An Analysis of Short Trip Passengers' Behaviors in a Marketing Process for Strategic Regional Transit Plan of *Hankai* Tramway

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Abstract: In Japan, trams (streetcars) are being reevaluated as urban and interurban transit modes, and have come to play an important role in the revitalization of a number of cities in recent years. However, the success of such services has not been universal. For example, the Hankai Tramway, which connects the cities of Osaka and Sakai in Osaka Prefecture, is one such service that has been suffering a reduction in the overall number of passengers. Accordingly, in order to ascertain countermeasures for negative trends and to realistically evaluate future prospects for tramways in general, this study analyzes the actual current situation related to the Hankai Tramway by examining the facilities, institutions, shops, and other amenities along the tramway routes, along with their conditions and distances from tramway stops, while paying specific attention to the number of origin-destination (OD) users.

Keywords: tramway, transportation planning, marketing

1. INTRODUCTION

In Japan, numerous streetcar services in many cities began operating during the late Taisho and early Showa Eras. However, as modernization progressed, it became clear that the inconvenience and danger related to boarding and exiting streetcar platforms, which were often located in the center of busy roads, were significant. These dangers were exacerbated by the rapid increase of the number of platforms, and the inconvenience streetcars themselves suffered due to growing traffic congestion, which made it difficult to ensure punctuality – factors that strengthened the trend towards private automobile ownership and use.

In the western counties, where the same problems were experienced, the focus shifted to a next generation system called light rail transit (LRT), which offers increased travel performance, reduced environmental impact, etc., and which was successfully introduced in numerous central urban areas in place of conventional streetcars. In Japan, introduction of new LRT systems was first carried out in Toyama City in 2006. As a typical example of the reviews that have been implemented in many cities of Japan, this study examines the *Hankai* Tramway and analyzes its current and future prospects.

2. CURRENT STATES OF HANKAI TRAMWAY

The *Hankai* Tramway operates on two routes that pass through the south part of Osaka City and Sakai in Osaka Prefecture, and has been suffering from a serious decline in ridership in recent years. Figure 2-1 shows the route map and figure 2-2 shows the trend of ridership. This is especially true of inner city areas of Sakai, where the downward trend in passengers has been marked by shifts to other modes of transportation. As figure 2-3 shows, when calculating profit and loss for the overall service, it is clear that while the Uemachi Line (the main line of the tramway) is operating in the black, the Hankai Line has been operating at a deficit in both Osaka and Sakai. This has forced Sakai city officials and the tramway itself to subsidize the route as a matter of policy, while simultaneously formulating passenger attraction measures, such as institution maintenance expense assistance, and subsidy for a part of fare.

