Planning Roadside Sign System for a Historical Park to Minimize Path Finding Errors

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Abstract: Sign systems in tourist areas are expected to give correct information for the benefit of visitors who could be familiar or unfamiliar with the area. A well designed sign system can improve the visitor's circulation within the area to improve exposure of attractions and facilities there. The aim of the signs is ensure visitors can visit more attractions than before. This study investigates the sign system in Nara Park which is one of most popular tourist areas in Japan. The new sign system introduced in 2011 has visitors circulation improved, although the number of visitors getting lost visitors has not deceased. This study investigates the rate of getting lost with respect to the installed sign system.

Keywords: sign system, trip chain, path finding error, Nara Park, IRG-22-2013

1. Introduction

1.1 Background

This study is concerned with identifying the impact of a roadside sign system on visitor movement experience at a historical park. Sign systems in large tourist areas such as Nara Park are important to ensure positive visitor experience with such areas. Administratively, Nara Park is the area constructed and managed by Nara Prefecture in central Japan. Though Nara Park does not include their surrounding historical areas owned by religious properties such as Todaiji Temple, Kofukuji Temple and Hasuga-taisha Shrine, most tourists consider such surrounding areas also as a part of the Nara Park. Furthermore, it appears that most tourists do not distinguish between nearby Nara-machi area and Nara Park as officially designated. From the view point of the general public, all areas described above as falls within 'Nara Park', and this study has adopted the wider definition of the public for the purpose of current analysis.

Nara Park attracts about 13 million visitors per year. A development project for modification of the sign system managed by Nara Prefecture was carried out leading up to 2010 as part of preparation for the 13th Centenary celebrations, considered one of the

most significant historical milestones for the nation and an opportunity to showcase this heritage area.

Religious properties (mentioned above) are separate jurisdictions and signs installed in their properties could not be interfered with by the park authorities. Also, the most signs in Nara-machi, a popular mixed retail shopping and residential area, were not changed as they were managed by a different administrative authority, Nara City. Under these circumstances, there are four areas with different sign system ownership arrangements:

(a) Areas with signs owned by Nara Prefecture - most of these signs are improved for a special even in 2013,

(b) Areas with signs owned and maintained by relevant landlords - These older style signs have remained unchanged,

(c) Areas with a mixture of signs, in particular near property boundaries, where new signs were installed by Nara Prefecture without changing or removing with signs constructed by landlords,

(d) An area where the sign density is relatively low for the road network density in the neighborhood. These are primarily owned by Nara City.

This study team has earlier investigated the circulation rates based on before and after surveys. The upgraded sign system has not been able to make a significant reduction of the rate of visitors getting lost events (Tsukaguchi et al. (2015)).

Signs in the area (a) and a part of the area (c) have been changed as shown in Figure 1.

Before improvement   After improvement

Figure 1 Signs in Nara Park before and after improvement

1.2 Previous studies

There are few studies focused on behavioral change by sign system arrangement and improvement. For example, we can show the following studies on the issues. Chiyoda (2006) studied the effect of temporally arranged public signs in Matsuyama City, Japan. Reagin (2002) discussed the effect of improved sign system in Vali, a ski resort in Colorado, USA. Mukai et al. (2011, 2012), Tsukaguchi et al. (2013) studied the effect of sign system improvement strategies in Nara Park. Also, the survey method applied to investigate way finding behavior was reported in Tsukaguchi et al (2015).

In general, there are two main reasons for supplying roadside signs for pedestrians. The category of signs considered in this paper aims to deliver correct way finding information to potential destinations for visitors who may or may not be unfamiliar with the area. There is another category of signs, with the particular objective of maximizing evacuation efficiency installed for the purpose of handling emergency or disaster situations. Such study treated that aspect as beyond the scope of the current study.

The authors conducted number of questionnaire surveys of visitors performed at Nara Park in different years in 2008, 2010, 2011, and 2013 (Tsukaguchi et al (2015)). The summary of the questionnaire surveys are shown in Table 1.

Table 1 Summary of questionnaire distribution and response rates

		Year of survey			
		2008	2010	2011	2013
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%
Progress of sign improvement		0 %	30 %	100 %	100 %
Percentage of getting lost	Completely lost	4.2%	5.4%	4.0%	3.4%
	Slightly lost	11.5%	19.5%	19.7%	23.0%

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, Kasuga-taisha Shrine, and Kofukuji Temple.

This study classified user experience of way finding errors into three types including "completely lost", "slightly lost", and "never lost". Completely lost experience was 4.2% in 2008 and the percentage was around 5% over the five year period of the surveys. On the other hand, the percentage with slightly getting lost increased from about 15% in 2008 to about 20% after 2010. This may appear counterintuitive. But it has been also apparent according to the sign system improvement, the average number of attractions visited per person increased from 2.89 in 2008 to 3.43 in 2013.

1.3 Purpose and methodology

The sign system improvement in Nara Park raises the average number of attractions,

on the other hand, it has not influence to reduction of getting lost. Therefore in order to make clear the effectiveness of sign system improvement, it is necessary to investigate the sign system more deeply. The purpose of this study is to investigate reasons for getting lost events in order to provide guidance to design of effective sign systems. This study is able to propose practical ways to improve the current sign system in Nara Park.

