

Traffic Monitoring System in Korea

Sunghan Lim^a, Taewoon Kim^b

^{a,b} *Advanced Transport Research Division, Korea Institute of Construction Technology, Goyang, 031-910-0325, Korea*

^a *E-mail: atdaya@kict.re.kr*

^b *E-mail: climb@kict.re.kr*

Abstract: Traffic volume is used as basic data for road and transportation planning, design and policymaking. Two survey methods are used: permanent survey and coverage survey. The permanent survey is taken to investigate data around the clock for 365 days while the coverage survey is to conduct a sample survey several times during the year. The permanent survey is designed to investigate the volume of traffic during a year by installing fixed instruments at some important points on road networks. It is one of the most ideal methods, but requires a great deal of costs. The coverage survey is designed to extensively ascertain the overall status of road uses in all the sections that need basic traffic data. The data collected through permanent and coverage surveys are provided to users after analysis and statistical processing. Against this backdrop, this paper aims to deal with Korea's traffic survey systems.

Keywords: Traffic volume survey, Traffic monitoring systems, Permanent survey, Coverage survey

1. INTRODUCTION

The volume of traffic passing roads per time unit is used as an index for the utility of road facilities, and is also used as an index for assessing the role of each road section through relative comparison with other points. The road traffic data are used as references for road traffic and management plans and also used for road planning, design and operation in an extensive way as well as in various areas. Now, the continuous or permanent survey has been conducted by installing fixed traffic instruments at 576 points so that it can figure out traffic variations in a time-series manner in some locations. On the other hand, the coverage survey has been conducted at 2,979 locations to assess the status of road uses across the nation. The continuous or permanent survey data are collected for each time zone throughout the year in order to evaluate the monthly and seasonal characteristics of traffic variations in a time-series manner including the traffic volume, speed and vehicle type in corresponding points. These data are also used for calculating an annual average daily traffic volume of coverage survey locations. Due to the lack of public relations on road traffic survey systems, users may find it difficult to utilize their information. Therefore, this study aims to promote easier use of road traffic information by introducing a road traffic information system.

2. TRAFFIC VOLUME SURVEY SYSTEMS

2.1 United States

The U.S. traffic survey is divided into continuous or permanent surveys, coverage surveys and vehicle classification counts. Its monthly and yearly traffic volumes investigated by each state are collected by the Federal Highway Administration and recorded on a nationwide scale. A control count is also

conducted for the purpose of assessing the traffic volume. When it comes to criteria for selecting survey points, at least one survey point is selected at and between intersections of roads in each state and one point is installed at every 6.4km on average. If the difference of traffic volumes between two survey points is more than 25%, a new point may be added in between them. A coefficient of variation calculated as data for continuous or permanent survey points is applied to those produced from a global survey to obtain an AADT (Annual Average Daily Traffic).

Table 1. U.S. Traffic volume survey system

Method	Continuous or permanent survey	Coverage survey
Survey Subject	Highways and some principal roads	-
Survey Period	Around the clock during a year	Two-day survey once a year (48 hours)
Survey Equipment	Loop detector (ATR)	Count Tubes

2.2 Japan

Japan's traffic volume survey includes a general traffic survey (national traffic condition survey), continuous or permanent survey (basic survey), four-season survey, control count, follow-up survey, etc. A general traffic survey takes place at intervals of three years as a part of the road traffic census.

Table 2. Japan's traffic volume survey system

Road Traffic Census	General traffic survey	Road condition survey, traffic volume survey, travel speed survey
	Origin-destination survey	O-D survey on road sides and O-D interview survey

As for criteria for selecting survey points, a section is designated as one without significant changes of traffic volumes and road conditions, and one survey point is installed at locations every 7km on average. A general traffic survey is carried out on any day out of Tuesday, Wednesday and Thursday in autumn (last 10 days of September to last 10 days of October) in order to investigate traffic volumes on average for each vehicle type and direction, and also conducted on ordinary holidays excluding autumn holidays or in abnormal weather conditions. The continuous or permanent survey is classified into a basic observation survey and a follow-up observation survey.

