robust, repeatable and nationally recognised technical evidence of subsystem performance under representative operating conditions for certification of rolling stock preceding complete rolling stock and infrastructure dynamic testing on the network. This will enable network approval to focus on validating only those operational interfaces that are specific to the receiving network which cannot reasonably be demonstrated through the laboratory based independent technical testing.

This subsystem-based approach would establish a more efficient and nationally consistent approval pathway by reducing the need for duplicate testing. It will promote mutual recognition of technical evidence across jurisdictions and reduce the scope of dynamic network testing while maintaining robust safety assurance.

See also responses to Question 7.

3.3 Question 3

In rolling stock approvals, there are three stages: certification, registration and network approval. For Table 1 – on pages 21-22, could the various tests be identified as either belonging to certification, registration and network approval? For example, 'Inspection based compliance checks' that are largely visual are related to certification.

Monash IRT Response:

Monash IRT supports identifying a primary approval stage for each test in Table 1. Many tests however generate evidence that is applicable across certification, registration and network approval. Rather than assigning each test exclusively to one stage, the National Pathway should recognise technical evidence generated during rolling stock sub-system certification throughout the approval process, with network approval focused on validating only network-specific operational interfaces.

3.4 Question 4

Are there additional learnings, or approaches from international jurisdictions that should be investigated to inform potential reforms to rolling stock testing requirements or locations in Australia?

International comparisons are noted in the Discussion Paper (p.16) with key points stated as follows:

- International jurisdictions like the United Kingdom and European Union (EU) increasingly accept validated simulation models in place of physical testing.
- The United States of America (US) and EU benefit from dedicated, centralised test facilities (e.g. Transportation Technology Centre in Colorado, Velim Test Centre in Czech Republic, Rail Tec Arsenal in Austria).
- In Europe and the US, test data often "follows the vehicle," enabling smoother transitions when ownership changes.

Monash IRT Response:

Monash IRT considers that international experience demonstrates that the greatest long-term value comes from developing an integrated engineering assurance framework rather than implementing individual reforms in isolation. Australia should investigate four key learnings from international practice, while tailoring them to the unique characteristics of the Australian rail network.

Learning 1 – Develop a nationally coordinated testing and certification capability

International testing centres demonstrate the value of independent testing capability; however, Australia should adopt a solution appropriate to its own operating environment.

Unlike many overseas rail systems, Australia's rail network encompasses multiple gauges, infrastructure standards, maintenance practices, operating environments and rolling stock types. Replicating this diversity within a dedicated test track would require significant investment and would still be unlikely to represent the full range of Australian operating conditions.

Accordingly, Monash IRT considers that Australia's initial priority should be the establishment of a versatile full-scale National Rolling Stock Testing and Certification Capability qualified and competent of reproducing representative operating conditions through laboratory-based testing and validated simulation. Such a capability would generate nationally recognised engineering evidence, support harmonisation of testing methodologies and validate simulation models before on-network dynamic testing is undertaken.

A dedicated test track may become appropriate as Australia's testing capability matures. However, in the near term, greater national benefit is likely to be achieved through investment in a versatile testing and certification capability that complements existing operational networks rather than attempting to replicate them.

Learning 2 – Adopt validated simulation as a complement to physical testing

Monash IRT strongly supports the use of engineering simulation; however, simulation should complement rather than replace physical testing. Simulation models are simplified representations of complex railway systems and are only valid within the operating envelope over which they have been demonstrated.

International experience, particularly within Europe, demonstrates that validated simulation can progressively reduce the scope of physical testing where confidence has been established through representative physical testing. Australia should adopt a similar approach by developing nationally recognised simulation validation protocols supported by representative physical datasets. This allows simulation to extend the value of physical testing while maintaining confidence in engineering evidence.

