

# Analysis of Path Finding Errors of Pedestrians Following Introduction of a New Direction Sign System

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**Abstract:** Route guidance information is important to visitors to tourist areas including persons who are not familiar with the area. Supplying a large amount of data may not be always helpful to the users. Therefore, the information system design has to pay attention to supplying the appropriate amount of information using a suitable layout. The primary objective of the sign system in a tourist area is to satisfy the user expectation to visit desirable attractions and use the budgeted time productively without getting lost. The analysis presented here is based on a case study using before and after data of a major tourist area that has modernized the sign system. The main focus of the analysis has been to identify the changes to circulation patterns within the site from view point of quantity and distribution of visitors getting lost.

**Keywords:** *sign system for pedestrians, tourist area, way finding behavior, EASTS IRG22*

## 1. BACKGROUND

In general, people visiting unfamiliar areas need guidance information about accessing specific destinations within the local area network. This is particularly true for visitors to tourist areas. Therefore provision of an effective information system is an important infrastructure issue to review in order to attract more visitors and enhance their level of satisfaction. There are number of guidance systems available but the primary method used worldwide to provide directions is to use permanent signboards erected at the roadside, often near intersections. There are other methods such as paper maps and GPS (global positioning system) enabled devices suitable for personal use to supplement the primary information system available for general public. The method of analyzing the functional effectiveness of a particular system of static roadside signs however, is not well understood.

Mobile phones and smart phones using GPS are gaining in popularity as navigation tools and some researchers have taken the opportunity to discuss differences among navigation methods based on GPS technology, paper maps and on-site signs. For example, Ishikawa et al. (2008) and Field et al. (2011) explored differences between paper map-based and GPS-based navigation. Their experiments appear to indicate that GPS-based navigation system was less effective compared to paper map-based navigation. These studies suggested that sign systems based on personal devices are not always effective for visitors in an unfamiliar area. Therefore, effective installation of traditional sign systems in such sites is

still an important issue to explore.

This study is based on before and after surveys to compare the visitor behavior between the old and modernized sign systems. This project has paid particular attention to investigate changes that has occurred to the circulation pattern, number of attractions visited and the phenomenon of visitors experiencing difficulties finding their way.

The sign improvement project and surveys reported here were carried out at the Nara Park situated at a historical capital in Japan. Over previous 10 years, this site has attracted about 14 million tourists in average per year, including overseas visitors. It is famous for its mix of heritage sites and harmony with the surrounding woodland area. Visiting this site is of great cultural importance to Japanese of all ages, from school children to elderly.

Researchers who have compared the use of paper maps and way finding method based on latest communication technology have observed that in spite of its popularity new technology based methods do not improve the spatial knowledge of travelers. For now, authorities of leisure activity centers such as Nara Park have to modernize the traditional static way finding system to minimize the level of inconvenience to enhance visitor experience. The primary objective of this research work is to monitor impacts on performance of traffic on the road network of the site.

## **2. SIGN SYSTEM IMPROVEMENTS IN NARA PARK**

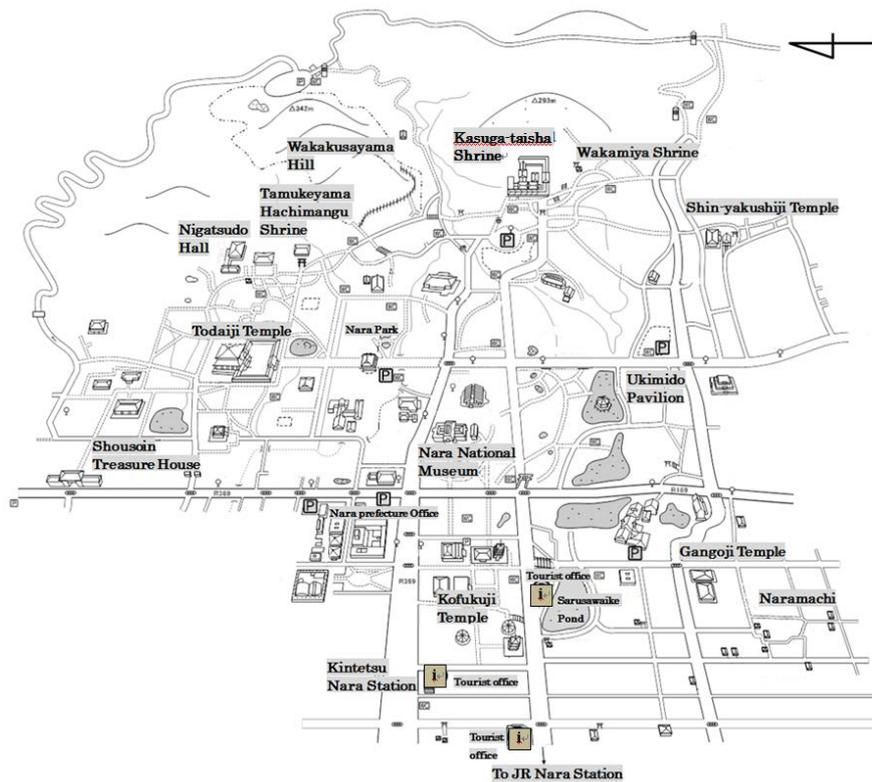
### **2.1 Brief description of Nara Park**

Nara Park was established in 1880 as an urban park managed by Nara Local Government. There are four world heritage sites in this area named Todaiji temple, Kofukuji temple, Kasuga-taisha shrine, and Gangoji temple. This area, excluding Kasugayama virgin forest next to the park, was designated for “Historic Monuments of Ancient Nara” in 1998. In addition to those sites of religious significance, the park contains a museum and green space as shown in Figure 1. Nara Park is an outstanding urban park in which cultural heritage and surrounding green spaces are well harmonized.

There is a difference between the administrative definition and what is commonly accepted by public as the Nara Park. Administratively, Nara Park is the area managed by Nara Local Government and this area does not include separately owned religious properties such as Todaiji Temple, Kofukuji Temple and Kasuga-taisha Shrine. Nevertheless, the general public considers such religious properties also as part of the Nara Park. The area considered in this study has its boundary consistent with this public perception. The researchers had to be mindful of sensitivities of different landlords and negotiate with multiple owners to perform the necessary field work, particularly when gaining permission to do surveys at different locations of what is considered as one park.

Nara was established as the capital of ancient Japan in the year 710, and held that status till relocation of the capital to Nagaoka-kyo in 784. As year 2010 was the 1300 anniversary since the establishment of the ancient capital, series of spectacular events were held to commemorate the centenary. The main site of the anniversary events was the exact location of the ancient capital near Nara Park.

In anticipation of the large number of visitors expected to arrive from all parts of Japan and beyond during that period the Nara local government embarked on a project to upgrade the sign system to a simplified and readily understandable system for both first timers as well as repeat visitors. After the 1300 anniversary event, it was revealed that more than 3.6 million visitors came between April and November 2010 to the main site of the anniversary events.



Figurer 1. Locality map of the study area

The total number of visitors to Nara Park in 2010 was 17.4 million.

The new system of signs within the path of the sightseeing tourists were aimed to provide continuity and consistency in route guidance provided. Previous signs in the Nara Park lacked uniformity and clarity of wording partly because different owners were responsible in installation of signs with little coordination and overall guidance. Furthermore, there were occasions with too many signs along routes with oversupply of information that could overwhelm and confuse visitors. The 1300 anniversary events provided the Nara local government the opportunity to embark on this project to upgrade the sign system within the park to a simplified and readily understandable system for both first time and repeat visitors.

