

Design your future. it is **KRRI**

Advancement and International Cooperation Plan for Korea Railway Technical Regulations and Standards

2021.10.14.

Railway Test & Certification Divisions

KRRI 한국철도기술연구원
Korea Railroad Research Institute



Railroad Safety Global Issue

- **Change from national management to regional standardization of EU TSI and OSJD**
Standardization of technical standards and evaluations for cross-border railway interoperability and product import/export.
- **Railway Safety International Standards and Independent Safety Assessment (ISA, SIL)**
In EU, China, Korea, etc., safety management and conformity assessment are mandatory in accordance with IEC 62278 (EN 50126).
Ensuring overall railroad safety through sub-system SIL certification and ISA of the entire system.
- **Conformity Assessment of International Standards and Cross-Acceptance**
Trade revitalization through mutual acceptance of conformity assessment systems in all industries.
“One Assessment, Accepted Everywhere”
Mutual acceptance of evaluation results in accordance with IAF MLA and ILAC MRA.
- **New challenges for railway safety**
It is necessary to manage new risk sources such as the application of new technologies in accordance with the 4th Industrial Revolution, a pandemic such as COVID-19, and cybersecurity due to social conflicts.

OSJD(OSShD) : Organization for Cooperation of Railways
 ISA : Independent Safety Assessment
 SIL : Safety Integrity Level
 IAF : International Accreditation Forum
 ILAC : International Laboratory Accreditation Cooperation
 MRA/MLA : Mutual Recognition Arrangement

Interoperability and Safety Management Between Countries

● EU TSI (Directive 2016/797) and Railroad Safety Act (Directive 2016/798)

TSI presents technical regulations for each field, such as INF, RS, CCS, and ENG. In particular, CCS makes RAMS standard mandatory.

Application of CSM (RA) and CSI to ensure safety.

Various CABs such as ISO/IEC 17025, 17020, and 17065 organizations are participating, and the assessment reports are mutually accepted.

● OSJD technical regulations and safety management of Korea Railroad

Presentation of technical specifications for passenger cars and wagons.

Insufficient procedures for mutual acceptance of evaluation subjects and results of technical regulations among member countries.

Korea Rail conducts SA safety assessment (ISA) and GA safety assessment (SIL) through the certification of 17065 bodies to IEC 62278.

● Railroad safety management based on life cycle (IEC 62278, EN 50126)

As an international standard, IEC 62278:2002 (EN 50126:1999) is being applied.

Revision of EN 50126:2017, expected international standardization such as partial adjustment of the life cycle, and the need for measures such as renewal of CAB's accreditation scope.

IEC 62278:2002

Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS)

IEC TR 62278-3:2010

Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS) - Part 3: Guide to the application of IEC 62278 for rolling stock RAM

IEC TR 62278-4:2016

Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS) - Part 4: RAM risk and RAM life cycle aspects

IEC TR 62267-2:2011

Railway applications - Automated urban guided transport (AUGT) - Safety requirements - Part 2: Hazard analysis at top system level

IEC 62279:2015

Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems

IEC 62425:2007

Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling

INF : Infrastructure, RS : Rolling Stock, ENG : Energy
 CCS : Control and Communication System
 RAMS : Reliability, Availability, Maintainability, Safety
 CSM(RA) : Common Safety Assessment(Risk Assessment)
 CSI : Common Safety Index
 CAB : Conformity Assessment Body
 SA : Specific Application, GA : Generic Application

Mutual Acceptance of Railway Safety Between Countries

- **Product functional safety assurance: SIL**

SIL safety evaluation for product unit functions.

Verification of target hardware and software conformity, SRAC compliance, and certification body qualifications.

- **Project Safety Assurance: ISA**

Check the adequacy of the SIL assignment of components.

