Australian STANDARD®

Rail systems interoperability

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

Operations Standard

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RISSB Office

Phone:
(07) 3724 0000
Overseas: +61 7 3724 0000

Email:
info@rissb.com.au

Web:
www.rissb.com.au

AS7450 **Assigned Standard Development Manager**

Name:
Cris Fitzhardinge

Phone:
0419 916 693

Email:
cfitzhardinge@rissb.com.au

This Australian Standard® AS 7450 Rail systems interoperability was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organizations:

Queensland Rail	Arcadis	ARTC
Doc Frank Rail Services	TfNSW	Shoal Group
Yarra Trams	RBTU	Calibre Group
UGL	Hitachirail	PTA WA
SMEC	PTV	Aurizon

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Development of the Standard was undertaken in accordance with RISSB's accredited process. As part of the approval process, the Standing Committee verified that proper process was followed in developing the Standard

RISSB wishes to acknowledge the positive contribution of subject matter experts in the development of this Standard. Their efforts ranged from membership of the Development Group through to individuals providing comment on a draft of the Standard during the open review.

I commend this Standard to the Australasian rail industry as it represents industry good practice and has been developed through a rigorous process.

Deb Spring
Exec. Chair / CEO
Rail Industry Safety and Standards Board

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Rail systems interoperability

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This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7450 Rail systems interoperability. Membership of this Development Group consisted of representatives from the organizations listed on the inside cover of this document

This Standard supersedes AS 7450:2013 Rail Systems Interoperability

Objective

Interoperability has the potential to provide many benefits to the Australian rail industry in terms of safety, harmonization, cost effectiveness and future proofing. The objective of this Standard is to provide interoperability principles that guide rail transport operators (RTO), rail infrastructure managers (RIM) and contractors towards improving interoperability within the Australian railway industry.

The intent of this Standard is to enhance the understanding of interoperability as well as to provide a methodology for considering interoperability when introducing new technology or implementing a change management process. Further, this Standard requires the consideration of improving interoperability at all opportunities where a change is proposed.

This Standard applies to all organizations who are involved in the design, supply and operation of new infrastructure, systems and rolling stock for the Australian railway industry.

Rail transport operators should implement where appropriate interoperability throughout the asset life cycle and implement this Standard where appropriate.

Compliance

There are four types of provisions contained within Australian Standards developed by RISSB:

1. Requirements.
2. Recommendations.
3. Permissions.
4. Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e., the identified control is not able to be applied or other controls are more appropriate or better.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints - provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities, or interfacing organizations where the risk may be shared.

Controls in RISSB standards address known railway hazards, and are addressed in Appendix A.

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by ‘C’ preceding the clause number and is printed in italics in a box. The commentary is for information and guidance, it does not form part of the requirements and recommendations of this Standard.

Contents

Appendix Contents

1 Scope and general

1.1 Scope

This Standard aims to improve the level of interoperability across the Australian Railway industry. This can be achieved by rail transport operators (RTO) working towards a level of interoperability commensurate with the financial and operational benefits as a result of interoperability.

This Standard provides a set of interoperability principles that the Australian Railway can use to achieve interoperability.

This Standard recognizes that in some circumstances it may be determined that interoperability cannot be practically achieved. To assist in this determination this Standard provides a process for reviewing the interoperability of current and future systems, assets or processes.

Interoperability is not equivalent to sameness. However this Standard provides recommendations for certain principles regarding the interoperability and compatibility of systems.

1.2 Exclusions

This Standard does not:

(a) address specific design standards for system architectures;

(b) address interchangeability (the quality of allowing individual components or modules to be swapped between different systems);

(c) prescribe solutions for interoperability;

(d) cover safeworking rules and procedures; and

(e) apply to tourist or heritage rail systems.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

- AS 7472 Railway Operations - Management of Change

NOTE: Documents for informative purposes are listed in the Bibliography (Appendix D).

1.4 Terms and definitions

For the purposes of this document, the terms and definitions given in RISSB Glossary: https://www.rissb.com.au/products/glossary/ and the following apply:

1.4.1

interoperability

ability of a process, system or a product to work with other process, systems or products

1.4.2

implementing RTO

rail transport operator that initiated the interoperability assessment

2 Interoperability

2.1 General

Interoperability is considered a vital part of rail systems in many parts of the world. Seamless operation should occur between all parts of a rail system, and also between adjacent rail networks.

An interoperable transport network enables efficient operations and services across boundaries and across technical, physical, geographical, legislative and organizational interfaces. For example, interoperability exists where rolling stock is able to operate on the whole (or a significant portion) of the national railway network, or when two previously separated networks are interconnected and able to support common fleet operations.

Full interoperability between rail systems is achieved when any railway system, process or asset is successfully operated seamlessly across or within multiple operational environments, without change to that system, process or asset.