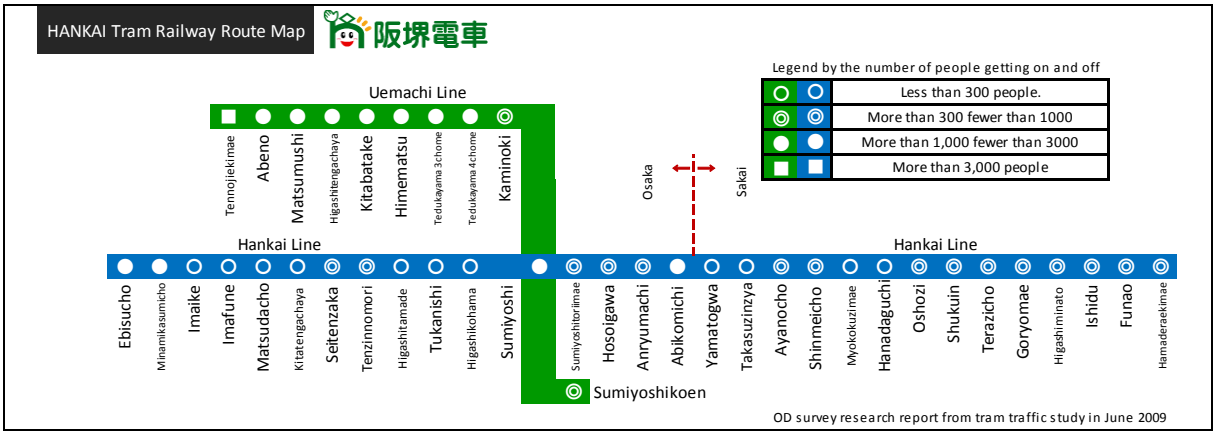


Figure 2-1: *Hankai* Tramway Route Map

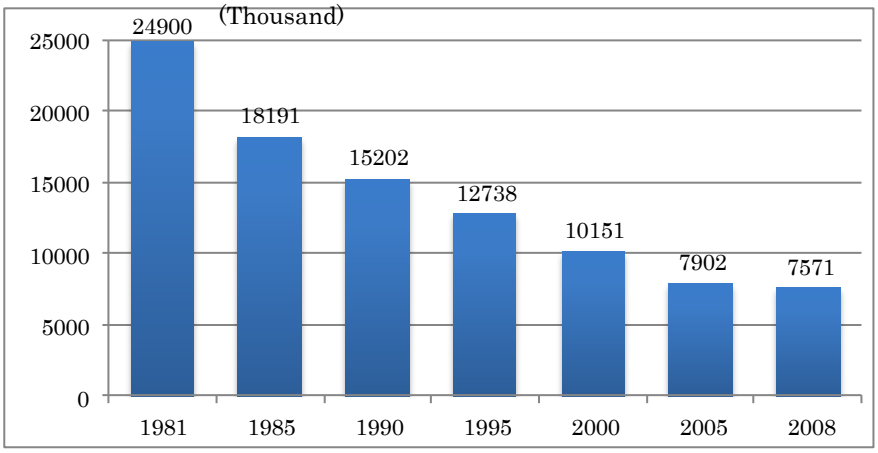


Figure 2-2: Yearly passenger totals (thousands)

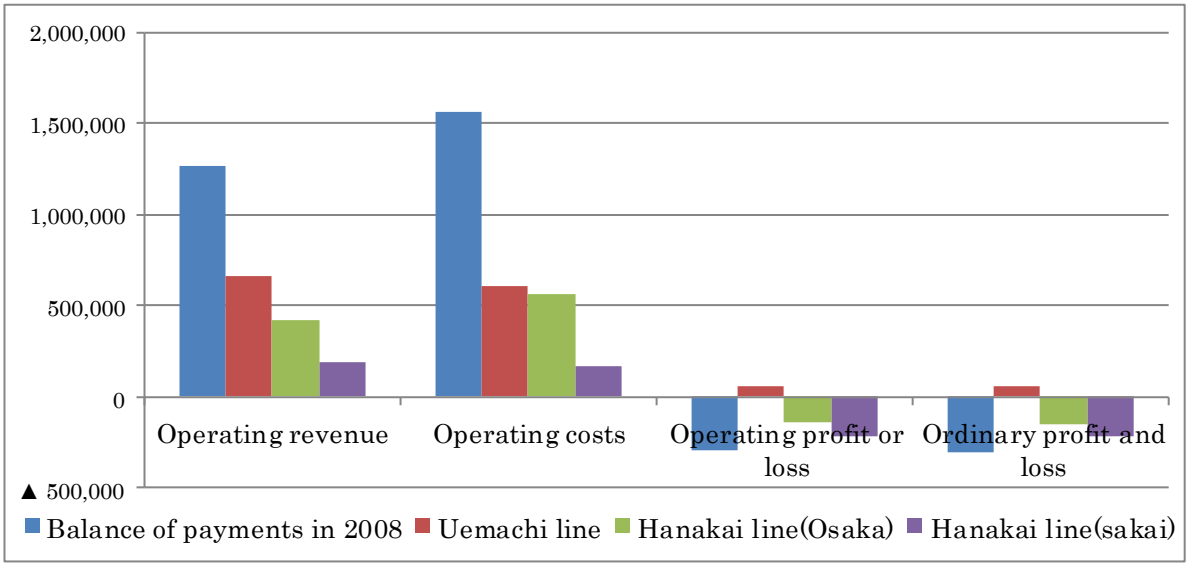


Figure 2-3: Revenue per line

3. PURPOSE OF THIS STUDY

Numerous studies have explored the various roles of city tramways, particularly in relation to “park and ride” systems. For example, in North America, where extensive park and ride facilities have been installed on a number of urban rail systems, there has been considerable interest in exploring the concept as a means of promoting the use of rail transit and encouraging a transfer of commuters from private automobiles to public transport.

However, while there is a general consensus about the most suitable types of location for park and ride facilities, there is less agreement on the development of a reliable method of forecasting demand, and on the required size of the parking sites. Furthermore, while experience in practice indicates that the park and ride concept is attractive to commuters, such schemes do not generally result in lasting reductions in highway congestion due to continued increases in car ownership and use, as well as the phenomenon of generated traffic (I. S. J. Dickins, 1991).

Nevertheless, from the viewpoint of urban economics, transport infrastructure network improvements increase both residential and commercial property values due to improved accessibility and other possible agglomeration benefits (M. Wrigley and P. Wyatt, 2001). Thus, the accessibility provided by tramways reduces time and distance expenditures between residences and daily shopping areas, work places and so on. However, it is not always easy to clarify which stops are popular for daily shopping and which are the origin-destination (OD) stops for daily commuters, especially in the more Densely Inhabited Districts of the city.

