A Basic Study on Evaluation of Social Effects based on Introduction of Mini-bus Circular System

Takao HIGASHINO* and Yasuo HINO**
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Synopsis

In recently, increase of automobiles has caused serious urban traffic problems. Both restraint of the car use and the improvement of public transport system including some kinds of buses must be indispensable. In addition, a new type of public transportation system based on viewpoint to secure mobility and accessibility for vulnerable people is required.

In this paper, both actual condition of bus use and the user's intention on future were analyzed by data obtained by a experiment of the mini-bus circular system in Sakai City of Osaka, Japan. As a result, it was clear that the modal shift to public transport from automobile may be encouraged and the mobility of vulnerable people like aged should be improved by introducing such bus system. Also some issues required to improve to promote these effects were revealed.

KEY WORDS: social experiment, mini-bus, public transport, consciousness survey, urban traffic problem, mobility of vulnerables

1. Introduction

Rapid motorization has brought some serious urban problems in many cities such as traffic accidents, environmental pollution, traffic congestion, decline of public transport, and so on. In order to improve and solve these problems, the suitable modal split should be realized. Especially, a role of public transportation system is extremely important. Therefore, some trials to introduce various new types of system intend to such target.

In this paper, based on the experiment of the mini-bus circular system in Sakai City, some social effects as well as major issues that encourage people to use public transportation system were surveyed and analyzed. And possibility of improving the urban traffic problems by introducing a new public transportation system is also examined basically from the introduction of mini-bus circular system.

2. Outline of Experiment of Mini-bus Circular System in Sakai City

Sakai City, located in south of Osaka Prefecture plays a core role in the region and the population is 803,000 in 1997. While three major railway lines, one tramline run, and four trunk roads run north and south, but transportation facilities connected east and west are in poor conditions because of the geographical features. Under these transportation conditions, there has been heavy traffic congestion and remarkably low services of bus system between north and south in the city.

* Master Course Student, Department of Civil Engineering
** Professor, Department of Civil Engineering
On the other hand, the ratio of aged people in city in 2000 is higher than the average ratio of Osaka Prefecture. Furthermore, the ratio in 2005 expected to be higher than national average.

A case study is located in the north of city where the service level of both public transportation and road facilities are lower than those of other areas, as shown in Table 1. This area should be one of areas required to improve the mobility for vulnerable people. Then, in this area, the mini-bus circular system that the outline is shown in Table 2 was introduced experimentally.

### Table 1 Bus service level by each zone in Sakai City

<table>
<thead>
<tr>
<th>Zone</th>
<th>Number of Bus Stops (point)</th>
<th>Total Mileage (car·km)</th>
<th>Per Unit Area Size</th>
<th>Per Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Bus Stops (point / km²)</td>
<td>Total Mileage (car·km / km²)</td>
<td>Number of Bus Stops (point / km²)</td>
<td>Total Mileage (car·km / km²)</td>
</tr>
<tr>
<td>Sakai</td>
<td>78</td>
<td>7724.3</td>
<td>4.47</td>
<td>442.7</td>
</tr>
<tr>
<td>West</td>
<td>51</td>
<td>3029.1</td>
<td>2.99</td>
<td>177.6</td>
</tr>
<tr>
<td>North</td>
<td>55</td>
<td>3573.1</td>
<td>3.53</td>
<td>229.2</td>
</tr>
<tr>
<td>Center</td>
<td>67</td>
<td>4532.4</td>
<td>3.71</td>
<td>250.7</td>
</tr>
<tr>
<td>East</td>
<td>21</td>
<td>2676.6</td>
<td>2.01</td>
<td>83.1</td>
</tr>
<tr>
<td>South</td>
<td>148</td>
<td>7424.7</td>
<td>3.64</td>
<td>182.4</td>
</tr>
<tr>
<td>Whole Sakai</td>
<td>420</td>
<td>27151.2</td>
<td>3.50</td>
<td>227.5</td>
</tr>
</tbody>
</table>

