Design Methodologies to the Wayfinding System of Public Transport Networks in West Japan – Sign Systems in the Transfer between Trains and City Buses –

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DESIGN METHODOLOGIES TO THE WAYFINDING SYSTEM OF PUBLIC TRANSPORT NETWORKS IN WEST JAPAN - SIGN SYSTEMS IN THE TRANSFER BETWEEN TRAINS AND CITY BUSES -

(西日本における公共交通機関のネットワークのサインシステムの構築の方法)

-鉄道とバスの接続のために展開して-

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DESIGN METHODOLOGIES TO THE WAYFINDING SYSTEM OF PUBLIC TRANSPORT NETWORKS IN WEST JAPAN
- SIGN SYSTEMS IN THE TRANSFER BETWEEN TRAINS AND CITY BUSES-

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DISSERTATION

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Abstract

Japan has a huge public transport network with highly developed transport systems. The governments in Japan give a significant weight with respect in the promoting the accessibility of public transport networks, particularly some White Papers reported by MLIT (Ministry of Land, Infrastructure, Transport and Tourism) outlined countermeasures to create a convenient and accessible environment for the bus utility at terminal stations, as well as the revitalization of the public transport networks to forge the Tourism Nation.

The study integrated insights from a broad review of the literature and particularly pays attention to the sign system in the transfer between trains and city buses at terminal stations in West Japan. Firstly, the research purpose is to identify that how the current sign system affects people’s wayfinding behavior in the transfer process in order to obtain problem-solving wayfinding strategies for improving the sign system. Secondly, the study attempts to develop a theory and establish a benchmark of design methodologies to the sign system between trains and city buses in the public transport networks. Thirdly, the research outcome will be discussed to improve urban intangible values.

In this study, it is structured in three sections and six chapters. The study selected Hakata Station in Fukuoka City and Kyoto Station in Kyoto City to conduct surveys and wayfinding protocols due to the stations’ importance and the cities’ attractiveness in West Japan to understand the characteristic of sign distribution and characteristic of sign usage by current sign systems. Based on the summaries and comparisons of the commonalities and differences regarding the sign systems at two sites, a problem-solving proposal to the wayfinding system in the transfer between trains and city buses was suggested. The proposal was composed of four aspects: plans of the urban positioning, surveys and analysis at terminal stations on site, implementations of common sign systems, and expansion of assistant
service networks. In addition, checkpoints of the proposal were also pointed out as design improvement guidelines on wayfinding designs. The proposal was an attempt to have a viewpoint to improve urban intangible values. The urban intangible values were to evaluate a wayfinding system of public transport networks and included three elements: individual value, information value, and spatial value. The three elements should be taken into account for creating a successful sign system of public transport networks.
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Chapter I

Research Backgrounds and Framework

1. Research backgrounds and purpose

1.1 Research backgrounds

Japan has a huge public transport network with highly developed transport systems. The transport modes include city buses, trains, trams, subways and so forth. Trains are also composed of rich types, such as local trains and Shinkansen lines; besides, every city has an extensive bus network. Overall, the public transport network is characterized by its punctuality and super service; however, the circumstances in relation to the public transport are becoming more severe (MLIT: Ministry of Land, Infrastructure, Transport and Tourism, 2013). In 2013, the Global Power City Index outlined six functions of global power cities that present city strengths, such as, economy, research and development, cultural interaction, livability, environment, and accessibility; therefore, the research backgrounds consider three levels (Figure 1-1) and five aspects based on the study.

Figure 1-1: Three levels of research backgrounds

1) Product level
   - Legibility of public transport networks
   Legibility refers to the quality of being easy to read (Anca D. Dragan, Kenton C. T. Lee, Siddhartha S. Srinivasa, 2013) and concerns users’ ability to read. It takes less effort to receive information and knowledge with a
good legibility in the public transport networks and users could have a good impression and use experiences. Legibility has long been recognized as an important factor in creating a good image of a city in individual’s minds (Negin Minaei, 2014). Therefore, in regard to users’ desires of receiving information, users’ physical reading, and mental satisfaction, the public transport networks need to create a legible and comfortable environment to make people understand clearly, move conveniently, and use easily at the network spaces.

- Issues of access to bus utility at terminal stations
  Due to the complexity of terminal stations, a terminal station building usually has a series of multifunctional spaces including commercial spaces, transport spaces, and cultural spaces, so access issues, which could be called wayfinding difficulties such as disorientation, orientation errors, getting lost, physical fatigue, route complexity and time spending exist and frustrate visitors to reach their desired destinations at ease. Particularly, the first-time visitors have no or inadequate knowledge of station configurations and boarding methods of buses, whereas repeated visitors could make a judgment based on their experiences. As a result, the quality of information, possibility of the information usability, and the accessibility should be taken into account to solve the issues.

- Wayfinding systems to bus stops at terminal stations
  Visitors, especially, first-time visitors always have wayfinding difficulties in the transfer between trains and city bus utility, for example, in a transfer process, they might lost their ways in the movement network from ticket entrance gates to desired bus stops, so a smooth movement network with a legible wayfinding system is needed to meet visitors’ need. As architecture cues, signage is a very important criterion for evaluation the overall quality of wayfinding at terminal stations (Mei Ling Tam, 2011), and the wayfinding difficulties are usually explained by inadequate signage (Romedi Passini 1996). Also, signs are regarded as one of four major variables of environment variables (Weisman (1981) & Michael O’ Neill
(1991). So, in this study, the wayfinding system refers to the sign system at the transfer process in terminal stations. However, relevant research as regards sign systems in the transfer between trains and city buses is not thoroughly studied.

2) Accessibility level

- Accessibility of public transport networks

Accessibility is one of the major issues related to the wayfinding of public transport networks. In 2014, MLIT reported a White Paper (2014) regarding policies on Promoting Measures Supported Regional Revitalization, and it pointed out that a city should improve the ease with which passengers’ transition from one means of transportation to another and augment the functions of transport nodes, and started a Basic Plan on Transport Policy from 2014 to 2020, for example, the Basic Plan outlines a Smooth Movement of the elderly, persons with disabilities, foreign visitors, and so on to restructure an easy-to-use transport network. Besides, principles on enhancing the accessibility of public transport were also carried out in accordance with the act on the promotion of smooth transport. In addition, a Tourism White Paper (2015) mentioned that a city should improve accessibility and convenience of the bus utility at terminal stations as efficient approaches to revitalizing the public transport networks and establish a Tourism Nation because of the drastic increase in travel demand, and White Paper of Transport Policies (2015) outlines countermeasures on current issues of bus utility, such as improving the environment of bus stops and waiting time, and increasing the convenience of bus usage and railway. Some research related to city ranking indexes also reveals the significance of accessibility of public transport to improve the urban intangible values, such as the accessibility referenced in Global Power City Index, (2013) by Institute for Urban Strategies in Japan. In a word, it is clear that governments in Japan give a significant weight with respect in the promoting the accessibility of public transport networks, particularly creating a convenient and accessible environment for the bus utility at terminal stations, as well as the revitalization of public transport networks to
forge the Tourism Nation. Indeed, accessibility is increasingly recognized as a key element of high quality, efficient and sustainable transport systems, and all of us as users of the transport system benefit from easier access to buses and trains (Cullen, 2006).

3) Cultural interaction level
   • Functions of terminal stations
   As one of paramount transport nodes in the public transport networks, a terminal station not only has the function to carry logistics and attract numerous people to use the various kinds of transport facilities that converge upon them but also, it plays an important role in improving a city image or city brand as a gateway or a name-card to other cities in terms of communication and identification, so the station should create a positive reputations for cities concerning to city attractiveness (Yong-Joo Ahn, Insin Kim, & Timothy J. Lee, 2016). In terms of legible access between terminal stations and bus utility, a good wayfinding system in the transfer between trains and city buses should be ensured at terminal stations, because the terminal station might give them the first experience of the city for most visitors and the overall transfer experiences, for example, relevant perceptions and sensibility regarding the wayfinding ease and spatial representation of stations influence the understanding with regard to the city image and urban intangible values.

1.2 Research purpose
The study integrated insights from a broad review of the literature and particularly pays attention to the sign system in the transfer between trains and city buses at terminal stations in West Japan to reach the product level, accessibility level, and cultural interaction level. Firstly, the research purpose is to identify that how the current sign system affects people’s wayfinding behavior in the transfer process in order to obtain problem-solving wayfinding strategies for improving the sign system. Secondly, the study attempts to develop a theory and establish a benchmark of design methodologies to the sign system between trains and city buses in
the public transport networks. Thirdly, the research outcome will be discussed to improve the urban intangible value.

2. Review of relevant research

This study is about sign systems in the transfer between trains and city buses and aims to create design methodologies to the sign system of public transport networks. The sign system research is an interdisciplinary research, which means it is not only related to environment graphic design (EGD) but also involves in other fields, such as architecture, urban planning, public design, human behavior, spatial cognition, and so forth.

![Figure 1-2: A conceptual framework of wayfinding research](image)

The conceptual framework of the relevant wayfinding research was discussed from three aspects (Figure 1-2), namely, users, sign systems, and spaces. The aspect of users overviewed the research on the wayfinding and spatial orientations and human behavior because the spatial orientation and human behavior affect each other in users’ wayfinding processes and relate to users’ mental models and behavior action. The aspect of spaces overviewed the research from the urban environment, public spaces to public transport networks and it was to understand the current situations and issues in the public transport networks. Besides, the sign guideline
references were involved in the two aspects above, so the references were also overviewed to explore the undiscovered problems. Therefore, the relevant research was conducted as following six aspects: 1) wayfinding and spatial orientation, 2) signs and human behavior, 3) signs and urban environment, 4) signs and public spaces including public spaces of aboveground and underground, 5) signs and public transport networks, and 6) signs and guideline references.

2.1 Wayfinding and spatial orientation
Kevin Lynch coined the term wayfinding in his pioneer book *The Image of the City* (1960) and the term was described how individual navigate the city and use an internal memory structure, which could be called the cognitive map consisting of five elements: paths, nodes, districts, edges, and landmarks. After that, some research used that buzzword, and the cognitive research related to the wayfinding became more and expanded his static concept to spatial orientation into a dynamic understanding of wayfinding. For example, *Wayfinding: A Conceptual Framework* (Romedi Passini, 1980), *Wayfinding Design: logic, application and some thoughts on universality* (Romedi Passini, 1996), *A Theoretical Model of Wayfinding in Virtual Environments: Proposed Strategies for Navigational Aiding* (Jui Lin Chen, Kay M. Stanney, 1999), and so forth.

Passini in the paper *Wayfinding: A Conceptual Framework* (1980/1981) conceptualized that wayfinding denoted man’s ability to reach a spatial destination in the light of spatial cognitive and it was a dynamic affair involved in purposeful mobility. Importantly, in terms of the spatial problem solving, three distinct of wayfinding, such as information processing, decision-making, and decision execution in the paper were identified, as well as some basic principles of spatial problem solving.

The paper *Wayfinding Design: logic, application and some thoughts on universality* (1996) mentioned that the wayfinding included all the mental process, which were involved in purposeful mobility. Two aspects regarding
wayfinding design were analyzed, for example, 1) the aspect related to spatial components of wayfinding design including the spatial organization and the circulation systems, and 2) the communication aspect of wayfinding design including the architectural and graphic communication. The paper gave an overview of methodologies and the underlying logic of wayfinding design and reflected on the questions of universality and its limits.

The paper *A Theoretical Model of Wayfinding in Virtual Environments: Proposed Strategies for Navigational Aiding* (1999) proposed and developed a theoretical model of wayfinding to guide designs of navigational aiding in virtual environment along with Romedi Passini’s model, and three types of spatial knowledge that played an important role in wayfinding process were pointed out: landmark knowledge, procedure knowledge, and survey knowledge, as well as other factors influencing wayfinding and navigation.

Overall, the research discussed the wayfinding as a dynamic and cognitive process and usually referred to the three distinctive aspects: processing making, decision-making, and decision execution. However, in this field, studies on the relationship between spatial cognition and sign systems were a few.

### 2.2 Signs and human behavior

The relevant research regarding signs and human behavior is few, some are as following, such as *A Study on Human Behavior and Information on a Composition Element in Urban Space 1-5* (Takeshi Ikeda, Yasuo Kawai, Ryo Masuoka, 2004), *Information Signs based on Users’ Wayfinding Behavior in Transfer between Underground Stations* (Meng-Cong Zheng, Tadao Shimizu, Kiminonbu Sato, 2009), *Time Constrains in Emergencies Affecting the Use of Information Signs in Wayfinding Behavior* (Meng-Cong Zheng, 2012), *Indoor Human Wayfinding Performance Using Vertical and Horizontal Signage in Virtual Reality* (Elisângela Vilar, Francisco Rebelo, Paulo Noriega, 2014), and so forth.
The paper *A Study on Human Behavior and Information on a Composition Element in Urban Space* 1-5 (2004) was a series of studies on signs at some terminal stations in Japan (Nagoya, Kanazawa, Fukuyama, Gifu, and Fukui). In the surveys, each sign was marked with a specific number, and then it analyzed the situations of sign distribution and human actions by experiments. Revealed findings were that sign plans should take the signs inside of the station (concourse) and outside of the stations (station square) into account in terms of ensuring the consistency of signs, the distribution of public signs and commercial signs should be coordinated to ensure the visibility of signs, and signs should be installed at right time and right locations for users to avoid the information repetition and overload because the deviation of sign usage existed even through the signs were symmetrically distributed on both sides of the concourse.

The paper *Information Signs based on Users’ Wayfinding Behavior in Transfer between Underground Stations* (2009) conducted the study to understand how the current information signs affected users’ wayfinding behavior. Based on authors’ previous findings, the results were figured out regarding two aspects: non-wandering priority behavior and wandering priority behavior. The paper also mentioned a mutual support of directional signs and orientation signs were required to meet users’ different demands, multilingual services to avoid the language hindrance, and extension of 3D maps integrating more surroundings with angle changes to assist users in the more easily understandable environment.

The paper *Time Constrains in Emergencies Affecting the Use of Information Signs in Wayfinding Behavior* (2012) was to understand how time constraints affected users’ wayfinding behavior corresponding to information signs. Signs were examined and classified by contents, presentation, and installation, and a think-aloud protocol method was used in wayfinding experiments. Result findings emphasized the importance of the first sign users saw and indicated the wayfinding behavior of people was influenced by spaces and time constraints.
The paper *Indoor Human Wayfinding Performance Using Vertical and Horizontal Signage in Virtual Reality* (2014) conducted the wayfinding experiments based on three conditions: horizontal signage, vertical signage, and neutral signage (no signs) by measuring the performance metrics (travelled distance, time spending, numbers of pause, and average speed). Research findings suggested that users assigned to the horizontal condition travelled smaller distance, spent less time, made fewer pauses, and moved at a higher speed than those assigned to vertical and neutral conditions.

Overall, conducting wayfinding experiments regarding human behavior was the general method in sign research. In a wayfinding task, the distribution of signs affected human behavior much, such as the sign visibility, legibility, locations, and so on.

2.3 Signs and urban environment
The relevant research related to signs and urban environment are many, for example, some of the research are *Concept and Typological Analysis of Environmental Installation Design* (Yoshitsugu Morita, 1991), *Wayfinding in Architecture* (Romedi Passini, 1992), *Type and Amount of Environmental Information in Urban Scene* (Yoshitsugu Morita & Yoichi Yamazaki, 1992), *Symbol for Urban Legibility* (Isao Miyazawa, 1997), *Benefit of Signage* (Teichi Tomonaga, 2013), and so forth.

The paper *Concept and Typological Analysis of Environmental Installation Design* (1991) was to establish a concept of “Environment Installation” design and its typological analysis and integrate the components that constructed the urban environment. It discussed the relationship between environmental installations and its city surroundings, and reclassified the urban structural components into three categories; namely, spatial series, intelligence series, and time series corresponding to the spatial value, intelligence value, and time value. It suggested that in a physical built environment, signs should be ensured the legibility and orderliness as one type of intelligence series among the environmental installations.
Based on looking at the built environment, Romedi Passini in his book *Wayfinding in Architecture* (1992) identified three types of signs, such as directional signs, identification signs and reassurance signs to communicate environment information because the information could be ambiguous or incomplete, requiring a particular effort of interpretation. The book discussed sign components including sign setting, sign types, sign identity, sign information, structure of information, contents and anticipating signs, and finally summarized that major difficulties in interpreting sign messages included four factors, such as insufficiently precise information on signs, inconsistent application of sign type and symbol, application of sign elements generally understood in familiar contents, and introduction of new symbols, sign systems without accounting for the learning process.

The paper *Type and Amount of Environmental Information in Urban Scene* (1992) was to call for the systematic organization of signage in an urban space due to a multitude of signs and difficulties in obtaining available information. It pointed out a new method to systematically classify items of signs according to the contents of information. Seven types were identified, such as geographical information, transportation information, traffic control information, behavior control information, disaster prevention information, public information, and commercial information. The need of cross-sectional and systematic environment design for information was also indicated.

The paper *Symbol for Urban Legibility* (1997) pointed out that urban sign plans regarded information of understanding of cities as the integration of structural components of the urban environment, and delineated three points related to the aims of urban sign plans: communicating the city configurations, communicating the city individuality, and the dramatizing the space communication. In terms of the relationship between urban signs and the symbol, it firstly revealed that urban information included functional information and emotional information, secondly, signs were usually composed of signal signs that functionally displayed clear
information including directional signs and information signs and symbol signs could communicate the city image.

The book *Benefit of Signage* (2013) was from a new standpoint to look at signs and edit the space to increase values. The author regarded signs as music theories in a metaphoric way, which means signs were displayed music at spaces, and the signs could be called visual orchestration graphics. For example, based on the elements of the music, tuning was to symbolize the space by fine-tuning visual elements, melody was to make a story with a process of sequences, rhythm was to feel the dancing beat in the experiences of space, harmony was to listen to the space surroundings with refined performance, tonality was to stimulate emotional effects with colors and materials, and so on.

Overall, as environment installations or street furniture, signs communicated the environment information to people, and signs not only displayed the signals to users concerning the aspects of physical functions but also represented the image of the urban environment. Moreover, as landscape products, the sign played an important role in the understanding of the legibility, configurations, and the image of cities; besides, it also improved the amenity and values of the urban environment.

2.4 Signs and public spaces

1) Public spaces of aboveground

The research relates to signs in the public spaces of aboveground has some, for example, *Sign Plans of Streets* (Isao, Miyazawa, 1987), *Characteristic of Public Signs in Urban Main Streets* (Kenichi, Koga, Yoshitsugu Morita, 1996), *Design and Evaluation of Environment Signs* (Masaru Sato, Toshimutsu Sadamura, 1996), *Planning and Practicing the Sign System for Aeon Mall Hanyu* (Yoshitsugu Morita, Kengo Saeki, Haruka Sogabe, Shinsuke Ishibashi, Hideaki Oonishi, Kenichi Uehara, 2008), *Basic Investigation Related to the Pedestrian City Signs of Beijing City, China* (Min Li, 2010), *Public Signs for Bunkyo Ward, Unification of Various Signs*
(Sari, Yamamoto, Kiyoshi Nishikawa, 2012), *Signology for Public Spaces* (Tatuszo Akase, 2013), and so forth.

The book *Sign Plans of Streets* (1987) came up with a new point for sign plans and street making as an important design approach to the urban plans. It suggested a proposal for sign plans: structure space communication, dramatize space communication, and identify space communication. The book defined the meaning of signs, discussed the relationship between signs and streets, and classified signs into two categories in general based on the functions and the media. Also, it analyzed signs located in different places as case studies, such as signs of district centers, signs of large-scale parks, and signs of the Expo. In the end, the book pointed out that signs should keep pace with the development of the information society.

The paper *Characteristic of Public Signs in Urban Main Streets* (1996) focused on the characteristic of public sign distribution in urban main streets because the research about the theme was quite a few at that time due to the different urban and environment characteristic. It gave the definition of the public signs and demonstrated that the public signs not only communicated the legible information related to the streets but also played an important role in forming urban landscapes and improving the legibility of cities. Some problems were revealed in accord with the environment characteristic, such as deviation of information distribution, inadequateness of information types, and consideration of influences on landscapes.

The paper *Design and Evaluation of Environment Signs* (1996) conducted a follow-up survey to check the situation of existed public signs and reaction of the users in Fukuoka City and proved that the expression methods agreed with design concepts. It pointed out that signs should display legible information as environmental installations, signs should display necessary information at proper locations to users, and signs should perform individuality, and also revealed problems, such as signs without any consideration for foreigners and signs without good visibility and legibility.
based on the surveys on sign size, font size, and multilingual usage. This paper was regarded as valuable materials for evaluation methods of public signs afterward.

The paper *Planning and Practicing the Sign System for Aeon Mall Hanyu* (2008) aimed to raise the level of hospitality of shopping centers by sign plans. Design principles of signs were made to use to display the essential ‘enjoyment of space’ aspect of the shopping center and promote understanding of the sense of location. The paper used a project circle to conduct study including surveys on site, surveys on users, design and implementation, and a post-implementation evaluation. It suggested that the consistency of spatial image, legible and easy-to-remember information, and utility of Japanese traditional colors should be taken into account as improvement approaches.

The paper *Basic Investigation Related to the Pedestrian City Signs of Beijing City, China* (Min Li, 2010) focused on the public signs for visited pedestrians and selected the typical route that was from the city terminal station to the sightseeing spot to understand the characteristic of sign distribution. It pointed out the problems, such as inadequateness of directional signs and information signs, small font size related to sign performance, a lack of efficient maintenance, and consistency of the signs between transport facilities and urban signs.

The paper *Public Signs for Bunkyo Ward, Unification of Various Signs* (2012) was to create a new signage system for the Bunkyo Ward of Tokyo. Because this ward had overloaded public signs managed by many different local government departments and had an adverse effect on the visual appearance of the area. The new sign system aimed at reducing the impact of signage on the landscape. Four types of the signs were identified, such as large-sized, medium-sized, small and medium sized, and small sized based on the hierarchy of the city configurations. Also, design principles to the new sign system were clearly outlined, for example, the signs should pay
attention to universal designs, consideration on landscapes, creating images for representing the ward contexts, and easy maintenance.

The book *Signology for Public Spaces* (2013) was based on the authors’ dissertation and elaborated on sign plans, for example, it reclassified the sign types compared the conventional sign typologies, such as identification signs, directional signs, illustrated signs and regulation signs and pointed out the basic attributes of signs including information message, sign forms, and spatial positions. Moreover, in terms of the sign plans, eight steps were proposed, such as 1) surveys on facilities, 2) analysis of behavior patterns, 3) analysis of needs, 4) analysis of spatial conditions, 5) coding planning, 6) arrangement plans, 7) graphic designs, 8) product designs. Importantly, the book recommended the necessity of implementation of common signs in common spaces at terminal stations and also used the design projects of the common signs to analyze as case studies.

2) Public spaces of underground

The relevant research is following, such as *Characteristic of Sign Distribution at Tenjin Underground Commercial Area in Fukuoka City* (Ji-sook Choi, Yoshitsugu Morita, 2002), *A Study on the Design Improvement Methods of a Subway Public Sign Focused on the Seoul Metro* (Seokhyun Lee, 2014), and so forth.

The paper *Characteristic of Sign Distribution at Tenjin Underground Commercial Area in Fukuoka City* (2002) studied the sign system for the pedestrian in the underground spaces. It conducted the surveys and analysis based on sign types, distributed locations, information contents, and installed height, also, the distribution of sign patterns was made to assist to lead the results. The paper identified the problems, such as the deviation of information distribution, difficulties in obtaining information, and inconsistency of the information.

The paper *A Study on the Design Improvement Methods of a Subway Public*
Sign Focused on the Seoul Metro (2014) conducted surveys based on the four aspects of the visibility, aesthetic values, functionality, and uniqueness of the information sign designs. It emphasized the informative function was the most important feature of signs and turned out the improvement of aesthetic values followed by quantity and appropriateness of the distribution of the signs, consideration of physically disadvantageous people, safety, and maintenance.

Overall, except the examples above, the relevant research about the signs in the public spaces of aboveground was related to many places: the urban streets, shopping facilities, hospitals, stations, and so forth. Most research figured out the general problems about public signs, such as the spatial inconsistency, inadequateness of sign numbers, small font size, and so on. These aspects referred to the orderliness of signs in spaces, but in the paper Planning and Practicing the Sign System for Aeon Mall Hanyu, it emphasized the importance of affective aspects, and in the book Signology for Public Spaces, it suggested the necessity of implementations of common signs at terminal stations and analyzes the detailed design projects of the common signs to ensure the good legibility and orderliness of signs. The research regarding the specific design methodologies to the common sign system was few, besides, the legible London (2007) sign project by Transport for London, which was a walking plan to reinvent the pedestrian-friendly urban areas and improved the walkability, was also successful design case of the common sign plans.

2.5 Signs and public transport networks
The relevant research about signs of public transport networks mainly focus on the railway stations and subway stations, but a few studies are about the bus stops and bus terminals. Such as A Study on Sign System in Bus Terminal (Na Ta, Yoshitsugu Morita, 2000), The Current Status of the Public Sign System Centering on the Busan Station (Wonjun Chung, 2010), Tailoring Map Design based on Map-Reading and Wayfinding Behavior in Subway Stations (Pei-Ying Li, Haruo Hibino, Shinichi Koyama,

The paper *A Study on Sign System in Bus Terminal* (2000) was to discuss how to design a convenient bus sign system at a bus terminal for passengers, and a follow-up experiment was conducted on site focusing on directional signs, information signs, identification signs, regulatory signs, bulletin signs, and advertisement signs. It turned out the problems, for example, wayfinding difficulties in searching for the bus platforms and confirming bus routes existed due to the inadequate amount of sign installations both Japanese subjects and international student subjects.

The paper *The Current Status of the Public Sign System Centering on the Busan Station* (2010) investigated and analyzed the current status of the public sign design of Busan Station to consider what a desirable public sign was in terms of users, sign producers, and designers. Based on the surveys and interviews on evaluations of public sign images, visibility, locations, and informativeness, the paper found the problems, for example, public signs and other signs had no consistency, temporary signs did not assist users much, sign materials and the spaces were not in harmony, signs lacked identities, and signs were without systematic multilingual services for foreigners.

The paper *Tailoring Map Design based on Map-Reading and Wayfinding Behavior in Subway Stations* (2012) emphasized the importance of maps in the subway stations affecting upon people’s cognitive maps and wayfinding, for example, the maps could provide comprehend spatial information, lead to greater knowledge of an area, predict environmental contexts, and be considered to be of much help as found in escape behavior study. The paper concluded that the map design should support direction and floor strategies for 3D navigation, strengthen the presentation of stairway symbols, reduce
the difference between real world and the map, and label the nearest exit.

The paper *Information on Public Transport: A Comparison between Information Systems at Bus Stops* (2015) presented a small theoretical framework and conducted comparisons between information panels at bus stops in five cities around the world aiming at analyzing whether the information panels had clear and objective information regarding the urban transport system. It analyzed the aspects of the spatial orientation process defined by Romedi Passini, and a check on desirable information elements at bus stops was pointed out. In the end, the paper mentioned a successful design of bus stops that allowed users to obtain the necessary information for their trips had achieved the main goals, such as the urban mobility and the use of urban spaces.

The book *Design Stations* (2015) was a supplement of the book *Signology for Public Spaces* by Tatuszo Akase to provide reader more legible photos for better understanding of public signs at terminal stations. It introduced more sign design cases including the common sign projects in Japan (Yokoyama, Sendai, Fukuoka, Tokyo, Kyoto, and Nagoya) and other cities around the world (London, Paris, Washington, New York, Beijing, Taipei, and Stockholm). It highlighted the significance of public designs and total designs related to sign plans because the public sign plans were separated with the architecture plans and construction plans as a “decoration session” in the whole building process, so all the sessions should be integrally organized when the design projects started. In the end, the book pointed out that the universal coding of route names, multilingual services, and legible and stress-free graphic design, should be taken into consideration.

Overall, the research about signs of public transport networks came up with new design approaches, such as the proposals for 3D navigation on information signs. A book called *Revitalization of Stations* (2002) also pointed out the importance of the implementations on the integration of signage and buildings. The research related to signs at bus stops and bus
terminals was few, but some advocated the check of bus information elements at bus stops to offer people adequate information.

2.6 Signs and guideline references
Guideline references of signs are becoming more, some represent the viewpoints on universal designs, and some are about tourism guidelines. For example, *Guidelines of Revitalization of Tourism Signs* (MLIT, 2005), *Guidelines of Information Improvement for Foreign Language at Public Transport Facilities* (MLIT, 2006), *Guidelines of Public Transport Facilities for Passengers* (MLIT, 2013), *Signage and Wayfinding Design* (Chis Calori, David Vanden-Eynden, 2015), and so forth.

The study *Guidelines of Revitalization of Tourism Signs* (2005) included three chapters: functions of signs of tourism information, basic principles of signs for the revitalization of tourism, and checkpoints of signs to tourists, and it aimed to provide pedestrians smooth and convenient travels when to walk or use public transport facilities. The study classified signs into three categories as Tatsuzo Akase did and included some standards regarding the design of layout, pictograms, and so on.