This suggests that aspects related to transport service disadvantages are likely to be of significant social policy concern, especially as they relate research and policy on the issues associated with the vulnerable segments of the population, and the factors that would be effective in reducing their social exclusion. Transport problems associated with these groups include those related to physical access, knowing where to go, and the need to feel protected against theft or attack when travelling. Tramways provide suitable opportunities for members

of these groups to travel outside their residences because they are operated on existing road networks and have boarding/exiting points that can be reached with relative ease. Therefore, this aspect encourages introduction (or extension) of tramway systems. (A. Delbosc and G. Currie, 2010).

Furthermore, in recent years there has been a proliferation of research into the effects of the agglomerated urban environment, including mass transit systems, on health-related issues. While there is general agreement that the urban environment affects travel choices and physical activity, it remains unclear how much of a public health benefit can be derived from land use policies that support walking, biking, and use of mass transit. In such cases, tramways can provide a key element to city policies designed to encourage citizens to walk, bicycle, or use other socially acceptable transport modes (R. Stokes, J. MacDonald and G. Ridgeway, 2008).

More specifically, it is hoped that streetcars will become accepted not simply as a means of transportation, but instead evolve to become to the basic social mode of an area, and eventually come to symbolize a particular town or city. However, the actual conditions cannot change until the idea that a streetcar is the same as other forms of rail travel is thrown away, and a new form is adopted in which the town and tramway evolve together.

When paying specific attention to the short distances between intermediate and main streetcar stations, a full appraisal of potential short-distance usages is indispensable to plans for revitalizing a town. To enhance continuation of the various roles that are fundamental to a particular area, and to preserve its traditional and symbolic values, a baseline assessment and problem discovery should be performed. The revitalization proposal used in this study was drawn up by verifying the relevance of the institutions along the line that show the highest level of rail use, then confirming that increased promotion of practical use could still be achieved. Figure 3-1 shows a chart diagram for this study.

