

Present Status and Applications of Railroad Disaster Prevention System in Korea

Lee, Chang-Ho Korean National Railroad (KNR)

Shin, Min-Ho Korea Railroad Research Institute (KRRI)

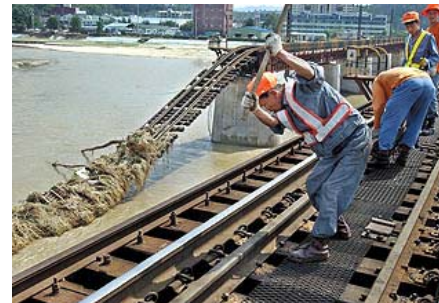
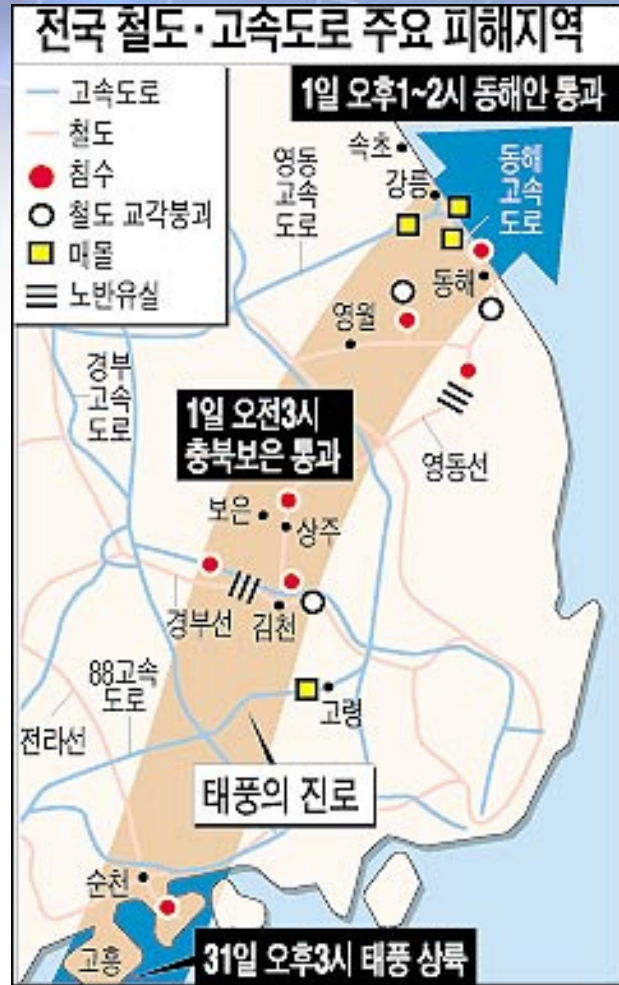




Present Status of Railroad Disasters and Future Plan

Lee, Chang-Ho Korean National Railroad (KNR)

Railroad Damage by Typhoon, RUSA('02)



Railroad Damage by Typhoon, MAEMI('03)

태풍 '매미' 피해 상황

(13일 오후 5시 현재)



- 정전피해
146만여호 : 경남(52만호), 부산(33만호), 대구(19만호), 제주(14만호), 전남(12만호), 충북 경북 등 16만호
- 주택침수 : 866동 • 농경지침수 : 3600ha
- 고속도로 : 중부내륙선, 중앙선 2곳, 구마선 2곳(북구)
- 철도유실
전라선(북구), 영동선, 중앙선(북구), 태백선, 여천선

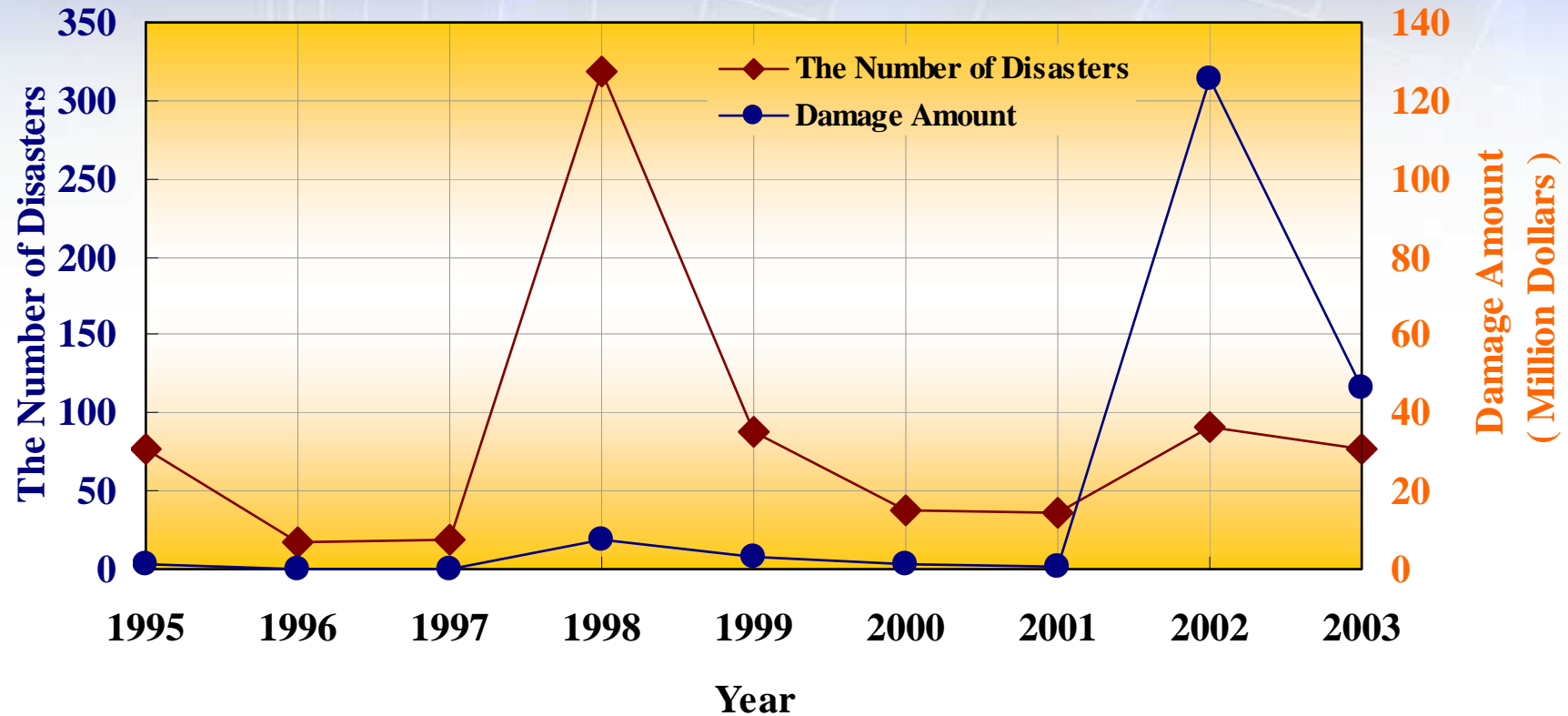


Subway Fire Damage ('03)

- Location : Jung-Ang Station, Dae-Gu (Feb. 18, 2003)
- Death & Injury : **337 persons (Death : 191 persons)**
- Cause and Result : Total Destruction of 2 Cars by Arson



