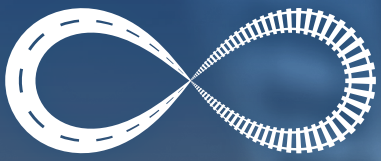

CETRA 2018

5th International Conference on Road and Rail Infrastructure
17–19 May 2018, Zadar, Croatia

Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR

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A STUDY ON THE TRANSPORTATION MODE CHOICE AFTER NEW EXTENSION OF HIGH SPEED RAIL IN JAPAN

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Kanazawa University, Department of Environmental Design Japan

Abstract

The competition between Aviation and High Speed Rail (HSR) are analyzed. Competition and cooperation between aviation and HSR occur in each place in Japan, and there are a lot of examples that the opening HSR is lead to the reduction of flights and the withdrawal of the domestic airline. Then, competitive condition between Aviation and HSR are different from previous condition in this research region which have some routes and transportation mode between Tokyo and research region. This transportation market will become super competitive condition because of the total travel time is almost same from Tokyo, and can be used some route using limited express train. After the new HSR opening, aviation market might be shrinks because of changing the users' transportation mode from aviation to HSR. Furthermore, new extension of HSR will open in 2023 in this region, then competitive condition, travelers' transportation mode choice and transportation preference might change compared with opening new extension of HSR. In this study, we discuss the competition and cooperation between Aviation and HSR under changing aviation market and new HSR opening. The purpose of this study is to examine mode choice priority using paired comparison method. In this study, some questionnaire surveys which is Stated Preference method were conducted for travelers at airport and railway station in research region. As a result of this analysis, it became clear that there is a difference in mode choice priority between railway users and airline users. Moreover, priority of mode choice under super competitive market are effected by new extension of HSR.

Keywords: stated preference survey, extension HSR, competition between Aviation and HSR, transportation mode choice

1 Introduction

In Japan, there are many studies on competition between aviation and the bullet train (HSR) [1] [2]. Competition and cooperation between aviation and HSR occur in each place in Japan and opening HSR is considered to be one of factors for withdrawal of the domestic airline [3]. Therefore, the domestic airline number is decreasing in Japan, and it is important problem. Especially decrease of airline number is caused in local area. The local government subsidies for air fare to prevent decrease the airline number. Then, competitive condition between aviation and HSR are different from previous condition in this research region which have some routes and transportation mode between Tokyo and research region.
In Fukui Prefecture, this research region, new extension of HSR will open in 2023. Then, competitive condition between Aviation and HSR are different from previous condition in this research region which have some routes and transportation mode between Tokyo and research region. People in research region often choice railway when go to Tokyo. Therefore,

after the new HSR opening, aviation market might be shrinks because of changing the users' transportation mode from aviation to HSR.
In this study, some questionnaire surveys which is Stated Preference method were conducted for travelers at airport and railway station in research region.

2 Outline of target market

2.1 Influence new opening of HSR

Hokuriku market is constituded Toyama Prefecture, Ishikawa Prefecture and Fukui Prefecture. The convenience of the transportation between Hokuriku market and Tokyo is improved by HSR opening at Kanazawa City, Ishikawa Prefecture March 14 2015. Before HSR opening at Kanazawa, about 4 hours need to travel Tokyo and Kanazawa. But HSR opening make it possible to shorten trvel time for about 1.5 hours. In addition number of traveler who comes Kanazawa City is increasing after HSR opening. In this way Kanazawa City is given economical benefits and improvement of traffic convenience by opening HSR. On the other hand, A airline which compete with HSR in Hokuriku market is given negative influence by opening HSR. That influence is fatal decrease of number of users in airline (Figure 1). Therefore, in the Hokuriku market, Fukui Prefecture, which is a survey site, has attracted attention as a demand for air demand.