Interoperability can be achieved through various means including:

(a) development of and adherence to national Standards, Codes of Practice and Guidelines;

(b) the use of similar hardware or software;

(c) the use of common communications, languages, data or systems;

(d) where similar technologies are adopted, alignment of the applications where appropriate; and

(e) through common and effective interfaces, processes or procedures.

Additional systems that benefit from interoperability are listed in Appendix B.

It is important that any interoperability work also involves good change management practices, and consideration of human factors and the human machine interface.

Commercial, operational, and technological realities should be assessed to determine the appropriate level of interoperability.

Interoperability should be scaled proportionate to the system in question, based on an assessment of the need for the infrastructure, system or rolling stock to be interoperable.

The individual obligations in this Standard may be partially or fully delegated to, or shared with, other stakeholders or representatives. This would typically be where the Standard is specified or mandated as part of an agreement. Refer section 3.2

The standard does not waive the existing change management obligations placed on rail industry participants to ensure adequate management of the change process (i.e. safety considerations, risk management, operational safety case) and to support, in turn their obligations to operators, track managers and the public.

2.2 Achieving compliance

To achieve compliance with this Standard an RTO should follow this flow chart, noting the specific clauses for further information.

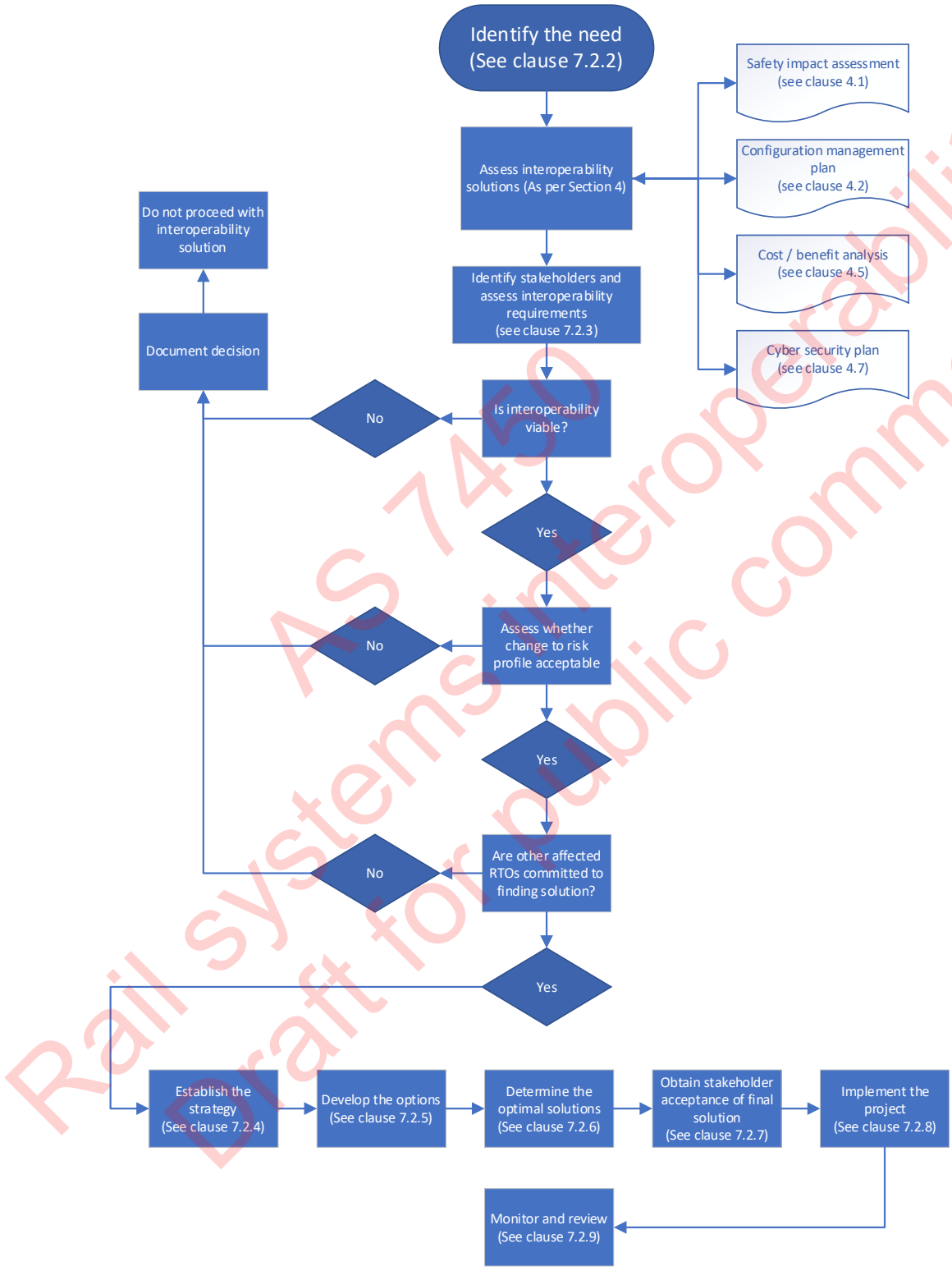

Figure 2.1 Interoperability assessment flowchart

3 Managing interoperability

3.1 General principles

The principles of interoperability should be applied across the entire spectrum of rail system processes, including human factors and the human / machine interface (HMI), through sound management of change practices. Interoperability should be considered for the full range and variability of rail operating conditions inclusive of infrastructure, track workers and rail vehicles.

