






# Basic Plan of Smart Railway Safety Management System

October 23, 2018

## Railway Safety



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# Status of Railway Safety

A dramatic landscape featuring a railway track curving through a field under a sunset sky. The track is the central focus, receding into the distance. The sky is filled with large, textured clouds, with the sun low on the horizon, creating a warm, golden glow. The foreground shows the details of the track: rails, wooden sleepers, and gravel ballast.



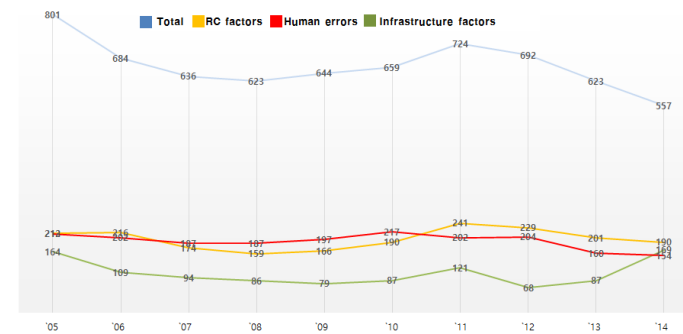
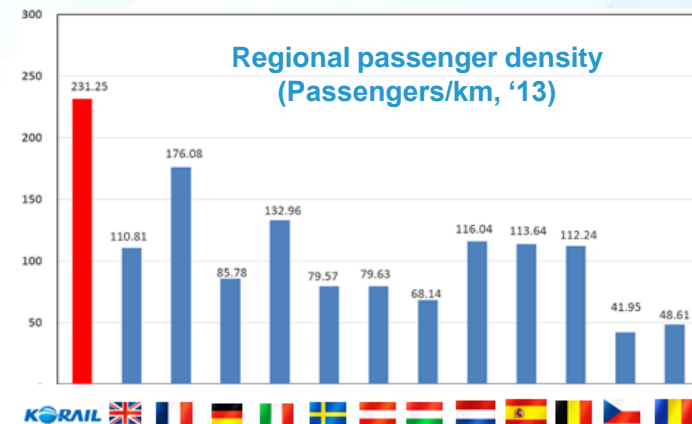
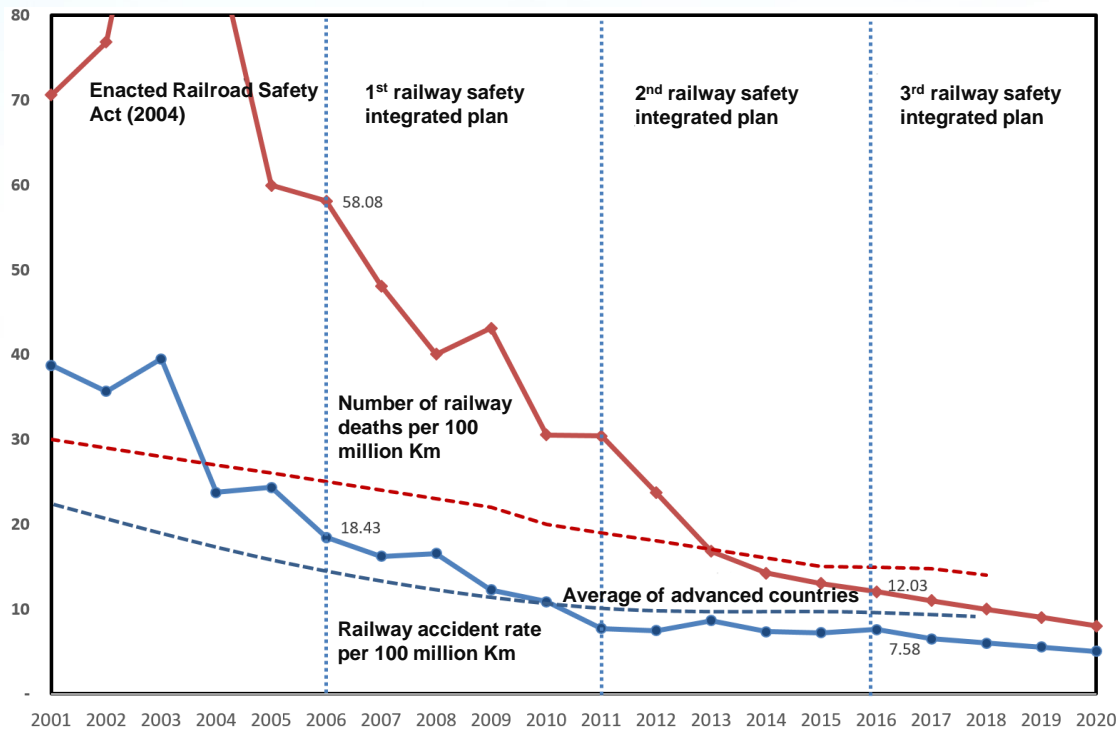
# Railway safety index