Learning 3 – Ensure engineering evidence follows the vehicle

Australia should establish a nationally recognised engineering evidence framework where test reports, validated simulation models and certification evidence are generated using nationally consistent methodologies and retained within a central register. This would enable engineering evidence to be reused when rolling stock operates across multiple networks or changes ownership, reducing unnecessary duplication while improving consistency and transparency.

This approach should be supported by nationally consistent reporting templates, standardised test methodologies and common documentation requirements so that engineering evidence generated by one approved testing organisation can be confidently interpreted by all RIMs.

Learning 4 – Strengthen national engineering capability

International testing centres provide benefits beyond rolling stock approvals by supporting research, evaluation of various international standards, the development of new and updates to those existing standards and support technology commercialisation. Australia should adopt a similar approach by ensuring that the National Rolling Stock Testing and Certification Capability also functions as a national engineering asset. In addition to supporting certification and registration, the capability should provide Australian researchers, OEMs and SMEs with access to independent testing and validation services that accelerate innovation, improve technology readiness and support commercialisation of Australian-developed railway technologies.

Overall

Monash IRT considers that Australia should not simply replicate overseas testing facilities but instead adopt the underlying principles that have made them successful. An integrated testing and certification capability that combines versatile laboratory-based testing, validated simulation, nationally recognised engineering evidence and ongoing research capability would provide greater long-term value than isolated investments in individual facilities or processes. Such an approach would strengthen the National Pathway by improving interoperability, reducing duplication, supporting Australian innovation and maintaining robust safety assurance.

3.5 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?

Monash IRT Response:

Monash IRT strongly supports the establishment of a nationally recognised independent testing and certification capability as a key enabler of the National Pathway. Such a capability should not simply provide a location for conducting tests, but generate trusted engineering evidence that supports certification, registration and network approval across Australia. Its primary value lies in reducing duplication, supporting national harmonisation, strengthening engineering assurance and accelerating innovation.

A national testing and certification capability would deliver value in four key areas:

(1) Support national harmonisation of testing and certification

Australia's current rolling stock approval process is characterised by differences in testing methodologies, acceptance criteria and interpretation between RIMs. While many tests seek to demonstrate the same engineering outcomes, differences in how they are conducted and assessed often result in duplicated testing and repeated engineering assessments.

A national capability would provide an independent engineering environment where different testing methodologies and acceptance criteria can be objectively evaluated under controlled conditions. This would allow engineering evidence, not historical practice, to determine where testing approaches can be harmonised and where genuine network-specific requirements should remain.

Where differences exist, the facility could undertake targeted engineering studies to understand the effect of alternative methodologies and support nationally agreed testing approaches. This evidence-based approach would significantly improve consistency while maintaining appropriate network-specific requirements.

(2) Provide independent testing and certification evidence

Australia has limited capability for comprehensive dynamic testing across the range of infrastructure and operating conditions experienced nationally. Existing dynamic testing facilities are generally not independent, developed around the characteristics of individual networks or contract requirements and cannot readily reproduce the diversity of Australian operating environments. As a result, engineering evidence generated under one set of conditions cannot always be confidently extrapolated to demonstrate performance across other networks with different infrastructure and operating characteristics.

A national capability should independently assess rolling stock against both nationally harmonised requirements and agreed network-specific requirements. It should be capable of reproducing representative operating conditions, including different gauges, track geometries, maintenance standards, wheel and rail wear states, adhesion conditions and operational scenarios. This would enable critical network interface subsystems, including bogies, braking systems, suspension, couplers and pantographs, to be assessed under representative Australian conditions before limited necessary on-network validation.

The engineering evidence generated through this process should be recognised throughout the approval pathway, allowing registration activities to focus primarily on validating residual network-specific operational risks rather than repeating technical assessments that have already been independently demonstrated. These residual assessments should focus on infrastructure and operational characteristics unique to the receiving network, for example, specific differences in kinematic envelope, track geometry, maintenance standards or operating conditions, that may influence rolling stock performance.

