Ministry of Land, Infrastructure and Transport

Capacity Building Program for
"Establishment of Master Plan for Building Road Traffic Volume Database in Cambodian and a Pilot Project"

Road Management System in Korea

March 5th, 2025

Korea Institute of Civil engineering & building Technology

Head of Integrated Road Management Research Center

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KICT KOREA INSTITUTE of CIVIL ENGINEERING and BUILDING TECHNOLOGY

Introduce

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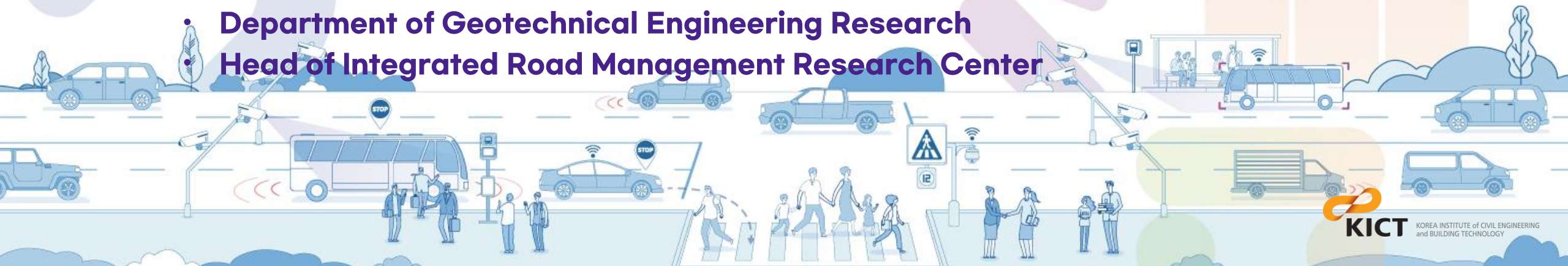
Experience

- **Department of Geology, Master(Pusan National University(PNU))**
- **Department of Geology, PhD(PNU)**
- **KICT Research Fellow**
- **Department of Geotechnical Engineering Research**
- **Head of Integrated Road Management Research Center**



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Ministry of Land, Infrastructure and Transport

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Road management & Its Issues

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Chapter 1. Road management & Its Issues

Roads in Korea

Road Extension Change

01

Continuous extension from 56,000km in 1990

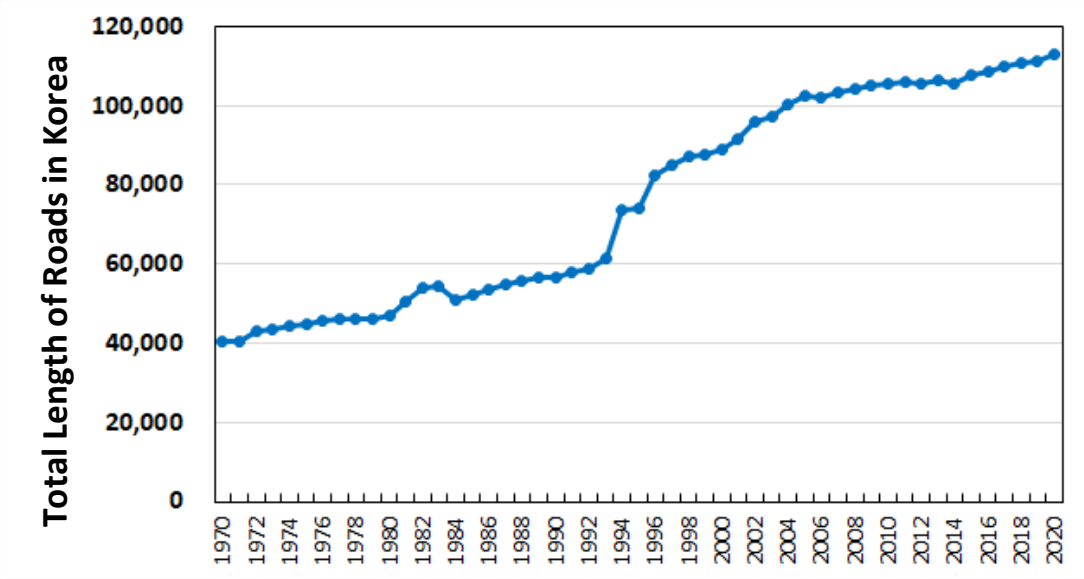
02

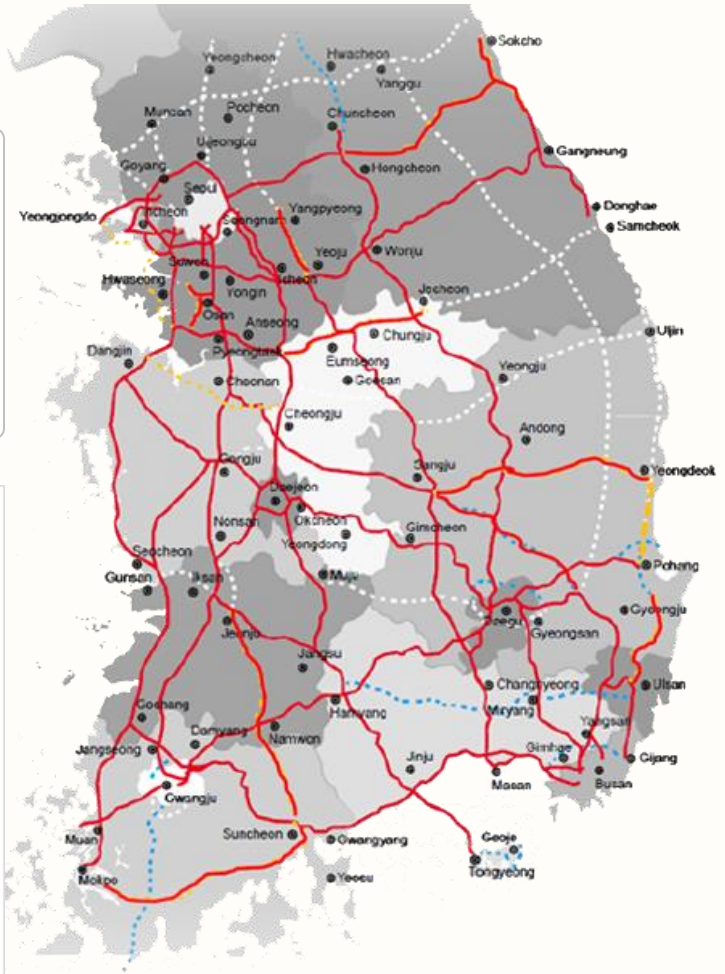
In 2004, over 100,000km

03

As of 2024, 114,877km

= 2.9 times the size of the Earth's perimeter (40,000km)



