Directions for Linking Big Data with Transportation Policies

Introduction to TOPIS, a city management hub

Seoul Metropolitan Government
ITS Global Leader, the Seoul TOPIS
Introduction to Seoul TOPIS: Definition

Seoul TOPIS (Seoul Transport Operation and Information Service)

Seoul TOPIS is the Intelligent Transportation System (ITS) brand of Seoul Metropolitan Government. As the first-of-its-kind service in Korea, it was introduced in 1998 to address urban transportation problems.

TOPIS 3.0, a city management hub

TOPIS 3.0 is a smart metropolitan city management hub that manages transportation, disasters, and other security-related events in an integrated manner. It is an advanced transportation information system that allows prompt judgments and responses to be made in times of emergency and predicts and prevents transportation problems through big data analysis.
Introduction to TOPIS: History of Seoul TOPIS(1)

1998
- Implemented the ITS in Nam-San area (10.6km)

2000
- Adopted and advanced traffic management systems in urban expressways

2004
- Opened TOPIS and installed the Smart Card System
- Introduced the Unmanned Regulation System

“The starting point” of ITS in Seoul
- 1998: Implemented the ITS in Nam-San area (10.6km)
- 2000: Adopted and advanced traffic management systems in urban expressways
Introduction to TOPIS: History of Seoul TOPIS(2)

**TOPIS 2.0**
- 2008: Installed Bus Information Terminals (BIT) on a pilot scale and expanded it
- 2009: Opened the mobile transportation information service
- 2010: Opened the transportation data in the private sector
- 2011: Introduced standard designs for ITS facilities (VMS, VDS)

**TOPIS 3.0**
- 2013: Opened the integrated control center to cover transportation, disasters and emergency response
- 2014: Released the TOPIS Platform (Seoul’s ITS Solution)
Introduction to TOPIS: Seoul TOPIS Today (1)

1,436 km
Extended length of roads for travel speed data collection

App. 70,000 vehicles
No. of taxis where GPS data can be collected

VDS
Volume Speed Incident – for contingencies e.g. traffic volume/speed/accident

1,969 detectors

477 CCTVs
24-hour traffic surveillance & monitoring

339 Variable Message Signs (VMS)

4,070 controllers
Real-time traffic signal controller

92 systems
Ramp Metering System (RMS)

31 systems
Lane Control System (LCS)
68% with BIT installed in bus stops out of total

4,506 Bus Information Terminal

85 mil. cases/day The number of open data (traffic & bus information)

24 mil. cases/day

9,453 devices BMS & Transportation card devices

94% Accuracy on bus information

96% User Satisfaction

3,000 Persons/year No. of foreign visitors experiencing Seoul TOPIS

367 km The length of the autonomous transportation network of Seoul
308 Unmanned Regulation System
(Surveillance for illegal parking, exclusive bus & bicycle lane violation)

240,000 cases/year
The number of penalties being charged

150 persons
Involved in maintenance personnel

4 teams
Organization of TOPIS

157 km
Length of roads based on traffic condition forecasts

Media platforms
Web, Mobile
Broadcasting (Radio, IPTV)
VMS & BIT
SNS, LED Sign
Main System of Seoul TOPIS: Integrated Control Center System

24-hour Integrated Monitoring and Surveillance
(Road traffic, Transit, Disaster & Emergency management)

- Data Integration & analysis
- Monitoring
- Control & Operating
- Analysis

- VDS/CCTV/AVI
- Bus OBE/Taxi GPS
- Incident & Disaster Information
- Traffic Signal
- Transportation Card Data

Manager/Operator
Control all devices & Provision of overall information

Citizen Reports

VMS/Traffic Signal/Web/Mobile/SNS/LCS/Broadcasting

Real-time Response and Analysis

Control Tower

Korea Meteorological Administration
National Police Agency
Seoul TOPIS

Collecting Data
1) Real time bus location (GPS coordinates, etc.) & bus speed
2) Arrival and departure time for bus stops
3) Data on driving (non-stop, sudden stop, sudden acceleration and starting with doors being opened, etc.)
4) Number of passengers riding on and taking off for each bus stop (including the number of those for a re-ride)
5) Various contingencies e.g. detours and accidents

Information Process & Management
1) Information on bus intervals/the last bus
2) Bus arrival time
3) Analysis of bus operation conditions
4) Analysis of bus passengers
5) Analysis of total traveling distance and time (used for time & distance revenues for buses, etc.)
Main System of Seoul TOPIS: BMS & BIS(2)

1) Integrated service for arrival time of all buses and subways
2) Information service the last bus and subway
3) All bus and subway routes and transfer information service
4) Bus detour & congestion information
5) Information on contingencies e.g. bus accident

Integrated “bus + subway” public transport information

评价的公共运输

1) Results of bus operation (non-stop, reckless driving, etc.)
2) Basic data for driving for making payment for bus operation and overall evaluation of bus companies (total travel distance, interval of bus operation, etc.)

提供给公交驾驶的信息

1) Real-time interval (time interval with a bus in front and at the back)
2) Real-time detour route information (for road controls during rallies, etc.)
3) Information on contingencies, etc.