(3) Build Australia's engineering capability through testing and simulation

The long-term value of the capability extends beyond supporting individual approvals. Internationally, leading testing centres combine physical testing with advanced simulation to develop validated engineering models that support future certification activities and improve engineering understanding.

A national capability should similarly integrate physical testing with validated dynamic simulation models. Once validated, these models can be used to assess operating conditions that are difficult or impractical to reproduce through physical testing alone, support future rolling stock modifications and reduce the extent of physical testing required for subsequent certification activities.

Test data, validated simulation models and certification evidence should become reusable engineering assets that support future approvals, standards development and continuous improvement across the Australian rail industry.

(4) Support innovation and continuous improvement

Beyond supporting approvals, a national testing and certification capability would provide Australia with an independent platform and equal access for developing and validating solutions to uniquely Australian rail challenges where no established solution exists or current solutions can be improved.

The capability would allow industry, researchers and operators to evaluate emerging technologies, investigate operational issues and validate new engineering solutions before deployment. Importantly, the capability would also support innovation by providing Australian start-ups, SMEs and manufacturers with access to nationally recognised testing and certification services. This would enable emerging technologies to be independently validated under representative operating conditions, increasing technology readiness, reducing commercialisation risk and accelerating the transition from research and prototype development to deployment across the Australian rail industry.

It would also capture operational learnings and translate them to improve national standards, testing methodologies and engineering practices, strengthening Australia's long-term capability in railway engineering.

Monash IRT considers that Australia's long-term objective should not simply be to establish a testing facility, but to develop a nationally recognised independent testing and certification capability to satisfy current and future needs of the railway industry. Such a capability would generate trusted, repeatable and reusable engineering evidence that supports harmonised approvals, strengthens certification processes and builds enduring national capability in railway engineering.

Beyond supporting individual projects, it would become enabling infrastructure for the National Pathway, reducing duplication, improving interoperability, accelerating innovation and strengthening Australia's long-term rail capability.

3.6 Question 6

Are the options for harmonisation mentioned in section 4.3 better considered as standalone options, as a combination of options, or altogether? Which options should be implemented as a priority?

Monash IRT Response:

Monash IRT considers that the options presented in Section 4.3 should be implemented as an integrated framework rather than as standalone initiatives. The options are interdependent and collectively establish a nationally consistent approach to demonstrating rolling stock compliance. Implementing them independently would deliver only limited benefit, whereas implementing them in a logical sequence would create a robust and efficient national testing and certification framework.

The implementation should be guided by three sequential phases.

Phase 1 – Harmonise requirements for demonstrating compliance

The first priority should be establishing a common understanding of what needs to be demonstrated during testing.

This should combine:

- a national test requirements matrix;
- consolidated Australian standards with documented RIM variations;
- standardised test methodologies and documentation; and
- harmonised assessment metrics.

These activities should be undertaken together because they address different aspects of the same objective. The requirements matrix identifies where networks align and differ, consolidated standards provide the technical reference, while standardised methodologies ensure testing is performed consistently and documented in a common format.

Monash IRT considers that harmonisation should focus primarily on standardising the engineering measures used to demonstrate compliance rather than requiring identical acceptance thresholds across all networks. Where genuine network-specific requirements exist, these should be explicitly documented so operators understand the incremental effort required to gain access to additional networks. This approach maintains transparency while recognising legitimate operational differences across Australian rail networks.

Phase 2 – Establish nationally recognised testing capability

Once nationally consistent testing requirements have been established, the next priority should be ensuring they can be delivered consistently.

Rather than simply recognising additional testing locations, Australia should establish nationally recognised testing capability through a network of certified testing centres operating under common governance and quality assurance arrangements. These centres should demonstrate the capability to undertake agreed few sets of test programs or entire set of test programs using agreed standardised methodologies for the tests, using calibrated equipment and ability to produce consistent reporting.

