Indicators and Data Collection to Support Performance Measurement System

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ABSTRACT **:** In Road Bureau, Ministry of Land, Infrastructure and Transport of Japan , the annual report of achievement and plan using performance indicators have been made since fiscal 2003 to carry out road policies more efficiently , effectively,and transparently ,and to carry out being conscious of 'PDCA cycle' .
Concerning performance indicators, it is important to promote efficiency of data collection and to invent new indicators which are more suitable for the people's needs.
Chapter 2 and 3 present current circumstances concerning performance indicators of traffic accident and traffic congestion and the reliability of the travel time as a indicator which is suitable for the people's needs.
Furthermore a machine to collect data and the way of obtain data collaborating with businesses are mentioned.
Chapter 4 presents the attempt of collaboration with businesses , which is done to obtain data more efficiently.It is an attempt of building up the collaboration with businesses , which offers NILIM(National Institute for Land and Infrastructure Manegement) the data such as truck tracking data and acceleration data ,and provides businesses with the information on accident-prone locations, road drivability information,and so on.
Chapter 5 presents the road drivability map , which expresses the level of service from a people's point of view.It is the map which expresses actual feelings of driver focusing on the structure of the road.
In conclusion, it is important to improve efficiency and reduce costs of collecting data concerning performance indicators to carry out road policies efficiently , effectively,and putting customers first. And it is also important to establish public-private partnership to obtain data more efficiently and continuously.

KEYWORDS: ***Data Collection , Performance Measurement, Indicator, Efficient , Continuous , Public-private partnership , Traffic Accident , Traffic Congestion***

1. INTRODUCTION

In Road Bureau, Ministry of Land, Infrastructure and Transport of Japan , the annual report of achievement and plan using performance indicators have been made since fiscal 2003 to carry out road administration more efficiently , effectively,and transparently ,and to carry out being conscious of 'PDCA cycle' .

Japanese National annual performance report on the road administration has now 21 indicators,and these are categorized into seven political themes (Figure 1).

As for these indicators, concerning the internal parts of the road administrative organ , it is important to reduce costs of collecting data and to establish systems which make it possible for the road administrative organ to obtain data more efficiently and continuously.

And it is necessary to develop indicators which are more suitable for the people's needs in order to carry out road policies putting customers first .

This report presents current circumstances concerning building up systems to collect data efficiently and continuously and the development of performance indicators which are more suitable for the people's needs. The objective is to consider what the road administration should be focusing on performance indicators.

This report describes 2 indicators, traffic accidents and congestion time loss.

And also 2 other traffic indicators, reliability and drivability , which are not adapted yet to national performance report now , are described.

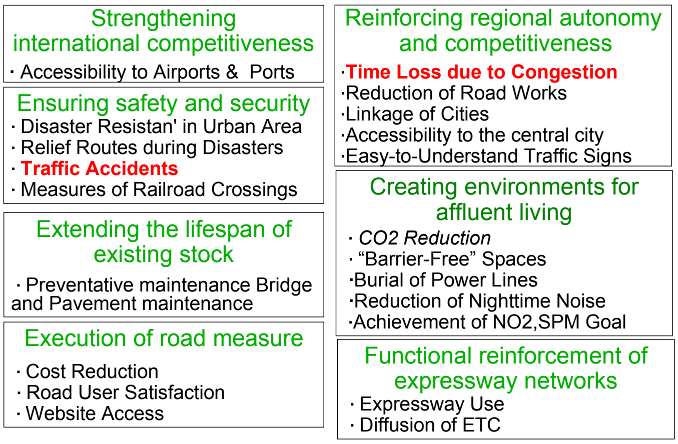


Figure 1 Current Performance Indicators

2. Data Collection System About Taffic Accident

2.1 Integrated Taffic Accident Database

In order to put the brake on the increasing tendency of fatalities, we have established the integrated traffic accident data base in 1988 (Figure 2.1) .

Traffic accident statistical data , which is provided from the National Police Agency (NPA) and the road traffic census data from our Ministry MLIT , are integrated to the Database by the location data which we call Matching data.

This Integrated Data Base can be used to analyse the relationship among road structures, traffic data and traffic accidents, thus it enables us more effectively to extract the hazardous spots where countermeasures are to be carried out.

In 2002, we have developed the Traffic Accident Analysis System, which can visually clarify the occurrence of accidents by displaying analysis results on a digital road map through Internet.