Present Status of Railroad Damage by Natural Disasters for 9 Years ('95~'03)



Problem Statement (1)

Technical Aspect

- **Difficulty in monitoring by human**
 - ☞ Average monitoring distance and time : 3.32km, 4.5 hours
- **Insufficiency of Train Operation Regulation Criteria**

Economic/Industrial Aspect

- **Rehabilitation Cost : About \$20 million per year**
 - ☞ Total Rehabilitation Expense for last 8 years('95-'03) : **\$186 million**
 - ☞ Rehabilitation Cost
 - by RUSA ('02.8.31~'02.9.1) : **\$125 million**
 - ☞ Rehabilitation Cost
 - by MAMI ('03.9.12~'03.9.13) : **\$46.5 million**

Problem Statement (2)

Social/Cultural Aspect

- Worldwide Abnormal Temperature and Frequent Occurrence of Disasters
 - ☞ Frequent Heavy Local Rainfall by **Global Warming**
- Increment of Safety Threatening Factors
 - as **Rolling Stocks are Getting Speedier and Lighter**



 **Railroad Disaster Prevention System** is Needed
for *Absolutely Safe Operation of Train*

Governmental Efforts to Prevent Railroad Damage

✓ **Railroad Facility Improvement Project ('01~'05) : \$ 574 million**

- **Prevention is needed through improvement of railroad facility**
 - **Establishment of annual plan to spend money**
 - **Improvement of bridges having water flow section shortage**
 - **Installation of retaining walls and drainage ducts**
at disaster-worried sites
 - **Installation of tunnel and fence at rock-fall worried sites**
 - **Foundation reinforcement to the scouring of piers and riverbed**

Continued

● Amount of money and Objects (Except for flood rehabilitation)

Unit : Hundred Million Won

Division	Main Objects		Financial (2003)		Financial (2004)		After 2005
	Amount	Site	Amount	Site	Amount	Site	
Total	688,748	1,362	11,450	18	15,000	24	1,302
Bridge	385,517	72	7,485	4	10,000	4	57
Sub-Pier	90,140	204	485	1	3,000	10	185
Drainage	10,319	126	700	5	500	5	109
Landslide	38,042	66	590	3	1,000	2	59
Retaining Wall	119,624	615	2,190	5	500	3	604
Roadbed	45,106	279	-	-	-	-	279

✓ Direction of Drive for Railroad Disaster Prevention

- **Prevention**
 - Enforcement of facility management
- **Establishment of Disaster Prevention System**
 - Enforcement of control function to train operation
and Effective management of works for preventing disasters
 - Thorough coping with railroad disasters
- **Positive Propulsion of Prevention Project**
 - Enforcement of monitoring of disaster-worried sites and training
- **Rapid restoration upon railroad disasters**

✓ **General Countermeasure for Disaster Management (KNR)**

● **Preparation Stage**

- Maintenance and Examination of Equipments or Structures
- Systematic Training

● **Countermove Stage**

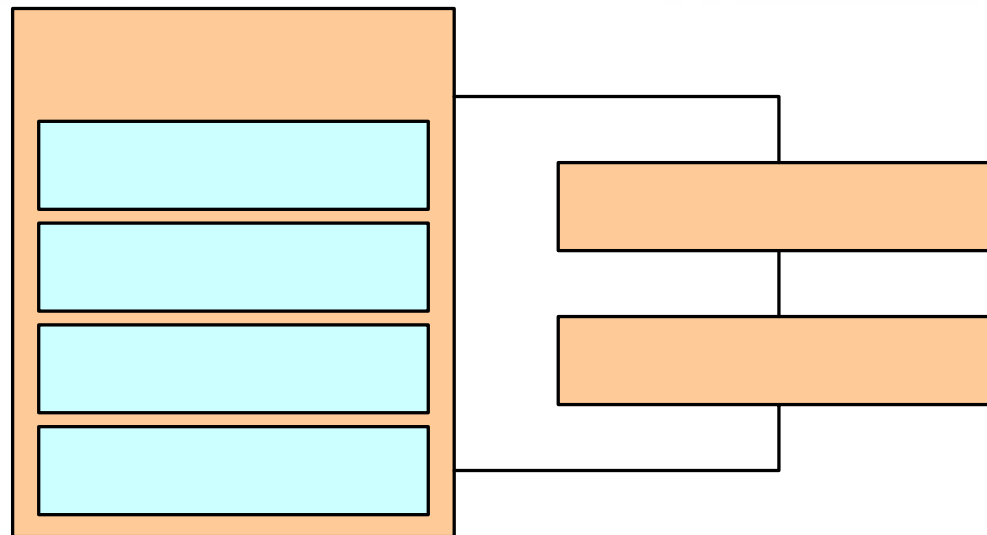
- Disaster Measure Headquarter
- Minimization of Railroad Disaster through Rapid Countermove

● **Restoration Stage**

- Execution of Permanent Restoration of Damaged Area
- Enforcement of Investigation and Feed-Back Function

✓ **Railroad Disaster Investigation Committee (RDIC) is working**

- **Optimal measures will be made**
 - **Systematic support and deployment of resources and manpower will be made**
- } **by RDIC**



Future Plan of KNR

Establishment of Railroad Disaster Prevention System(RDPS)

Establishment of Emergency Restoration Support System
for Disasters

Evaluation of Risk

Reinforcement

Monitoring

Establishment of
RDPS program

2003~2004

Development
of RDPS

Installation and Application
of RDPS

2005~

Technological Development and Application of Railroad Disaster Prevention System

Shin, Min-Ho Korea Railroad Research Institute (KRRI)

Technological Development of Railroad Disaster Prevention System

✓ The Present Status of the Researches in Railroad Disaster Prevention

- **The Study for the Database Construction of Falling Rocks/Landslide nearby Railroad** (1999-2000)
 - Numerical Topographical Map, Plane Figure of Railroad Station, Plane Figure of Station Building, Database of Falling Rocks/Landslide
- **The Stability Development Technology of Railway Facilities** (1999.9-2003.9)
 - Construction of Disaster Prevention System for Railway Earthwork Facilities
 - Suggestion of Standard for the Assessment of Slope Stability
 - Railway Slope & Falling Rocks Area Monitoring System

● **Development of Auto Rainfall Warning Equipment (2001-2002)**

- KRRI's Projects
- Suggestion of Rail-Transport Operation Control
- Development of Auto Rainfall Observation System based on Proto-type Web

● **Research of Observation System for Water Level of Flood (2003-2004)**

- Important Transportation Technology Project

● **Railroad Slope Stability Assessment and Alternatives** (2003.11-2004.12), KNR

- Investigation of Slope (90places), Close Investigation (40places)
- Evaluation of Unstable Slopes and Establishment of Reinforcement Methods