提供给公交公司的信息

1) Basic operation information e.g. bus location and speed for each company
2) Data related with bus operation management

信息提供媒体

BIT
Web, Mobile
Web Portal(OpenAPI)
Telecommunication company

首尔TOPIS
Main System of Seoul TOPIS: Unmanned Regulation System

Fixed unmanned regulation system (308)
1) Automatic enforcement for illegally parked cars within 200m
2) Controlling vehicles violating bus and car-only roads

Automatic enforcement system (7 routes, 28 buses)
1) Automatic detection and enforcement violation at all routes using camera systems mounted on the bus
2) All bus route enforcement (from the origin to the final destination)
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Main System of Seoul TOPIS: Automatic Penalty Charging System

1) Searching for vehicle owners found in violation and their address

2) Issuing a fine bill and electronically sending it

3) Automatically sending the fine bill to the owners

Takes 2-3 days to deliver the fine bill to vehicle owners (without the automatic system: 10~15 days)
Collecting Traffic Data
1) Travel speed using detectors(Urban express way) or taxi GPS data(City road)
2) Weather conditions from Korea Meteorological Administration
3) Traffic volume / Traffic situation from CCTC
4) Incident / data of real time traffic signal operation

Information Process & Management
1) All traffic information process
2) Analysis of traffic congestion areas & roads
3) Planning of real time traffic signal operating
4) Control device & information provision(VMS, LCS, Traffic signal)
5) Real time speed change monitoring of rods → Traffic event detection
6) Traffic information service for citizens(Web, Mobile, VMS, etc)
Main System of Seoul TOPIS: Big Data Analysis System

Card data
- **85 mil./day** (bus+subway+taxi)

Real-time operation data
- **26 mil./day**
  - "bus, subway, taxi"
  - Location, GIS data, traffic speed & volume

Socio-economic Index
- The changing trend of population, vehicle, lane use, and plans, etc

Big data analysis

Calculation of policy index

Visualizing

Big data progress

Evaluation of bus stop congestion

Adjusting running intervals for public transportation, etc
Main System of Seoul TOPIS: Traffic Forecasting System

Using the transportation data accumulated for over 5 years

Traffic forecasting based on the model developed by Korea Transport Institute

1) Short-time traffic forecasting within 1 hr. (15-minute interval)
2) Long-time traffic prediction within 30 days (1-hour interval)
3) Traffic forecasting in normal conditions and special occasions e.g. Korean Thanksgiving
4) Traffic forecasting during road control e.g. special events

Traffic Forecasting Service for Urban Expressways (website)

Accuracy rate of traffic forecasting for urban expressways

<table>
<thead>
<tr>
<th>Year</th>
<th>Length</th>
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<tbody>
<tr>
<td>2015</td>
<td>157km</td>
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<tr>
<td>2016</td>
<td>574km (417km)</td>
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Seoul TOPIS Platform: Introduction (1)

**Center Platform**
Response system for various contingences along with center operation and integrated urban management monitoring

**Bus Platform**
Bus Information System (BIS)
Bus Management System (BMS)

**UR Platform**
Unmanned Regulation System
Automatic Penalty Charging System

**FTMS Platform**
Urban expressway traffic management system

**ATMS Platform**
Traffic Management System for Main Roads
Traffic Signal Operating System

**Big Data Platform**
Traffic Forecasting System
System for Supporting Transport Policies
1. OS (operating system) free
Windows, Linux, Unix OS

2. DB free
Oracle, MS-SQL, MySQL, Tibero

3. Media service free
Global web standard protocol, HTML5

4. Free embedded ITS Solution

5. Hardware free
Global standard connecting interface & protocol to equipment
Seoul TOPIS Platform: Framework

Information service and control (Service Layer)
- Providing information device (VMS, BIT, OBE etc.)
- Homepage
- Mobile
- Open API

Data processing (Business Layer)
- Processing
- Control
- Operation
- Analysis

Data collecting (Communication Layer)
- Byte Stream
- Linkage (ASN.1)
- Open API
- Message

Sharing Database
- Common GIS
- Common DB
- Fused DB

Data Compatibility
- Batch service
- Batch job

Platforms:
- Center Platform
- Bus Platform
- Big data Platform
- FTMS Platform
- ATMS Platform
Seoul TOPIS Platform: Features & Functions (1)

- Sensing of and Response to Various Incidents
  - Fast incident detection & response
  - Analysis of incident influence

- Integrated Monitoring of Traffic Situations
  - Congestion area & road
  - Change of speed & volume

- Integrated System Monitoring
  - Operation monitoring of all hardware & device
  - Monitoring of program process

A dashboard-type solution for prompt judgment & response solution
Seoul TOPIS Platform: Features & Functions (2)

Integrated control of ITS devices on site
VMS, VDS, CCTV, LCS, RMS, BIT, Bus OBE & Traffic Signal

Strict management of authorized users
User-specific menu options, and authorization per user level, etc.

Service using all media
Web, Mobile, Open API, IPTV, Digital panel, etc.
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ITS Global Leader,
The Seoul TOPIS
Next Vision of Seoul TOPIS: C-ITS

- **Good driving**
  - Reduce the travel time up to 20%

- **Safe driving**
  - Reduce the travel time up to over 58%

Key features:
- **TOPIS PLATFORM**
- **ITS Infrastructure**
- **ITS Vehicle Station**
- **V2V** (Vehicle to Vehicle)
- **V2I** (Vehicle to Infrastructure)

- **Bicycle & Pedestrian Warning Systems**
- **Left Turn Assist**
- **Forward Collision Warnings**
- **Red Light Warning**
- **Sudden Braking Ahead Warning**

*110 km/h, 92 km/h, 7.83 km*
Next Vision of Seoul TOPIS: Traffic Volume Management System

Traffic Volume Management System in the Green Traffic Zone: 45 entry points (ANPR)

- Information collected - entry & exit per hour
- Vehicle information
- Old diesel vehicle volume & enforcement information

ANPR (Automatic Number Plate Recognition) Location
Advancement in Seoul TOPIS leading changes in global ITS