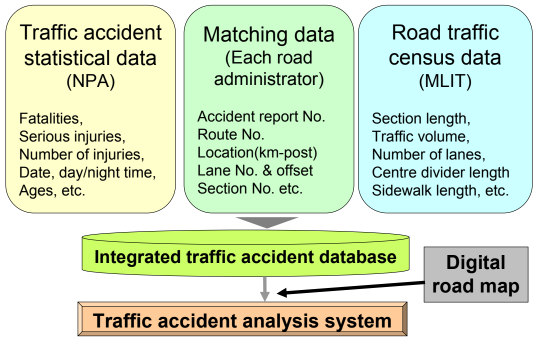


Figure 2.1 Integrated Taffic Accident Database

2.2 Raod Safety Map

We have used the Integrated Traffic Accident Database to designate accident hot spots at about 4,000 locations, which includes sections and intersections, with high rates of accidents causing death or injury (Figure 2.2.1) .

Concerning accident hot spots, concentrated accident countermeasures are being taken to cut accidents by 30%

Figure 2.2.1 Hazardous Spots

Figure 2.2.2 indicates the accident rate of roads around Tokyo centre, per every section of traffic census investigation, average length is 5kilometers or so.

Read color indecates the road at where accidents frequently occur whose rate of the occurrence of accidents is over 300 accidents per 100 million vehicle kilometre.

On the other hand , in the suburbs of Tokyo , an accident rate is lower than that of Tokyo center (Figure 2.2.3) .

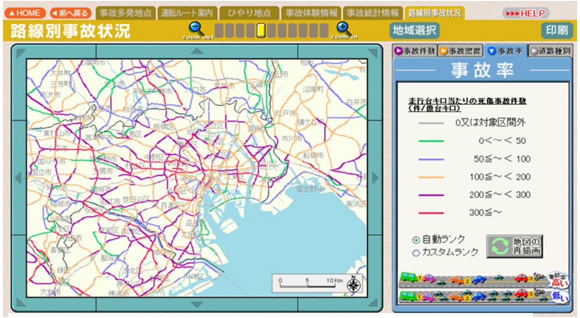


Figure 2.2.2 Accident Rate(urban area)

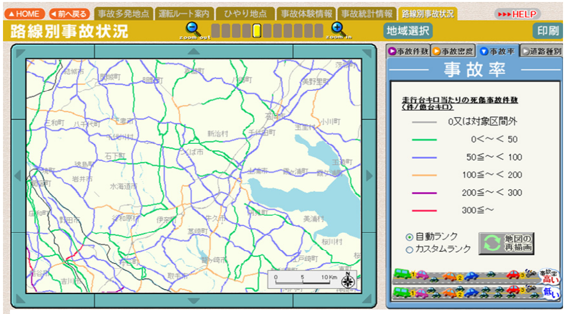


Figure 2.2.3 Accident Rate(suburban area)

2.3 Accident Rate Curve

We have introduced "Priority Specification Method", which is one of the performance measurement techniques by which we can grasp high prior sections where many traffic problems exist, which can accomplish the accountability for the road policies including road safety.

Such a curve can be drawn by sequencing the sections where the accident rate is high. The red sections are where accidents occur twice or more as much as the average. This enables to concentrate measures only on high prior sections (Figure 2.3) .

Not only "High Priority Sections" but olso grey sections are important, so we would expect another technology, for example, smart warning car

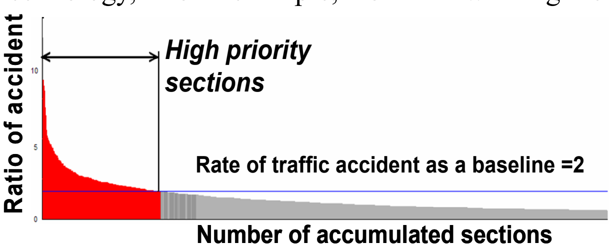


Figure 2.3 Accident Rate Curve

navigation system or other ITS technology of private sectors.

3 Data Collection System About Taffic Congestion

3.1 Evaluation of Taffic Congestion

Figure 3.1.1 shows so-called 3D map ,which indicates traffic congestion time lost.

We often use the 3D map images, because easy to indicate the problematic location spatially.

We have also used priority indication method for the traffic congestion countermeasure. Figure 3.1.2 shows the effectiveness of all the projects as a whole in a region.