Table 3. Japan's traffic volume survey methods

Method	Descriptions Using Survey Results
Basic observation survey	Target drawing no., route name, number of roads, side space, etc.
Follow-up observation survey	Time traffic volume, daily traffic capacity, etc.

The four-season survey takes place over two days (12 hours each) four times a year in order to ascertain seasonal variations at continuous or permanent survey points, and is also conducted in a manual way in order to assess the traffic volume of 24 hours a day and Sunday for each vehicle type and direction. The survey time is 12 hours from 7 a.m. to 7 p.m. and 24 hours (weekdays: 7 a.m. to 7 a.m. on

following day and holidays: 3 a.m. to 3 a.m. on the following day) only for sections requiring nighttime traffic survey.

2.3 The United Kingdom

The U.K. traffic survey is divided into three types: rotating census, continuous or permanent survey and weigh-in-motion census. The rotating census takes place every year at about 2,000 points on main roads. It is conducted at about 10,000 points on main roads and at about 4,000 points on minor arterial roads every sixth year. Its survey period is selected from weekdays excluding weekends or holidays in the months of April, May, June, September and October without a significant influence of weather conditions, and is conducted by census takers according to a manual method for 12 hours from 7 a.m. to 7 p.m. The continuous or permanent survey is designed to accumulate continuous or permanent data for the same points, and is divided into two types: a manual survey and an electronic survey. The vehicle classification count is taken according to an 11-type classification system including the rotating survey and continuous or permanent survey.

Table 4. U.K. Traffic volume survey system

Classification	Manual Continuous or Permanent Survey (Short-Term Manual Survey)	Electronic Continuous or Permanent Survey
Points	180 continuous or permanent survey points nationwide	120 continuous or permanent survey points nationwide (existing survey points are converted into electronic ones)
Methods	Manual type	Traffic survey equipment (AVC, WIM)
Periods	Three weekdays	365 days
Times	6 a.m. to 10 p.m. (16 hours)	24 hours a day
Contents	Traffic volume	Vehicle speed, headway spacing, 24-hour traffic data, etc.
Characteristics	-	Self-governing bodies: Maintaining continuous or permanent survey data Central government: Estimating traffic volumes nationwide

2.4 France

The continuous or permanent survey is taken at about 5,000 points, out of which 1,000 follow a fixed type (2-Loop system) and the rest of 4,000 points are conducted four times every two year. The coverage survey was taken at 270 points (at an interval of 50km on principal road networks) in both directions for one hour, 12 times every year. The vehicle classification count is taken based on a 14-type classification.

2.5 Germany

The continuous or permanent survey is carried out as a 2-Loop system at about 1,100 points, and the

coverage survey takes place eight times a year if average traffic volume is 5,000 cars or more on roads, but six times if it is less than 5,000 cars. The vehicle-classification count is taken based on seven-type classification.

3. TRAFFIC MONITORING SYSTEM IN KOREA

3.1 Permanent survey (or continuous survey)

A long-term traffic count at certain location for a year or longer. Permanent count is intended to identify the traffic variation at certain point for extended time in time series including monthly and seasonal changes. Grouping result at the location for permanent count is used to estimate AADT at the point for coverage survey. Permanent count is carried out on national highway and national road. As of 2012, 4,997.1km of total length of national road 12,634.5km has been classified as permanent count zone and permanent counts have been under way at 560 points.

As devices for permanent survey used in studying traffic volume in national roads, there are AVC (Automatic Vehicle Classification) and WIM (Weigh-In-Motion). The AVC system collects data on travel time and velocity of a vehicle, lanes and types of vehicles while WIM system collects traffic data regarding travel time, velocity, lanes, vehicle types and weight.