● **The Construction for Railway Rainfall Disaster Prevention System**

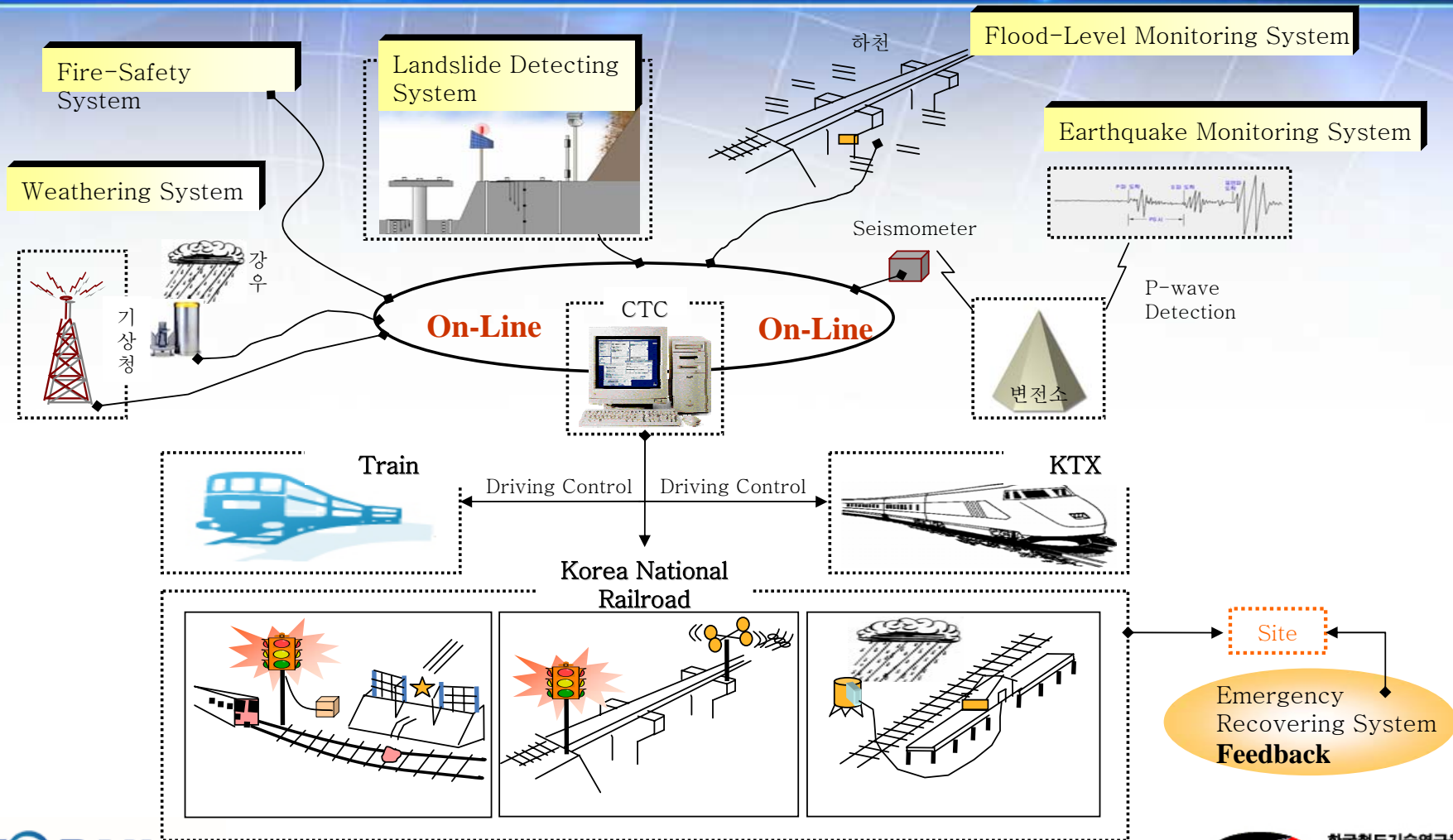
(2003.12-2004.12), KNR

- Construction of Auto Rainfall Warning System (209national places)
- Establishment of Roadmap for construction of Railway Rainfall Disaster Prevention System

Major Factors for preventing Railroad Disasters

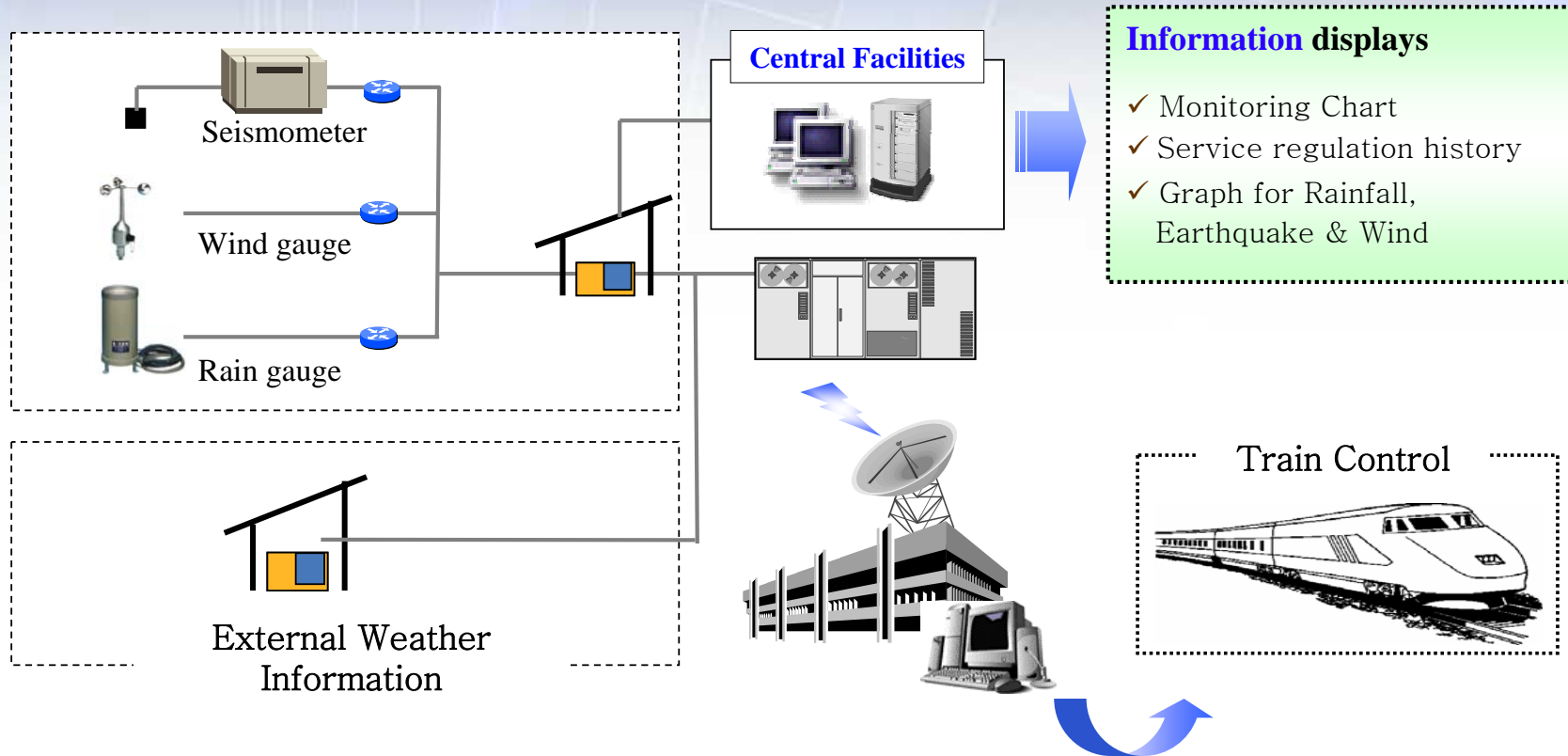
- **Risk Assessment** for Vulnerable Structure
- **Reinforcement** of Railway Structure
- **Rail-Transport Operation Control**
- **Information Network** for Disaster Prevention
- **Emergency Recovery System**