## 2.2 Sign system improvements in Nara Park

Selection of attractions to be included in the guidance destination set was given much thought at the planning stage of the new sign system. This was achieved through a ranking process that relied on two interrelated selection criteria. One criterion considered for ranking of attractions is the heritage importance and the other is the popularity. The significance to heritage is determined through inspection of the status of the attraction in the register of 'important cultural properties'. This classification was adopted as the basis of ranking attractions within the park according to the cultural significance. Some cultural properties enjoy an elevated status within the nation and are referred to as 'national treasures' and they have been placed at the top of the ranking system. However, some 'national treasures' are open only at selected periods during the year and these were ranked below full time attractions for the purpose of this project. The top half of the Table 1 shows how heritage (criterion 1) was accounted for in determination of the ranking of attractions for the purpose of signage design.

Table 1. Ranking of attractions within the zone

Attribute		Rank A	Rank B	Rank C	Rank D
Heritage	National treasures - open for public all year around	✓	✓		
	National treasures - available only at selected periods			✓	
	Important cultural properties - open for public all year round			✓	
	Important cultural properties - available only at selected periods				✓
Popularity	Very high popularity in the first survey	✓			
	High popularity in the first survey		✓		
	Medium level popularity in the first survey			✓	
	Described in major guidebooks and tourist brochures	✓	✓	✓	✓
Number of attractions		4	25	19	24

The other criterion adopted is the popularity, which has been measured from responses to the first questionnaire survey that is described later in Section 3. The lower half of Table 1 refers to the classification of attractions according to the level of popularity (criterion 2). Another obvious consideration is whether the site has been mentioned in guide books, tourist information websites and other documentation accessible to general visitors. The first survey revealed that most newcomers visited four major attractions. They were designated as rank A attractions of the park. The four sites were Todaiji temple, Kofukuji temple, Kasuga-taisha shrine and Nara National Museum all of which enjoy the highest status according to the significance to heritage criterion as well. A similar association was observed between rankings according to heritage and popularity, in the lesser ranked attractions as well. There were four sites as named above classified as rank A attractions. The number of attractions finally selected in each rank is shown in the last row of Table 1.

Figure 2 provides a schematic diagram for comparison of the concept of previous signs and the improved sign system. The former sign system shown in the left side of the figure lacked uniformity and clarity of explanations as there were no identifiable logic or hierarchy in directions provided. Information was accurate but had little user focus. The design concept of the improved sign system is shown in the right side which attempted to be aligned with user expectations. From the view point of planners, it has been expected to encourage visitor circulation among attractions and provide a sense of confidence to visitors that they are unlikely to get lost. The proposed concept was based on (1) the site importance considered through the ranking system already mentioned and (2) distance to attractions.

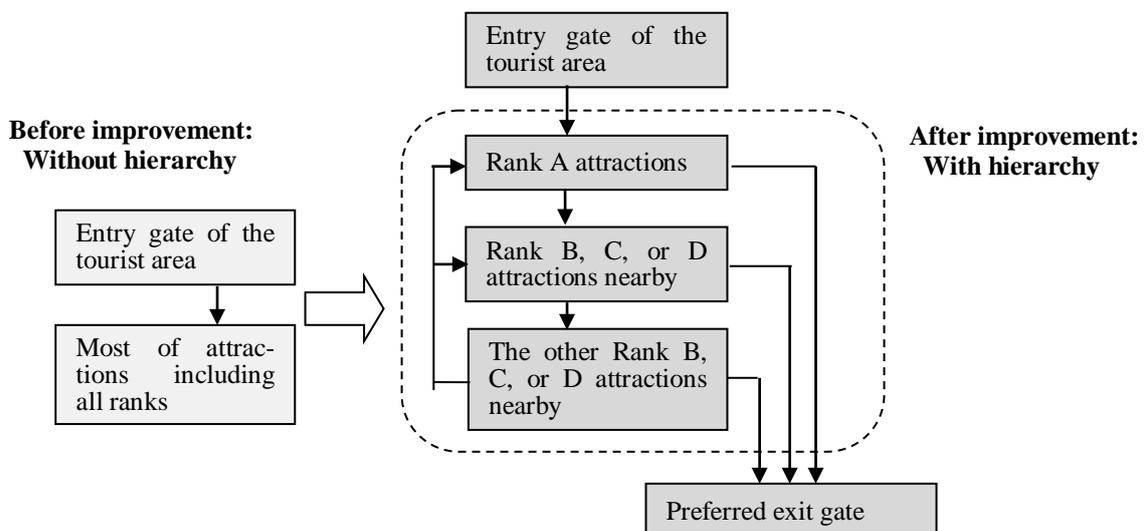


Figure 2. Concept diagram of the design objective of the modified sign system

There are three types of signs in the modified sign system of the Nara Park. They have been named arrow signs, map boards and explanatory signs. The arrow signs are the simplest category. Here, destination boards are mounted on vertical posts and precisely aligned and spaced between each other to avoid the old style haphazard appearance. To further reduce the clutter, the maximum number of arrow boards mounted on a post was limited to 6. And the maximum number of destinations that can be indicated by one arrow was set to 2. Symmetry of signs is attempted where possible for aesthetic reasons. A consistent symbol system similar to computer icons is also included in the destination board to indicate the type of destinations.

