November 16, 2017
Seminar on “Boot up Digital Transport 2021”
Ministry of Transport, Kingdom of Thailand
Digital Transport System

Why do we need Digital Transport System?

- Ensure Safety
- Improve Environmental Quality
- Improve Customer Service
- Mitigate Labor Shortage
- Reduce O&M Cost

How we can boot up Digital Transport?

- Big Data
- Network Technologies
- Artificial Intelligence
Expressway Companies in Japan -toll road networks-

- National Expressway
  - Nippon Expressway Co., Ltd. (NEXCO) (West, Central, East)

- Urban Expressway
  - Metropolitan Expressway Co., Ltd.
    - Hanshin Expressway Co., Ltd.

- Other Expressway
  - Honshu-Shikoku Bridge Expressway Co., Ltd.

※Jointly established by 5 companies for overseas investment project
Tokyo Metropolitan Expressway

- Total Length in Service: 318.9Km
- Traffic Volume: 0.97 million veh/day (ave)
- Toll Revenue: 269.4 billion JPY ($2,449 million USD)
Our Mission
“Provide Safe, Reliable and Comfortable driving to customer”

- Safety
- Reliability
- Comfort
- Maintenance
- Construction/Renewal
- Operation
Digital Transport Systems for Operation and Maintenance in Shutoko

Operation

• Intelligent Transport Systems (ITS)
• Electric Toll Collection (ETC)

Maintenance

• Maintenance Information Management Systems (InfraDoctor and i-Dreams)
Intelligent Transport System (ITS)

- System to integrate people, roads and vehicles
- Solve road traffic issues
  - Congestion
  - Accidents
  - Environmental impacts

Source: ITS Technology Enhancement Association (ITS-TEA) https://www.its-tea.or.jp/english/
ITS Progress in Japan

Source: ITS Technology Enhancement Association (ITS-TEA) https://www.its-tea.or.jp/english/
Traffic Management of Shutoko - A Million Daily Traffic -

Incidents

<table>
<thead>
<tr>
<th>Incidents</th>
<th>Year</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallen Objects</td>
<td>25,522</td>
<td>70</td>
</tr>
<tr>
<td>Accident</td>
<td>10,342</td>
<td>28</td>
</tr>
<tr>
<td>Vehicle Breakdown</td>
<td>11,209</td>
<td>31</td>
</tr>
</tbody>
</table>

As of April 2015

Every 11 min. 1 incident!

Facilities control system

Lane regulation

Patrol

Traffic control system

Rescue

Crackdown (Overloaded Truck)
ITS Solution for Traffic Management

Provide drivers with real-time traffic information (update *every minute*)

**Data Collection**
- Vehicle Detector
- Anemometer
- CCTV Camera
- Emergency Phone
- Patrol Car
- #9910

**Data Processing**

System (Main functions)
1. Preparation of Traffic Data
2. Judgment of Congestion
3. Calculation of Travel Time
4. Production of Data to be Provided

**Data Provision**
- Graphic Information Board
- Variable Message Sign
- Travel Time Information
- Graphic Information Board on street
- Congestion Information
- Wind Speed Information
- MEX Navi

Related Organizations
- Japan Road Traffic Information Center
- Related Organizations

Traffic Control Center
Traffic Information for Drivers

Japan Road Traffic Information Center

Personal Media

Car Navigation

Smart Phone
Advanced Operation Systems

**Incident Detection System**
- Traffic incidents are automatically detected by processing images from CCTV camera.
- Employed for long-distance tunnel.