Outline of Railroad Disaster Prevention System



Disaster Prevention System for Korea Train eXpress

✓ Automatic Weather System of KTX



✓ Safety & Disaster Prevention System of KTX

Overheat Detecting System



Fence Detecting System



Train Access Warning Equipment



Tunnel Warning Equipment



Rail Temperature Monitoring System



Trail Detecting System



Disaster Prevention System for Railroad Roadbed

✓ Monitoring System using Wireless Data Communication

In Situ Test (38km Kyung-Chun Line)



✓ Data Input/Output System based on WEB

Construction Management (Illo-DaeBul)



철도연 인터넷 실시간 계측관리 시스템

자동안시스템 소개 회원가입

Home 과업개요 계측계획 계측결과/분석 자문의견 자료실 게시판

대성리 현장
 일로 현장
 과업개요
 계속목적
 자동화계측구성

일로 과업개요

서남권 신산업지대 철도노선도

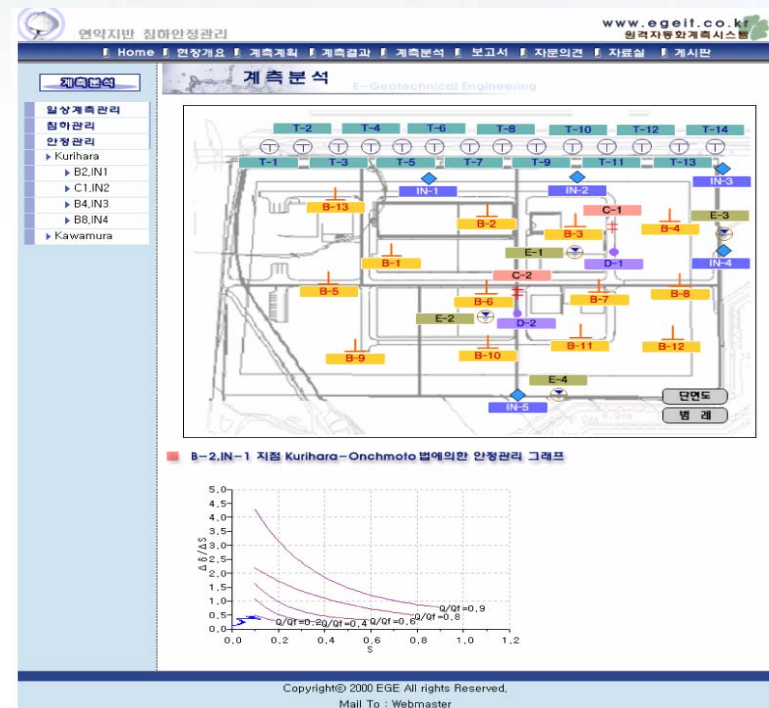
- 공사개요 : 호남선 일로역 ~ 대불 국가산업 단지(대불항 주변)내 단선철도 신설 (L=12.4km)
- 효과 : 동북아 경제권의 부상과 대중국 및 동남아 교역증대에 대비하여 추진중인 신산업지대(대불 국가산업단 산호지방산단)개발 등으로 증가하는 수송수요를 담당하여 낙후된 서남권 개발촉진
- 도급 현황 : 1단계 노반공사 (일로역~대불공단 L=12.4km)

도급자	도급금액 (총액)	공사기간	도로금액		미발 주
			기시행 (1차~8차)	2002년도 (제9차)	
도로사(공동도급) 현대건설(주) 55% (주)신성 13% 월성건설(주) 13% (주)한진중공업 12% 남양건설(주) 7%	150,084	(1997.9.5~2002.12.31)	126,674(84%) (1997.9.5~2001.12.15)	20,967(14%) (2002.1.22) ~ (2002.12.31)	(98%) (2%)

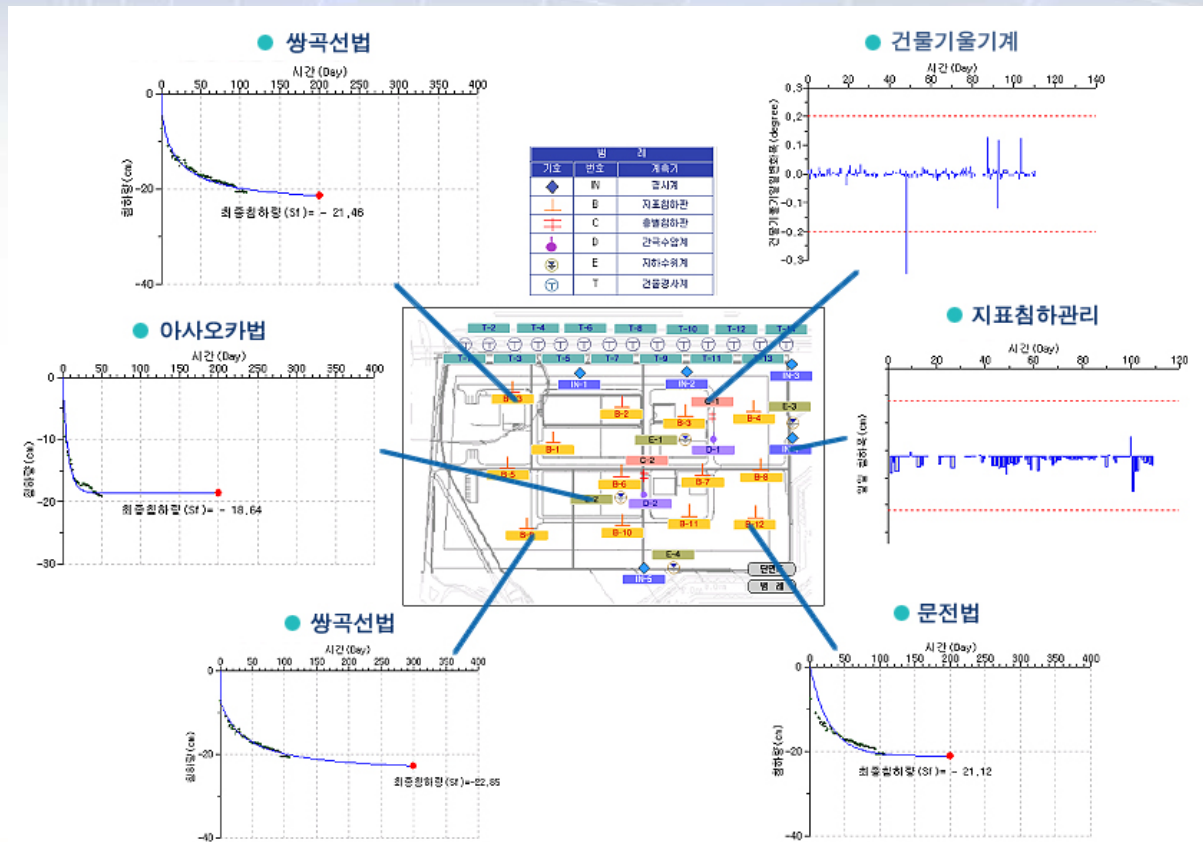
Disaster Prevention System for Railroad Structures