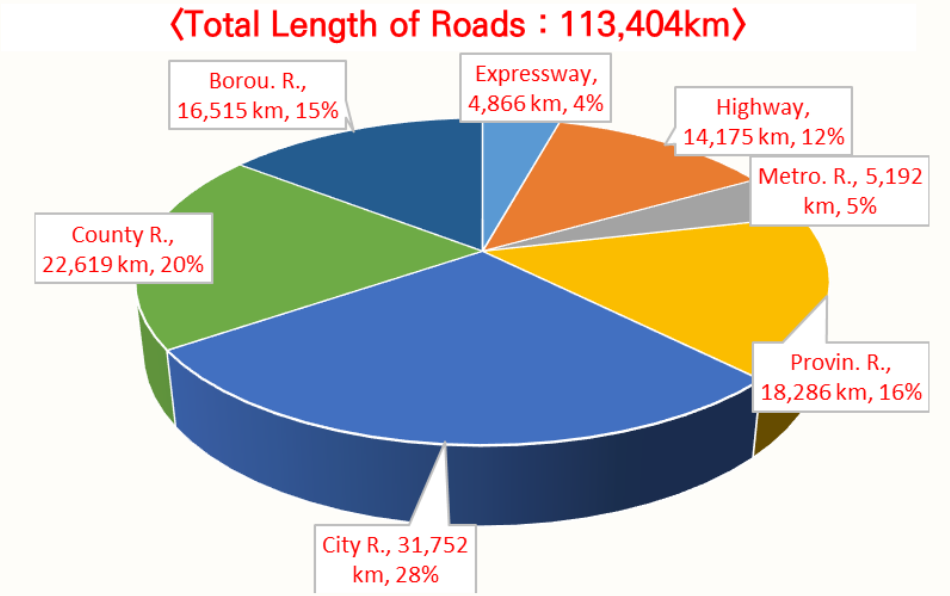


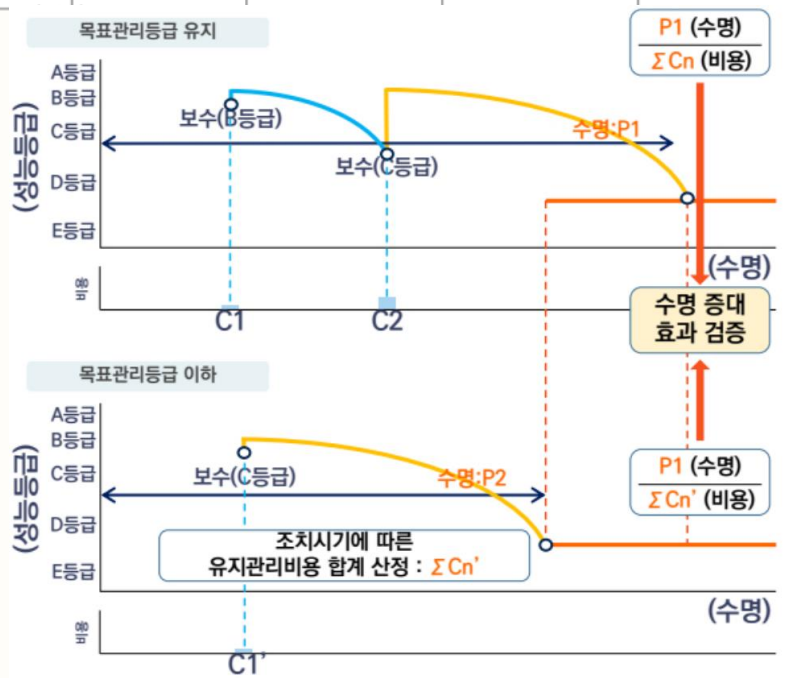
Source : Road Statistics and Maintenance Information System(http://www.rsis.kr)

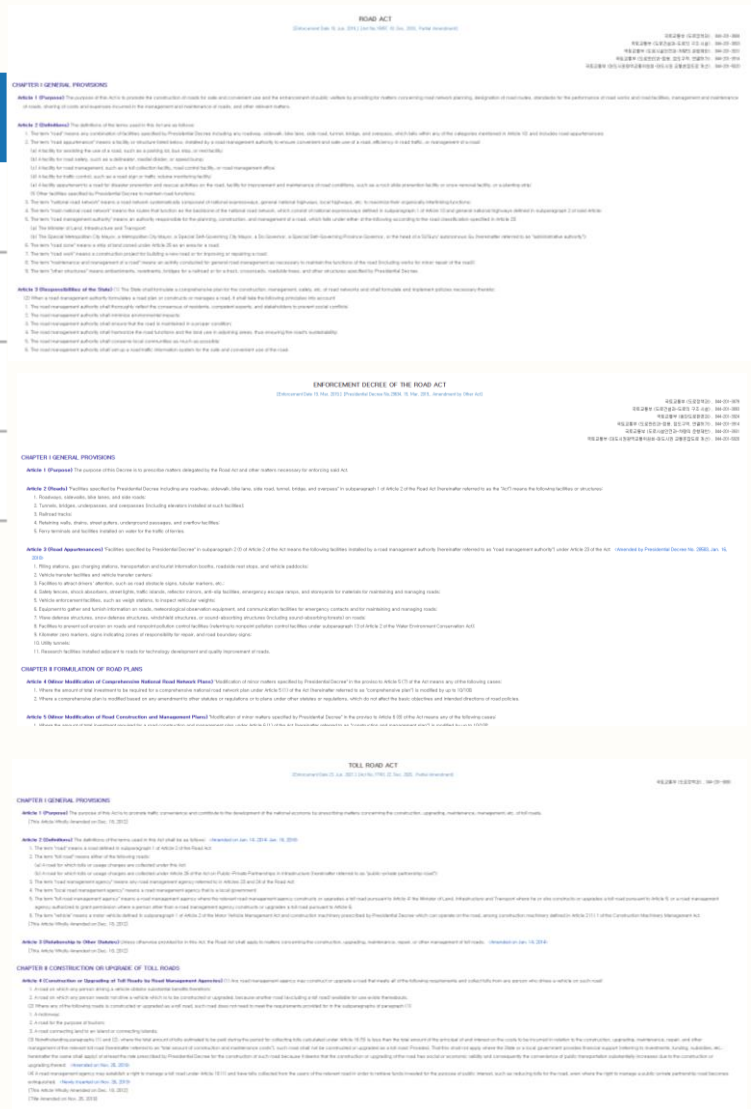
Chapter 1. Road management & Its Issues

Current status of roads and road facilities in Korea

Classification	Total	Expressway	Highway	Metropolitan Road	Provincial Road	City Road	County Road	Borough Road
Pavement (km)	98,683	4,866 [4.9%]	14,046 [14.2%]	5,133 [5.2%]	16,113 [16.3%]	26,059 [26.3%]	17,103 [17.3%]	16,287 [16.4%]
Bridge (Each.)	36,501	10,676 [29.2%]	8,850 [24.2%]	1,464 [4.0%]	5,571 [15.3%]	5,007 [13.7%]	4,146 [11.4%]	787 [2.2%]
Tunnel (Each.)	2,742	1,232 [44.9%]	786 [28.7%]	214 [7.8%]	246 [9.0%]	210 [7.7%]	41 [1.5%]	13 [0.5%]
Slope (Each)	-	10,426	30,747	Non-Statistics	Non-Statistics	Non-Statistics	Non-Statistics	Non-Statistics







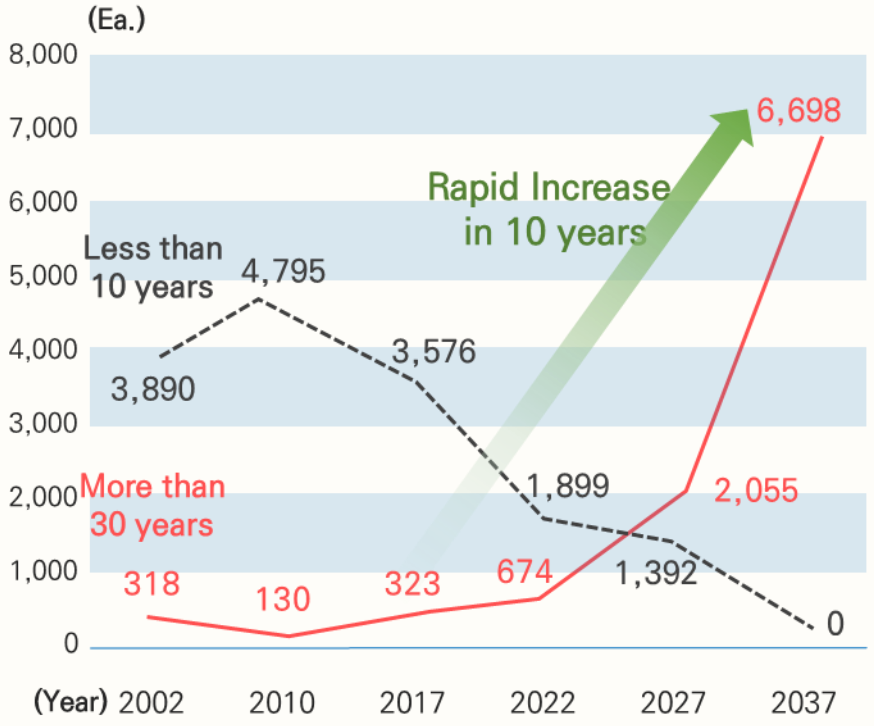
Chapter 1. Road management & Its Issues

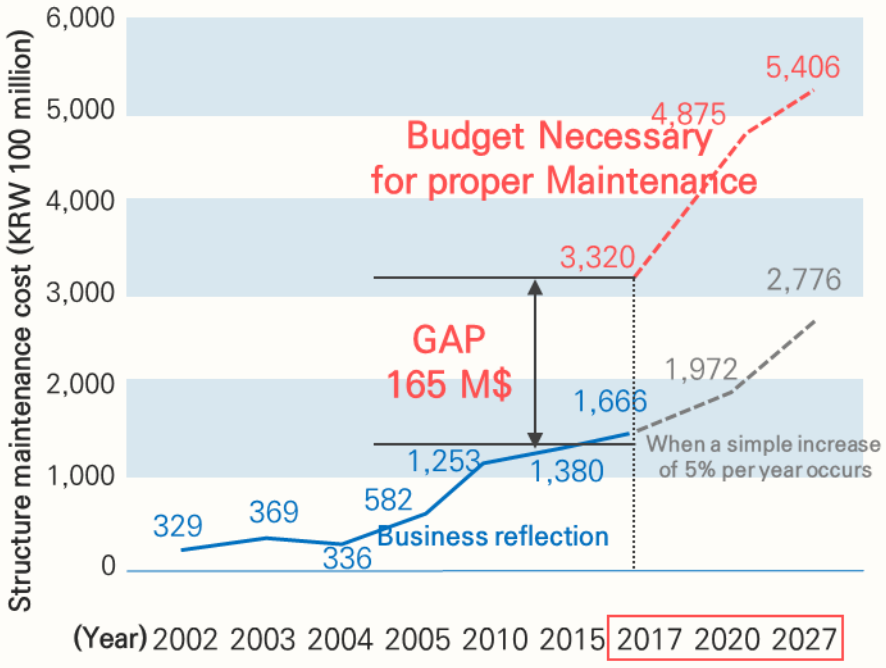
Maintenance Issue 1._ Aging of Road Structures