This study focuses on events of individual tourists getting lost and the nature of sign boards available in surrounding area. All signs in Nara Park constructed by Nara Prefecture, Nara city and temples or shrines become the object of this study. As mentioned above, the authors carried out four times questionnaire surveys. Addition to these, A face to face interview survey was carried out in 2015 (Wu et al (2016)).

This paper mainly relies on data from the questionnaire survey in 2013 and interviews conducted in 2015 in particular to derive recommendations related to reducing way finding errors.

2   Brief description of sign system in Nara Park

2.1 Types of Sign in Nara Park

There are currently three types of sign providers in Nara Park. As mentioned earlier, they are Nara Prefecture, owners of certain temples and shrines, and Nara City.

Signs constructed by Nara Prefecture have been redesigned and renovated in 2010 to coincide with the 1300 anniversary events held that year. Those signs were simplified to a readily understandable system suitable for visitors. For the purpose of improving their sign system, park attractions were classified in an importance hierarchy as illustrated in Figure 2 (Tsukaguchi et al (2015)). Attractions were classified into four types, as Types A to D where A was for the most important and D was for the least important attractions according to (α) a public perception survey conducted earlier and (β) a government registry of historical properties (Tanaka et al (2009). In 2011, sign improvements were complete except within historic sites owned by Todaiji Temple, Kasuga-taisha Shrine, and Kofukuji Temple. Addition to these, signs constructed by Nara City remained unimproved.

Concept plan for selection of content and style of roadside signs constructed by Nara Prefecture within the Park grounds are shown in Figure 2.
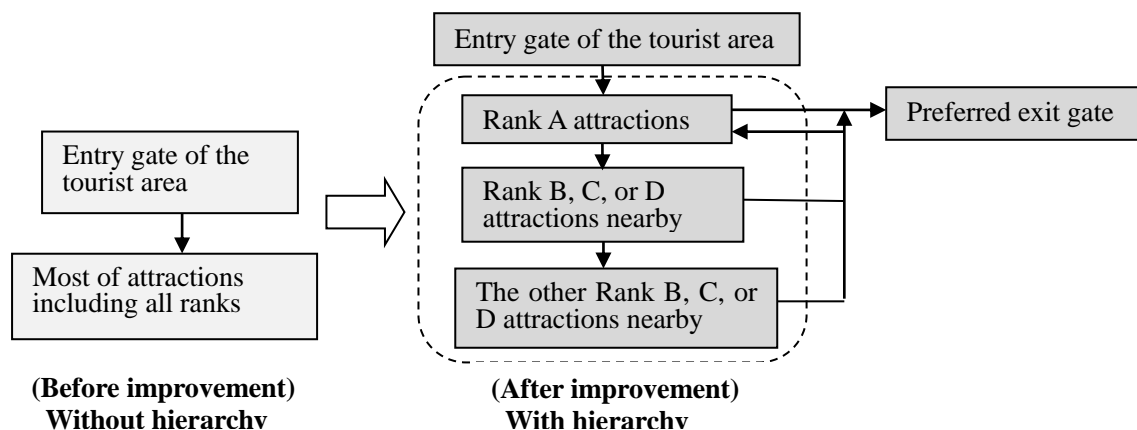

Figure 2 Concept diagram of design objective of the modified sign system

For the purpose of balancing simplicity and consistency of the prefecture constructed signs, the number of styles of signs has been limited to three. Figure 3 shows examples from each of the style categories. The first category is referred to as 'map boards' which focused on providing an overview of the spatial distribution. The next type is called 'arrow signs' which focused on providing directions to destinations and landmarks by pointing arrows (see Fig 3). A consistent icon system has been adopted to denote landmarks, destinations and services indicated on arrow signs. About 50% of signs provided by the prefecture are arrow signs. The third category is called 'Map and Arrow signs', indicating these locations contain a hybrid version of map boards and arrow signs. About 20% of signs provided by the prefecture belonged to this 'map and arrow' category (see Table 2).

Figure 3 Examples of signs improved by Nara Prefecture

On the other hand, signs constructed by Temples and Shrines, and those constructed by Nara City remained as they were in the past. Some examples are shown in Figure 4. When maps are shown as the example shown in Figure 4, they are inaccurate schematics designed for the purpose of highlighting facilities and services for the sign owners benefit. Even arrow signs maintained by temples and shrines are laid out in haphazard and unhelpful manner, making them difficult to convey the correct direction. Nara city maintains the square post type signs from a different era which are primarily of value as curiosity items pointing at sites that may have been of some importance in past. These posts in Nara-machi area require an effort from road users to decipher the content in a useful manner to find specific destinations.


| Todaiji Temple | Kasuga-taisha Shrine | Nara City |

Figure 4 Examples of sign boards constructed by other organizations

## 2.2 Spatial distribution of different types of signs

An inventory survey was carried out in June and July 2016 to document the current situation of all signs installed in Nara Park. Figure 5 shows the spatial distribution of roadside signs constructed by Nara Prefecture. Figure 6 shows the spatial distribution of signs belonging to other organizations. It can be readily observed that there is an overlap of signs installed by different providers, spread out over this historical park land.