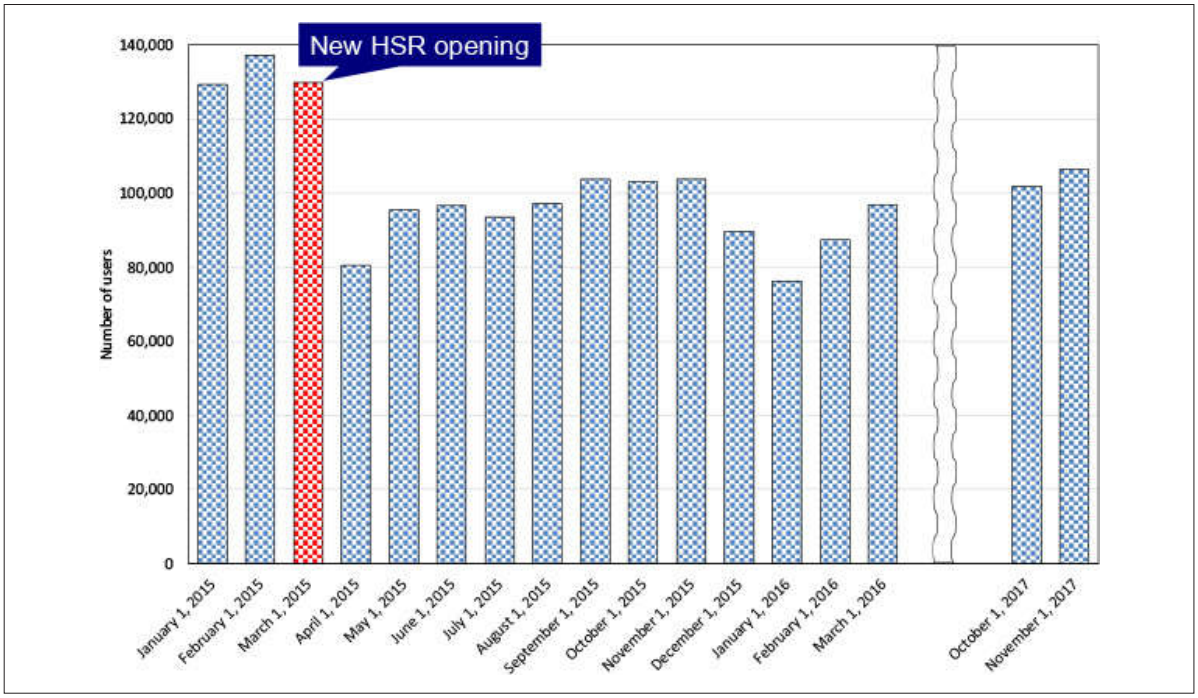

Figure 1 Number of airline users between KMQ and HND

2.2 Transportation condition in Fukui Prefecture

If new extension of HSR is open in Fukui Prefecture, there are 6 traffic modes between Fukui Prefecture and Tokyo (Figure 2). Between Hokuriku market and Tokyo, shown in Table 1 the aviation and rail traffic sharing rate. As shown in Table 1, in the Fukui Prefecture, the proportion of people traveling to Tokyo using railway is very high at 90 %, the route 1 in Figure 2 being the most frequently used. Therefore, it is conceivable that many people shift to HSR usage after the HSR extension has been opened. Table 2 shows the LOS (number of times of transfer, required time, cost) of each movement route when the departure point is set as

the representative station of Fukui Prefecture and the destination is set to Tokyo station. As shown in Table 2, currently available transport modes require transit, and the first is the Shinkansen which opens in the direction of transport that can move directly to Tokyo. Focusing on the required time, it takes about 3 hours and 20 minutes for one way by route 1, which is the most mainstream in terms of transportation to Tokyo, and it is difficult to cut off 3 hours with currently available transportation methods, and it is in a side by side. Regarding expenses, if you purchase a ticket on a previous day discount, there is no big difference between rail and air. From these points, it can be said that this market is a rare market where the LOS of aviation and railway is antagonistic.