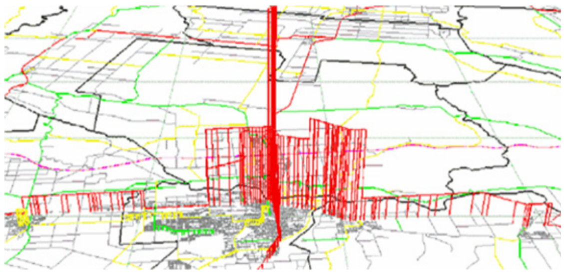


Figure 3.1.1 3D map

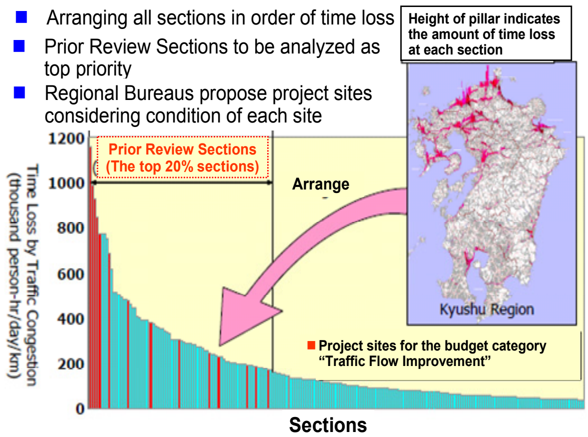


Figure 3.1.2 Priority Indication Method (about traffic congestion)

3.2 Data Collection System About Taffic Congestion

Concerning the performance measurement against traffic congestion , the Vehicle Information

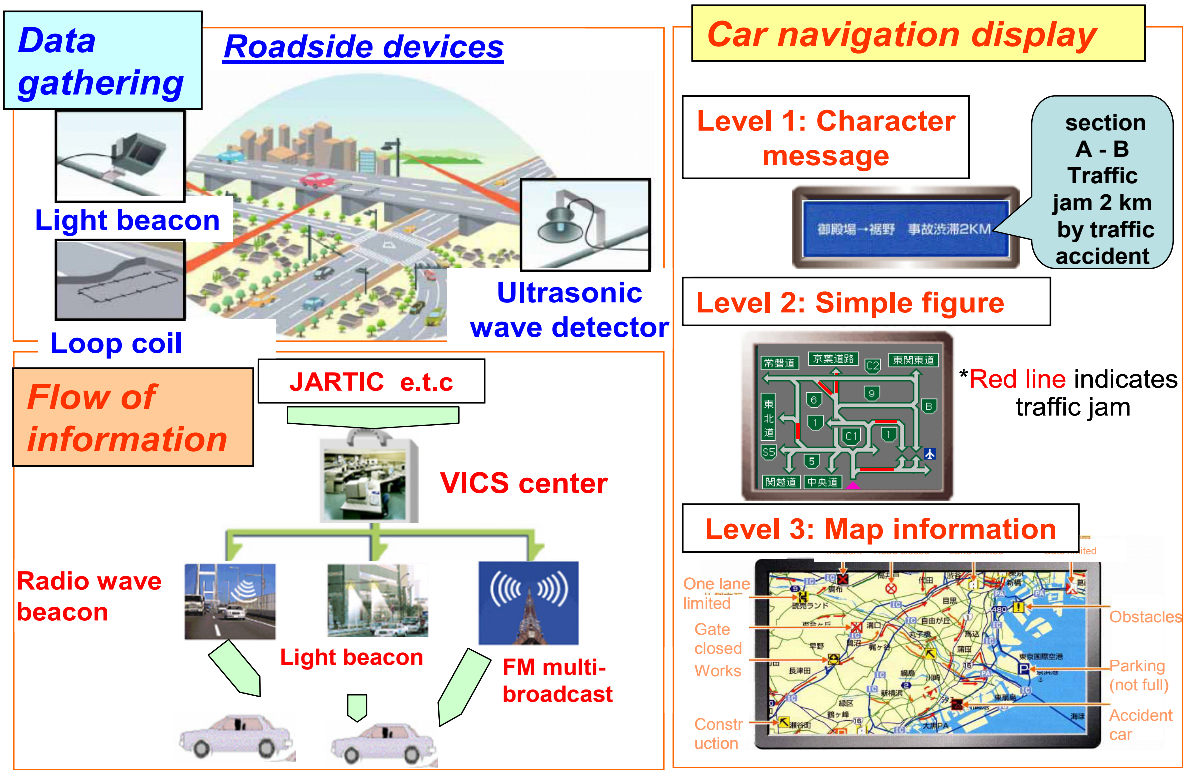


Figure 3.2 Applicable use of VICS data

Communication System, shortly called VICS, has been used as well as vehicle detectors (Figure.3.2) . VICS has provided the real-time congestion information to the car navigation every 5 minutes through roadside beacons and FM multi broadcast.