Table 5. Status of continuous or permanent survey points by provinces

	Total	GG	GW	CB	CN	JB	JN	GB	GN
Total	576	80	66	49	72	81	82	92	54
2-lane	184	8	38	12	18	34	28	32	14
4-lane	376	65	28	36	52	46	53	58	38
6-lane	9	2	-	1	1	1	1	2	1
8-lane	7	5	-	-	1	-	-	-	1

3.2 Coverage Survey

The count carried out at the location for a short period more than a day as needed to estimate the daily average traffic. It's intended to collect the basic data for planning and building the road including expressway and national and local road as well as to count the traffic to identify the basic traffic data to estimate annual average daily traffic(AADT). Coverage survey is carried out on part of national highway and road and whole area of local road and government-supported local road and 7,637.4km of total length 12,634.5km was classified as the zone for coverage survey as of 2012 and coverage survey has been carried out at 1,014 locations. Coverage survey is carried out in all roads estimated to require traffic volume data. It comprises a survey for national routes and the other is conducted in October for expressways, national-aid provincial road and local roads, depending on survey subjects and methodology.

Table 6. Status of coverage survey by road classes

Classification	National Roads	Highways	Local Roads
Surveyed by	The Ministry of Land, Infrastructure and Transport	Korea Expressway Corporation	Self-governing bodies

Times	Once a year (24 hours a day)	Once a year (24 hours a day)	Once a year (24 hours a day)
Period	March to November	3rd week in October	3rd week in October
Method	Mechanical	Mechanical/Manual	Mechanical/Manual
Point	1,064 points	483 points	1,483 points

Table 7. Status of regional coverage survey points

	Total	GG	GW	CB	CN	JB	JN	GB	GN	JJ
Total	2,979	498	233	274	321	301	349	476	460	67
Highway	482	132	30	29	64	40	51	56	80	-
National roads	1,014	115	114	89	101	106	145	179	165	-
Local roads	1,483	251	89	156	156	155	153	241	215	67

3.3 Vehicle Classification Survey

Traffic data by vehicle classification is very useful in various fields including road design, pavement design and traffic plan. For vehicle classification, accurate data which will identify the vehicle class in traffic count is necessary and the standard for vehicle classification shall be in conformity with the use of traffic data.

According to the vehicle classification standard, vehicles were classified into 7 classes till 1973, which was changed to 8 by adding ordinary truck in 1974 and 7 again because of grouping the passenger cars into single class in 1977 and 8 in 1988 and then 11 classes were applied to national road only since 1995. A dualized system into 8 and 11 was unified to 12 in 2006.

Table 8. Vehicle classification guideline

Class	Axle	Description
1	Two-axle four-wheel	Compact cars, sedans, less than 16 seater SUV, RV, van
2	Two-axle six-wheel	Medium and large buses
3	Two-axle six-wheel	Two-axle, one-unit, 1-2.5 ton cargo truck
4	Two-axle six-wheel	Two-axle, one-unit 2.5 ton cargo truck
5	Three-axle ten-wheel	Three-axle, one-unit cargo truck
6	Four-axle twelve-wheel	Four-axle, one-unit cargo truck
7	Five-axle sixteen-wheel	Five-axle, one-unit cargo truck
8	Four-axle fourteen-wheel	Four-axle, two-unit semi-cargo trailer
9	Four-axle fourteen-wheel	Four-axle, two-unit semi-cargo trailer
10	Five-axle eighteen-wheel	Five-axle, two-unit semi-cargo trailer

- | | |
|------------------------------|--|
| 11 Five-axle eighteen-wheel | Five-axle, two-unit full cargo trailer |
| 12 Six-axle twenty two-wheel | Six-axle, two-unit semi-cargo trailer |

3.4 Data analysis and processing

Automated program for data management is designed and built for effective data management and error data is identified with incomplete data corrected based on a variety of error identification standards, providing systematic data management. Reliable analysis of data is conducted to produce AADT in coverage survey stations by applying daily, monthly and yearly correction factors and floating rates of permanent survey stations. Statistics data consist of years of data on the basis of road class, year, vehicle type, time and direction.