### Table 2 Outline of the experimental mini-bus circular system

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period</strong></td>
<td>8/11/1999-7/1/2000</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>7.2km</td>
</tr>
<tr>
<td><strong>Number of Bus Stop</strong></td>
<td>19 points</td>
</tr>
<tr>
<td><strong>Number of Service per day</strong></td>
<td>Clockwise : 26 times, Counterclockwise : 26 times</td>
</tr>
<tr>
<td><strong>Time Required</strong></td>
<td>30 minutes</td>
</tr>
<tr>
<td><strong>Capacity of Mini-bus</strong></td>
<td>40 passengers (13 Seats and Driver's Seat)</td>
</tr>
<tr>
<td><strong>Fare</strong></td>
<td>Adult : 100 yen, Child : 50 yen</td>
</tr>
</tbody>
</table>

### 3. Outline of Survey

#### 3.1 Contents of survey

Questionnaire survey was carried out for both bus users and residents along on the bus line, in order to reveal the operational issues based on the actual condition of bus use. For bus users, the frequency of bus use, the Origin and Destination (=OD), the purpose, and so on were surveyed, as well as the opinion for the service of this experimental bus. On the other hand, for residents, both the information, the understanding about this experiment and also the intention of bus use were surveyed.

#### 3.2 The implementation of survey and the ratio of the respondents

1) The survey for bus users

Questionnaire sheets were distributed to passengers with hearing about bus usage as well as personal attribute. Replied sheets were collected by mail. The ratio of respondents was 64% of distributed sheets.
2) The survey for residents

After completing the experiment, Questionnaire sheets were distributed to 900 households, which were selected from residents along the bus route. The number of response by mail was 704.

4. Effects and Issues Mini-bus Circular System

4.1 Basic results of survey

The number of bus users on the days of survey came to an average of 274 persons (5.3 persons per vehicle) on the weekday, 184 persons (3.5 persons per vehicle) on the holiday, and the maximum was 380 persons (7.3 persons per vehicle). Majority of them was the female of middle and old age, as the composition age and sex showed as follows; over 60 years old was 44%, 40-59 years old was 26%, under 39 years old was 30%, and also the female was 65%.

4.2 Frequency and mobility

In case of over sixty percent of the aged people who used this bus system, the frequency of expedition increased as shown in Figure-1. In addition, the trips accompanied by other persons like children or old age people seem to increase, as shown in Figure-2. These results are considered to show the mobility of the vulnerable people such as female, old age and children were improved by introducing this bus service.

![Figure-1 Change of frequency of expedition by age class](image1)

![Figure-2 Change of frequency of expedition with or without companion](image2)
4.3 Change of modal split

As shown in Figure-3, many of mini-bus users had belonged to the group of pedestrians or cyclists. On the other hand, the ratio converted from cars was only around 10%. However, this value may be expected to increase according to the spread both chances and areas introduced such systems. That is, the introduction and spread of such system may improve a part of road traffic problems because of reduction of car use.

![Figure-3 Typical modes before introducing mini-bus system](image)

4.4 Trend of mini-bus system in future

According to the answer of intention of bus use in future, while most users indicated their intentions to keep using mini-bus, 70% of the non-users had no intention of using mini-bus even if it is improved as shown in Figure-4. Therefore, it can be said that strategies from viewpoint of both improvement of bus system and restraint of car use should be indispensable to establish this system based on the stable operation with fixed users. As to the former, the expansion of the operation hour and the supply of the suitable route according to demands should be the most important issues. By the way, 63% of residents along the bus route did not use the mini-bus, in addition 10% of them did not know the introduction of this system, as shown in Figure-5 and 6. Therefore, it goes without saying that especially the publicity of experiment and the encouragement of bus use should be essential.

![Figure-4 Intention of using the mini-bus system in future](image)
5. Summary

Some major finding came out of this study as follows;

1) As the mobility of vulnerable people such as female, aged people and children was improved by this bus system, more improvement may be possible if more suitable routes according to the characteristics of demands are supplied.

2) 30% or more of the non-used people will be expected to use this system according to the improvement of services.

3) According to the expansion of the system in this and other areas, the conversion to this bus service from car use must be possible.

4) The publicity and encouragement of the system should be essential to establish such system to improve the traffic problems in urban area.

Furthermore, in order to improve the major problems caused by automobiles in future, some new trials should be required as follows; the introduction of vehicles with the barrier free facilities, the advanced system integrated with the Park and Ride system (P&R), the Public Transport Priority System (PTPS), and so on, more reasonable fare system including other public system.

Acknowledgement

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