Aging of Road Structures

- Bridges with more than 30 years of common year increase rapidly after 10 years
- Increasing the maintenance project cost requirement due to the aging and deterioration of bridge components and accessories

*(Timing point) Active road aging improvement "effort" and "budgeting" timing





Source: KIM, Kyung-Suk(EX in Korea)

Chapter 1. Road management & Its Issues

Maintenance Issue 2._ Repeat disasters caused by global warming

Abnormal disasters and complex disasters caused by heat waves, Typhoons, Fires, Black ice

- Blow-up of road pavement and damage to bridge joints due to heat waves
- Landslide damage caused by increased number of typhoons and forest devastation caused by forest fires
- Traffic accident caused by black ice
- Road inconvenience caused by fine dust and strong winds

*(Timing point) Policies need to be prepared to increase the prediction rate of road disasters

Gyeongju Landslide(2018.10.)

Black ice accident(2019.12.)

Blow-up by heat wave(2018.7.)

Road facility damage by strong wind

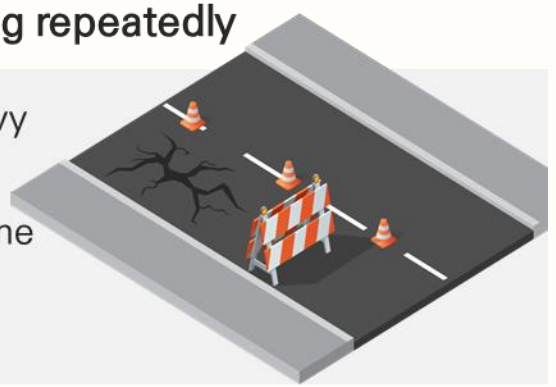
Chapter 1. Road management & Its Issues

Maintenance Issue 3._ Damage to pavement and lack of visibility to road signs

Pavement fatigue (portholes, etc.) and lane signs and lane painting repeatedly

- Repeated occurrence of potholes, cracks, and lutting due to increased heavy vehicles, aging & deterioration of pavement, behavior of lower slopes, etc.
- Repeat public inconvenience due to lack of recognition of lane signs and lane painting at certain times such as rainy season and night.

*(Timing point) the most uncomfortable component when using the road



Chapter 1. Road management & Its Issues

Maintenance Issue 4._ Road Site and its surrounding area Utilization

Diversification of Road Site Utilization

- Increasing public requests for the use of road sites
- Diversification of types of road sites such as renewable energy facilities around the road
- Indiscriminate use of road sites leads to illegal cases
- Social conflict intensified due to GTX construction in downtown area
  *(Timing point) Repeated public complaints related to "road occupancy" and “Deep tunnel" response

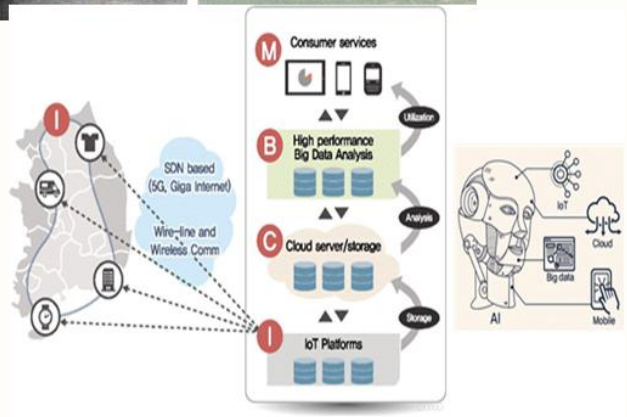
Chapter 1. Road management & Its Issues

Maintenance Issue 5._ Changes in Road Traffic Environment

Changes in road traffic environment, such as autonomous vehicles and various means of transportation

- Increasing new vehicles and means of transportation
  ; self-driving cars, electric vehicles, hydrogen vehicles, personal mobility, hyperloop
- Need to respond to all roads to support self-driving cars
- Increased demand for future road infrastructure management using 4th industrial technology

  * (Timing point) Need to prepare "Smart Digital Integrated Road Management System" to break away from expressway and national road management and create new industries



Chapter 1. Road management & Its Issues

Type of Road Management systems

Objective

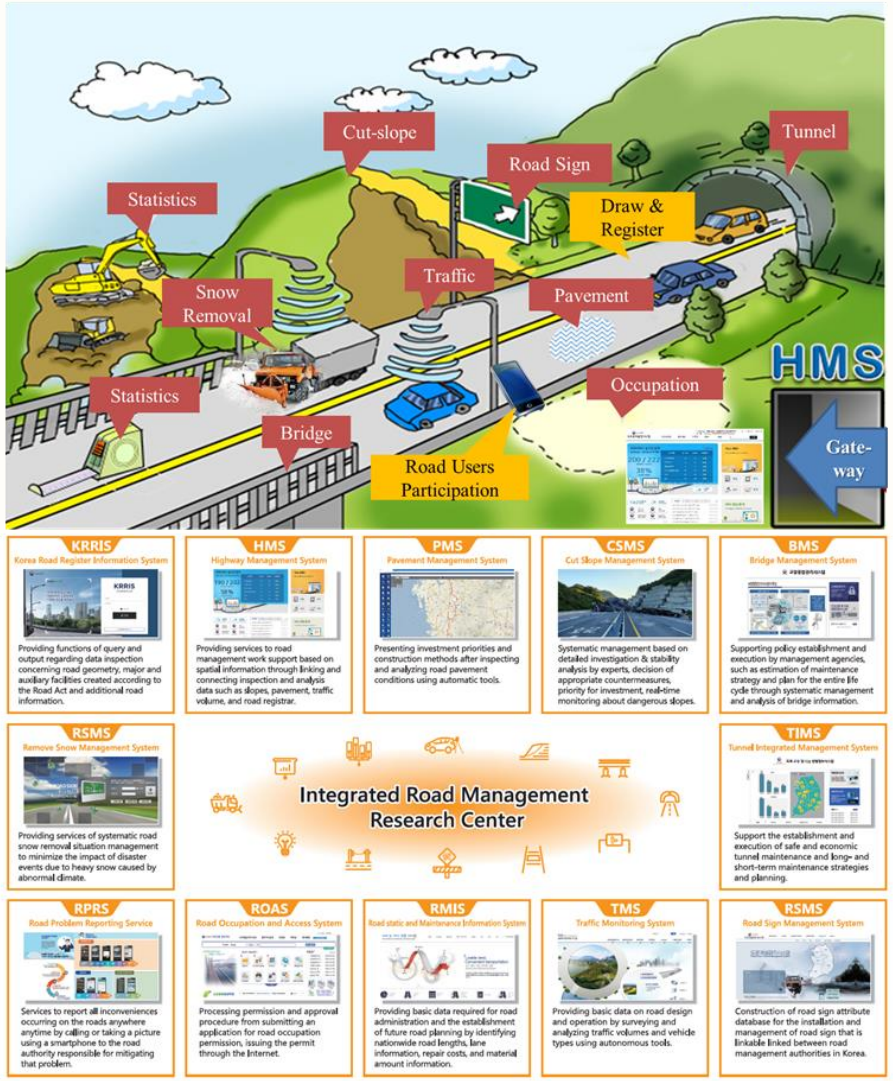
- To provide safe and comfortable road services by performing systematic management of road facilities and scientific road work support functions

Road Facility Management System (5types)

- Pavement Management System(PMS)
- Cut Slope Management System(CSMS)
- Bridge Management System(BMS)
- Tunnel Integrated Management System(TIMS)
- Road Sign Management Center(RSMC)