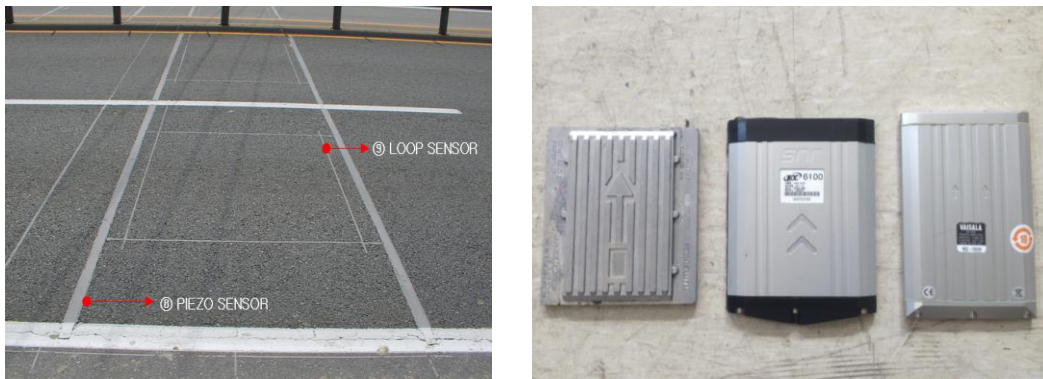
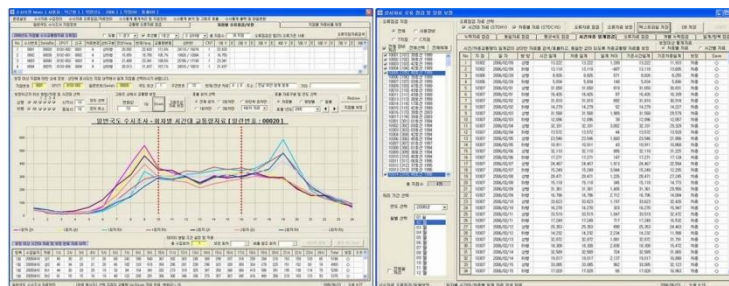
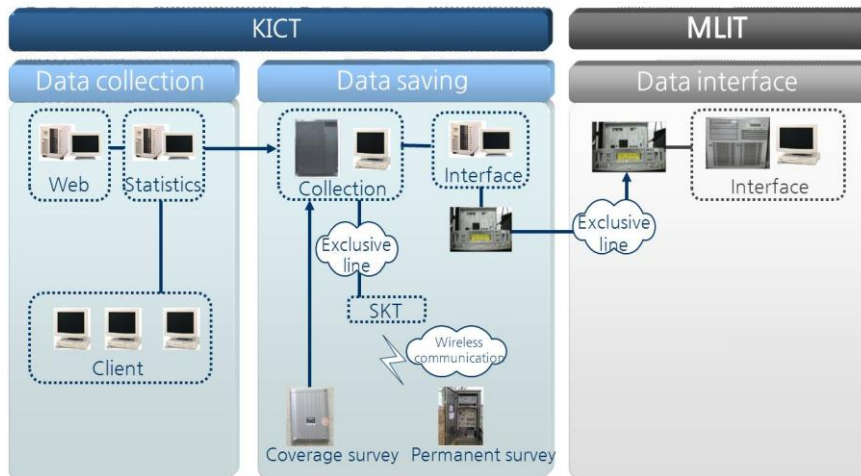


Figure 1. Traffic monitoring system: Data collection



Data Analysis



Figure 2. Traffic monitoring system: Data processing

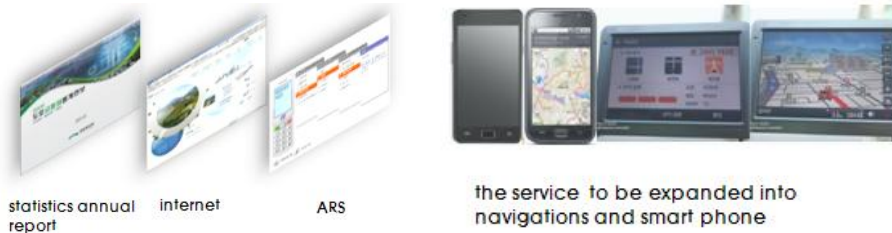


Figure 3. Traffic monitoring system: Providing information

3.5 Information provision

Traffic volume statistics annual reports provide yearly analysis results of traffic volume based on road class, sections and vehicle types while also providing annual average daily traffic, average daily traffic, five-year statistics based on the publication year, monthly correction factors and daily correction factors. Past statistics data, traffic of each vehicle based on 12 classes of vehicle classification and survey location information using electronic maps, which are not included in the annual reports for lack of space, are provided on the website, www.road.re.kr. Traffic information is provided via ARS 1333 regarding expressways, roads, downtown streets, railroad, passenger ships, express buses, and intra-city buses.