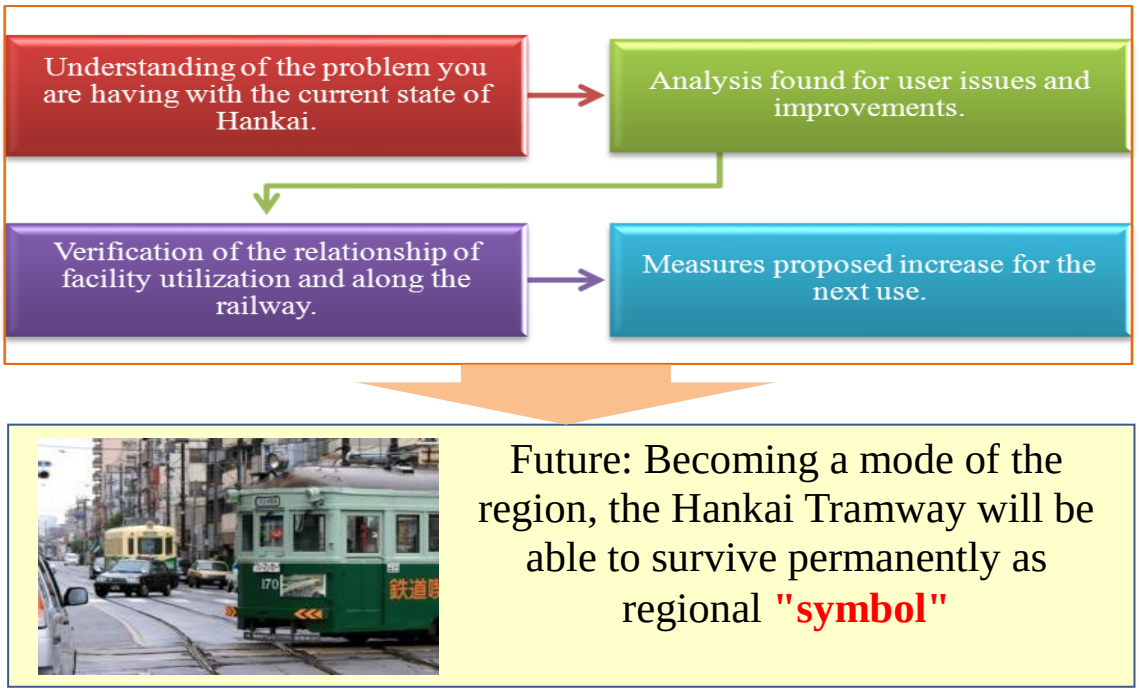


Figure 3-1: Chart diagram for the purposes of this study

4. ANALYSIS OF SURVEY DATA

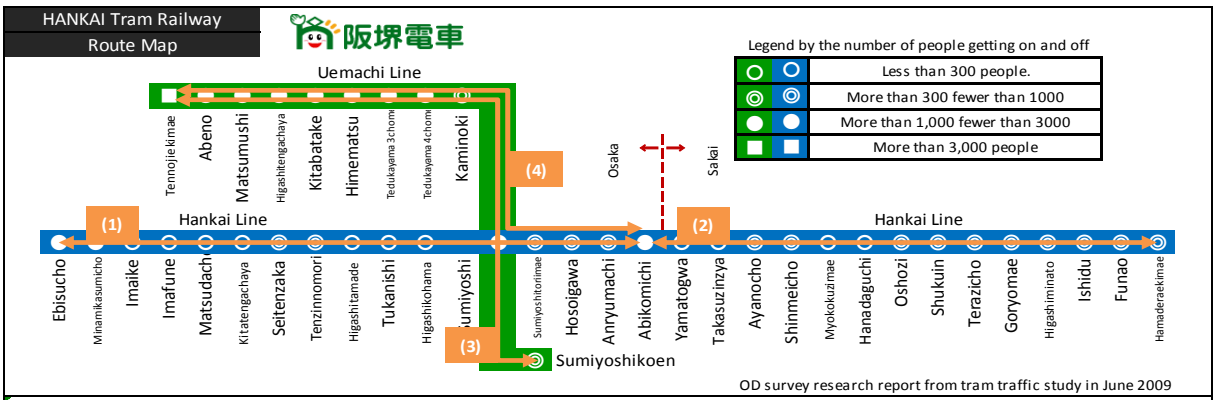
4-1 Usage characteristics of each section

In the "user according to section" phase of the analysis, it is necessary to observe which types of users frequent certain specified sections of a route. Based on the abovementioned expectation that streetcars will assume functions relevant to the basic social modes of an area, and not be seen merely as means of medium distance transportation, it is hoped that they will come to symbolize a town or area. Promoting tramway use between short distance stations is expected to support such revitalization activities.

For example, we can begin with the assumption that the user of a particular section is almost consumers who go shopping to department stores, while commuting to work, school, or to a terminal station. On the *Hankai* Tramway, the distance between stations is short and the streetcars themselves have limited carrying capacity. Furthermore, they operate at slower speeds than typical railroads. Because of these facts, the promotion of intermediate stations along streetcar routes is indispensable to actively promoting future use of the tramway. Like a common bus, increasing the number of short distance users increases the overall number of users, and can thus be seen as one means of revitalization.

In the 2009 Traffic Survey Report(HANKAI Tramway OD Survey Report, 2009) used in this study. The data was collected by a questionnaire survey which was carried out in 24 of June in 2009 and targeted all passengers. The numerical data of the 40 Hankai Tramway stations, along with the total passenger numbers for particular sections, were analyzed to establish forms of use. For intermediate stations, which are defined as the small stops between main stations, the OD value of a cell can be assumed to be small. Therefore, it is necessary to analyze the actual use conditions of each intermediate station in detail. The analytic technique and analysis results are specified below.

Passengers do not go throughout all of the line but from each station near his/her house et al. to the terminals. Therefore the trip lengths are middle distance and can be categorized into four parts in area shown in figure 4-1:



(1) (Hankai line) between EBISUCHO and ABIKOMICHI.

(2) (Hankai line) between ABIKOMICHI and HAMADERA-EKIMAE.

(3) (Uemachi line) between TENNOJI-EKIMAE and SUMIYOSHIKOEN.

(4) (Uemachi line) between TENNOJI-EKIMAE and ABIKOMICHI.

Figure 4-1: Description of the divided area.

Table 4-1: Description Number of OD table

Description Number of OD table	
0 or blank	
1 to 10 people	
11 to 50 people	
51 to 100 people	
More than 100 people	

Actual short distance usage conditions and points for future improvement are first discovered by extracting information from a specific section of a line and its surrounding area, and then considering the number of users for just that portion. When OD investigations are conducted, they are aimed at the main operation forms. Since it appears that there are few passengers between Osaka and Sakai, it can be concluded the intercity usage of the tramway has declined.

Since the portion of the section of a value minute as OD use is observed from the inside this time, the "Tennojiekimae", "Abeno", "Ebisucho", and "Minamikasumicho" are removing with extremely many use. These analyses used data that correspond to the daily OD demand, or for morning peak or evening peak hours.