3.3 Evaluation of "Reliability of Travel Time"

3.3.1 Reliability of Travel Time

In the socioeconomic activities of ordinary citizens and businesses, social diseconomy occurs when people set aside extra time when choosing traffic behavior after considering "fluctuations in travel time."

For example, a freight vehicle sometimes parks on street according to the Just in time transport demand, which may cause the traffic congestion.

Reliability of travel time may be one of performance indicators of traffic service level, as well as average values such as congestion time loss, which cannot evaluate actual traffic conditions.

We have been trying to establish this indicator systematically.

3.3.2 Changes of Reliability before/after New Service of Expressway

As part of this attempt , a survey has been conducted between 2 expressway interchanges on National Route 16, which were expected to reduce traffic congestion by the opening of the Ken-O Expressway between these interchanges.

3 ring expressways and 9 radial expressways

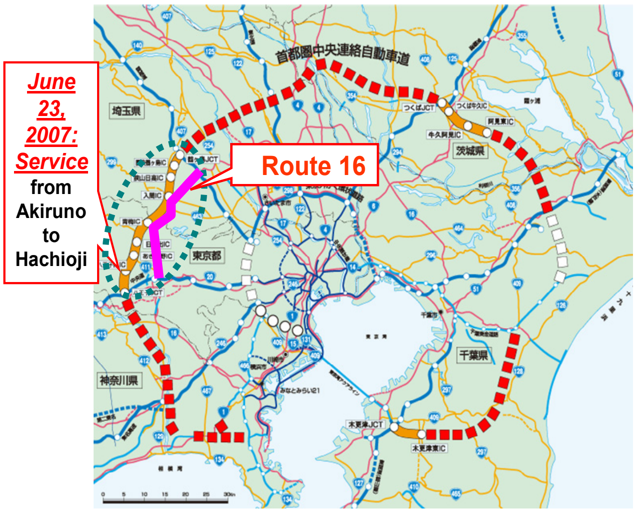


Figure 3.3.2.1 The partial opening of the Ken-O Expressway

compose expressway network of Tokyo metropolitan area, which planned 40years ago and has not completed yet.

Especially rack of ring expressways has caused severe traffic congestion everyday.

2 radial expressway were linked by the Ken-O Expressway in June 2007, which gave us the opportunity to survey the influence to the National Route 16, which runs parallel to the Ken-O Expressway (Figure 3.3.2.1) .

We have observed that the buffer time has changed from 21minutes to 15minutes, that has been 6minutes reduction, while average travel time has changed from 56minutes to 51minutes, that has been 5minutes reduction (Figure 3.3.2.2) .

VICS data.

In order to gather wide area network and to reduce prove survey cost, we have been trying to make several data collecting systems (Figure 3.3.3) .

3.3.4 Data from Expressway Bus-Location System

Several traffic agencies or private bus service companies have their own bus location systems to provide estimated arrival time or real time connection information to the customers. We established total system to gather and combine all expressway bus location data from each company 2 years ago.

For instance, we can get travel time data of expressway between the city center and the air port

