Basic Plan of Smart Railway Safety Management System

October 23, 2018

Railway Safety
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Status of Railway Safety
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
Railway safety management trends

- 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

**Korea Rail Network Authority**
- Build general information system for railway facility history management
- Pursue Smart Railway Safety Management System
  - Build smart railway vehicle inspection system
  - Continue to expand smart convergence and monitor advanced test equipment
  - Build condition-based monitoring facility

**Korea Railroad Corporation**
- Pursue smart railway safety management using IoT, Big-Data, AI, and VR by six sectors until 2019
  - Establish management
    - Build smart railway vehicle inspection system
    - Continue to expand smart convergence and monitor advanced test equipment
    - Build condition-based monitoring facility
  - Facility management
    - Implement smart maintenance system
    - Evaluate and diagnose status of smart facilities
  - Operation management
    - Operate system to share real-time operation and safety information

**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
  - “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
    - 1st step (2018~2022) / 2nd 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
Progress

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

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.
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.

The country responsible for my life
Society protecting people’s safety and lives

- Reduce railway accidents by over 50%
- Reduce operational failures: 99% of on-time ratio
- Promote railway industry: Creating 5,465 jobs
- Reduce recovery time: Within 5 hrs.
- Smart security check: 50% of checking rate
Basic Plan of Smart Railway Safety Management System

**Actual plan**

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

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**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) 15.1 → (2022) 9.2 → (2027) 6.4

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**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

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**Detailed goals and key projects by sector**

**Vehicle management**

| Operation failure due to vehicle problem (case): (2017) 151 (estimated) → (2022) 105 → (2027) 74 |
|---|---|
| 1. Real-time fault detection and prediction of main parts |
| 2. Develop high safety control system platform for railway vehicle |
| 3. Introduce smart factory for vehicle maintenance |
| 4. Condition-based maintenance through smart vehicle history management |

**Facility management**

| Operation failure due to facility breakdown (case): (2017) 31 (estimated) → (2022) 22 → (2027) 15 |
|---|---|
| 1. Secure advanced inspection equipment such as IoT and drone |
| 2. Mechanize of railway facility maintenance work |
| 3. Build railway facility history management system |
| 4. Establish the base for advanced railway infrastructure |

**Personnel management**

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<td>1. Prevent human errors by employee monitoring and education</td>
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<td>2. Strengthen emergency response capabilities using VR and AR</td>
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<td>3. Enhance employee competence through evaluation, training, etc.</td>
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<td>4. Train 4th Industrial Revolution professionals</td>
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**Risk management**

| Manage safe status and prevent risk factors |
|---|---|
| 1. Big data-based safety management |
| 2. Introduce scientific maintenance system |
| 3. Introduce systematic risk assessment |
| 4. Build supervision support system |

**Operation management**

| Number of dead workers (person/100 mill km): (2016) 2.2 → (2022) 0.5 |
|---|---|
| 1. Build real-time railroad safety control |
| 2. Real-time operation safety monitoring |
| 3. Smart train operation control |
| 4. Improve emergency response system |

**Security management**

| Prevent railway terrorism source and achieve zero railway security accident |
|---|---|
| 1. Build smart railway security system |
| 2. Establish basis for railway security management system |
| 3. Secure railway facilities security |
| 4. Strengthen cyber security system |

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**Secure motivation for the base**

Diffuse technologies developed

Advanced SMART

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Land transport technology leading the future
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
Major technologies for facility management

- **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.