The study *Guidelines of Information Improvement for Foreign Language at Public Transport Facilities* (2006) aimed at making foreigners confidently walk the city by themselves, so it established the criterions of signs for foreign visitors, such as the types of foreign language selections, English performance, and so on.

The study *Guidelines of Public Transport Facilities for Passengers* (2013) was a guideline about Barrie free for public transport facilities including four chapters. Sign types were classified into four categories and relevant principles were also introduced.

The study *Signage and Wayfinding Design* (2015) was a complete guide to creating environmental graphic design systems (EGD) including six
chapters. It described many overlapping aspects of the sign design field, such as the sign design process, pyramid methods, information contents systems, and so on.

Overall, the guideline references of signs were about the criterions to signs. The study *Signage and Wayfinding Design* was more detailed to explain and describe how to make sign plans. However, these studies including the sign design approaches in Japan and Western did not make a common benchmark to the sign system.

2.7 Summaries of relevant research

<table>
<thead>
<tr>
<th>Wayfinding research</th>
<th>Research highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>• Wayfinding is a dynamic, cognitive, purposeful process.</td>
</tr>
<tr>
<td></td>
<td>• Three distinctive aspects were revealed.</td>
</tr>
<tr>
<td>Wayfinding and spatial orientation</td>
<td></td>
</tr>
<tr>
<td>Signs and human behavior</td>
<td>• Methods of observations regarding human behavior are general methods in sign studies.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Signs and urban environment</td>
<td>• Concerning physical functions of signs.</td>
</tr>
<tr>
<td></td>
<td>• Signs represent the image of urban environment.</td>
</tr>
<tr>
<td></td>
<td>• Signs Improve amenity and values of a city.</td>
</tr>
<tr>
<td>Spaces</td>
<td></td>
</tr>
<tr>
<td>Signs and public spaces</td>
<td>• General problems identified, such as the spatial inconsistency, inadequateness of sign numbers, small font size, and so on.</td>
</tr>
<tr>
<td></td>
<td>• A suggestion of a common sign system.</td>
</tr>
<tr>
<td></td>
<td>• Aspects of sign orderliness.</td>
</tr>
<tr>
<td></td>
<td>• Importance of sign affective aspects.</td>
</tr>
<tr>
<td>Signs and public transport networks</td>
<td>• Proposals for 3D navigation on information signs.</td>
</tr>
<tr>
<td></td>
<td>• Implementations on the integration of signage and buildings.</td>
</tr>
<tr>
<td>Sign systems</td>
<td>• Guidelines represent the viewpoints on universal designs.</td>
</tr>
<tr>
<td>Signs and guideline references</td>
<td>• Research on sign systems of public transport networks especially, the sign systems in the transfer between trains and city buses at stations is not thoroughly studied.</td>
</tr>
</tbody>
</table>

Table 1-1 shows the summaries of relevant research above, it turned out that the research on wayfinding and spatial orientation discussed the wayfinding as a dynamic, cognitive, purposeful process and pointed out three distinctive aspects, such as processing making, decision-making, and decision execution.
The research on signs and human behavior turned out that methods of observations about human behavior were general methods in sign studies. The research on signs and urban environment turned out that signs not only displayed the signals to users concerning the aspects of physical functions but also represented the image of the urban environment. The research on signs and public spaces turned out that general problems, for example, spatial inconsistency, inadequateness of sign numbers, small font size, and so forth. These aspects were involved in aspects of sign orderliness and affective aspects. The research on signs and transport stations suggested proposals for 3D navigation on information signs, especially in subway spaces, and research on signs at bus stops and bus terminals was few. So it was clear that the current research regarding the sign system of the public transport networks was not thoroughly studied, particularly between trains and city buses at terminal stations, so the research objective was identified that it was to research the sign system in the transfer between trains and city buses at terminal stations.

3. Definitions of relevant terminologies

1) Directional sign: directional signs typically designate a place, an object, or an event in the form of a name, a symbol, or a pictograph and an arrow (Passini Romedi, 1984). Signs are located remotely from destinations to direct people the various destinations within a given environment and display arrows to point out specific paths, such as, left, right, straight ahead to destinations (Chris Calori, David Vanden-Eynden, 2015).

2) Information sign: information signs interpret the meaning of an environment, or places and the relationship of locations (Guidelines of Public Transport Facilities for Passengers, 2013).

3) Identification sign: identification signs are located at a destination to identify that destination or place in an environment (Chris Calori, David
Vanden-Eynden, 2015). The signs are the most elementary state description of the location (Passini Romedi, 1984).

4) Regulatory sign: regulatory signs intended to regulate people’s behavior or prohibit certain activities within an environment (Chris Calori, David Vanden-Eynden, 2015).

5) Compound sign: compound signs, at least, mix the either of two types above. In this study, the compound sign is a combination of the directional sign and the information sign.

6) Else signs: in this study, except the five types of signs above, else signs include the timetable and explanations of tickets fares and parking.

7) Human behavior: human behavior refers to the array of every physical action and observable emotion associated with individuals.

8) Transfer behavior: wayfinding can be defined a process that people orientate themselves to destinations, so transfer behavior refers to the array of every physical action and observable emotion associated with individuals in the transfer process. It is considered as the same meaning with human behavior in this study.

9) Nodes: Kevin Lynch (1960) defined “nodes are the strategic foci into which the observer can enter, typically either junctions of a path or concentrations of some characteristic”. So in this study, nodes refer to important decision points, such as gates (entrance and exit of buildings), starting point of wayfinding task, stairs, elevators and bus stops.

10) Urban intangible value: cities evoke feelings of comfort, excitement or pride and have the power to appeal to human sensitivity in terms of urban attractiveness (Global Power City Index 2013).
11) Common sign systems: public signs providing the information ought to be in the common modes for improving the convenience of utility no matter where the signs located within public spaces.

12) Think-aloud: it is a protocol used to gather data to assist evaluators identify what is confusing and how those problems can be solved in usability testing in product design and development, in psychology and a range of social sciences (Paul A. Green, Jin-Seop Park, 2013).

4. Research methodology and framework

4.1 Research methodology

4.1.1 Empirical analysis
The study conducted surveys on sites and wayfinding protocols. In the surveys, it aimed to understand 1) the distribution of signs and 2) bus information in the physical environment of terminal stations. Target signs were classified into categories based on signs’ functions and were composed of directional signs, information signs, identification signs, and compound signs because regulatory signs did not affect human behavior much in the transfer process. Besides, each sign was marked with a specific number, and the amount, locations, functional types, and information contents regarding signs were recorded on site.

The wayfinding protocol included two aspects: 1) a wayfinding experiment and 2) post-test interviews and questionnaires that recorded the participants’ wayfinding experiences were conducted to assess their wayfinding processes.

4.1.2 Comparison analysis
The study used comparison analysis to find out the commonalities and differences. Based on the analysis at two terminal stations in two cities, the characteristic of sign distribution and sign usage were summarized.
4.2 Selections of research sites

The study is to understand how the current sign system affects people’s wayfinding behavior in the transfer between trains and city buses at terminal stations and attempt to establish a benchmark of design methodologies to sign systems of public transport networks in West Japan.

Table 1-2: Selection factors of research sites

<table>
<thead>
<tr>
<th>City</th>
<th>Fukuoka</th>
<th>Hiroshima</th>
<th>Okayama</th>
<th>Kobe</th>
<th>Osaka</th>
<th>Kyoto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Station</td>
<td>Hakata Station</td>
<td>Hiroshima Station</td>
<td>Okayama Station</td>
<td>Kobe Station, Shin-Kobe Station</td>
<td>Osaka Station, Shin-Osaka Station</td>
<td>Kyoto Station</td>
</tr>
<tr>
<td>CGJ</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>CP</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>CS</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td></td>
<td>⬤</td>
</tr>
<tr>
<td>T/B</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td></td>
<td>⬤</td>
</tr>
<tr>
<td>JR/S</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td></td>
<td>⬤</td>
</tr>
<tr>
<td>SR</td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
CGJ: Cities designated by government ordinance of Japan, and the city has a population greater than 500,000.
CP: Capital city of the Prefecture.
CS: Complex station: A complex station is with multiple functions, such as commercial, transport, culture, cinema, shopping and restaurant and so forth.
T/B: Train and city bus: In this study, it focuses on the transfer between trains and city buses, but Hiroshima Station prioritizes to provide the trams instead of buses.
JR/S: JR Lines and Shinkansen Lines can be used in one terminal station.
SR: Selection of research site.

From the list of cities designated by government ordinance of Japan, six cities, as well as the capital cities of its Prefecture in West Japan were selected. Compared with the following factors, Hiroshima Station, Okayama Station, and Kobe Station are not complex stations; besides, Hiroshima Station prioritizes to provide the trams instead of buses. Shinkansen lines and JR local lines are separated at Shin-Kobe Station, Shin-Osaka Station, and Osaka Station. As a result, Hakata Station in Fukuoka City and Kyoto Station in Kyoto City were selected as the research sites (Table 1-2).
4.3 Research framework
This study is structured in three sections and six chapters (Figure 1-3):
Introduction section describes the research backgrounds and research purpose, overviews the relevant research regarding the field of signs, explains the definitions of terms in this study, introduces methodologies and framework, and comes up with issues.

Section One includes the Chapter Two and the Chapter Three, surveys and experiments related to the distribution of target signs and bus information and the usage of signs are conducted at two research sites by using the same research methods. This section is based on the analysis of two case studies as empirical studies for leading the results of the Chapter Four.

Section Two is the Chapter Four, after the respective analysis at the Chapter Two and the Chapter Three, this section conducted comparisons and summaries regarding the characteristic of sign distribution and the characteristic of sign usage to figure out the commonalities and differences in order to obtain problem-solving wayfinding strategies and propose design methodologies to the sign system in the transfer between trains and city buses.

Section Three includes the Chapter Five and the Chapter Six. A proposal for sign systems of public transport networks was suggested and the conclusions of this study were revealed.

The brief introductions of the six chapters are as following:
Chapter One Research Backgrounds and Framework introduces the research backgrounds and purpose, overviews the relevant research including six aspects, explains the methodology and framework of this research. It also identified the selections of research sites.

Chapter Two Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Hakata Station was to
understand the characteristic of sign distribution and the characteristic of sign usage, as well as the relationship between them. The sign distribution was analyzed from the distribution of sign types, spatial locations, and bus information, whereas the wayfinding experiments measured the performance metrics, such as wayfinding time, sign usage, wandered places, and wayfinding tools. Based on the surveys and wayfinding protocols, problems related to the current sign system were identified.

Chapter Three Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Kyoto Station used the same methods including surveys and wayfinding protocols to understand the characteristic of sign distribution and the characteristic of sign usage, as well as the relationship between them at Kyoto Station. Due to different space configurations compared with Hakata Station, the wayfinding tasks were remade to clarify problems.

Chapter Four Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations summarized and compared the previous results about the characteristic of sign distribution and the characteristic of sign usage at two terminal stations to find out the commonalities.

Chapter Five A Proposal for Design Methodologies to the Wayfinding System between Trains and City Buses at Terminal Stations suggested a proposal of design methodologies and outlined design improvement guidelines on a wayfinding system in the transfer between trains and city buses based on the analysis and results at Chapter Four. The urban intangible value was also discussed corresponding to the proposal as evaluation methods of a wayfinding system.

Chapter Six Conclusions was the conclusions of this study including the summaries of each chapter and the prospects of the future study.
Chapter I Research Backgrounds and Framework

- Research backgrounds and purpose
- Review of relevant research
- Definitions of relevant terminologies
- Research methodology and framework

Section One: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations

Chapter II Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Hakata Station

- Research purpose of this chapter
- Characteristic of sign distribution
- Characteristic of sign usage
- Information demands based on human wayfinding behavior
- Discussions about the wayfinding system in Hakata Station
- Conclusions

Chapter III Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Kyoto Station

- Research purpose of this chapter
- Characteristic of sign distribution
- Characteristic of sign usage
- Information demands based on human wayfinding behavior
- Discussions about the wayfinding system in Kyoto Station
- Conclusions

Section Two: Comparisons and Summaries regarding Characteristic of Sign Distribution and Sign Usage

Chapter IV Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations

- Research purpose of this chapter
- Summaries: characteristic of sign distribution and sign usage
- Comparisons of the characteristic of sign distribution
- Comparisons of the characteristic of sign usage
- Comparisons of bus information elements at bus stops
- Discussions about the information system
- Conclusions

Section Three: A Proposal for Design Methodologies to Sign Systems of Public Transport Networks

Chapter V A Proposal for Design Methodologies to the Wayfinding System between Trains and City Buses at Terminal Stations

- Research purpose of this chapter
- The framework of the proposal
- Discussions
- Conclusions

Chapter VI Conclusions

- Research summaries
- Prospects of the future study

Figure 1-3: Flowchart of this study
References


http://www.mlit.go.jp/common/000059348.pdf#search='観光活性化標識ガイドライン'.

http://www.jterc.or.jp/topics/kanko-guideline_pdf/00honpen.pdf.


Section I
Characteristic of Sign Distribution and Sign Usage in the Transfer between Trains and City Buses at Terminal Stations
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Section I: Characteristic of Sign Distribution and Sign Usage in the Transfer between Trains and City Buses at Terminal Stations

Chapter II
Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Hakata Station

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   4.1 Introduction ..................................................... 80
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Chapter II

Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

1. Research purpose of this chapter

According to the *Global Power City Index 2014*, Fukuoka ranks the 36th place in the world and the 3rd place in Japan (The Mori Memorial Foundation, 2014). Furthermore, Hakata Station is the largest and busiest terminal station in Kyushu but also, a gateway to other cities; as a result, a number of visitors visit Fukuoka by railways and then take buses to reach their desired destinations. There are some advantages of taking buses instead of subways, such as it could give people plenty of time to enjoy the sightseeing along the streets and taking a bus is also a flexible way to enhance people’s opportunities to arrive at detailed spots.

This chapter focused on the understanding of sign distribution and sign usage based on people’s wayfinding behavior in the transfer from the JR trains to city buses at Hakata Station. Wayfinding conceptualized in terms of spatial problem solving (Romaedi Passini, 1984), so it could give people especially for the visitors, a better understanding of the station’s complexity. In addition, people not only benefit from a good wayfinding system but also, the wayfinding system will increase people’s confidence to get lost and encourage them to rely on using it. As a result, a legible and user-friendly wayfinding system of transfer in the public transport networks is one of the key elements of civic imageability to improve the urban intangible value.

In this chapter, three aspects were analyzed; firstly, a survey regarding the situations of bus operating and distribution of signs that included arrangements of bus information related to bus transfer on signs at Hakata Station were conducted in order to have a better understanding of the characteristic of the sign distribution. Secondly, a wayfinding protocol was
conducted for understanding the characteristic of the sign usage. Thirdly, information demands based on subjects’ wayfinding behavior was discussed to analyze the issues of the current information.

2. Characteristic of sign distribution

2.1 Targets of the survey
The targets of the survey in this chapter included two aspects, 1) one was the bus operating information including bus routes and bus numbers at Bus Stop A-F and Hakata Bus Terminal, 2) the other one was the distribution of signs, which referred to the installed public signs in the target spaces (no commercial signs). Considering the people’s transfer behavior, regulatory signs did not affect human behavior much, hence, in this survey, target signs were directional signs, information signs, identification signs, and compound signs. Target spaces were Station Concourse, Station Square, and Hakata Bus Terminal.

2.2 Methods of the survey
Signs were classified into categories based on sign functions and each sign was marked with a specific number. The number, location, function, and information contents regarding signs, in addition, bus routes, bus numbers and bus categories were also recorded on site (Table 2-1).

<table>
<thead>
<tr>
<th>Date</th>
<th>2015.08.28.</th>
<th>Daytime: 09:30 am. ~ 16:00 pm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target sign</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directional sign</td>
<td>Information sign</td>
<td>Compound sign</td>
</tr>
<tr>
<td>Identification sign</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>Take photos of signs: record the amount, locations, functional types, and information contents of signs; mark signs with numbers.</td>
<td></td>
</tr>
<tr>
<td>Target space</td>
<td>Station Concourse, Station Square, and Hakata Bus Terminal.</td>
<td></td>
</tr>
</tbody>
</table>

2.3 Methods of the analysis
In order to understand the distribution of bus information and signs, the methods were as follows:
1) The buses were categorized by bus operating companies and bus
functions. Bus routes and numbers at Bus Stop A-F and Hakata Bus Terminal were listed.

2) The distribution of target signs were analyzed in three aspects:
   • Distribution of signs based on functional types,
   • Distribution of signs based on spatial locations (Ji-sook, Choi, 2002),
   • Distribution of bus information on signs.

The distribution of signs based on functional types was to examine how many types of signs in the current sign system at Hakata Station. The distribution of signs based on spatial location was to analyze how signs distributed in target spaces, such as the distribution of sign types and amount in each target space. The distribution of bus information was to understand the situation of bus information on signs regarding the transfer between trains and city buses.

2.4. Results of sign distribution
2.4.1 Situations of bus operating
1) Bus Types
   • Based on operating companies

<table>
<thead>
<tr>
<th>Types</th>
<th>Routes</th>
<th>Bus Locations of getting on and off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nishitetsu Bus</td>
<td>Many</td>
<td>Bus Stop A-F / Hakata Bus Terminal</td>
</tr>
<tr>
<td>JR Kyushu Bus</td>
<td>Nogata</td>
<td>Hakata Bus Terminal</td>
</tr>
</tbody>
</table>

Bus types were based on two factors, one was based on the operating companies and the other was based on the bus functions. Three major bus companies operated in Fukuoka (Table 2-2): Nishitetsu, Showa and JR Kyushu. Nishitetsu Bus ran the bus business covering almost all of areas in Fukuoka, so the locations for getting on and off were many, while Showa Bus operated in the western region and had three route lines at Hakata Station such as Katsura, Imari and Itoshima, and JR Kyushu operated in the eastern region and visitors could take the Nogata line.
Based on bus functions

Based on the bus functions, five types (Table 2-3) were found at Hakata Station and the location of each type was also clear (Figure 2-1). Three special bus routes: Tenjin Liner (also called Downtown High-speed Bus line), 100-yen Loop Bus, and Fukuoka City Loop Bus “Green” could be used, and the other two types were the City Bus and the Highway Bus.
2) Bus information at Bus Terminal and Bus Stops in layout

- **Hakata Bus Terminal**

Figure 2-2 shows all the bus information at Hakata Bus Terminal for people to use and the popular sightseeing spots such as Tenjin and Canal City HAKATA are from stop platform No. 2 to No.4. Platform No.3 operates the most bus lines that have 10 lines and the next is platform No.6, which operates 9 lines. Platforms No. 7, 8, 9, and 10 are for getting off.

![Bus information at the layout of Bus Terminal 1F](image1.png)

![Bus information at the layout of Bus Stops A-F in Station Square](image2.png)
Bus Stop A-F at Hakata Square

Figure 2-3 shows the detailed bus information at Bus Stop A-F for people to use, and the Stop A operates the most bus lines such as the 100-yen bus, Express lines, and local buses, and the buses could take people to the main popular sightseeing spots. The Stop E is for the Hakata Port area.

The Hakata Station, Canal City HAKATA, and Tenjin composed the 100-yen free area by the Nishitetsu bus. When the survey conducted, visitors always complained they did not know where to take the 100-yen Loop Bus, and some visitors even did not know the 100-yen bus.

2.4.2 Characteristic of sign distribution

Target signs in the target spaces have possibilities to be used in the transfer process between trains and city buses, so all the target signs were considered to survey and analyze (Figure 2-4, Appendix A-4).

---

Figure 2-4: The distribution of target signs at target spaces in the layout of Hakata Station
1) Distribution of signs based on functional types
Directional signs mainly distributed at the Station Concourse (47 numbers) and the Station Square (25 numbers) (Figure 2-5), particularly, at the JR Kyushu part of the Station Concourse with consistent design styles and the Hakata Station Square. No directional signs were at the Chikushi Station Square. Directional signs were the fewest at the Bus Terminal IF. Directional signs were quite higher at the Hakata Gate than other places. Information signs also centralized in the Station Concourse (17 numbers) and the Station Square (15 numbers). Only one compound sign was at the Hakata Station Square (Table 2-4).

Table 2-4: Categories and numbers of target signs

<table>
<thead>
<tr>
<th>Locations</th>
<th>Types of signs</th>
<th>NC</th>
<th>DS</th>
<th>IF</th>
<th>ID</th>
<th>CS</th>
<th>TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hakata Station Concourse</td>
<td>JR West</td>
<td>3</td>
<td>14</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>JR Kyushu</td>
<td>5</td>
<td>33</td>
<td>13</td>
<td>9</td>
<td>0</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Chikushi</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hakata Station Square</td>
<td>9</td>
<td>25</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Bus Terminal</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>14</td>
<td>0</td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

Legend: 
2) Distribution of signs based on spatial locations

- Hakata Station Concourse

Figure 2-6 shows the ratio of signs is that the Station Concourse is 54%, the Station Square is the 30%, and the 1F of Bus Terminal is the 16%. The directional signs in the Station Concourse were two types based on the two different operating companies: JR West and JR Kyushu (Table 2-5). The JR West operated Shinkansen and the directional signs were white on black, whereas, the JR Kyushu operated local train lines and the directional signs were black on white and the mount types of them were consistently overhead suspended from the ceiling. Besides, the illumination types (Figure 2-7) were also quite different. The JR Kyushu part was the internal illumination of the entire sign face and external illumination that washed the sign face, while, the JR West was the internal illumination of the contents only with an opaque sign background. As a result, it was found that directional signs stood out sharply in the background with the color-coding of black on white. Additionally, the maintenance of sign illumination both directional signs and information signs had quality problems.

![Figure 2-6: The ratio of sign distribution in the three locations](image1)

![Figure 2-7: Illumination types of directional signs at the Station Concourse](image2)
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Table 2-5: Directional signs at the Station Concourse

<table>
<thead>
<tr>
<th>Companies</th>
<th>Operating lines</th>
<th>Mount types</th>
<th>Color codes</th>
<th>Illumination types</th>
<th>Distribution modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>JR Kyushu</td>
<td>JR Kyushu local trains</td>
<td>Overhead suspended, Freestanding</td>
<td>White on black</td>
<td>Internal illumination (Whole panel), External illumination</td>
<td>Crossing</td>
</tr>
<tr>
<td>JR West</td>
<td>Sanyo Shinkansen</td>
<td>Column Mount, Wall Mount</td>
<td>Black on white</td>
<td>Internal illumination (Contents)</td>
<td>Linear, Crossing, Four-sides</td>
</tr>
<tr>
<td></td>
<td>Kyushu Shinkansen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Shinkansen Entrance (Central Gate) and JR Lines Entrance (North Ticket Gate) at Station Concourse

Table 2-6: Sign distribution at entrance gates in the Station Concourse

<table>
<thead>
<tr>
<th>Station Concourse</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shinkansen Entrance (Central Gate)</td>
<td>JR Lines Entrance (North Ticket Gate)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Mount type</th>
<th>Type</th>
<th>Code</th>
<th>Mount type</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-A012</td>
<td>Column Mount</td>
<td>DS</td>
<td>S-C010</td>
<td>Ceiling mount</td>
<td>ID</td>
</tr>
<tr>
<td>S-B002</td>
<td>Column Mount</td>
<td>IF</td>
<td>S-B010</td>
<td>Wall Mount</td>
<td>IF</td>
</tr>
<tr>
<td>S-B003</td>
<td>Column Mount</td>
<td>IF</td>
<td>S-A029</td>
<td>Overhead suspended</td>
<td>DS</td>
</tr>
<tr>
<td>S-B004</td>
<td>Column Mount</td>
<td>IF</td>
<td>S-A030</td>
<td>Overhead suspended</td>
<td>DS</td>
</tr>
<tr>
<td>S-C004</td>
<td>Ceiling mount</td>
<td>ID</td>
<td>S-A031</td>
<td>Overhead suspended</td>
<td>DS</td>
</tr>
</tbody>
</table>

Legend:
- •: DS: Directional sign, □: IF: Information sign, ◆: ID: Identification sign, ☐: Time table,
  ↓: The display direction of information contents.

At the Shinkansen Entrance, only the directional sign (S-A012) perpendicularly provided bus information to the entrance. At the JR Lines Entrance (North Ticket Gate), an information sign (S-B010) and directional signs (S-A030,
S-A031) provided bus information, but only timetables on the columns were right ahead to the entrance, not directional signs (Table 2-6).

- **Station Square**
  The height of directional signs at the Hakata Gate was higher than others installed at the Station Concourse (Figure 2-8), but they were in the consistent design, which meant they were in the same colors, materials, and mount types. Information signs centralized in three places at the Station Square: close to the Hakata Bus Terminal, close to the Hakata Gate and close to the Stop A and B.

![Figure 2-8: Directional signs at the Hakata Gate and the Station Concourse](image)

- **Hakata Bus Terminal**
  The Bus Terminal had three floors: the first floor was for taking the city bus; the second floor and third floor were for taking the highway bus. The second one was the arrival floor while the third one was the departure. Signs in the Bus Terminal were messy and inconsistent, besides, bilingual and multilingual messaging of signs were issues (Figure 2-9), for example, the biggest information sign hang on the wall was written only in Japanese. The font size of English display on identification signs was 8 mm and 6 mm on information signs. 6 mm was smaller than the standard (Table 2-7).

<table>
<thead>
<tr>
<th>Range of visibility</th>
<th>Font size of Japanese</th>
<th>Font size of English</th>
</tr>
</thead>
<tbody>
<tr>
<td>30m</td>
<td>More than 120mm</td>
<td>More than 90mm</td>
</tr>
<tr>
<td>20m</td>
<td>More than 80mm</td>
<td>More than 60mm</td>
</tr>
<tr>
<td>10m</td>
<td>More than 40mm</td>
<td>More than 30mm</td>
</tr>
<tr>
<td>4~5m</td>
<td>More than 20mm</td>
<td>More than 15mm</td>
</tr>
<tr>
<td>1~2m</td>
<td>More than 9mm</td>
<td>More than 7mm</td>
</tr>
</tbody>
</table>

Table 2-7: The standard of font size (Guidelines of Public Transport Facilities for Passengers, 2013)

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Figure 2-9: Different information signs at the 1F of Bus Terminal

- Bus Stop A

The Bus Stop A provided the most bus lines and had five information signboards. However, the information was not integrated (Table 2-8) and it was observed some people checked the signboards one by one to obtain the available information with the increase of numbers of people.

Table 2-8: Bus information on signboards at Bus Stop A

<table>
<thead>
<tr>
<th>Mount type: freestanding</th>
<th>Left to right (order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval distance of each signboard: 5,400 mm</td>
<td></td>
</tr>
<tr>
<td>1. Timetable</td>
<td></td>
</tr>
<tr>
<td>2. Guide of destination and Timetable</td>
<td></td>
</tr>
<tr>
<td>3. Guide to the 100-yen loop bus and Timetable</td>
<td></td>
</tr>
<tr>
<td>4. Guide from Hakata Station to primary destination (English, Chinese and Korean)</td>
<td></td>
</tr>
<tr>
<td>5. Guide from Hakata Station to primary destination (Japanese)</td>
<td></td>
</tr>
</tbody>
</table>

- The consistency of sign distribution at three spaces

From the Table 2-9, it indicated the inconsistency of signs corresponding to sign illumination types, mount types (Transportation research board, 2011), and the color modes. Directional signs were two types in the Station Concourse, and they kept the same design styles at the JR Kyushu part with the ones located at the Hakata Gate and the Station Square, but completely different with the directional signs that were in the Bus Terminal. Information signs were the same design styles at the Station Concourse and the Station Square.
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Table 2-9: Comparisons of sign distribution in three locations

<table>
<thead>
<tr>
<th>Sign types</th>
<th>Elements of comparisons</th>
<th>Station Concourse</th>
<th>Hakata Station Square</th>
<th>Hakata Bus Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS</td>
<td>Illumination</td>
<td>Internal (contents), Internal (panel), External.</td>
<td>Internal (contents), Internal (panel), External.</td>
<td>Internal (contents), External.</td>
</tr>
<tr>
<td></td>
<td>Color type</td>
<td>White on black, Black on white.</td>
<td>Black on white</td>
<td>White on black, White on green, White on blue</td>
</tr>
<tr>
<td>IF</td>
<td>Illumination</td>
<td>Internal (panel)</td>
<td>Internal (panel), External</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mount type</td>
<td>Wall Mount, Column Mount, Freestanding.</td>
<td>Freestanding</td>
<td>Wall Mount</td>
</tr>
<tr>
<td>ID</td>
<td>Illumination</td>
<td>External</td>
<td>Internal (panel), External</td>
<td>Internal (panel)</td>
</tr>
<tr>
<td></td>
<td>Mount type</td>
<td>Ceiling mount, Wall Mount, Freestanding, Canopy mount.</td>
<td>Freestanding, Flag mount</td>
<td></td>
</tr>
<tr>
<td>CS</td>
<td>Illumination</td>
<td>Internal (panel),</td>
<td>Freestanding.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mount type</td>
<td>Freestanding.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
DS: Directional sign, IF: Information sign, ID: Identification sign, CS: Compound sign,
External illumination: external illumination washes the sign face.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

However, the information signs were different with the information signs at the Bus Terminal. Identification signs were totally different in the three spaces.