- Innovative safety enhancement through institutional improvement and technology development

High severity in the event of failures or accidents due to high operating density  
 Response to system deterioration is critical

Necessary to move from number of accidents and failure-oriented response to risk-oriented one



Number of Korea Railroad Failures

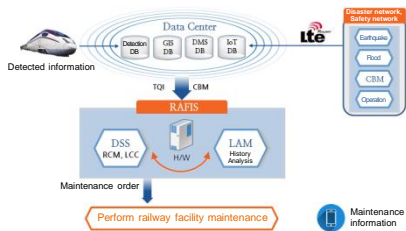
## ● Response plan of the Presidential Committee on the 4th Industrial Revolution

Increase competitiveness of all industries and create new industries and jobs by fully converging with intelligent technology

## ● Domestic Railway Sector Trends

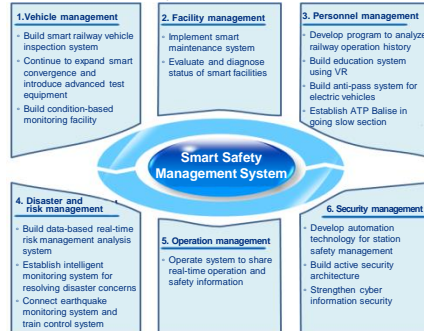
### KRR Korea Rail Network Authority

- Build general information system for railway facility history management
- Pursue Smart Railway Safety Management System



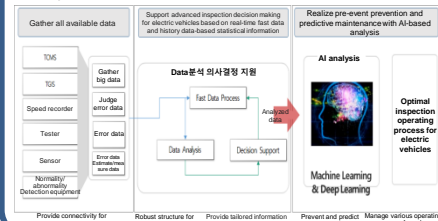
### KORAIL Korea Railroad Corporation

- Pursue smart rail safety management using IOT, Big-Data, AI, and VR by six sectors until 2019



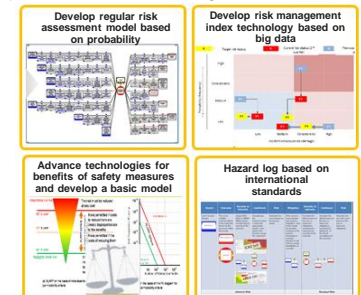
### S Seoul Metro Corporation

- Establish IT general office to realize Smart Connected Metro (SCM)
- Pursue three phases of digital management for systematization of processes, maximizing customer experience, and operating efficiency by 2019



### KRRI Korea Railroad Research Institute

- “Develop evaluation technology for risk-based safety management system” for three years from 2017
- Develop scientific risk management system based on Big-Data



# Basic Plan of Smart Railway Safety Management System





# Overview



## ● Background

- Make railway safety management advanced and scientific
- Reduce human error and improve management efficiency
- Promote to establish preventive safety management