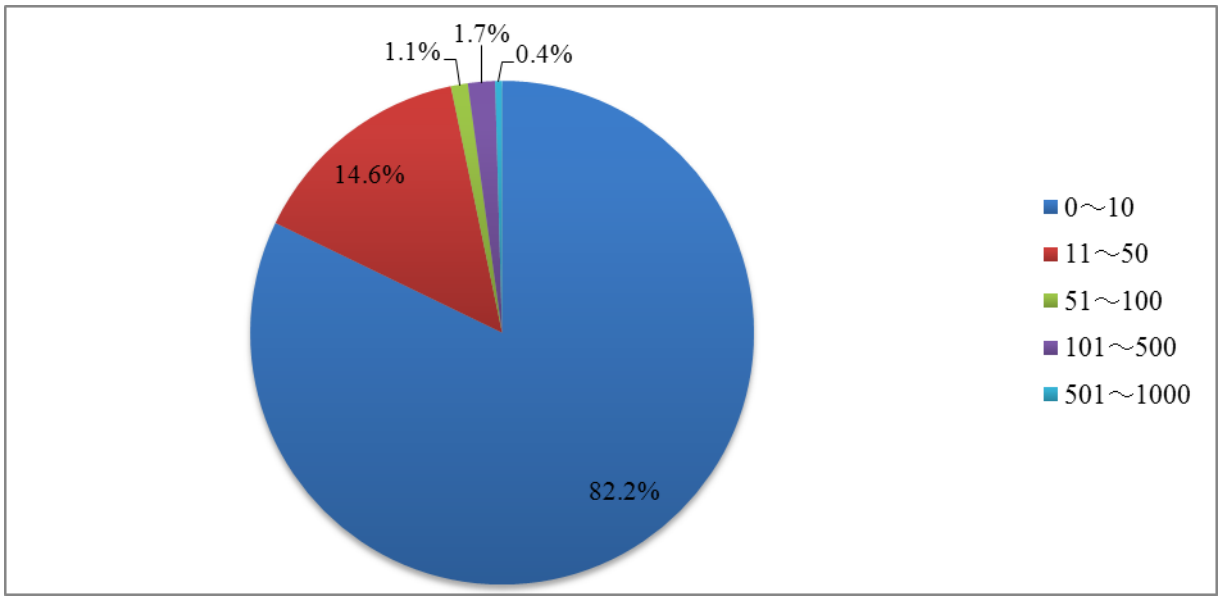


Figure 4-2: The ratio of the number of OD

Table 4-2: Table OD (1) [(Hankai Line) between Ebisucho and Abikomichi.]

Stop riding \ Stop getting off	Ebisucho	Minamikasumicho	Imaike	Imafune	Matsudacho	Kitatengachaya	Seitenzaka	Tenzinnomori	Higashitamade	Tukanishi	Higashikohama	Sumiyoshi	Sumiyoshitoriimae	Hosoigawa	Anryumachi	Abikomichi
Ebisucho		15	7	12	18	20	47	48	26	25	30	29	23	21	50	114
Minamikasumicho	11		4	25	37	18	61	82	20	21	15	17	10	9	35	142
Imaike	7	2			1	5		7	2	2		3	2	4	5	4
Imafune	11	29				4	3	8	4	4	1	2	4	4		9
Matsudacho	22	48		1		1		2	4	3	8	1		2	1	5
Kitatengachaya	9	21	1		1		2	9	2	12	2	3	1	3	3	5
Seitenzaka	31	79	2	4	1					2	4	7	2	2	6	9
Tenzinnomori	41	116	2	3	2	8	1		2	3	2	4			1	5
Higashitamade	25	39	4	7	1	6						1	1	1	2	8
Tukanishi	22	28	1	2	1	5	2		1		1	5		1	2	12
Higashikohama	26	21	4	2	4	1	5		1			1		1	2	6
Sumiyoshi	23	17	4	3	3	1	3	2	3	2			1	5	11	27
Sumiyoshitoriimae	26	7	1	5	2	7	4	7	1	4		2		1	9	48
Hosoigawa	17	23	4	2	3	1	1		1	3	3	2	2		2	8
Anryumachi	50	81	4	3		2	6		1	5	3	10	13	1		8
Abikomichi	88	183	9	6	2	6	9	4	4	19	11	13	39	4	7	

*The red frame section to be analyzed

Table 4-3: OD (2) [(Hankai Line) between Abikomichi and Hamadera-Ekimae.]