**Automatic Axle-load Detection System**
- Overloaded vehicles are automatically detected
- Installed at the toll gates
Electric Toll Collection

- Accurate, Fast and Secure Transaction
- Various Tolling
  - time, zone, Traffic Demand Management
- Reduce Workforce/Workload in Tolling
- Reduce Congestion and Accident in Toll Plaza
- Reduce Carbon Dioxide and Noise
Tolling in Shutoko

Toll Rate: 5 class, distance based

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>ETC (JPY)</th>
<th>Cash (JPY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact</td>
<td>270~1,070</td>
<td>1,070</td>
</tr>
<tr>
<td>Standard</td>
<td>300~1,300</td>
<td>1,300</td>
</tr>
<tr>
<td>Middle</td>
<td>310~1,380</td>
<td>1,380</td>
</tr>
<tr>
<td>Large</td>
<td>390~2,040</td>
<td>2,040</td>
</tr>
<tr>
<td>Extra-large</td>
<td>460~2,600</td>
<td>2,600</td>
</tr>
</tbody>
</table>

- Toll rate increases JPY10 per 0.1 km
- Payment with credit card exclusively used for Electronic Toll Collection System

High ETC Usage Ratio

<table>
<thead>
<tr>
<th>Year</th>
<th>ETC Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1%</td>
</tr>
<tr>
<td>2008</td>
<td>80%</td>
</tr>
</tbody>
</table>

ETC Cleared Toll Gate Congestion

95.1% (Sep. 2017)
Electronic Toll Collection (ETC)

Error Ratio 0.03%

- Wireless Device (Antenna)
- ETC Lane Display
- Vehicle Detector
- Departure Point Control Unit
- Surveillance Camera
- Roadside Display Unit
- Entrance
- Exit (Free Flow Type)
Nationwide ETC System

Credit Card Company

Common System
Operated by agreement of each company

NEXCOs
Honsyu Shikoku Bridge Expressway
Hanshin Expressway
Other Road Operator Employing ETC

Metropolitan Expressway

Customers
Mission of ITS-TEA

- Promotion
- Tech/Security Standards
- R&D incl. Expansion
- Tech Exchange w/other Orgs.
ETC 2.0

- Driving Support Services Using ETC System
- Communication between Roadside Antennas and Vehicles
- High-Throughput Bidirectional Communication System

- Information includes:
  - Safe Driving
  - Hazard ahead
  - Congestion Bypassing
  - Real time traffic condition
  - Disaster Management
  - Earthquake
Maintenance System

Objective:
- Ensure Safety for Customer and Society
- Appropriate Asset Management
- Reduce Maintenance Cost regarding Life Cycle Cost

Means:
- Strategic Maintenance Approach
- Maintenance Cycle
- Information Management System
Various Asset to be Maintained in Shutoko

◆Approx. 95% Structures out of 318.9 km

<table>
<thead>
<tr>
<th>Type of structures</th>
<th>Length (km)</th>
<th>Percentage of length (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Girder</td>
<td>202.6</td>
<td>63.5%</td>
</tr>
<tr>
<td>Concrete Girder</td>
<td>38.6</td>
<td>12.1%</td>
</tr>
<tr>
<td>Tunnel</td>
<td>43.2</td>
<td>13.5%</td>
</tr>
<tr>
<td>Semi-Underground</td>
<td>18.9</td>
<td>5.9%</td>
</tr>
<tr>
<td>Surface Earthwork</td>
<td>15.9</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>318.9</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

◆Approx. 920 items/km Facilities

i.e. light, signage, traffic detector

Total 350 types, 290,000 items (Approx.)
Heavily Used Road Network

- The average traffic volume **970,000 vehicle per day**
- High Large-sized vehicle volume **5 times of local roads in Tokyo**

![Traffic Volume Graph]

Number of violation vehicle with more than 12tf axle weight: 150,000 times
⇒ **Approx. 410 time/day**

Source: Road Traffic Census, 2010
All data: Spot traffic volume of large sized vehicle on weekdays;
Total of traveller km of 24h (weekday) of vehicles mentioned / Total length of routes
Aging Structures Over 50 years

- 11% (35km) in service 50+ yrs
- 35% (111km) in service 40+ yrs

In 2027 1/3 structures are 50+ yrs

As of March 2017
Maintenance System with Integrated Database

- Asset Database
- Inspection Database
- Repair Database

- Data Recording / Database System
- Construction Management / Quality Control
- Design and Construction of Repair Work
- Maintenance Planning
- Inspection / Evaluation