## ● Status

- National comprehensive plan suggesting smart rail safety policy direction

1<sup>st</sup> step (2018~2022) / 2<sup>nd</sup> step(2023~2027)

## ● Main contents

- Concept and goal setting of smart railway safety management
- Changes and prospects of future railway for 4th Industrial Revolution
- Smartization of six sectors
- Road map and promotion system

## ● Participation of various experts

60 people including 22 researchers, 18 external experts, and those from advisory and related entities

Performed a total of 10 regular meetings, progress reporting, advisory conference, workshops

Apr. 28, 2017: Service start meeting (three external experts )

Jun. 21, 2017: Progress report

Jun. 28, 2017: Progress report

Aug. 31, 2017: Advisory conf. (two external experts )

Sep. 27, 2017: Progress report

Oct. 20, 2017: Progress report

Oct. 26, 2017: Workshop (four external experts )

Nov. 22, 2017: Interim report (five external experts )

Dec. 15, 2017: Completing service

Dec. 22, 2017: Prof. entity (KAIA) consults  
National R&D promotion



**스마트 철도안전기술 아이디어 공모전**

주 제 4차 산업혁명 기술을 활용한 철도안전 강화

참여대상 철도안전기술에 관심 있고 스마트 기술 아이디어를 가진 사람이면 누구나

참여방법 공모전참가 - 주관기관 홈페이지 참조 (이메일 제출)  
\*접수시 유의사항- 참가신청서, 접수자명\*으로 파일 송부 (우기설정파일이 있을 시 첨부)

공모일정 접수기간 : 2017.09.25~10.23.  
시 상 식 : 국토교통부 하반기 안전보고대회 예정(2017.12.)  
\*수상자는 시상식 전 통보

시상계획 심사 일정 : 2017.10.24~10.25.  
1등 1명 국토교통부장관 표창(상금 100만원)  
2등 2명 한국철도기술연구원장 표창(상금 50만원)  
3등 3명 한국철도학회장 표창(상금 30만원)

문의사항 한국철도기술연구원 철도안전연구실  
(031-460-5548 평일 오전 09시~오후 06시, mirk727@krrri.re.kr)

유의사항 수상작품의 저작권은 주최, 주관기관에 귀속됨  
저작권 등 출품작품 관련 모든 법적 책임은 출품자가 부담  
타 공모전 등에서 동일 아이디어로 수상한 이력이 있는 경우 시상이 취소될 수 있음

주 관

## ● Competition for Smart Railway Safety Technology

Sep 20~Oct 19, 2017 Competition for general public

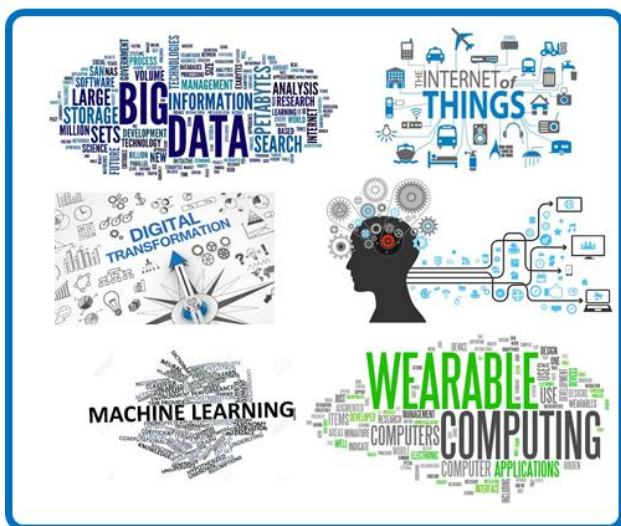


# Vision of Smart Railway Safety Management System

## ● Railway safety

Smart Railway Safety Management analyzes, monitors and responds proactively to risk sources in real time using cutting-edge technologies such as IoT and big data

Vision: Achieve fault-free seamless safety with automated fault detection and real-time active management with sensors in each field of railway such as vehicles, facilities, and manpower