Table 2 shows number of signs cross-tabulated according to the sign owners and area where the signs are located. It can be seen there that Nara Prefecture accounts for about 35% of signs in the study area, but those signs are reasonably spread across complete park. Locations of signs constructed by temples and shrines are mostly within their properties, as it could be expected. More than 80% of signs owned by Nara city are found in Nara-machi Area. Many of these signs are the square post type displayed in a Figure earlier in this paper.
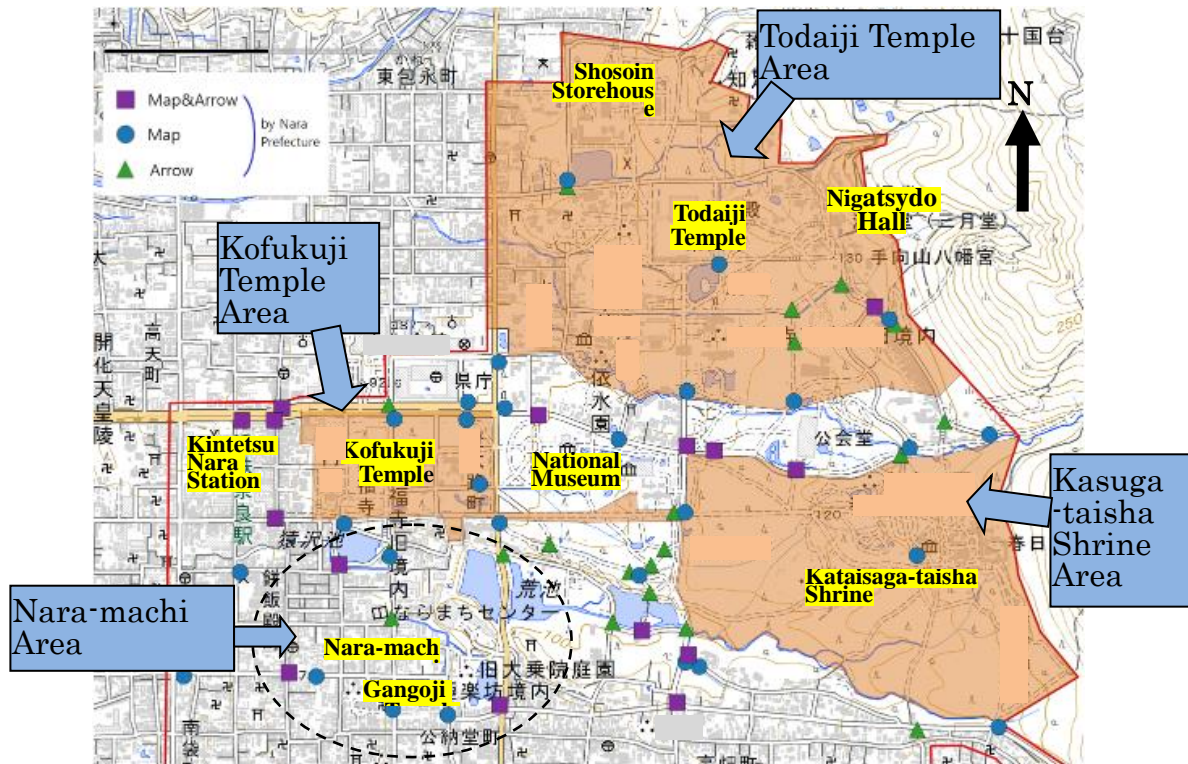
Note:(1) Orange-colored areas are historical grounds owned by religious properties.
    (2) Since Todaiji temple is large temple, there are several famous attractions including Daibutsuden, Nigatsudo Hall, and Shosoin Storehouse. 'Todaiji Temple' in this map is shown in the location of Daibutsuden which is the most famous attraction in this temple.

