

# **IMPACT OF THE BUS LOCATION SYSTEM ON BUS USAGE**

**- Morioka City -**

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## **ABSTRACT**

The impact of the bus location system introduced in Morioka City in 2003 was evaluated by site observation and questionnaire survey. Information displays were found to present incorrect information with surprisingly high frequency (26–59%). However, 6% of users surveyed indicated that their frequency of bus use had increased after the introduction of the system and 52% of users felt relaxed while waiting for buses because bus location information reduced irritation. But only 2% of respondents made use of the bus location information available on the Internet. Therefore the system should be improved to show more accurate bus location information and should be more widely advertised.

## **INTRODUCTION**

Public transport buses on city routes are often delayed due to adverse traffic conditions, and such delays can discourage the use of buses because of perceptions of poor reliability. Bus location systems are considered as one possible way to help bus users catch buses at the correct time, and could potentially increase the number of bus users by reducing waiting time. The bus location system is in use by 65 bus corporations in Japan and covers 3,500 bus routes, as of fiscal year 2003 (1). A bus location system was introduced in Morioka City in March 2003, and involved the installation of global positioning system (GPS) equipment in buses that transmit their location periodically to a bus information center. The information is processed and distributed to bus users as bus location information on display units at bus stops and on an Internet webpage (2), which is also accessible from mobile telephones. While the displays do not show bus location information in real time, they show fixed information of the destination and scheduled arrival time of the next bus. When the bus is one or two stops away, the display indicates the approach of the bus with an image and indicating the destination of the bus, and