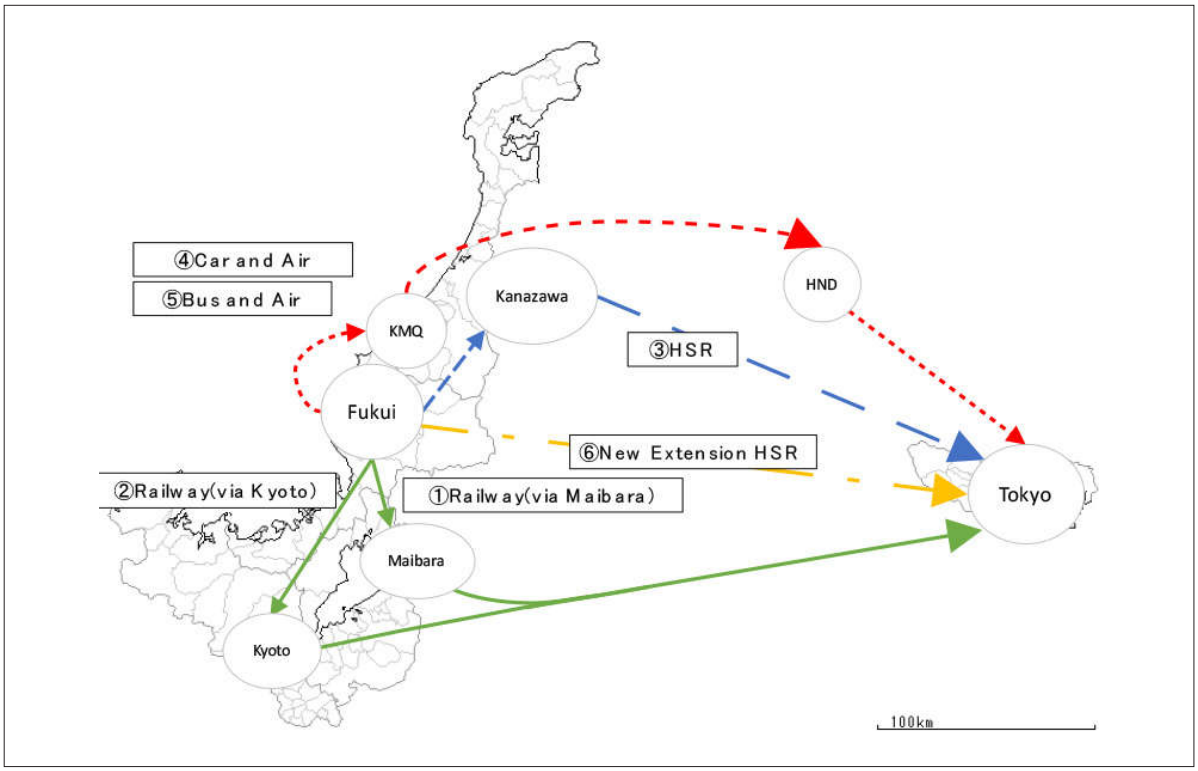

Figure 2 Traffic modes between Fukui Pref. and Tokyo in new extension HSR opening

Table 1 Transport sharing ratio of Hokuriku market

	Rail	Air
Fukui Pref.	90 %	10 %
Toyama Pref.	73 %	27 %
Ishikawa Pref.	42 %	58 %

Table 2 LOS of each route

Route	Number of transfers	Time required	Cost (JPY)
1 Railway (via Maibara)	1	3 hours 22 minutes	14,660
2 Railway (via Kyoto)	1	3 hours 43 minutes	16,700
3 HSR	1	3 hours 32 minutes	16,050
4 Car and Air	2	3 hours 15 minutes	14,760
5 Bus and Ari	2	3 hours 20 minutes	14,590
6 New Extension HSR	0	2 hours 50 minutes	16,740

3 Questionnaire survey

3.1 Outline of questionnaire survey

In this research, we conducted a questionnaire survey using SP survey for air users and railway users who live in the research site. Distribution location was collected by mailing at two places, the representative station of the survey site and the airport nearest from the investigation site. Table 3 shows the outline of the questionnaire survey.