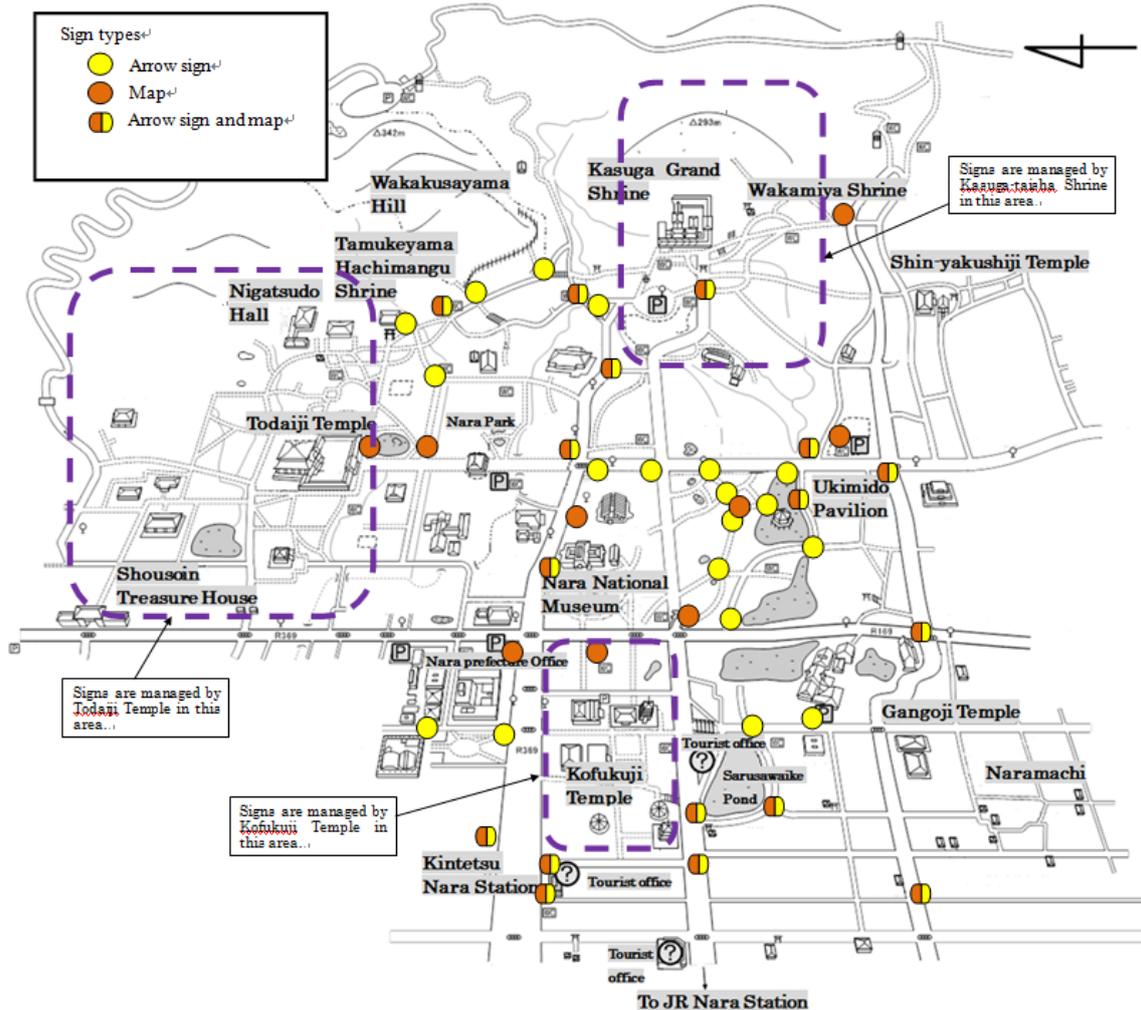


Figure 3. Present sign system in Nara Park

Map boards and explanatory signs are vertical display panels, usually below the eye line of the visitors. An appropriate title is at the top frame of these displays. These information panels are mounted on two side posts and the posts are driven into a paved surface to complete the professional appearance of these signs. Map boards are helpful in providing orientation as well as the overall layout of sites whereas explanatory signs are helpful in providing a narrative and photographs to explain significant details related to this heritage site.

As mentioned earlier, religious properties are separate jurisdictions and signs on those properties cannot be interfered with by the park authorities. These separate administrative zones are indicated by dotted line boundaries shown in Figure 3. Therefore the sign improvement project team decided to leave signs within those boundaries without change. In

other words those areas have the old style signs at their original locations.

Similarly, Naramachi area located in the South West part of the Figure 3 are managed by the Nara City Government, and the sign system there is completely different form signs reconstructed by Nara Prefectural Government. Most of these signs are old and considered difficult to understand as navigation aids especially to new comers but this area was also left out of the sign improvement project to avoid conflicts with the responsible entity.

### 3. RESEARCH METHODOLOGY

#### 3.1 Survey of Circulation and Way finding Behavior

This study investigates the effect of sign system improvements through field surveys of “way finding behavior” and “circulation behavior”. There were two main expectations from the improved sign system. They were, increase of circulation level and decrease in effort required for way finding as indicated in Figure 3. This study performed before and after questionnaire surveys, four times, at approximately 2 year intervals. Questionnaires were distributed to visitors at the site to be filled and returned by post.

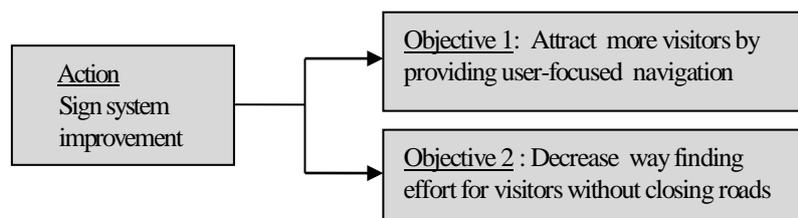


Figure 4. Planning objectives of the sign system improvement project

#### 3.2 Data Collection

Questionnaire surveys were performed at four different years in 2008, 2010, 2011, and 2013. The survey in 2008 was carried out to investigate the situation before the sign system improvement, and the surveys in 2010, 2011, and 2013 belong to different stages after improvement. In 2010 the improvement was about 30% completed, and in 2011 most improvements were completed except within historic sites owned by Todaiji Temple, Kasugataisha Shrine, and Kofukuji Temple. The number of questionnaires distributed and response rates are shown in Table 2. The fourth survey carried out in 2013 provided a return envelope with a physical stamp individually pasted on it and achieved the highest response rate.

Table 2. Summary of questionnaire distribution and response rates

	Year of survey			
	2008	2010	2011	2013
Progress of sign improvement	0 %	30 %	100 %	100 %
Number of questionnaires distributed	10,020	932	2,000	997
Number of questionnaires returned	1,075	298	711	507
Response rate	10.7%	32.0%	35.5%	50.9%

### 3.3 Characteristics of respondents

The percentage of female respondents was between 50% and 60% in the four surveys and always larger than that of male response rate.

As shown in Figure 5, respondents between 30 and 40 years old account for 10 - 20 % of the sample, between 40 and 50 account for also 15 - 20%, between 50 and 60 account for 21 - 28%, between 60 - 70 accounts for 22 - 26%. It can be said that age distribution in these surveys do not have large bias. In general there was little variation of the response rate except for the groups under 20 and above 70 years of age.

Table 3. Gender distribution of respondents in different surveys

Gender	Year of survey			
	2008	2010	2011	2013
Male	529 (49.2 %)	109 (36.6 %)	245 (34.9 %)	205 (44.1%)
Female	546 (50.8 %)	188 (63.1 %)	404 (57.5 %)	260 (55.9%)
Total	1,075 (100.0 %)	298 (100.0 %)	702 (100.0%)	465 (100.0%)

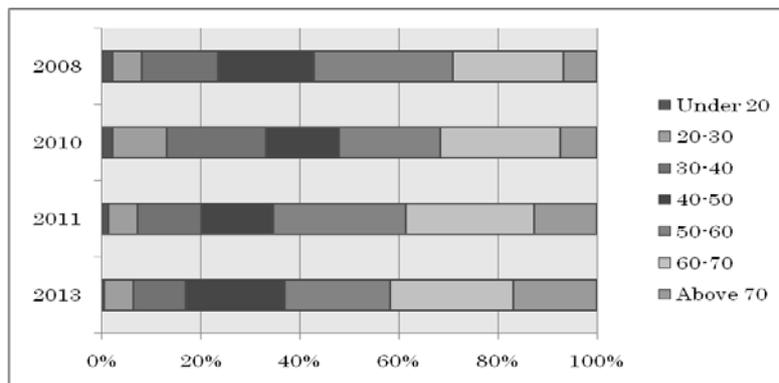
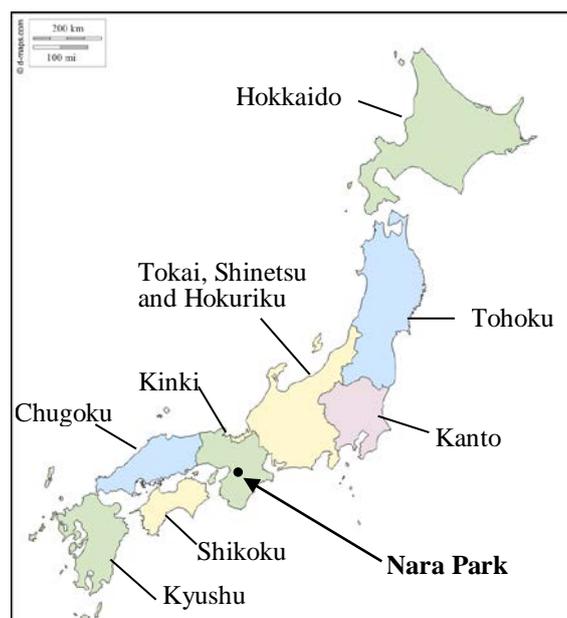


Figure 5. Age distribution of respondents in the four surveys



Note: Modified from the map available at [http://d-maps.com/carte.php?num\\_car=71883&lang=en](http://d-maps.com/carte.php?num_car=71883&lang=en)

Figure 6. Visitor origin regions considered (i.e. main regions of Japan)

For the purpose of identification of origins of visitors, Japan has been divided into eight regions as shown in Figure 6. Most visitors of Nara Park had come from Kinki Region immediately surrounding Nara Park, except in 2010 when the 1300 anniversary events were held in the ancient capital site close to Nara Park when there was a surge from all other parts of Japan as well. Figure 7 shows that in 2010 when 13<sup>th</sup> centenary celebrations were held, the most number of visitors (about 30%) came from Kanto Region where the capital Tokyo is located and has the largest population among the eight regions.