© Metropolitan Expressway Company Limited 2017
Team up for Maintenance with Integrated Data Base

All engineers can share information in data base by individual PC through internal LAN

Shutoko Operation Bureau
- Maintenance Management Div.
- Planning and Environment Div.
- Civil Engineering Maintenance Design Div.
- Maintenance Work Office

Shutoko Group
- Shutoko Engineering (Inspection)
- Shutoko Maintenance (Maintenance of Work)
- Highway Technology Research Center (Database)
Maintenance System with Virtual Road Model

InfraDoctor

New Maintenance System launched in 2017

3D point cloud data, GIS platform and Cloud Server

1. 3D-point cloud measurement of structures using MMS (Mobile Mapping System)
2. Cloud data server
3. Data processing, management and browsing on individual PC

Metropolitan Expressway Company Limited
Shutoko Engineering
ELYSIUM
AERO ASAHI CORPORATION

©Metropolitan Expressway Company Limited 2017
InfraDoctor

3D Point Cloud Data
by Mobile Mapping System
- Laser Scanners
- 360 deg. Camera
- High Density Camera

Cloud Server
3D Point Cloud Data + GIS Map
- Asset Database
- Inspection Database
- Repair Data
- As-built drawing
Deployment of InfraDoctor in Thai

Measurement work in EXAT

GIS Database with 3D Point Cloud Data (Rama 9 Bridge)

Measurement of signboard dimension

Example of 3D Point Cloud Data (EXAT)

Road surface monitoring (level)
i-DREAMs
Intelligence-Dynamic Revolution for Asset Management Systems

i-DREAMs provide seamless dataflow among design, construction and maintenance.

Structural Deterioration Analysis

InfraDoctor

Smart Inspection Systems

Damage Analysis by Artificial Intelligence

Information Management for On-going and Future Projects
“Boot up Digital Transport” Current effort in Japan

i-Construction

- Integration of construction and ICT (Information and Communication Technologies)
- Seamless dataflow from design to maintenance
- Dramatically enhance overall productivity of construction

Autonomous Vehicle

- 3D point cloud data from InfraDocotr will be able to use for 3D digital map for the vehicle
What we have learned form Digital Transformation

- Digital Transformation is key element for operation and maintenance of the expressway.

- Expressway companies need to commit technical development of digitalization, because the road operators own needs.

- On the other hand, human factor is very important especially in decision making process (i.e. defining system specification, evaluate output from systems...)
Shutoko in Thailand

- Shutoko Bangkok office (since June 2011)
- MOU with 5 road related-organizations
- Tech. exchange program (training/seminars) in Japan and Thailand (5 in Thailand)
- 9 Engineering consulting projects (ETC and ITS)
- 4 JICA/MLIT consulting projects

List of MOU (Thailand)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressway Authority of Thailand (EXAT)</td>
<td>2010.4.7</td>
</tr>
<tr>
<td>Bangkok Expressway and Metro Public Co., Ltd. (BEM)</td>
<td>2012.7.18</td>
</tr>
<tr>
<td>Don Muang Tollway Public Co., Ltd. (DMT)</td>
<td>2012.8.30</td>
</tr>
<tr>
<td>Sirindhorn International Institute of Technology, Thammasat University (SIIT)</td>
<td>2015.7.21</td>
</tr>
<tr>
<td>Department of Highways, Ministry of Transport (DOH)</td>
<td>2016.9.13</td>
</tr>
</tbody>
</table>

※MOU: Memorandum of Understanding

MOU Signing Ceremony with DOH (Sep. 2017)

JICA Project (Technology Transfer) (DRR Bridge Inspection Manual)
Shutoko Bankgok Office

**Director:** Mr. Seiji KUROKAWA

Address: Suite 1806, Level 18, Park Ventures Ecoplex, 57 Wireless Road, Lumpini, Patumwan, Bangkok, Thailand 10330

TEL: +66(0)2-309-3670, FAX: +66(0)2-309-3535, E-mail: bangkok@shutoko.jp
Thank you for your attention