- Types of sign distribution in the layout
  It indicated (Table 2-10) that three types of sign distribution existed at Hakata Station, such as the regular type at the Station Concourse, the centralized types at the Bus Terminal 1F, and the dispersive type at the Station Square. The sign distribution had a close relationship with its space form.

<table>
<thead>
<tr>
<th>Types of sign distribution in the layout</th>
<th>Regular type</th>
<th>Centralized type</th>
<th>Dispersive type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space form</td>
<td>Station Concourse</td>
<td>Bus Terminal 1F</td>
<td>Station Square</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>[Diagram]</td>
<td>[Diagram]</td>
<td></td>
</tr>
<tr>
<td>[Diagram]</td>
<td>[Diagram]</td>
<td>[Diagram]</td>
<td></td>
</tr>
</tbody>
</table>

3) Distribution of bus information on signs
- Directional signs
  It was figured out (Figure 2-11) that 35 numbers of directional signs provided the bus information and the information was completely the “Bus Terminal” at the Station Concourse. All the bus information was displayed on the surface of panels that faces Chikushi Gate. However, the signs provided two types of bus information at the Hakata Gate (Figure 2-10), such as “Bus Terminal” and “Bus Stop A-F”. Additionally, directional signs at the Hakata Gate were higher than the ones installed at the Station Concourse. So it indicated that the directional signs inside of Station Concourse was to lead people’s wayfinding to the Bus Terminal to take buses due to the consideration to the consistency of bus information (Bus Terminal).
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

<table>
<thead>
<tr>
<th>Hakata Gate</th>
<th>Station Concourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of Hakata Gate signage]</td>
<td>![Image of Station Concourse signage]</td>
</tr>
</tbody>
</table>

Figure 2-10: Directional signs with bus information at Hakata Gate and Station Concourse

- Information signs and compound signs

It was clear that only three sets of information signs with the same contents provided bus information at the Station Square, and the bus information was about the transportation introduction to reach main fourteen attractions of Fukuoka City by JR lines, subways lines, and buses from the Bus Terminal and the Bus Stop A/E. Besides, only one compound sign was installed in the target spaces, and this sign provided the information of the Bus Stop Guide, which included the Bus Terminal and the Bus Stop A-F.

2.5 Summaries: characteristic of sign distribution

2.5.1 The characteristic of sign distribution

The characteristic of sign distribution was shown at Table 2-11 (Appendix A-5). It was clear that three types of sign distribution were in Hakata Station, such as the regular type at the Station Concourse, the centralized types at the Bus Terminal 1F, and the dispersive type at the Station Square. There were two types of sign performances: white on black at the JR West of Station Concourse and black on white at the JR Kyushu of Station Concourse and Station Square. Based on sign functional types, spatial locations of signs, and distribution of the bus information, some problems were revealed: only one compound sign distributed and might be considered to use more; directional signs at Hakata Gate were much higher than the others. At the Station Concourse, the maintenance of signs was an issue. At the Bus Terminal, bilingual and multilingual messaging of signs should be considered and provide systematic information. At Bus Stop A, the bus information was not integrated and inadequate.
Figure 2-11: The distribution of bus information on signs in the layout of Hakata Station

Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station
Table 2-11: Characteristic of sign distribution

<table>
<thead>
<tr>
<th>Sign distribution</th>
<th>Actual situation in space</th>
<th>Problems</th>
<th>Characteristic</th>
</tr>
</thead>
</table>
| Functional types  | • Directional signs mainly distributed at the Station Concourse (47 numbers) and the Station Square (25 numbers), particularly, at the JR Kyushu part of the Station Concourse with consistent design styles and the Hakata Station Square. No directional signs were at the Chikushi Station Square. Directional signs were the fewest at the Bus Terminal 1F. Directional signs were quite higher at the Hakata Gate than other places.  
• Information signs also centralized in the Station Concourse (17 numbers) and the Station Square (15 numbers).  
• Only one compound sign was at the Hakata Station Square.  
• The most types of signs distributed at Hakata Station Square. | The distribution of directional signs existed differences.  
Compound signs were inadequate and should be taken into account.  
The heights of directional signs were not consistent.  
Font of identification signs at the Bus Terminal was less than the standard. | The regular type (Station Concourse),  
The centralized types (Bus Terminal 1F),  
The dispersive type (Station Square). |
| Spatial location   | • At Station Concourse, directional signs at JR West part were white on black, but at JR Kyushu part were black on white. Some illumination of signs both directional and information signs had quality problems. The ratio of sign distribution: Station Concourse (54%), Station Square (30%), and 1F of Bus Terminal (16%).  
• At the Bus Terminal, most of information signs were only Japanese and information was in visual clutter. | At the Station Concourse, the maintenance of signs was an issue.  
At the Bus Terminal, bilingual / multilingual messaging of signs should be systematic.  
At the Bus Stop A, bus information was not integrated and adequate. |  |
| Bus information    | • At Station Concourse, 35 numbers of directional signs provided bus information and the bus information was completely “Bus Terminal” on directional signs.  
• At the Hakata Gate, signs provided two types of bus information, such as “Bus Terminal” and “Bus Stop A-F”. So it indicated that the directional signs inside of Station Concourse were to lead people’s wayfinding to the Bus Terminal.  
• Three sets of information signs with the same contents provided bus information at the Station Square.  
• Only one compound sign in target spaces provided the information of the Bus Stop Guide, which included the Bus Terminal and Bus Stop A-F at the Station Square. | Bus information on signboards was not integrated at the Bus Stop A.  
Bus information was in visual clutter, and signs provided non-systematic and non-multilingual at the Bus Terminal. |  |
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

3. Characteristic of sign usage

3.1 Methods of the wayfinding protocol
The purpose of the wayfinding protocol was to understand the human behavior in the transfer in order to figure out the characteristic of sign usage. The wayfinding protocol included two aspects: 1) a wayfinding experiment. 2) After the experiment, a questionnaire and an interview that recorded their wayfinding experiences were conducted to assess their wayfinding processes.

(1) Participants
Due to difficulties and limitations of the recruitment, fifteen international students (four males and eleven females) who just arrived at Fukuoka City without any experiences at Hakata Station were recruited to conduct this experiment (Table 2-12).

Table 2-12: The demographic characteristic of subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sex</th>
<th>Age</th>
<th>Nationality</th>
<th>English level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>M</td>
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<td>C</td>
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<td>G</td>
<td>M</td>
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<td>C</td>
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<td>H</td>
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<td></td>
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<td>I</td>
<td>F</td>
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<td>C</td>
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<tr>
<td>J</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
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<tr>
<td>K</td>
<td>F</td>
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<td>F</td>
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<td>C</td>
<td></td>
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<tr>
<td>O</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Note: F: Female, M: Male, C: China, F: France, T: Turkey.

(2) Dates
- Date: 2015.10.12～2015.10.18.
- Daytime: 09:30am.～16:00pm.
(3) Wayfinding tasks
The task was composed of the route A and the route B. As noted that sex differences appeared to have a significant effect on wayfinding strategy and males have better spatial capabilities (Chien-Hsiung Chen, Wen-Chih Chang, Wen-Te Chang, 2009), but, males were quite fewer than females among recruited participants, besides, the route A was longer and more difficult than the route B, thus, eight subjects (four males and four females) were from the route A, while the other seven female subjects were asked to start from the route B. The route A started from the Shinkansen Entrance, and the route B started from the JR Line Entrance North Ticket Gate. Because the wayfinding journey from the Shinkansen Entrance to the destination of this experiment included the part, which was the JR Line Entrance Central Ticket Gate, so, no subjects started from here in this study. The destination of the wayfinding task was asked to get to the bus stop of Canal City HAKATA. The reason of selection of Canal City HAKATA was because the Canal City HAKATA ranked the 2nd place of visiting and the first one was the JR Hakata City in Fukuoka (Tourism statistics 2013, 2013). During the wayfinding process, all subjects were permitted to use any tools or ask people for assistance to complete their tasks.

(4) Measurements
The measurement was conducted by observing and accompanying subjects together. As regarded the subjects’ task performances related to the study, the following data was measured:

- Wayfinding time: time spending was calculated from the starting point to the destination with a timer.
- Sign usage: the sign usage referred to how many signs and what functional type of signs was used in the wayfinding process. It was recorded at each node, such as the starting point, the Hakata Gate, and the Bus Stop A. as well as paths in the Station Concourse, the Station Square, and the Hakata Bus Terminal.
- Wandered place: the places that subjects stayed at least two seconds (Elisangela Vilar, Francisco Rebelo, Paulo Noriega, 2014).
Wayfinding tools: what other tools subjects used except signs, such as smartphones, guide maps or asking people.

3.2 Results of the wayfinding protocol
The destinations heading for Canal City were two locations, one was the Bus Stop A in the Station Square, and the other was the platform No. 4 in the 1F of Hakata Bus Terminal. Thus, there were two types of wayfinding behavior patterns either in the route A or the route B. The wayfinding pattern of each subject was shown at Appendix A-2.

3.2.1 Results in route A
In route A, three subjects moved to the Bus Stop A, while five subjects moved to the Bus Terminal. For example, Subject A (Figure 2-12-1) regarded a directional sign of the Bus Terminal as an identification sign because an exit of underground covered the view of the arrow on the directional sign. Subject C spent about 3 minutes that was the shortest time because subject C saw the buses coming at the Hakata Gate and just wanted to move there for having a try. Only subject D reached the 2F Pedestrian Deck by an escalator (Figure 2-12-2), when subject D got close to the escalator and did not notice the directional sign hang on the ceiling in the left front and just looked at the right unconsciously and saw the information with the Bus Terminal on a directional sign located on the right of the escalator, also, subject D used the most numbers of signs due to moving into the 2F shops of the Bus Terminal. Subject F (Figure 2-12-3) firstly arrived at the Bus Stop A, but subject F could not confirm this was the correct place or not and then moved to the Bus Terminal after asking people, and subject F spent the longest time (Figure 2-13) and was the only one who moved to the Bus Stop A and the Bus Terminal (Table 2-13). Subject G used the fewest numbers of signs because of asking people for assistance three times. Subject A and D (Figure 2-14) moved to the shops of the Bus Terminal instead of the city bus area at first, that was the reason why they spent more time than others. Subject A, D, E, F, and H all moved to the Bus Terminal and most of them spent almost 6 minutes.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- - - - - : Subjects’ behavior patterns (aboveground 1F); - - - - - : Subjects’ behavior patterns (aboveground 2F).

Figure 2-12: Subjects’ overall wayfinding behavior patterns
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- - - : Subjects’ behavior patterns (aboveground 1F);
- - - - : Subjects’ behavior patterns (aboveground 2F).

● : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure 2-12-1: Wayfinding behavior pattern of subject A
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- - - - : Subjects’ behavior patterns (aboveground 1F);
- - - - - : Subjects’ behavior patterns (aboveground 2F).

○ : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure 2-12-2: Wayfinding behavior pattern of subject D
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- : Subjects’ behavior patterns (aboveground 1F);
- : Subjects’ behavior patterns (aboveground 2F).

: Signs used by subjects; : Spots subjects ask for assistance;

Figure 2-12-3: Wayfinding behavior pattern of subject F
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- - - - : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

• : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure 2-12-4: Wayfinding behavior pattern of subject L.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Note:

- - - - : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

○: Signs used by subjects; ★: Spots subjects ask for assistance;

Figure 2-12-5: Wayfinding behavior pattern of subject M
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Figure 2-13: Wayfinding time and sign usage in route A

Table 2-13: Results of wayfinding experiment in route A

<table>
<thead>
<tr>
<th>Wayfinding process</th>
<th>Route A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting point</td>
<td>Shinkansen Entrance (Central Gate)</td>
</tr>
<tr>
<td>Subjects</td>
<td>A</td>
</tr>
<tr>
<td>Wayfinding time (min. sec)</td>
<td>6.07</td>
</tr>
<tr>
<td>Average time (min. sec)</td>
<td>5.49</td>
</tr>
<tr>
<td>Ask people for assistance</td>
<td>●</td>
</tr>
<tr>
<td>Use smartphone</td>
<td>●</td>
</tr>
<tr>
<td>Go to the 2F pedestrian deck</td>
<td></td>
</tr>
<tr>
<td>Arrive at Bus stop A</td>
<td></td>
</tr>
<tr>
<td>Arrive at Bus Terminal</td>
<td>●</td>
</tr>
</tbody>
</table>

Subject A

See the directional sign without the arrow
Move to the Bus Terminal 1F (shop)

Subject D

See the directional sign
Decide to go upstairs

Figure 2-14: Subjects’ (A, D) wayfinding patterns in the route A
Subject A: I move to the shop because I see a sign (Bus Terminal) at the Hakata Gate, but I realize it is a shop, not Bus Terminal when I move inside. I do not think I am wrong because the sign really tells me it is the Bus Terminal. Now I understand the reason is the exit of an underground covers my view, so I do not see the arrow...

Subject D: I move here and I do not know which way to go next without seeing any signs. I look right unconsciously and notice people go upstairs by elevator, so I decide to go upstairs. I see a directional sign close to the elevator, but firstly I do not see the contents due to its installed angle...

Subject G: I do not see information signs at the Station Concourse because the signs are parallel with my view. Later, I cannot easily find the bus stops on the information sign located at the Station Square, as well as the Canal City. The contrast of the sign performance is not good, and I cannot focus...

3.2.2 Results in route B

In route B, five subjects moved to the Bus Stop A and two subjects moved to the Bus Terminal (Table 2-14). The most wayfinding time was subject L (Figure 2-15), just a little more than subject N. Subject L also moved to the Bus Stop A and the Bus Terminal as subject F did, but on the contrary, subject L (Figure 2-12-4) firstly moved to the Bus Terminal and asked the staff for assistance, however subject L had to move back to the Hakata Gate to find the destination at the Bus Stop A in the Station Square, and that was very unreasonable because the No. 4 platform heading for the Canal City direction was in the vicinity of subject L, but the staff did not tell the bus could be taken at the Bus Terminal. Subject N used the Google map for navigating the direction instead of relying on signs, but it did not work well because current technologies could not focus and assist users to explore so specific and accurate scale of areas. Subject M read the information signs and confirmed the direction and then saw the buses coming at the Hakata Gate and moved there, so subject M spent the shortest time (Figure 2-12-5). Subject K firstly also saw the directional sign on the shop gate, so subject K reached the shop gate and realized there were no ways to the main gate if not go through the shop of the Bus Terminal, finally subject K decided to go along the road curbside to reach the main gate of the Bus Terminal, but the curbside was dangerous due to many cars driving (Table 2-15).
Table 2-14: Results of wayfinding experiment in route B

<table>
<thead>
<tr>
<th>Wayfinding process</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting point</td>
<td>JR Line Entrance (North Ticket Gate)</td>
</tr>
<tr>
<td>Subjects</td>
<td>I  J  K  L  M  N  O</td>
</tr>
<tr>
<td>Wayfinding time (min. sec)</td>
<td>2.57  6.3  4.52  7.16  2.39  7.11  4.07</td>
</tr>
<tr>
<td>Average time (min. sec)</td>
<td>4.87</td>
</tr>
<tr>
<td>Ask people for assistance</td>
<td>●</td>
</tr>
<tr>
<td>Use smartphone</td>
<td>●</td>
</tr>
<tr>
<td>Go to the 2F pedestrian deck</td>
<td>●</td>
</tr>
<tr>
<td>Arrive at Bus stop A</td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td>Arrive at Bus Terminal</td>
<td>● ● ● ● ● ●</td>
</tr>
</tbody>
</table>

Figure 2-15: Wayfinding time and sign usage in route B

Table 2-15: Subjects’ (J, K, L) wayfinding patterns at Bus Terminal in route B

<table>
<thead>
<tr>
<th>Subject J</th>
<th>Subject K</th>
<th>Subject L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go through the crosswalk</td>
<td>Go along the curbside</td>
<td>Back to the Hakata Gate</td>
</tr>
<tr>
<td>Legend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Directional Sign</td>
<td>● Identification Sign</td>
<td>● Compound Sign</td>
</tr>
<tr>
<td>● Information Sign</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2.3 Results of sign usage at decision points

- Starting point: Shinkansen Entrance Central Gate

It indicated (Figure 2-17) that five subjects used the directional signs at the starting point and the other three were not. No subjects used information signs.
Subject D, F, and G said they did not see directional signs. The font size of Japanese display was 40 mm and English display was 15 mm (Figure 2-16) that was smaller than the standard.

Figure 2-16: The font size of the directional sign (S-A012) at the starting point

- Starting point: JR Line Entrance North Ticket Gate
  It indicated that six subjects used directional signs located at the right of the entrance, but subject O firstly used an information sign instead of directional signs. Subject L firstly saw two timetables on columns (Figure 2-17).

Figure 2-17: Sign usage at starting points in the route A and route B

- Hakata Gate
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

From Figure 2-18, it shows an information sign (S-B016) provides “Hakata Station Area Map”, however, no subjects saw it in the route A. Subject G stood close to the information sign, but subject G asked people and did not see the information sign. Only subject O saw the map among fifteen subjects. The contents of other four information signs were related to guides of the commercial and the station building. Maybe the location of this information sign should be adjusted to close to the path in order to make people see with ease and the priorities of the information signs should be taken into account. Moreover, in route A, three subjects did not see the directional sign, and in the route B, two subjects did not see it (Figure 2-19).
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

- Hakata Bus Terminal
  Signs were quite different with other two spaces and did not make subjects’ behavior patterns straight (Figure 2-20). There were no waiting rooms on the first floor, so people waited for the bus against walls, as a result, with the increase numbers of waiting people, subjects could not see the signs on the floor. Identification signs in flag mount type showed specific destinations, and it was measured that the font size of English display on identification signs was 8 mm, so it was readable within 2 m, but it was difficult to read between two identification signs because the distance was more than 11 m, so the font size of English should be more than 30 mm (Guideline of Public Transport Facilities for Passengers, 2013).

Figure 2-20: Overall subjects’ behavior patterns at Hakata Bus Terminal

- Subject E: I even do not know this floor is for the city bus when I come into the first floor (Bus Terminal); many signs are hang up at the left, right, and the front, so the visual clutter makes me difficult to focus. Finally, I find the information on an information sign, but the location is not good and the font size on it is quite small to read...

- Bus Stop A
  The difficulty at the Bus Stop A was the confirming of desired bus information, such as bus routes, numbers, boarding ways and ticket fares. The information on signboards was not integrated and inadequate. Additionally, the signs were not consistent with other spaces.
3.2.4 Summaries of the wayfinding protocol

The route B was quite shorter than the route A corresponding to the distance and time spending. Most subjects confused and wandered at six places (Table 2-16), mainly at the Hakata Gate and the Bus Terminal Gate.

- Directional signs

It was clear that directional signs at the JR Kyushu part of the Station Concourse sequentially made all the subjects confident to move and behavior patterns consistent because all of the texts on directional signs related to bus transfer consistently displayed “Hakata Bus Terminal”, but the Hakata Gate displayed “Hakata Bus Terminal” and “Bus Stop A-F”, most subjects said, they could not understand the differences of two contents and could not confirm next move. It (Table 2-16) was clear that subjects used the directional signs mainly at the starting points (H-W5 and H-W6) and the Hakata Gate (H-W3 and H-W4).

Only subject E used the directional sign at the Bus Terminal Gate (H-W1). Twelve subjects used directional signs at Hakata Gate, but the locations of the directional signs were high to pay attention. In Figure 2-21, 0.6 means nine of fifteen subjects checked the item of “location is very high at Hakata Gate” in the questionnaire process, so the ratio of this item evaluation is 9 divided by 15 equals 0.6.

![Figure 2-21: How do you think of the directional signs?](image-url)
### Table 2-16: Sign usage at wandered places by subjects overall

<table>
<thead>
<tr>
<th>Wandered Places</th>
<th>Decision Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-W1</td>
<td>Bus Terminal Gate</td>
</tr>
<tr>
<td>H-W2</td>
<td>Bus Stop A</td>
</tr>
<tr>
<td>H-W3</td>
<td>Hakata Gate</td>
</tr>
<tr>
<td>H-W4</td>
<td>JR Line Entrance</td>
</tr>
<tr>
<td></td>
<td>(North Ticket Gate)</td>
</tr>
<tr>
<td>H-W5</td>
<td>Shinkansen Entrance</td>
</tr>
<tr>
<td></td>
<td>(Central Gate)</td>
</tr>
</tbody>
</table>

H-W1: wandered place, HVA-1: verbal assistance

#### Usage of directional signs at wandered places

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>H-W1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-W2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-W3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-W4</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>H-W5</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>H-W6</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

#### Usage of Information signs at wandered places

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-W1</td>
<td>● ● ●</td>
<td>● ● ●</td>
</tr>
<tr>
<td>H-W2</td>
<td></td>
<td>● ● ●</td>
</tr>
<tr>
<td>H-W3</td>
<td></td>
<td>● ● ●</td>
</tr>
<tr>
<td>H-W4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-W5</td>
<td></td>
<td>● ● ●</td>
</tr>
<tr>
<td>H-W6</td>
<td>● ● ●</td>
<td>● ● ●</td>
</tr>
</tbody>
</table>
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

- Information signs

Information signs were parallel to subjects’ views at the Station Concourse and difficult to understand due to the sign performance and small font size (Figure 2-22). The font size of contents on information signs was 1～5 mm (smaller than 7 mm). The amount of information, the font size, the contrast of sign performance, systematic display of foreign languages and locations should be adjusted.

![Bar Chart](image)

Figure 2-22: How do you think of the information signs?

- Identification signs and compound signs

Only one compound sign including the directional sign and the information sign was in target spaces, and this compound sign provided the information about the Bus Stop Guide, which included the Bus Terminal and Bus Stop A-F at the Station Square. Problems of identification signs were mainly revealed at the Bus Terminal and bus stops. For example, the font size of bus information was less than the standard. Moreover, the bus information at bus stops was not adequate and integrated.

- Overall evaluations of the wayfinding system
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Figure 2-23: Overall image of the wayfinding system in the transfer

The evaluation of image in the wayfinding experiment was clear (Figure 2-23). Subjects were satisfied with current wayfinding system in general, for example, they thought the signs were conspicuous, legible, and easy to find and trustful, especially directional signs at Station Concourse, however, the neatness and friendly sense were general, such as signs in the Bus Terminal.
Table 2-17: Process of sign usage in wayfinding tasks by subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Wayfinding process</th>
<th>✔️</th>
<th>✍️</th>
<th>✏️</th>
<th>❌</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Route A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>PM</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>12</td>
<td>2</td>
<td>3</td>
<td>0</td>
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<td>8</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>14</td>
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<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>H</td>
<td></td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Route B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>J</td>
<td></td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>O</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

- ✔️: Directional sign; ✍️: Information sign; ✏️: Identification sign; ❌: Compound sign; 
- PM: Time table; ☐: Ask people for assistance; ☐: Use smartphone for navigation

![Figure 2-24: Comparisons of sign usage by subjects](image-url)
3.3 Summaries: characteristic of sign usage

3.3.1 The situation of sign usage

The sign usage was analyzed from the three aspects:

- The relationship between sign usage and sign functional types,
- The relationship between sign usage and spatial locations,
- The relationship between sign usage and information demands.

The relationship between sign usage and sign functional types was to figure out in the actual physical environment, how directional signs and information signs affected people’s wayfinding behavior. The relationship between sign usage and spatial locations was to figure out how people used signs in different spaces. The relationship between sign usage and information demands was to understand the information demands in the wayfinding transfer based on human wayfinding behavior and mental models, the statement was conducted at the Episode 4 of this chapter.

1) The relationship between sign usage and sign functional types

At the beginning of each route, (Table 2-17) ten subjects used directional signs, two subjects used information signs, one subject used the smartphone, one subject asked people, and one subject saw the timetable. Directional signs were used the most in the wayfinding process (Figure 2-24).

2) The relationship between sign usage and spatial locations

Figure 2-25 shows the sign usage at each location. Table 2-18 shows the ratio of sign usage at each location, for example, 11% at the Station Concourse means 16 signs are used here, so the ratio of sign usage is 16 (numbers of used signs) divided 142 (numbers of total signs) equals 11%. The ratio of sign usage in the total signs at each location was as follows, in route A, Station Concourse is 11% (16 numbers), Station Square is 4% (5 numbers), and Bus Terminal / Bus Stop A is 2% (3 numbers). In route B, Station Concourse is 4% (5 numbers), Station Square is 6% (8 numbers), and Bus Terminal is 2% (3 numbers). The ratio of sign usage in route A was
highest at the Station Concourse, whereas at the Station Square in route B, additionally, the ratio of sign usage was the same at Bus Terminal both in route A and route B. At the Station Concourse, the wayfinding journey in route A was longer than route B, so subjects relied on more signs to reach the Hakata Gate. At the Station Square, numbers of subjects who went to the Bus Stop A in route A was fewer than the subjects in the route B, so the ratio of sign usage in route A was lower than the ratio in the route B. At Bus Terminal, subjects mainly used signs at Bus Terminal Gate.

<table>
<thead>
<tr>
<th>Location</th>
<th>Ratio of sign distribution</th>
<th>Ratio of sign usage in route A</th>
<th>Ratio of sign usage in route B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Concourse</td>
<td>54%</td>
<td>Station Concourse</td>
<td>Station Concourse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11%</td>
<td>4%</td>
</tr>
<tr>
<td>Station Square</td>
<td>30%</td>
<td>Station Square</td>
<td>Station Square</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Bus Terminal</td>
<td>16%</td>
<td>Bus Terminal</td>
<td>Bus Terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2%</td>
<td>2%</td>
</tr>
</tbody>
</table>

3.3.2 Characteristic of sign usage

It showed (Table 2-19) the characteristic of sign usage corresponding to the wayfinding protocol. Signs and the information at the paramount key nodes, such as the starting points of two routes, the Hakata Gate, the Bus Terminal Gate and the Bus Stop A were very important, and sign issues, such as the consistency, clarity, continuity, conspicuity and information amount at these locations should be taken into consideration again. Subjects used more directional signs in a straight pathway, such as the Station Concourse. Many signs were designed in the physical environment, however only a few were used, such as the signs at Station Square, so it indicated the differences existed between the sign distribution and the sign usage. Signs shaped spaces, so it should be clear enough what information to display for visitors among decision points of the movement network at first to make full use of the signs.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

<table>
<thead>
<tr>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph A" /></td>
<td><img src="image2.png" alt="Graph B" /></td>
</tr>
<tr>
<td>Station Concourse</td>
<td>Station Concourse</td>
</tr>
<tr>
<td><img src="image3.png" alt="Graph C" /></td>
<td><img src="image4.png" alt="Graph D" /></td>
</tr>
<tr>
<td>Hakata Gate</td>
<td>Hakata Gate</td>
</tr>
<tr>
<td><img src="image5.png" alt="Graph E" /></td>
<td><img src="image6.png" alt="Graph F" /></td>
</tr>
<tr>
<td>Station Square</td>
<td>Station Square</td>
</tr>
<tr>
<td><img src="image7.png" alt="Graph G" /></td>
<td><img src="image8.png" alt="Graph H" /></td>
</tr>
<tr>
<td>Bus Terminal/Bus Stop A</td>
<td>Bus Terminal/Bus Stop A</td>
</tr>
</tbody>
</table>

Figure 2-25: Sign usage in different locations
### Table 2-19: Characteristic of sign usage

<table>
<thead>
<tr>
<th>Sign usage</th>
<th>Actual situation</th>
<th>Patterns</th>
<th>Problems</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional type</td>
<td>• At the beginning of each route, ten subjects used directional signs, two subjects used information signs, one subject used the smartphone, one subject asked people, and one subject saw timetables. Directional signs were used at the most in the wayfinding process.</td>
<td>• Directional signs affected behavior patterns much.</td>
<td>• Directional signs should be consistent.</td>
<td>Many signs were installed in the physical environment, but only a few signs were used, especially, information signs.</td>
</tr>
<tr>
<td></td>
<td>→</td>
<td>• Information signs were used a few.</td>
<td>• Usage of information signs and Compound signs should be taken into account.</td>
<td>The differences between sign distribution and sign usage should decrease.</td>
</tr>
<tr>
<td></td>
<td>→</td>
<td>• Using the compound sign, subjects firstly paid attention to the part of the information sign.</td>
<td></td>
<td>Information on signs at key nodes should be in clarity and consistency.</td>
</tr>
<tr>
<td>Spatial location</td>
<td>• In route A, Station Concourse is 11% (16 numbers), Station Square is 4% (5 numbers), and Bus Terminal / Bus Stop A is 2% (3 numbers).</td>
<td>• From the Hakata Gate, behavior patterns became quite different.</td>
<td>• The Hakata Gate often made people confused.</td>
<td>The aspects of the sign system and the aspect of the information system should be coordinated.</td>
</tr>
<tr>
<td></td>
<td>• In route B, Station Concourse is 4% (5 numbers), Station Square is 6% (8 numbers), and Bus Terminal is 2% (3 numbers).</td>
<td>• Behavior patterns were more complex at the starting point in route A than the starting point in route B.</td>
<td>• Signboards at Bus Stop A were not integrated.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The ratio of sign usage in route A was highest at the Station Concourse, whereas at the Station Square in route B, the ratio of sign usage was the same at Bus Terminal both in route A and route B.</td>
<td>• Behavior patterns were more complex at the Bus Terminal than the Bus Stop A.</td>
<td>• Signs at Bus Terminal did not provide subjects available information and most of the information was not systematic and multilingual.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>→</td>
<td>→</td>
<td>• Information contents on signs were inconsistent and inconspicuous.</td>
<td></td>
</tr>
</tbody>
</table>
4. Information demands based on human wayfinding behavior

4.1 Introduction
In the study above, it figured out that people usually used directional signs at the most, and the next was the information signs. Therefore, in this episode, the directional signs and the information signs still should be taken into account to analyze the human wayfinding behavior and mental models in order to understand the information demands of people in the bus transfer system at Hakata Station.