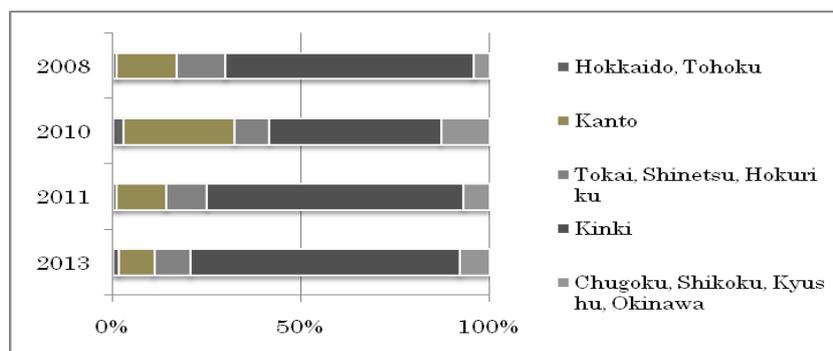


Figure 7. Distribution of origin locations of visitors

This study classified visitors as newcomers and repeat visitors into two categories according to their familiarity with the park. A newcomer is a person visiting for the first or second time to the park. Because majority of Japanese schools have excursions to this important historical area, it was decided to discount that visit. Newcomers have been considered to be unfamiliar with the orientation and layout of the park whereas repeat visitors possess some familiarity. A repeat visitor is a person who made at least two previous visits to Nara Park. Figure 8 shows that in 2010 newcomers were more than 30% when the 1300 anniversary events were held, whereas the percentages in other years were about 20%.

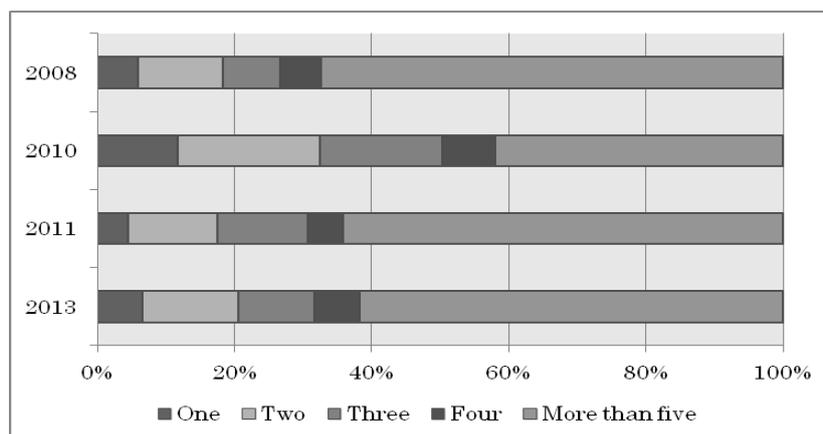


Figure 8. Count of visits (including the current day) to Nara Park

Information sources used by visitors are shown in Figures 9 and 10. Figure 9 shows that internet, guidebooks, and pamphlets were the major sources of information prior to coming to the site. After arriving at Nara Park, street sign system is the most influential source that amounts to about 40% of the sample. Then, guidebooks and maps obtained from the information center together amounted to about 40% of responses.

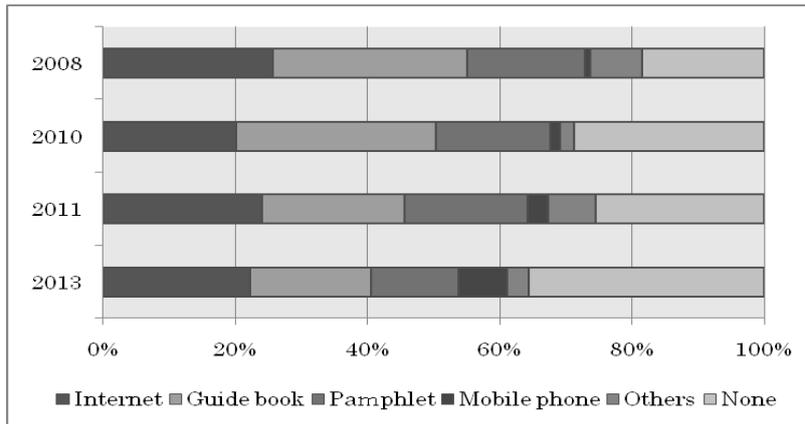


Figure 9. Information sources prior to arrival at Nara Park

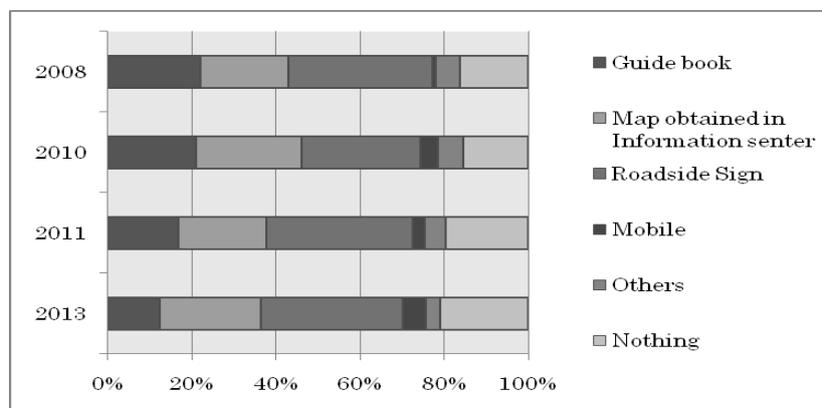


Figure 10. Information sources after arriving at Nara Park

## 4. ASSESSMENT OF VISITOR BEHAVIOR WITH SIGN SYSTEM IMPROVEMENTS

### 4.1 Use of the sign system

As mentioned earlier, some visitors are familiar with Nara Park and others are not familiar with it. It can be expected that user expectations of the of sign system is different according to familiarity with Nara Park. Table 4 indicates that the relationship between familiarity with Nara Park and frequency of use of the sign system. The question related to the sign system usage was asked only in the third survey carried out in 2011, and it is acknowledged that comparable data for other years are not available.

From this table, it is clear that new comers often rely on the sign system as seen by values 15, 15, 32 and 31 in the four cells at the upper left corner. On the other hand, the percentage of those often using signs reduces with the number of visits. Then, there is a corresponding increase of the percentage of visitors not using signs with the number of visits. Interestingly, this keeps the percentage of visitors using signs occasionally at a steady level in the range of 40 to 50% irrespective of the number of visits.

In general, repeat visitors contained more of older persons whereas newcomers contained more of younger persons as expected. Therefore the breakdown according to newcomers and repeat visitors given above may provide some ability to view the roadside sign usage of an aging population. However, the older groups have more experience with the site and therefore they are able to manage with less reliance on guidance information according to Table 4.

Table 4. Level of use of sign system by familiarity in Nara Park from 2011 survey.  
(Note: Percentage values are shown within brackets)

Number of visits		Sign usage			Total
		Often	Sometimes	Never	
1	New comers	15 (46.9)	15 (46.9)	2 ( 6.2)	32 (100)
2		32 (47.0)	31 (45.6)	5 ( 7.4)	68 (100)
3	Repeat visitors	20 (37.7)	26 (49.1)	7 (13.2)	53 (100)
4		10 (30.3)	15 (45.5)	8 (24.2)	33 (100)
More than 4 times		59 (20.8)	124 (43.9)	100 (35.3)	283 (100)
Total		136 (29.0)	211 (50.0)	122 (26.0)	469 (100)

## 4.2 Changes in way finding behavior

This study classified user experience of way finding errors into three types. These were "completely lost", "slightly lost", and "never lost". Percentages of visitors in each category are illustrated in Figure 11. Completely lost experience was 4.2% in 2008 and decreased a little in following surveys although, the percentage increased a little in 2010 when visitors from far away origins increased because of the 1300 anniversary events. Anyhow, the percentage value was around 5% over the five year period of the surveys. On the other hand, the percentage with slightly lost experience increased from about 15% in 2008 to about 20% after 2010. This may appear counterintuitive but it will be shown later that the average number of attractions visited per person also increased during this period. We discuss changes in way finding behavior and changes to circulation in sections 5 and 6.

