TS051
Effectiveness of Road-Vehicle Cooperative and Infra-Only Safety System

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Ministry of Land, Infrastructure and Transport

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Contents

1. Commencement of Road-Vehicle Cooperative Safety System
2. Sangubashi Field Test
3. Measures Taken by the Chugoku Regional Development Bureau, MLIT
4. Conclusion
1. Commencement of Road-Vehicle Cooperative Safety System

2) Concept of AHS

Driver behavior immediately prior to accident (human error) is the cause of 75% of all accidents.

### Classified Traffic Accident Countermeasures with temporal transition

<table>
<thead>
<tr>
<th>Before</th>
<th>Immediately before Accident</th>
<th>During &amp; Immediately after Accident</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countermeasures Taken in Advance</td>
<td>Countermeasures Taken Immediately before Accident</td>
<td>Countermeasures Taken During Accident and “Immediately after” Accident</td>
<td>Countermeasures Taken After Accident</td>
</tr>
<tr>
<td>Improving Roadway Itself</td>
<td>Areas Where Measures Were Delayed for Technical Reasons</td>
<td>Mandatory of Seatbelt use</td>
<td>Establishing emergency Call Systems</td>
</tr>
<tr>
<td>Installing Road Signs and Lightings</td>
<td></td>
<td>Widespread of Airbag Use</td>
<td>Advanced Emergency Medical Service</td>
</tr>
<tr>
<td>Safety Driving Education</td>
<td></td>
<td>Installation of Guardrails</td>
<td></td>
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</tbody>
</table>

Areas of Accident Fatalities Reduction

Areas of Accident Reduction

Time-Based Progression and Traffic Accident Countermeasures

Source: 2000 Traffic Accident Statistical Data
1. Commencement of Road-Vehicle Cooperative Safety System

1) Concept of AHS

The providing of information through road-vehicle cooperation and countermeasures immediately prior to an accident are about 90% effective against delays in recognition.

<table>
<thead>
<tr>
<th>Roadside information boards (infrastructure only)</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-board unit display (road-vehicle cooperation)</td>
<td>90%</td>
</tr>
</tbody>
</table>

Effects resulting from countermeasures immediately prior to an accident (reaction rate by providing information)
1. Commencement of Road-Vehicle Cooperative Safety System

Three next-generation road services and safe-driving support measures

(1) Information provision services along roadways

Safety information

Traffic information

Provision of easily understood road traffic information

(2) Information connection services at roadside rest area

Road station, SA, PA etc. road to information provision

(3) Public parking lot payment services

Payment of fees at public parking areas

Entry/exit control at public parking areas
2. Sangubashi Field Test

1) Confirmation of Concept Validity Through Field Tests

[Test Summary]

Sensors detect traffic congestion, standing vehicles and slow-traveling vehicles

Roughly 10% of vehicles are equipped with three-media VICS-compatible car navigation systems

Test Period: March 1 to May 31, 2005

Car navigation display

Simple diagram display of conditions at the start of a curve

Beep!

Message sign

Installed on April 27
## 2. Sangubashi Field Test

### 2) Verification of Effects by Monitoring Traffic Flow

Comparison of dangerous behavior with and without the service

<table>
<thead>
<tr>
<th></th>
<th>Traffic congestion, standing or slow-traveling vehicles</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective sample size (30km/h or faster)</td>
<td>Frequency of rapid change in behavior</td>
<td>Frequency of high-speed curve entry (60km/h or faster)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4G or more</td>
<td>0.5G or more</td>
</tr>
<tr>
<td>Without Service</td>
<td>2,217 (7 days)</td>
<td>29.6%</td>
<td>17.5%</td>
</tr>
<tr>
<td>(Feb. and Sep. 2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Service</td>
<td>10,769 (28 days)</td>
<td>26.7%</td>
<td>16.8%</td>
</tr>
<tr>
<td>(Sep. to Nov. 2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction Percentage</td>
<td></td>
<td>2.9</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Notes:
1) Before introduction of service: Based on images from October 15 to November 12, 2003 (28 days). After introduction of service: Based on images from March 1 to May 31, 2005 (92 days).
2) The number of days by road condition indicates the number of days with precipitation of 10mm or more, according to weather data from the Japan Meteorological Agency (Tokyo).
3) Effectiveness in reducing accidents

Number of accidents per year, past 3 fiscal years

- Rear-end collisions (low speed)
- Secondary accidents
- Rear-end collisions (other)
- Other accidents

Note: Secondary accidents are accidents that occur within 60 minutes of the first accident (primary accident) in the same road section. This 60 minutes is the average time required to clear an accident scene in the Tokyo Metropolitan Expressway.
2. Sangubashi Field Test