인공지능, 머신러닝, 디지털화, Big-Data 등 스마트 기술을 활용한 위험요인의 선별과 위험사건, 사고로의 발전 억제



# Goals of Smart Railway Safety Management System

## ● Goal setting

Smart safety management aims to quantitatively reduce accidents and operational failures, shorten accident recovery time, revitalize the industry, and enhance security check effectiveness

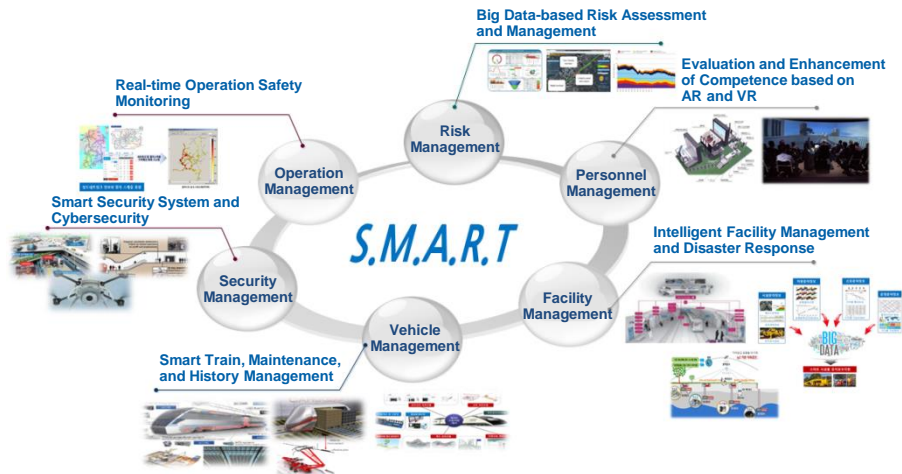
Transition to advanced country's risk-based safety management by establishing a risk-based safety management system in the first phase managed by the State



# Basic Plan of Smart Railway Safety Management System

## Actual plan

Establish phase 2 to achieve vision  
four key projects in six major sectors



Secure motivation for the base

Diffuse technologies developed

Advanced SMART

(2018~2022)

(2023~2027)

(2028~)

- Achieve visible performance using existing technology
- Establish institutional basis for applying advanced technology
- Prioritize required technology
- Actualize vision of smart safety management

- R&D based on AI and big data
- Diffuse technologies developed in six major sectors
- Standardize performance evaluation

- Advance digital information-based railway safety management
- Prevent and manage failures and accidents

**Vision**

**Achieve fault-free seamless safety with self-diagnosis and real-time active management**

- Accidents per 100 mill km of operating distance: (current) 7.2 → (2022) 5.0 → (2027) 3.5
- Deaths per 100 mill km of operating distance: (current) 13.1 → (2022) 9.2 → (2027) 6.4

**Goal by phase**

- (Phase 1: 2018 ~ 2022) Establish Basic Plan (2017), Core R&D, Standardization
- (Phase 2: 2023 ~ 2027) Performance evaluation, standardization and diffusion of R&D by sectors such as vehicle and facility