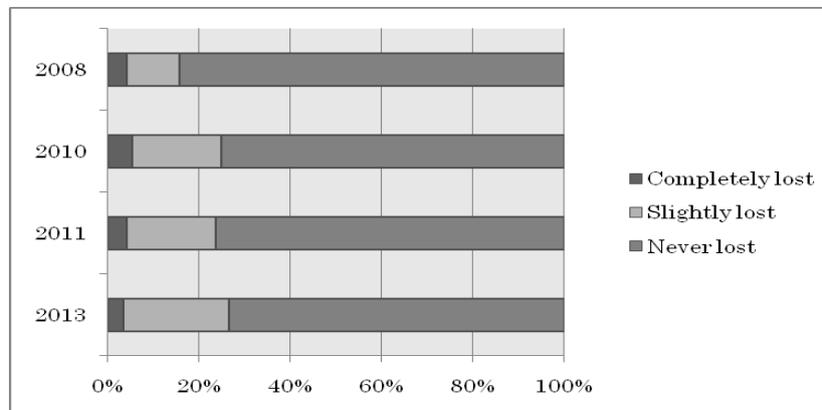


Figure 11. Percentage of visitors according to the level of way finding difficulty

## 5. ANALYSIS OF WAY FINDING BEHAVIOR

### 5.1 Locations where visitors lose their way

An attempt was made to record the distribution of locations where visitors lose their way. Here, attractions were divided into 6 zones as shown in Figure 12 and identified in the tabulation provided at the bottom of the figure. The study areas were divided into 5 zones, and the remaining space was considered as the 6<sup>th</sup> zone for the purpose of this arrangement.

In the survey, the respondents were asked to when they got lost by naming the origin and destination landmarks at the time of the problem in addition to the approximate location

of the event. At the next step of the analysis, origins and destinations of trips where visitors encountered way finding difficulties were transformed to zone numbers specified above.

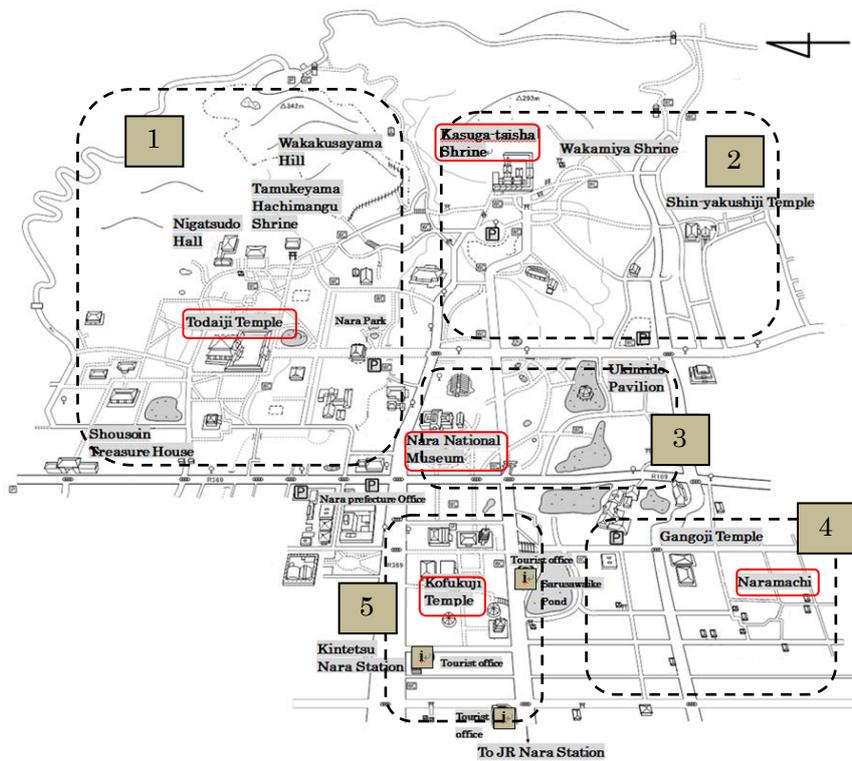
Then it was possible to compute a numerical magnitude for the intensity of way finding errors. An index referred to as the proportion of way finding difficulties is introduced for this purpose. This value is available by dividing the number of respondents who lost their way between a given zone pair by the total number of visitors who have reported to have travelled between that zone pair in the same direction. Therefore;

$$P_{ij} = L_{ij} / T_{ij} \tag{1}$$

Where  $P_{ij}$  = Proportion of travelers experiencing way finding difficulties between origin  $i$  and destination  $j$ ;

$L_{ij}$  = Number of respondents who lost their way between origin  $i$  and destination  $j$ ; and

$T_{ij}$  = Number of respondents who traveled between origin  $i$  and destination  $j$ .



Zone	Major facilities
1 Todaiji Temple area	Todaiji Temple, Shosoin, Nigatsudo, Temukaiyama-hachiman Shrine, Yakakusayama Hill
2 Kasugataisha Shrine area	Kasuga Shrine, Wakamiya Shrine, Shin-Yakushiji Temple
3 National Museum area	Nara National Museum, Ukimido
4 Naramachi area	Gangoji Temple, Naramachi
5 Kofukuji Temple area	Kofukuji Temple, including Kintetsu Nara Station
6 Other space	Other attractions

Figure 12. Zoning for analysis of way finding difficulties

For the purpose of analysis, visitors who reported completely lost or slightly lost experience were counted in the numerator of the above formulation.

Table 5 shows values of above proportions computed for zone pairings in the second row of each cell. The first row in each cell contains two numbers, the first value is the number of respondents reported to have lost their way (i.e. the numerator of the above computation) and the second value within brackets is the total number of respondents who have reported to

have travelled between the particular origin destination pair (i.e. the denominator of the above computation). First five zones were considered as the relevant origins and destinations.

Table 5 allows us to identify areas where way finding problems were more frequent. In Table 5 cells that exceeded 10% are indicated in red font. Red value cells in the generation column and attraction rows provide an initial indication for zones and pairings of concern. More than 10% visitors who went to Naramachi zone lost their way in each of the four surveys. Visitors leaving Kasugataisha zone have provided unacceptable level of this value in the last two surveys performed. Therefore, comparison of data from the four surveys does not show a reduction in way finding errors to users even after the sign system improvement. This is in agreement with observations from Figure 11. Section 6 will further analyze this ineffectiveness aspect of the new sign system.