3.2 SP survey

As the contents of the SP survey, we adopted a method of evaluating six traffic modes between the surveyed site and Tokyo on a brute-force basis, assuming that the HSR extended its opening to the investigation site. The setting of LOS of each route is as shown in Table 2. For all routes, set the departure point to the representative station of the survey site and the destination to Tokyo station. The number of transfers, required time, and cost are calculated. The cost is an adult one-way fee, and the railway is calculated by the designated seat usage fee.

Table 3 Outline of survey

Dates	September, October 2017
Target	Transport user residing in the research area
Question items	Personal attribute Usual traffic situation during use SP survey
Distribution number	4767
Collected number	620

4 Person attribute of samples

Sex
As shown in Figure 3, the basic aggregation result on the sample's "sex" was 59 % for "male" and 41 % for "female".

Age
As shown in Figure 4, the basic aggregation result on the sample ages is 33 % in "50's", followed by 22 % in "60's", 18 % in "40's", and the middle aged There were many samples.

Occupation
As shown in Figure 5, the basic result of the samples occupations is "37 %" for "employee and group staff". Next, "company officers and group officers" was 16 %, "civil servants" was 12 %.

The purpose of the trip
As shown in Figure 6, the basic result of the sample travel purpose is "business" at 38 % most. Then "tourism" was 25 %.

Regular means of transportation between the research region and Tokyo
As shown in Figure 7, the basic calculation result of the usual transportation method between the sample survey site and Tokyo is 56 %, "Tokaido Shinkansen (via Maibara or Nagoya)". Next, 'Aviation (via Komatsu Airport)' was 34 %. In this aggregation result, the percentage of aviation use is high, but this is influenced by selecting Komatsu Airport as the distribution place in the questionnaire survey.

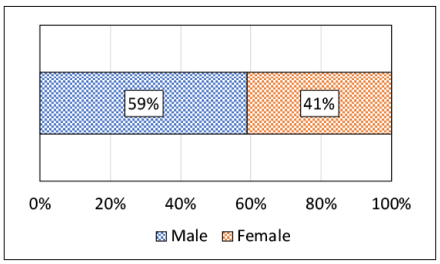

Figure 3 Sex (n = 620)

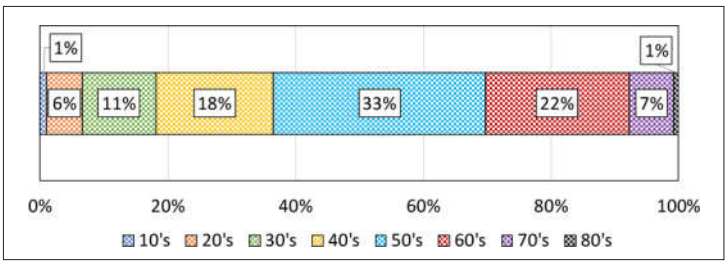

Figure 4 Age (n = 618)

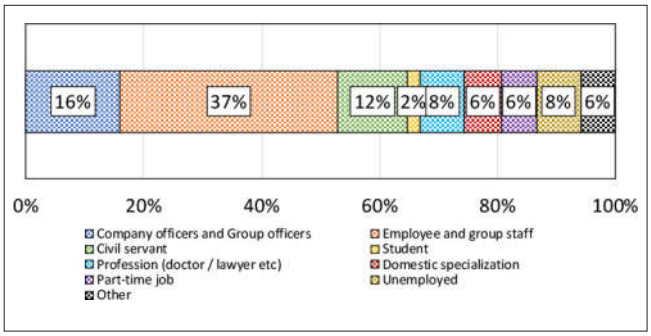

Figure 4 Occupation (n = 613)