Over time, these centres should be linked to, or operate under the governance of, a national testing and certification capability. This would ensure engineering evidence generated anywhere within the network of certified testing centres is directly comparable and trusted by all RIMs.

Phase 3 – Enable national recognition of engineering evidence

Once consistent testing requirements and certified testing capability are established, engineering evidence should be recognised throughout the approval pathway.

Standardised reporting formats and independently generated technical evidence would enable certification evidence to be reused across multiple networks, allowing registration activities to focus primarily on validating network-specific operational risks rather than repeating technical assessments.

This approach would significantly reduce duplication while maintaining the flexibility for networks to impose additional requirements where justified by infrastructure or operational considerations.

Monash IRT considers that the greatest benefits will not be realised by implementing the options individually, but by treating them as a connected framework. Harmonising requirements establishes consistency in what must be demonstrated, certified testing capability ensures evidence is generated consistently, and mutual recognition enables that evidence to be reused throughout the approval process. Together, these reforms provide the foundation for a nationally consistent, efficient and technically robust rolling stock approval system.

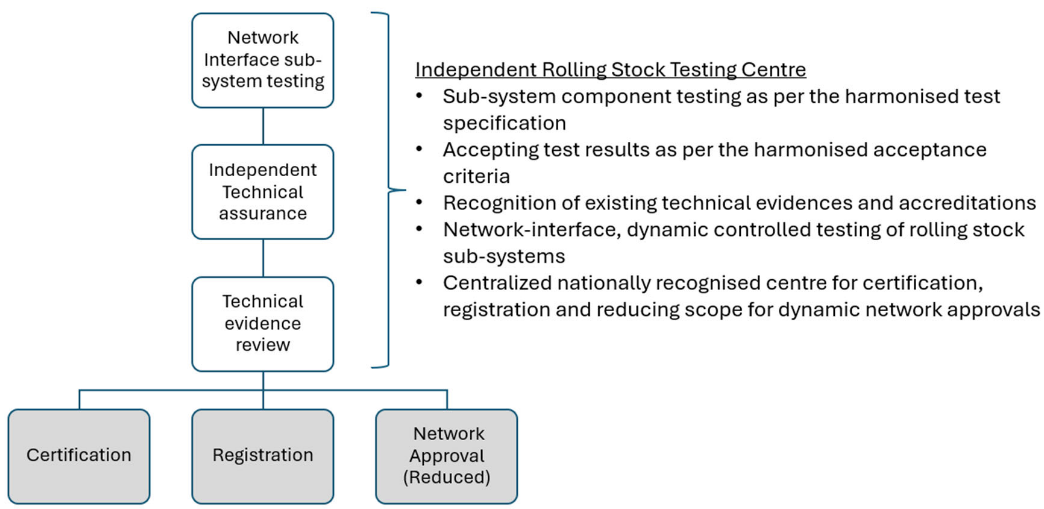
3.7 Question 7

Are there specific acceptance criteria or documentation requirements that could be quickly harmonised to deliver immediate benefits ('quick wins')?

Monash IRT Response:

Monash IRT considers that immediate benefits can be achieved by harmonising the generation, assessment and recognition of engineering evidence within the existing rolling stock approval framework. Australia already has a well-established certification process through AS 7501; however, greater national consistency can be achieved by strengthening how engineering evidence is generated, independently assured and recognised across RIMs.

The figure below illustrates a proposed technical assurance framework that complements the existing approval process.



IMPROVED TECHNICAL ASSURANCE FRAMEWORK

Independent assessment of critical network interface subsystems generates nationally recognised engineering evidence that supports certification, registration and network approval. This enables engineering evidence to be generated once and reused throughout the approval lifecycle, reducing duplication while maintaining robust safety assurance.

The highest priority should be the development of nationally agreed engineering requirements, subsystem test specifications and acceptance criteria for critical network interface subsystems. Priority should be given to systems that directly interact with railway infrastructure, including bogie systems, braking systems, pantograph systems and coupler systems. Harmonised test specifications based on recognised Australian and international standards would reduce inconsistent interpretation between RIMs and minimise repeated project-specific assessments while maintaining legitimate network-specific requirements.