Figure 5 Current sign boards improved by Nara Prefecture
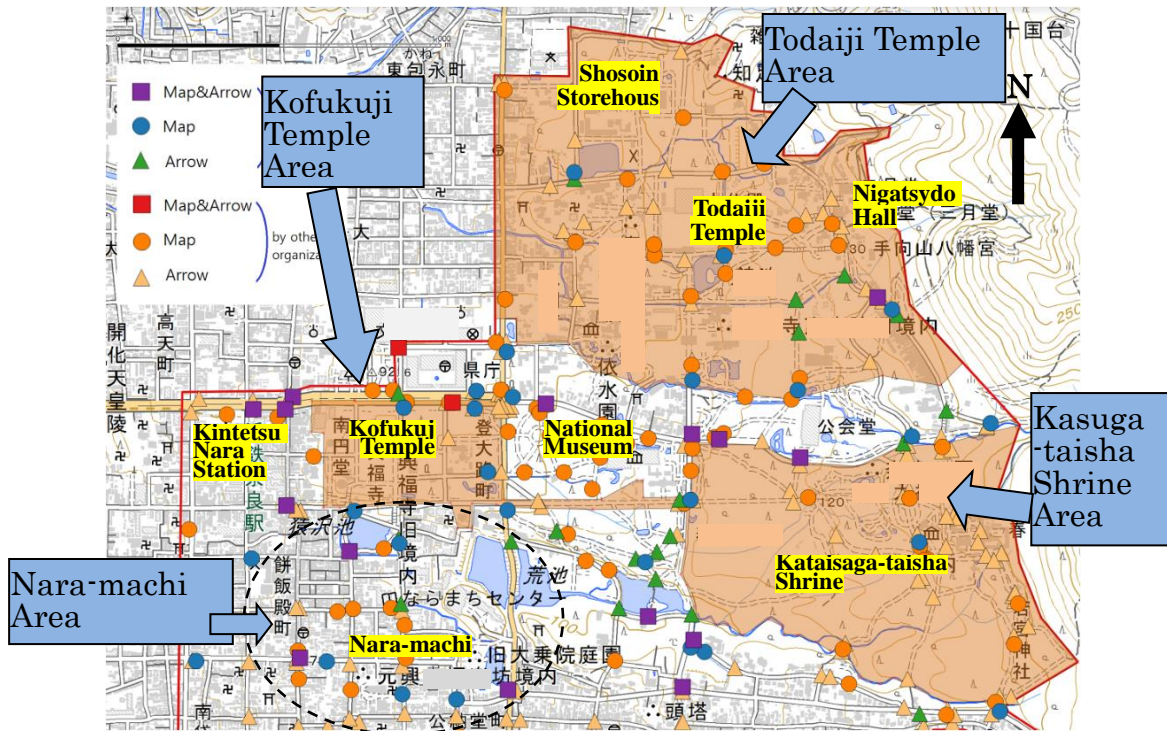
Note:(1) Orange-colored areas are historical grounds owned by religious properties.
(2) Since Todaiji temple is large temple, there are several famous attractions including Daibutsuden, Nigatsudo Hall, and Shosoin Storehouse. 'Todaiji Temple' in this map is shown in the location of Daibutsuden which is the most famous attraction in this temple.

Figure 6 Current all sign boards located around Nara Park

Table 2 Cross-tabulation of current road signs in Nara Park Area

Organization	Sign type	Location			Total
		Prefectural Nara Park	Temples and Shrines	Nara-machi etc	
Nara Prefecture	Map	22	3	12	37
	Arrow	18	1	2	21
	Map & arrow	10	0	7	17
	Sub total	50	4	21	75
Nara City	Map	1	4	0	5
	Arrow	0	2	33	35
	Sub total	1	6	33	40
Temples and Shrines	Map	0	25	13	38
	Arrow	1	58	0	59
	Sub total	1	83	13	92
Total		52	93	67	212

3   Common reasons for getting lost in the park

3.1 Locations of getting lost

Where visitors get lost was surveyed using a self-administered questionnaire survey performed in 2008, 2010, 2011, and 2013.   As mentioned before, this paper mainly

uses the data from survey performed in 2013. Responses were collated on to the map of Nara Park to identify problem areas from the point of view of way finding. There were 90 respondents whose getting lost place was identified on the map. Figure 7 identifies the reported locations where respondents lost their way with star symbols. The size of the star symbol is proportional to the number of reported lost-events. This method was applied to prepare a shortlist of six priority locations to investigate. These are labeled from (A) to (F) in Figure 7.

Figures 5, 6 and 7, and Table 2 were inspected to identify the type of signs available in the vicinity of the locations where visitors getting lost reports were high. Table 3 summarizes preliminary observations.