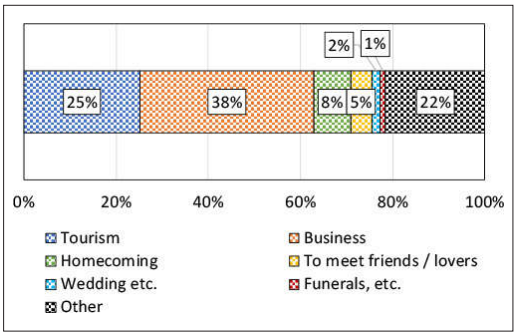

Figure 6 The purpose of the trip (n = 595)

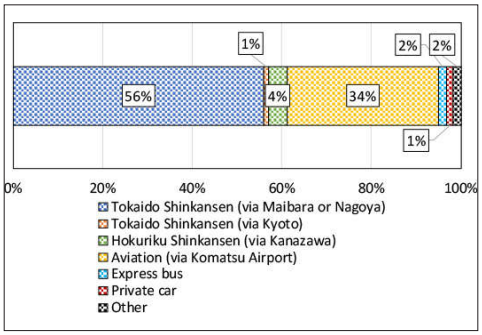

Figure 7 Regular means of transportation between the research region and Tokyo (n = 620)

5 Result of analysis

5.1 Analysis overview

Using the data obtained from the SP survey, we will clarify the priority order of transport choice from the pairwise comparison method. From the results obtained by the analysis, we will clarify the influence of the opening of new extension HSR on the transportation selection behavior of the transportation Furthermore, similar analysis is carried out in each of the air user and the railway user to clarify the change of the transportation selection behavior of the survey site in more detail.users of the surveyed area.

5.2 Fukui prefecture's transportation selection priority order

The analysis results using the pair comparison method for Fukui prefecture's SP data are shown in and Figure 8. As shown in Figure 8, in Fukui citizens' transportation selection priority order, "6 New Extension HSR " became No. 1, which was the easiest to select. After that, it continued in the order of "1 Railway (via Maibara)", "4 Car and Air", "5 Bus and Air", "3 HSR". As a result, it is suggested that many of Fukui prefecture are hoping for the opening of

new extension HSR. Moreover, it was suggested that the use of the Tokaido Shinkansen via Maibara is highly likely to be used deeply even after the extension, for Fukui citizens for the second place because it was "1 Railway (via Maibara)".

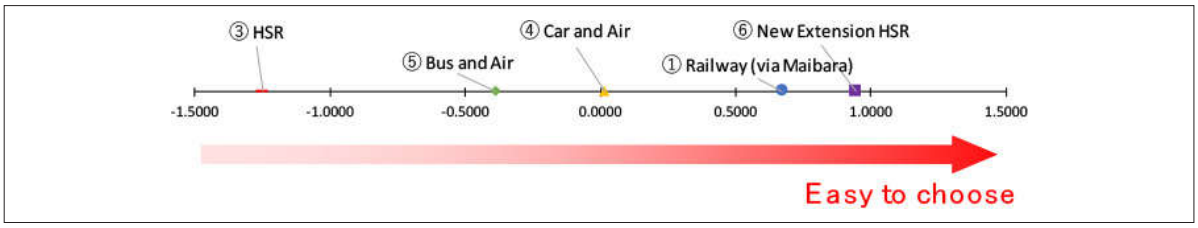

Figure 8 Relationships among orders of transportation selection priorities

5.3 Transportation selection priority order for aviation users

For air users, we analyzed the SP survey data by a pair of comparisons and clarified the priority of choice for transportation. The results of the derived transportation selection ranking are shown in Figure 9. As shown in Figure9, the travel route selection priority for air travellers. After new extension HSR opening, aviation use was located at the top of the route. Subsequently, the Fukui citizen's preference of choosing transportation was No. 1 "6 New Extension HSR " was the third place. As a result, it was suggested that among people in Fukui prefecture, those who have a custom of using aviation to move between Fukui Prefecture and Tokyo have a high possibility of utilizing aviation unchanged after opening new extension HSR. In other words, even after opening new extension HSR, it can hardly be thought that the utilization of Komatsu- Haneda fleets of Fukui prefecture will be significantly lower than it is now.