Solutions that restrict future development or the introduction of new technology shall be reassessed and altered to remove restrictions.

Interoperability should be pursued as a platform for innovation to enable creation of value for the rail industry.

The implementation of interoperability should be designed to promote flexibility of choice, a high level of upgradability and a high level of maintainability. Interoperability should be considered in a way that allows more choices for users rather than a restriction of available options. This should encourage cost effectiveness and efficiency in solutions with a clear view to delivering improved service and functionality.

3.2 Responsibilities for compliance

The overall responsibility shall remain with the organization initiating the change to prove compliance with the Standard.

The individual obligations in this Standard may be partially or fully delegated to, or shared with, other stakeholders or representatives. This would typically be where the Standard is specified or mandated as part of an agreement.

3.3 Achieving interoperability

When assessing the need for interoperability RTOs shall:

(a) ensure any risks introduced through interoperability are managed so far as is reasonably (SFAIRP);

(b) assess all changes with the rail system against the opportunity to progress the goal of interoperability;

(c) include provision for interoperability with existing or proposed systems within the jurisdiction of the change and with other directly or indirectly connected networks;

(d) engage with all affected stakeholders as early as possible.

Interoperability solutions driven by business requirements and needs should not decrease levels of interoperability.

C.3.3 Commentary

The aim of this Standard is to increase the levels of interoperability within Australia. Where new systems or infrastructure are introduced they should not reduce the existing level of interoperability. However, it is recognized that in some circumstances this could be impractical due to the nature of the system or infrastructure, or the overall cost-benefit analysis.

3.4 Improving interoperability solutions

Interoperability solutions can be improved through assessment and implementation of the following recommendations.

(a) The implementation of increased interoperability should aim to support seamless operation now and in the future.

(b) All identified interoperability options should be recorded and analysed to the level necessary for justifying their inclusion or exclusion in the design of the change.

(c) Opportunities to improve interoperability should be taken where practicable.

(d) The chosen options should:

i. be based on open Standards and interfaces where practical;

ii. aim to support a multi-vendor competitive market; and

iii. be chosen to provide for technical harmonization.

(e) In designing new systems or processes, the railway should:

i. remain capable of supporting new and emerging technologies through technology roadmaps;

ii. consider how updates and improvements can be implemented into an interoperable system, using processes such as configuration management;

(f) Interoperability planning should support the safety and business needs of RTOs.

(g) The manner in which interoperability options are implemented should provide for evolution and efficient migration from one system or technology to another and avoid technological dead ends.

(h) The assessment of the level of interoperability to be implemented in a change process should be considered and agreed at the appropriate organizational or rail industry level to allow for any system or operational changes to be designed and implemented across the rail industry.

4 Interoperability considerations

4.1 General

Any change that involves interoperability has the potential to affect the accreditation and operational abilities of multiple rail transport operators. The initiating rail transport organization should consider the accreditation requirements of all affected rail transport operators when designing interoperability solutions.

When considering interoperability Australian Standards should be reviewed in the first instance, as these documents are written to encourage harmonization and interoperability across the railway industry.

Australian Standards cover areas discussed in this section and should be reviewed as part of any interoperability consideration.

4.2 Safety

It is important that the impact of any proposed interoperability solution on the safe operation of the railway is assessed.

A safety assessment could impact on the ability to achieve a fully interoperable outcome, where to do so would introduce an unacceptable risk to the railway. In other instances (such as in the areas of track safety, monitoring, compliance and certification), interoperable solutions could provide an overall reduction in risk to personnel, assets and the public. Alternatively, an interoperability solution that has minimal to no impact on safety could be assessed as not worthwhile (from a safety improvement perspective).

All safety impacts of the proposed change shall be assessed and the decision to implement interoperability solutions informed by the change in the risk profile for each RTO affected by the change.

4.3 Configuration management and maintenance

Interoperability solutions could require systems and infrastructure used across multiple RTOs to be maintained and software updated over the lifecycle of that solution. This requires careful management to ensure all systems and infrastructure are maintained and updated to the same level.

The initiating RTO shall be responsible for ensuring that all affected RTOs are advised of all maintenance, upgrade and update requirements for the affected systems and infrastructure.

Any works that risks the interoperability of the system, asset or process being maintained shall not be conducted until an assessment is completed on the impact of that work.

Any changes recorded in the configuration management system shall be communicated by the RTO implementing the change to all stakeholders affected by the change to ensure that the change does not adversely affect interoperability.