Table 3 Relationship between getting lost behavior and sign boards installation

| Spots	Characteristics of roadside signs	Owner
(A) and (B)	Most Sigs in these areas are constructed by Todaiji Temple and Kasuga-taisha Shrine.	landlords
(C)	New signs installed by Nara Prefecture and older type signs constructed by Temples or Shrines are mingled in this area.	Mixed suppliers of roadside signs
(D) and (E)	These are two signal controlled intersections near to each other connected by a short road link. Similarity of orientation of roads and other identifying features may have caused confusion to visitors. New signs installed by Nara Prefecture are available at both locations.	Nara Prefecture
(F)	This area contains of dense network of narrow lanes with only few road signs. Pedestrians can obscure the short square post type signs.	Nara City
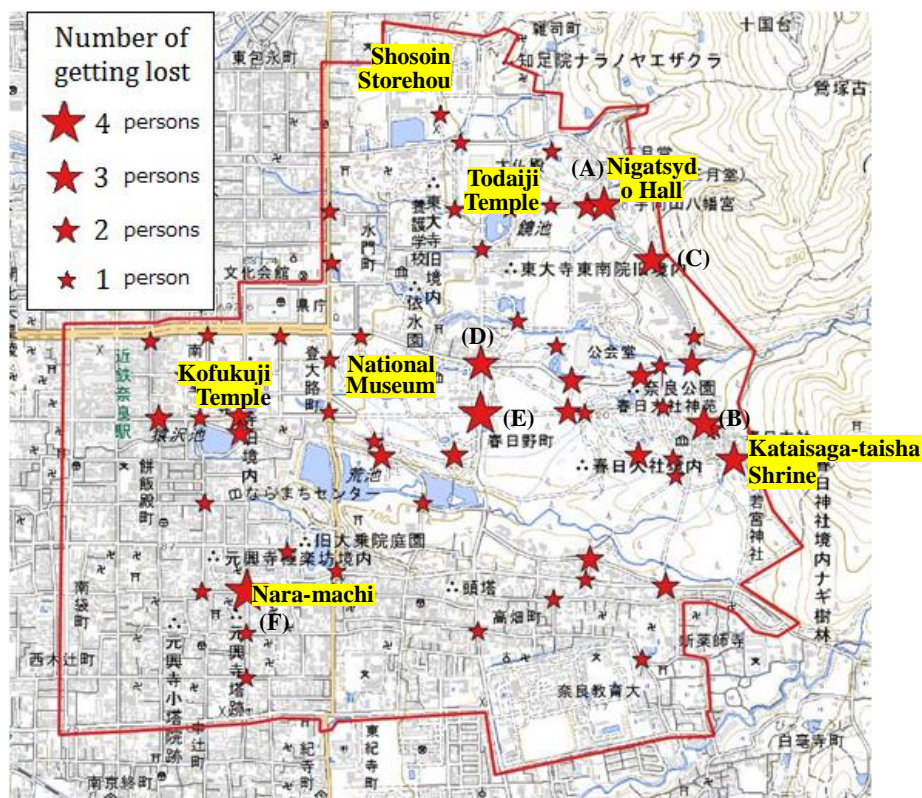
Figure 7 Distribution of getting lost events

3.2 Pedestrian routes associated with getting lost events

This section investigates examples of pedestrian routes associated with getting lost events. Figures 8.1 to 8.6 are examples of routes that could have been involved with getting lost events for each of the priority locations mentioned earlier.

There are number of potential routes that could have caused confusion at location (A). These routes are shown in Figure 8.1 and the location (A) is marked as X there. Route from Kasuga-taisha Shrine to Nigatsudo Hall is one possibility. Route from Daibutsuden (Todaiji main hall) to Nigatsudo Hall is another possibility. There is also a possibility that visitors on route from Daibutsuden to Kasuga-taisha Shrine also experienced way finding problems at this location. Daibutsuden and Nigatsudo Hall belong to Todaiji Temple. Signs installed near that location are shown in Figure 8.1. Photograph of the map sign constructed by Todaiji Temple is also shown in Figure 8.1. All of the signs installed there were not arrow type but map type which was not useful for direct guidance to the destination. Addition to this, the signs has little information to other organizations. Therefore it is not easy to determine the correct direction using this schematic map.

Tourists coming from Kasuga-taisha Shrine to Daibutsuden or Nigatsudo Hall got lost at location (B) marked as X in Figure 8.2. Map boards are installed near this location by Kasuga-taisha Shrine. However, they limit information to their own shrine and have not considered the information need of visitors walking to Todaiji Temple and other popular destinations.

At location of (C) mentioned before, there are two different types of signs, one provided by Nara Prefecture and the other constructed by Kasuga-taisha Shrine. Figure 8.3 shows school students studying these signs during an excursion to the park, because different maps with its own concept show different information in almost the same area.

Locations (D) and (E) are located at major intersections in Nara Park. Sign boards are available at these locations. However, since the intersection is large and sign boards exist only at a particular corner, some tourists seemed to be confused here to find their ways.