### Detailed goals and key projects by sector

<b>Vehicle management</b>	<b>Operation failure due to vehicle problem (case):</b> (2017) 151 (estimated) → (2022) 105 → (2027) 74	<ol style="list-style-type: none"> <li>① Real-time fault detection and prediction of main parts</li> <li>② Develop high safety control system platform for railway vehicle</li> <li>③ Introduce smart factory for vehicle maintenance</li> <li>④ Condition-based maintenance through smart vehicle history management</li> </ol>
<b>Facility management</b>	<b>Operation failure due to facility breakdown (case):</b> (2017) 31 (estimated) → (2022) 22 → (2027) 15	<ol style="list-style-type: none"> <li>① Secure advanced inspection equipment such as IoT and drone</li> <li>② Mechanize of railway facility maintenance work</li> <li>③ Build railway facility history management system</li> <li>④ Establish the base for advanced railway infrastructure</li> </ol>
<b>Personnel management</b>	<b>Railway accidents due to human errors (case):</b> (2006~2015) average 5.4 → (2022) 4 → (2027) 3	<ol style="list-style-type: none"> <li>① Prevent human errors by employee monitoring and education</li> <li>② Strengthen emergency response capabilities using VR and AR</li> <li>③ Enhance employee competence through evaluation, training, etc.</li> <li>④ Train 4th Industrial Revolution professionals</li> </ol>
<b>Risk management</b>	<b>Manage safe status and prevent risk factors</b>	<ol style="list-style-type: none"> <li>① Big data-based safety management</li> <li>② Introduce scientific maintenance system</li> <li>③ Introduce systematic risk assessment</li> <li>④ Build supervision support system</li> </ol>
<b>Operation management</b>	<b>Number of dead workers (person/100 mill km):</b> (2016) 2.2 → (2022) 0.5	<ol style="list-style-type: none"> <li>① Build real-time railroad safety control</li> <li>② Real-time operation safety monitoring</li> <li>③ Smart train operation control</li> <li>④ Improve emergency response system</li> </ol>
<b>Security management</b>	<b>Prevent railway terrorism source and achieve zero railway security accident</b>	<ol style="list-style-type: none"> <li>① Build smart railway security system</li> <li>② Establish basis for railway security management system</li> <li>③ Secure railway facilities security</li> <li>④ Strengthen cyber security system</li> </ol>

A photograph of a railway track curving through a landscape under a dramatic, cloudy sky at sunset or sunrise. The track is made of steel rails on concrete sleepers, supported by gravel ballast. The sky is filled with large, billowing clouds, with the sun low on the horizon, creating a warm, golden glow. The landscape is flat and open, with some dry grass and a few trees in the distance.

# **Actual Plan by Sector for Railway Safety Management**

# Major technologies for risk management

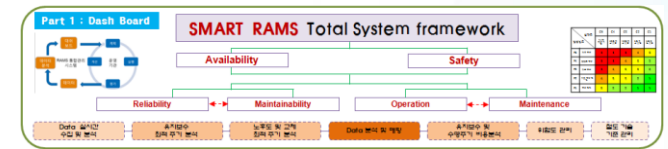
- **Big data-based safety management**

Provide risk factor prediction and preventive measures with systematic management and analysis of causes of accidents, failures, dangerous events, etc.



- **Scientific maintenance system**

Manage cycle, method, etc. of improvements and maintenance by utilizing and analyzing all stages of data such as production, maintenance, improvement, disposal of vehicles, parts and facilities

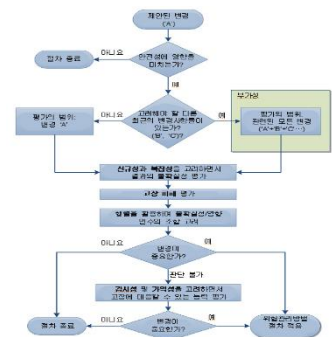


- **Systematic risk assessment**

Build a system so that railway operators, etc. can analyze the causes of accidents, failures, and risk incidents in a comprehensive way to reduce risk

- **Build supervision support system**

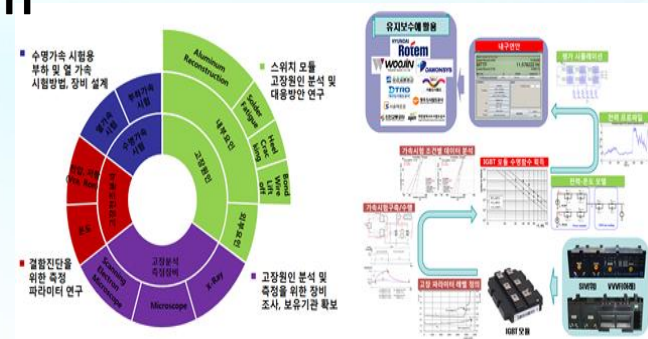
Build a system for the integrated management of accidents, supervision and follow-up, and provide concentrated management goal and optimal action order through data analysis