4.2 Methods of the analysis
The purpose of the wayfinding experiment was to understand the human wayfinding behavior and characteristic of behavior patterns. Fifteen subjects conducted the experiment, and eight subjects were from the Shinkansen Entrance Central Gate (Route A), while seven subjects were from the JR Line Entrance North Ticket Gate (Route B). The experiment recorded their mental models and observed their behavior, because there would be differences between memory information and information performance (Kei Takashima, KeiAsako Nakagawa, 2014), and observations could be adopted to obtain a better understanding about people’s behavior in the environment, as it was a method of looking at action between people and their environment. (Tianjiao Zhao and Kin Wai Micheal Siu, 2014). The wayfinding process was divided into five parts corresponding to the spatial environment: starts, paths in the Hakata Station Concourse, nodes at Hakata Gate, paths at Station Square and destination at bus stops (Figure 2-26).

4.3 Results of the analysis
It indicated two types of wayfinding actions were identified based on subjects’ mental models when they moved, one was “bus information priority”, and the other was “non-bus information priority”. Most subjects were the type of “bus information priority” and they preferred to search for and use bus information to complete their wayfinding journeys.
Figure 2-26: Subjects’ wayfinding behavior patterns at the five parts.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Figure 2-27: Subjects’ mental models at each key location in the route A.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

Figure 2-28: The amount of information on directional signs

Figure 2-29: The ratio of the display “Bus Stop A-F” and “Hakata Bus Terminal” on directional signs

4.3.1 Bus information priority

1) Starting point

With a clear destination, most subjects began to search for bus information after coming out of the ticket entrance gates from trains. They wanted to know where was the bus stop, was there any guide information in the vicinity of the ticket entrance gate, could they obtain the bus information such as bus routes, the direction of the bus stop at ease. So the behavior patterns showed (Figure 2-26) in Route A, five subjects found and used directional signs at the start, three subjects did not because they could not see the signs. Signs with bus information here was just a directional sign that displays one item “Hakata Bus Terminal”. Subjects confused and could
not confirm whether they could take the bus for moving to destinations although they saw it. So they made a decision that they had to explore to move there and see what would happen then.

2) Station Concourse
The Station concourse was a straight route with a very sharply lucid directional signs. The directional signs made most of subjects move confidently in straight pattern lines, but they still did not know where was the bus stop and how long they could reach the bus stops.

3) Hakata Gate
The amount of information on directional signs became more at the Hakata Gate (Figure 2-28), as well as the bus information. Another bus information item “Bus Stop A-F” was displayed on directional signs, and five subjects saw the directional signs, whereas three subjects did not in Route A. The item made subjects who saw it wandered and confused because they did not know the differences between them and they hesitated whether they could take a bus for moving to the destination if they chose to move to the Bus Stop A-F (Figure 2-27).

4) Station Square
In Route A, five subjects moved to the Hakata Bus Terminal. Only subject E and H smoothly reached the destination stop and Subject A, D, and F took some time and explored there.

5) Hakata Bus Terminal and Bus Stop A
The ratio of the item usage was showed in Figure 2-29, the item of “Hakata Bus Terminal” was much higher than the item of Bus Stop A-F. As a result, in route A, five subjects moved to the Hakata Bus Terminal and three subjects moved to the Bus Stop A, while in route B, two subjects moved to the Hakata Bus Terminal and five subjects moved to the Bus Stop A, besides, most of the subjects who moved to the Bus Stop A saw buses coming to the stop or followed the stream of people, so they just moved
there without clear understanding of the station configuration.

4.3.2 Non-bus information priority
People preferred to go out of the station at first and then to find buses to take due to the complexity of the station. In the wayfinding experiment, it was figured out that subject F and H moved like this.

4.4 Summaries: information demands of the bus transfer system
All the subjects finally found the task destinations, but the information demands of the bus transfer system were not quite adequate in Hakata Station if it was from a standpoint of visitors. The information should be restructured as follows (Figure 2-30):

4.4.1 The information of leisure and amusement
The information of leisure and amusement means the station should provide guide signs including the information, such as toilets, restaurants, shopping, rest, hotels, and so forth to meet people’s general demands.

4.4.2 The information of public transport in transfer
The information of public transport in the transfer means the station should provide signs including the information, such as subways, buses, and airport and so forth for people to transfer in the public transport networks.

4.4.3 The information of bus guide
The information of bus guide means the station should provide signs including available bus information to assist people to transfer buses smoothly. The bus stop is not a destination, but one of the important nodes during the people’s journeys. Hence, the process of wayfinding of the bus transfer system should start from the point where people come out of ticket entrance gates to getting on buses conveniently afterward, importantly, the bus information elements also should be taken into consideration (Table 2-20). The information should be provided as follows:
The information of reaching main popular attractions.
In the wayfinding protocol, subjects were asked to find the bus stop heading for the Canal City HAKATA due to its popularity, but no signs provided the information. Main popular attractions referred to some key nodes that represent a city and they were the knowledge of large-scale network of a city. So, these spots could be destinations for visitors and visitors prefer to obtain the information of attractions at first. As an attractive city, it is very important to make visitors recognize and understand the information at ease when they just get off trains and then know about the city (Moribe Yoichiro, 2012).

The information of reaching bus stops at stations.
Some information might be missing at some decision points in the transfer process and the information was knowledge of small-scale network of a city that related to the stations. So a continuous and consistent sign system with common design styles was needed to assist people to reach the desired bus stops with ease.

Recognizable and conspicuous information at bus stops.

Integrated and clear guide information of bus routes, bus destinations, bus numbers, timetables, and the name of bus companies at the bus stop and bus platform at the Bus Terminal.

Methods of getting on and off buses.
It is very important to point out that many subjects have no ideas how to buy tickets when they board, such as number-printed tickets as well as fare cost and methods of getting off, especially, at Bus Stop A.

In this episode, it concluded that subjects had two types of priorities corresponding to people’s mental models and wayfinding behavior when they used the bus information: bus information priority and non-bus information priority. With a clear purpose, the characteristic of subjects’ wayfinding patterns included two types, namely explorational pattern and orientational pattern (Hara Hiromichi, Yoshiyachi Yutaka, Teraoka Natsuki, Tanaka Fumiaki, Shimizu Tadao, 2006). In the aspect of the bus transfer system, bus information on directional signs just displayed two items such as “Hakata Bus Terminal” and “Bus Stop A” and the two displayed items confused people to decide to move next at the Hakata Gate. The bus transfer system in Hakata Station led people to move to the Hakata Bus Terminal to take and transfer buses. When people arrived at the bus stop, they still had confusions how to take a bus due to unintegrated and inadequate information. Based on integrating the results of the information system at bus stops (A. S. Tavares, C. Gálvez, L. W. N. de Albuquerque, A. L. Almeida, R. Q. Barros, M. Soares, V. Villarouco, 2015), a list of bus information elements at bus stop was drawn. Table 2-20 shows the current bus information provided at the Bus Stop A and the Bus Terminal, and it was clear that provided information were mainly about the bus names, numbers, routes and arriving time, however, other important information including payment, boarding methods, guide maps, and so forth was not provided, so the bus information should be reclassified and restructured to ensue the adequateness. Moreover, the directional signs and the information signs did not communicate the distance with people, which meant how long people could reach the bus stop and transfer. Signs especially information signs could not assist people to build a complete mental model because people thought the signs were full of much information and they were afraid to use them.
Table 2-20: List of bus information elements at Bus Stop A and Bus Terminal

<table>
<thead>
<tr>
<th>Bus information elements</th>
<th>Bus Stop A</th>
<th>Bus Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus stop identification (name and number)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Numbers / names of the bus</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Full itinerary of bus lines</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Bus arriving time</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Bus leaving time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night buses itineraries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boarding methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spending time to main spots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maps and Attractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Map of area nearby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City map</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sightseeing attractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer to other public transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information on accessibility for disabled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic English for foreigners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency numbers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Discussions about the wayfinding system in Hakata Station

5.1 The inconsistency of signs at decision points
In term of functional types, performances of directional signs were not consistent corresponding to the mount types, the color codes, installed height, illumination types, design styles from the JR West to the Bus Terminal and the Bus Stop A. Particularly, directional signs were only consistent at the JR Kyushu part of the Station Concourse, so signs here made subjects have straight behavior patterns and perform confidently. Information signs should be perpendicular to people’s view rather than parallel at the Station Concourse.
Chapter II Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Hakata Station

In term of spatial decision points, such as starting points, the Hakata Gate, the Bus Terminal Gate, bus stops were paramount, so they should provide clearer, reliable, and predictable information to enable people orient smoothly, so directional signs should decrease the differences. For example, at the Shinkansen Entrance, the font size should be enlarged. At the JR Line Entrance North Ticket Gate, not only two timetables on the columns should be provided but also, directional signs and information signs should also be provided on columns that were right ahead of the entrance in order to make people firstly receive the information from signs with ease. At the Hakata Gate, signs and information should be consistent and simple to lead people’s wayfinding journeys, moreover, bus information should be provided here to make users have a better understanding of the transfer information and the space layout. It should strike an appropriate balance between the consistency and predictability (The Yellow Book: a prototype wayfinding system for London, 2007). At the Bus Terminal, information signs should be more clear and legible to read, for example, the amount of information, locations and systematic display of the foreign language should be adjusted.

In term of information contents related to bus taking, the information was also not consistent, for example, it indicated “Bus Stop A” and “Hakata Bus Terminal” on directional signs confused subjects to move next, so behavior patterns performed differently from the Hakata Gate.

5.2 Difficulties of obtaining bus information at bus stops
Some subjects reached either the Bus Stop A or the Bus Terminal and they still did not confirm this was the correct place or not because the information was not inadequate and integrated. The bus stop was not a destination, so it was necessary to assure people receiving available information to go next. Under this situation, designers should make people recognize the information without taking physical fatigue and feel secure from worries. Firstly, the bus information elements should be analyzed in order to meet people’s need. Three types of bus information were suggested, secondly, the integration of information, proper locations, clarity of contents, the consistency with other signs should be taken
into account.

5.3 Space limits on affecting human behavior
Due to the space limits, subjects did not see some signs because signs were hidden by the exit of underground. Some subjects even saw the directional signs without seeing the arrows; consequently, those created mistakes and took subjects’ effort. Designers should take the space limits into account at the beginning of the project in order to decrease the barriers and make people move correctly.

5.4 Clarity of sign contents
Clarity of the contents, such as the clarity of terminologies, especially the native and correct translations for solving the problems of language hindrance (Meng-Cong Zhang, Tadao Shimizu and Kiminobu Sato, 2008), integrity of the pictograms, understandability of the arrows, and simplicity of the information amount should also be taken into account. Performances of the foreign language should be systematic (Wonjun Chung, 2010).

5.5 Issues of information priorities
Priorities of the information referred to the priority of the information contents and the priority of information locations in the sign system. The priority of information contents meant urban planners and managers should firstly consider what Fukuoka City could provide for visitors as an attractive city and the information necessity of attractions and sightseeing in the sign system at Hakata Station. If needed, how to connect popular attractions within Hakata Station by what means. It was clear that directional signs only provided the information related to the “Bus Terminal” and “Bus Stop A-F”; besides, there were no hierarchies of information on information signs, so subjects could not prioritize to find the available information with ease. The priority of information locations meant the information should be provided at proper locations. It turned out that no directional signs at starting points directed the way to reach the attractions or sightseeing. Providing the attractions information at starting points (entrances) either on directional signs or information signs should be taken into
consideration at Hakata Station due to the complexity of the station and the attractiveness of Fukuoka City, if a visitor planned to reach the Canal City HAKATA, the visitor firstly had no ideas how to reach there and had to get to the Bus Stop A or the Bus Terminal, and then took effort to search for the accurate boarding stop, bus routes, bus numbers and payment to complete the task by using the current sign system, but if a visitor knew the desired information when just came out of ticket entrance gates, the situation changed better because the information assisted the visitor in forming a mental map, which was quite helpful for the coming wayfinding journey.

6. Conclusions

From the survey of sign distribution and a wayfinding protocol, this study figured out difficulties existed in the transfer between trains and city buses by using the current sign system. The following problem-solving wayfinding strategies were identified (Table 2-21): firstly, in term of sign functional types, directional signs were not consistent based on the mount types, color codes, illumination types, and the height. The sign performance of information signs, such as the font size, the contrast and hierarchies of contents affected people wayfinding behavior much. In addition, the location should be more conspicuous and installed angles should not be parallel to people’s view. Identification signs at the Bus Terminal should adjust the font size to make the information clearer and more readable. The compound sign was only one located at the Station Square, so the compound signs should be more installed to strike an appropriate balance of the information between the consistency and the predictability. Secondly, in term of spatial key decision points, such as train ticket entrances, the Hakata Gate, the Bus Terminal Gate and the Bus Stop A, they should assure consistent signs. Paths linked nodes were also paramount, it was clear that only the path from the JR Kyushu part to the Hakata Gate made subjects move straight due to the consistent directional signs and bus information, however, paths between the Hakata Gate and the Bus Terminal Gate had different behavior patterns. As a result, the continuity, consistency,
conspicuity and clarity of signs should be emphasized in the path of the wayfinding process. Thirdly, the consistency and adequateness of bus information should be taken into consideration. Particularly it was figured out the information at the Bus Stop A was inadequate and not integrated, so bus information elements should be adjusted. Fourthly, the differences between the Bus Terminal and the Bus Stop A-F at the Station Square should be clearer to make people understand better and smoothly lead people to take buses. It indicated that subjects did not know the differences at the Hakata Gate and they could take the bus heading for the desired destination either at Bus Stop A or Bus Terminal. Fifthly, priorities of information on signs should be significantly taken into account for Fukuoka City as an attractive city that ranked the 36th place in the world. The experiences in the transfer were quite important because the experience had a strong expression to people who was the first time to visit.

Table 2-21: Wayfinding strategies in the transfer between trains and city buses at Hakata Station

<table>
<thead>
<tr>
<th></th>
<th>Trains → City buses Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional types</td>
<td>Consistent, predictable, clear information</td>
</tr>
<tr>
<td>Spatial relationship</td>
<td>Signs at spatial decision points and pathways</td>
</tr>
<tr>
<td>Tactical level 1 at bus stops</td>
<td>Adequate bus information elements</td>
</tr>
<tr>
<td>Tactical level 2 at bus stops</td>
<td>Clarity of differences of bus stops at Station Square and Bus Terminal</td>
</tr>
<tr>
<td>Strategic level</td>
<td>Priorities of information</td>
</tr>
</tbody>
</table>

This study pointed out not only methods to improve the current sign system in order to lead people to transfer from trains to city buses at Hakata Station smoothly but also, it suggested a proposal based on four points for other complex terminal stations at attractive cities. Firstly, it was very important to assure the consistency of signs at each decision point (nodes) and paths in the wayfinding process, secondly, the integrity and adequateness of bus information at bus stops should be taken into consideration, thirdly, if a complex station had a Bus Terminal and bus stops at Station Squares, it was quite necessary to clarify the differences between the Bus Terminal and bus stops in order to make users complete the bus taking at ease, fourthly, priorities of the information at the whole sign system was also significant to a station, what information should
be provided by what forms was needed to consider, because users preferred to obtain available information at first and then carry out an act.

Postscripts

In this chapter, the paper was accepted for publication:
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Chapter III

Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

1. Research purpose of this chapter

A Wayfinding system in the transfer between train and city buses plays a very important role in urban public transport networks, as well as the urban accessibility, and meanwhile, it will create the actual image of a city in individual’s mind to make people have a deep impression on the legibility of the system at ease, especially visitors, as a result, legibility has long been recognized as an important factor in creating a good image of a city in individual’s mind (Negin Minaei, 2014), but wayfinding difficulties such as disorientation, time spending, fatigue and getting lost always frustrate visitors for reaching their destinations. In term of wayfinding communication, designers should have to respond to three major questions: what information should be presented, where and in what form (Romedi Passini, 1996). In addition, as we know, Kyoto Station is visited by huge amounts of visitors as the city’s transportation hub and gateway due to the city’s powerful attractiveness. To respect that bus utility is the major mean of the public transport in Kyoto City, also, there is a large Bus Terminal providing service that assist people to reach their desired destinations in an extensive bus network.

This chapter focuses on the wayfinding system in transfer between train and city buses to see how the sign system would affect people's wayfinding behavior in order to have a better understanding of the characteristic of sign distribution and usage in the transfer between trains and city buses. The availability of information was also taken into account, such as, the deviation of information, appropriateness of information location and adequateness of information amount, because in a circulation system of terminal, availability of information signs is important to passengers.
(Seneviratne, P.N., Martel, N., 1994) and the informative function is the most important feature of signs (Seokhyun Lee, 2014). Finally, results indicate problems and the evaluation of the current wayfinding system.

2. Characteristic of sign distribution

2.1 Targets of the survey
This survey includes two parts, one is the public sign, such as directional signs, information signs and identification signs and compound signs; regulatory signs are not included due to the less affect on people’s wayfinding behavior in the transfer. The range of public signs is in the six spaces: Bus Terminal, Station Square, Station Central Concourse, Pedestrian Walkway, Shinkansen Central Entrance Gate area, and Hachijo Gate area (Figure 3-1, Appendix A-6).

Considering the research is related to the bus transfer from trains, so a survey was conducted to understand the situation of bus operating afterward about how many bus routes, bus categories, bus functions, and bus stops are at Kyoto Station. It is quite important that how people use the information and get on buses when they reach the bus stop by using signs.

2.2 Methods of the survey
Target signs were classified into categories based on sign functions and each sign was marked with a specific number. The numbers, locations, functions and information contents of signs were recorded. Bus routes, numbers and categories were also recorded (Table 3-1).

<table>
<thead>
<tr>
<th>Date</th>
<th>2015.10.01. – 2015.10.02.</th>
<th>Daytime: 09:30am – 16:00pm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target sign</td>
<td>Directional sign</td>
<td>Information sign</td>
</tr>
<tr>
<td></td>
<td>Identification sign</td>
<td>Compound sign</td>
</tr>
<tr>
<td>Task</td>
<td>Take photos of signs; record the amount, locations, functional types, and information contents of signs; mark signs with numbers.</td>
<td></td>
</tr>
<tr>
<td>Target space</td>
<td>Bus Terminal, Station Square, Station Central Concourse, Pedestrian Walkway, Shinkansen Entrance Central Gate, Hachijo West Gate</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3-1: The distribution of target signs at target spaces in the layout of Kyoto Station

Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station
2.3 Methods of the analysis

1) The situation of bus operating at Kyoto Station (Bus Terminal)
Bus types at the Bus Terminal were recorded and listed based on the bus functions and boarding locations.

2) Sign distribution were analyzed corresponding to the following three respects:

- Distribution of signs based on functional types,
- Distribution of signs based on spatial locations,
- Distribution of bus information on signs.

Signs were classified into categories to understand how each type of signs distributed. The distribution of signs based on spatial locations was to analyze and compare the situation of sign distribution at each target space. The distribution of bus information was to understand the arrangements of bus information in order to examine the availability of bus information, such as deviation of information, appropriateness of information location, and adequateness of information amount. All the three respects above contributed to the results about the characteristic of sign distribution.

2.4 Results of sign surveys

2.4.1 Situations of bus operating

1) Bus types
Seven types of buses were found at the Bus Terminal, such as City Bus, JR Bus, Kyoto Bus, Keihan Bus, Keikan Kyoto Bus, Tankai Bus and Expressway Bus. Bus Terminal faced the Station Central Concourse with nineteen numbers of bus stops and provided rich bus routes lines. Stops of the City Buses were for the main sightseeing spots by twelve numbers of bus stops (Table 3-2).
Table 3-2: Situation of bus operating at Bus Terminal

<table>
<thead>
<tr>
<th>Bus types</th>
<th>Bus Locations of getting on and off</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Bus</td>
<td>A1, A2, A3, B1, B2, B3, C1, C4, C5, D1, D2, D3</td>
<td>12</td>
</tr>
<tr>
<td>Kyoto Bus</td>
<td>C3, C6</td>
<td>2</td>
</tr>
<tr>
<td>Keihan Kyoto Bus</td>
<td>C2</td>
<td>1</td>
</tr>
<tr>
<td>Keihan Bus</td>
<td>C6</td>
<td>1</td>
</tr>
<tr>
<td>Tanhai Bus</td>
<td>C2</td>
<td>1</td>
</tr>
<tr>
<td>JR Bus</td>
<td>JR3</td>
<td>1</td>
</tr>
<tr>
<td>Expressway Bus</td>
<td>JR1, JR2, JR3</td>
<td>3</td>
</tr>
</tbody>
</table>

2.4.2 Characteristic of sign distribution

1) Distribution of signs based on functional types

It (Table 3-3) showed the Station Central Concourse had the most categories of signs; most of the spaces at least provided the basic functions (Figure 3-2), including directional signs, information signs, and identification signs. At the Station Square, Station Central Concourse, and Pedestrian Walkway, compound signs composed of directional signs and information signs were provided due to facing three main entrance gates (JR West Gate, JR Central Gate, and Kyoto Station Central Gate).
2) Distribution of signs based on spatial locations

- Distribution types of signs in the layout

Signs distributed at spaces in two types: the regular type and the centralized type. The regular type distributed intermittently at the Station Square, Pedestrian Walkway, Hachijo Gate area, Shinkansen Central Entrance Gate area, and Bus Terminal, and the centralized type centralized at the Station Central Concourse (Table 3-4). The sign distribution had a very close relationship with its space form.
Table 3-4: Types of sign distribution

<table>
<thead>
<tr>
<th>Types and locations</th>
<th>Patterns of distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular type</td>
<td>![Regular type pattern]</td>
</tr>
<tr>
<td>Locations</td>
<td>Bus Terminal</td>
</tr>
<tr>
<td></td>
<td>Hachiyo Gate area,</td>
</tr>
<tr>
<td></td>
<td>Station Square</td>
</tr>
<tr>
<td></td>
<td>Pedestrian Walkway,</td>
</tr>
<tr>
<td></td>
<td>Shinkansen Gate</td>
</tr>
<tr>
<td>Space form</td>
<td>![Space form pattern]</td>
</tr>
<tr>
<td>Centralized type</td>
<td>Station Central Concourse</td>
</tr>
<tr>
<td></td>
<td>Space form</td>
</tr>
</tbody>
</table>

- The ratio of sign distribution

Figure 3-3 shows the ratio of sign distribution: Station Square is 30%, Bus Terminal is 23%, Pedestrian Walkway is 16%, Shinkansen Central Entrance Gate area is 11% as well as the Station Central Concourse, and Hachijo Gate is 9%. Inside of the station, the Shinkansen Central Entrance Gate area is 11%. So it indicated that signs existed the deviation of distribution corresponding to the locations.

![Figure 3-3: Ratio of sign distribution based on spatial locations]
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

<table>
<thead>
<tr>
<th></th>
<th>Bus Terminal</th>
<th>Station Square</th>
<th>Station Concourse</th>
<th>Pedestrian Walkway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Directional signs</strong></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td><strong>Information signs</strong></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
</tr>
</tbody>
</table>

Figure 3-4: Signs in the Kyoto Station (1)
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

<table>
<thead>
<tr>
<th>Directional signs</th>
<th>Information signs</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Shinkansen Central Gate" /></td>
<td><img src="image2" alt="Shinkansen Central Gate" /></td>
</tr>
<tr>
<td><img src="image3" alt="Hachijo West Gate" /></td>
<td><img src="image4" alt="Hachijo West Gate" /></td>
</tr>
<tr>
<td><img src="image5" alt="Underground" /></td>
<td><img src="image6" alt="Underground" /></td>
</tr>
</tbody>
</table>

Figure 3-5: Signs in the Kyoto Station (2)
Table 3-5: Comparisons of directional signs at six locations

<table>
<thead>
<tr>
<th>Locations</th>
<th>Mount types</th>
<th>Color codes</th>
<th>Illumination types</th>
<th>Distribution modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus Terminal</td>
<td>Freestanding</td>
<td>White on black, Black on white</td>
<td>Internally illuminated, No illumination</td>
<td>Standing</td>
</tr>
<tr>
<td>Station Square</td>
<td>Freestanding, Column Mount</td>
<td>Black on white, White on black, Multicolor on white</td>
<td>Internally illuminated</td>
<td>Four-sides standing, Linear, Parallel</td>
</tr>
<tr>
<td>Station Central Concourse</td>
<td>Freestanding, Post Mount</td>
<td>Black on white, Black on glass</td>
<td>Internally illuminated</td>
<td>Crossing, Standing</td>
</tr>
<tr>
<td>Pedestrian Walkway</td>
<td>Overhead suspended</td>
<td>White on black</td>
<td>Internally illuminated</td>
<td>Crossing, Parallel</td>
</tr>
<tr>
<td>Shinkansen Central Entrance Gate</td>
<td>Overhead suspended, Freestanding, Column Mount</td>
<td>White on brown, Black on yellow, Black on white</td>
<td>Internally illuminated</td>
<td>Crossing, Parallel</td>
</tr>
<tr>
<td>Hachijo Gate area</td>
<td>Overhead suspended, Column Mount</td>
<td>Black on white, White on brown</td>
<td>Internally illuminated, No illumination</td>
<td>Crossing, Parallel</td>
</tr>
</tbody>
</table>

• Inconsistency of sign distribution
Based on Figure 3-4 and Figure 3-5, comparisons of directional signs were conducted. It was figured out that signs were quite different and inconsistent, however, the signs at the Pedestrian Walkway, the Station Square, and the part of Central Concourse were in the same design styles and totally different with the ones at the Shinkansen area. Color types of directional signs included six types (Table 3-5). Moreover, a few signs at the Bus Terminal and the Hachijo Gate were without illumination at night, so the maintenance of signs also should be taken into consideration.

3) Distribution of bus information on signs
Users directly received the information from signs and built a communication with signs, so the availability of information was very important in the process of communications. Here, it analyzed the consistency of the bus information regarding directional signs and information signs in the physical environment (Figure 3-6, Appendix A-7).
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Note:

- Directional signs with bus information; S-A001: Code number of signs

Figure 3-6: The distribution of bus information on signs in the layout of Kyoto Station
Directional signs

Directional signs displayed the directions and were always used by people, so the directional signs should provide the consistent information to people. It was clear that the bus information mainly centralized at places close to the Station Central Gate and north gate of Pedestrian Walkway (Figure 3-6). At the Shinkansen Central Entrance Gate area, signs provided the least bus information compared with other places in Kyoto Station, and two signs displayed the bus information (Table 3-6), one sign only displayed the item “Group Bus Terminal” (S-A001), and the other one was “City Bus Terminal” (S-A013), however, this sign S-A013 actually belonged to the sign system of Shinkansen inner part, so the design style including the color coding, illumination types was completely different with sign S-A001. Except the two signs, no signs with bus information were found. In terms of the numbers of bus information (Figure 3-7), it was clear that the bus
information centralizes at the Station Square and the Pedestrian Walkway, especially the most numbers of bus information was provided at the Station Square. Bus information at Hachijo West Gate area showed the bus information such as “Airport Bus”, “Expressway Bus”, and “Regular Sightseeing Bus”. At bus terminal, only one directional sign S-A056 provided bus information and the other one sign S-D008 without bus information displayed distances to reach destinations.

Figure 3-7: Numbers of bus information on directional signs

- Information signs
At Shinkansen Central Entrance Gate area, two information signs were here, one was Kyoto Station Map of IF and 2F of Shinkansen part and the other one was Kyoto Station Area Information, which was about hotel information hang on a column closes to stairs between Shinkansen Central Entrance Gate and Pedestrian Walkway. So it indicated that information signs were not adequate, besides, six compound signs composed of directional signs and information signs were provided from the Pedestrian Walkway to the Station Square.