ISO 10007 provides guidance on configuration management.

AS 7473 provides further guidance on configuration management in complex systems.

4.4 Deployment and maintenance

As part of an interoperability change, the management of maintenance is a critical factor. The implementing RTO shall ensure that rail asset's maintenance regimes are communicated to all affected RTOs so that interoperable assets can be maintained in a manner that protects any interoperability functionality.

4.5 Commercial

4.5.1 General considerations

The cost / benefit ratio should be considered for all interoperability proposals. The cost / benefit ratio should be considered for both the implementing RTO and all affected stakeholders.

The allocation of the engineering and operational costs attributed to interoperability between RTOs should be supported by commercial agreements. This should allow for cooperation between all stakeholders.

A satisfactory commercial outcome should be developed by:

(a) minimising duplication (the use of multiple systems or processes such as on-board and track side equipment, processes etc.);

(b) being conscious of potential integration issues;

(c) minimising retrofit requirements and minimising interface requirements to effect the change;

(d) applying interoperability principles across the entire rail system processes;

(e) allowing for information privacy and security management;

(f) assessing the full range of operating conditions, infrastructure and train types;

(g) assessing whole of life and total cost of ownership costs;

(h) assessing the time required for migration and implementation;

(i) maintaining or improving performance and reliability of the train and/or systems; and

(j) maximising the cost effectiveness for the whole industry and allowing for distribution of costs between stakeholders if appropriate.

The cost of implementing some identified interoperability solutions could outweigh the immediate benefit. However, this could change in the future. Any cost / benefit analysis should include the assessment of possible future requirements where these are known or can be reasonably identified.

4.5.2 Commercial operations considerations

Due consideration should be given to current agreements, including those held with third parties, that may be impacted by the change. The assessment of interoperability considerations should also consider the value of benefits which accrue to the end users.

In freight rail operations, the assessment of interoperability considerations should consider intermodality of freight with other modes of transport, and interfaces as appropriate.

4.5.3 Replacement of current assets

Interoperability solutions can result in the replacement of assets that are not life expired or are otherwise performing as required for the current needs of the system.

Interoperability timelines should be reviewed to reduce the need to replace current assets until they are life expired or the cost of replacement can be justified by the benefits of implementing interoperability.

4.6 Technology

Technology used within the rail industry should have characteristics and attributes that contribute to interoperability.

A satisfactory technology outcome should be achieved by:

(a) assessing technical harmonization of all systems as an option for achieving interoperability;

(b) assessing future technology roadmaps and design changes to minimize any restriction of further development of systems;

(c) enabling open market competition and innovation in the design of future system development, additions or upgrades;

(d) developing a defined and publicly available design concept to allow interoperability of other systems and technology when required;

(e) ensuring that there is a route for migration from the legacy systems;

(f) using similar or consistent reliability standards;

(g) using common terminology and definitions in both system and operational interface; and

(h) allowing for the ability to deal with variations in operating rules.

An optimal technology outcome should be derived by:

(i) identifying targets for reliability, availability, maintainability and safety;

(j) supporting a consistent user information delivery interface;

(k) assessing a technology roadmap and potential associated changes;

(l) assessing system obsolescence;

(m) assessing scalability for future expansion; and

(n) assessing the interface between passenger and freight operations where applicable.

Interoperability of technology should be focussed on the alignment of commonality regarding inputs and outputs.

The different operational elements of the railway should also be assessed when deciding which systems can most readily be adapted to increase interoperability.

By means of example, interoperability of on-board systems on rolling stock could be implemented in a manner which allows for operation with multiple infrastructures using a single onboard system, or which may only be capable of interfacing with other infrastructures with the addition of some kind of ‘add-ons’. By contrast, interoperability could also be achieved by allowing the different infrastructures to operate together to allow trains equipped with different systems to traverse different systems and networks.

A clearly defined and proven verification and testing process shall be established by the implementing RTO to test the level of interoperability that is achieved.

Any interoperability solutions proposed shall be assessed under both normal and degraded operational conditions. For example, any rail traffic that has experienced a system failure or is not equipped with the relevant system should be considered when assessing interoperability solutions and their impact on efficiency and effectiveness of the railway.

4.7 Security

Cyber security and security of intellectual property (IP) needs to be carefully considered with regards to interoperability. For example, there may be a need to deploy updates or upgrades across an interoperable system or fleet in a short space of time. This may require organizations other than the originating RTO to implement the change, leading to potential cyber security and IP issues.

Interoperable systems and assets shall have a documented policy and process that addresses how cyber security and IP issues are managed.

Further information is provided in AS 7770 and RISSB Rail Cyber Security Guideline.