The existing AS 7501 certification process may be strengthened by enabling engineering evidence generated at the accredited network of certified testing centres to progress to the dynamic on track testing phase.

3.8 Question 8

Would allowing greater flexibility in where dynamic and static tests are conducted (for example, recognising results from a wider range of approved sites or simulators) help reduce costs and improve timing?

Monash IRT Response:

Monash IRT considers that allowing greater flexibility in where static and dynamic testing is undertaken has the potential to improve project delivery timelines and reduce project risk, provided nationally consistent testing methodologies, reporting requirements and facility certification arrangements are first established. Flexibility should be based on demonstrated testing capability rather than simply recognising additional testing locations.

For static testing, greater flexibility provides immediate benefits. Once nationally consistent testing methodologies and reporting requirements have been established, static assessments, including dimensional verification, weighing, twist testing and other compliance assessments, can be undertaken by a wider range of certified facilities. This enables testing to commence earlier, reduces dependency on a limited number of providers and allows testing activities to proceed in parallel with other engineering activities, improving overall project delivery timelines.

For dynamic testing, the greatest opportunity is not necessarily to reduce the duration of on-track testing itself, but to reduce the engineering risk associated with it. Comprehensive pre-testing through certified testing facilities and validated simulation provides greater confidence that rolling stock will perform as expected before entering network trials. This reduces the likelihood that significant issues are first identified during on-track testing, where engineering changes, repeat testing and project delays are substantially more expensive to resolve.

As confidence in nationally recognised testing methodologies and validated simulation increases, there may also be opportunities to progressively reduce the scope of network testing where equivalent engineering evidence has already been independently demonstrated. International practice is moving in this direction, with standards such as EN 14363 permitting validated simulation to replace certain elements of physical testing within a defined operating envelope. However, physical testing remains essential for validating simulation models and confirming performance under representative operating conditions.

Cost savings are also expected, although they are likely to be secondary to improvements in delivery certainty. Once testing methodologies and reporting requirements are standardised, operators can select appropriately certified testing providers based on capability, availability and cost. While the relatively small number of rolling stock approval programs in Australia is unlikely to create significant competitive price reductions, greater flexibility will improve utilisation of national testing capability, reduce scheduling constraints and minimise the costs associated with project delays and repeat testing.

Greater flexibility should only be introduced where testing facilities and simulation providers have demonstrated the capability to generate nationally recognised engineering evidence. This requires certification or accreditation of testing capability, including the range of tests that can be performed, representative operating conditions that can be reproduced, instrumentation, quality assurance processes and standardised reporting as well as subject matter expertise. The same principle should apply to simulation providers through nationally recognised model validation and verification protocols.

3.9 Question 9

Is simulation testing a viable alternative to physical trials and, if so, what protocols would need to be adopted to validate simulation models? Are there specific tests that simulation testing could be used to demonstrate compliance?

Monash IRT Response:

Monash IRT considers that simulation should not be viewed as an alternative to physical testing, but as a means of extending the value that can be derived from physical testing. Physical testing establishes confidence that a simulation model accurately represents the behaviour of the real system, while validated simulation enables engineers to efficiently investigate a much wider range of operating conditions than could reasonably be achieved through physical testing alone. Applied together, physical testing and simulation deliver a more robust and cost-effective approach to demonstrating rolling stock performance than either approach in isolation.

Simulation models are inherently simplified representations of complex physical systems. Unlike physical testing, simulations will always produce an answer, regardless of whether the model is valid for the conditions being evaluated. Consequently, confidence in simulation-based evidence depends not only on the quality of the model, but on demonstrating the range of operating conditions over which the model has been validated.