2.5 Summaries: characteristic of sign distribution

2.5.1 The characteristic of sign distribution
Table 3-7 shows the characteristic of sign distribution and the distribution
types are two types, such as the regular type and the centralized type in Kyoto Station. Distribution type has a close relationship with its physical environment.

The signs at most of spaces were the regular types and the signs in the centralized type at Station Central Concourse centralized close to the Central Entrance Gate including directional signs, information signs and compound signs.

Signs were not consistent. Directional signs in the Pedestrian Walkway, the part of Central Concourse, and the Station Square were in the same design styles, whereas, the directional signs in the Shinkansen Central Entrance Gate and the part of Hachijo West Gate were in the same design styles, and the others were quite different. The distribution of signs existed the deviation at some places based on sign numbers and types, such as Shinkansen Central Entrance Gate area and some same information contents were displayed in different ways without the maintenance.
### Table 3-7: Characteristic of sign distribution

<table>
<thead>
<tr>
<th>Sign distribution</th>
<th>Actual situation in space</th>
<th>Problems</th>
<th>Characteristic</th>
</tr>
</thead>
</table>
| **Functional type** | • Directional signs and information signs centralized at the Station Square.  
• Directional signs intermittently distributed in the regular type.  
• Directional signs were in different design styles. | Types were inadequate in some spaces; information and compound signs should be taken into account. | Types of sign distribution were the regular type and the centralized type. |
| **Spatial location** | • Signs were distributed at the most in the Station Square and inside of the station; the Shinkansen Central Entrance Gate area had the fewest signs. | Deviation existed, Inconsistent |  |
| **Bus information** | • Only one directional sign without bus information displayed the distance at the Bus Terminal.  
• Bus information centralized at the Pedestrian Walkway and the Station Square.  
• Directional signs lacked bus information at the Shinkansen Central Entrance Gate.  
• Signs did not display the “Bus Terminal” at the Hachijo West Gate area.  
• Information contents were not consistent at the Shinkansen Central Entrance Gate and the Hachijo West Gate and some same contents were in different ways. | Inconsistent, Inadequate, Inconspicuous, Deviation existed, Some contents lacked maintenance | The types had a close relationship with its space form.  
Sign systems were not consistent |
3. Characteristic of sign usage

3.1 Methods of the wayfinding protocol
The wayfinding protocol was a method to examine and evaluate the current public sign system in order to have a better understanding of the characteristic of sign usage based on subjects’ wayfinding behavior. The protocol included two aspects: 1) a wayfinding experiment observed and recorded their wayfinding processes on site and 2) post-test interviews and a questionnaire were conducted to assess their wayfinding tasks.

1) Participants
Fifteen subjects who were visitors without any experiences at Kyoto Station were recruited to conduct this experiment (Table 3-8).

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sex</th>
<th>Age</th>
<th>Nationality</th>
<th>English level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>M</td>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>F</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>M</td>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>F</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>M</td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

2) Dates
- Date: 2015.10.03 ~ 2015.10.10.
- Daytime: 09:30am ~ 16:00pm.
3) Wayfinding Tasks
To respect the train lines in the station, JR Lines and Shinkansen Lines were focused, and the task was composed of three routes. The starting points of the route A, the route B, and the route C were asked from the Shinkansen Central Entrance Gate, JR West Gate, and JR Central Gate. No subjects started from the Central Gate of Kintetsu Lines. The destination of the protocol task was asked to reach the bus stop of Kiyomizu-dera. The Shinkansen Central Entrance Gate was actually quite the opposite side of the central gate of Kintetsu Railway and both of them used the same sign system between their central gates, the JR West Gate located in the middle of the Pedestrian Walkway, and the JR Central Gate located at the Central Concourse facing the Kyoto Station Central Gate and the Bus Terminal. Eight subjects (four males and four females) started from the Shinkansen Central Entrance Gate, three subjects (two males and one female) were from the JR West Gate, and four subjects (two males and two females) were from the JR Central Gate. All the subjects were permitted that they could ask people for assistance or use smartphones in their wayfinding processes.

4) Measurements
The measurement was conducted by observing and accompanying subjects together. As regarded the subjects’ task performances related to the study, the following data was measured:

- **Wayfinding time**: time spending was calculated from the starting point to the destination with a timer.
- **Sign usage**: the sign usage about how many signs and what functional type of signs was used in the wayfinding process. It was recorded at each node, such as the starting point, the north gate of Pedestrian Walkway, as well as paths in the Station Central Concourse, the Station Square, and the Hachijo Gate area.
- **Wandered place**: the places that subjects stayed at least 2 seconds.
- **Wayfinding tools**: what other tools subjects used except signs, such as smartphones, guide maps or asking people.
3.2 Results of the wayfinding protocol

Fifteen subjects were asked to conduct the wayfinding experiment in three routes. In regard to the ways of orientation, it was observed that subjects asked staff for assistance and used guide maps or smartphones for navigation except using signs. The wayfinding pattern of each subject was shown at Appendix A-3.

Table 3-9: Results of wayfinding experiment in route A

<table>
<thead>
<tr>
<th>Wayfinding process</th>
<th>Route A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting point</td>
<td>Shinkansen Central Gate</td>
</tr>
<tr>
<td>Subjects</td>
<td>A    B     C    D    E    F    G    H</td>
</tr>
<tr>
<td>Wayfinding time (min: sec)</td>
<td>10.38 6.36 15.22 13.19 9.46 15.18 10.51 9.51</td>
</tr>
<tr>
<td>Average time (min: sec)</td>
<td>11.23</td>
</tr>
<tr>
<td>Ask people for assistance</td>
<td>●     ●     ●     ●</td>
</tr>
<tr>
<td>Use smartphone/map</td>
<td>●     ●</td>
</tr>
<tr>
<td>Go to Kyoto Tourist Information Center</td>
<td>●     ●     ●     ●     ●</td>
</tr>
<tr>
<td>Go to Hachijo Gate</td>
<td>●     ●     ●     ●     ●</td>
</tr>
<tr>
<td>Go to Underground Pedestrian Walkway</td>
<td>●</td>
</tr>
<tr>
<td>Go to Porta(underground)</td>
<td>●     ●     ●     ●     ●</td>
</tr>
</tbody>
</table>

Figure 3-8: Comparisons of sign usage by subjects
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Legend:
- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure 3-9: All the subjects’ wayfinding behavior patterns
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Legend:
- : Directional sign; : Information sign; : Identification sign; : Compound sign (directional + information sign); : Signs used by subjects; : Spots subjects ask for assistance; : Subjects’ behavior patterns (aboveground); : Subjects’ behavior patterns (underground).

Figure 3-9-1: Wayfinding behavior pattern of subject A
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Legend:

- ●: Directional sign; ■: Information sign; ○: Identification sign; □: Compound sign (directional + information sign);
- ●: Signs used by subjects; ⭐: Spots subjects ask for assistance;
- - - - : Subjects’ behavior patterns (aboveground); - - - - : Subjects’ behavior patterns (underground).

Figure 3-9-2: Wayfinding behavior pattern of subject E
Legend:

- : Directional sign;  - Information sign;  - Identification sign;  - Compound sign (directional + information sign);
- : Signs used by subjects;  - : Spots subjects ask for assistance;
- - - - : Subjects’ behavior patterns (aboveground);  - - - - : Subjects’ behavior patterns (underground).

Figure 3-9-3: Wayfinding behavior pattern of subject F
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Legend:
- Directional sign;  Information sign;  Identification sign;  Compound sign (directional + information sign);  Signs used by subjects;  Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);  Subjects’ behavior patterns (underground).

Figure 3-9-4: Wayfinding behavior pattern of subject H
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Legend:

- Directional sign
- Information sign
- Identification sign
- Compound sign (directional + information sign)
- Signs used by subjects
- Spots subjects ask for assistance
- Subjects’ behavior patterns (aboveground)
- Subjects’ behavior patterns (underground)

Figure 3-9-5: Wayfinding behavior pattern of subject J
3.2.1 Results in route A
In route A; firstly, in terms of the wayfinding time of the experiment, the average time of them was around 11 minutes (Table 3-9). Three subjects of them exceeded the average time, such as subject C, D and F and the other five subjects were below it. Subject B spent the shortest time while subject C used the longest time. The reasons were subject B was quite clear about where to take a bus after asking a staff and moved to the Bus Terminal without any hesitation, and subject C spent approximately six minutes at Kyoto Tourist Information Center due to language hindrance and crowds of people inside of it. Secondly, the situation of numbers of sign usage was that subject A used 14 numbers which were the most signs, and subject D used 2 numbers of signs which were the fewest numbers (Figure 3-8).

Subjects moved in two directions, they moved left to the Hachijio West Gate and moved right to the Pedestrian Walkway. Four of them, such as subject A, E, F and H moved to the Hachijo Gate, which was opposite to the Bus Terminal due to the unclear bus transfer information. All of four subjects mentioned that only the “Group Bus Terminal” on directional signs could be found and referred. Subject A, E and H moved downstairs to continue to search for routes, however, subject A returned to the starting point afterward (Figure 3-9-1). Subject E (Figure 3-9-2) and H kept moving and stopped intermittently to Underground Pedestrian Walkway and when they got into the Underground Pedestrian Walkway, they totally thought they were lost and emotionally wanted to quit the task with a negative mood on account of the wayfinding fatigue and orientation errors.

Figure 3-10: Signs used by subjects F and G at Porta gate in Station Square
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

- Subject H (Figure 3-9-4): I only see one directional sign that displays the “Group Bus Terminal” and I do not think this information is correct, but I have no ideas where to go, so I decided to go that way… later, I can not find any information about taking the bus and I really want to give up myself at the underground because I think I lost my ways and it frustrates me to keep moving…

Even though the other four subjects: subject B, C, D, and G did not move to the Hachijo Gate, all of them also said they could not find available information for transferring buses at this area. Subject B and D wandered for a while and decided to ask station staff; subject C used a smartphone and a guide map for obtaining information and subject G just followed the stream of people. Subject F (Figure 3-9-3) and G reached the Station Square, but, both of them went downstairs to the underground of Porta, the reason was they all saw the bus information regarding the transfer on the signs hang on the entrance gate of Porta (Figure 3-10), consequently, it took them much time with fatigue at the underground.

3.2.2 Results in route B and route C

In route B (Table 3-10), the distance and wayfinding time were quite shorter than the route A and the average time was around 7 minutes. Subject I also went downstairs to the Porta as subject F and G did and then felt lost, finally subject I returned to the aboveground. Subject J (Figure 3-9-5) just followed a stream of people to move outside of the Pedestrian Walkway and used three compound signs (information signs). Subject K read the guide map firstly and then moved straightly to the north gate. In a word, three subjects had different wayfinding behavior patterns at Station Square (Table 3-11).

- Subject I: I see the bus information on signs at the Porta gate, so I move downstairs to the underground, later, I try to find the bus stop, but I cannot, so I think I am in a wrong way, as a result, I have to move to the aboveground again. I still do not know why the bus information is displayed at the gate, and I think the bus information is too much…
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Table 3-10: Results of wayfinding experiment in route B and route C

<table>
<thead>
<tr>
<th>Wayfinding process</th>
<th>Route B</th>
<th>Route C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjects</td>
<td>I</td>
<td>J</td>
</tr>
<tr>
<td>Subjects</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>Wayfinding time (min. sec)</td>
<td>9.29</td>
<td>8.18</td>
</tr>
<tr>
<td>Average time (min. sec)</td>
<td>7.29</td>
<td>1.4</td>
</tr>
<tr>
<td>Ask people for assistance</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Use smartphone/map</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Go to Information Center</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Go to Porta (underground)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3-11: Subjects’ (I, J, K) wayfinding behavior patterns at Station Square

<table>
<thead>
<tr>
<th>Subject I</th>
<th>Subject J</th>
<th>Subject K</th>
</tr>
</thead>
<tbody>
<tr>
<td>04.49 (min. sec)</td>
<td>06.0 (min. sec)</td>
<td>01.10 (min. sec)</td>
</tr>
</tbody>
</table>

In route C, four subjects spent the shortest time and the average time was around 1 minutes (Table 3-10). Considering the space configuration, the Central Concourse was the nearest to the Bus Terminal, because people tend not to have a wandering priority for short distance wayfinding. (Meng-Cong Zheng, 2011), the four subjects were confident of their wayfinding capabilities and could reach the bus stop faster and easier than others.

- Subject L (Table 3-12): I see the detailed bus information when I read the information sign at the Station Square, and it shows me the bus routes, bus numbers, and the place where to take buses, additionally, the staff who stands close the information sign assists me to find the bus stop easily, and it makes me feel very friendly…
- Subject O: I just follow the stream of people to move outside the concourse firstly, and then I see the bus stop, so I think it is quite simple to find the bus stop…
Table 3-12: Subjects’ (L, M, N, O) wayfinding behavior patterns

<table>
<thead>
<tr>
<th>Subject L</th>
<th>Subject M</th>
<th>Subject N</th>
<th>Subject O</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Legend:
- Directional Sign
- Identification Sign
- Information Sign
- Compound Sign
- Signs used by subjects

3.2.3 Summaries of the wayfinding protocol
- Directional signs

Among the main four wandered places, directional signs were used more at K-W1 and K-W4 (Table 3-13). K-W1 was most confused place (Figure 3-12) and the problems of directional signs were “few numbers of installation” and “no information I need”, especially at the Shinkansen Central Entrance Gate, so it turned out that signs with available information were inadequate (Figure 3-11). Subjects did not see the directional sign S-A013 due to the improper location, and only one sign S-A001 was used by subjects, but the bus information was not helpful.

![Chart](image5.png)

Figure 3-11: How do you think of directional signs at Shinkansen Central Entrance Gate?
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Figure 3-12: Where do you confused most in the following spaces?

- Information signs

At main wandered places, information signs were mainly used at K-W4 (Table 3-13). At the bus stops, subjects did not understand how to take buses even if they reached the bus stop and it (Figure 3-13) indicated that the three most difficult things were pointed out to understand: “Bus route”, “Boarding methods”, and “confirm the bus stop”. Some screens displayed information about bus direction heading for the popular sightseeing, but the bus information related to boarding methods, such as payment, buying one-day ticket were not adequate and it was also difficult to pay attention to the information signs nearby with the increase of visitors. Moreover, in the wayfinding process, subjects also identified difficulties, such as “numbers are few”, “no available information”, “small font”, and “inconspicuous location”, as well as the problems of the compound signs (Figure 3-14).
Table 3-13: Sign usage at wandered places by subjects overall

<table>
<thead>
<tr>
<th>K-W1</th>
<th>K-W2</th>
<th>K-W3</th>
<th>K-W4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shinkansen Central Entrance</td>
<td>Entrance of underground</td>
<td>Entrance of Porta (Station Square)</td>
<td>North gate of Pedestrian Walkway</td>
</tr>
</tbody>
</table>

Usage of directional signs at wandered places

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
<th>Route C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>K-W1</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>K-W2</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>K-W3</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>K-W4</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Usage of information signs at wandered places

<table>
<thead>
<tr>
<th>K-W1</th>
<th>K-W2</th>
<th>K-W3</th>
<th>K-W4</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Overall evaluation of the wayfinding system
The quality of informativeness had a close relationship with continuity in the wayfinding system; inappropriate location and inadequate information could lead lower evaluation of continuity (Figure 3-15). From the starting point to the destination of the wayfinding experiment, the whole evaluation of the image of the wayfinding system was around general; especially the verbal assistance decreased wayfinding difficulties of subjects and made them feel friendly (Figure 3-16). Besides, the evaluation of the refinement was lower than other items, so the sign system might improve the individuality to show impressive identity regarding the station and the city.
3.3 Summaries: characteristic of sign usage

3.3.1 The situation of sign usage

The sign usage was analyzed from the three aspects:

- The relationship between sign usage and sign functional types,
- The relationship between sign usage and spatial locations,
- The relationship between sign usage and information demands.

The relationship between sign usage and sign functional types was to figure out in actual physical environment, how each type of signs affected people’s
wayfinding behavior. The relationship between sign usage and spatial locations was to figure out how people used signs in different spaces. The relationship between sign usage and information demands was stated at the Episode 4 of this chapter.

Table 3-14: Process of sign usage in wayfinding tasks by subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sign usage in the wayfinding process</th>
<th>●</th>
<th>■</th>
<th>●</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image" alt="Sign usage diagram A" /></td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td><img src="image" alt="Sign usage diagram B" /></td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>C</td>
<td><img src="image" alt="Sign usage diagram C" /></td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td><img src="image" alt="Sign usage diagram D" /></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td><img src="image" alt="Sign usage diagram E" /></td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>F</td>
<td><img src="image" alt="Sign usage diagram F" /></td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>G</td>
<td><img src="image" alt="Sign usage diagram G" /></td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>H</td>
<td><img src="image" alt="Sign usage diagram H" /></td>
<td>11</td>
<td>0</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>I</td>
<td><img src="image" alt="Sign usage diagram I" /></td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>J</td>
<td><img src="image" alt="Sign usage diagram J" /></td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>K</td>
<td><img src="image" alt="Sign usage diagram K" /></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>L</td>
<td><img src="image" alt="Sign usage diagram L" /></td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>M</td>
<td><img src="image" alt="Sign usage diagram M" /></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td><img src="image" alt="Sign usage diagram N" /></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>O</td>
<td><img src="image" alt="Sign usage diagram O" /></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

●: Directional sign; ■: Information sign; ●: Identification sign; ○: Ask people for help; □: Compound sign (directional + information sign); M: Reading guide map; PM: Use smartphone for navigation; ?: Move to Kyoto Tourist Information Center

1) The relationship between sign usage and sign functional types
At each starting point of three routes, seven subjects used directional signs, two subjects used information signs, two subjects used identification signs, two subjects used the guide maps, one subject firstly asked staff instead of using signs, and one subject used compound signs. The numbers of directional signs were the most used by subjects (Table 3-14).

2) The relationships between sign usage and spatial locations
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Figure 3-17: Sign usage in different locations

Figure 3-17 shows the numbers of sign usage at each location. Table 3-15 shows the ratio of sign usage by subjects at each location, for example, 7% means nine signs are used at Pedestrian Walkway, so the sign usage here is 9 (numbers of used signs) divided by 123 (numbers of total signs) equals about 7%. The ratio in each location as follows: Pedestrian Walkway is 7% (9 numbers), Station Square is 7% (8 numbers), Shinkansen Central Entrance Gate is 5% (6 numbers), Hachijo West Gate is 3% (4 numbers), Station Central Concourse is 3% (4 numbers). The ratio in the Pedestrian Walkway and the Station Central Concourse is nearly the same.
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Table 3-15: Differences between sign usage and sign distribution in route A

<table>
<thead>
<tr>
<th>Locations</th>
<th>Numbers of sign distribution</th>
<th>Deviation</th>
<th>Ratio of sign usage in physical spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers (high→low)</td>
<td></td>
<td>Locations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ratio (high→low)</td>
</tr>
<tr>
<td>Station Square</td>
<td>37</td>
<td></td>
<td>Pedestrian Walkway</td>
</tr>
<tr>
<td>Pedestrian Walkway</td>
<td>20</td>
<td></td>
<td>Station Square</td>
</tr>
<tr>
<td>Central Concourse</td>
<td>14</td>
<td></td>
<td>Shinkansen Gate</td>
</tr>
<tr>
<td>Shinkansen Gate</td>
<td>13</td>
<td></td>
<td>Hachijo West Gate</td>
</tr>
<tr>
<td>Hachijo West Gate</td>
<td>11</td>
<td></td>
<td>Central Concourse</td>
</tr>
</tbody>
</table>

It turned out that the deviation existed between the sign distribution in the physical environment and the sign usage by subjects (Table 3-15). The Station Square had the most numbers of signs and the numbers were much more than those at the Pedestrian Walkway, however, the sign usage was nearly the same at the Station Square and the Pedestrian Walkway. Pedestrian Walkway was a long rectangle form, so subjects used the most signs to go through it. Besides the comparison of sign usage at the Bus Terminal was not included in Table 3-15 because each subject used the identification sign at the Bus Terminal to recognize the task destination.

3.3.2 Characteristic of sign usage
Based on the subjects’ wayfinding behavior in the experiment, it concluded that the sign usage and the sign distribution existed differences. Characteristic of sign usage should take the following two aspects into consideration.

1) Sign distribution in physical environment
   In the physical environment, spaces with the most numbers of signs, that did not mean this space had the highest ratio of sign usage, such as the most numbers of signs were installed at the Station Square, however, the highest ratio of sign usage was the Pedestrian Walkway. In term of signs with bus information (Table 3-16), 24 numbers of directional signs distributed and the signs mainly centralized at the Station Square. Information signs (compound signs) with bus information were 6
numbers, mainly distributed at the Station Square and faced the north gate of Pedestrian Walkway and Kyoto Station Central Gate, so information sign (compound signs) with bus information were not adequate at other locations.

Table 3-16: Numbers of target signs with bus information at target locations

<table>
<thead>
<tr>
<th>Locations</th>
<th>NDS</th>
<th>NIF (NCM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus Terminal</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Station Square</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Central Concourse</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Pedestrian Walkway</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Shinkansen Central Entrance Gate Area</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hachijo West Gate Area</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24</td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Note:
NDS: Numbers of directional signs with bus information,
NIF: Numbers of information signs with bus information,
NCM: Numbers of compound signs with bus information.

(2) Sign usage based on wayfinding experiment

The Station Square had the most numbers of signs, but only few signs were used. Decision points between important spaces made people’s wayfinding behavior patterns more complex, such as the patterns at the north gate of Pedestrian Walkway, so signs at each node were very important for guiding people how to move next. Moreover, directional signs with good consistency in a straight space could make people’s behavior patterns simpler.

The characteristic of sign usage (Table 3-17) had a very close relationship with sign distribution. In spatial locations, it should consider the appropriateness of the sign locations because the signs at the important nodes between spaces affected people’s wayfinding behavior much and it took plenty of time and effort of people if the signs were not conspicuous in inappropriate locations. The consistency of signs was still one of the most important issues. Compound signs and manual service (verbal assistance) decreased the wayfinding difficulties of people at Kyoto Station.
### Table 3-17: Characteristic of sign usage

<table>
<thead>
<tr>
<th>Sign usage</th>
<th>Actual situation</th>
<th>Patterns</th>
<th>Problems</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional type</td>
<td>At each beginning of task route, seven subjects used directional signs, two subjects used information signs, two subjects used identification signs, two subjects used the guide maps, one subject firstly asked staff instead of using signs, and one subject used compound signs.</td>
<td>Behavior changed corresponding to sign functional types</td>
<td>The usage of information signs was inadequate.</td>
<td>Sign usage based on subjects’ wayfinding behavior and sign physical distribution had differences. Problems among users, environment, and signs should be adjusted and coordinated.</td>
</tr>
<tr>
<td>Spatial location</td>
<td>The ratio in each location as follows: Pedestrian Walkway is 7% (9 numbers), Station Square is 7% (8 numbers), Shinkansen Central Entrance Gate is 5% (6 numbers), Hachijo West Gate is 3% (4 numbers), Station Central Concourse is 3% (4 numbers). The ratio in the Pedestrian Walkway and the Station Central Concourse is nearly the same.</td>
<td>In route A, at the beginning, there were two types of behavior; subjects had different patterns at the Station Square.</td>
<td>Sign usage in different location existed differences (deviation) compared with the physical distribution</td>
<td></td>
</tr>
</tbody>
</table>
4. Information demands based on human wayfinding behavior

4.1 Introduction
Wayfinding is how human orient and navigate in space, and it requires wayfinders to seek and process spatial information, such as architectural cues, signs, and maps (Lauren H. Mandel, 2011). The physical environment includes natural factors such as weather or geography, population density, availability and access as pedestrian or passengers to facilities such as public transportation (availability and accessibility). (Meinder Haveman, Vera Tillmann, Reinhilde Soppler, Stefan Kcas, Daniel Monninger, 2013). So availability of information plays a very important role in the sign system, the availability of information, such as locations, amount, and legibility of information was examined in this part based on subjects’ wayfinding behavior to see whether the bus transfer information on the current sign system could meet people’s need.

4.2 Methods of the analysis
At the wayfinding experiment, subjects’ wayfinding behavior was recorded, and interviews recorded how they thought in their wayfinding processes. The spatial orientation process, which included three aspects: decision making, decision execution and information processing (Romedi Passini, 1984). So this study was conducted based on the three aspects to understand the current usability and informativeness of information.

4.3 Results of the analysis
4.3.1 Starting points
It (Figure 3-18) explained the subjects’ mental models at their beginning of tasks in route A. All the six subjects at first searched for signs and wanted to find bus information on directional signs and people who firstly looked at the guide map and also searched for bus information on directional signs. So eight subjects acted as bus information priority.
### Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

Figure 3-18: Subjects’ mental models in route A

<table>
<thead>
<tr>
<th>Subjects</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (min:sec)</td>
<td>4:38</td>
<td>1:38</td>
<td>2:28</td>
<td>4:22</td>
<td>0:45</td>
<td>3:47</td>
<td>1:30</td>
<td>0:55</td>
</tr>
<tr>
<td>Information processing</td>
<td>Search for signs, Find signs, Search for bus information, Confirm “Group Bus”, Predict bus stop is near, Go out station to see</td>
<td>Search for signs, Find signs, Search for bus information, Confirm “Group Bus”, Confused, Go to the next station to see</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
<td>Search for signs, Find signs, Search for bus information, Confused, Ask stuff for help</td>
</tr>
<tr>
<td>Decision making</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
<td>Decide next stop</td>
</tr>
<tr>
<td>Decision execution</td>
<td>Act, Can not find bus stop, Last and return</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
<td>Act, Move to Pedestrian Walkway</td>
</tr>
</tbody>
</table>
4.3.2 Destination (Bus Terminal)

All the subjects reached the bus stop and they said they did not understand the bus routes, bus boarding, and payment methods. If subjects had been to Kyoto Tourist Information Centers and asked for the staff before arrived at bus stops, they knew they could buy one-day unlimited bus tickets to take buses and recommended travel routes.

4.4 Summaries: information demands of the bus transfer system

1) Difficulties of obtaining bus information

Difficulties of receiving bus information mainly happened in route A, at the Shinkansen Central Entrance Gate, to obtain bus information was difficult due to the inadequate provision of bus information on directional signs and information signs because one directional sign only displayed one item of “Group Bus Terminal” without any other bus information, the other directional sign with bus information was not seen by subjects due to the improper location. Besides, information signs displayed the floor information of Shinkansen part in Kyoto Station and the hotel information nearby that could not assist subjects to navigate.

2) Non-systematic bus information at bus stops

At the Bus Terminal, bus stops should have adequate and systematic information elements (A.S. Tavares, 2015). Without this information, it also would take much effort and time of people or make people disoriented. The information should consider satisfying the local people and visitors’ need (Table 3-18).

In three task routes, it was clear that the Shinkansen Central Entrance Gate was the most difficult location for transferring buses and lacked available bus information. The bus stop was a key node in the transfer between trains and city buses and it was not a destination, so people should obtain useful and available information when they reached the bus stop, particularly, the visitors who did not have the knowledge of the surroundings, and also the bus stops should provide systematic information to ensure people that they
could smoothly board on buses at ease.

Table 3-18: List of bus information elements at Bus Terminal

<table>
<thead>
<tr>
<th>Bus information elements</th>
<th>Bus Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus stop identification (name and number)</td>
<td>●</td>
</tr>
<tr>
<td>Numbers / names of the bus</td>
<td>●</td>
</tr>
<tr>
<td>Full itinerary of bus lines</td>
<td>●</td>
</tr>
<tr>
<td>Bus arriving time</td>
<td></td>
</tr>
<tr>
<td>Bus leaving time</td>
<td>●</td>
</tr>
<tr>
<td>Night buses itineraries</td>
<td></td>
</tr>
<tr>
<td>Payment</td>
<td></td>
</tr>
<tr>
<td>Boarding methods</td>
<td></td>
</tr>
<tr>
<td>Spending time to main spots</td>
<td></td>
</tr>
<tr>
<td>Maps and Attractions</td>
<td></td>
</tr>
<tr>
<td>Map of area nearby</td>
<td></td>
</tr>
<tr>
<td>City map</td>
<td></td>
</tr>
<tr>
<td>Sightseeing attractions</td>
<td></td>
</tr>
<tr>
<td>Transfer to other public transportation</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Information on accessibility for disabled</td>
<td></td>
</tr>
<tr>
<td>Systematic English for foreigners</td>
<td>●</td>
</tr>
<tr>
<td>Emergency numbers</td>
<td></td>
</tr>
</tbody>
</table>

5. Discussions about the wayfinding system in Kyoto Station

5.1 The deviation of information distribution
The wayfinding could cause people to be mentally “aware” of their surroundings and had a better memory of it (Mondschein, 2011). But the deviation of information existed in spaces, the first sign people saw was quite paramount and salient, however, people did not find available bus transfer information at the Shinkansen Central Entrance Gate in the route A. The consistency from here to the Bus Terminal was not good and people could see the clear bus information until arrived at the Pedestrian Walkway.
If people moved to the opposite side of the Pedestrian Walkway, the wayfinding experience became worse. Locations with the most signs were contrarily used only a few by subjects. In order to facilitate smooth movements of users, the deviation by locations should be corrected to give continuity to information (Yoshitsugu Morita, Yoichi Yamazaki, 1992). The deviation should be coordinated between spatial distribution and usage and the signs should be considered where people were most likely to look for the information.