✓ Railroad Bridge Monitoring System

KwangYang Harbor Line

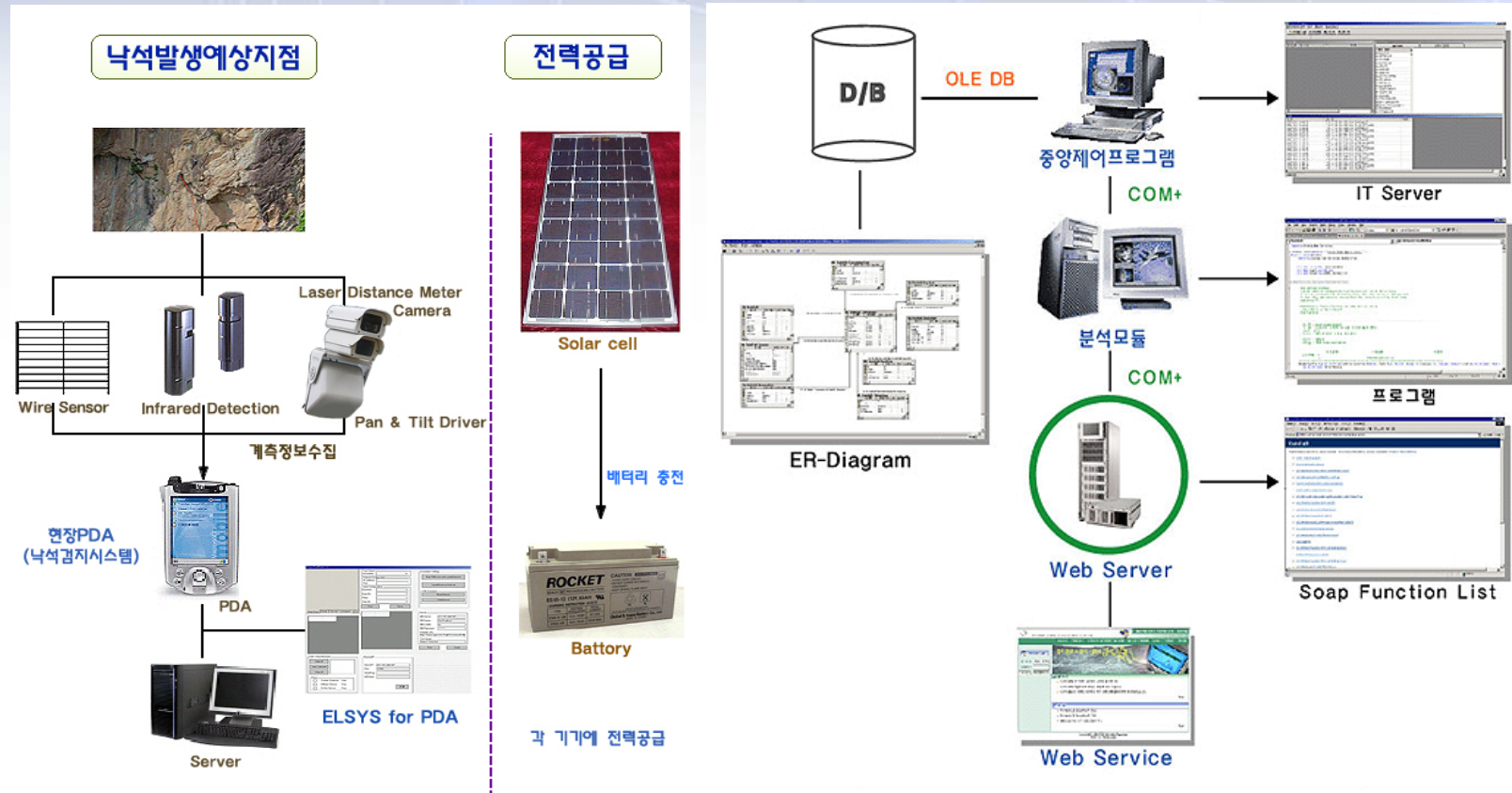


Stability Management of Vulnerable Structure on Internet



Rock-fall Monitoring System

✓ Constitution & Internet Program



✓ Field Test of Rockfall Detecting System

- In Situ Emergency Warning

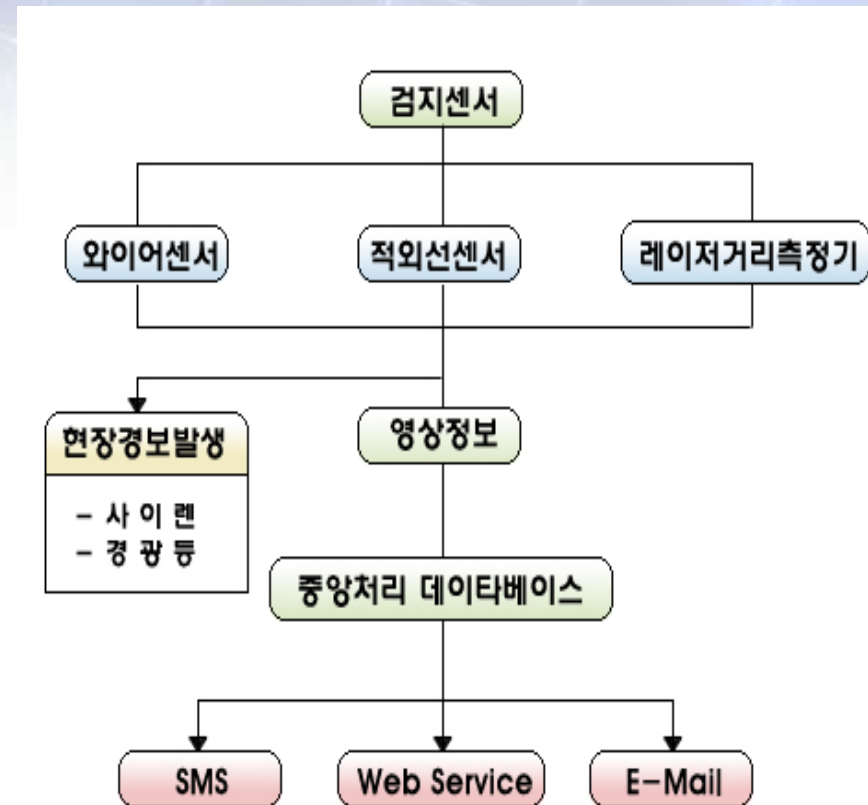
- Siren & Warning Lights

- Warning for Train & Manager

- Siren & Warning Lights
- Short Message Service (SMS)