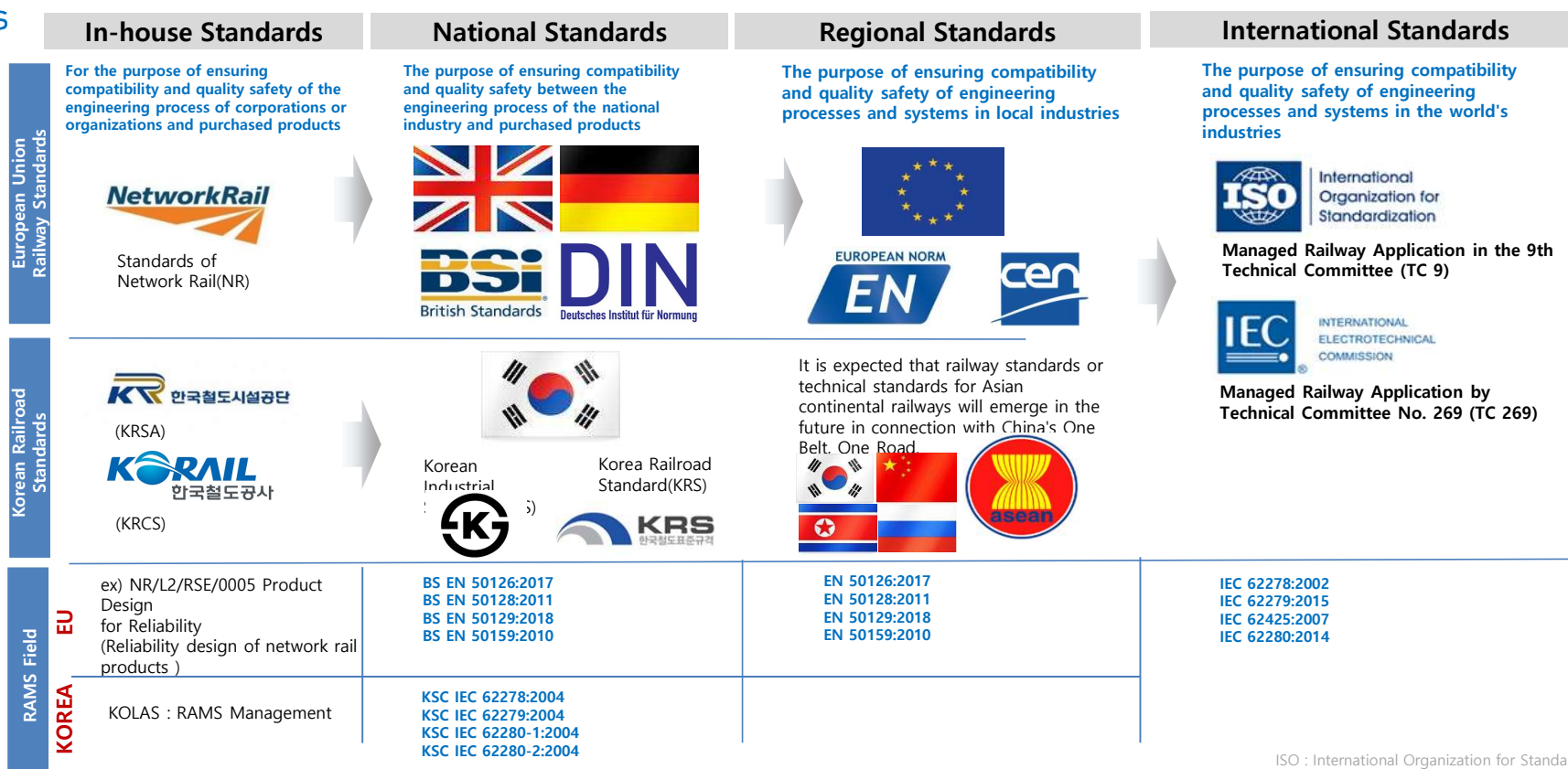
Verification of SRAC conformance to interfaces and operational scenarios.

- **International standards for railway safety (IEC 62278, 62425, 62279, 62280)**

Check the evaluation standards included in country-specific laws and contracts.

International Standards for Railway

- ISO Technical Committee No. 269
- IEC Technical Committee No. 9
- Hierarchy of standards



ISO : International Organization for Standardization
IEC : International Electrotechnical Commission

National Railway Standards(Korea)

- **Current status of Korean railway standards (KS, KRS)**

International harmonization of domestic railway standards (43 cases) as of 2021 (39% of IEC TC 9 standards).
 TSI conformance rate of type approval technical standard (vehicle) 70% (2021 ERA).

- **Korea Railroad Standards (KS, KRS) plan by 2026**

International compliance with domestic railroad standards (63 cases) (57% of IEC TC9 standards).
 TSI conformance rate of type approval technical standard (vehicle) 90% (2021 ERA).

- **International Cooperation Agenda**

International standardization of Korea's leading technologies (LTE-R, cybersecurity, etc.)

Leading the International Standard (IEC) for Recycling Calculation Criteria for Railroad Vehicles, leading the 3GPP Standard for LTE-R.

Promoting international cooperation for the establishment of International Standards (IEC) through the WG-led initiative for dynamic wireless power transmission (WPT) interoperability and safety for railways.