Location (F) is different from other locations mentioned above. Four photos presented with Figure 8.6 were taken at that particular location, toward north, south, east and west directions. Those photos show that there are no visible signs in any direction, at this intersection.
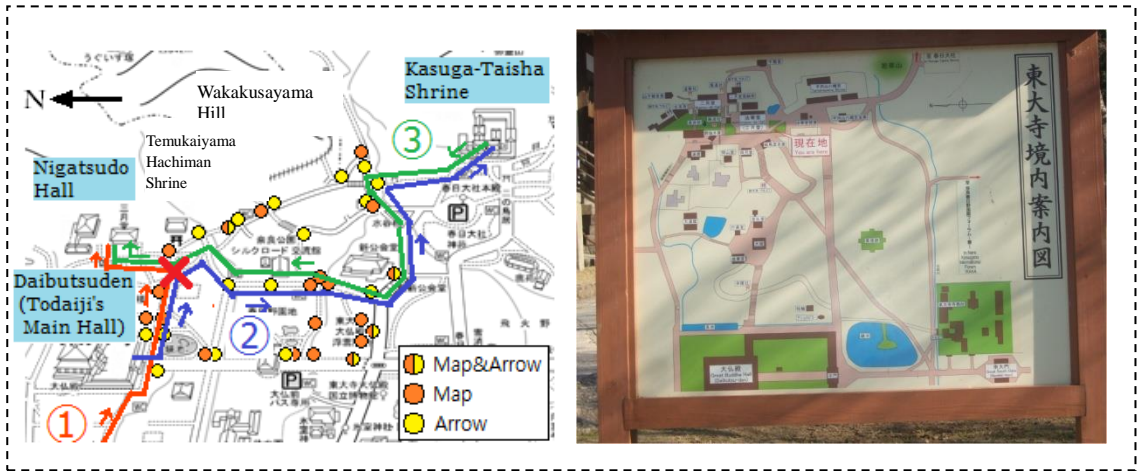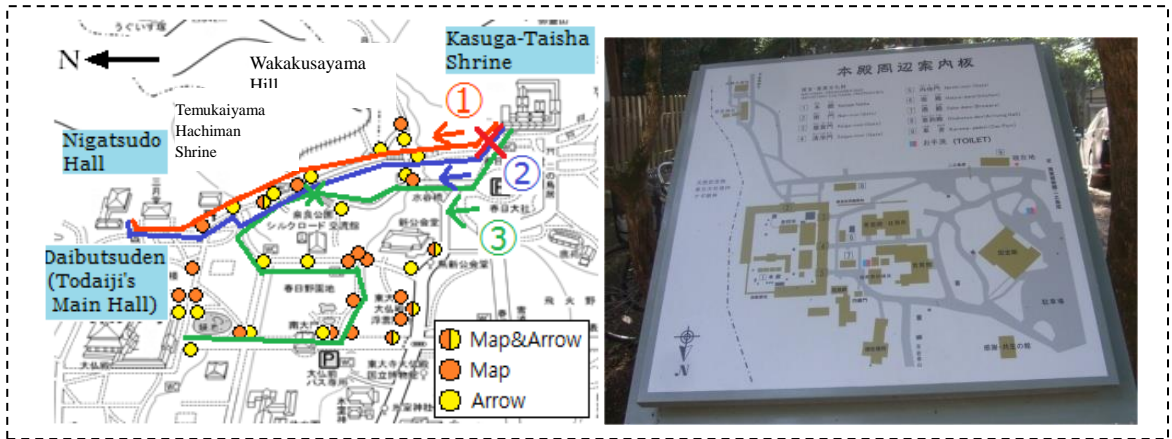
Figure 8.1 Spot (A)

Figure 8.2 Spot (B)

Figure 8.3 Spot (C)

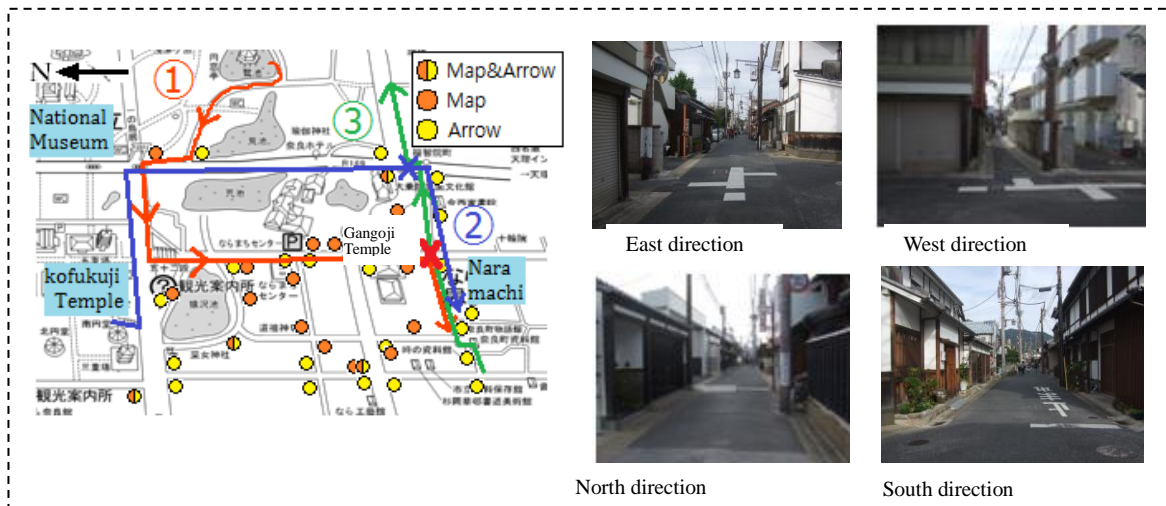Figure 8.4 Spot (D)

Figure 8.5 Spot (E)

Figure 8.6 Spot (F)

3.3 Interview survey of tourists who reported getting lost

Interviews were carried out in November, 2015, at areas where the count of getting lost events were found to be high as described in a former section, to uncover the reasons for such events. There were two interview locations. First location was in Todaiji Temple area and second interview location was in Kasuga-taisha Shrine area as illustrated in Figure 9.

Figure 9 Locations of Interview sites

The interviewer selected the passengers at random at the study area. 86 tourists interviewed. Subjects were answered the following questions including origin and destination of their trip, utilization of road signs, existence of getting lost, and reasons of getting lost.

Their situations of way finding activities were shown in Table 4. The percentages of getting lost were 32.6 %. Comparing average percentage of getting lost of 26.4 % in 2013 (Tsuakguchi, et al. 2015), it can be said that the abovementioned sites were more confused areas for visitors.

