Application of GIS and GPS to Railway Operations – *Case in Japan and Further Possibilities* -

Institute of Transportation Economics
Fumio KUROSAKI, Ph.D.
Outline of the Presentation

1) Development of the Digitised Railway Facility Management System

2) Application of the GPS to Railways

3) Utilization for Railways with Vertical Separation
1) Development of the Digitised Railway Facility Management System

2) Application of the GPS to Railways

3) Utilization for Railways with Vertical Separation
Outline of the JNR Restructuring

**JR-Freight and 6 Passenger JR Companies**

JR-Freight does not own its infrastructure and accesses to the 6 passenger railways’ tracks.
Problems in Traditional Facility Management

Difficulties in:

1) identifying and obtaining the latest information;
2) sharing information among different sections;
3) managing the maintenance and upgrading of data;
4) developing coordination with train operations.
Characteristics of the System

Problem
Difficulties to allocate the coordinate representations to the alignment and the various assets.

The New Asset Management System
All facilities are linked to the kilometrage of the rail lines.
Function of the System

- Record of Works
- Photos
- Record of Maintenance Works
- Assessment of the Asset Conditions
- Planning of Maintenance Works
- Digitized Railway Facility Management System
- Maintenance & Inspections at Site
- Site Inspections with PDA
- Reference of the Data
- Recording the Data
- Ordinary Works
- Drawings
- Maps
- Maintenance Records
- Inspection Records
- Sharing the drawing, maps, other Information
Effects and Utilization of the System

1) As the updated data are recorded to the database, the latest information can be easily identified.

2) As the data are electronically recorded to the database, it can be retrieved in a timely manner.

3) The digitised asset information provided a smooth and seamless data flow for construction and maintenance works.

4) It has become much easier to share updated information among different departments.
Further Development of the System

Usage of the system has been developed in various ways.

The system can be combined with other related data.

Utilization for Disaster Prevention.
(Integration with topography images)

Utilization for Urban Planning
(Integration with 3-D images)
1) Development of the Digitised Railway Facility Management System

2) Application of the GPS to Railways

3) Utilization for Railways with Vertical Separation
“PRANETS” introduced by JR Freight in 2008

PRANETS: Positioning system for RAil NEtwork and Safety operating.

Two Functions

1) A train driving support system
2) A container information system
Application of the GPS to Railways

PRANETS: A Train Driving Support System

Data about Timetable, Slowing Down, Limit of the Speed, etc.

Safe Driving Supported by the System

Messages by sound and display

Display with a Message

Display within a Station

(Reference)
“The Digitised Railway Facility Management System and the Application of GIS and GPS to Railway Operation” EASTS Journal vol.11
Application of the GPS to Railways

PRANETS: A Container Information System

GPS Satellite

Detection of the Train Location

GPS on the Train

<Information>
Location of Containers, etc.

Clients & JR Freight

<Information>
Train Location
Delay of trains, etc.

JR Freight
Operation Manager
(HQs, Branch Office, Operation Center, etc.)

JR Freight System Center

Information Server

PRANETS Server

<Reference>
“The Digitised Railway Facility Management System and the Application of GIS and GPS to Railway Operation” EASTS Journal vol.11
“Portable Tablets” utilized by JR East (1)

JR East introduced “Portable Tablet System” in 2013. At present, all drivers and conductors take a portable tablet with them.

The necessary information can be transferred to the tablets particularly in unusual operational conditions.

They do not need to carry bulky manuals as the tablet also includes the data of the related manuals.
Application of the GPS to Railways

“Portable Tablets” utilized by JR East (2)

Conductors and station staff can provide appropriate information to the passengers.

(Copy Right: JR East)
1) Development of the Digitised Railway Facility Management System

2) Application of the GPS to Railways

3) Utilization for Railways with Vertical Separation
Utilization for Railways with Vertical Separation

Vertical Separation of Railways

Vertical Integration

Railway Operation

Infrastructure

Vertical Separation

Railway Operator A

Access

Infrastructure
Sharing the data among different entities.
Merit of Utilization of GIS (2)

Management of Complex Infrastructure Assets.

Railway Operator A

Complex Assets

Digitised Asset Data
Train Driving by Vertical Separation/Integration

1) Operation of vertically separated railways (Ex. JR Freight)

(Track of Railway A) (Track of Railway B) (Track of Railway C)

Drivers travel a long distance on other entities’ track

2) Operation of vertically integrated railways

Drivers travel on its track only and they are familiar with the track.
Merit of Utilization of GPS

Reliable Train Operation with GPS Application.

Train Detection without GPS

Train Detection with GPS
Summary

1) Digitising the railway asset information has various advantages.

2) GPS can be applied to railway operation effectively.
   > Application of GIS and GPS is especially effective for vertically separated railways.
Thank you for your attention.

Application of GIS and GPS to Railway Operations

– Case in Japan and Further Possibilities –

Institute of Transportation Economics
Fumio KUROSAKI, Ph.D.