# Major technologies of vehicle management

## ● Real-time failure detection and prediction

- Real-time monitoring of major parts status such as braking device and electrical parts
- Condition information analysis and risk assessment
- Failure prediction and automatic warning



## ● Automatic maintenance

- Planning and preparation of maintenance based on failure prediction information
- Maintenance process design and automatic maintenance



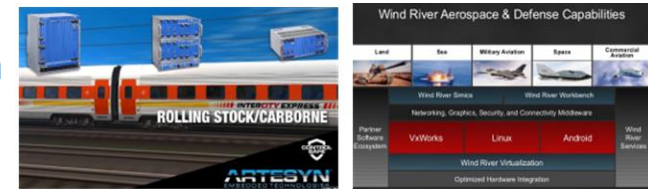
## ● Railway vehicle history management

- Standardization of national level history management and provision of guidelines
- Constant monitoring of railway vehicles and parts

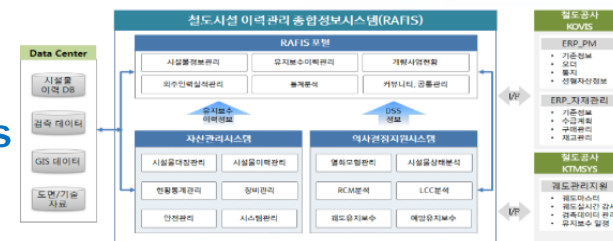
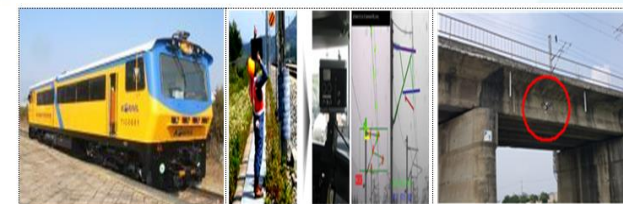


## ● High safety railway control platform

- International railway safety standard certification
- Develop high safety common platform of embedded system



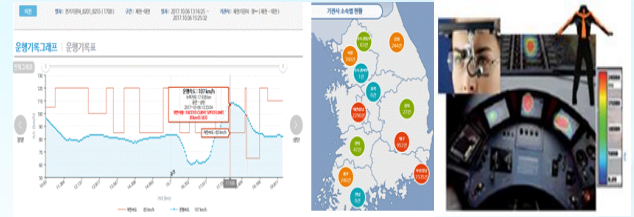
- Advanced inspection equipment**
  - Improve performance of existing inspection vehicles (high-speed inspection vehicle)
  - Introduce advanced equipment such as drones and IoT, and collection of facility status information
- Automation of maintenance**
  - Develop alternative equipment for personnel-focused maintenance work
  - Modernization of old equipment
- Build history management system**
  - Information management such as facility maintenance, improvement history, inspection results
  - Build decision support system such as establishment of maintenance plan
- Establish basis of smart facility management**
  - Improve facility management efficiency and safety and provide various railway services
  - Build railway spatial information system and railway wireless communication network



# Major technologies for personnel management

## ● Prevent human error

- Analyze human elements based on big data and monitor human body signals
- Detect and proactively manage abnormalities and behavior of drivers



## ● Enhance work capacity of employees

- Develop and complement experiential educational infrastructure such as VR and AR
- Enhance capacity of emergency response and cooperation of railway employees



## ● Employee qualification management

- Scientific evaluation and inspection of work performance and safety management ability
- Railway employee qualification management