Table 4 Percentage of getting lost

	Number of respondents
Completely getting lost	20 (23.3%)
Slightly getting lost	8 (9.3%)
Never getting lost	58 (67.4%)
Total	86 (100.0%)

As for reasons of getting lost, Table 5 is obtained. It suggests that the main cause for getting lost events has been the lack of understandable signs for respondents both of Todaiji Temple area and Kasuga-shrine area, though there were several signs. Also, respondents near Kasuga-taisha Shrine identified lack of signs.

Table 5 Reasons for getting lost

Cause of getting lost event	Number of getting lost		
	Todaiji Temple area	Kasuga-taisha Shrine area	Total
I could not find sign board	0	3	3
Not enough sign boards	1	4	5
My destination was not shown in sign board	4	1	5
Sign boards were not easy to understand	5	4	9
Sign board were not consistent with the site	2	1	3
Others	1	1	2
Total	13	14	27

4. Way finding error distribution along trip chains

4.1 Trip chains of park visitors

Visitors make several trips within the historical park during the time they spend there. Figure 10 shows the pattern of first three trips visitors made according to a field survey reported in 2009. Figure 10 confirms that Todaiji Temple, Kofukuji Temple, Kasuga-taisha Shrine, and Nara National Museum are major attractions and they have become the destination in the first link of the trip chain of park visitors (Tanaka et al. (2009)). Todaiji Temple and Kasugataisha Shrine are large religious organizations, therefore number of historical and cultural sites spread out within their individual premises. For example, Daibutsuden, Nigatudo Hall, and Shosoin Storehouse belong to Todaiji Temple.
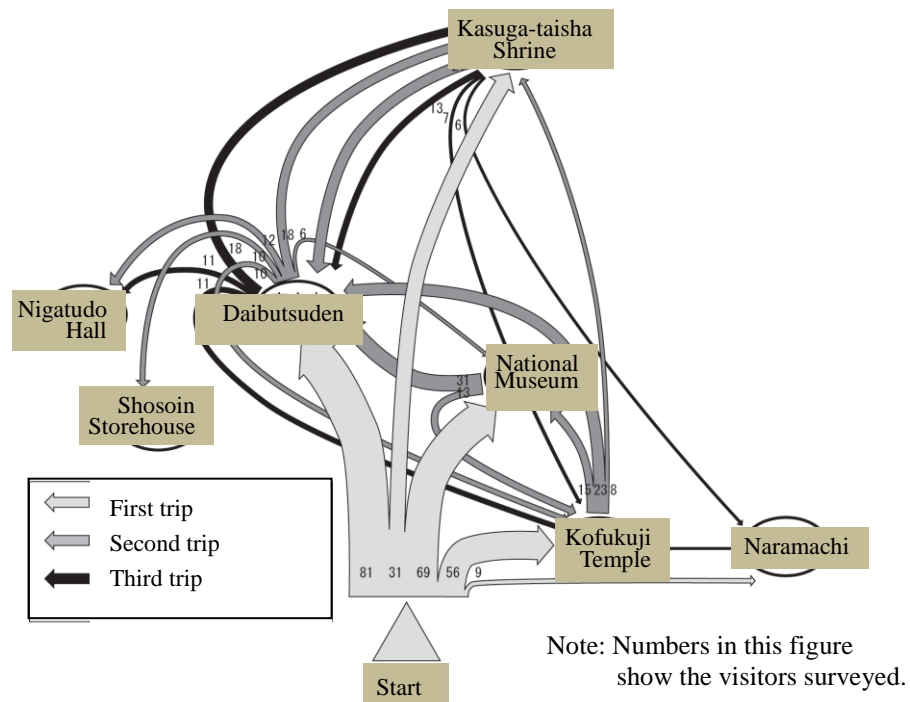

Note: Numbers in this figure show the visitors surveyed.

Figure 10 Trips chains of those who visited the park for the first or second time

4.2 Distribution of path finding errors

Figure 11 illustrates the distribution of count of getting lost events in percentage terms with respect to the length of the trip chain. Figure 11 was drawn using the 140 data which were clear the relationship between getting lost events and the trip chain in the survey carried out in 2013. It is apparent that there is an upward trend in the latter half of trip chain. For example, in the case of tourist visiting six attractions and more, most got lost events occurred after the third trip.

A previous study has indicated that the average number of attractions in the trip chain of visitors is 3.13 (Tsukaguchi, et.al. (2015)). Therefore, it is better to focus on length of trip chains such as three or four. When they visited three or four attractions, most getting lost events occurred after the first link. It is likely that visitors experienced only little problem in finding way to their selection of the most important attraction in the park, that may have been the destination of the first link.

Visitors who performed a trip chain of two links, reported a tendency to get lost in the second trip more than in the first trip of the trip chain, according to Figure 11. Visitors with three links had more difficulties encountered in the second and third than in the first link of the trip chain.