Stop riding \ Stop getting off	Abikomichi	Yamatogwa	Takasuzinzya	Ayanocho	Shinmeicho	Myokokuzimae	Hanadaguchi	Oshozi	Shukuin	Terazicho	Goryomae	Higashiminato	Ishidu	Funao	Hamaderaekimae
Abikomichi		3	9	29	19	27	11	26	14	20	14	32	10	15	24
Yamatogwa	7			1			1	1				4			6
Takasuzinzya	6			2	2	2		8	4	1	2	11	5	6	13
Ayanocho	26		5				5	6	8	6	7	14	10	7	8
Shinmeicho	16	1	1	1			1	4	9	8	9	4	8	7	18
Myokokuzimae	18	1	4	1			1	3	2	1	4	7	6	7	4
Hanadaguchi	10	1	1	5					2	3	7	10	1	16	18
Oshozi	12	3	4	8	2	5	1			7	3	20	18	30	18
Shukuin	10		5	3	5	9	3				2	23	16	38	25
Terazicho	18	1	2	6	4	4	2	7			1	8	11	13	26
Goryomae	14	1	3	13	5	2	3	7	1	2		2	11	9	20
Higashiminato	30	2	11	20	12	2	13	28	18	5	6		20	28	63
Ishidu	9	1	8	7	8	5	5	18	17	11	10	20		5	9
Funao	17		4	9	6	7	13	43	29	17	11	23	7		4
Hamaderaekimae	23	3	13	11	20	13	17	31	27	31	42	80	7	6	

Table 4-4: OD (3) [(Uemachi Line) between Tennoji-Ekimae and Sumiyoshikoen.)

Stop getting off / Stop riding	Tennojiekimae	Abeno	Matsumushi	Higashitengachaya	Kitabatake	Himematsu	Tedukayama 3chome	Tedukayama 4chome	Kaminoki	Sumiyoshikoen
Tennojiekimae		20	326	561	800	738	391	394	150	157
Abeno	33		20	71	71	86	79	37	26	36
Matsumushi	301	27		6	13	32	13	9	11	28
Higashitengachaya	565	131	3		4	7	15	5	5	21
Kitabatake	781	153	14	3		5	20	7	5	15
Himematsu	741	124	30	8	6		15	3	6	11
Tedukayama 3chome	467	108	13	10	20	17		2	3	19
Tedukayama 4chome	388	96	10	7	7	2	1			18
Kaminoki	177	42	13	5	11	6		2		
Sumiyoshikoen	207	72	47	19	41	27	17	35	6	

*The red frame section to be analyzed

Table 4-5: OD (4) [(Uemachi line) between Tennoji-Ekimae and Abikomichi.]

Stop getting off / Stop riding	Tennojiekimae	Abeno	Matsumushi	Higashitengachaya	Kitabatake	Himematsu	Tedukayama 3chome	Tedukayama 4chome	Kaminoki	Sumiyoshikoen
Sumiyoshi	221	56	16	4	4	10	9	18	2	1
Sumiyoshitoriimae	76	31	16	3	3	6	7	5	1	
Hosoigawa	105	37	9	7	4	4	7	1		
Anryumachi	185	69	12	9	5	9	6	12	5	
Abikomichi	475	128	35	14	10	21	23	12	6	

Stop getting off / Stop riding	Sumiyoshi	Sumiyoshitoriimae	Hosoigawa	Anryumachi	Abikomichi
Tennojiekimae	282	138	111	204	562
Abeno	42	29	21	29	85
Matsumushi	10	15	4	18	20
Higashitengachaya	8	17	2	7	11
Kitabatake	8	14	1	1	14
Himematsu	16	6	3	8	13
Tedukayama 3chome	11	10	3	6	33
Tedukayama 4chome	17	10	1	10	14
Kaminoki	4	2	2	6	6
Sumiyoshikoen					