Road operation support system(7types)

- Highway Management System(HMS)
- Traffic Monitoring System(TMS)
- Road Occupation & Access System(ROAS)
- Remove Snow Management System(RSMS)
- Road Statistics and Maintenance Information System(RSIS)
- Road Problem Reporting System(RPRS)
- Korea Road Register Information System(KRRIS)



Chapter 1. Road management & Its Issues

Road survey and analysis, road statistics, public affairs, and operation

Support for Road management agencies

- Daily maintenance performance management
- Preparation of safety management checklist
- Support for fact-finding inspection
- Equipment and vehicle operation management

Use of information

Road survey and analysis

- Pavement Investigation and Maintenance
- Bridge/Tunnel Inspection and Diagnosis
- Slope Investigation and Maintenance

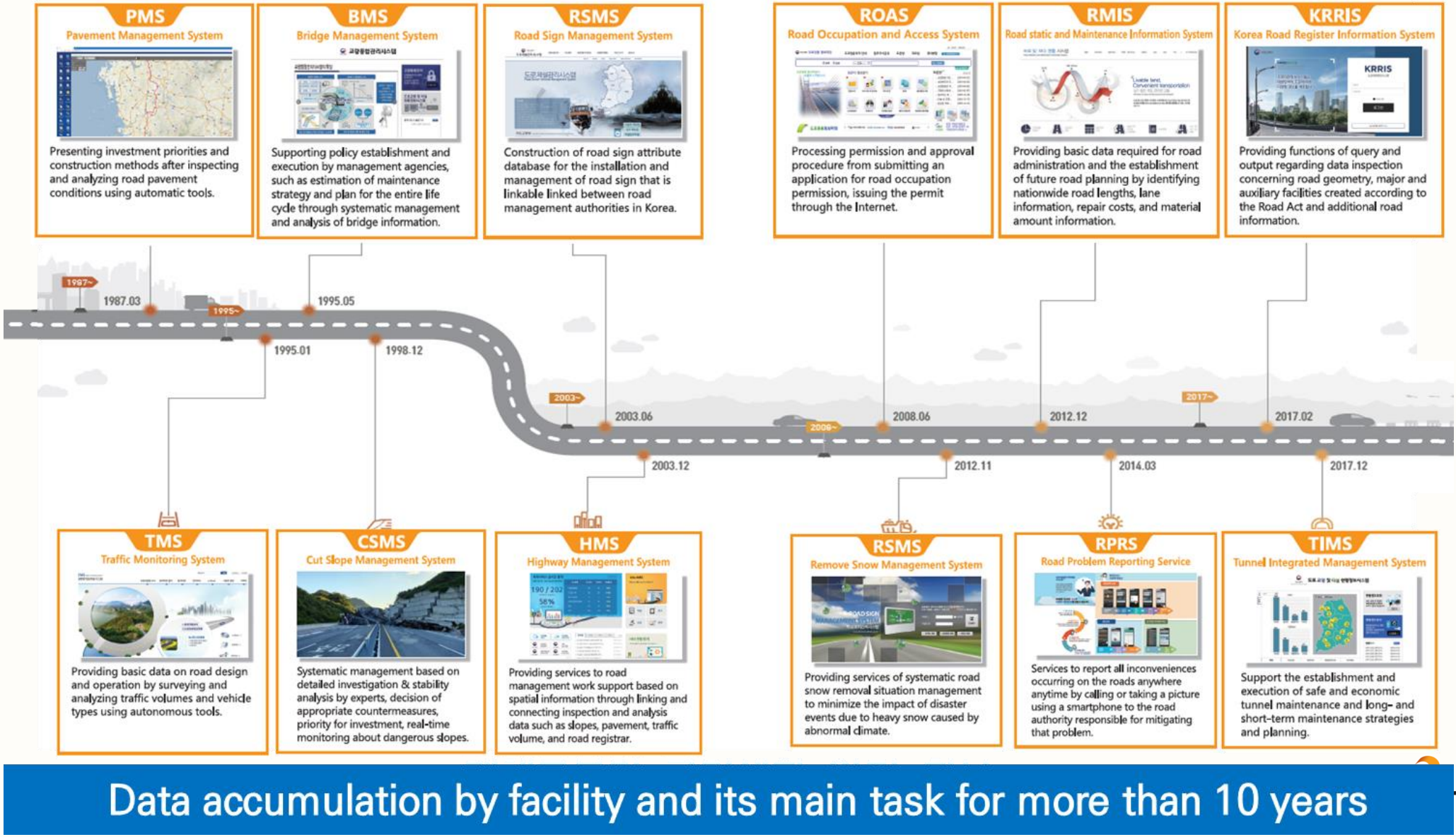
Road Statistics Status

- Traffic Survey and Status
- Road status and maintenance status
- Road Register Information

Civil Service

- Road inconvenience reception
- Road occupation
- Snow-Removal
- Road sign

Chapter 1. Road management & Its Issues



Chapter 1. Road management & Its Issues

Limitation of Road Management System

Problem 1 : Manage only some roads & Insufficient data standardization

- MOLIT※'s data management targets – limited management of Expressway and National roads

  (*MS is mainly for National roads) (※MOLIT : Ministry of Land, Infrastructure and Transport)

  : MS has only main road facilities(paved, bridge, slope, tunnel, road signs) database at national road

  : Korea Expressway Corporation has Expressway maintenance data.

  : Small roads below National highway have no data themselves.

  → Need to establish the **Data Standardization**

Problem 2 : Low-effective data acquisition and low-reliability with outdated technology

- Initiatives to Acquire and Manage Data Using IoT Technology

  : Use outdated methods of acquiring data **using people and vehicles**

  : Recently, data acquisition and management methods that incorporate the latest smart technologies into slope monitoring, bridge inspection, traffic measurement, and pavement analysis are introduced. (But, Initial stage)

MOLIT
Ministry of Land,
Infrastructure and Transport

02 Road Management System in Korea

Road Management System

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Chapter 2. Road Management System

Integrated Road Management Research Center

VISION Human-centered Smart Road Management

GOAL

Smart Road Management using 4th Industrial Technology

Goal 01	Goal 02	Goal 03
Building a safe road	Convenient Road Environment	Smart Road Management

MAIN TASK

Government Policy Support	Government Technical Support	Support for Social problem solving	Supporting SMEs & developing countries
• Government Policy Leadership (conference, seminar et al.) • Government Support • Support for national statistics	• Establishment of government facility standard • Government Education Support • Application of 4th industrial technology	• Social problem-solving prevention measures • Social problem resolution support activities • Support for the improvement of social problem resolution system	• Technical Support for Small and Medium Businesses • Promotion of win-win cooperation between small and medium-sized enterprises • Transfer of customized road maintenance technology to developing countries

Chapter 2. Road Management System

PMS Pavement Management System — Since 1987

Rapid industrialization since the '70s
Accelerate pavement breakage

Environmental changes such as heavy rain, increased traffic, increased heavy vehicles, and heavy snow

→ Increased road management extension

Budget problem

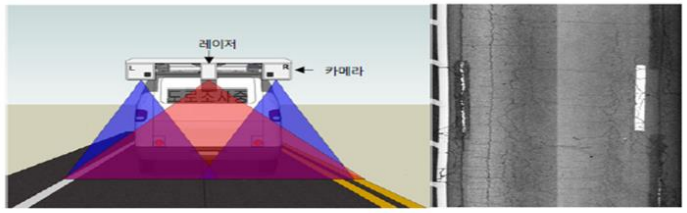
→ **Limited Resource**

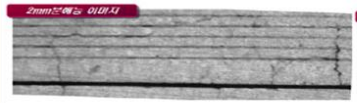
Maintaining and repairing road pavement in a timely method

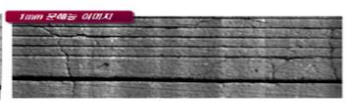
- Investigate and evaluate road pavement conditions and allocate road maintenance budget efficiently
- Use for decision support and maintenance to secure common performance of road pavement