For railway applications this is particularly important because vehicle-track interaction is specifically non-linear. Rolling stock performance is influenced by factors including vehicle loading, suspension characteristics, wheel and rail wear, track geometry, track stiffness, adhesion conditions and operational speed. A model validated under one operating condition cannot automatically be assumed to remain valid under another.

Accordingly, Monash IRT recommends that nationally recognised simulation validation protocols be developed. These protocols should define:

- standardised modelling assumptions and input parameters;
- component-, subsystem- and system-level validation requirements;
- representative static and dynamic physical test datasets for calibration and validation;
- the operating envelope over which model predictions are considered valid;
- defined validation criteria and acceptable prediction tolerances;

- independent verification of modelling methodologies; and
- configuration management and traceability of simulation models, assumptions and validation data.

A full-scale national testing and certification capability would play a critical role in supporting simulation-based approvals by generating the high-quality physical data required to validate simulation models across representative operating conditions. Importantly, validation should extend beyond static testing. While static measurements are essential for establishing vehicle characteristics, they do not fully capture the dynamic behaviour of railway vehicles. Dynamic validation under representative operating conditions is therefore necessary to ensure models accurately predict vehicle behaviour throughout the intended operating envelope.

For example, a wagon dynamics model should first be validated against physical measurements in both loaded and empty conditions using representative static and dynamic tests. Once confidence has been established across these bounding conditions, the validated model can be used to investigate a much broader range of scenarios, including different track conditions, wheel and rail wear states, degraded adhesion, operating speeds and infrastructure characteristics, without requiring physical testing for every individual case.

Once validated, simulation could be used to demonstrate compliance for a wide range of engineering assessments, including vehicle dynamics, curving performance, ride quality, wheel unloading, wheel-rail forces, suspension performance, fatigue loading, braking performance, and pantograph-overhead interaction. However, Monash IRT recognises that some aspects of network approval will continue to require physical verification on the receiving network.

Overall, Monash IRT considers that the future of rolling stock approval should combine physical testing and validated simulation within a single engineering assurance framework. Physical testing establishes confidence in the models, validated simulation expands the range of conditions that can be assessed, and together they provide trusted engineering evidence that reduces unnecessary physical testing while maintaining robust safety assurance.

3.10 Question 10

Should harmonisation of testing requirements and locations be progressed as a separate, dedicated project, or could it be effectively managed by the Technical Working Group for a single registration application pilot during a future stage of the National Pathway?

Monash IRT Response:

Monash IRT considers that harmonisation of testing requirements and locations should be progressed as a separate, dedicated national work program. While the Technical Working Group (TWG) and a future registration application pilot can play an important role in validating the practical implementation of the framework, they should not be the primary mechanism for developing it.

Harmonisation is fundamentally an engineering and standards development exercise that extends well beyond the approval of an individual rolling stock application. It requires consideration of testing requirements, engineering measures, testing methodologies, simulation validation protocols, acceptance criteria, testing capability and the mutual recognition of engineering evidence across a broad range of rolling stock types, operating environments and rail networks. These issues should be evaluated holistically rather than through the context of a single approval project.

A registration pilot is, by its nature, focused on achieving an operational approval outcome within project delivery constraints. The primary objective is the successful approval of the rolling stock rather than the development of nationally applicable engineering frameworks. Consequently, opportunities to evaluate alternative methodologies, investigate broader engineering questions or consider long-term harmonisation outcomes may be limited by project scope, timelines and commercial priorities.

Furthermore, the selection of the pilot vehicle, operating environment and RIMs will inevitably influence the issues considered. This creates a risk that the resulting framework becomes optimised for a particular class of rolling stock or operating environment rather than providing a robust national solution applicable across the diversity of Australian rail networks.

Monash IRT therefore recommends that a dedicated national work program be established to develop the harmonised testing framework, supported by targeted engineering studies where required. These studies should objectively evaluate alternative testing methodologies, determine where nationally consistent approaches can be adopted and identify where genuine network-specific requirements remain justified based on infrastructure characteristics, operating environments and safety outcomes.