4.8 Human interfaces

A satisfactory human interface outcome should be achieved by:

(a) a common set of operating rules (or part thereof);

(b) a common set of procedures and processes (particularly those which are used in urgent, emergency or degraded mode situations) which should be intuitive and in-line with a common set of practices;

(c) consistency of driver interfaces to allow seamless transition across interoperable systems, networks and between assets (i.e. changing from one type of rail vehicle to another);

(d) a consistent view of rail traffic safety arrangements and presented information regardless of the system or infrastructure (This is relevant for both train-borne and infrastructure systems); and

(e) the minimisation of human intervention when transitioning rail traffic from one system to another (This is required to enable intuitive operation, minimize training requirements, avoid mistakes through lack of familiarisation and optimize a smooth, seamless transition).

Any program of change which requires interoperability shall ensure that training formats and content for systems and processes are intuitively aligned.

Further information is provided in AS 7470 and RISSB Guideline - Integration of Human Factors in Engineering Design.

4.9 Seamless operation

A key objective for interoperability is that a rail system, process or asset can be operated seamlessly across, or within multiple operational environments with minimal change to those systems, processes or assets.

Seamless operation should allow trains to progress over a boundary with minimal change to operational performance and associated procedures.

Transfer from one system to another should consider the requirements for control interfaces, safety in transition, commercial aspects and transparency to users. For example, effective seamless operation should result in the minimization of human intervention.

Transition from one interoperable system to another should allow for handover zones or overlapping points to facilitate transfer of responsibility between systems within a practical time frame dependent on distance and speed.

All systems should be designed to achieve seamless communications and operations across network boundaries.

5 Levels of interoperability

The levels of interoperability assist in determining the extent of interoperability to be achieved in planning for the implementation of new systems, processes or assets.

Following completion of the assessment process detailed in Section 7 an assessment on the level of interoperability to be achieved should be made. An accompanying assessment of the

current level of interoperability in the system and hence the gap between the current and desired future levels of interoperability, should also be undertaken.

Stakeholders shall achieve full interoperability wherever possible. Where this be deemed impractical, then solutions that facilitate a progressive increase in interoperability should be considered.

The optimal level of interoperability should be determined for each change through the interoperability assessment process described in section 6. The optimal level is the most cost effective degree of interoperability that can be attained without incurring more marginal costs than benefits. This may be no interoperability, a degree of partial interoperability or full interoperability depending upon the circumstance.

Every change is an opportunity for improvement in interoperability and to progress through the levels of interoperability. The level of interoperability achieved should be reviewed in every stage of a project.

The level and degree of interoperability to be achieved in a change should be determined taking into account other current and planned changes.

Levels of interoperability for the various disciplines are provided in Appendix C.

6 Assessing interoperability

To ensure that opportunities to achieve increased interoperability are not missed, an interoperability assessment shall be carried out by the RTO when any of the following conditions are satisfied.

(a) Changes are made to an existing asset, process, procedure or system with a potential impact on more than one system.

(b) Developing a strategic direction and operational plan.

(c) New infrastructure, systems or rolling stock are being planned or procured, with a potential impact on more than one system.

(d) A change affects third parties or other assets.

(e) Technology road maps have been reviewed and aligned as part of procurement processes for new assets and infrastructure.

Interoperability assessments should consider both the short term and long term requirements of all rail networks, rolling stock types and operations.

The RISSB Rail System Interoperability Guideline provides further information on interoperability, and should be referenced when conducting an interoperability assessment.

A justification shall be developed if an opportunity to increase the level of interoperability is not taken, following the roadmap assessment process in section 7.2. The justification should include details of any specific options considered as an alternative.

All stakeholders shall work collaboratively and commit to the introduction and implementation of agreed measures to improve interoperability documented in the interoperability assessment report described in section 8 of this document.

7 Interoperability methodology

7.1 Methodology

The methodology for implementation of interoperability shall include safety assessments, commercial assessments, factors that could impact operational performance, the assessment of technology options and human interfaces.

The assessment of these factors shall be recorded in an interoperability assessment report (IAR), prepared by the implementing RTO in accordance with section 8 of this Standard.

The planning process for any asset, system or operational change shall assess interoperability, and thus interoperability assessment should be addressed during the change management process.

The roadmap in the following sections should be utilized when assessing interoperability. It provides processes for identifying, assessing, implementing and achieving interoperability.

Further information on integration of complex systems is provided in AS 7473.

7.2 Interoperability roadmap

7.2.1 General stages

The following roadmap provides a high-level methodology for the identification and implementation of opportunities to improve interoperability. It is consistent with a system engineering approach.

The process for planning and implementing changes to achieve interoperability is described in the roadmap and is divided into the following stages.

(a) Identify the need.

(b) Identify affected stakeholders and prepare a consultation plan.

(c) Establish the strategy.

(d) Develop the options.

(e) Determine the preferred options.

(f) Achieve acceptance solution, commercial, ownership by all relevant stakeholders.

(g) Implement the project.

(h) Monitor and review the project.

The roadmap should be iterative, not linear, and each stage should be reviewed (or repeated) as the objectives, goals and priorities change.