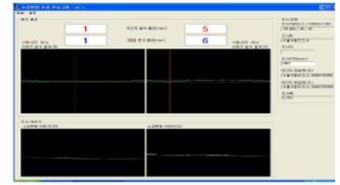
Pavement Management System

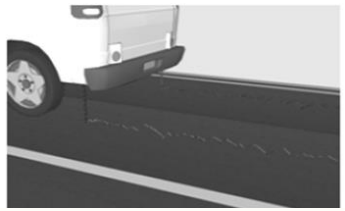
Pavement Marking Management System

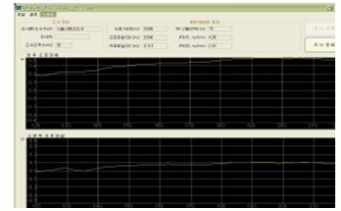










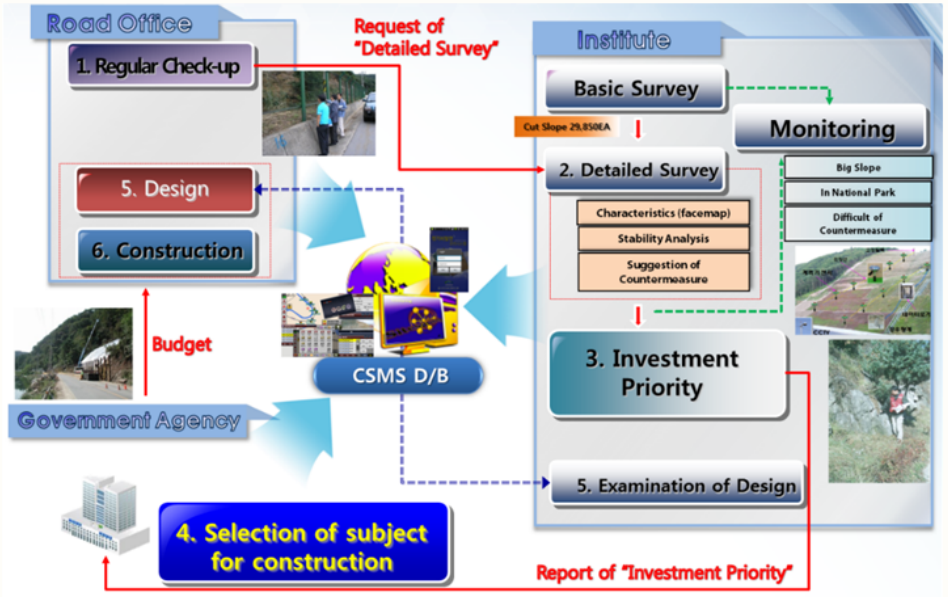


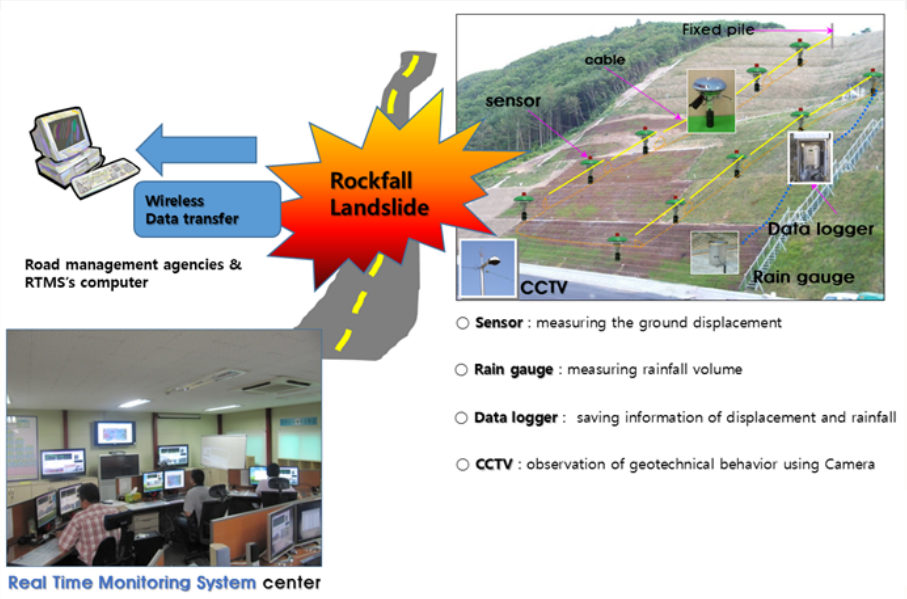
Secure safe and pleasant road driving

Chapter 2. Road Management System

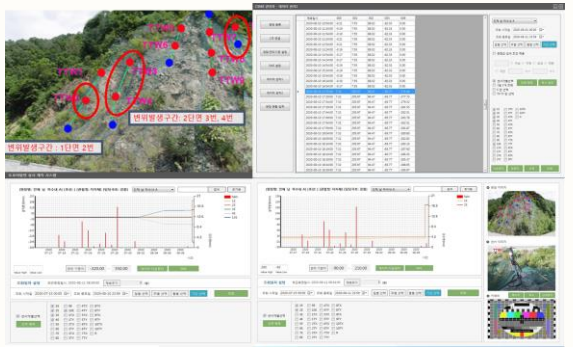
CSMS Cut Slope Management System — Since 1997

- Preparation of a strategy to respond to landslides through a preemptive prevention system for risk slopes
- Basic data management for all national slopes based on the Geographic Information System (*GIS)
- Detailed investigation by experts on risk slopes and selection of efficiently
- Leverage state-of-the-art IT technology with smart applications
- Helps efficiently execute national budgets based on scientific investment priorities
- Real-time monitoring system considering rainfall conditions and big data





- **Sensor** : measuring the ground displacement
- **Rain gauge** : measuring rainfall volume
- **Data logger** : saving information of displacement and rainfall
- **CCTV** : observation of geotechnical behavior using Camera

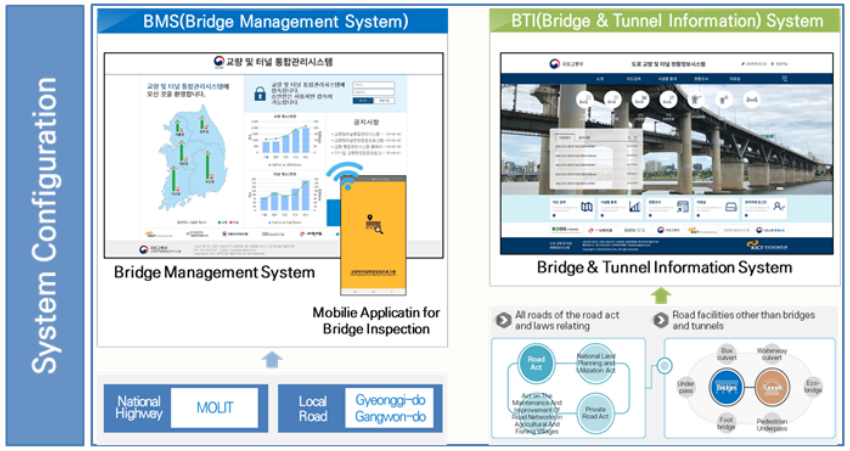


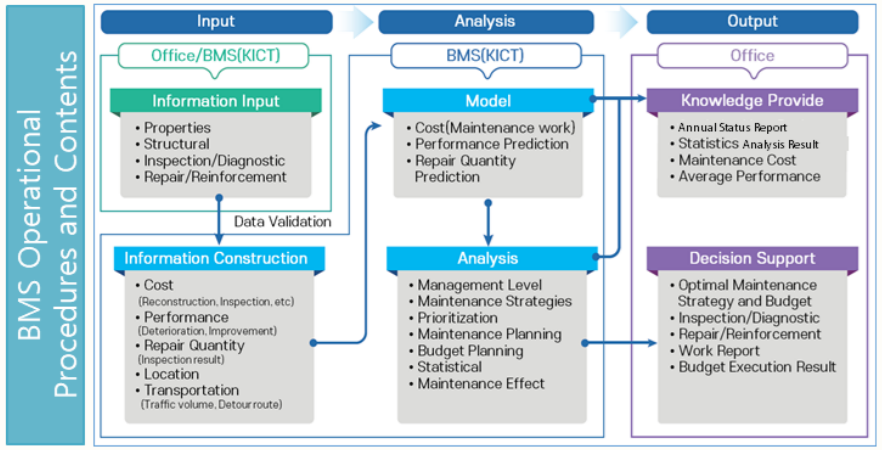
Securing the safety of people's lives from disasters

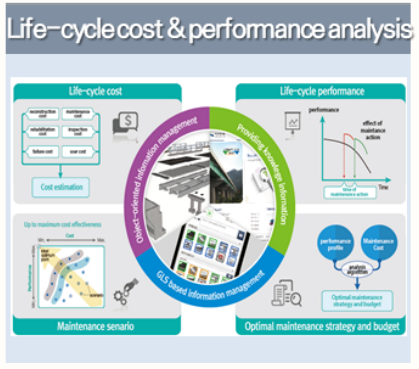
Chapter 2. Road Management System

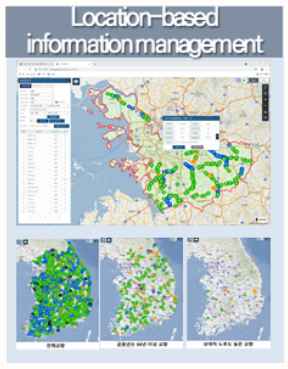
BMS Bridge Management System — Since 1995