5.2 Difficulties of communications between users and signs

Figure 3-19: Hierarchies in the communications between users and signs

To obtaining bus information included three aspects corresponding to space properties. The information must be adjusted based on what was trying to be communicated at each key node. Firstly, it was the starting point where users could obtain the available information or not, secondly, it was the way searching process that should assure users of the consistency, accuracy and prediction of the information; thirdly it was the bus stop where users could take buses at ease. People obtained the information from the signs, and meanwhile, created the communication with signs. Passini (1980) mentioned two structural components could be identified in a total set of decisions
taken to complete a wayfinding task, 1) decision hierarchies and 2) decision plans. Hierarchies of the information existed in the information processing of people due to the problems that “where am I”, “where is my way”, and “how do I reach there”, which directly affected people’s decisions. Information on signs also existed hierarchies, which related to the priorities of the information, signs should consider where to provide the information, when to provide the information, how to provide the information and what should be provided and could provide the useful and available bus information to users (Figure 3-19). So under this situation, the appropriateness and availability of bus transfer information on signs should be taken into account again.

5.3 Issues on maintenance of the sign system
As a gateway to other cities, signs directly left visitors a good image or not in their wayfinding processes. The maintenance of signs at the Hachijo Gate was a big issue and some contents lacked integrity, for example, the same content was displayed “Pedestrian Walkway” on signs at the Pedestrian Walkway, Station Central Concourse, and the Station Square, but it was completely displayed “North-South Pedestrian Deck” at the Shinkansen area and the Hachijo Gate. The difference cannot assist users form a complete mental model.

5.4 The wayfinding distance and people behavior
It indicated that subjects more or less were confident at the starting point of the wayfinding task but gradually lost their confidence and some subjects decided to quit the tasks due to unclear distance because the wayfinding behavior of people could change corresponding to the wayfinding distance (Meng-Cong Zheng, 2011). Information concerning the remaining distance should be covered on signs (Julien Tardieu, Patrick Susini, Franck Posson, Hiroshi Kawakami, Stephen McAdams, 2009) to make them assure the next wayfinding journeys. However, only one directional sign at the Bus Terminal communicated the distance and all subjects were observed that they did not use it.
5.5 Non-integrity of temporary signs
Temporary signs at the Hachijo Gate area were messy in general and increased the visual clutter because a new improvement project was under construction. The temporary signs were quite different and less integrated with other existed signs. Subject E and G wandered for a while when they were confused by using the temporary signs. Temporary signs constituted the integrity of the whole sign system, so it should assure people of the consistency and clarity.

6. Conclusions

As a tourism city, Kyoto City was a bus-centered city and bus utility was more frequent than subways, so a large Bus Terminal providing service that took people to reach their desired destinations in an extensive bus network was close to the Station Square to meet people’s need. Compared with other complex terminal stations, the station was to lead people to reach the Bus Terminal for taking buses. However, problems were identified:

- Unavailability of information (nodes).
- The spatial inconsistency of information (wayfinding process).
- Difficulties of information confirming (Bus Terminal).

The bus information at key nodes, such as the starting point, particularly the Shinkansen Central Gate, subjects could not obtain the available information due to the inadequate information. In the wayfinding process, on the one hand, subjects had different behavior patterns at the north gate of the Pedestrian Walkway; on the other hand, subjects spent much time if they moved to the Hachijo West Gate area due to inconsistent and inadequate information. Difficulties of confirming the bus information at the Bus Terminal were also one of the issues.

This study analyzed the characteristic of sign distribution, the characteristic
of sign usage, and information demands based on people’s mental models in the wayfinding process. Signs distributed in the regular types at the Station Square, the Pedestrian Walkway, the Hachijo Gate area, the Shinkansen Central Entrance Gate area, and the Bus Terminal; whereas, the centralized type centralized at the Station Central Concourse. People referred information from signs and signs provided information to people to create a communication at the same time, so wayfinding strategies were identified to adjust the differences between the sign distribution and sign usage in the wayfinding process.

Figure 3-20: Wayfinding strategies in the transfer between trains and city buses at Kyoto Station

Figure 3-20 shows five aspects of wayfinding strategies. The spatial consistency of information assured the consistent wayfinding behavior; for example, subjects only had the consistent wayfinding behavior patterns at the Pedestrian Walkway. The appropriateness of information location assured the conspicuity and proper placement of signs increased the visibility of wayfinding searching. The adequateness of information amount assured the continuity, for example, information on signs at the Shinkansen Central Gate and the Hachijio Gate lacked adequate information. The legibility of information contents could deliver the clarity to people. Available information could assist people to confirm the next move with confidence and a complete mental model. Paul Mijksenaar (2013) also claimed that a sign system should follow the “four-C” rule, namely, consistency, continuity, conspicuity, and clarity.

In terms of the consistency, the inconsistency exists in a profusion of
wayfinding systems if varied companies implement the sign projects. As a result, under this situation, the wayfinding system should provide a common wayfinding structures to assure the integration and coherence complying with the urban positioning and city policies in order to enable visitors to have a better understanding of located environment and increase the wayfinding awareness.

Moreover, people’s wayfinding behavior was quite influenced by wayfinding distances. If the distance was quite long, people could think they were in the wrong direction and then backtracked to the original places, on the contrary, people did not wander in a short distance and moved quickly to complete wayfinding journeys, so the information on signs should communicate the distance to people in order to assist them to form a better mental model. Additionally, the manual services, such as verbal assistance, which could be enhanced by a facility’s wayfinding information system (Arthur & Passini, 1992) at the Station Square and the Kyoto Tourist Information Center decreased the wayfinding difficulties of people and the assistance made subjects fell friendly.

Postscripts

In this chapter, the paper was accepted for publication:
Chapter III Characteristic of Sign Distribution and Usage in Transfer between Trains and City Buses in Kyoto Station

References
service in air terminals. Transportation Research Record 1461, 24-30.


Section II
Comparisons and Summaries regarding Characteristic of
Sign Distribution and Sign Usage
Section II: Comparisons and Summaries regarding Characteristic of Sign Distribution and Sign Usage

Chapter IV
Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations

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Chapter IV

Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations

1. Research purpose of this chapter

In this chapter, the sign systems at Hakata Station and Kyoto Station compared and summarized the characteristic of sign distribution and sign usage in the transfer between trains and city buses to find commonalities and differences. Although the differences between the two terminal stations existed, the commonalities were revealed. Compared with directional signs, it indicated that information signs were not adequate in terms of the distribution and the usage; so diverse information signs were discussed. Moreover, a common sign system was suggested.

2. Summaries: characteristic of sign distribution and sign usage

2.1 Characteristic of the sign distribution

1) Hakata Station

It indicated that the station included three types of sign distribution, such as the regular type, the centralized type, and the dispersive type. The regular type was that signs intermittently distributed based on the regular distance in spaces, particularly, directional signs and information signs distributed in this way at the Station Concourse, as well as identification signs at the Bus Terminal. The centralized type was that signs centralized at building gates, such as the Bus Terminal Gate. Due to the space limits, only the information signs distributed in this way. The dispersive type was that signs irregularly distributed in spaces, the directional signs and the information signs were all in this way at the Station Square.
In terms of the sign distribution based on the sign functional types and spatial locations, problems were identified, the deviation of sign distribution existed, for example, directional signs and information signs mainly distributed at the Station Concourse and the Hakata Station Square. No directional signs were installed at the Chikushi Station Square. Besides, only one directional sign was at the Bus Terminal Gate and only one compound sign was close to the Hakata Gate at the Station Square. Three types of sign distribution should assure the consistency and the wayfinding ease, especially at the decision points, such as the starting points (entrance gates of trains), the Hakata Gate, the Bus Terminal Gate, and the bus stops in the wayfinding process.

2) Kyoto Station
It indicated that the station included two types of sign distribution, such as the regular type and the centralized type. Directional signs distributed in the regular type at the Pedestrian Walkway, the Shinkansen Central Gate, the Station Square, and the Hachijo Gate area, besides, identification signs distributed in this way at the Bus Terminal. Moreover, the centralized type containing directional signs and information signs centralized between the JR Central Gate and the Kyoto Station Central Gate at the Station Central Concourse. Overall, signs were distributed at the most in the Station Square, and inside of the station, signs were the fewest at the Shinkansen Central Entrance Gate compared with the Station Concourse and the Pedestrian Walkway. Either the regular type or the centralized type, signs should be consistent and both the two types of sign distribution should take the connection and consistency into consideration.

2.2 Characteristic of the distribution of bus information on signs
1) Hakata Station
- Directional signs
It was figured out that directional signs (35 numbers) provided the bus information and the bus information was completely “Bus Terminal” at the Station Concourse. All the bus information was displayed to face the
Chikushi Gate. However, signs provided two types of bus information at the Hakata Gate, such as the “Bus Terminal” and the “Bus Stop A-F”. So it indicated that directional signs inside of the Station Concourse were to lead people’s wayfinding to the Bus Terminal to take buses due to the consistency of the information “Bus Terminal”.

- Information signs
  It was clear that only three sets of information signs with the same contents provided the bus information at the Station Square and the bus information was related to the transportation introduction of reaching the main fourteen attractions in Fukuoka City by the JR lines, subways lines, buses from the Bus Terminal and Bus Stop A/E. Additionally, the bus information on information signs was in visual clutter and provided non-systematic multi-languages at the Bus Terminal.

- Compound signs
  Only one compound sign including the directional sign and the information sign was in all target spaces, and this compound sign provided the information about the Bus Stop Guide, which included the Bus Terminal and Bus Stop A-F at the Station Square.

- Identification signs
  Problems of identification signs were mainly revealed at the Bus Terminal and bus stops. For example, the font size of bus information was less than the standard and the bus information at bus stops was not adequate and integrated.

2) Kyoto Station
   - Directional signs
     The numbers of directional signs with bus information corresponding to locations was clear that the Station Square had ten numbers, the Pedestrian Walkway had eight numbers, the Station Concourse had four numbers, the Shinkansen Central Entrance Gate had two numbers, and the Bus Terminal
had one number. Compared with all locations inside of Kyoto Station, the bus information was the least at the Shinkansen Central Entrance Gate, for example, one sign displayed “Group Bus Terminal” and the other one displayed “City Bus Terminal”, which kept the same design styles with the directional signs installed inside of the Shinkansen Central Entrance Gate. Overall, the Bus information centralized at the Station Square and the Pedestrian Walkway, especially the most amount of bus information was provided at the Station Square. At the Hachijo West Gate, directional signs displayed bus information, such as “Airport Bus”, “Expressway Bus”, and “Regular Sightseeing Bus”. At the Bus Terminal, only one directional sign provided the bus information and the other one without bus information displayed the distance to reach attractions.

- Information signs
Two information signs were found at the Shinkansen Central Entrance Gate, one was the Kyoto Station Map IF/2F of the Shinkansen part of the station, and the other was the Kyoto Station Area Information that was about the hotel information nearby hung on a column close to stairs between the Shinkansen Central Entrance Gate and the Pedestrian Walkway. So it indicated information signs were not adequate and no information signs showed the layout of the station.

- Compound signs
Six compound signs that were composed of directional signs and information signs provided the bus information at the Pedestrian Walkway, the Station Concourse, and the Station Square.

- Identification signs
Nineteen numbers of identification signs with bus information were provided at the Bus Terminal.

2.3 Characteristic of the sign usage
1) Hakata Station
At the beginning of each route, ten subjects used directional signs, two subjects used information signs, one subject used a smartphone, one subject asked people for assistance, and one subject saw timetables. Directional signs were the most used and affected subjects’ wayfinding behavior patterns much in the wayfinding process. Information signs were used quite a few.

The ratio of sign usage in the route A was highest at the Station Concourse, whereas at the Station Square in route B. The ratio of sign usage was the same at the Bus Terminal in two routes. Overall, it indicated that many signs were installed in the physical spaces, however, only a few were used, so it revealed the differences between the sign distribution and the sign usage existed. The proper amount of signs should be adjusted to avoid the visual clutter and the issue of overloaded information because signs could be regarded as the attractive landscape for improving the environment amenity (Seokhyun Lee, 2014). The information on signs at important decision points, such as the starting points, the Hakata Gate, the Bus Terminal Gate, and the bus stops made the wayfinding difficulties.

3) Kyoto Station
The sign usage based on subjects’ wayfinding behavior and sign physical distribution existed differences. For example, the most numbers of signs were installed at the Station Square and were much more than the numbers at the Pedestrian Walkway; however, the ratio of sign usage was nearly the same with the ratio at the Pedestrian Walkway. In spatial locations, it should consider the appropriateness of the sign locations because it could take plenty of time and effort of people if signs were not conspicuous in inappropriate locations. The signs at the important nodes affected people’s wayfinding behavior much, for example, the subjects’ behavior patterns became more complex at the north gate of the Pedestrian Walkway and the Shinkansen Central Entrance Gate.

Moreover, directional signs with good consistency in a straight space could
make people’s behavior patterns simple. Information signs with available bus information were not adequate at the Shinkansen Central Entrance Gate and the Hachijo West Gate. Six compound signs and manual service (verbal assistance) decreased the wayfinding difficulties of people at Kyoto Station. As a result, the consistency of signs was still one of the most important issues.

2.4 Characteristic of the usage of bus information
1) Hakata Station
Subjects used the information, such as the “Hakata Bus Terminal” from the starting points of the route A and route B to the Hakata Gate. From the Hakata Gate to the Bus Terminal or the Bus Stop A, the signs offered the bus information “Hakata Bus Terminal” and the “Bus Stop A-F” to subjects. It was clear that both the two contents of the bus information above made subjects confused who saw them because subjects did not understand the differences between them. Moreover, subjects also could not obtain the available information at ease either at the Bus Terminal or the Bus Stop A because the information was not integrated, adequate, legible, and conspicuous.

2) Kyoto Station
From the starting point of the route A, signs provided the bus information, such as the “Group Bus Terminal” and the “City Bus Terminal”. But, no subjects saw the “City Bus Terminal” due to its inappropriate placement and the “Group Bus Terminal” confused all the subjects who saw it. The information of “Bus Terminal” was displayed only at the Shinkansen Central Entrance Gate. Overall, in terms of the usage of the bus information, on the one hand, the signs contained the information, such as the “Airport Bus”, the “Expressway Bus”, and the “Regular Sightseeing Bus” at the Hachijo West Gate, but the information could not assist subjects to find the destination at ease, on the other hand, the signs provided the information “Bus” for subjects to use and assist them at the Pedestrian Walkway, the Station Concourse, and the Station Square.
Table 4-1: Comparisons of the characteristic of sign distribution at Hakata Station and Kyoto Station

<table>
<thead>
<tr>
<th>Sign environment</th>
<th>Hakata Station (HS)</th>
<th>Commonalities</th>
<th>Kyoto Station (KS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparisons</td>
<td>Actual situation of sign distribution</td>
<td>Station Concourse, Station Square, Bus Terminal</td>
<td>Bus Terminal, Station Square, Station Central Concourse, Pedestrian Walkway, Shinkansen Central Entrance Gate, Hachijo West Gate.</td>
</tr>
<tr>
<td>Target spaces</td>
<td>Station Concourse, Station Square (Bus Stop A-F), Bus Terminal.</td>
<td>Station Concourse, Station Square, Bus Terminal</td>
<td></td>
</tr>
<tr>
<td>Functional types</td>
<td>Directional signs mainly distributed at the Station Concourse and the Station Square. Information signs also centralized in the Station Concourse and the Station Square. Only one compound sign was at the Hakata Station Square providing the information of the Bus Stop Guide. The most types of signs distributed at Hakata Station Square.</td>
<td>Four types of signs were installed at both stations. Directional signs mainly centralized at the Station Square and were the fewest at the Bus Terminal. Directional signs distributed in the regular type. Information signs were the fewest at the Shinkansen Entrance Gate.</td>
<td>Directional signs and information signs centralized at the Station Square. Directional signs intermittently distributed as the regular type. Directional signs were in different design styles.</td>
</tr>
<tr>
<td>Spatial locations</td>
<td>Signs had differences corresponding to locations. Station Concourse (54%), Station Square (30%), and 1F of Bus Terminal (16%). Directional signs centralized the main station gates.</td>
<td>Signs were in different design styles at the Shinkansen Entrance and JR local lines gates. Signs were quite different at the Bus Terminal than other locations.</td>
<td>Station square (30%), Bus Terminal (23%), Pedestrian Walkway (16%), Station concourse (11%), Shinkansen Central Entrance Gate (11%), Hachijo Gate (9%). Compounds signs centralized the main station gate. Signs centralized at the JR Central Gate.</td>
</tr>
<tr>
<td>Informativeness</td>
<td>The bus information centralized at the Station Concourse (&quot;Bus Terminal&quot;) and the Hakata Gate (&quot;Bus Terminal&quot;/&quot;Bus Stop A-F&quot;). Bus information was not systematic multilingual using at the Bus Terminal.</td>
<td>The bus information centralized at the Pedestrian Walkway and the Station Square. Directional signs lacked available bus information at the Shinkansen Central Entrance Gate. Signs did not display the “Bus Terminal” at the Hachijo West Gate area. Some same contents were in different ways.</td>
<td></td>
</tr>
<tr>
<td>Problems</td>
<td>Compound signs were only one and may be considered more. The heights of directional signs were inconsistent at the Hakata Gate. Illumination issues.</td>
<td>Inconsistent information, inadequate information at bus stops, maintenance issues.</td>
<td>Categories of signs were inadequate in some places.</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Regular type and centralized type</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Comparisons of the characteristic of sign distribution

Kyoto Station and Hakata Station were quite different corresponding to their space properties. For example, it was clear that Kyoto Station was more complex than Hakata Station from the differences of the target spaces in this study; also, the Bus Terminal was outdoor at Kyoto Station but indoor at Hakata Station. However, in terms of the sign distribution at both two stations, the commonalities of the characteristic were figured out (Table 4-1), such as signs distributed among the Station Concourse, the Station Square, and the Bus Terminal with four functional types. Particularly, directional signs centrally distributed at the Station Square and the numbers were the fewest numbers at the Bus Terminal. Information signs were the fewest at the Shinkansen Entrance Gate. To consider the aspect of spatial locations, overall, the consistency of signs was higher at the Station Concourse and the Station Square than the Bus Terminal and signs were quite distinctive at the Bus Terminal compared with other locations either Kyoto Station or Hakata Station. Signs, especially directional signs were designed in different styles regarding the color codes, illumination modes, and mount types between the part of Shinkansen Lines and the part of the JR Local Lines at both two stations. In general, the signs distributed in the regular type and centralized type.

The common problems were identified; firstly, the consistency of sign distribution was still one of the most important issues at terminal stations. The information was not consistent, for example, directional signs were in different design styles at Hakata Station and the bus information on directional signs did not provide consistent information at Shinkansen Central Entrance Gate in Kyoto Station. Secondly, the bus information was inadequate at bus stops and not integrated at the Bus Terminals. Thirdly, maintenance issues, such as illumination problems at Hakata Station and inconsistency of the same information contents at Kyoto Station were revealed.
Table 4-2: Comparisons of the characteristic of sign usage at Hakata Station and Kyoto Station

<table>
<thead>
<tr>
<th>Signs usage</th>
<th>Hakata Station (HS)</th>
<th>Commonalities</th>
<th>Kyoto Station (KS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparisons</td>
<td>Characteristic of sign usage</td>
<td>Directional signs were used at the most at the starting points. Directional signs affected subjects’ wayfinding behavior much: it made subjects’ behavior patterns simple who saw it. The usage of information signs was less.</td>
<td>At each beginning of task route, seven subjects used directional signs, two subjects used information signs, two subjects used identification signs, two subjects used the guide maps, one subject asked staff, and one subject used compound signs.</td>
</tr>
<tr>
<td>Functional types</td>
<td>At the beginning of each route, ten subjects used directional signs, two subjects used information signs, one subject used a smartphone, one subject asked people, and one subject saw timetables.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial locations</td>
<td>In route A, the ratio of sign usage was the highest at Station Concourse and the lowest at Bus Terminal.</td>
<td>The Bus Terminals should take the adequateness of the bus information into account.</td>
<td>In route A, the ratio of sign usage was the highest at Pedestrian Walkway and Station Square, and the lowest at Bus Terminal.</td>
</tr>
<tr>
<td>Informativeness (Bus information)</td>
<td>Bus information confused subjects at the Hakata Gate. Subjects could not confirm the information at the Bus Stop A and obtain the information at the Bus Terminal at ease.</td>
<td>Difficulties of obtaining available bus information.</td>
<td>The bus information was not available at the Shinkansen Central Entrance Gate.</td>
</tr>
<tr>
<td>Behavior patterns</td>
<td>In route A, at the beginning, two types of behavior patterns were found.</td>
<td>Directional signs where located in a straight space made subjects’ wayfinding behavior patterns straight and simpler. Subjects acted in two types of behavior at the starting points in both route A.</td>
<td>At the starting point in route A, subjects moved in two directions.</td>
</tr>
<tr>
<td>Problems</td>
<td>The issues of sign consistency. Difficulties and orientation errors happened at important decision points, such as the starting points, the Hakata Gate.</td>
<td>The sign arrangement and sign consistency at decision points affected sign usage much. Differences existed between sign distribution and sign usage.</td>
<td>The issues of sign arrangement. Difficulties and orientation errors mainly happened at the Shinkansen Central Entrance Gate, the Hachijo West Gate, and the underground.</td>
</tr>
<tr>
<td>Characteristic of distribution</td>
<td>The legible information and systematic provision of multilingual service should be considered.</td>
<td>Diverse information system, The aspects of the sign system and the aspect of the information system should coordinate. Problems among users, environment, and signs should be taken into account.</td>
<td>The differences between the sign distribution and the sign usage should decrease. The adequateness and continuity of information at entrance gates should be taken into consideration.</td>
</tr>
</tbody>
</table>
4. Comparisons of the characteristic of sign usage

The commonalities of the sign usage by subjects at two stations were revealed (Table 4-2). As we know, the first sign at the beginning of the whole wayfinding process was very important to users because it showed directional signs were the most used at the starting points and affected subjects’ wayfinding behavior much, but the usage of information signs was less. Difficulties of obtaining available bus information existed, for example, subjects could not confirm the bus information with ease at Bus Stop A or the Bus Terminal in Hakata Station because of the inadequate information, besides, subjects could not obtain the available information at the starting point of the route A and not understand the boarding methods at the Bus Terminal in Kyoto Station.

Problems of the commonalities were identified, firstly, many signs were designed and installed at the target spaces, but subjects used only a few, so differences of the sign distribution and sign usage existed and the differences should be decreased. Secondly, decision points in spaces were significant for users to smoothly move next, so the sign distribution should assure to provide the consistent and legible information at these decision points, such as the starting points, the Hakata Gate, the Shinkansen Central Entrance Gate, and so forth. Overall, the main issue was the consistency of signs at Hakata Station but the arrangement of signs at Kyoto Station, based on the revealed problems, the aspects of the sign system and the information system should coordinate to satisfy people’s need.

4.1 Summaries 1: comparisons of the usage of directional signs

It was clear that the total amount of directional signs were much more at Hakata Station (74 numbers) than the ones at Kyoto Station (58 numbers) (Table 4-3) although the numbers target spaces were less at Hakata Station than Kyoto Station. Most subjects used directional signs at the starting points and the ratio of sign usage was almost the same at Hakata Station and Kyoto Station. The ratio 38% of directional signs at Hakata Station means
28 (numbers of used directional signs) divided by 74 (numbers of total directional signs) equals 38%. Besides, the usage was the least at the Bus Terminal and directional signs were also the fewest at each Bus Terminal (2 numbers).

Table 4-3: Comparisons: numbers of the directional sign distribution

<table>
<thead>
<tr>
<th>Target spaces</th>
<th>Station Concourse</th>
<th>Station Square</th>
<th>Bus Terminal 1 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>JR West</td>
<td>14</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>JR Kyushu</td>
<td>33</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Chikushi</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hakata</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total numbers</td>
<td>74</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: NDS: Numbers of directional signs.

Table 4-4: Comparisons of the directional sign usage

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Used DS at starting point</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Used DS at station gates</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Used DS at Station Square</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Used DS at 1F Bus Terminal</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Total numbers</td>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>

Numbers of directional sign usage: 28  Ratio of directional sign usage: 38%
Table 4-5: Overall wandered places by subjects

<table>
<thead>
<tr>
<th>Places</th>
<th>NIF</th>
<th>Decision points</th>
<th>Places</th>
<th>NIF</th>
<th>Decision points</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-W1</td>
<td>5</td>
<td>Bus Terminal Gate</td>
<td>K-W1</td>
<td>2</td>
<td>Shinkansen Central Entrance</td>
</tr>
<tr>
<td>H-W2</td>
<td>0</td>
<td>Bus Stop A</td>
<td>K-W2</td>
<td>1</td>
<td>Entrance of underground</td>
</tr>
<tr>
<td>H-W3</td>
<td>5</td>
<td>Hakata Gate</td>
<td>K-W3</td>
<td>0</td>
<td>Entrance of Porta (Station Square)</td>
</tr>
<tr>
<td>H-W4</td>
<td>5</td>
<td>JR Line Entrance (North Ticket Gate)</td>
<td>K-W4</td>
<td>3</td>
<td>Pedestrian Walkway (North gate)</td>
</tr>
<tr>
<td>H-W5</td>
<td>1</td>
<td>JR Line Entrance (North Ticket Gate)</td>
<td></td>
<td></td>
<td>Note:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H-W1: Wandered places at Hakata Station,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HVA-1: Verbal assistance at Hakata Station,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>K-W1: Wandered places at Kyoto Station,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>KVA-1: Verbal assistance at Kyoto Station,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NIF: Numbers of information signs (compound signs)</td>
</tr>
</tbody>
</table>
Table 4-6: Comparisons: numbers of the information sign (compound sign) distribution

<table>
<thead>
<tr>
<th>Target spaces</th>
<th>JR West</th>
<th>JR Kyushu</th>
<th>Chikushi</th>
<th>Hakata</th>
<th>Bus Terminal 1 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIF</td>
<td>4</td>
<td>13</td>
<td>1</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total numbers</td>
<td>17</td>
<td>16</td>
<td>6</td>
<td></td>
<td>39</td>
</tr>
</tbody>
</table>

Note: NIF: Numbers of information signs, NCF: Numbers of compound signs.

Table 4-7: Comparisons of the information sign usage at wandered places

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
<th>Route C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>'H-W1'</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>'H-W2'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'H-W3'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'H-W4'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'H-W5'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'H-W6'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total numbers</td>
<td>3</td>
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<td>2</td>
</tr>
<tr>
<td>Numbers of information sign usage: 9</td>
<td>Ratio of information sign usage: 23%</td>
<td></td>
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</tr>
</tbody>
</table>

Kyoto Station

<table>
<thead>
<tr>
<th>Task</th>
<th>Route A</th>
<th>Route B</th>
<th>Route C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>'K-W1'</td>
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<tr>
<td>'K-W2'</td>
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<td>'K-W3'</td>
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<tr>
<td>'K-W4'</td>
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<td>Total numbers</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Numbers of information sign usage: 10</td>
<td>Ratio of information sign usage: 26%</td>
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</tbody>
</table>

Note: IF: Information signs (compound signs).
4.2 Summaries 2: comparisons of the usage of information signs

From the analysis above, it was clear that directional signs were used more than information signs because directional signs directed the ways and made subjects move straight ahead. However, information signs provided more information and could assist visitors to form mental maps that made people understand the relationships of space configurations in an unfamiliar environment. In this study, compound signs were composed of directional signs and information signs and subjects paid first attention to the part of the information sign, so the following analysis related to information signs included compound signs.

Table 4-5 shows the main places where subjects wandered based on subjects’ wayfinding behavior patterns, such as six wandered places were at Hakata Station and four wandered places were at Kyoto Station. From Table 4-6, it was clear that the total amount of information signs were nearly the same at two stations, as well as the Bus Terminal and the Shinkansen part of the station, but the ratio of the information sign usage was higher at Kyoto Station than the ratio at Hakata Station. The ratio 23% of information signs at Hakata station means 9 (numbers of used information signs) divided by 39 (numbers of total information signs) equals 23%. It showed that information signs were used quite a few at the starting points (H-W5, H-W6, and K-W1) in two stations, for example, two subjects (subject F and O) used the information sign at Hakata Station and two subjects used the information sign at Kyoto Station (Table 4-7). In terms of information sign usage at station gates, only one subject (subject O) saw the information at Hakata Station (H-W3) and three subjects (subject B, C, and J) saw information signs at Kyoto Station (K-W4). The Bus Terminal of Hakata Station was indoors and seven subjects used information signs here (H-W1), on the contrary, no subjects used information signs at the Bus Terminal in Kyoto Station because the Bus Terminal was outdoors with better visibility.