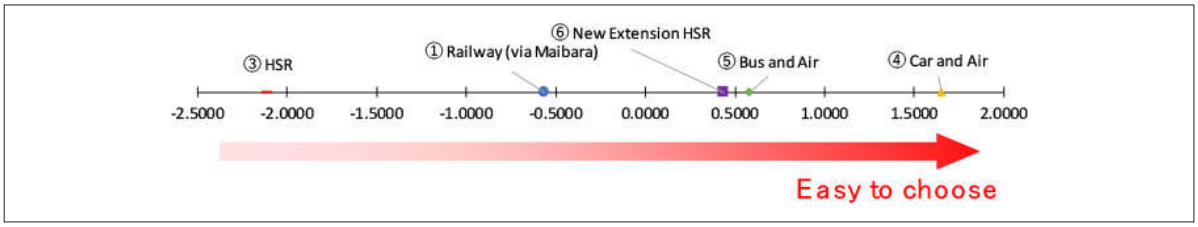

Figure 9 Relationships among orders of transportation selection priorities in railway users

5.4 Transportation selection priority order for railway users

A pair comparison was conducted using SP survey data of railway users. The analysis results are shown in Figure 10. As shown in Figure 10, the priority for transportation selection was dominated by railway use. It is suggested that many of the Fukui citizens who use railroad are accustomed to using the "1 Railway (via Maibara)", which is thought to be preferable, and that opening new extension HSR Even after that, use of the "1 Railway (via Maibara)" is expected to get support from railway users.

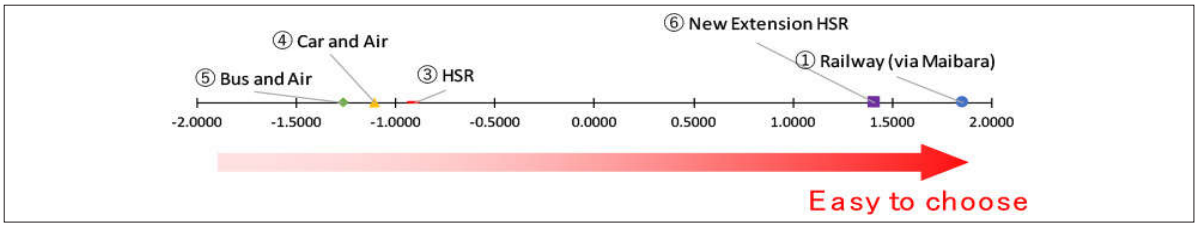

Figure 10 Relationships among orders of transportation selection priorities in aviation users

6 Conclusion

In this research, we conducted a questionnaire survey on Shinkansen unopened areas where the aviation utilization rate is low and the reliance on railway is high, and the influence on the selection of transportation by the new extension HSR stretching has been clarified. Based on the preference order of transportation selection obtained from the pairwise comparison method, it became clear that those who reside in the investigation site are the easiest to select opening new extension HSR after opening new extension HSR. As a result, it can be said that expectations for people living in the investigation area are great for opening new extension HSR. In addition, it is suggested that the low aviation use ratio situation may continue.
Even if analyzed by attribute, it became clear that opening new extension HSR has a big influence. However, both the aviation user and the railway user have a strong tendency to depend on the transportation means currently being used, and at this stage, it is thought that the users of the transportation companies will rapidly shift to using new extension HSR It can be said that it is hard to bear. However, the opening of the Shinkansen is five years later. Therefore, it is possible to disclose various information so far, and the intention to use will change accordingly. It is necessary to clarify the questionnaire survey in the future. In addition, I would like to clarify the influence of the more detailed new extension HSR by quantitatively grasping the degree of influence on transportation selection behavior by the opening of new extension HSR.

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