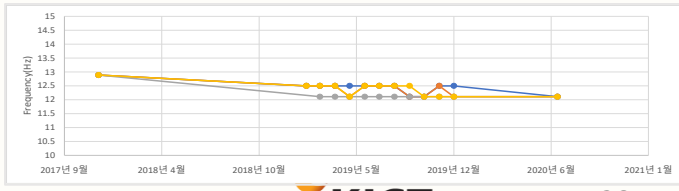
- Bridge Information Management and Analysis to Support Management Body Decision Making
- BMS Configuration: BMS + Field Survey Program, Bridge and Tunnel Status Information System
- BMS functions: information management and analysis, knowledge information provision, decision support / investigation for improvement project, operation of measurement system, etc.
- BMS Characteristics : Strategic Analysis Considering Member-based Information Management, Mobile and Location-based Information Management, Life Cycle Cost and Performance







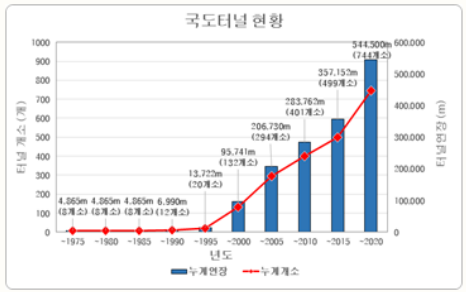




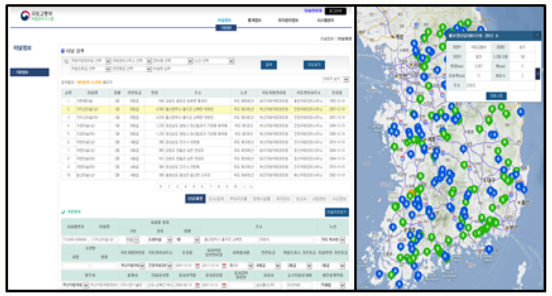
Chapter 2. Road Management System

TIMS Tunnel Integrated Management System — Since 2017

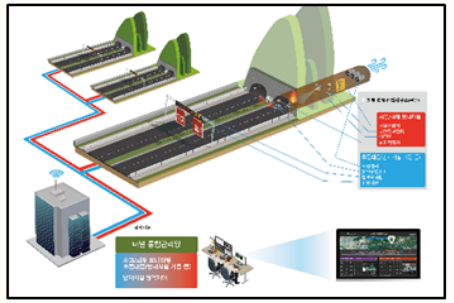
- Data integration and systematic management for economical tunnel maintenance
  (number of tunnel locations and extensions since 2000)
- Basic data management for Expressway/National highway's tunnels based on GIS
  - Basic information: tunnel specifications, investigation/design information, disaster prevention facilities, etc.
  - Statistical information : Tunnel management status, etc.
  - Maintenance information: Operation of tunnel management office (tunnel integrated management network), etc.
- National Road Tunnel Disaster Prevention Rating Re-evaluation
- Establishment of a supplementary plan for the maintenance and long-term management of tunnel disaster prevention facilities



Tunnel Status



Query and provide tunnel information



Tunnel Integrated Management Network

Secure and economical tunnel maintenance

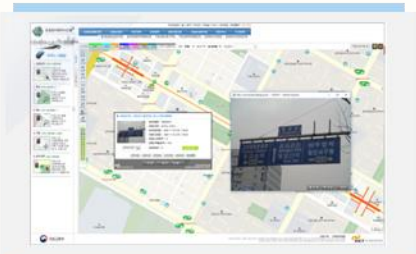
Chapter 2. Road Management System

RSMC Road Sign Management Center — Since 2003

- Support comprehensive management of road signs, visibility, safety, etc. throughout the country
- Pre-design review of new/renewed roads and improve error review of existing signs
- Operation and function development of road sign management system, improvement of road sign-related system, and support for technology-related constantly
- Design of the cover design of tourist attractions, improvement of the form of the display of the cover to secure the night's legibility, etc.

Review the appropriateness of new signs

Review the appropriateness of existing signs



Road Sign Web System

Research (ex. For tourist attractions)

Comprehensive management and improvement of road signs

Chapter 2. Road Management System

TMS Traffic Monitoring System — Since 1996

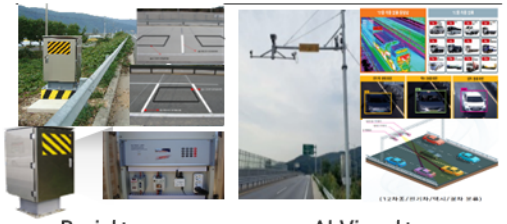
- A survey that records the number of vehicles passing through the road by time, vehicle type, and direction

Collecting traffic data

Current status of traffic survey point

657 permanent survey points

3,136 Occasional survey point



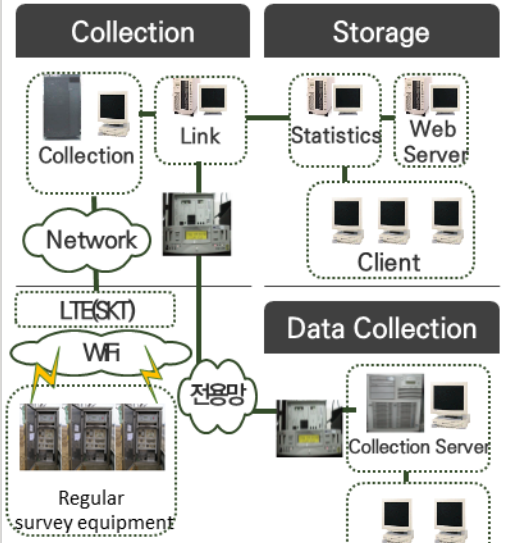
Burial type — AI Visual type

[Permanent equipment]

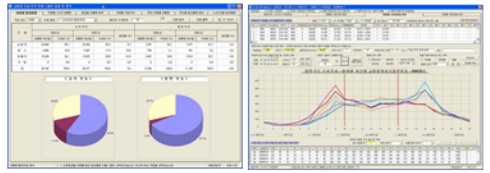
[Occasional equipment]

[Type of Vehicle]

Traffic information processing



Data analysis and statistical processing



Providing and utilizing traffic information

Web service for Nation(stat.molit.go.kr)

- Average daily traffic volume and composition ratio by vehicle type
- Extension and composition ratio according to the distribution of traffic volume by road type

Statistical yearbook

- Traffic survey analysis results
- Traffic volume by road type
- Average daily traffic volume by section
- Average daily traffic volume

Web service for Public(www.road.re.kr)

- Information such as location/line/road type of survey point, etc.
- Daily traffic volume by time zon
- Data from the past 5 years