Overall, it indicated that the usage of information signs was inadequate at the starting points, however, subjects relied on more directional signs than
information signs and their wayfinding behavior patterns performed differently at these decision points from the previous study. A better wayfinding experience between two places must be based on putting the users at ease by providing information signs to confirm that the user was on the right way and it also involved what enjoyable surroundings could be created (Meng-Cong Zheng, Tadao Shimizu, Kimio Sato, 2009).

The identified problems of information signs were different at two stations (Figure 4-1), for example, on the one hand, at Hakata Station, the main problems were “Hard to understand”, “font size is small to read”, and “location is inconspicuous”. It was figured out that the range of font size of English contents was between 1mm and 5 mm and the titles of English contents were 7mm or 3mm, which were smaller than the standard. Difficulties of obtaining the information at ease also existed due to lacking hierarchies of the sign performances. Besides, most of the subjects did not see the information signs because they were parallel to subjects’ view especially at the Station Concourse. On the other hand, at Kyoto Station, the main problems such as “numbers of sign installations are few” and “no available information” were revealed, and the problems mostly occurred at the Shinkansen Central Entrance Gate and the Hachijo West Gate. For example, information signs provided the information was about the layout
of Shinkansen part in the station building and hotels nearby at the Shinkansen Central Entrance Gate, in addition, only one information sign (S-B001, Figure 3-7) was installed at the Hachijo West Gate area.

5. Comparisons of bus information elements at bus stops

It turned out (Table 4-8) that the comparisons of bus information elements at Hakata Station and Kyoto Station. Bus information were displayed at two station, such as “bus stop identification (name and number)”, “numbers / names of the bus”, and “full itinerary of bus lines”, besides, Kyoto Station provided more bus information, such as “bus leaving time” and “systematic English for foreigners”. In addition, other bus information was not completely displayed, such as bus payment, boarding methods, and so forth. So the bus information elements at bus stops should be taken into account because inadequate bus information could bring difficulties of getting on buses.

Table 4-8: Comparisons of bus information elements at bus stops

<table>
<thead>
<tr>
<th>Bus information elements</th>
<th>Hakata Station</th>
<th>Kyoto Station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bus Stop A</td>
<td>Bus Terminal</td>
</tr>
<tr>
<td>Bus stop identification (name and number)</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Numbers / names of the bus</td>
<td>●</td>
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<tr>
<td>Full itinerary of bus lines</td>
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<td>Bus arriving time</td>
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<td>Bus leaving time</td>
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<td>Night buses itineraries</td>
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<td>Payment</td>
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<td>Boarding methods</td>
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<td>Spending time to main spots</td>
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<tr>
<td>Maps and Attractions</td>
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<td>Map of area nearby</td>
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<td>Sightseeing attractions</td>
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<td>Transfer to other public transportation</td>
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<td>Others</td>
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<tr>
<td>Information on accessibility for disabled</td>
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<td>Systematic English for foreigners</td>
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<td>Emergency numbers</td>
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</tbody>
</table>
6. Discussions about the information system

6.1 Directional signs

- Information of displaying city attractions

It was found that only one directional sign displayed the arrival ways of the city attractions, which located at the underground in Kyoto Station (Figure 4-2); however, all subjects did not see it. Except this one, all the directional signs only displayed the bus information contents such as “Bus” and “Bus Terminal” about how to reach the Bus Terminals. Therefore, it was necessary to consider the respect regarding the information of displaying city attractions on current directional signs.

![Figure 4-2: The directional sign with information of city attraction by buses](image)

6.2 Information signs (compound signs)

It turned out that information signs were inadequate (Table 4-9). For example, the contents of information signs about the station were the most and no information sign maps displayed the routes to the bus stops or the Bus Terminals from trains for the transfer. So the inadequateness should firstly take the functions of information into account and that meant the diverse information was requested to meet people’s need. Morita (1992) classified seven types of urban environment information for public sign systems in his studies, such as the geographical information, transport information, public information, commercial information, disaster
prevention information, behavior control information, and traffic control information. Based on integration of the geographical information, the transport information, and the public information, the taxonomies of information signs were classified into following six types (Table 4-10) corresponding to three levels of functions, such as the richness of city interactions, the accessibility, and the mobility. (Figure 4-3):

![Figure 4-3: The model of diverse information signs](image)

1) City comprehensive sign
The city comprehensive sign offered comprehensive information about the city guide to make visitors have a better understanding of a city. It should include the information of attractions, sightseeing, and so on. As a complex station in an attractive city, the information system not only should provide the information to solve the problems of the mobility in the station but also, it should provide information to represent the city to visitors and make them have knowledge of the city. The information signs should be installed at the starting points (ticket entrance gates) because it was meaningful for visitors who visited the city and just came out of the ticket entrance gates or left the city soon.
<table>
<thead>
<tr>
<th>Categories of information signs</th>
<th>Station maps</th>
<th>Bus Terminal maps</th>
<th>Bus-stop maps</th>
<th>Area maps</th>
<th>City maps</th>
<th>Wide-area maps</th>
<th>Comprehensive maps</th>
<th>Access maps</th>
<th>Attraction maps</th>
<th>Transport networks</th>
<th>Route to bus stops</th>
<th>Boarding methods</th>
<th>Others</th>
<th>Common problems</th>
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### Table 4-10: Diverse information signs

<table>
<thead>
<tr>
<th>Information signs</th>
<th>Descriptions</th>
<th>Wayfinding processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>City comprehensive sign</td>
<td>City comprehensive sign offers comprehensive information about the city guide to make visitors have a better understanding of the city. It should include the attractions, sightseeing, and so on.</td>
<td>SP</td>
</tr>
<tr>
<td>Access information sign (Large-scale access network)</td>
<td>A city is composed of important nodes and connects the nodes to form the networks of the city. The nodes include terminal stations, parks, and facilities…The transfer information among main nodes is guided on the access information sign.</td>
<td></td>
</tr>
<tr>
<td>Transfer route sign (Small-scale access network)</td>
<td>The transfer route sign guides the clear routes to reach bus stops or the Bus Terminals.</td>
<td></td>
</tr>
<tr>
<td>&quot;You are here&quot; Map</td>
<td>&quot;You are here&quot; Map communicates the relationships of locations between users and the physical environment. The signs could display users' current locations and orientation.</td>
<td></td>
</tr>
<tr>
<td>Boarding way sign</td>
<td>Boarding ways sign guides the specific information how to take buses, including payment, fare, bus itineraries, numbers and names…</td>
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<tr>
<td>Others</td>
<td>The signs refer to the information on accessibility for disabled, emergency numbers, and so on.</td>
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</tbody>
</table>

Note: SP: Starting points, DP: Decision points, BS: Bus Stops.
2) Access information sign
A city was composed of important strategic nodes (Kevin Lynch, 1960) and connected the nodes to form the networks of a city. The nodes referred to terminal stations, large parks, large squares, larger-scale facilities, and so forth. The access information sign was also a route sign of the urban wide-area guide or a large-scale access network to reach the nodes. The transfer information among the networks should be guided on the access information sign. Also, the information signs should firstly install the entrance gates to make visitors have a better understanding of the nodes and accessibility to the nodes.

3) Transfer route sign
The wayfinding route sign guided clear routes to reach the near facilities such as the bus stops or the Bus Terminals. In a station, the information signs should be composed of two types of information, namely, the inner station and the outer station, and especially, information signs should display the transfer routes to reach the outer facilities (Akase Tatsuzo, 2015). Moreover, the sign also displayed the route knowledge (procedure knowledge) and once the knowledge was acquired, it would benefit users in estimating the distance between two points along the route and the direction for travel between two locations (Juilin Chen, Kay M. Stanney, 1999). So, the transfer route sign should be considered at Hakata Station and Kyoto Station and the signs could assist visitors to complete their wayfinding tasks if the signs were considered at the decision points such as the entrance gates (starting points), main gates of the stations, and the bus stops.

4) “You are here” Map
“You are here” Map communicated the relationships of locations between visitors and the physical environment. The information could make visitors confirm their current accurate locations and directions ahead in order to smoothly move next.

5) Boarding way sign
The bus information elements were analyzed in previous chapters and boarding way sign guided the specific information how to get on buses, including the contents such as payment, fare, bus itineraries, bus numbers, and bus names. The information signs should assure the adequateness and legibility at proper locations with the display of the systematic and multilingual information because the information was quite important for the visitors who had no or less knowledge of the station and the city but also, the signs (bus stop sign) at bus stops or the bus terminals ought to be unified with other transport means (Miyazawa, Isao, 1987). The placement of boarding way information might be also installed at the ticket entrance gates of stations to make visitors know the knowledge in advance and avoid the difficulties of receiving the information afterward at bus tops with crowds of people.

6) Other information sign
The signs referred to the information on accessibility for disabled, emergency numbers, contacts of tourist centers, and so on.

7. Conclusions
In this chapter, comparisons and summaries regarding Chapter Two and Chapter Three were conducted. In Hakata Station, the sign distribution was inconsistent at target spaces based on different design styles, illumination types, mount types, and color types, for example, the signs were not consistent at JR West part and JR Kyushu part of Station Concourse and Bus Terminal, as well as the bus information contents at Hakata Gate, Station Square, and Station Concourse. In Kyoto Station, the sign distribution also had the issues of inconsistency, but the issues of sign arrangements were more serious than the issues of inconsistency, for example, the inadequate directional signs, inadequate bus information contents, and improper locations of information signs at Shinkansen Central Entrance Gate were figured out. So, revealed problems in the wayfinding
process at Hakata Station were mainly related to the issues of sign consistency, whereas the issues of sign arrangements at Kyoto Station. Some common problems were reflected at the two stations, such as inadequate sign functional types, inadequate amount of sign installations, inconsistent design styles of signs, improper sign placements, and so forth. As a result, creating diverse information about information signs was needed, and a common sign system at common spaces of stations was suggested (Akase Tatsuzo, 2013). The common sign system was defined as public signs providing the information ought to be in the common modes for improving the convenience of utility no matter where the signs located within the spaces. Signs could be regarded as attractive landscapes products for improving the environmental amenity (Seokhyun Lee, 2014), so the common sign system should coordinate two aspects including 1) the physical aspect of the sign system, such as sign functional types, placements, and forms, and 2) the aspect of the information system, such as the contents, message hierarchies, terminologies, multilingual messaging and graphic elements including color coding, typography, kerning, and so on.

Postscripts

In this chapter, the paper was accepted for publication:
Chapter IV Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations

References

Section III
A Proposal for Design Methodologies to Sign Systems of Public Transport Networks
Chapter V A proposal for design methodologies to the wayfinding system between trains and city buses at terminal stations

Section III: A Proposal for Design Methodologies to Sign Systems of Public Transport Networks

Chapter V
A proposal for design methodologies to the wayfinding system between trains and city buses at terminal stations

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Chapter V
A proposal for design methodologies to the wayfinding system between trains and city buses at terminal stations

1. Research purpose of this chapter

This chapter suggested a proposal based on the studies at previous chapters, and outlined design improvement guidelines on the wayfinding system in the transfer between trains and city buses at terminal stations. The proposal and improvement guidelines on wayfinding design aimed to discuss the urban intangible values.

2. The framework of the proposal
The proposal was composed of four aspects as follows:

<table>
<thead>
<tr>
<th>Table 5-1: Framework of the proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urban positioning</td>
</tr>
<tr>
<td>It is to understand the identity and configuration of the city and then classify the important nodes into categories based on their functions and network with the nodes.</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>2. Surveys and analysis at terminal stations on site</td>
</tr>
<tr>
<td>It is to have a better understanding of the stations and bus stops/Bus Terminals, such as the space characteristic, decision points, and circulation pathways.</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>3. Common sign systems</td>
</tr>
<tr>
<td>The common sign system should take the following three aspects into account:</td>
</tr>
<tr>
<td>• Sign systems (hardware systems)</td>
</tr>
<tr>
<td>Hardware systems include sign functional types, location plans, and forms.</td>
</tr>
<tr>
<td>• Information systems</td>
</tr>
<tr>
<td>Information signs include the contents and the graphic system of signs.</td>
</tr>
<tr>
<td>• Maintenance</td>
</tr>
<tr>
<td>All the elements above should be checked and examined for the regular utility.</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>4. Expansion of assistant service networks</td>
</tr>
<tr>
<td>• Verbal assistance</td>
</tr>
<tr>
<td>• Expanding the networks of the Tourist Information Centers</td>
</tr>
</tbody>
</table>
2.1 Urban positioning
In the field of urban and planning design interest focus on identifying the type of urban environment that generated desirable places to live (Carmen Linares, Alvaro Page, Jaime Linares, 2013), however, in terms of the wayfinding system in the transfer between trains and city buses at a complex terminal station in an attractive city, the design methodologies should also need to take the city identity into account at first and then embark on the design projects.

2.1.1 City identity
As to the concept of the city identify, Lynch (1960) addressed this term and defined as the extent to which a person can recognize or recall a place as being distinct from other places. In this study, the city identity emphasize that the city should meditate the diversity of city typologies based on city functions, such as the Commercial City, the Tourism City, the University City, and so forth. Because differentiated city typologies affect the arrangement of the information contents at the whole sign system, which could influence the qualities of the wayfinding system and the ease of wayfinding tasks. For example, Kyoto City is designated the International Tourism Culture City and the International Conference Tourism City, whereas Fukuoka City is designated the latter (Japan Tourism Agency, 2010), so Kyoto City should consider to display the information related to main attractions, sightseeing, and international conference spots on signs to visitors at decision points with a conspicuous location in Kyoto Station, moreover, Fukuoka City should also offer the information correlating with the international conference spots and some attractions that could represent the city on signs at Hakata Station.

2.1.2 City configuration
Understanding of the configuration of a city at ease is quite important to visitors, local residents, and city managers, so a city ought to outline the elements that constructed the configuration. In this study, the meaning of the configuration refers to the strategic points (nodes) of the city networks,
and the strategic points are the large squares, parks, commercial facilities, transport hubs, landmarks, and so on. The networks are extended and thickened to improve transport and productive efficiency, increase interaction and access (Kevin Lynch, 1984). These key nodes and connected networks improving the interaction and access could also assist people to have knowledge of the city and the access information to reach the strategic junction points plays an important role in the process of people’s wayfinding journeys at terminal stations.

2.1.3 Representation of city image and city branding
A city is a multidimensional, cognitive, and emotional construct emerging through an interaction between the physical realities of cities and our subjective perception of these realities (Henrik Gert Larsen, 2015; Graham, 2002), and the qualities of the wayfinding system at terminal stations could be influenced much by the image of the city or the city branding that referred to the process of applying product-branding practices to cities, aiming at integrating and highlighting a city’s competitive advantages though persistent imaged identities or brands (Kavaratzis, 2007; Zhao, 2015). The public sign system not only could shape the station spaces as attractive landscape products but also, it evokes a strong image to visitors. For most visitors, the terminal stations are their first steps to be aware of the city and the initial image and impression to the visited city would directly derive from their wayfinding experiences at the stations because the overall image is influenced by cognitive evaluation (beliefs and knowledge about an object) and affective evaluations (feelings about the object) (Qu, Kim, & Im, 2011). Therefore, to improve the image of the station and the city or establish the city branding, designers, urban planners, and city managers ought to be clear that what image that represents the city to deliver to visitors and how to build the communications between cities and visitors by a sign system at terminal stations.

In a word, as the first step of design methodologies to the wayfinding system in the transfer between trains and city buses at terminal stations,
urban participants, such as city managers, urban planers, designers, and stakeholders should outline strategic positioning of a city because these relative strategies influence upon the selections of the information contents on signs afterward (Figure 5-1), for example, whether or not should provide the information to visitors by signs, such as the contents about the city attractions and the sightseeing, the access information about reaching major nodes, and so forth. Also, the selected information contents should be classified into three categories, such as the comprehensive information, nodes information, and access information, in order to make visitors have a better understanding of the richness and diversities of city interactions, the accessibility and the mobility.

![Diagram](image)

**Figure 5-1:** Process of the urban positioning

### 2.2 Surveys and analysis at terminal stations on site

A complex terminal station is composed of the station building and the bus terminal in general and each station has different spatial configuration and characteristic, so it is quite necessary to survey and analyze the current space properties and bus information elements at both sites.
## Contents

### Information systems (Communication function)

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<th>Items</th>
<th>Contents (Physical characteristic)</th>
<th>Terminal stations</th>
<th>Urban intangible values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign systems</td>
<td></td>
<td>Fukuoka City</td>
<td>Kyoto City</td>
</tr>
<tr>
<td>Sign types</td>
<td>Four types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location plans</td>
<td>Locations at the layout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foma</td>
<td>Mount modes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information systems</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Function coding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Message hierarchy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multilingual messaging</td>
<td>Multilingual service should be systemic and enhance the networks of the Tourist Information Centers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diverse information</td>
<td>Information signs should be adequate and six types of the diverse information are needed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic systems</td>
<td>Relative elements such as the font, pictogram, arrow, typography, color, keruing, etc. should be legible to users.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4. Expansion of assistant service networks

<table>
<thead>
<tr>
<th>Items</th>
<th>Contents (Physical characteristic)</th>
<th>Terminal stations</th>
<th>Urban intangible values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal assistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expanding the networks of the Tourist Information Centers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2.1 Terminal Station

In terms of the transfer at a terminal station, factors that affect people’s wayfinding behavior include the spatial characteristic, decision points, and circulation pathways. The spatial characteristic means the station configuration and arrangements of spaces are based on space functions, for example, it was clear that information at stations should be classified into three categories to meet people’s need, such as the information of amusement and leisure, the information of public transport in transfer, and the information of bus guides. Decisions points mean important nodes at stations, such as the ticket entrance gates, station gates, stairs, elevators, and so on. The decision points determine sign locations and are quite significant in the wayfinding process because the decision points are associated with situations that whether or not people should continue their routes or change direction, so the numbers of decision points should be reduced to ensure creating a coherently structured pathways. Circulation pathways include the lateral and vertical circulation, which affect the wayfinding efficiency much, so the circulation pathways ought to be simple and not include many choices to visitors. Overall, the following ten aspects should be taken into account to design methodologies at target terminal stations based on surveys and analysis on site:

- Understand of the arrangements of spaces,
- Classify and code spaces,
- Clarify the distribution of decision points,
- Understand of characteristic of wayfinding behavior,
- Understand of visitors’ need,
- Clarify differences among similar information at decision points,
- Do not provide many choices at decision points,
- Create simple and well-structured pathways,
- Ensure visual dominance to pathways,
- Make information content plans of signs.

2.2.2 Bus stops at Bus Terminal and Station Square
In the wayfinding process, bus stops are not destinations but key nodes. The check of bus information elements should not be ignored and the differences of bus stops between the Station Square and the Bus Terminal also should be clear to visitors such as Hakata Station. Table 5-3 shows the relative elements of bus information at bus stops, which ought to be considered.

Table 5-3: Bus information elements at bus stops/Bus Terminal

<table>
<thead>
<tr>
<th>Bus information elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus stop identification (name and number)</td>
</tr>
<tr>
<td>Numbers / names of the bus</td>
</tr>
<tr>
<td>Full itinerary of bus lines</td>
</tr>
<tr>
<td>Bus arriving time</td>
</tr>
<tr>
<td>Bus leaving time</td>
</tr>
<tr>
<td>Night buses itineraries</td>
</tr>
<tr>
<td>Payment</td>
</tr>
<tr>
<td>Boarding methods</td>
</tr>
<tr>
<td>Spending time to main spots</td>
</tr>
<tr>
<td>Maps and Attractions</td>
</tr>
<tr>
<td>Map of area nearby</td>
</tr>
<tr>
<td>City map</td>
</tr>
<tr>
<td>Sightseeing attractions</td>
</tr>
<tr>
<td>Transfer to other public transportation</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Information on accessibility for disabled</td>
</tr>
<tr>
<td>Systematic English for foreigners</td>
</tr>
<tr>
<td>Emergency numbers</td>
</tr>
</tbody>
</table>

2.3 Common sign systems
A common sign system is suggested due to the inconsistency of distributed signs at stations. This research integrated and improved the theories of *legible London* (2007) and Akase’s studies (2013). The term “common” contains two levels of meanings, firstly, it is defined that different signs including directional signs, information signs, identification signs, and compound signs, should be consistent and common design styles in terms of the sign functional types, secondly, it is defined that signs at different spaces of the station should be in consistent and common design styles in terms of the spatial distribution of signs. The commonalities ensure the consistency of signs and establish the order of signs to improve the convenience of sign
In this study, the common sign system is composed of the physical sign system, the information system, and the maintenance. The physical sign system is the hardware aspect of signs and it includes the sign functional types, location plans, and forms of signs, whereas the information system includes contents of signs and graphic systems. The maintenance refers to checks and examining to the hardware aspects and the information aspects above. To design a common sign system, the process firstly takes the selection of contents into consideration (Figure 5-2), which means what information should communicate to users because what to design is more important than how to design to solve problems regarding inquiring the nature of design (Yoshitsugu Morita, 2001). Secondly, it should be location plans and decision points determine the location plans. It is important to point out that designers and managers should understand where users are most likely to look for the information and information needs to be released sequentially in understandable sets of appropriate simplicity and the appropriate point in the sequence (Joel Katz, 2012). Thirdly, it is the form making of signs and the form include mount types, illumination types, and design styles. Fourthly, it is about the graphic system of signs regarding the problem-solving methodologies to the legibility of signs. In a word, the process aims to make users to understand information at ease and obtain the available information what they really need and have a better wayfinding experience in spaces.

2.3.1 Physical sign systems (hardware systems)
1) Sign functional types
Directional signs, information signs, and identifications signs are usually used in a sign system, however, compound signs including directional signs and information signs could improve efficiency of the wayfinding and conserve spaces, so this type is paid more attention, especially at Kyoto Station.

- Directional signs
Information contents on directional signs should be classified and coded based on using functions (Figure 5-3). As a complex terminal station, it generally contains the transport facility, the commercial facility, and the culture facility, so diverse information is needed to satisfy people’s demands. People behavior usually includes three aspects, for example, they would continue to transfer, complete tasks and go outside of the station, and do shopping or something else related to eating and rests. Bus information not only displays where the Bus Terminal and bus stops are, but also displays how to reach major nodes that represent the city because it would assist visitors to grasp the major available information.

- Information signs
Information signs should also take diverse information into account. Six types of information are identified in the previous study (Table 4-9, Chapter IV), such as the city comprehensive sign, the access information sign, the transfer route sign, the “You are here” Map, the boarding way sign, and the other information sign. Among the six types, the access information sign
and transfer route sign are all about the accessibility, but the former one is a citywide and large-scale network, whereas the latter one is a small-scale network that displays the specific transfer routes to bus stops at a station. Moreover, implementations regarding multilingual displays should be systematic, for example, legible maps for foreigners are needed.

*Legible London* (2007) addressed 3D images (Figure 5-4) for landmarks to make sites memorable and prominent and pointed out the advantages of 3D criterion were four aspects, such as wayfinding beacons, memorable, seeing yourself “in” the map, and adds visual interest to the map. It might be a better way to make information more legible and interesting to visitors and reinforce memorability.

![Figure 5-4: 3D images of landmarks in *Legible London* (2007) project.](image)

The other information signs including 24-hour information service, Tourist Information Centers, and emergency numbers are also important and the information should provide multilingual services.

- **Identification signs**
  Identification signs should create the identity for the signs in order to make the signs more recognizable, but the differentiated identities should also ensure the consistency associated with other signs in the whole sign system.

2) **Location plans**
Location plans should consider the following elements:

- **Locations at the layout**
Decision points and circulation pathways determine the sign locations at the layout, so sign functional types should be firstly confirmed, for example, signs particularly directional signs should be installed at each decision point (Figure 5-5), and information signs and identification signs ought to be installed corresponding to specific situations.

![Figure 5-5: Distribution of signs at decision points](image)

- **Position**
  In this study, the term “position” refers to a place, in which signs are located. Signs should be conspicuous and appropriately situated, for example, sign orientation ought to be perpendicular rather than parallel to people’ view; also, signs should avoid space limits and obstructions to ensure a better visibility regarding the viewing angles and distances.

- **Orientation**
- **Viewing angles**
- **Viewing distances**

3) **Forms of signs**
Forms of signs referred to mount types, illumination types, and design styles. Basic mount types include ceiling mount, overhead suspended mount, wall mount, column mount, flag mount, freestanding, and so forth, and
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Illumination types include internal illumination, external illumination, non-illumination, and ambient lighting. Design styles should be coordinated with the space performance at a station and represent the image of a city. Whatever types are selected and signs should select proper form elements because the signs shape spaces and ought to create an ordered environment for people to use as landscape products.

2.3.2 Information systems
The information system includes two aspects, such as information contents and graphic systems. Compared with the physical sign system (hardware systems), the information system plays an important role in the communication process with visitors and it relates to the arrangements and legibility of the information contents.

1) Information contents
   • Information priority (hierarchy)
Information priority has two levels of meaning in the previous study, namely, the priority of contents and the priority of locations. The priority of information contents means urban planners and managers should firstly consider what a city tries to communicate to people, so the information should be hierarchically classified and selected from complicated elements that feature the city. For example, Table 5-4 offers methods of information contents hierarchies in Hakata Station. The information contents should be logically and gradually subdivided from city major areas, city key nodes, decision points of stations, to bus stops, and this process assures understandable, structural, and identifiable information involving in the knowledge of urban large-scale networks, small-scale networks, and interface points. The final selections and arrangements of contents at stations influence qualities of sign plans in the wayfinding process. The priority of information locations means the information should be provided at proper locations, so, the very important decision points such as starting points (ticket entrance gates) and main gates of stations, should provide information that people really need because the advance information could assist people to predict next movement ahead.
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### Table 5-4 Methods of information contents hierarchies

<table>
<thead>
<tr>
<th>Methods</th>
<th>Examples (Hakata Station)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cities (large-scale networks)</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>Outline city major areas</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>• Hakata Station Area</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>• Nakasu-Kawabata Area</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>• Tenjin Station Area</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>• Ohori Park Area</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>• Seaside Momochi Area</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>(<a href="https://yokanavi.com/areaguide/">https://yokanavi.com/areaguide/</a>)</td>
<td>Understand city typologies</td>
</tr>
<tr>
<td>Outline city key nodes</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Hakata Station</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Tenjin Station</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Canal City HAKATA</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Fukuoka Convention Center</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Fukuoka Tower</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>• Fukuoka Dome</td>
<td>Outline city key nodes</td>
</tr>
<tr>
<td>Network with city key nodes</td>
<td></td>
</tr>
<tr>
<td>Terminal stations (small-scale networks)</td>
<td></td>
</tr>
<tr>
<td>Outline decision points</td>
<td>Connect decision points and outline transfer routes</td>
</tr>
<tr>
<td>• JR Line Entrance (North Ticket Gate)</td>
<td></td>
</tr>
<tr>
<td>• Hakata Gate</td>
<td></td>
</tr>
<tr>
<td>• Hakata Bus Terminal Gate</td>
<td></td>
</tr>
<tr>
<td>• Bus Stop A...</td>
<td></td>
</tr>
<tr>
<td>Network with decision points</td>
<td></td>
</tr>
<tr>
<td>Bus stops at Station Square/Bus Terminal</td>
<td></td>
</tr>
<tr>
<td>(interface points)</td>
<td></td>
</tr>
<tr>
<td>Outline bus categories</td>
<td>Connect decision points and outline transfer routes</td>
</tr>
<tr>
<td>• Highway Bus Terminal</td>
<td></td>
</tr>
<tr>
<td>• City Bus</td>
<td></td>
</tr>
<tr>
<td>• Tenjin Liner</td>
<td></td>
</tr>
<tr>
<td>• Fukuoka City Loop Bus</td>
<td></td>
</tr>
<tr>
<td>Outline locations of bus stops</td>
<td></td>
</tr>
<tr>
<td>Outline bus information elements</td>
<td></td>
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<tr>
<td>Bus information elements</td>
<td></td>
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<tr>
<td>Maps and attractions</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>

Connect decision points and outline transfer routes
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- Function coding

Function coding is defined that selected information especially directional signs should be classified based on using functions (Figure 5-3). The current information on directional signs is classified based on heading directions at Hakata Station and Kyoto Station, such as “left”, “up ahead”, “right”, and so on; however, information regarding bus transfer is difficult to seek in this way because visual prominence of bus information contents should be higher.