The following sections expand upon the requirements for each of these stages.

7.2.2 Identify the need

Rail industry participants should be actively engaged in an ongoing process of ensuring that systems, procedures, assets and organizational culture are managed so that interoperability principles are achieved.

To achieve this, needs identification should be based on:

(a) identification that a change is to occur which will require consideration of interoperability;

(b) assessment of what the current interoperability level of the system, asset, or process is;

(c) determination of what interoperability level will be required; and

(d) understanding of the gap between current and required levels.

7.2.3 Identify affected stakeholders and assess interoperability requirements

It is important that the impact of the interoperability solution is understood by the initiating RTO. An assessment of the current systems in use and any options available shall be carried out which includes:

(a) identifying the stakeholders impacted by the change;

(b) assessing any change to the risk profile of all affected rail transport organizations;

(c) assessing any required accreditation changes required by the initiating and affected rail transport organizations;

(d) a cost-benefit analysis;

(e) identifying all benefits of the options for stakeholders; and

(f) identifying consequences and risks of implementing and not implementing the change.

C.7.2.3 Commentary

To be effective the cost-benefit analysis needs to consider the benefits to the wider rail industry as well as that of the initiating RTO. This can be achieved through consultation with affected stakeholders and other industry bodies.

This assessment is part of a typical change management process and should be carried out in accordance with AS 7472.

An assessment shall be conducted to identify and compare the benefits of the different levels of interoperability which may be achieved by the different options. A cost benefit analysis of the change should be completed.

Once the assessments are carried out the implementing RTO should obtain commitment to the process from relevant stakeholders before proceeding to the next stage.

Where achieving improved interoperability cannot be justified based on the above assessment this decision shall be documented in the interoperability assessment report. In this instance it is not necessary to continue with the later stages of the interoperability assessment roadmap in sections 7.2.4 to 7.2.9 below.

7.2.4 Establish the strategy

Once the need for improved interoperability has been identified, a strategy for implementation shall be defined.

The strategy should include the development of:

(a) a framework to cover the principles for interoperability;

(b) a definition of requirements;

(c) the scope of the improvement in interoperability;

(d) the available options to improve interoperability;

(e) interoperability scenarios

(f) identification of key performers, activities and high-level interfaces from the scenarios;

(g) any governance requirements;

(h) a stakeholder management and communications plan; and

(i) the necessary migration strategy (if applicable).

During the preparation of the interoperability strategy a stakeholder analysis process shall be conducted to identify who will be impacted by the change and how they will be impacted.

7.2.5 Develop the options

A guidance proposal for the achievement of interoperability through the proposed change shall be developed.

Options to achieve the desired level of interoperability should be developed, based on the approaches to interoperability contained within this Standard. They should be developed to ensure that all stakeholders are informed of the alternative benefits and associated costs for each option. Future proofing strategy options should also be developed.

In order to achieve the desired level of interoperability it is necessary to test and document the degree to which the solution fulfils the interoperability needs. This should be achieved by using an interoperability test plan (or other means).

All requirements and proposed options for interoperability shall be tested to ensure they do not inhibit innovation.

Once all factors are considered, all options should be further analysed to determine the optimal solution/s as described in the next sub-section.

7.2.6 Determine the Optimal Solution/s

The project group should consider the following in determining the optimal solution/s:

(a) Define all interfaces and associated engineering.

(b) Provide a list of functional requirements.

(c) Assess the operability of each of the options.

(d) List all of the essential attributes of each option with respect to:

i. technology;

ii. cost;

iii. safety;

iv. Industry cost effectiveness.

(e) List the interoperability impacts of the change.

(f) Determine:

i. if interoperable solutions already exist;

ii. if interoperable solutions can be developed;

iii. impact if interoperability is not achieved;

iv. each option provides user interface consistency;

v. if the appropriate technology has been chosen and is fit-for-purpose' and

vi. whether to progress with each interoperability option.

(g) Understand if the solution/s provide for interoperable degraded modes of operation.

(h) Assess if the system impacted by the change will interact with other systems, equipment or processes in the foreseeable future.

(i) Assess if each option will meet standard design principles (cost effectiveness, safety, upgradability, safety case, maintainability, operability etc.).

(j) Investigate whether a viable system/process solution exists if no technical solution is viable (both commercial and cost considerations should be part of these solutions), and

(k) Consider the level of difficultly in implementing the options.

The chosen interoperability solution shall be evaluated to prove that it meets the functional requirements.

7.2.7 Obtain stakeholder acceptance of final solution

The optimal solution shall be presented to the project stakeholders for acceptance and endorsement. The interoperability change management strategy should inform, involve, and prepare all stakeholders.

To facilitate stakeholder acceptance the following approach should be adopted.

(a) Gain industry ownership and support for the project by development of awareness and understanding of the project by all parties involved either directly or indirectly.