Table 5. Proportion of way finding difficulty values in four surveys

2008 survey

Destination Origin	1 Todaiji Temple	2 Kasugataisha Shrine	3 National Museum	4 Naramachi	5 Kofukuji Temple	Generation
1 Todaiji	11 (134) 8.2	4 (76) 5.3	0 (38) 0	4 (24) 16.7	2 (135) 1.5	21 (407) 5.2
2 Kasugataisha	4 (50) 8.0	5 (29) 17.2	2 (17) 11.8	3 (17) 17.6	1 (62) 1.6	15 (175) 8.6
3 Museum	3 (125) 2.4	1 (42) 2.4	5 (16) 31.3	2 (52) 3.8	1 (170) 0.6	12 (405) 3.0
4 Naramachi	0 (11) 0	3 (8) 37.5	1 (13) 7.7	4 (14) 28.6	2 (107) 1.9	10 (153) 6.6
5 Kofukuji	2 (109) 1.8	0 (37) 0	4 (298) 1.3	5 (66) 7.6	0 (161) 0	11 (671) 1.6
Attraction	20 (429) 4.7	13 (192) 5.0	12 (382) 3.1	18 (173) 10.4	6 (635) 0.9	69 (1811) 3.8

2010 survey

Destination Origin	1 Todaiji Temple	2 Kasugataisha Shrine	3 National Museum	4 Naramachi	5 Kofukuji Temple	Generation
1 Todaiji	8 (124) 6.5	4 (42) 9.5	0 (9) 0	4 (19) 21.1	2 (107) 1.9	18 (301) 6.0
2 Kasugataisha	2 (55) 3.6	5 (16) 31.3	1 (11) 9.1	1 (4) 25.0	1 (32) 3.1	10 (118) 9.3
3 Museum	1 (11) 9.1	0 (5) 0	0 (0) 0	1 (6) 16.7	1 (16) 6.3	3 (38) 7.8
4 Naramachi	1 (11) 9.1	0 (5) 0	0 (1) 0	3 (9) 33.3	1 (43) 2.3	5 (69) 7.2
5 Kofukuji	4 (106) 3.8	6 (48) 12.5	0 (19) 0	6 (29) 20.7	6 (111) 5.4	22 (313) 7.0
Attraction	16 (307) 5.2	15 (116) 12.9	1 (40) 2.5	15 (67) 22.4	11 (309) 3.6	58 (991) 5.9

2011 survey

Destination Origin	1 Todaiji Temple	2 Kasugataisha Shrine	3 National Museum	4 Naramachi	5 Kofukuji Temple	Generation
1 Todaiji	15 (238) 6.3	6 (79) 7.6	2 (49) 4.1	5 (46) 10.9	5 (190) 2.6	33 (602) 5.5
2 Kasugataisha	9 (47) 19.1	5 (21) 23.8	5 (18) 27.8	4 (14) 28.6	1 (44) 2.3	24 (144) 16.6
3 Museum	8 (168) 4.8	1 (20) 5.0	1 (4) 25.0	4 (34) 11.8	5 (132) 3.8	19 (358) 5.3
4 Naramachi	1 (11) 9.1	1 (6) 16.7	1 (13) 7.7	7 (24) 29.2	3 (121) 2.5	13 (175) 7.4
5 Kofukuji	10 (169) 5.9	1 (28) 3.6	5 (256) 2.0	10 (66) 15.2	2 (147) 1.4	28 (666) 4.3
Attraction	43 (633) 6.8	14 (154) 9.1	14 (340) 4.1	30 (184) 16.3	16 (634) 2.5	117 (1945) 6.0

2013 survey

Destination Origin	1 Todaiji Temple	2 Kasugataisha Shrine	3 National Museum	4 Naramachi	5 Kofukuji Temple	Generation
1 Todaiji	19 (207) 9.2	11 (90) 12.2	2 (25) 8.0	3 (25) 8.0	7 (136) 5.1	42 (483) 8.7
2 Kasugataisha	19 (87) 8.0	4 (16) 25.0	1 (20) 5.0	1 (25) 4.0	5 (59) 8.5	30 (207) 14.5
3 Museum	2 (18) 11.1	1 (31) 3.2	0 (0)	3 (8) 37.5	2 (36) 5.6	8 (93) 8.6
4 Naramachi	0 (9) 0	0 (3) 0	1 (8) 12.5	3 (9) 33.3	3 (74) 4.1	7 (103) 7.8
5 Kofukuji	6 (165) 3.6	5 (68) 7.4	4 (36) 11.1	8 (40) 20.0	3 (111) 2.7	26 (420) 6.7
Attraction	46 (486) 9.5	21 (208) 10.1	8 (89) 9.0	18 (107) 16.8	20 (416) 4.8	113 (1306) 8.7

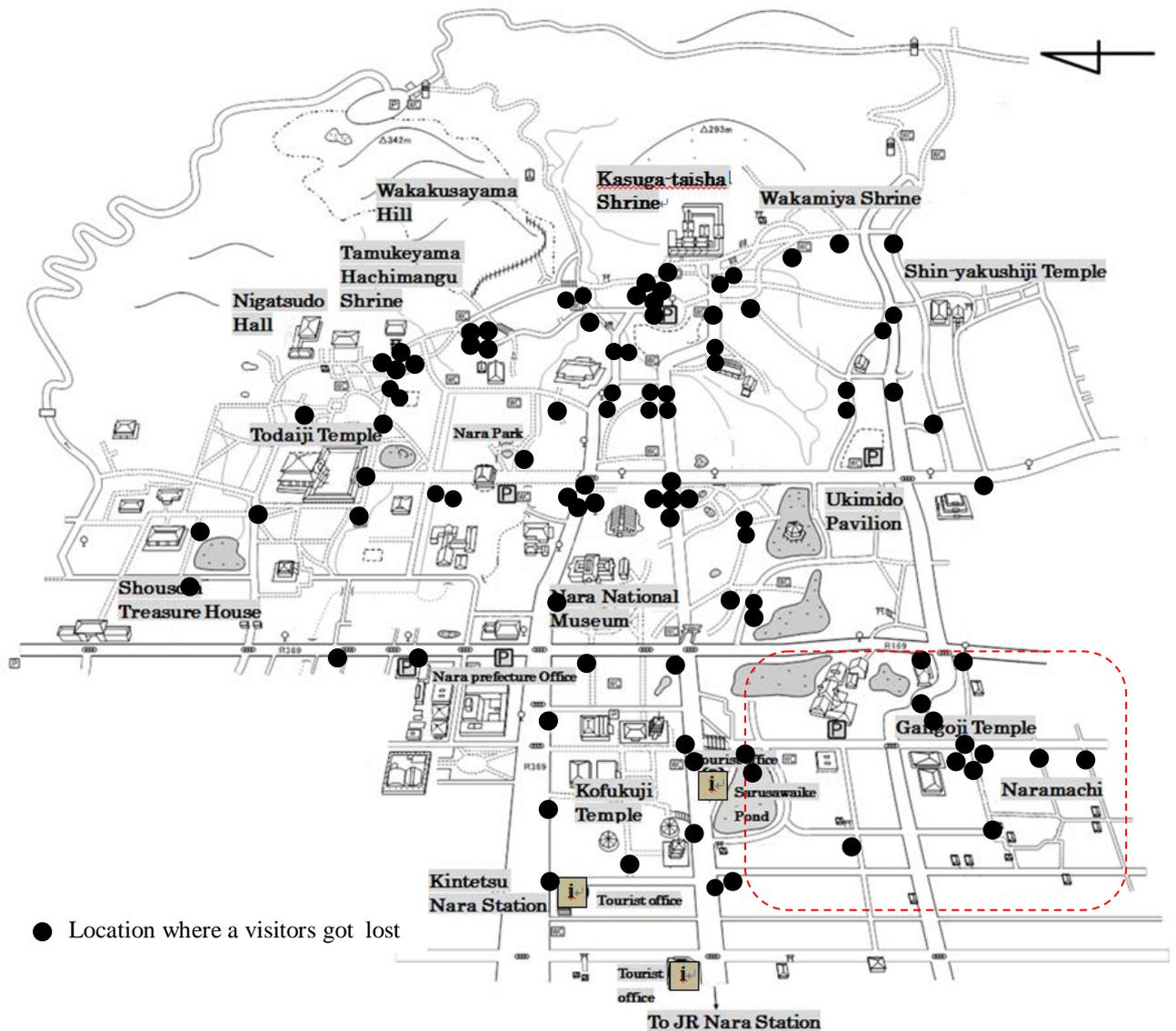


Figure 13. Locations where visitors lost their way

Locations where visitors got lost have been plotted in Figure 13. As expected from observation of Table 5, the distribution of these locations appears more dense in the upper left

quadrant of Figure 13, mainly between Todaiji Temple and Kasuga-taisha Shrine. Similarly there is a patch of high density area of black spots on the lower right corner of the map, in the Naramachi zone.