## ● Training experts

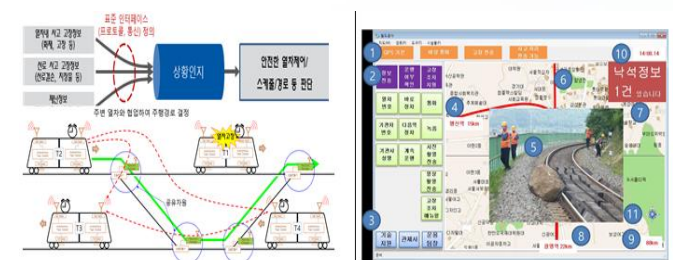
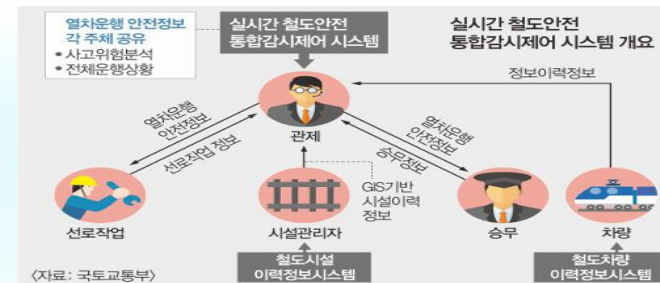
- Build expert training program for railway safety
- Secure skilled manpower in various fields





# Major technologies for operation management

- **Real-time railroad safety control**
  - Transmit failures of railway equipment and signs of fault to traffic control center (vehicles, railways, signal devices, etc.)
  - Real-time operating system management
- **Real-time operational safety monitoring**
  - Integrated management of safety information such as vehicles, signals and work
  - Build real-time information system for drivers, traffic controllers, and workers
- **Smart train operation control**
  - Autonomous control of headways and support for route determination
  - Improve safety and efficiency of train operation
- **Improve emergency guidance system**
  - Support quick and systematic decision making on emergency response in case of an accident
  - Improve emergency communication system



# Major technologies for security management

- **Build smart railway security system**

- Implement automatic security system for improvement of checking convenience and human factors
- Intelligent CCTV, patrol, security robot, automated identification system for dangerous goods, etc.



- **Establish institutional and technological basis for security management system**

- Improve railway security laws and regulations
- Build integrated system of smart railway security, monitoring and decision making



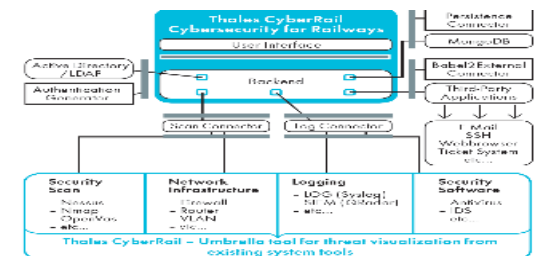
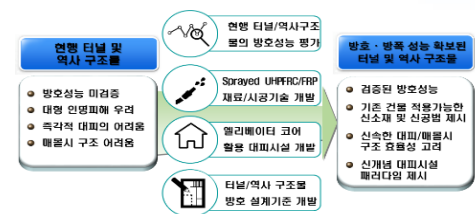
- **Secure railway facilities security**

- Strengthen security facilities such as CCTV for surveillance, sensors and drones
- Establish standards and strengthen management for structures



- **Strengthen cybersecurity system**

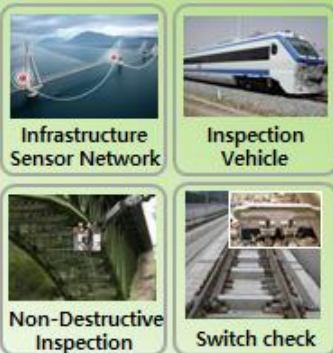
- Strengthen defense system against cyberattacks and encrypt private network
- Physical network separation and protection



# Thank you.

## Safety measures

### Signaling



### Infrastructure

### Equipment Level Hazard



### System Level Hazard

### Accident

### Rolling Stock



### Operating