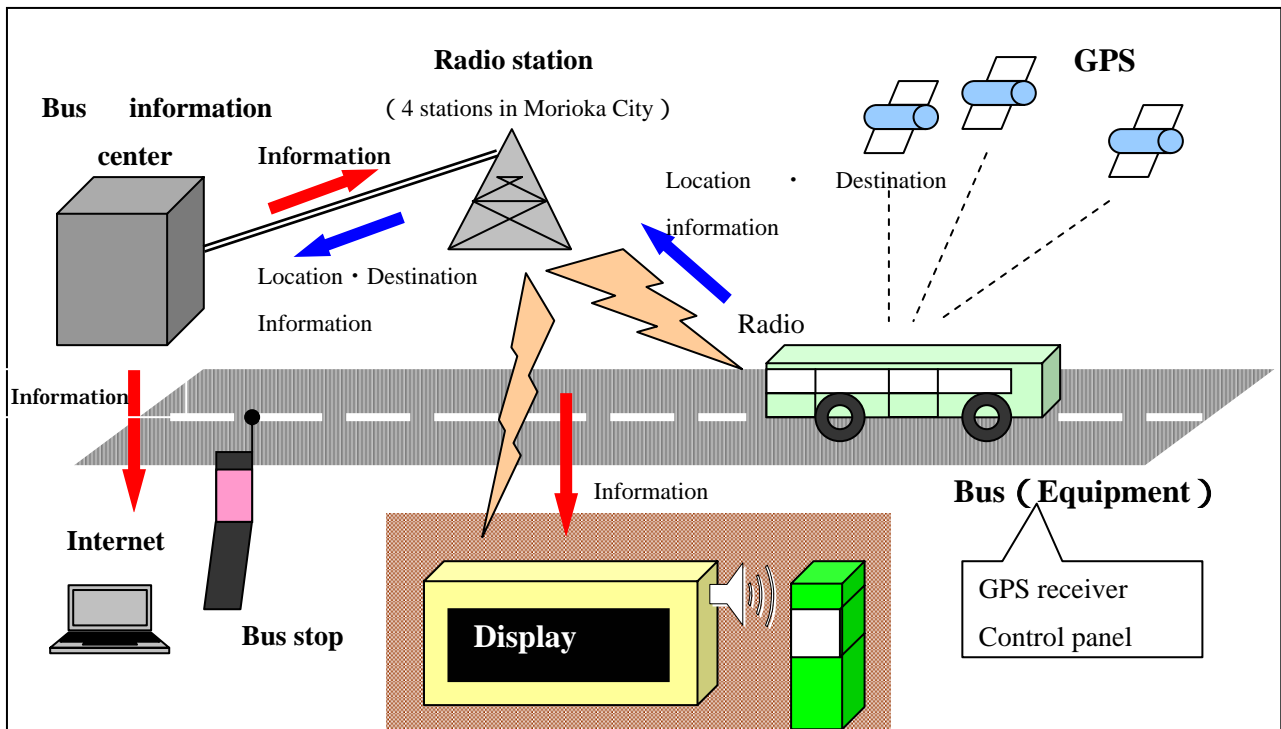


Figure 1. Bus location system



Figure 2. Bus stop and display

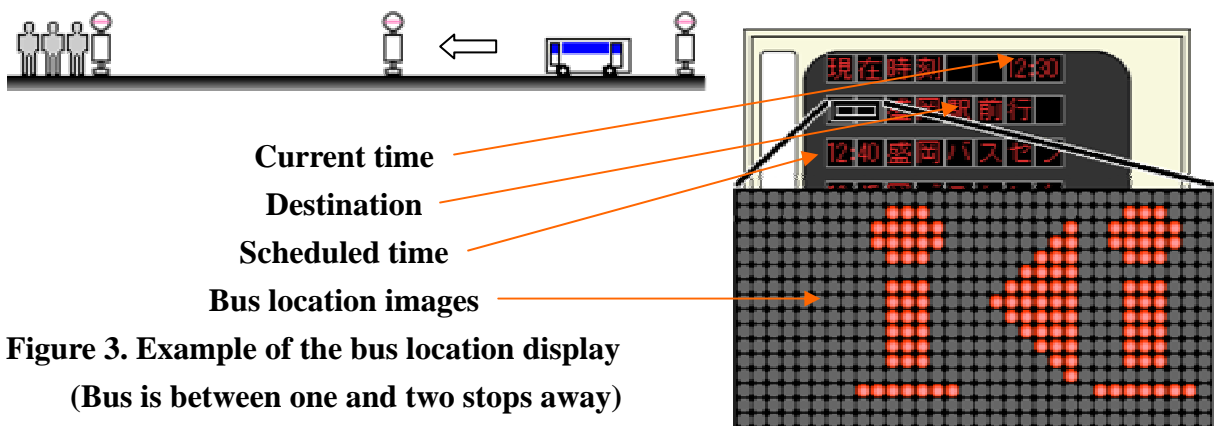


Figure 3. Example of the bus location display  
(Bus is between one and two stops away)

providing an audio announcement when the bus arrives (Figure 1).

Figure 2 shows a bus stop in Morioka City equipped with the bus location information display. Two routes are fitted with this technology. For each route of approximately 10 km, there are 23 stops, 10 of which are equipped with bus location displays. Figure 3 explains the information displayed, and in this case, the bus is between one to two stops away.

## SITE OBSERVATION

### ACCURACY OF THE INFORMATION

The accuracy of the bus location information was evaluated by site observation. The authors selected three major bus stops on each route and recorded the accuracy of bus location information from the first bus to the last bus on three days in 2003. Misinformation was defined as either incorrect display (shown in Table 1) or lack of audio guidance. The results are listed in Table 1. Lack of audio guidance always occurred when the display was incorrect.

Date	Name of bus stop	Misinformation rate (%)		
		Incorrect display*	No audio	Total
June 9	Midorigaoka Sanchome	27.5	9.4	36.9
July 14	Prefectural Central Hospital	51.7	7.0	58.7
October 23	Chuodori Ichome	18.9	7.5	26.4

\*1. No bus location image displayed or 2. No schedule time displayed or 3. Sudden disappearance of information etc.

**Table 1. Misinformation rate**

The misinformation rate was unexpectedly high, and the reasons for this have yet to be determined. However, according to the bus location information manager, these faults may be due to operational error by the driver. The driver must switch on the equipment on the bus and input the destination before leaving the depot. However, some drivers have been reported to forget because they are not yet accustomed to using the system.