From way finding point of view, Naramachi zone needs attention for two issues. For some visitors finding the way to Natamachi was difficult. For some others, circulation within the zone was the problem. Kasugataisha Shrine area has a different kind of a problem because relatively high proportion of visitors leaving Kasugataisha Shrine zone encountered way finding errors.

As mentioned in section 2.2, Kasugataisha Shrine and Naramachi zones being private properties, the sign modernizing project could not be fully implemented in those zones. Many old signs remain according to wishes of those property owners. Therefore some incompatibilities exist with modern signs introduced during the improvement project. Further coordination of signs is necessary in these zones.

**5.2 Way finding methods used by those getting lost**

The way finding methods visitors were using before they got lost were classified into the following three categories, including;

- (a): Signs
- (b): A paper map
- (c): Other ; i.e. not a map or signs.

Figure 14 shows that the percentage of visitors who were using signs was about 40 percent and using maps was also about 40 percent, about 80 percent in total. In other words most visitors relied on traditional guidance sources although they were not perfect in assisting users.

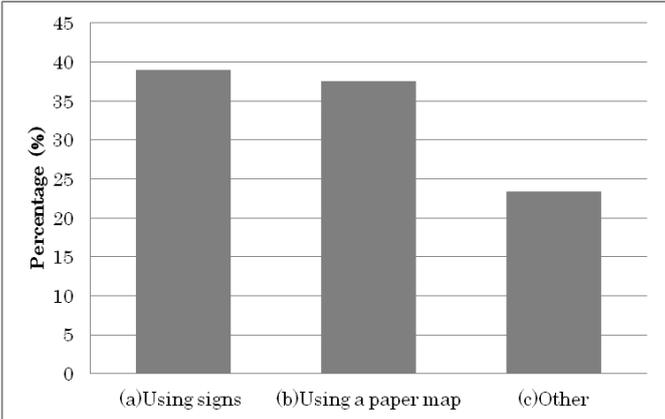


Figure 14. Breakdown of percentage of encountering difficulties according guidance used before visitors got lost

The distribution of way finding method used, however, has a somewhat different pattern when the analysis was done with respect to the location where the way finding error occurred. It is acknowledged that the sample size is low when the overall sample was divided to perform the analysis specific to different zones. Figure 15 indicates that lost visitors following signs account for about 50 percent around Todaiji and Kasuga-taisha Shrine zones. On the other hand, approximately 60 percent of lost visitors were using paper maps around Naramachi and Kofukuji Temple zones.

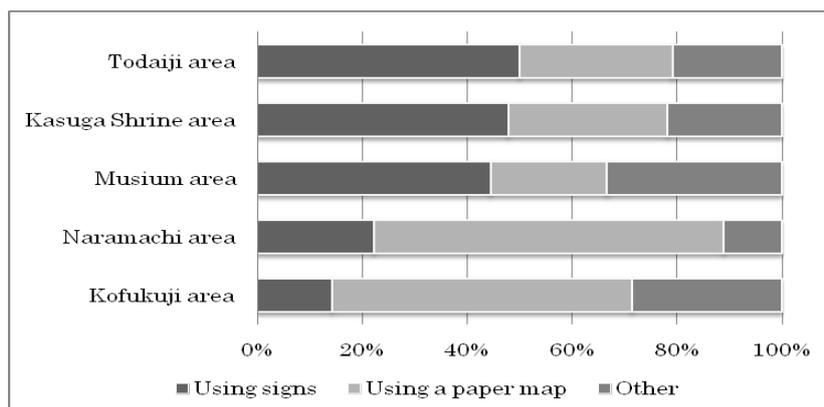


Figure15. Location distribution where visitors lost their way

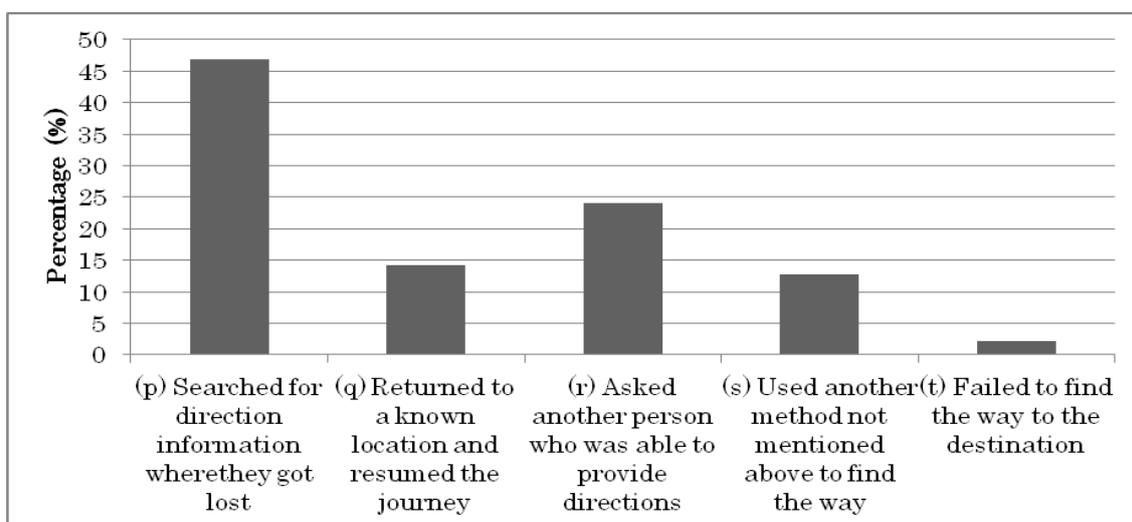


Figure16. Distribution of recovery behavior

### 5.3 Way finding recovery behavior

Invariably, visitors who lost their way tried to recover from the incident to resume the journey. Survey allowed five answers to the relevant questions. What did the respondent do to find the way to the planned destination when they got lost? Answers were separated into following five categories:

- (p) Searched for direction information where they got lost,
- (q) Returned to a known location and resumed the journey,
- (r) Asked another person who was able to provide directions,
- (s) Used another method not mentioned above to find the way.
- (t) Failed to find the way to the destination.

Figure 16 shows that the most frequent behavior in a lost situation was looking for direction information in the neighborhood of the incident. The percentage of this response was 47%. The next frequent behaviour was to ask someone (24% of the sample) a small percentage of those who got lost had failed and given up searching for the planned destination.

The breakdown of this behavior with signs and no signs available at location of the lost incident is shown in Figure 17. It indicates that if signboards were available at the location then 60% of lost visitors could manage to find the way by searching for information nearby.

As expected, when signs were not installed at such a location, the percentage who can recover directly from the lost location is reduced according to Figure 17. Interestingly, returning to a known location and other strategies researchers have not mentioned have become more useful on a percentage basis, when sign posts were not available, according to this analysis.