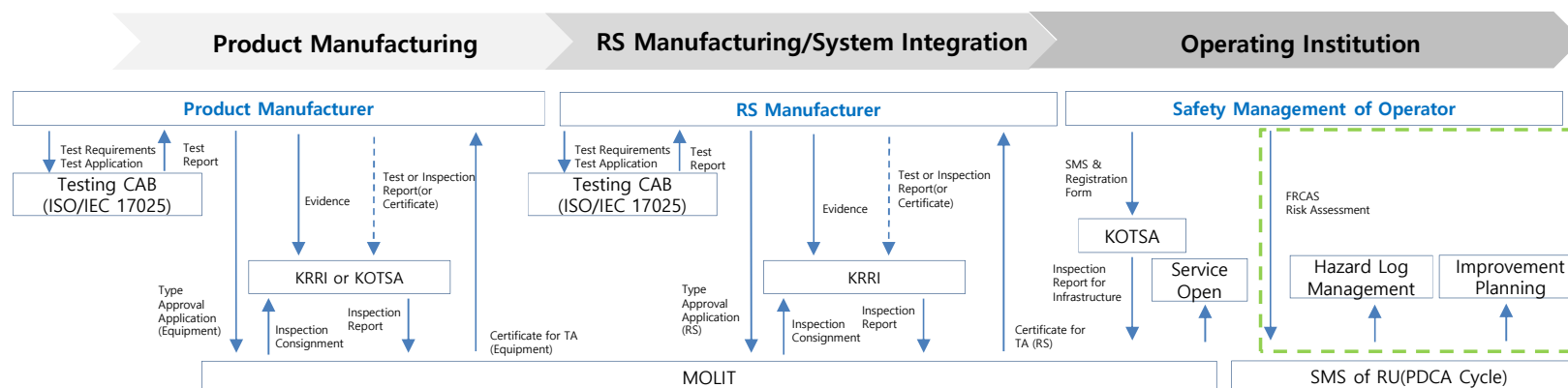
A study on the Hazard and Risk Control standard (draft) of the operation control system using AI.

Railway Inspection Process (Korea)

- MOLIT announces technical regulations for rolling stock, railway products, and QMS
- Type approval of RS and supplies / Approval for remodeling of RS
 KRRI and KOTSA inspect according to the Railroad Safety Act, and MOLIT issues a certification according to the inspection result.

- Acceptance of test and inspection reports

Acceptance of ISO/IEC 17025 bodies report for the test requirements of technical regulations.
 Acceptance of ISO/IEC 17020 bodies report for inspection requirements of technical regulations.
 The QMS requirement of the technical regulation is to accept the report of the CAB that has signed an MOA with KRRI.



- International Cooperation Agenda

Expanded international mutual recognition of railway equipment test and inspection, product certification.

MOLIT : Ministry of Land, Infrastructure and Transport
 QMS : Quality Management System
 MOA : Memorandum of Agreement
 KRRI : Korea Railroad Research Institute
 PDCA : Plan-Do-Check-Act

Product Functional Safety SIL

- Safety Integrity Level 1~4

The user reflects the SIL Allocation result by function by PHA in RFP.

Assessment of requirements by SIL of IEC 62425, 62279, 62280.

- Major issues by SIL in the controller, software, and communication fields

SRAC Compliance.

Renewal of GA certificate according to product improvement.

Assessment of the safety of software application data.

- SIL and ISA of Korean IT technology (LTE-R, safety control, etc.)

The safety of EU ETCS CCS is evaluated by AsBo, and TSI (ESC, RSC) is evaluated by NoBo.

SIL and LTE-R conformity of KTCS evaluated by ISO/IEC 17065 Bodies, KSC evaluated by ISO/IEC 17025 and 17020 bodies.

The safety of advanced technologies such as hydrogen technology and AI control is evaluated by CAB for conformity to IEC 62278.

PHA : Preliminary Hazard Analysis
 RFP : Request for Proposal
 IT : Information Technology
 AsBo : Assessment Body for EU, NoBo : Notified Body for EU
 ESC : ETCS System Conformity, RSC : Radio System Conformity

Project ISA

- **System Independent Safety Assessment**

Evaluate SRAC compliance to maintain SIL for each major component.

Safety evaluation including operation scenario, external factors (human error, environmental factors) and peripheral equipment interface (IEC 62278).

- **LTE-R-based KTCS pilot project ISA trend (Korea-UK collaboration project)**

Collaborated with EU CAB, KRRI issued Non-Accredited Certification of major components as Accredited Certificate.

Promotion of KTCS-2 for general and high-speed rail and KTCS-M for urban rail.