(b) Inform stakeholders of the scope, recommendations, implementation activities, timing, and implications of the project and its associated components as well as how they will help the industry to achieve the interoperability objective.

(c) Prepare the stakeholders for the project and corresponding process changes that will directly impact them.

(d) Distribute accurate information to eliminate inconsistent messages and errors. This will assure that realistic expectations regarding the impact and benefits of the project are developed.

(e) Provide a detailed interoperability assessment report.

7.2.8 Implement the project

7.2.8.1 General

This phase identifies the process of project delivery.

Interoperability leadership and consultation teams within projects should be established and should include representatives from all stakeholders to ensure that interoperability is considered. They should also ensure that project change processes do not detract from the identified goal for interoperability.

The change management process is a method by which changes to an asset, system or process are defined, evaluated and approved prior to implementation. It should be based on industry project processes.

During project implementation, the implemented solutions should be tested to confirm that they have met the functional requirements defined in the process described in section 7.2.6 above.

7.2.8.2 Staged introduction

Interoperability may be implemented as a staged or incremental approach to minimize both cost and operational impacts. This approach also serves to mitigate the risk involved in a rapid and/or complex change strategy.

A staged approach also enables the implementation of interoperability to be initially targeted on projects that offer the most significant safety, operational and/or cost benefit.

A staged approach also significantly reduces resourcing requirements particularly in relation to personnel.

The success of a staged introduction is dependent on stakeholder involvement at all decision levels.

7.2.9 Monitor and review

After it has been implemented, the interoperability solution should be assessed to determine its impact and effectiveness. To assess the level of success of the interoperability solution measures that can be assessed include:

(a) the volume of information exchanged between processes, systems, or products;

(b) the quality of the information exchanged, its utility and impact to the operation of the railway;

(c) the increase in availability of an asset;

(d) the decrease in operational and maintenance costs.

The IAR should be reviewed and reissued to reflect the findings of this assessment.

8 Interoperability assessment report

An IAR shall be written so that it addresses the requirements contained within this Standard. RTO's and stakeholders assessing the need for interoperability when planning a change to a rail system or conduct an audit of current interoperability status should refer to the IAR.

The IAR shall be reviewed at 3 stages of the interoperability assessment roadmap:

(a) identification Stage (to confirm the need for interoperability to progress);

i. If interoperability is justified at this stage, the IAR shall then be updated:

(b) prior to implementation (to confirm that the interoperability needs are met); and

(c) post implementation (to close out and review the effectiveness of the outcome).

The IAR shall address the following as a minimum:

(d) project aspects where interoperability could be assessed and implemented;

(e) the current level of interoperability;

(f) any decisions and justification where potential improvements to interoperability are not utilized;

(g) the level of interoperability that is to be achieved through the project;

(h) impacts on other stakeholders;

(i) methods for improving the assessed level of interoperability;

(j) reasoning as to why interoperability was not implemented, and recommendations for the review of that assessment in the future;

(k) how the determined solution (if any) was assessed to achieve interoperability requirements;

(l) the consultation plan used.

The level of detail required in the IAR shall be determined by the depth of assessment required to comply with the interoperability roadmap in section 7.2 of this Standard. For example where early cost-benefit analysis indicates that there is no requirement for interoperability to be

incorporated into a project solution, the IAR shall record this decision and the depth of analysis undertaken to support it, with reference to the eight issues outlined above.

All projects shall develop and retain an IAR to document the adoption or rejection of interoperable solutions. Where interoperability solutions are not adopted or are not fully implemented, a justification for the decision shall be provided to all interested stakeholders and documented within the IAR.

Appendix A Hazard register

Informative

Hazard number	Hazard	Section number(s)
5.4.1.58	Inadequate rolling stock design	3.4
5.5.1.6	Incompatible couplers causing operational inflexibility	3.4
5.5.1.45	Design deficiency causing the inability to operate trains	3.4
5.5.1.48	Operational deficiencies causing the inability to operate trains	3.4
5.5.1.56	Inadequate wayside access preventing access to, onto or through train or vehicle	3.4
5.5.1.57	Incompatible inter-vehicle systems creating operational inflexibility	3.4
5.12.1.3	Incompatible brake systems on vehicles in the train (Brake not released)	3.4
9.26.1.15	No interacting existing system	3.4
9.26.1.16	Unexpected or incompatible interfaces, software and communications	3.4
10.1.1.1	Operating incompatible rolling stock	3.4

Appendix B Interoperable items

Informative

Below is a list of areas where rail interoperability should be considered:

(a) Wheelsets interfacing with the rails (e.g. wheel profiles).

(b) Gauge clearance issues (especially at turnouts and loops).

(c) Differing kinematic envelopes and passing clearances.

(d) Different crew-change / train operating procedures (e.g. stowing, handbrake application).

(e) Communications and train control systems (both onboard and wayside).

(f) GPS / location devices (e.g. formats, accuracy).

(g) Wayside systems (particularly train monitoring systems).