**6. CHANGES IN CIRCULATION BEHAVIOR**

**6.1 Circulation behavior during sign system improvement**

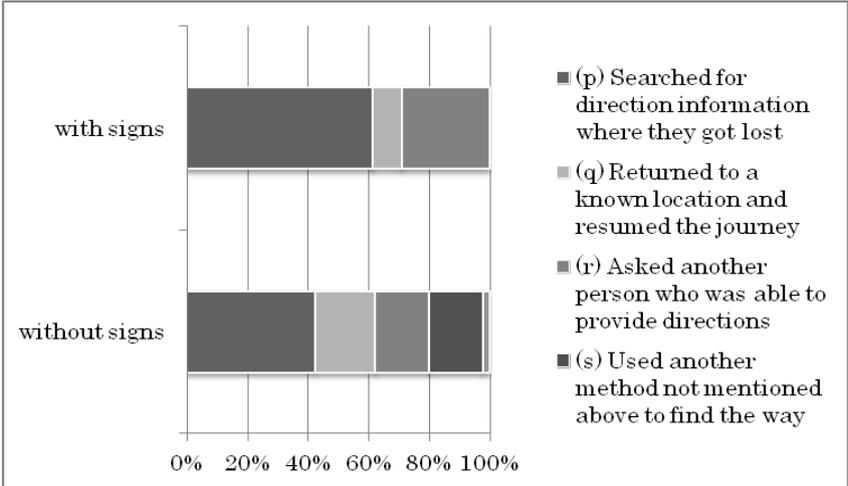


Figure 17. Comparison of recovery behavior with and without signs

Here, we investigate way finding behavior and level of circulation among attractions using Figure 18 which provides the average number of attractions visited per visitor. The average values for overall samples show a jump going from 2008 to 2010 and then a smaller jump going to 2011 surveys. The values appear to have stabilized after that showing only a small increase from 2011 to 2013. As explained in an earlier section, the 2008 survey represents the before sign improvement project. By 2010, the project was partially complete and 2011 represents the first fully complete sign systems installed by the prefecture. It has been verified that the difference is significant between the average number of visits in 2008 and 2011, and 2008 and 2013 based on t-test at 1% significant level. T-test has also shown that there is a statistically significant difference between 2008 and 2011, and 2008 and 2013 for repeat visitors. On the other hand, the apparent difference between 2008 and 2011, and 2008 and 2013 values are not significant for newcomers at 1% significant level.

Comparing the repeat visitors and newcomers, average number of attractions visited by newcomers was larger than those visited by repeat visitors in each survey. That is partly because that the new comers tend to visit many popular attractions as possible, on the other hand the repeat visitors are likely to focus on their favorite attractions.

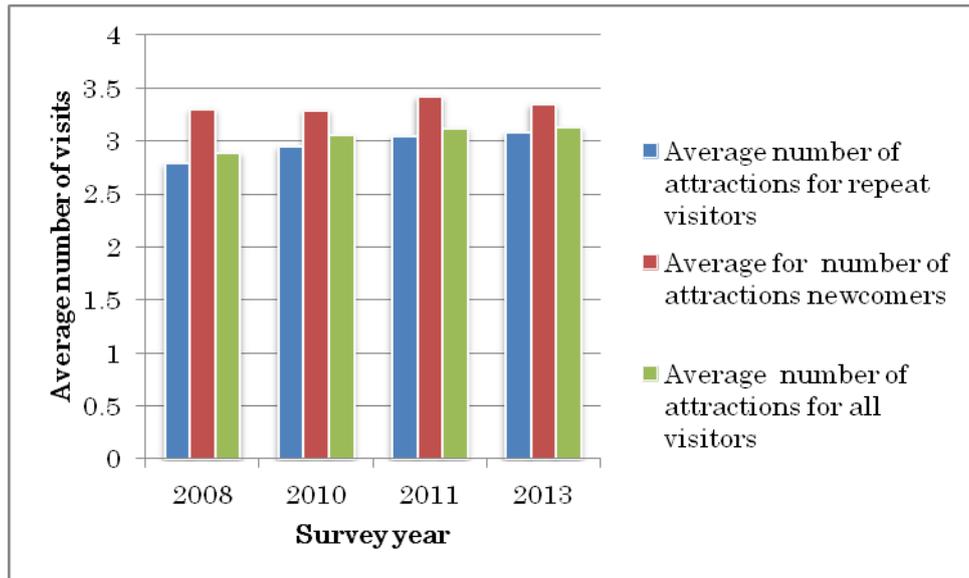


Figure 18. Average number of attractions visited

## 6.2 Relationship between way finding efforts and increase of circulation level

Section 4.2 and Figure 18 have already shown that getting lost percentage has slightly increased after the sign system improvement although the percentage getting completely lost has decreased and stayed decreased after the full implementation. Figure 19 now explains how these different results fit together. In the face of the increased circulation in terms of number of attractions visited per person, the proportion of the worst category of way finding errors have reduced and remained low. This indicates a general decline in way finding errors experienced by users. This maybe also interpreted as an improvement of the ‘quality’ of the guidance system. Nevertheless, the total amount of visitors getting lost to some extent (though not to the serious level), has increased in keeping with the increased amount of travel performed within the study area by each visitor. This indicates that there are still challenges ahead to be solved by the project team.

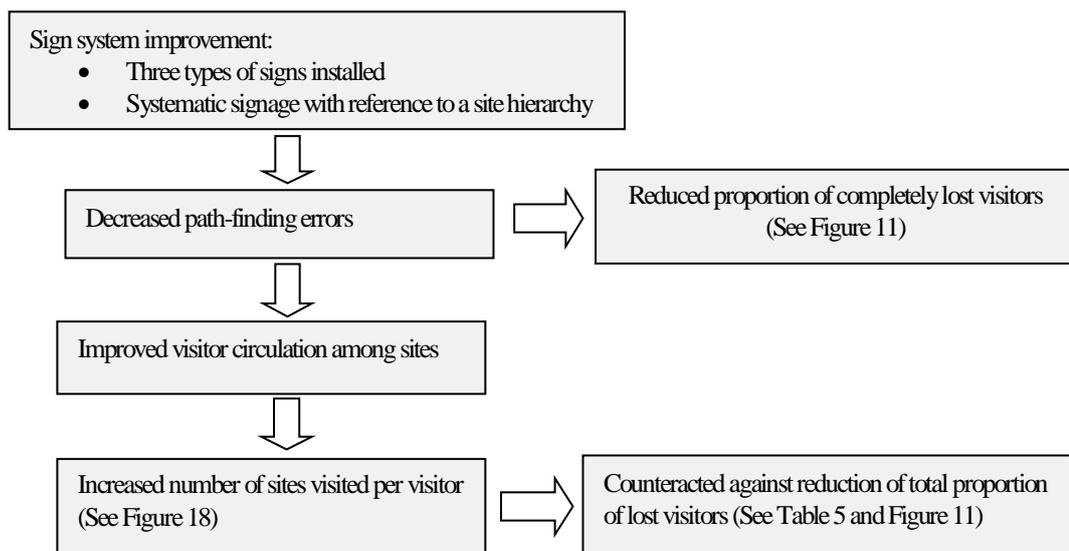


Figure 19. Observed effects of the sign system improvement

## 7. CONCLUSIONS

This study has investigated the effects on users following the sign system improvement project in the Nara Park containing many famous attractions including world heritage sites. This study is based on a series of data collections conducted as one before and three after surveys. Section 4 has shown that percentage of visitors using roadside signs have increased. This can be regarded as a positive outcome from the sign system improvement. Research value of this project is in demonstration of the ability to quantify impacts of the sign improvement activity to capture the experience of users in terms of way finding difficulties and the number of attractions they can visit.

As described in Section 5, percentage of visitors getting lost did not reduce after sign system improvement although the percentage who claimed to have been completely lost has reduced. This is an interesting situation created because the average number of attractions visited per visitor increased during the sign system improvement as shown in section 6.2.

The analysis presented has shown that visitors getting lost are more frequent in Naramachi and Kasuga-taisha zones. These areas correspond to areas where owners of properties could not be convinced to fully cooperate with the new signs project. A black spot diagram has been prepared to aid the analysis that has also referred to a numerical index to help identify the intensity of navigation errors experienced by visitors. These measures have provided an insight to the nature of the navigation errors that occur in problem areas. The difficulty to visitors at some locations is to how to find the location. At some other locations the difficulty is in efficiently locating an exit path to the next destination.

Analysis method is able to identify locations where further improvement of the sign system is required.

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