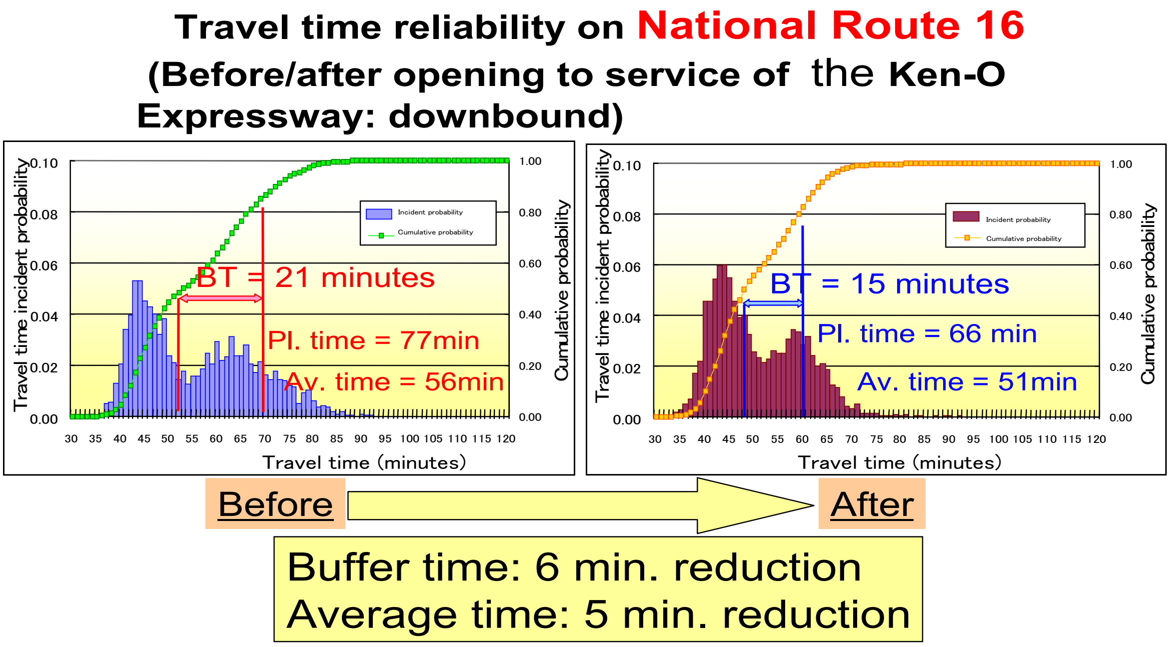


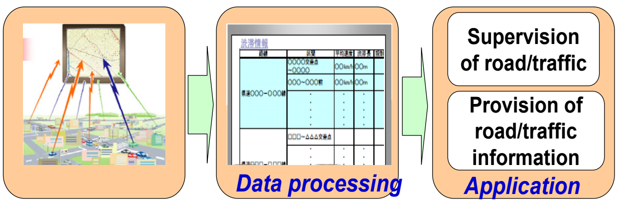
Figure 3.3.2.2 Travel Time Reliability

3.3.3 Probe Technology

In previous example, we have used AVI(Automatic Vehicle Identification) equipment to collect accurate travel time data.

But AVI takes too much cost to survey wide area road network.

So in general we often adapt probe car survey, after extracting the congested section and time using



- **Probe car survey** (High cost)
- **Probe person (Survey of person trip by a cellar phone)**
- **Bus location system**
- **Taxi probe (Vehicle allocation system)**
- **Drive recorder**
- **ITS equipped vehicle**

Low cost

Figure 3.3.3 Probe Technology

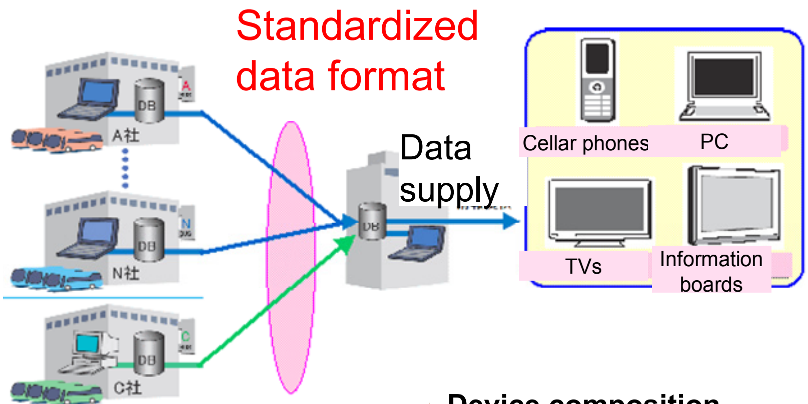


Figure 3.3.4 Data from Expressway Bus-Location System

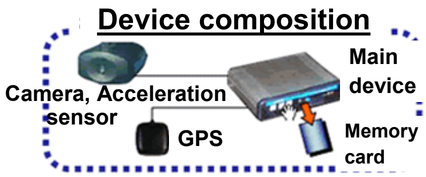


Figure 4.1.1 Drive Recorder

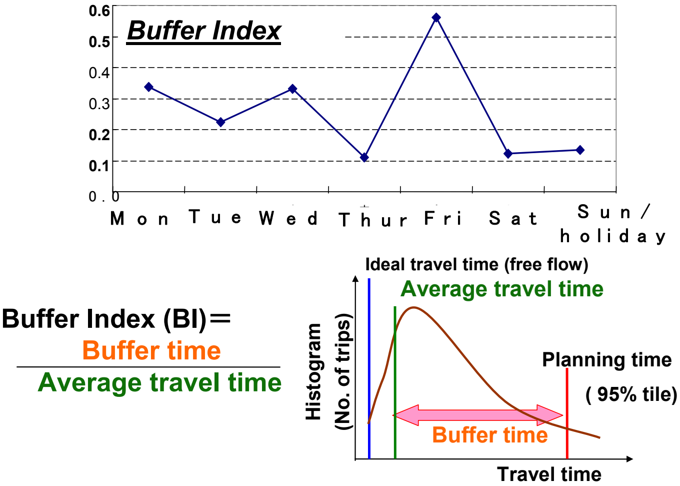


Figure 3.3.5 Reliability of Travel Time using Bus-Location Data

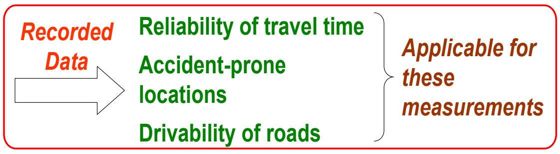


Figure 4.1.2 Use of Drive Recorder

(Figure 3.3.4).