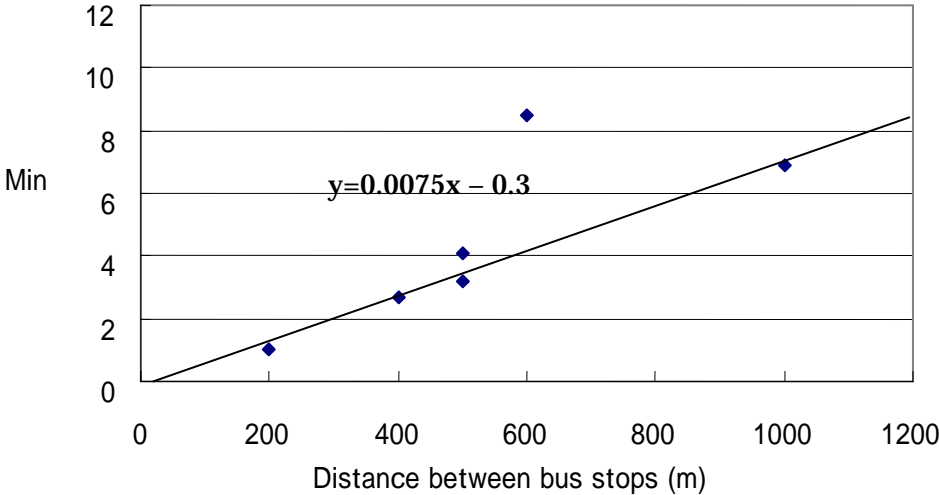
### TIME TO BUS ARRIVAL

The time between the indication of an approaching bus on the display and its actual arrival was calculated. The results are shown in Table 2. The time varies between bus stops due to variable

distances and traffic conditions. At Midorigaoka Sanhome bus stop, average waiting time from the departure of the next bus from the bus stop before is only about 1 minute. However, at Prefectural Central Hospital, the average waiting time is more than 4 minutes. Figure 4 shows the relationship between waiting time and distance between bus stops. The isolated dot in Figure 4 is due to a large signaled intersection between stops that the bus must stop at. This data shows that when the distance between stops is more than 440 m, waiting time will be more than 3 minutes. Due to the irritation that a long wait can cause, the authors suggest that bus users are kept informed of bus arrival times by displaying information at intermittent stages between bus stops than 1 or 2 stops before.

Name of bus stop	Av. Waiting time from 1 <sup>st</sup> bus stop	Av. Waiting time from 2 <sup>nd</sup> bus stop
Midorigaoka Sanhome	1.0 min (0.8)	3.2 min (1.3)
Prefectural Central Hospital	4.1 min (2.3)	6.9 min (2.8)
Chuodori Ichome	2.7 min (2.9)	8.5 min (3.6)

**Table 2. Time from bus shown approaching on the display to actual arrival (Standard deviation in parentheses)**



**Figure 4. Relationship between waiting time and distance between bus stops**

## QUESTIONNAIRE SURVEY

### OUTLINE

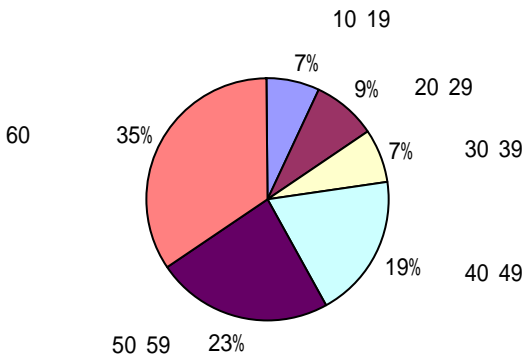
A questionnaire survey of the awareness and evaluation of the bus location system was also

conducted. Questionnaires consisting of 16 items, for return by mail in November 2003, were distributed to 1,000 bus users at 9 bus stops equipped with bus location displays. A total of 421 completed questionnaires were returned (return rate: 42.1%).

**RESULTS**

**Gender, age, and affiliation**

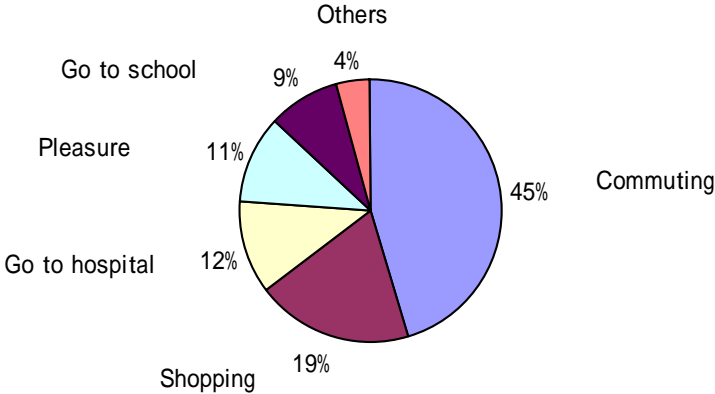
Females accounted for 72.0% of respondents. Such a high percentage might reflect the greater number of female bus users in general. Classification of respondents by age revealed that users aged over 60 years had the greatest representation at 35% (Figure 5), due to fewer seniors holding driver’s licenses than non-seniors, thus making them more dependent on public transportation. Housewives had the largest affiliation (23%),