- Warning for Site Manager & CTC

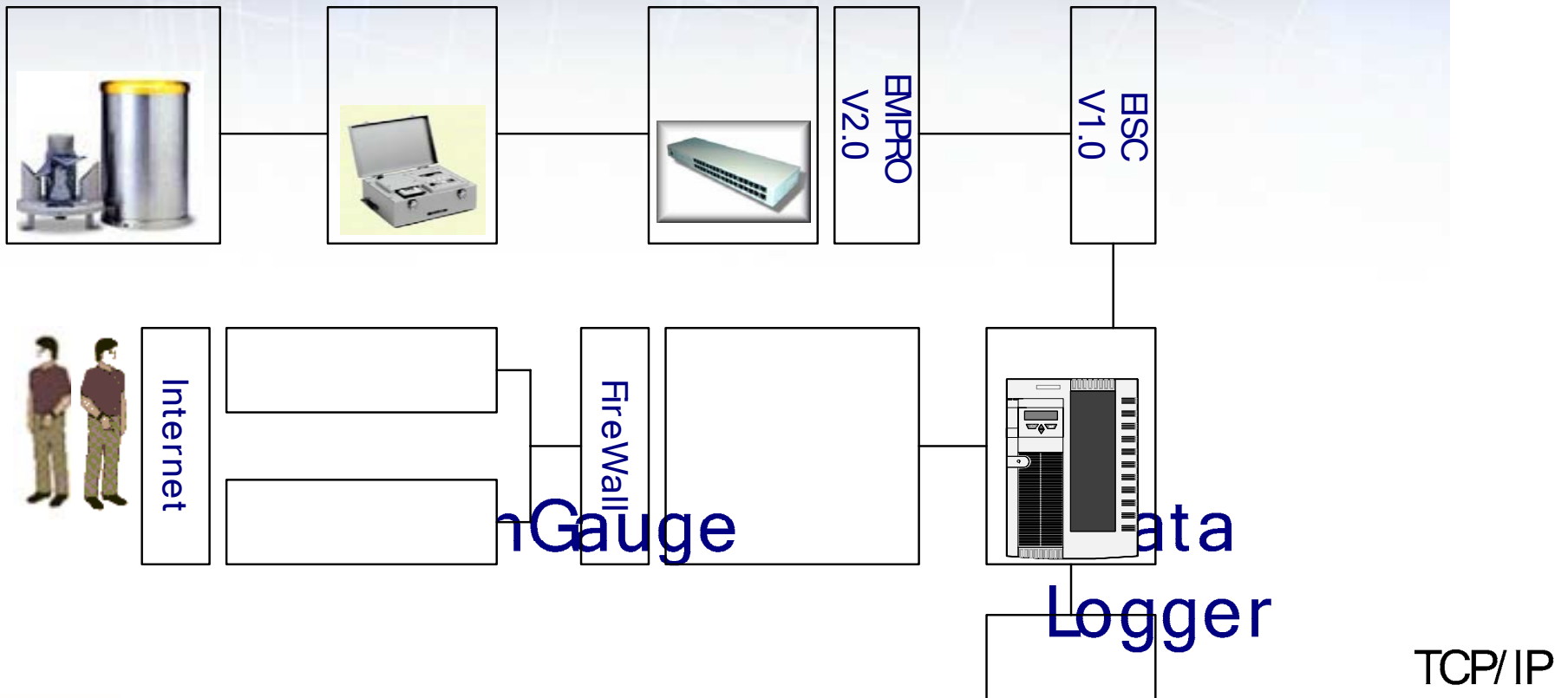
- E-Mail & WEB Service
- Short Message Service (SMS)



Rainfall Automatic Warning System

Continued

Auto Rainfall Data Collecting System on WEB
Establish Dangerous Degree of Rainfall



Automatic Rainfall Monitoring Program

http://www.egait.co.kr/rain.html - Microsoft Internet Explorer

2003년 2월 4일 화요일 경기지역 우량정보 측정현황

17:18:3
상세지도

경기지역	강원지역
충청지역	영남지역
호남지역	전체지도

우량정보
데이터열람
온도정보
일반온도 레일온도

경보설정
누적강우량
경보열람
경보시스템설정

정책설정 및 열람
운전규제열람
규제이력열람

레포트
우량정보 / 레일온도정보
시스템정보

기타 우량정보열람
기상청 W365

수동 데이터 입력
강우량정보
온도정보
레일온도정보

시스템설정
데이터베이스설정
로그설정
시스템경고
온라인설정
System Reset

경고

- 경고대상: 도라산역
- 경고내용: 누적 강우량 초과
- 현재누적강우량: 170mm
- 경고누적강우량: 150mm
- 조치내용

E-mail 보내기 설정

SMS 보내기 설정

경고방송하기 설정

그래프 확인 취소

출길동

강창원

지명환

확인 취소

도라산역 강우량 그래프

시간강우량(mm/hr)

누적강우량(mm)