We have use approximately 800 samples of travel time data to calculate buffer index.

Friday has great variation and shows high index values (Figure 3.3.5) .

There is little variation in travel time on weekends and holidays compared to weekdays.

4. Collaboration with Private Sectors for Data Collection

4.1 Drive Recorder

Drive recorder is a device that collects forward image, acceleration, brake, speed, blinker with location data of GPS. Recently many freight transport or taxi company have introduced this type of equipment (Figure 4.1.1) ,because they feel benefits of effect such as proof of traffic accident, secure driving, and improving driving behaviour.

We have intend to exploit the data from drive recorder to make indicators of traffic condition such as reliability of travel time (Figure 4.1.2) .

4.2 Collaboration with Private Sectors for Data Collection

Conceptual image of a public-private partnership of data collection is like Figure 4.2.

Distribution companies give us probe data, and we feedback to them the calculation result of accident-prone location, reliability, and so on.

We began Installing an experimental server this year in order to verify communications security and feasibility, limiting around 500 vehicles, toward

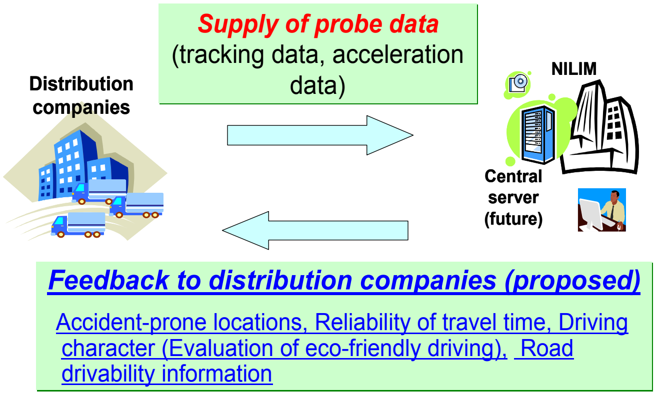


Fig 4.2 Collaboration with Private Sectors system establishment.

5.Road Drivability Map

5.1 An Outline of Road Drivability Map

A road Drivability Map incorporates three kinds of factors, "road structure design", “Driving speed", and “Driving safety” so that drivers can travel safely and comfortably (Figure 5.1) .

Road Structure design factors consist of the number of lanes, radius of curves, sidewalk or shoulder width, and so on.

These factors are assessed in 6 ranks M, S, A, B, C, and D, to be shown in the map by color.

Driving speed factor is replaced by congested point shown as red circle icon on the Map.

Driving safety factor is a Hazardous Spot shown as a yellow star icon on the Map, which is in accordance with the Road Safety Map.

While ordinary maps show only classification of roads by color, the Drivability Map shows differences of the number of lanes and other structural factors of roads by thickness and color of the line.

5.2 Criteria for Ranking

In the Drivability Map, roads which forming a wide-area network are selected. Generally these are prefectural or higher level roads.

Total length of the roads on the Map is about two hundred thousand kilometers, which is18% of the whole roads in Japan.

Roads are divided in about five hundred meters sections.