*The red frame section to be analyzed

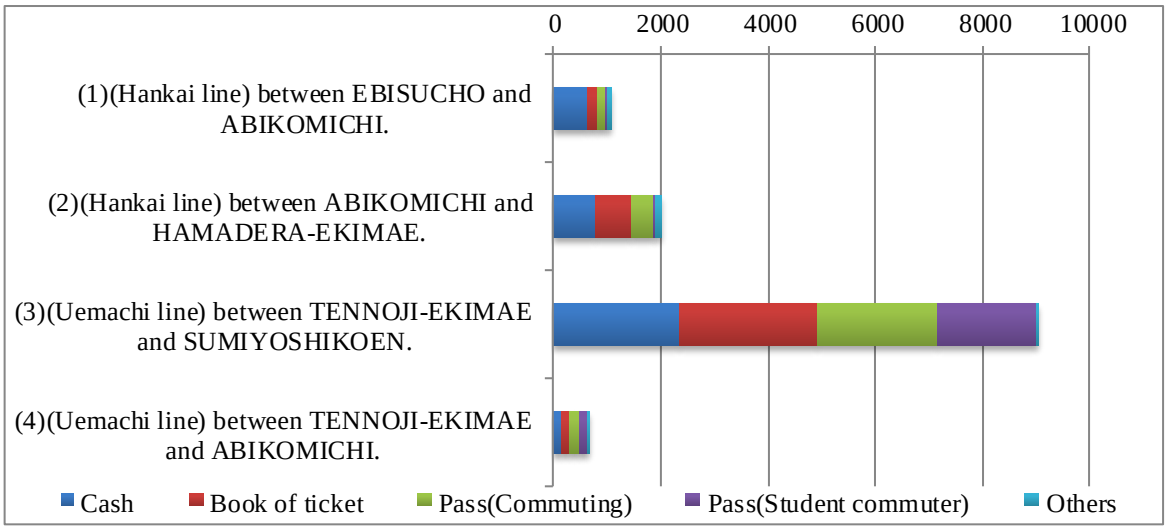


Figure 4-3: Type the user's total ticket of each area

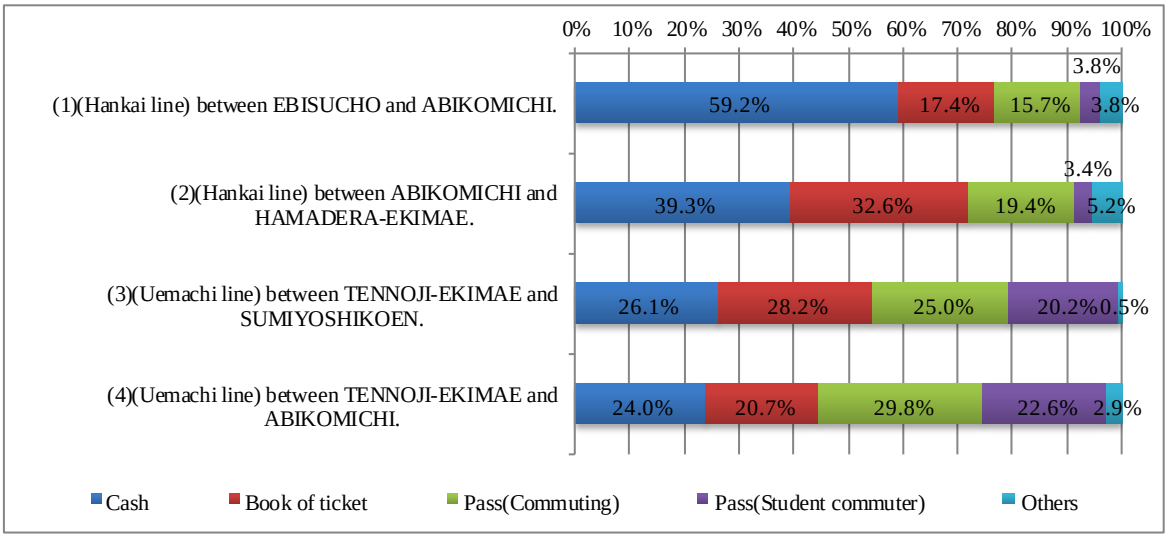


Figure 4-4: Ticket sale by percentage for each area

4-2 Passenger characteristics of each cell

The figures above show the total number of passengers traveling between various stations, along with a breakdown by ticket types. As can be seen in station use numbers, the “ten passengers or less” cell accounts for 82% of the whole shown in figure 4-2. However, if the range is extended to 100 or less, it becomes about 97% of the whole. Furthermore, even in the Hankai Tramway route areas where the population is large, the Abeno center and the direction of Ebisucho are understood to be popular starting and terminal points.

The results of O-D survey are shown in table 4-2, -3, -4, and -5 and figure 4-3 and 4-4. The flow that was expected to be heading to and from Tennojiekimae accounts for 25% of the total number of boarding or exiting passengers. However, how should demand for the little

used interior stop be developed towards the future revitalization of a route?

When conducting a verification analysis of each area of the OD table, it is necessary to look for facilities with potential significance for use in every other area. Such facilities can be institutions, stores, or other resources that can promote the value of using the *Hankai* Tramway from any of its other stations, or which can be used to facilitate connections to buses or other railway lines.

5. ANALYSIS OF PERIPHERAL FACILITIES

5-1. The purpose of this survey

Although many parts of passengers of tramway may be people inhabited around the stations, consumers of shopping area there will be additional passengers who will be expected to promote activity of the area. Many intermediate stops are in near proximity to middle-scale shopping centers that grew on neighborhood outskirts from small-scale roots. Such district facilities include numerous institutions and stores along the railroad line that are geared to local resident use and broader-based institutions that cater to sightseers or which draw their customers from a wider area. Analyzing and differentiating between such establishments by passenger number totals is important.

This analysis is designed use such important data when proposing a revitalization package that includes future growth prospects. The *Hankai* line was selected because the number of little-used stations is kept constant if the primary boarding and exiting stations are removed.