- Message hierarchy

A study (Chen, J. L. Stanney, K. M., 1999) pointed out three types of spatial knowledge in virtual environment of wayfinding processes, such as landmark knowledge that refers to the information about the visual details of specific locations, procedure knowledge (route knowledge) that refers to the information about a sequence of actions required to follow a particular route, and survey knowledge (configuration knowledge) that refers to the configuration relations among locations and routes. Three types of spatial knowledge are requisite in sign systems. On a sign panel, directional signs should not only provide the information about the city key nodes of large-scale networks to connect the terminal station to the major nodes but also, provide the decision points of small-scale networks to connect the inner and outer facilities of the terminal station (Table 5-5). Information contents need message hierarchies and key information such as city key nodes and decision points of stations should be highlighted to improve the conspicuity and legibility. Whereas on information signs, the information also needs hierarchical rankings to enhance the efficiency of informative communications, for example, based on the six types of information signs, city comprehensive sign firstly should subdivide into chunks, such as areas, communities, neighborhoods, routes, and so forth. Access information signs should classify nodes based on relative importance and each element of them ought to be integrated and consistent. Transfer route signs should outline and connect specific decision points to assure the route knowledge. “You are here” Map should highlight the heading direction in an
understandable and logical way to make users understand the current location and the relationship with other settings. Boarding way signs should assure the bus information elements in a legible and clear way. Other signs are quite essential components as assistant information.

Table 5-5 Methods of message hierarchies

<table>
<thead>
<tr>
<th>Sign types</th>
<th>Locations</th>
<th>Diverse information</th>
<th>Message hierarchies</th>
<th>Spatial knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional sign</td>
<td>Decision points</td>
<td>Large-scale networks</td>
<td>Highlight the legibility of city key nodes</td>
<td>Survey knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small-scale networks</td>
<td>Highlight the legibility of decision points of stations</td>
<td></td>
</tr>
<tr>
<td>Information sign</td>
<td>Decision points</td>
<td>City comprehensive sign</td>
<td>• Subdivide cities into chunks: areas → communities → neighborhoods,</td>
<td>Survey knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Locations of transportation modes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• City key nodes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Major routes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Pedestrian routes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• City attractions...</td>
<td></td>
</tr>
<tr>
<td>Access information sign</td>
<td>Decision points</td>
<td></td>
<td>• Locations of city key nodes</td>
<td>Procedure knowledge</td>
</tr>
<tr>
<td>Transfer route sign</td>
<td></td>
<td></td>
<td>• Locations of decision points</td>
<td></td>
</tr>
<tr>
<td>“You are here” Map</td>
<td></td>
<td></td>
<td>• Heading direction</td>
<td></td>
</tr>
<tr>
<td>Boarding way sign</td>
<td></td>
<td></td>
<td>• Bus information elements</td>
<td>Landmark knowledge</td>
</tr>
<tr>
<td>Other signs</td>
<td></td>
<td></td>
<td>• Emergency numbers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Accessibility for disabled...</td>
<td></td>
</tr>
<tr>
<td>Identification sign</td>
<td>Decision points</td>
<td></td>
<td>• Create identifies</td>
<td></td>
</tr>
</tbody>
</table>

- **Terminology**
  Clarities of terminologies, especially native and correct translations and interpretations for solving problems of the language hindrance should be paid more attention because ambiguous terminologies confuse people to make a judgment and act.

- **Multilingual messaging**
  As attractive cities, four languages are used in Hakata Station and Kyoto Station, such as Japanese, English, Chinese, and Korean. Four languages are not equally treated and English display is subordinate, as well as Chinese and Korean. Generally, the multilingual messaging on signs might make information overloaded, so a common interpretation, such as an inclusive
design of pictogram or the 3D image display may enhance better understandability and conserve spaces.

- Diverse information

Regarding the inadequateness of bus information, diverse information is needed to meet people’s demands. The information on directional signs suggests to be classified into five categories based on people basic behavior at stations and information on information signs includes six types.

2) Graphic systems

Graphic elements, such as the font, pictograms, arrows, typography, color-coding, kerning, and so on, are paramount to people in terms of legibility. This study only analyzed the font element at Hakata Station due to the results of the questionnaires, so graphic elements would be conducted in the future study.

2.3.3 Maintenance

PDCA (plan-do-check-act) is a continuous feedback loop and process improvement, particularly, “check” is to monitor and measure processes and products and report results, and “do” is to take actions to continually improve the process (Praveen Gupta, 2006). Therefore, in the maintenance, station managers and sign designers who carried on the sign project should check the signs and act to fix if problems occur. Maintenance problems were revealed at Hakata Station and Kyoto Station, for example, illumination problems at Hakata Station and inconsistency of the same
contents at Kyoto Station. The aspect of sign hardware and the aspect of information contents should be carefully checked and flexibly updated.

2.4 Expansion of assistant service networks

Expansion of assistant service networks means to establish and expand Tourist Information Centers and the network is to provide friendly verbal assistance services to assist visitors to smoothly complete their wayfinding tasks. In terms of the search strategies of the wayfinding, verbalized strategies and visualized strategies were usually used by people and the verbal assistance is more efficient than obtaining information on signs and make visitors increases more interactions with the local people. The staff and volunteers should be good at more than two languages (domestic language and English language) and have good knowledge of large-scale networks of the city and small-scale network of the station. Particularly, it was clear that verbal assistance by station staff decrease wayfinding difficulties and gave visitors good impression at Kyoto Station. So placements of Tourist Information Centers or dependent verbal assistance also should take decision points into account and be properly organized.

Table 5-6 outlines the checkpoints of the proposal for the wayfinding system between trains and city buses. In the process of the urban positioning, the city planners and relevant stakeholders also should understand the real needs of visitors, such as their operation behavior and locomotion patterns. Sign plans should be deliberated at decision points of terminal stations and Bus Terminal. Moreover, the wayfinding tools including the common sign system and assistant service networks should be meshed to decrease wayfinding difficulties.
Chapter V A proposal for design methodologies to the wayfinding system between trains and city buses at terminal stations

<table>
<thead>
<tr>
<th>Table 5-6: Checkpoints of the proposal for a wayfinding system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban positioning</strong></td>
</tr>
<tr>
<td>Cities</td>
</tr>
<tr>
<td>Understand city typologies,</td>
</tr>
<tr>
<td>Outline and network nodes,</td>
</tr>
<tr>
<td>Classify and select information contents to understand visitors where to go,</td>
</tr>
<tr>
<td>Confirm what information contents would display on signs at stations.</td>
</tr>
<tr>
<td>Visitors</td>
</tr>
<tr>
<td>Understand visitors, (operation behavior, locomotion, and legibility),</td>
</tr>
<tr>
<td>Understand characteristic of visitors’ wayfinding behavior.</td>
</tr>
</tbody>
</table>

Surveys and analysis of stations on site

Surveys and analysis at terminal stations

Understand the arrangements of spaces,
Classify and code spaces,
Clarify distribution of decision points,
Understand characteristic of wayfinding behavior and visitors’ needs,
Clarify differences among similar information at decision points,
Do not provide many choices at decision points,
Create simple and well-structured pathways,
Ensure visual dominance to pathways,
Making information contents plans of signs.

Surveys and analysis at bus stops and Bus Terminals

Understand the arrangements of space at Bus Terminal,
Clarify distribution of decision points at Bus Terminal,
Check bus information elements at bus stops,
Ensure visual dominance to bus stops.

Common sign systems

<table>
<thead>
<tr>
<th>Physical systems</th>
<th>Information systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse information display on signs,</td>
<td>Information priority,</td>
</tr>
<tr>
<td>Create identity on identification signs,</td>
<td>Function coding,</td>
</tr>
<tr>
<td>Proper location corresponding to decision points,</td>
<td>Messaging hierarchy,</td>
</tr>
<tr>
<td>Perpendicular view rather than parallel view,</td>
<td>Accurate and clear terminology,</td>
</tr>
<tr>
<td>Avoid space limits and visual obstructions,</td>
<td>Multilingual messaging,</td>
</tr>
<tr>
<td>Create an ordered sign environment,</td>
<td>Diverse information,</td>
</tr>
<tr>
<td>Personalized contexts performance.</td>
<td>Legible graphic systems</td>
</tr>
</tbody>
</table>

Maintenance

PDCA

Expansion of assistant service networks

Expand networks of Tourist Information Centers,
Enhance and ensure multilingual verbal assistance.
Chapter V A proposal for design methodologies to the wayfinding system between trains and city buses at terminal stations

3. Discussions

3.1 Connections of wayfinding tools

![Diagram showing connections of wayfinding tools](image)

Figure 5-7: Connections of wayfinding tools for obtaining bus information

It is clear that the common sign system and the expansion of assistant service networks could enhance the information availability for visitors from the station ticket entrance gate to their desired bus stops, but it is also quite important to make them easily get on buses when they reach the bus stops. Most people rely on using smartphones to obtain specific and available information; for example, smartphones could provide bus information when they reach bus stops, such as bus routes, bus platforms, and so forth. So it is a better suggestion to connect the wayfinding tools when people arrive at bus stops to search for desired information, such as the common sign system, expansion of assistant service networks, and IT technologies (Figure 5-7).

3.2 Design methodologies for urban intangible values

Based on the proposal, a concept concerning the urban intangible values is pointed out. The urban intangible value is defined that cities evoke feelings of comfort, excitement or pride and have the power to appeal to human sensitivity in terms of urban attractiveness (*Global Power City Index 2013*). Based on the index items of the urban intangible value (The Mori Memorial Foundation, 2015), such as efficiency, accessibility, accuracy, safety,
diversity, hospitality, this study identifies the urban intangible value that people would be evoked the human sensibility such as satisfaction, wayfinding ease by the sign system in the transfer process between trains and city buses at terminal stations. It is an attempt to have a viewpoint to evaluate a wayfinding system of public transport networks and it is composed of three elements, such as individual value, information value, and spatial value (Figure 5-8).

Figure 5-8: The matrix of urban intangible values

3.3.1 Individual value
Individual value refers to human general evaluation standards, which derives from people's experiences and individual knowledge and is influenced by individual sensibility, judgment, and perception. For example, people would evaluate a wayfinding system based on the satisfaction and wayfinding ease that people feel from their wayfinding experiences. As an actor with the spatial interaction in the transfer process, people’s need
should be satisfied, such as the ease of operation, relax locomotion, and legible information. Visitors prefer efficient and convenient accessibility to desired destinations, specially, for the first-time visitors, a station is their starting point to come and last point to leave, therefore, the qualities and experiences of the bus transfer from trains are important to understand a city they visit.

3.3.2 Information value
Information value involves the functionality and the informativeness of a common sign system. The functionality of signs refers to hardware qualities of signs, which means adequate sign types, proper locations, and appropriate sign forms should be ensured. The informativeness refers to qualities of information contents, which means a successful sign system should offer adequate and available information to people. Signs shape spaces as landscape products and establish communication with people as wayfinding cues, so creating an ordered sign environment and offering the legible and accurate information are needed. In a wayfinding design project, selection of information contents, surveys on site, understanding of users’ needs and behavior characteristic, sign types, location plans, forms, and graphic systems are significant to increase information value. Moreover, each city has its own distinctive characteristic, such as different city scale, amounts of visitors, attractions, and so forth, as well as the different space properties of terminal stations; therefore, a successful sign system also should perform the personalization based on its distinctive contexts to visitors.

3.3.3 Spatial value
The space characteristic, decision points, circulation pathways, and identity of stations are involved in the spatial value. In the wayfinding process of the bus transfer from trains, the wayfinding behavior happens at several spaces from the ticket entrance gates at the Station Concourse to bus stops either at the Station Square or at the Bus Terminal, the spaces should ensure a neat transfer environment, safety from being lost, well-structured pathways,
understandable configuration, and appropriate information amount at each decision point.

Figure 5-9: Design methodologies of wayfinding systems in the transfer between trains and city buses.

4. Conclusions

This chapter suggested a proposal and outlined the checkpoints of the proposal as design improvement guidelines on wayfinding design in the transfer between trains and city buses at terminal stations, additionally; the urban intangible value was also discussed to have respect for an evaluation. Overall, three elements interact at people’s wayfinding processes and the three elements have to be taken into consideration in a wayfinding design project. The individual value derives from the spatial value and the information value. The spatial value should ensure good accessibility and have users form complete mental models (Figure 5-9). The information value ought to ensure availability of information to users; also, information value could improve stations' amenity and increase the spatial value. Moreover, to achieve the urban intangible value, it requires balancing the relationships between the characteristic of sign distribution and sign usage involving in spatial arrangements, the common sign system, and users’ need to create a successful transfer wayfinding system between trains and city buses at terminal stations.
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Chapter VI

Conclusions

1. Research summaries

This study focused on the wayfinding system in the transfer between trains and city buses at stations because wayfinding difficulties existed and always frustrated visitors in their wayfinding processes. The study selected Hakata Station in Fukuoka City and Kyoto Station in Kyoto City to conduct surveys and wayfinding protocols due to the stations’ importance and the cities’ attractiveness in West Japan in order to understand the relationships between sign distribution and sign usage by current sign systems. After analyzed comparisons of the wayfinding system at two stations, a problem-solving proposal for the wayfinding system in the transfer between trains and city buses was suggested and it was composed of four aspects, such as plans of urban positioning, surveys and analysis at terminal station on site, implementation of common sign systems, and expansion of assistant service networks. The plans of urban positioning pointed out the necessity regarding the understanding of city typologies, networking with key nodes, and selection of information contents. The surveys and analysis at terminal stations on site emphasized the importance related to the understanding of space characteristic and functions, distribution of decision points, and circulation pathways, particularly the necessary and important checks on bus information elements at bus stops in Station Square and Bus Terminal. The common sign system including the aspect of the hardware system and the aspect of the information system highlighted a specific design proposal and improvement guidelines on the wayfinding system in the transfer between trains and city buses, as well as other means of public transport networks. The expansion of assistant service networks was to expand the networks of Tourist Information Centers and enhance verbal assistance as interactions to visitors in the wayfinding process.
Chapter VI Conclusions

This proposal was also an attempt to have a viewpoint to improve urban intangible values. The urban intangible values included three elements, namely, individual value, information value, and spatial value and these three elements should be taken into account for creating a successful wayfinding design project.

The summaries for each chapter is shown as following:

Chapter 2 Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Hakata Station. Based on the surveys of sign distribution and a wayfinding protocol on site, this chapter figured out wayfinding difficulties existed in the transfer between trains and city buses by using the current sign system and revealed five aspects of problems. Additionally, the chapter not only pointed out methods to improve the current sign system in order to lead people to smoothly transfer from trains to city buses at Hakata Station but also, it suggested a proposal based on four points for other complex terminal stations, which were quite similar to Hakata Station at attractive cities. Firstly, it was very important to assure the consistency of signs at each decision point or nodes and paths in the wayfinding process, secondly, the integrity and adequateness of bus information at bus stops should be taken into consideration, thirdly, if a complex station had a Bus Terminal and bus stops at Station Squares, it was quite necessary to clarify the differences between the Bus Terminal and bus stops in order to make users complete the bus taking at ease, fourthly, priorities of the information at the whole sign system was also significant to a station, which meant what information should be provided by what forms was needed to consider because visitors preferred to obtain available information at first and then carry out an act.

Chapter 3 Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses in Kyoto Station. This chapter used the same methods conducted at Chapter 2 to analyze the characteristic of sign distribution, the characteristic of sign usage, and information demands by users. Five points were suggested regarding the wayfinding strategies to improve the wayfinding difficulties by using the current sign system at
Kyoto Station, such as the spatial consistency of information (consistency), the appropriateness of information locations (conspicuity), the adequateness of information amount (continuity), the legibility of information contents (clarity), and establishing a complete mental model (confidence). Moreover, people’s wayfinding behavior was quite influenced by the wayfinding distance, for example, the distance was around five-minute journey in the route A of Hakata Station and the information might communicate the approximate time to reach the bus stops. If the distance was quite long, people could think they were in the wrong direction and then backtracked to the original places, on the contrary, people did not wander in a short distance and moved quickly to complete wayfinding journeys, so information on signs should consider communication methods regarding the distance to people in order to assist them to generate a better mental model of environmental settings. Additionally, the verbal assistance, which enhanced a facility’s wayfinding information system and decreased the wayfinding difficulties at Station Square and Kyoto Tourist Information Center, made subjects have a friendly image of Kyoto City.

Chapter 4 Summaries: Characteristic of Sign Distribution and Sign Usage in Transfer between Trains and City Buses at Terminal Stations. In this chapter, comparisons and summaries regarding Chapter 2 and Chapter 3 were conducted. Revealed problems in the wayfinding process at Hakata Station were mainly related to the issues of sign consistency, whereas the issues of sign arrangements at Kyoto Station. Some common problems were reflected at the two stations, such as inadequate sign functional types, inadequate amount of sign installations, inconsistent design styles of signs, improper sign placements, and so forth. As a result, to establish the diverse information about information signs was needed and a common sign system at common spaces of stations was suggested. The common sign system was defined as public signs providing the information ought to be in the common modes for improving the convenience of the sign usability no matter where the signs located within the spaces. Moreover, signs should be regarded as attractive landscapes for improving the environmental amenity,
so the common sign system ought to coordinate the two aspects including 1) the physical aspect of the sign system, such as the sign functional types, placements, and forms, and 2) the aspect of the information system, such as the contents, message hierarchies, terminologies, multilingual messaging, and the graphic system.

Chapter 5 *A Proposal for Design Methodologies to the Wayfinding System between Trains and City Buses at Terminal Stations*. This chapter showed a framework of the proposal and the checkpoints as design improvement guidelines on wayfinding systems between trains and city buses. The proposal was composed of four elements, namely, plans of urban positioning, surveys and analysis at terminal stations on site, implementation of a common sign system, and expansion of assistant service networks. Based on the proposal, a concept concerning the urban intangible values was pointed out and it was an attempt to have a viewpoint to evaluate a wayfinding system of public transport networks. The matrix of the urban intangible values, such as individual value, information value, and spatial value had to be taken into consideration in a wayfinding design project. The individual value derived from the spatial value and the information value. The spatial value should ensure good accessibility and have users form complete mental models. The information value ought to ensure availability of information to users; also, information value could improve stations’ amenity and increase the spatial value. Moreover, to achieve the urban intangible values, it required balancing the relationships between the characteristic of sign distribution and sign usage involving in spatial arrangements, the common sign system, and users’ needs to create a successful wayfinding system.

2. Prospects of the future study

This study conducted surveys and wayfinding protocols to understand the characteristic of sign distribution and sign usage at two complex terminal
stations. Based on the identified results and conclusions, further solutions would be taken into account in the future study as follows:

2.1 Quantitative analysis
In this study, fifteen subjects were recruited as participants at each station, so further quantitative analysis regarding sex, educational backgrounds, occupational, and so forth, is needed to receive more precise data for better understanding of the characteristic of sign usage.

2.2 Graphic systems regarding legibility issues
Only surveys and analysis of the font size related to legibility of signs were conducted at Hakata Station due to results of questionnaires, however, many relative graphic components could affect the legibility at wayfinding processes, such as kerning, color coding, pictograms, typography, and so forth, and these elements are quite paramount to improve the legibility of signs. Also, the endeavor to explore the possibilities of combining legible graphic systems and digital technologies should be taken into account.

2.3 Improvements to the environment of bus stops
Bus stops are not the destinations but very important nodes at the wayfinding process and this paper studied the sign system at the bus stops, but the other issues are also identified and should be solved to improve the environment of bus stops and convenience of bus usability, such as the endeavor and improvement to the waiting environment, better implementations of barrier-free to disabilities, the integrity of bus stops operated by differentiated bus companies, connections of common sign systems and IT technologies, and so forth.

2.4 Issues of universal design on sign systems
A successful sign system also should take universal designs into consideration, but this study did not include the relevant surveys and analysis, so it is considered to be conducted in the future study to satisfy more users’ needs.
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A-1. Papers regarding the study in publications:


A-2. Patterns of subjects’ wayfinding behavior at Hakata Station

Note: 

---. Subjects’ behavior patterns (aboveground 1F); -----: Subjects’ behavior patterns (aboveground 2F).

Figure HS: All the subjects’ wayfinding behavior patterns at Hakata Station
Note:

- - - - : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

: Signs used by subjects;  : Spots subjects ask for assistance;

Figure HS-1: Wayfinding behavior pattern of subject A at Hakata Station
Appendix

Note:

- - - - - : Subjects’ behavior patterns (aboveground 1F);  - - - - - : Subjects’ behavior patterns (aboveground 2F).

● : Signs used by subjects; ⭐ : Spots subjects ask for assistance;

Figure HS-2: Wayfinding behavior pattern of subject B at Hakata Station
Note:

- - - - : Subjects’ behavior patterns (aboveground 1F);  - - - - : Subjects’ behavior patterns (aboveground 2F).

○ : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-3: Wayfinding behavior pattern of subject C at Hakata Station
Appendix

Note:

- - - : Subjects’ behavior patterns (aboveground 1F);
- - - : Subjects’ behavior patterns (aboveground 2F).

● : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-4: Wayfinding behavior pattern of subject D at Hakata Station
Note:

- - - - - : Subjects’ behavior patterns (aboveground 1F);
- - - - - : Subjects’ behavior patterns (aboveground 2F).

○ : Signs used by subjects;
★ : Spots subjects ask for assistance;

Figure HS-5: Wayfinding behavior pattern of subject E at Hakata Station
Note:

- - - : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

: Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-6: Wayfinding behavior pattern of subject F at Hakata Station
Note:

- : Subjects’ behavior patterns (aboveground 1F);
- : Subjects’ behavior patterns (aboveground 2F).

: Signs used by subjects;
: Spots subjects ask for assistance;

Figure HS-7: Wayfinding behavior pattern of subject G at Hakata Station
Note:

- - - - - : Subjects’ behavior patterns (aboveground 1F);
- - - - : Subjects’ behavior patterns (aboveground 2F).

: Signs used by subjects;
: Spots subjects ask for assistance;

Figure HS-8: Wayfinding behavior pattern of subject H at Hakata Station
Note:

- : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

- : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-9: Wayfinding behavior pattern of subject I at Hakata Station
Note:

Legend

- Directional Sign
- Information Sign
- Identification Sign
- Compound Sign
- Regulatory Sign
- Table of Ticket Fares
- Time Table
- Parking
- Information Center
- Lost & Found
- Bus Stop
- Taxi
- Bus Terminal Gate
- Way to Subway
- Way to Underground/Subway

Legend:

- : Subjects’ behavior patterns (aboveground 1F);
- - - - : Subjects’ behavior patterns (aboveground 2F).

- : Signs used by subjects;
- : Spots subjects ask for assistance;

Figure HS-10: Wayfinding behavior pattern of subject J at Hakata Station
Note:

- - : Subjects’ behavior patterns (aboveground 1F); - - - - : Subjects’ behavior patterns (aboveground 2F).

● : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-11: Wayfinding behavior pattern of subject K at Hakata Station
Subject's behavior patterns (aboveground 1F); ——— ———: Subjects' behavior patterns (aboveground 2F).

*: Signs used by subjects; ★: Spots subjects ask for assistance;

Figure HS-12: Wayfinding behavior pattern of subject L at Hakata Station
Note:

- : Subjects’ behavior patterns (aboveground 1F);
  - - - - : Subjects’ behavior patterns (aboveground 2F).

○ : Signs used by subjects; ★ : Spots subjects ask for assistance;

Figure HS-13: Wayfinding behavior pattern of subject M at Hakata Station
Note:

- - - - : Subjects’ behavior patterns (aboveground 1F);
- - - - - - - : Subjects’ behavior patterns (aboveground 2F).

○ : Signs used by subjects;
★ : Spots subjects ask for assistance;

Figure HS-14: Wayfinding behavior pattern of subject N at Hakata Station
Note:

- : Subjects’ behavior patterns (aboveground 1F);
- : Subjects’ behavior patterns (aboveground 2F).
: Signs used by subjects; : Spots subjects ask for assistance;

Figure HS-15: Wayfinding behavior pattern of subject O at Hakata Station
A-3. Patterns of subjects’ wayfinding behavior at Kyoto Station

Legend:

- : Directional sign
- : Information sign
- : Identification sign
- : Compound sign (directional + information sign)
- : Subjects’ behavior patterns (aboveground)
- : Subjects’ behavior patterns (underground)

Figure KS: All the subjects’ wayfinding behavior patterns at Kyoto Station
Legend:

- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Signs used by subjects;
- Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure KS-1: Wayfinding behavior pattern of subject A at Kyoto Station
Legend:
- Directional sign; 📌: Information sign; 🟢: Identification sign; 🟦: Compound sign (directional + information sign); ⚫: Signs used by subjects; ⭐: Spots subjects ask for assistance;
- -: Subjects’ behavior patterns (above ground); ·····: Subjects’ behavior patterns (underground).

Figure KS-2: Wayfinding behavior pattern of subject B at Kyoto Station
Legend:
- •: Directional sign; ■: Information sign; ◆: Identification sign; ◆◆: Compound sign (directional + information sign);
- ○: Signs used by subjects; ★: Spots subjects ask for assistance;
- Dotted line: Subjects’ behavior patterns (aboveground); Dotted: Subjects’ behavior patterns (underground).

Figure KS-3: Wayfinding behavior pattern of subject C at Kyoto Station
Legend:

- ✓: Directional sign;
- ✷: Information sign;
- ○: Identification sign;
- ◊: Compound sign (directional + information sign);
- ●: Signs used by subjects;
- ★: Spots subjects ask for assistance;
- ———: Subjects’ behavior patterns (aboveground);
- · · · · : Subjects’ behavior patterns (underground).

Figure KS-4: Wayfinding behavior pattern of subject D at Kyoto Station
Legend:

- Directional sign
- Information sign
- Identification sign
- Compound sign (directional + information sign)
- Signs used by subjects
- Spots subjects ask for assistance
- Subjects’ behavior patterns (aboveground)
- Subjects’ behavior patterns (underground)

Figure KS-5: Wayfinding behavior pattern of subject E at Kyoto Station
Appendix

Legend:

- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Signs used by subjects;
- Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure KS-6: Wayfinding behavior pattern of subject F at Kyoto Station
Appendix

Figure KS-7: Wayfinding behavior pattern of subject G at Kyoto Station
Appendix

Legend:

- Directional sign;  - Information sign;  - Identification sign;  - Compound sign (directional + information sign);
- Signs used by subjects;  - Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);  - - - - : Subjects’ behavior patterns (underground).

Figure KS-8: Wayfinding behavior pattern of subject H at Kyoto Station
Legend:
●: Directional sign; □: Information sign; ●: Identification sign; ◎: Compound sign (directional + information sign); ●: Signs used by subjects; ★: Spots subjects ask for assistance;
___: Subjects' behavior patterns (aboveground); - - - - : Subjects' behavior patterns (underground).

Figure KS-9: Wayfinding behavior pattern of subject I at Kyoto Station
Appendix

Legend:

- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Signs used by subjects;
- Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure KS-10: Wayfinding behavior pattern of subject J at Kyoto Station
Appendix

Legend:

- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Signs used by subjects;
- Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure KS-11: Wayfinding behavior pattern of subject K at Kyoto Station
Legend:

•: Directional sign; [I]: Information sign; [I]: Identification sign; [O]: Compound sign (directional + information sign); ●: Signs used by subjects; ★: Spots subjects ask for assistance;

---: Subjects’ behavior patterns (aboveground); ⋯⋯⋯: Subjects’ behavior patterns (underground).

Figure KS-12: Wayfinding behavior pattern of subject L at Kyoto Station
Appendix

Legend:
- Directional sign;  - Information sign;  - Identification sign;  - Compound sign (directional + information sign);
- Signs used by subjects;  - Spots subjects ask for assistance;
- --- Subjects’ behavior patterns (aboveground);  ------ Subjects’ behavior patterns (underground).

Figure KS-13: Wayfinding behavior pattern of subject M at Kyoto Station
Appendix

Legend:

●: Directional sign; ■: Information sign; ○: Identification sign; □: Compound sign (directional + information sign); ●: Signs used by subjects; ★: Spots subjects ask for assistance; ——: Subjects’ behavior patterns (aboveground); ·····: Subjects’ behavior patterns (underground).

Figure KS-14: Wayfinding behavior pattern of subject N at Kyoto Station
Legend:

- Directional sign;
- Information sign;
- Identification sign;
- Compound sign (directional + information sign);
- Signs used by subjects;
- Spots subjects ask for assistance;
- Subjects’ behavior patterns (aboveground);
- Subjects’ behavior patterns (underground).

Figure KS-15: Wayfinding behavior pattern of subject O at Kyoto Station
Appendix

A-4. The distribution of target signs at target spaces in the layout of Hakata Station

Legend

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>Directional Sign</td>
</tr>
<tr>
<td>■</td>
<td>Information Sign</td>
</tr>
<tr>
<td>●</td>
<td>Identification Sign</td>
</tr>
<tr>
<td>○</td>
<td>Compound Sign</td>
</tr>
<tr>
<td>◎</td>
<td>Regulatory Sign</td>
</tr>
</tbody>
</table>

Else Signs

- Table of Ticket Fares
- Time Table
- Parking
- Information Center
- Lost & Found
- Bus Stop
- Taxi
- Bus Terminal Gate
- Way to Subway
- Way to Underground/Subway

Diagram of Hakata Station layout with various signs and routes.
A-5. The distribution of bus information on signs in the layout of Hakata Station
A-6. The distribution of target signs at target spaces in the layout of Kyoto Station
A-7. The distribution of bus information on signs in the layout of Kyoto Station
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