Each section is categorized as suburban/mountain

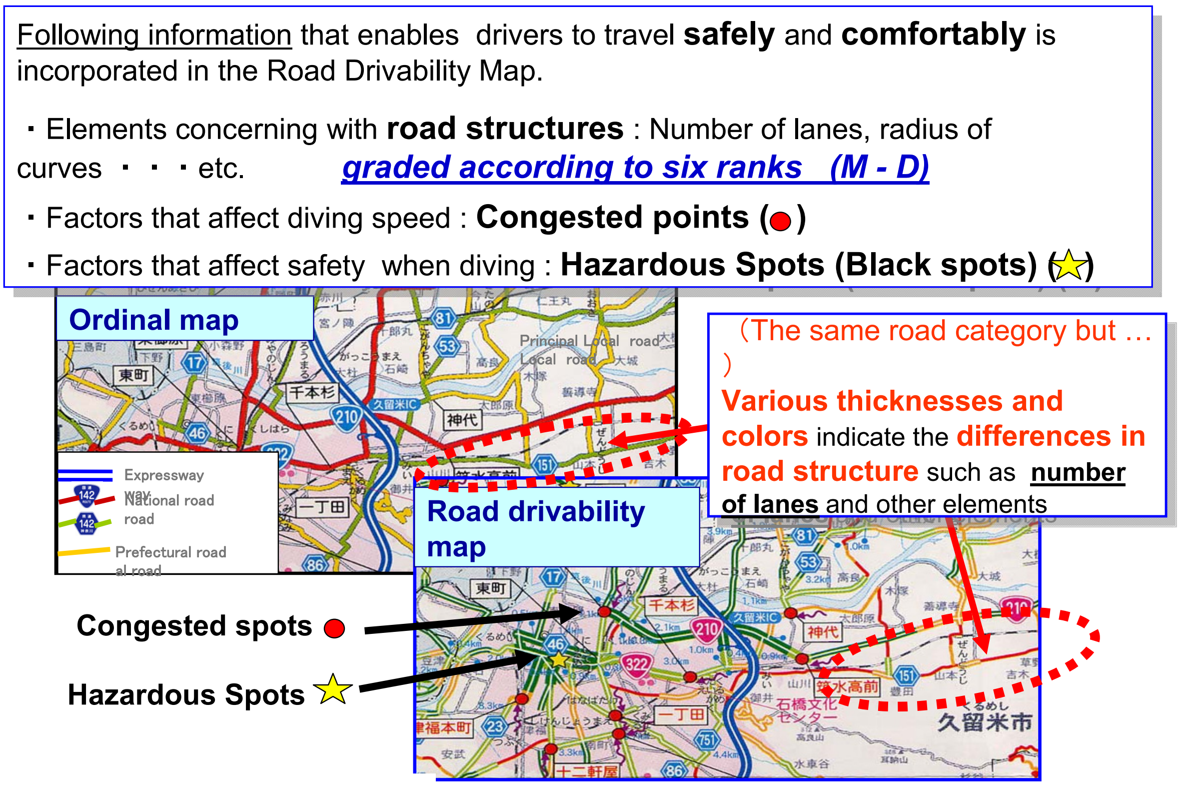


Figure 5.1 Road Drivability Map

and urban according to roadside conditions, and ranked from M to D according to the number of lanes, curve radius, shoulders and sidewalk conditions.

Lank M is the most drivable road, which is a motorway which only automobiles are permitted to use.

Lank S is the second most drivable road as shown in Figure 5.2.1 .

Drivability rank in the suburban or mountain area is classified according to factors of drive speed. The factors are the number of lane, radius of curves and slopes, width of shoulders or sidewalk.

Rank A is displayed in green line on the Map. Rank B, C, D are yellow green, orange, and red respectively. These photos give you rough images of the roads ranked A through D (Figure 5.2.2) .

In urban districts, drivability rank is judged considering the presence of pedestrians.

Roads ranked A have 2 or more lanes and only gentle curves, and also have wide sidewalks and shoulders (Figure 5.2.3) .

In urban districts, priority is on separating automobiles and pedestrians (installing sidewalks) considering the presence of pedestrians.

5.3 Collecting Road Evaluation Data

The wide-area network roads in the Drivability map are ranked on the basis of survey data generated by special vehicle-mounted probes.

The probe data is augmented by video images used to confirm road structural conditions (Figure 5.3) .

5.4 Application of Road Drivability Map to Car Navigation System

In order to incorporate the Drivability Map into

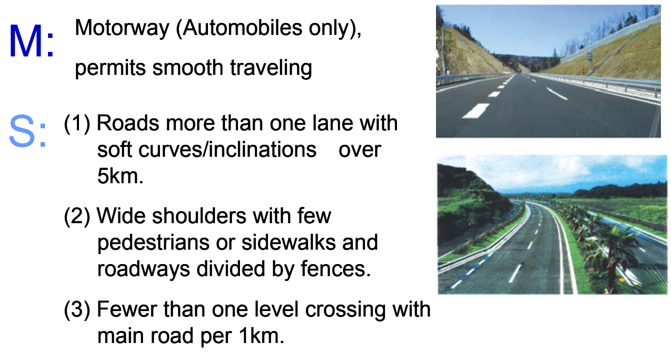


Figure 5.2.1 Criteria for Ranking(Motorway)