(h) Operating rules / commercial / performance reporting.

(i) Locomotion - power, speed, braking.

(j) Rolling stock differences (e.g. loco length, cab visibility , wagon length, couplings).

(k) Infrastructure specifications (e.g. cant, platforms, signage).

Appendix C Levels of interoperability

Informative

C.1 Levels of interoperability for Australian railways – rolling stock

Level	Designation	Degree	Description	Example of operational impact or consequences
0	No Interoperability	Interoperability has not been introduced or considered.	Rolling stock is unable to operate across networks or boundaries. Restricted to specific operation.	Rolling stock allocated to specific operation
1	Partial Interoperability	A level of interoperability has been introduced with conditions. There is capacity for further development towards optimal or full interoperability.	Rolling stock can operate across networks and boundaries with some restrictions. Australian Standards are complied with to improve harmonization and interoperability.	Rolling stock has to be remarshalled to operate on some lines. Rolling stock is not compatible with all other types e.g., wagons may only operate with particular locomotives.
2	Full Interoperability	Complete interoperability among the systems and operations has been attained.	Highest level of interoperability exists between rolling stock and networks	Rolling stock is not limited in its ability to travel within networks and between systems

C.2 Levels of interoperability for Australian railways – train control systems

Level	Designation	Degree	Description	Example of operational impact or consequences
0	No Interoperability	Interoperability has not been introduced or considered.	The system is of a separated, isolated or stand-alone nature and has no interoperability.	Trains are unable to cross train control boundaries.
1	Partial Interoperability	A level of interoperability has been introduced with conditions. There is capacity for further development towards optimal or full interoperability.	Interoperability is achieved by compliance with Standards, regulations, guidelines or common base documentation for operations that interface with other external asset, process or system users. Systems may be harmonized Australian Standards are complied with to improve harmonization and interoperability.	Trains are restricted in crossing boundaries by reliance on processes and procedures. Trains are interoperable, but with major differences.
2	Full Interoperability	Complete interoperability among the systems	Highest level of interoperability exists	Trains operate between train control systems without the driver noticing any change.

Level	Designation	Degree	Description	Example of operational impact or consequences
		and operations has been attained.	between systems and/or processes.	

C.3 Levels of interoperability for Australian railways – information

Level	Designation	Degree	Description	Example of operational impact or consequences
0	No Interoperability	Interoperability has not been introduced or considered.	The system or process is of a separated, isolated or stand-alone nature and has no interoperability.	Train data has to be manually inputted as the train moves from system to system
1	Partial Interoperability	A level of interoperability has been introduced with conditions. There is capacity for further development towards optimal or full interoperability.	Knowledge of interfaces is readily available. Based on availability of information, common language, meanings, and documented information is utilized for operational requirement.	Data is automatically transferred between systems, however as some systems require different data some manual checking and input is required
2	Full Interoperability	Complete interoperability among the systems and operations has been attained.	Highest level of interoperability exists between systems and/or processes.	Data is seamlessly transferred between systems with no manual intervention

C.4 Levels of interoperability for Australian railways – safety systems

Level	Designation	Degree	Description	Example of operational impact or consequences
0	No Interoperability	Interoperability has not been introduced or considered.	The system or process is of a separated, isolated or stand-alone nature.	Safety systems are completely incompatible with adjacent systems
1	Partial Interoperability	A level of interoperability has been introduced with conditions. There is capacity for further development towards optimal or full interoperability.	Some safety and safeworking methods are compatible with adjacent systems. Rules are largely harmonized with some differences. Australian Standards are complied with to improve harmonization and interoperability.	Some forms and electronic systems work on multiple systems with minimal need for area specific inputs.
2	Full Interoperability	Complete interoperability among the systems and operations has been attained.	Highest level of interoperability exists between systems and/or processes. Rules are completely harmonized between adjacent systems	Implementation of a national safeworking rule book.

Appendix D Bibliography

Informative

The following referenced documents are provided here for information only:

(a) AS 4292 Railway Safety Management.

(b) AS 7470 Human factors integration in engineering design – general requirements.

(c) AS 7473 Complex system integration in railways.

(d) AS 7666 Train Control and Protection Interoperability.

(e) AS 7770 Rail cyber security.

(f) AS ISO 10007 Quality management - Guidelines for configuration management.

(g) EN 50126.1 The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) Part 1: Generic RAMS Process.

(h) EN 50128 Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems.

(i) EN 50129 Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling.

(j) ONRSR Major Projects Guideline.

(k) RISSB Guideline - Integration of Human Factors in Engineering Design.

(l) RISSB Guideline - Rail Cyber Security Guideline.

(m) RISSB Guideline - Rail Systems Interoperability.

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For information regarding the development of Australian Standards developed by RISSB contact:

Rail Industry Safety and Standards Board

PO Box 518
Spring Hill, QLD, 4004

T +61 7 3724 000
E Info@rissb.com.au

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