Since it was necessary to determine the availability of institutions within a set radius, and since the average distance between stations on the *Hankai* Tramway is approximately 500 m as shown in figure 5-1. Our investigation used the "circumference search service" of the "Mapion" Internet map search service shown in figure 5-2 and set a 250-m radius object circumference range centering on each stop, which was judged as appropriate “walking distance” for each stop.

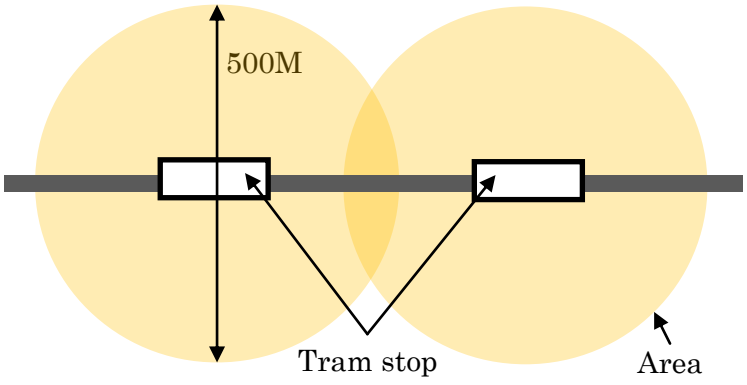


Figure 5-1: Circumference search image

Figure 5-2: Mapion search example

5-2. Survey Results

The results of our investigation identified 1,289 institutions and stores. At one station, it becomes calculation of 44.4 pieces. As a result of our analysis of the *Hankai* Tramway as it passes through various residential and business districts, various patterns could be clarified and the number of institutions along with the number of users at each station could be summarized. Furthermore, it was learned that the *Hankai* Tramway has also marketed tickets that include discount admission prices for various institutions along the line. However, the success of such efforts has been limited because there are few such tickets and there are other measures available for users that wish to visit such institutions.

As for local residents, under the current model, potential users have to pay a fare of 200 yen when traveling at the distance with less than four stations. However, this model is unattractive to those who can simply ride on a bicycle and avoid paying the 200 yen. In order to find a model that would make using the *Hankai* Tramway worthwhile, it is necessary to adopt measures that encourage behavior modifications in cooperation with the commercial establishments of a town, etc. Even if it applied to the entire country, the actual condition has not realized the convenience improvement measure epoch-making like it can bring about the change of land use.

6. CONCLUSIONS

In this research, a baseline assessment of the *Hankai* Tramway by usage situations and a classification of institutions along the tramway lines was performed to gain an understanding of tramway user OD data. It was determined that, in the future, the *Hankai* Tramway will need to function as a basic mode of the area it serves, and not simply as a means of

transportation. And that it will eventually need to symbolize the area it serves.

However, it is not possible to change actual conditions at this stage, so efforts must be made to increase the tramway's integration with the surrounding area. Currently, there is little distance between streetcar stations, and no changes in the fare amounts paid. However, while increasing short-distance streetcar use between intermediate stations is indispensable to revitalizing an area, if use conversion is offset by a decrease in population or advancements in other means of transportation, the utility value of such revitalization efforts may be lost.

Nevertheless, the following points have been clarified as practical measures applicable to future of the Hankai Tramway:

1) Despite decreasing population levels, increasing the number of repeat users of the *Hankai* Tramway can prevent further erosion to overall ridership, and incentives can be adopted that will motivate one time users into becoming repeat users.
2) It will be necessary for the *Hankai* Tramway to undertake a central revitalization package with self-governing bodies and institutions along the line with the aim of revitalizing the entire area.

While decisions to invest large sums of money in order to achieve modest practical use countermeasures is unappealing, efforts aimed at promoting current features of the *Hankai* Tramway have been relatively inexpensive to date. Nevertheless, the adoption of practical measures in cooperation with other transportation services, institutions, etc. has the potential to promote further area development.

One practical use measure that the *Hankai* Tramway has adopted to date involves promoting Osaka or Sakai city amenities to students and local citizens. For example, the "Nonbiri-Odekaken" admission ticket to visitors to the Tsutenkaku Tower, which is one of the symbolic landmarks of Osaka, shown in figure 6-1, includes a free ride ticket for the *Hankai* Tramway, and has become a choice for tower visitors.

This shows that it is important to package sightseeing sites together with other practical use measures, such as cooperative ventures with transportations, local institutions, etc. in order to revitalize areas and promote commerce. Furthermore, when considering residents along the line who usually it for single point commuting, it will be important to introduce practical use measures (such as fare reductions) in cooperation with institutions, businesses or other means of transportation to encourage other forms of use.

Figure 6-1: Nonbiri-Odekaken ticket

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SAKAI City WEB Site.: http://www.city.sakai.lg.jp/