Traffic information application field

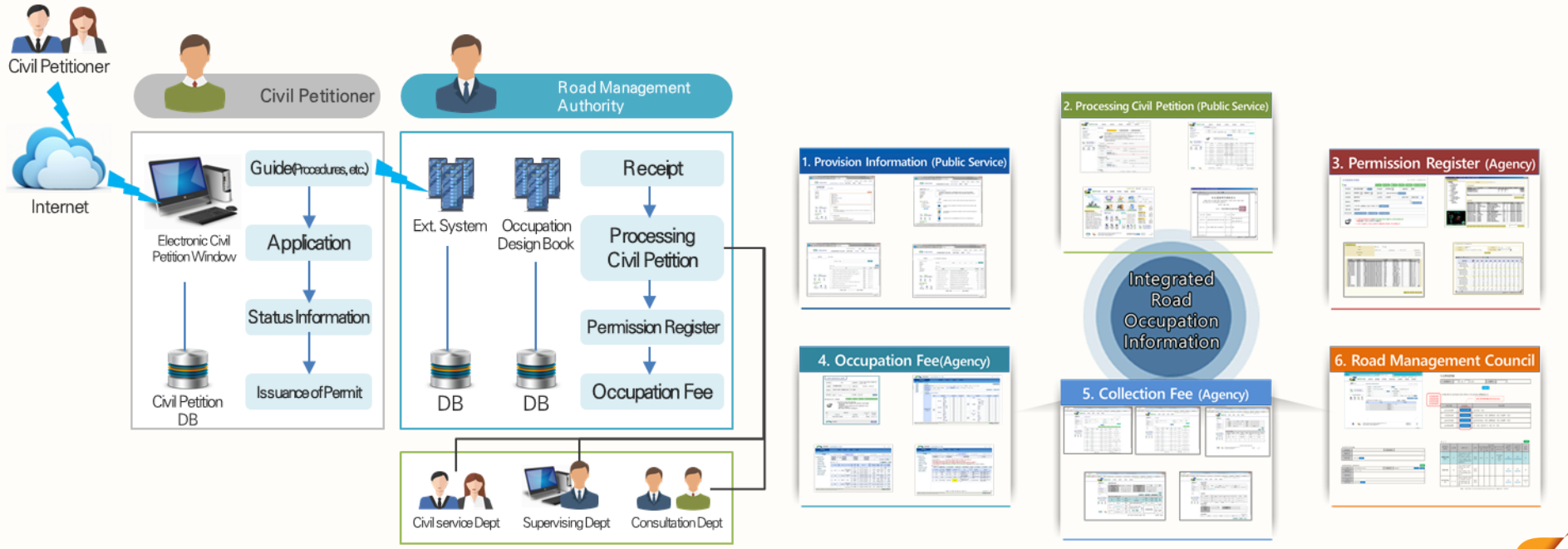
- Estimation of traffic demand, road planning and design, pavement design, traffic effect evaluation, corporate location selection, post-mortem evaluation, etc.

Chapter 2. Road Management System

ROAS Road Occupation & Access System — Since 2008

- Integrated and systematically managed and provided information at all stages of road occupation and access work
- Civil complaints related to road occupancy permission, and support for Internet business processing by the Road Management Office
- Semi-automatic calculation and collection of road occupancy fees every year based on the road occupancy permit ledger

※ Relieving the burden of collecting occupancy fees imposed annually according to the introduction of the system (shortening period: 3 months ▶ 15 days)

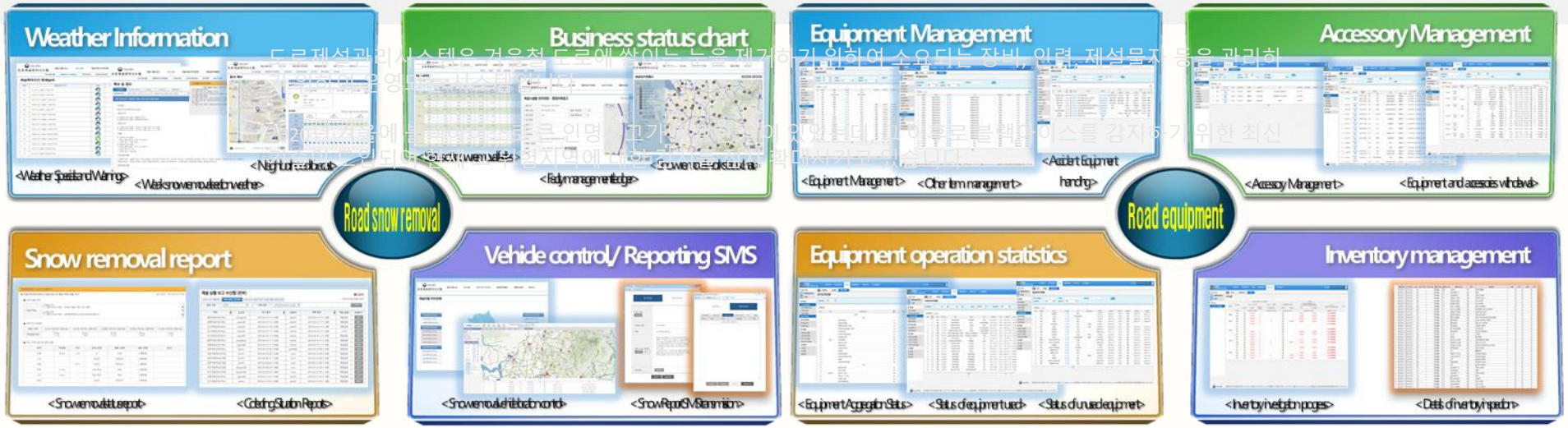


Advancement of work through systematic management of occupancy information

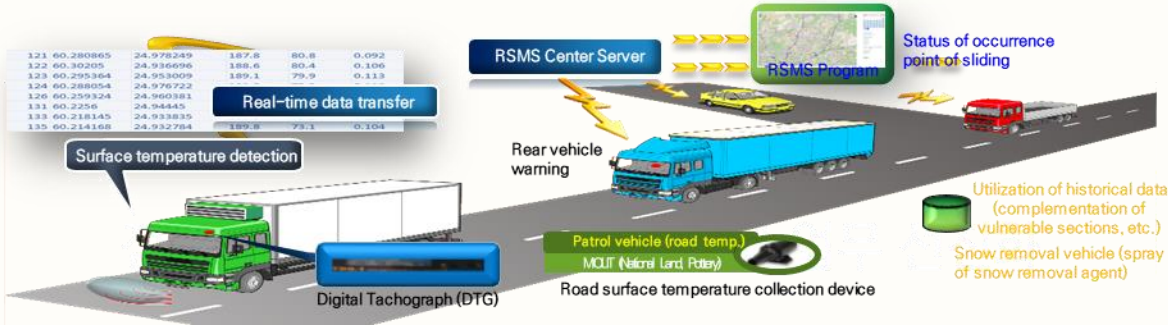
Chapter 2. Road Management System

RSMS Remove Snow Management System — Since 2012

- (Road Removal) Snow removal work Management to minimize traffic accidents caused by road snowfall in winter.
  - Performing entrusted tasks such as operation, management and analysis of RSMS, and revision of related manuals.
- (Road Equip.) Efficient management of road equipment and related accessories and consumables performed.
  - Computerized system management and operation for equipment management, accessory management, statistics, etc.



Efficient management of freezing vulnerable sections and detection of road surface temperature by patrol vehicles



Expanding the connection of weather information such as road surface temperature with Korea Meteorological Administration

Chapter 2. Road Management System

RSIS Road Statistics and Maintenance Information System

Vision

National statistics on road status and statistical services for Road Status trusted by the public

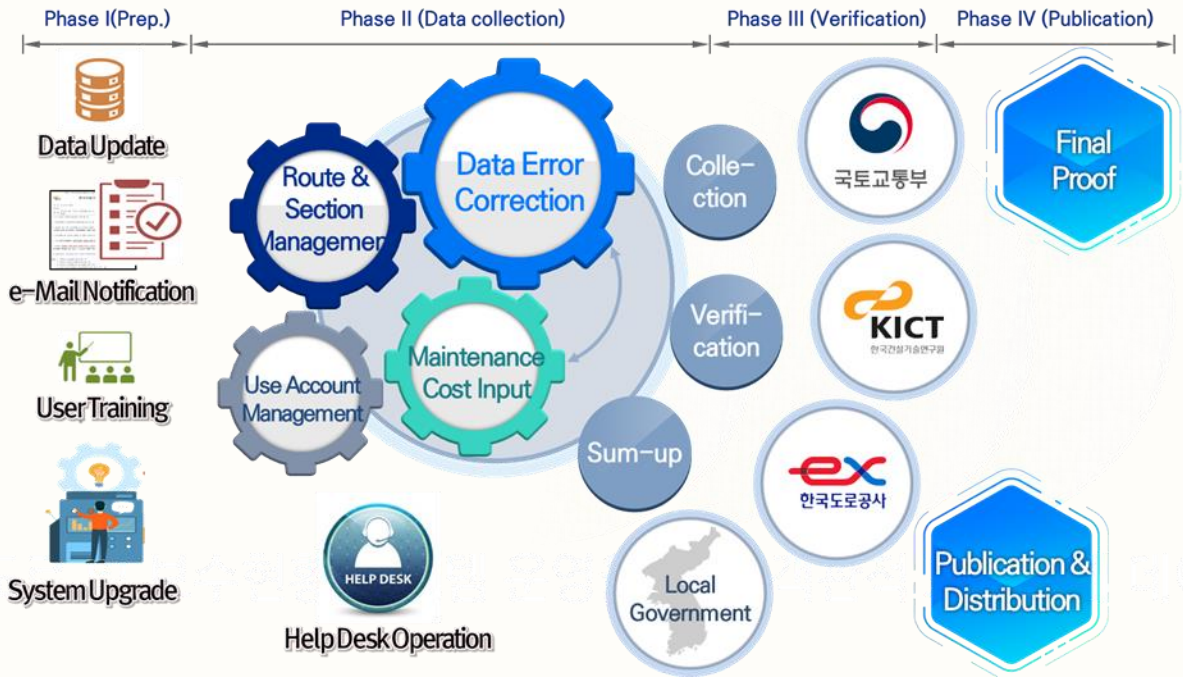
Objective

01 Quickly publishing statistics without delay

02 Accurate statistical calculation without errors

03 Stable service operation without interruption

Management



Chapter 2. Road Management System

RPRS Road Problem Reporting System

How to report road inconvenience in the past

Road User

It is difficult for the general public to grasp the exact location of the current road and the road management agency