출차정지
출차서행
경계발령
출차정상운행

철도강우자동경보시스템V1.0
Map Control

Flood-level Monitoring System for Railroad Bridges

Composition of System

Immersion Level Transmitter

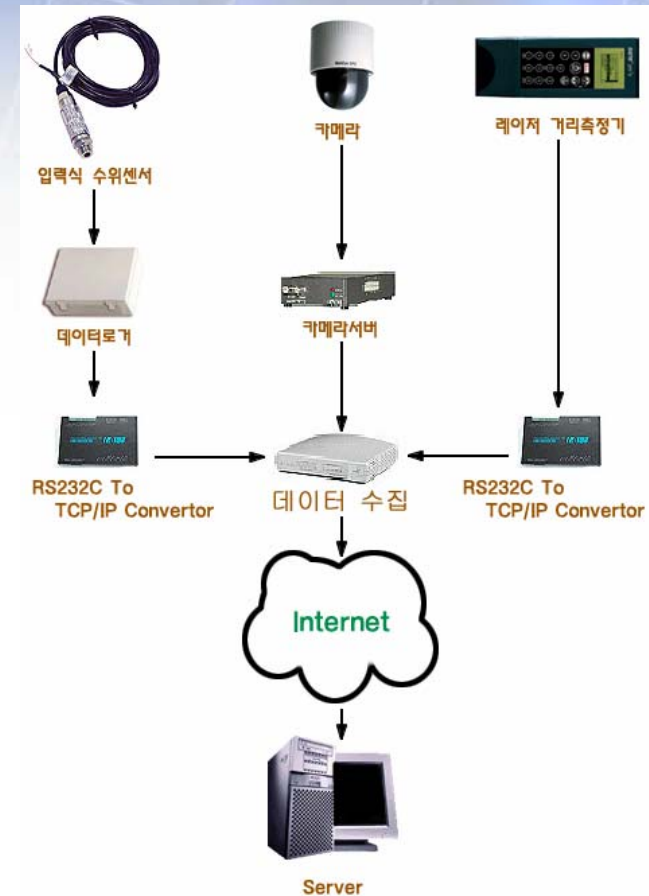
- ☞ Easy to install and use widely

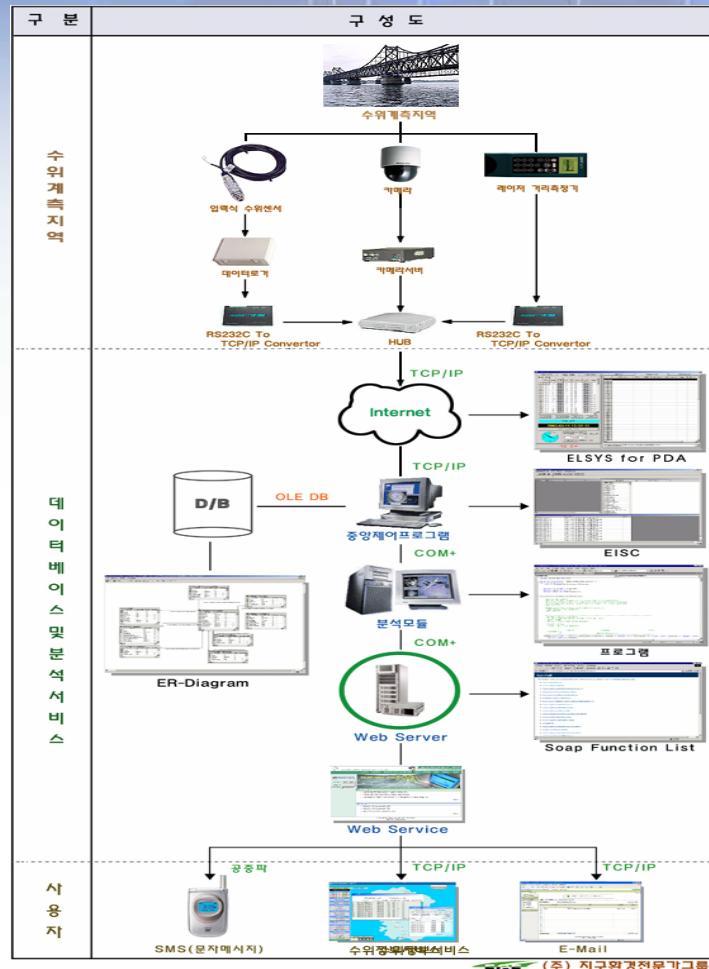
Laser Distance Measuring Instrument (LDMI)

- ☞ Measure water-level using LDMI
- ☞ Possibility of precise measurement

CCTV System

- ☞ Measure water-level through image analysis





Data Acquisition & Analysis System

- ☞ Central Control Program
 - Collection and Analysis of Data
 - Possible to process High Capacity Data

Internet Service of Water-Level Information

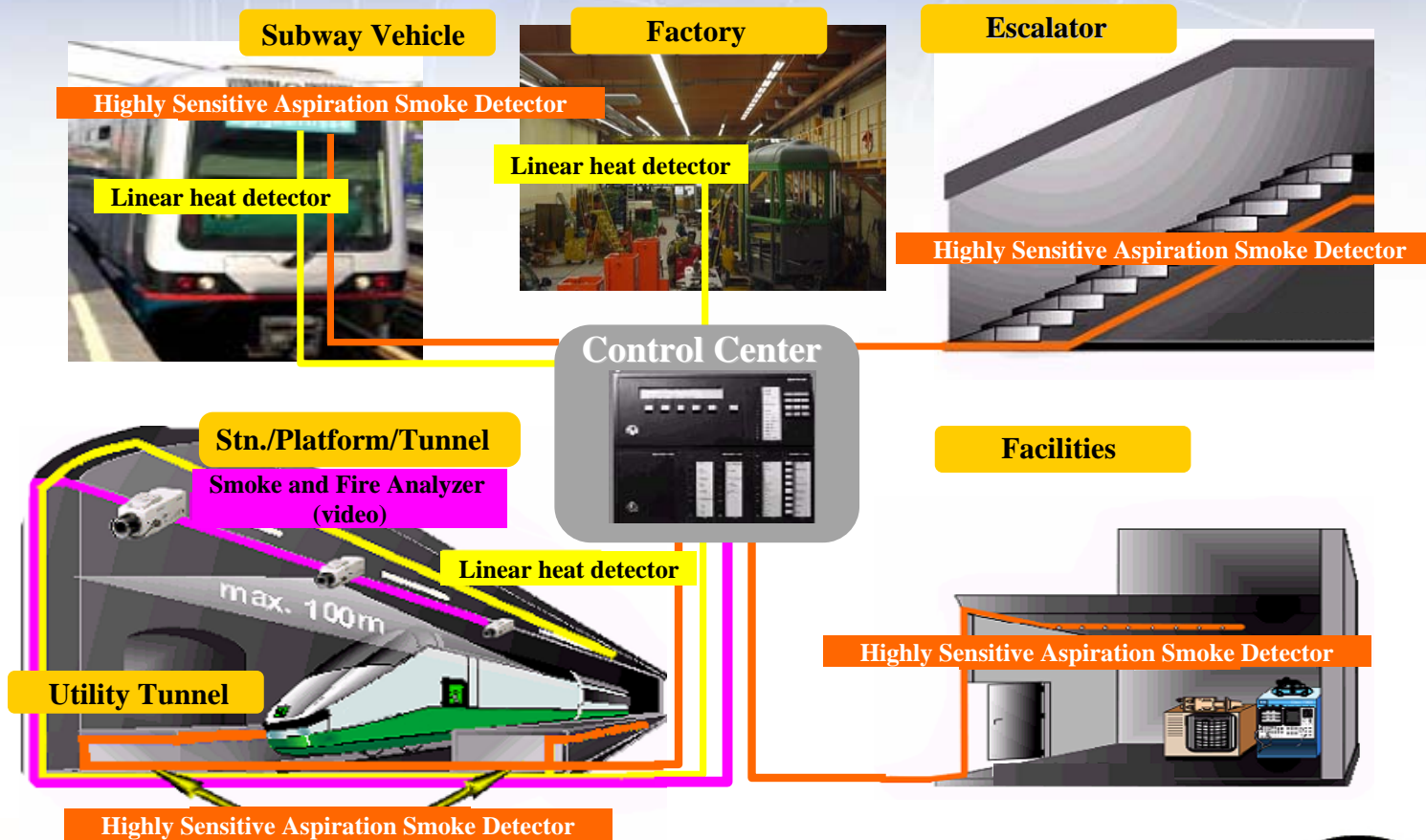
- ☞ Easy to access to information through web page
- ☞ Supply the convenient visual interface