**Figure 5. Distribution of age (N=418)**

**Purpose and frequency of bus rides**

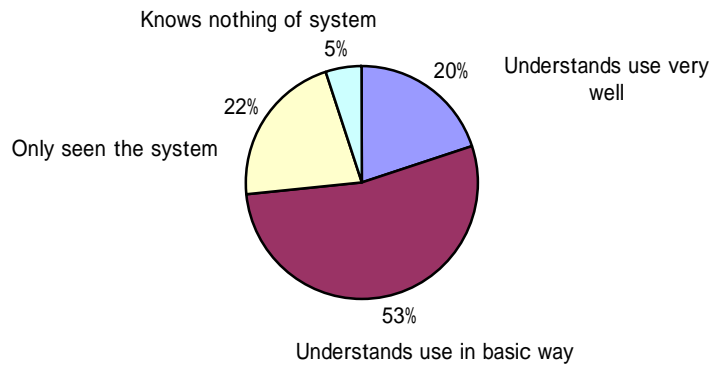
The purpose of bus rides is shown in Figure 6. Commuting held the largest share (45.2%), followed by shopping (19.2%). For frequency of bus rides, half of respondents (48.2%) use the bus almost every day; however, this frequency is likely to be artificially high because the questionnaires were distributed at bus stops.



**Figure 6. Purpose of bus ride (N=416)**

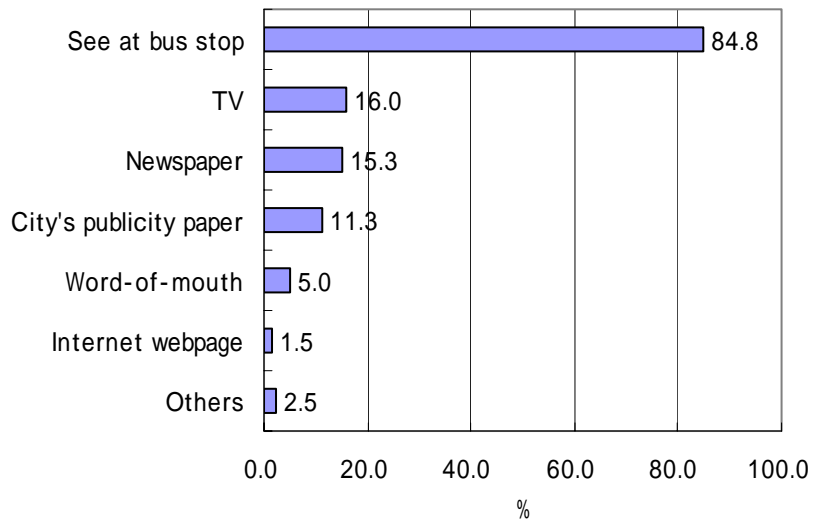
## Awareness of the bus location system

The results show that 20 % of respondents knew how to use the system very well, while 53 % knew how to use it in a basic way, with only 5 % knowing nothing of the system (Figure 7). Thus, awareness of the system appears to be generally high. We also asked respondents



**Figure 7. Awareness of Bus Location System (N=420)**

excluding “Knows nothing of system” how they had first learned of it (Figure 8). Most respondents discovered the system when they saw it at bus stops. Few people had learned of the system through the mass media (e.g. newspaper and TV), because the city authorities had not yet advertised the bus location system actively.

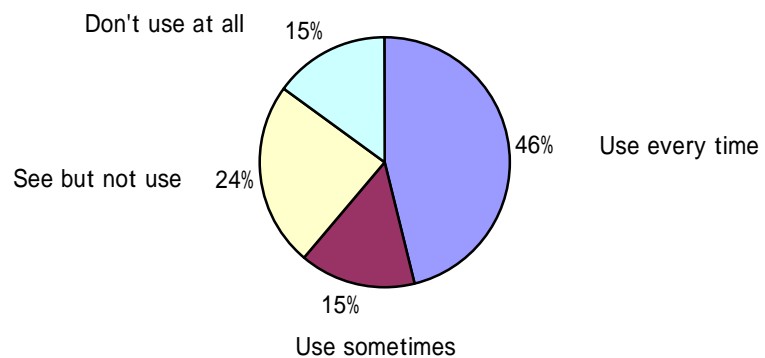


**Figure 8. Source of Information (N=399)**

Only 2 % of respondents made use of the bus location information available on the Internet, including via a mobile phone, perhaps also because of the lack of advertisement by city authorities.