Main page of www.road.re.kr

Statistical Yearbook of Traffic Volume

Figure 4. Information provision

3.6 Use of traffic data

Traffic data is used as important source for planning and designing the traffic and road and environment. The use is as in Table 5. Traffic data by vehicle class is more important in road management.

Table 9. Use of traffic data

Area	Use
------	-----

Traffic plan	Traffic demand forecast & verification, national road network plan, traffic facility investment evaluation, preliminary feasibility study, determination of priority in structuring ITS
Road plan	Road network plan, determination of investment in road and priority, bypass road plan and pavement plan
Road design	Service quality analysis, analysis of required number of lane, yield lane, tollgate on expressway, other road facilities
Road management	Road expansion and pavement overlay, determination of overloaded truck inspection point
Road environment	Exhaust gas estimate, noise barrier wall

3.7 Future plan

Currently, road traffic annual statistical report provides the traffic data on expressway, national road and local road but the use of traffic data base been reduced due to lack of spatial continuity. The demand for urban road traffic data has been increasingly growing and to deal with such demand, traffic data in urban road needs to be additionally collected and provided to satisfy the user' s deeds. Many municipal governments have established ITS and collected traffic data on urban road and the traffic data using such urban traffic will be provided.

The cost of AVC equipment used for permanent count is ¥40 mil /unit which is too high to be distributed generally. Thus coverage survey conducted by municipal governments is carried out manually and lack of skill and professionalism may lead to low reliability of the data. The Ministry of Land, Infrastructure and Transport has been pushing for developing diffusion model.

4. CONCLUSIONS

The Ministry of Land, Infrastructure and Transport established the guideline for investigation of road traffic (The Ministry of Land, Transport and Maritime Affairs, 2009) and developed definition of permanent and coverage survey, scope and location of count. To effectively implement input the traffic data on national highway and local road and identify the data in past, it developed the traffic investigation operation service system, which enables to collect and provide the traffic data collected by municipal governments via Internet. According to current Act on Road, the road is categorized into expressway, national highway, special & metropolitan area road, local road, city road, gun road and gu road. Traffic count system introduced in this study could be applied to permanent and coverage survey on expressway, national highway and local road. This road traffic information provision system is expected to help better understand the road traffic data as well as use them in more efficient way.

References

- The Korea Institute of Construction Technology. (2004) Statistical Yearbook of Road Traffic Counts Revised.
- The Ministry of Land, Transport and Maritime Affairs. (2009) Guidelines on road traffic survey.
- The Korea Research Institute for Human Settlements. (1993) Research on Method for Improving Road Traffic Survey and Control System.
- The Korea Institute of Construction Technology. (2004) Select for Optimum Traffic Data Survey Site. 8-13

- The Traffic Information Offering System (www.road.re.kr)
- The ITS National Transport Information Center (<http://www.road.re.kr>)
- Ministry of Land, Infrastructure and Transport. (2013) 2012 Statistical Yearbook of Traffic Volume. Gyeonggi, Korea, 3-7
- The Korea Institute of Construction Technology. (2005) Research on Coverage Survey System Improvement Plan. 10-17
- Lindsay Liggett, Mark Burris, Shawn Turner. (2009) Analysis of Seasonal and Day-of-Week Traffic Patterns at National Parks. *Journal of the Transportation Research Record*, (2119), 76-77
- Lisa Dykstra, Doug McLeod, Allison Piszczatoski. (2011) Standard K Factors for Transportation Planning and Design. *ITE Journal*. 81, 20-25
- Don R. Crownover. (2006) Use of Short-term interval counts to determine K Factors. Oregon Department of Transportation.