KAS-P-027



KTCS-2 : Korea Train Control System(Compatible with ETCS L2.)
 KTCS-M : Korea Train Control System for Metro Line

New Threats to Railway Safety(Application of new technology)

- Need to verify the integrity of key safety decisions using AI

ISO/IEC AWI TR 24368 Artificial intelligence - Ethics and social concerns.

Preparing for standardization to secure safety for each AI application field.

- Increased exposure of workers and passengers to high frequency by applying wireless power feeding technology

Extension and reinforcement of the existing railway electromagnetic compatibility standard (IEC 62236) and conformity assessment.

- Increased probability of fire and explosion due to railway application of hydrogen and fuel cell technology

Standardization and conformity assessment for large-capacity batteries and hydrogen trains.

- Demand for advanced emergency response in closed space following the emergence of hypertube

Standard procedures for emergency evacuation in tube-type structures and high-speed trains are required.

New Threats to Railway Safety(Disease)

- Risk sources that must be newly managed by railways due to unprecedented outbreaks such as pandemics

Research on safety measures for the spread of airborne infectious diseases such as COVID-19 among workers and passengers.

Re-evaluation of risk of existing infectious disease-related hazards.

(Frequency reduction: Prevention / Severity reduction: Epidemiological investigation).

Standardization of safety measures for risk control and establishment of conformity assessment system.

It is necessary to standardize the prevention of airborne infectious diseases in dense, close, and enclosed environments.

New Threats to Railway Safety(Security)

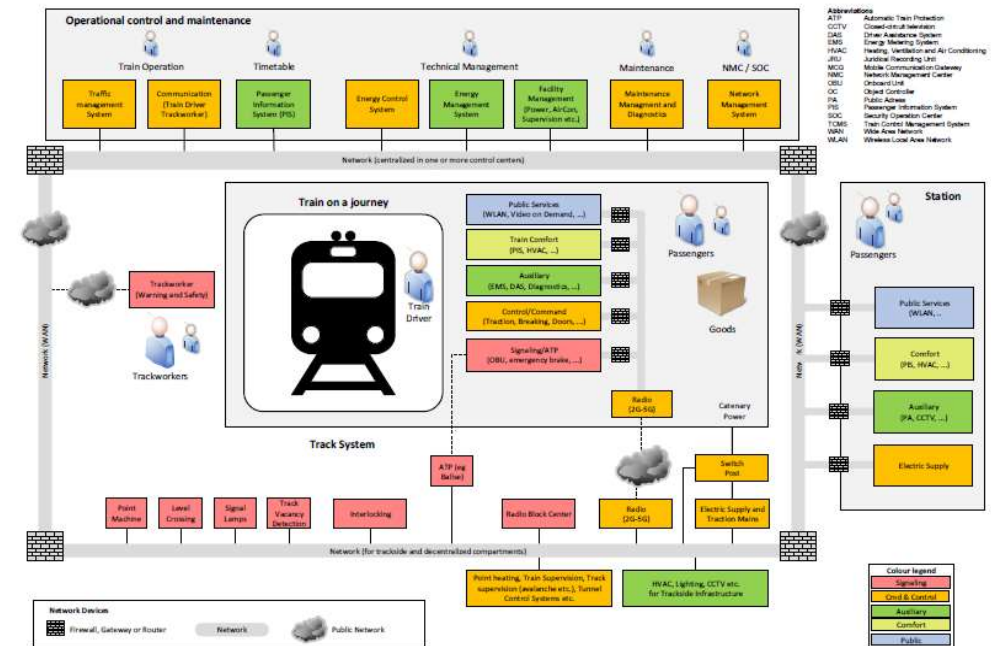
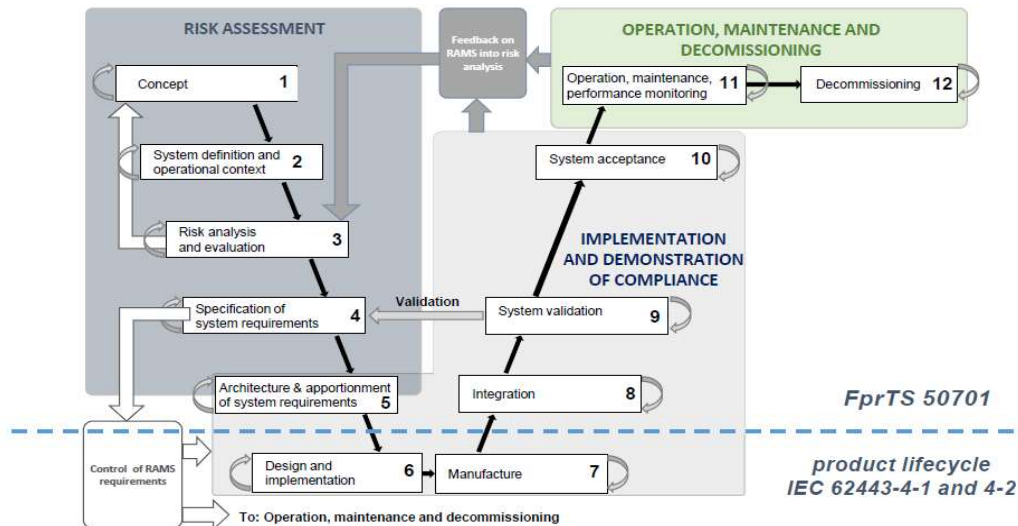
- Increased possibility of physical terrorism due to regional hegemony and spread of religious/racial conflict