Road Manager

Road aging and road management extension continue to increase

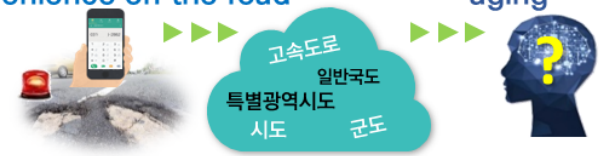
Improving the problem

- It is possible to report road inconvenience easily and quickly using GPS location information on smartphones
- Road users' satisfaction increased due to easy reporting and fast processing

BEFORE

Difficulty for the general public to report inconvenience on the road

Increase in the work of managers due to road aging



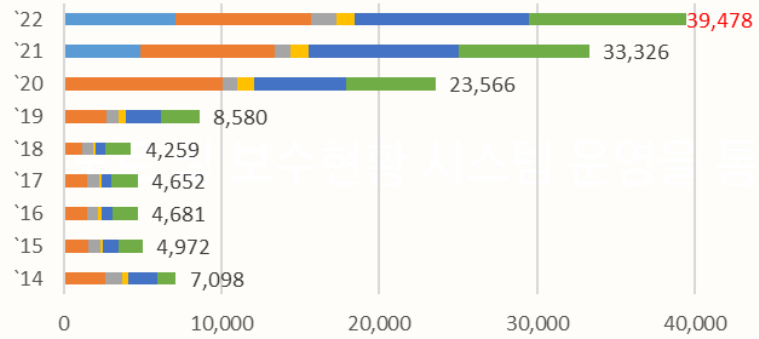
AFTER

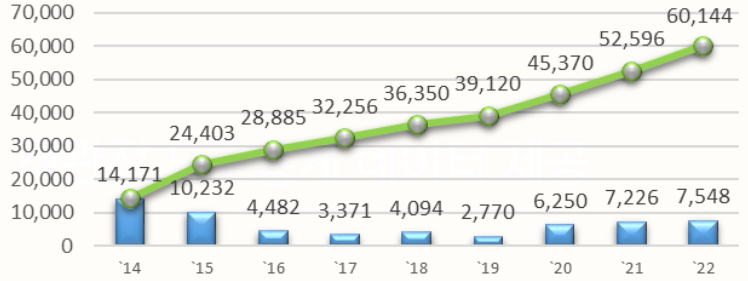
MOLIT

EX

Local government

Operation performance of the solution service(No. of Report : 130,612Ea. / No. of Download: 60,144Ea.)





Chapter 2. Road Management System

National Performance Test-bed for Road Infrastructure

- Promotion of the construction of a real-scale national performance test site capable of evaluating infrastructure performance and safety in various road and transportation environments.
- Responding to road traffic safety problems caused by climate change (heavy rain, heat wave, freezing) and increased aging infrastructure.
- Establish an efficient road management system such as revision of road infrastructure construction and management standards, development of new technologies, and verification of public methods.
- A preemptive response to changes in the road traffic system with the emergence of various future means of transportation such as autonomous vehicles

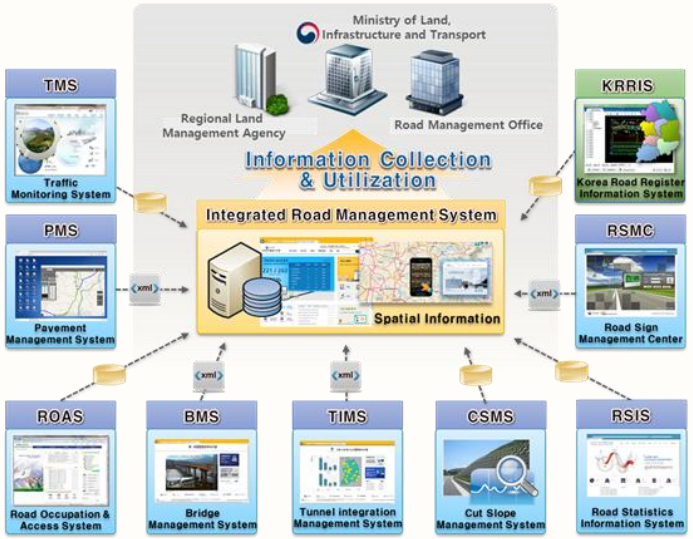
Securing public safety and revitalizing the road industry in the future

Chapter 3. Future of Road Management System

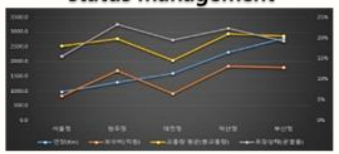
Integrated Smart Road Management System

- Road management support service that can provide road status information based on spatial information by linking survey and analysis data such as slopes, pavement, bridges, traffic volume et al. with electronic maps

Unifying information	Unified window for field surveys, analysis, and collection and provision of completed data on road facilities (pavement, slope, etc.)
Sharing information	Maintaining consistency of data through integrated DB linkage Sharing information on road construction work using mobile technology
Supporting	Portal service specialized in the field of roads • Provide real-time information on field work through the web/app.



Maintenance worker work information real-time status management



Strengthening safety accident prevention for road users and maintenance personnel using location-based ICT technology

MOLIT
Ministry of Land, Infrastructure and Transport

03 Road Management System in Korea

Future of Road Management System

KICT KOREA INSTITUTE of CIVIL ENGINEERING and BUILDING TECHNOLOGY

Chapter 3. Future of Road Management System

Smart Digital Road Management Innovation Initiative

01 Digital road management precise map

- 3D precision map
- Technical support for self-driving cars
- Utilization of disaster safety
- Road management map combined with MS information

02 Data Capitalism

- Realize the era of data capital
- Building a big data ecosystem
- Realize data for industrial creation
- Creating ideas to utilize data in the private sector

03 Smart technology &5G Communication

- Introduction and localization of various sensing technologies
- Real-time information sharing through 5G communication
- People's lives are free from traffic accidents and congestion

04 Total Network

- Spread of MS management system for local governments
- Data standardization project
- Improving the legal system for multi-ministerial cooperation.

What should we do to open the era of smart digital road management?

Chapter 3. Future of Road Management System

Development of a Generative AI Tool for Sustainable Road Infrastructure Management Using Big Data

HOT ISSUE

Road Infrastructure Issue : *Continuous Exposure of Road Users to Risk*

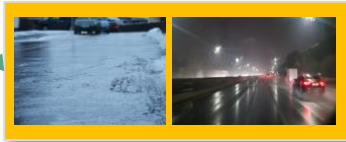
- Increase in Aging Road Infrastructure
  - Expressways: 60% will be aged after 20 years
  - Insufficient budget for road maintenance/retrofitting
- Extreme Weather Due to Climate Change
- Lack of Strengthened Road Safety and Environmental Standards
  - Lack of safety-focused management plans
  - Inadequate proactive management system in the autonomous driving era


Pothhole Blow-ups


Bridge deterioration


Sinkhole


Landslide


Black ice
Poor Lane visibility

Solutions

- Prediction of Road Infrastructure Deterioration and Risk
  - Estimation of budget required for road maintenance/retrofitting
- Strategy for Strengthening Road Infrastructure Safety
- National Standards Focused on Road Safety
- Adaptive Road Management System

Key Tasks

Development of Generative AI Tool Based on MS Big Data

- Extraction and analysis of factors related to road risk
- Establishment of Road Management System (RMS) Data Set
- Additional data set construction (IoT, validation of new industry technology, etc.)
- Development of AI model v1.0 for road infrastructure
- Establishment of AI platform specialized for road infrastructure
- Establishment of Adaptive System: Integration of MS-AI Platform

Development of Road Management Strategy Utilizing Generative AI Tool

- Prediction of road risks and development of decision-making systems
- Development of strategies for enhancing road infrastructure safety

Capacity Building Program for
"Establishment of Master Plan for Building Road Traffic Volume Database in Cambodian and a Pilot Project"

Road Management System in Korea

Thank you

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