Real-time Warning Service

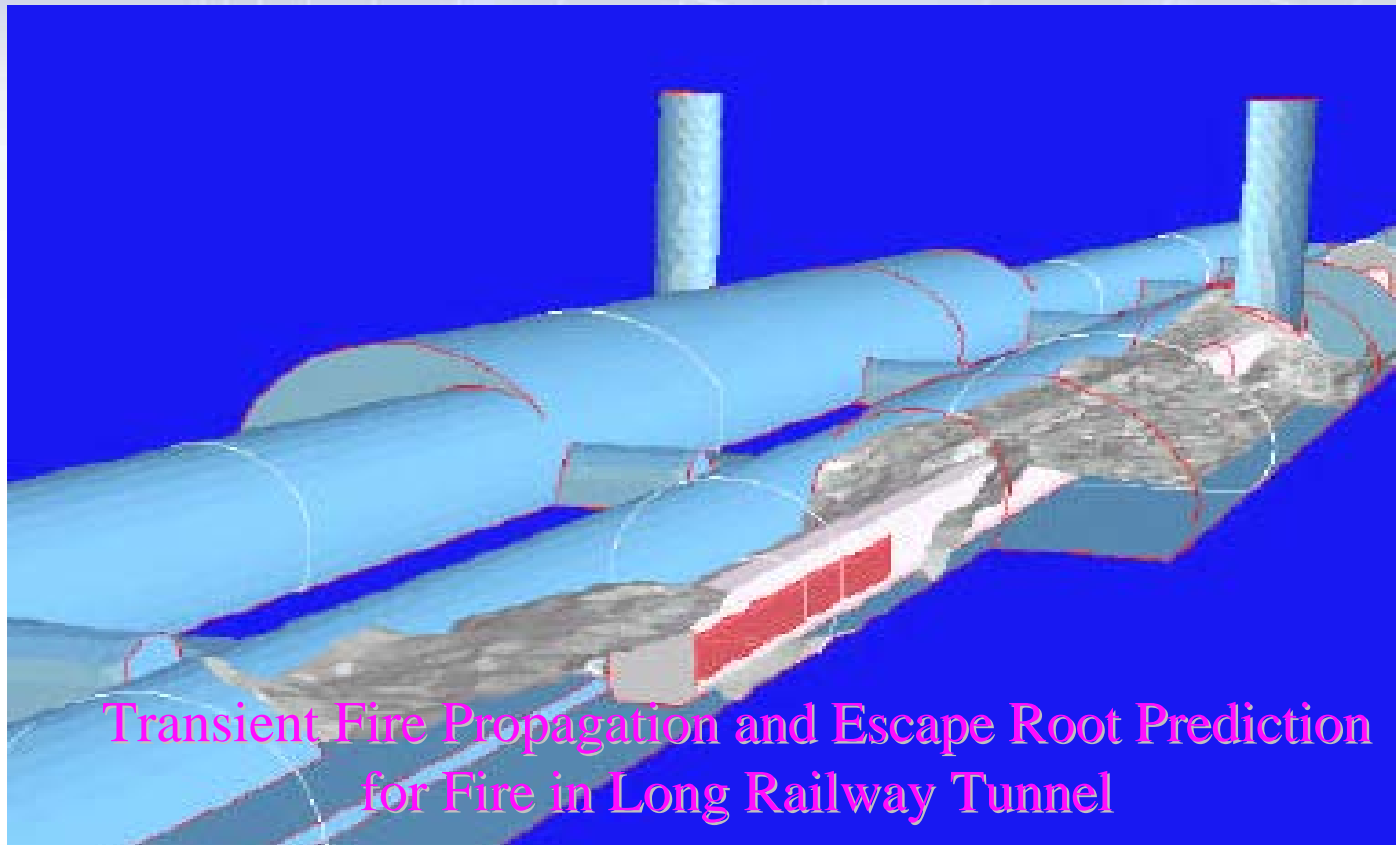
- ☞ Short Message Service of mobile phone
- ☞ Warning Service of E-mail

Railroad Fire Monitoring System

✓ Fire detection system for subway stations and tunnels

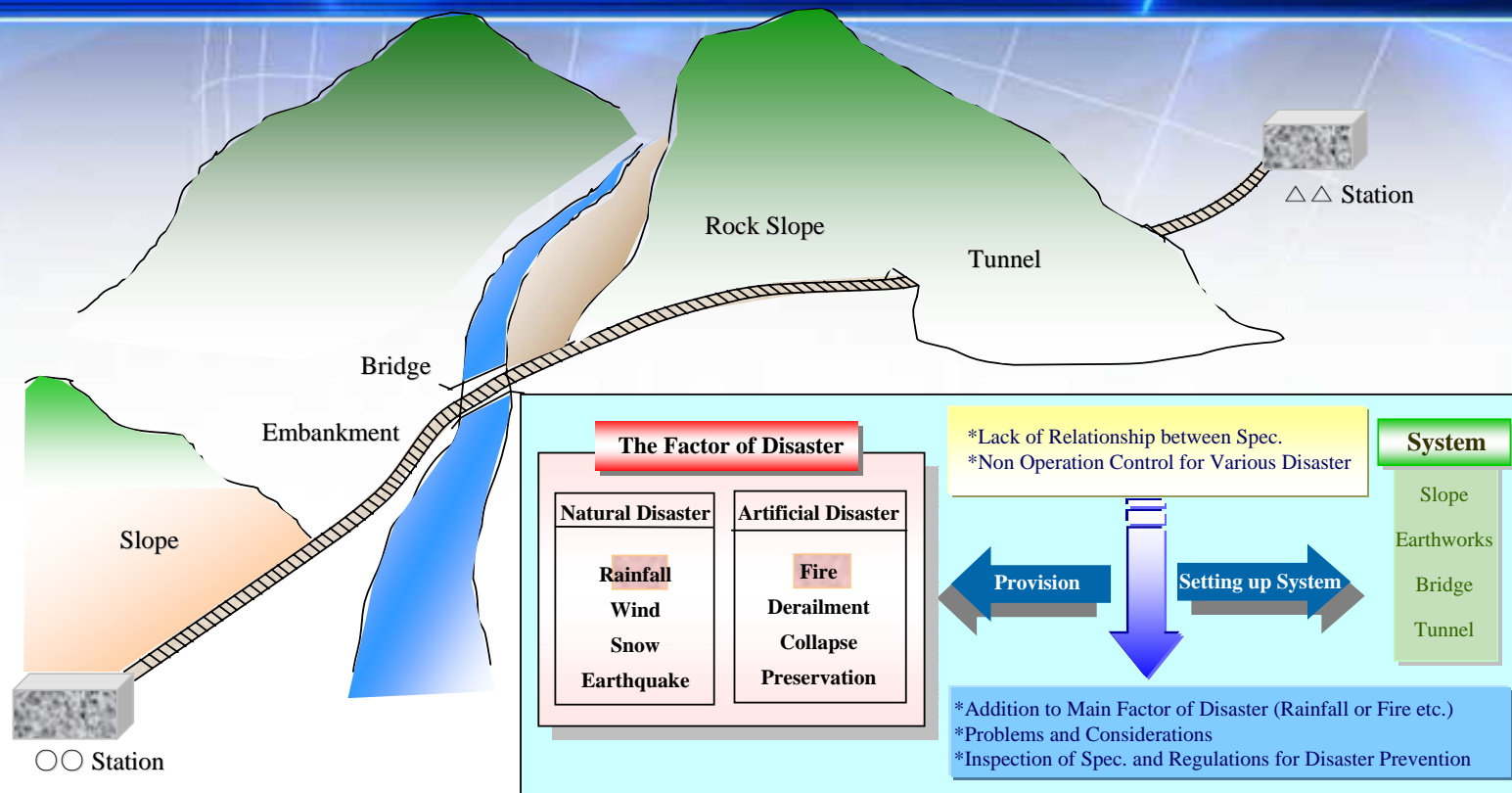


✓ Development of Fire Propagation Prediction & Monitoring System



Transient Fire Propagation and Escape Route Prediction for Fire in Long Railway Tunnel

Application of Railroad Disaster Prevention System



Railroad Disaster Prevention System (○○ Station-△△ Station)

Conclusion and Suggestion

- The Fundamental Effort for **Disaster Prevention must be Made by the KNR**
- Effort to minimize the Disaster through the Construction of the **Integrated Disaster Prevention**
- **KRRI have Studied & tried the Development of Disaster Prevention** before Railway Disaster became an issue
- Development of many Kinds of System with **IT has been a Good Help to Railway Disaster Prevention**

- The Planning & Securing of an ample budget is Required for the Construction of Long/Short Term Integrated Disaster Prevention System
- Improvement of all Sorts of Regulation and Existing System is Required for the Construction of Integrated Disaster Prevention System



Thank You for Your Attention

선도하는 연구원. 봉사하는 연구원. 변화하는 연구원

Korea Railroad Research Institute