Once developed, the harmonised framework should then be trialled through the TWG and future registration pilots. This would allow the practical implementation of the framework to be validated under real project conditions, with lessons learnt informing refinement prior to broader national adoption.

This approach separates framework development from project delivery while ensuring that the final harmonised testing framework is technically robust, nationally applicable and validated through practical implementation.

3.11 Question 11

Would a testing location register be useful?

Monash IRT Response:

Monash IRT considers that a testing location register would provide significant value; however, it should be developed as a national testing capability register rather than simply a list of testing locations. The objective should be to provide industry with a clear understanding of the testing capability available across Australia and the extent to which engineering evidence generated at each facility can support certification and registration activities.

The register should identify, for each recognised testing facility:

- the static and dynamic tests that can be undertaken;

- the range of infrastructure and operating conditions that can be reproduced (for example, gauge, track geometry, wheel and rail conditions, adhesion conditions, operating speeds and loading conditions);
- the applicable Australian Standards, Network Interface Standards and nationally recognised test methodologies supported by the facility;
- the Rail Infrastructure Managers (RIMs) for which the testing capability is recognised or accepted;
- available measurement systems, instrumentation and engineering capabilities;
- simulation and model validation capabilities; and
- accreditation or certification status, including the scope of recognised testing activities.

Providing this information would allow manufacturers, operators and certifying bodies to select facilities capable of generating engineering evidence that is recognised for the intended approval pathway. It would also improve transparency by allowing applicants to understand which testing requirements can be satisfied at each facility and identify any additional network-specific testing that may still be required.

Over time, the register should operate as part of a nationally recognised testing and certification capability. Facilities included within the register should demonstrate that they can deliver testing in accordance with nationally agreed methodologies, quality assurance processes and reporting requirements, ensuring that engineering evidence generated at different locations remains consistent, repeatable and mutually recognisable across Australian rail networks. This would ensure engineering evidence generated anywhere within the network of certified testing centres is directly comparable and trusted by all RIMs.

4. FINAL COMMENTS

As one of the main technology service providers to heavy haul, freight, passenger, mass-transit and light-rail railway operations and railway systems both nationally and around the globe to a client base of more than 170 national and international railway entities, Monash IRT considers that harmonisation of testing requirements and a framework which delivers consistency and transparency for interpretation of requirements should be treated as one of the highest priorities within the National Pathway. Harmonisation should extend beyond aligning documented requirements and should also establish a common interpretation of technical standards, acceptable evidence, testing methodologies and risk acceptance criteria among all RIMs.

Monash IRT strongly supports the establishment of a National Rolling Stock Testing and Certification Capability to provide independent simulation and laboratory testing to deliver a technically robust mechanism for reducing reliance on network-specific dynamic testing and improve the efficiency of rolling stock approvals across Australia.

Monash IRT, as an independent railway specialist research institute has been leading the conversation with Australia’s most critical stakeholders in rail, advocating for a National Rolling Stock Testing and Certification Capability. Stakeholders have included the NTC where the value of such a facility has been highlighted to propel Australia forward in its national and international endeavors to have consistent accreditation of all rolling stock operating in this country. Streamlined processes of type testing and a digital repository for test outcomes will also support advancing sovereign capability and onshore manufacturing of rolling stock and enhance Australia’s reputation as a leader in rail innovation.

5. ABBREVIATIONS

ARISO	Australian Rail Industry Standards Organisation
Monash IRT	Monash University's Institute of Railway Technology
NIS	Network Interface Standards
NTC	National Transport Commission
OEM	Original Equipment Manufacturer
RIM	Rail Infrastructure Manager
RISSB	Rail Industry Safety and Standards Board
RSO	Rolling Stock Operator
SME	Small and Medium-sized Enterprises
TWG	Technical Working Group