Anyhow, implications of the distribution shown in Figure 11 need further investigation.
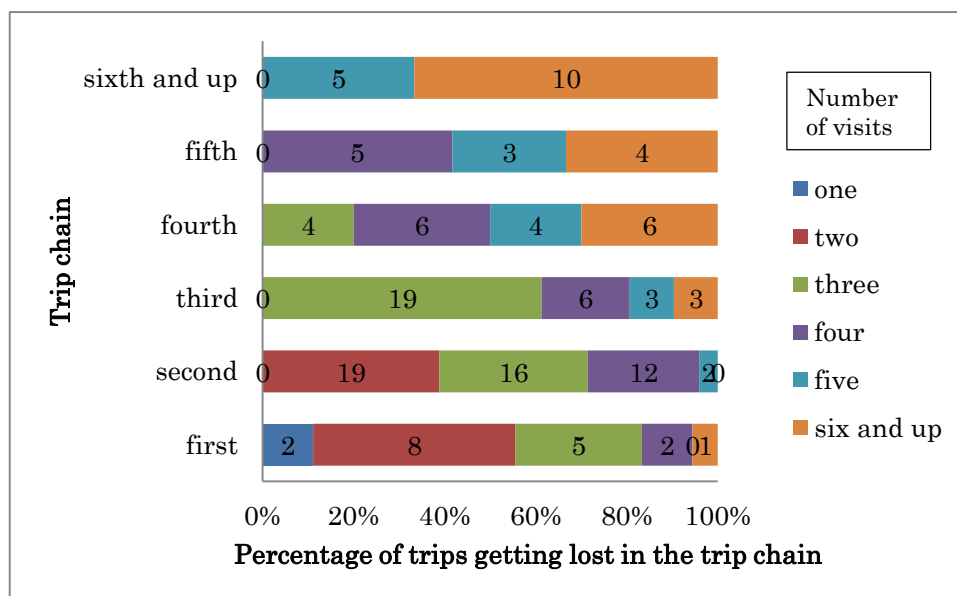

Figure 11 Getting lost behavior considering tourist's trip chain

Importance of the second and third links of trip chains shown earlier in Figure 7 is consistent with more getting lost events being reported in locations such as (D) and (E) which are between two level A attractions. In these areas, where sign boards are owned by temples and shrines, there is a need to persuade the owners to cooperate in assisting

visitor outflow also with their signs while not compromising their main objective of attracting visitors. A mutually agreeable systemized approach may need to be developed to improve smooth flow among competing attractions. In this context, some form of formalization of best practice in use of map boards as roadside signs may be of long term benefits as improved visitor experience to this park, particularly for newcomers and unfamiliar visitors.

5. Recommendations

The sign system of Nara Park which was supported by different providers has allowed the study team to make the following recommendations.

(1) This study has revealed that there is still some confusion of the sign system after the major improvements completed in 2013. The main cause of confusion to tourists is the difference in sign system concepts in Nara Park and its adjacent area public perceive as part of the that historical grounds. Other proprietors should be persuaded to catch-up with the style and concept of sign system introduced by Nara Prefecture,

(2) Sign system is vital to smooth circulation performance and visitor experience. Therefore signs must consistently display attractions with conformity of their importance ranking in Nara Park. Signs of competing proprietors distract visitors from the required consistency. Way finding difficulties encountered in second and third links of trip chains of visitors appear to be concentrated in areas where temples and shrines have ownership of signs,

(3) Several areas where there is a lack of effective signs have been identified in this study. Additional signs consistent with the new sign system provided by Nara Prefecture should be introduced to such areas, and

(4) Frequency of tourists getting confused their way is relatively high at large intersections. These locations have been identified. Map boards near those locations should be reviewed and revised if necessary. Precise locations of sign boards should be considered carefully. Not only map sign boards, it is better for tourists to install arrow signs at crucial locations. Installation of supplementary arrow signs should be also considered such critical intersections.

6. Conclusions

The findings of the author's previous study (Tsukaguchi et al. (2015) include:
Since the average number of attractions visited increased after the sign system improvement, it can be said that the improved sign system in Nara Park contributes to rise tourist's circulation behavior, but getting lost rates did not decrease after the sign system improvement.

Therefore, some problems may exist related to getting lost behavior.   This is the reasons behind the study.

After identifying the locations where getting lost behavior often occurred, detailed sign boards including locations, establisher, and board types were investigated. Then the following findings were obtained:

(a) Two particular areas (Todaiji Temple and Kasuga-taisha Shrine) where visitors reported losing their way were identified. Probable cause is signs constructed and managed by relevant landlords inconsistent with the modernized signs elsewhere in the park (Figs. 8.1 and 8.2).

(b) There are locations where improved sign boards and older style constructed by other owners exist close to each other. An attempt must be made to minimize the occurrence of such redundancies and confusions (Fig. 8.3).

(c) Frequency of getting lost events peaks at the second or third links of trip chains of park visitors (Figs. 8.11, 8.1, and 8.2).

(d) Count of getting lost events was high at several large intersections, although at least one sign has been available in the area. These locations may need further evaluation. Additional signs maybe required to assist visitors (Figs. 8.4 and 8.5).

(e) Nara-machi area has been identified as an area with insufficient supply of signs. Few signs are available there and they could be easily obscured and not readily understandable to visitors (Fig. 8.6).

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