## Use of bus location display at bus stops

The results of the frequency of use of bus location information at bus stops are shown in Figure 9. About half of the respondents make use of bus location information every time they take a bus, and 15% made no use of the information.



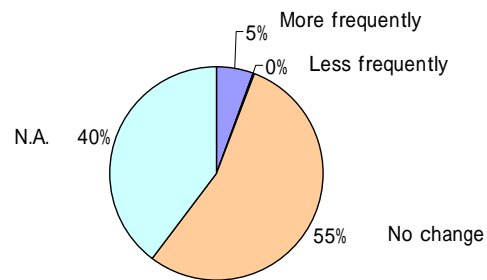
**Figure 9. Use of Bus Location Information (N=421)**

**Usefulness of bus location information**

Of the respondents who replied “Use every time” or “Use sometimes” to frequency of use of bus location information, when asked about the usefulness of bus location information (Figure 9), 71.5% reported the information to be useful. However, a little less than half (48.6%) reported that the information was reliable. This result is similar to that of the site observation, in that respondents felt the information was not necessarily reliable.

**Change in frequency of bus use**

About 55% of respondents stated that they had not increased frequency of bus use following the introduction of the bus location system, while 6% stated that they used the bus more frequently, which is possibly attributable to use of the bus location system (Figure 10).



**Figure 10. Change in Frequency of Bus Use (N=421)**

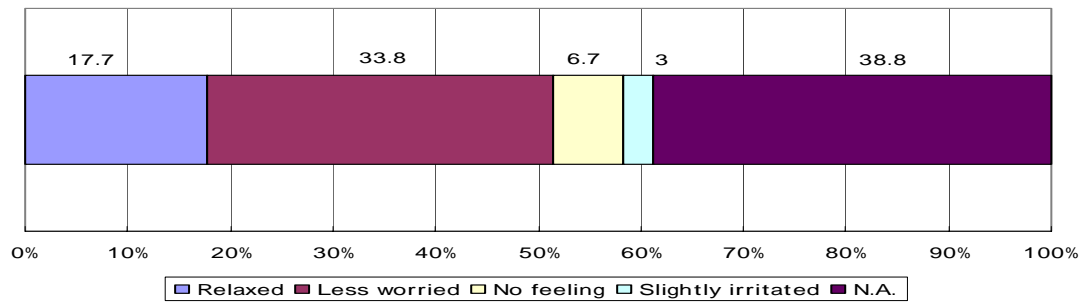
The total bus fare takings did in fact increase by 6% from 2002 to 2003, also possibly as a result of the implementation of this system (Table 3).

Month	April	May	June	July	August	September	Total
Rate	107.0	100.2	109.6	104.3	106.4	106.5	105.6%

**Table 3. Rate of total bus fare takings between 2002 and 2003 (%)**

**Impact of the system on user’s feelings**

About 18% of respondents indicated that they felt more relaxed while waiting for the bus and 34 % were slightly less anxious while waiting due to use of the bus location system (Figure 11). This suggests that the system reduces user irritation while waiting for buses.



**Figure 11. Impact of bus location system on user's feelings (N=421)**

## CONCLUSION

The bus location system was found to display misinformation with surprising frequency, possibly due to operation errors by bus drivers. Although waiting time varied according to the distance and extent of traffic congestion between bus stops, there was generally an excessive waiting time after departure information from the bus stop before was displayed. Therefore, when the distance between bus stops is far, the authors recommend that information be displayed closer to arrival at the bus stop rather than from departure at the bus stop before. User awareness of the system was quite high, but very few users access bus location information over the Internet. Bus authorities should therefore focus on promoting the system to users more effectively. It is interesting to note that despite the rather high rate of misinformation, 6% of respondents increased their frequency of bus use following introduction of the system. Similarly, 52% of respondents felt relaxed by knowing bus location information while waiting for the bus. One goal of the bus location system is to increase the number of bus users, which should be attainable if the system can be improved to show more accurate bus location information and if it is more widely advertised.

## ACKNOWLEDGEMENT

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## . REFERENCES

- (1) By Ministry of Land Infrastructure and Transport
- (2) <http://gps.iwatebus.or.jp>