It is necessary to standardize prevention measures such as facial recognition, movement control, and search devices, and severity control such as explosion-proof structures.

- Reinforcement of cybersecurity demands due to increased dependence on IT in railways

Conformity assessment for cyber security such as IEC 62443 (industrial security), ISO/SAE FDIS 21434 (automotive cyber security).

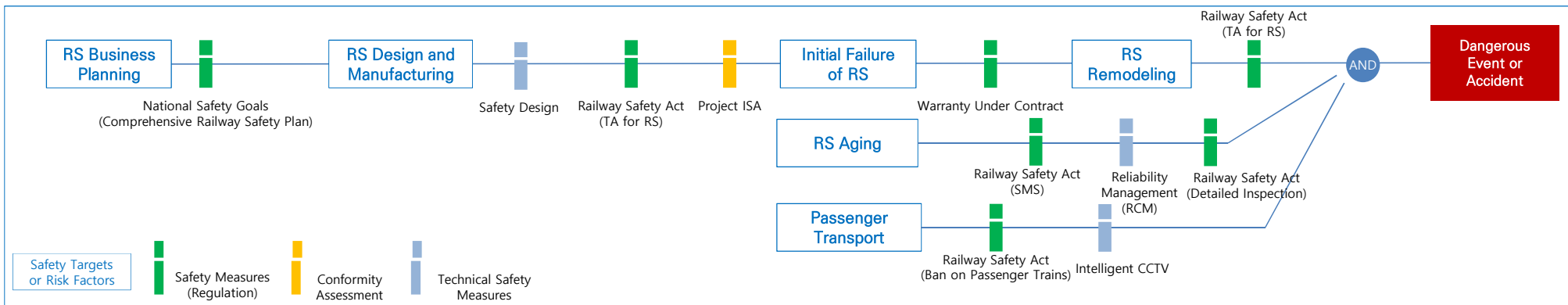
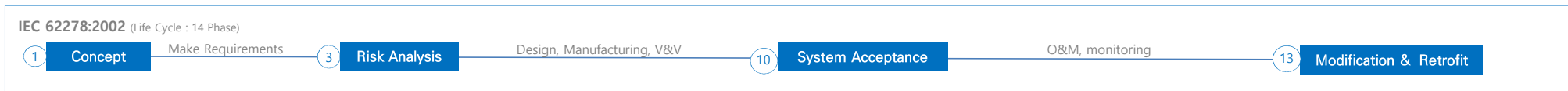
CENELEC CLC/TS 50701 (Railway Application : Cybersecurity) : 2021



Joint Response to New Threats

- Continuous information sharing such as risk analysis, country-specific systems and cases
- Sharing of technical and institutional solutions for safety measures against threats
- Quantitative DB formation and sharing of the effects of new safety measures
- Establishment of international standardization and conformity assessment system (mutual acceptance among countries)

Top Model of RS



V&V : Verification and Validation
 O&M : Operating and Maintenance
 SMS : Regulation of Safety Management System
 RCM : Reliability Centered Maintenance

Role of the Leading Group

- Continuous development: From Good Practice to Best Practice
- UIC, ERA's Commitment and IRSC's Information Sharing
- Commercialization of consulting on core issues such as technology development considering conformity assessment and CSM RA
- Reducing the gap between countries through joint implementation of local businesses

Summary

- With the globalization of rail safety management, we are faced with an environment in which reasonable safety can be secured through risk assessment.
- By actively sharing risk-based safety management experiences and systems, differences in railway safety by country should be reduced.
- Conformity assessment and mutual acceptance should be expanded so that rapidly developing technologies can be safely applied to the railway industry.
- Information sharing and case studies on new threats are expected to greatly contribute to railway safety.

Thank you.