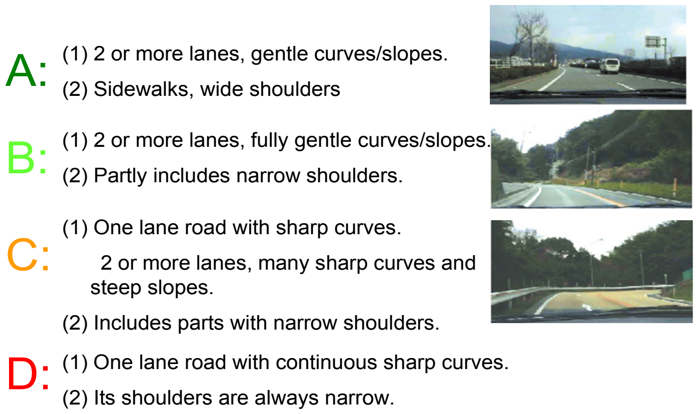


Figure 5.2.2 Criteria for Ranking (Suburban/Mountainous Area)

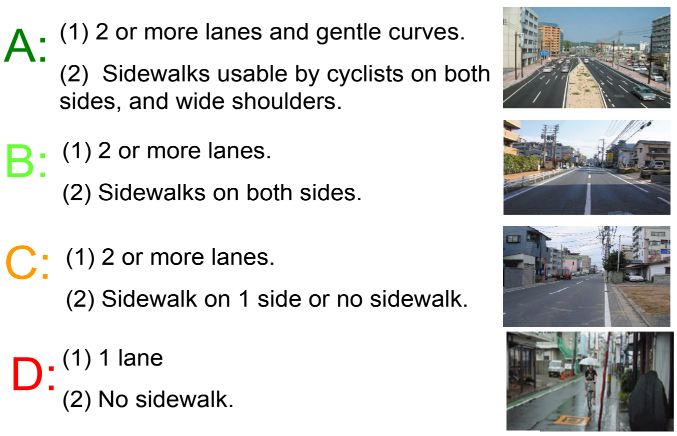


Fig.5.2.3 Critera for Ranking (Urban Area)

Evaluation data	Method of measuring data
Design speed (radius of curvature)	Measured by **probe car**
Number of lanes	Observed by passenger (Digital video images to confirm observed data and to get additional information)
Sidewalk	
Shoulder	
Road mergers/divisions	
Frequency of traffic signals	
Roadside structures	Observed by passenger; checked by maps
Longitudinal slop	Confirmed from the road design

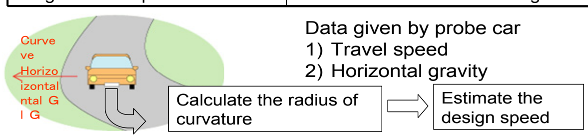


Figure 5.3 Collecting Road Evaluation Data

the car navigation system, we have executed a joint research together with the private companies including the car navigation system manufacturer (Figure 5.4).

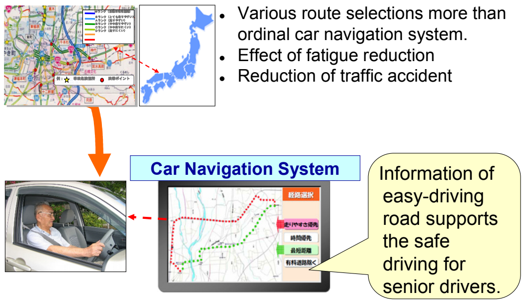


Figure 5.4 Application of Road Drivability Map to Car Navigation System

6 SUMMARY

In this report , concerning current performance indicators , traffic accident and congestion have been described in terms of data collection.

Concerning traffic accident, Priority Specification Method , Integrated Taffic Accident Database and its application have been described. These measures have enabled us to carry out countermeasures more effectively and efficiently.

Concerning traffic congestion , Priority Specification Method has been described , which has enabled us to invest national budget in road projects more effectively.As for traffic congestion, Reliability of Travel Time and its application have been described , which have enabled us to grasp fluctuations in travel time. And also Probe Technology and Collaboration with Private Sectors have been described , which have enabled us to obtain travel time data more efficiently.

And Road Drivability Map in terms of road users and its application have been described .

It is necessary to obtain data concerning performance indicators more efficiently and to develop indicators which are more suitable for the people's needs in order to carry out road policies efficiently , effectively,and putting customers first . It is also necessary to establish public-private partnership to obtain data more efficiently and continuously.

Lastly, I appreciate Tadashi Okutani sincerely who has guided me in writing this report ,the head of the Traffic Engineering Division, National Institute for Land and Infrastructure Management.

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