4) Occurrence of accident (compared with other curves)

Accidents at similar curve sections on the Metropolitan Expressway, Route No.4

Before introduction of service
(Apr.-Sep.2004)

After introduction of service
(Apr.-Sep.2004)

Dramatic reduction

Number of accidents by accident type

Yoyogi Curve  Sangubashi Curve  Shinjuku Curve

Yoyogi Curve  Sangubashi Curve  Shinjuku Curve

Number of accidents by accident type

Other  Rear end collision  Minor collision  Rollover  Minor collision with fixed objects
3. Measures taken by the Chugoku Regional Development Bureau

Two services were implemented within the jurisdiction of the Chugoku Regional Development Bureau of the Ministry of Land, Infrastructure and Transport (MLIT)

(1) Oncoming vehicle information provision service
- Infrastructure detects the presence of oncoming vehicles in poor visibility zone.
- The information is displayed on roadside information boards to driver entering the zone.

Reduces head-on collisions, passing collisions or damage

(2) Standing vehicles, slow-moving vehicles and merging vehicles information provision service
- Infrastructure detects the presence of standing vehicles or slow-moving vehicles in poor visibility zone.
- The information is displayed on roadside information boards.

Reduces collisions with standing vehicles/slow-moving vehicles or damage
3. Measures taken by the Chugoku Regional Development Bureau

1) Oncoming vehicles information provision service

a. Overview of service

- Detection of oncoming vehicles using infrastructure
- Driver is presented with information on the oncoming vehicle from the information board
- Vehicle monitored by the Service
- Zone of poor visibility
- End point of poor-visibility zone
- Starting point of poor-visibility zone
3. Measures taken by the Chugoku Regional Development Bureau

1) Oncoming vehicles information provision service
b. Configuration

- Camera for oncoming vehicles (96.796kp)
- Information board (97.070kp)
- Lane-departure measurement site
- Toward Shimonoseki (upslope)

- Camera for oncoming vehicles (97.312kp)
- Information board (97.218kp)
- Lane-departure measurement site
- Toward Hagi (downslope)

On those sections, the road signs, images, and the lane-departure measurement system are equipped with cameras for oncoming vehicles. The information boards consist of two, one for the construction of the viaducts and the other for the viaducts themselves.
3. Measures taken by the Chugoku Regional Development Bureau

1) Oncoming vehicles information provision service
   c. Service evaluation indices

To provide an index of the effectiveness of introduction of the service, the percentage of vehicles that depart from their lanes was measured.

Discriminating between lane-departing vehicles and lane-keeping vehicles.
3. Measures taken by the Chugoku Regional Development Bureau

1) Service evaluation indices
d. Proving of results of service introduction

- Before introduction, the number of accidents averaged 6.5 per year
- Since introduction in April 2005, no accidents have occurred.

![Graph showing rate of lane departure](image)

Rate of lane departure (upslope)

- Before introduction: 59.2%
- After introduction: 33.7%
- "Oncoming vehicles present": 30.8%

Rate of lane departure (downslope)

- Before introduction: All vehicle types 4.3%, Large vehicles 5.7%
- After introduction: All vehicle types 1.0%, Large vehicles 2.0%
- "Oncoming vehicles present": All vehicle types 0.6%, Large vehicles 0.0%
3. Measures taken by the Chugoku Regional Development Bureau

2) Standing vehicles, slow-moving vehicles and merging vehicles information provision service
3. Measures taken by the Chugoku Regional Development Bureau

2) Standing vehicles, slow-moving vehicles and merging vehicles information provision service

a. Configuration
3. Land Preparation Measures in Chugoku

2) Standing vehicles, slow-moving vehicles and merging vehicles information provision service
b. Service evaluation indices

Group of vehicles

Standing vehicles

Headway between vehicles

When headway is short, the gap between vehicles is dangerously narrow

1 second or less of headway is defined as dangerous driving behavior
3. Land Preparation Measures in Chugoku

2) Standing vehicles, slow-moving vehicles and merging vehicles information provision service
   c. Results of introduction of service

Note: “Merging vehicles present” is only displayed for the inbound lane
4. Conclusions

1. Road-vehicle cooperative safety system

• In the Sangubashi tests, it was confirmed that vehicle behavior became significantly safer.
• After introduction of the service, the accident rate declined dramatically.

2. Infrastructure-only safety system

• Providing information on oncoming, standing, slow-moving or merging vehicles, confirmed that vehicle behavior became significantly safer.
• After introduction of the service, the accident rate declined.