# A Case Report of Improve Bus Networks of the Kyoto City as a Means of Transportation for a Large City

## -A Report on the Possibility of Restructuring Bus Networks Based on Scientific Analyses -

Keisuke SHIOJI*

## 1. Introduction

Located in the Kinki metropolitan area – one of the three largest metropolitan areas in Japan – Kyoto is an international tourist city visited by as many as 50 million Japanese and international tourists annually. As for principal means of transportation in the city, six railway companies run trains connecting the city to the areas outside. And yet since the railway terminals of these companies are located separately, the Kyoto City Bus (operated by Kyoto municipal transportation bureau) plays the important role of connecting these railway terminals. This study reports on efforts to restructure the service routes and improve the convenience of the Kyoto City Bus based on scientific analyses such as passenger research and a questionnaire survey with a view to making the buses easy to understand and use for the citizens and tourists.

Table1. Items which Japanese tourists were satisfied or regretted (General survey of Kyoto tourism, 2013)

| | Very much satisfied | (%) |
|---|---|---|
| 1 | Shrine,Temple | 47.4 |
| 2 | Landscape of nature | 44.3 |
| 3 | Traditional culture | 37.4 |
| 4 | Mental satisfaction | 31.9 |
| 5 | City landscape | 27.5 |

| | Regrettable | (%) |
|---|---|---|
| 1 | **Public transport** | **13.2** |
| 2 | Too many people | 12.9 |
| 3 | Shrine,Temple | 7.2 |
| 4 | Traffic jam | 6.5 |
| 5 | Expensive | 5.8 |

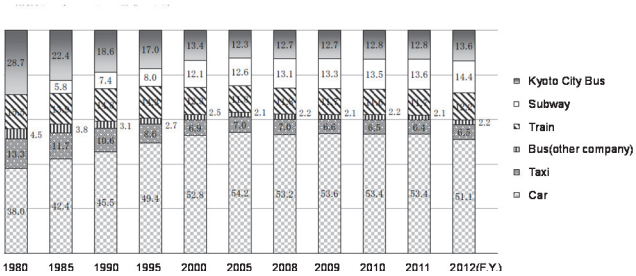



Figure1. Component ratio by mode of transportation in Kyoto city

## 2. Current status and challenges of bus transportation in Kyoto City

(1) Need for promoting the use of public transportation

While Kyoto, one of the most touristic cities in Japan, has temples, shrines, scenic and historic places, traditional culture, nature and landscape that are highly evaluated, the city is also characterized by a low-level of satisfaction about its means of transportation such as the trains and buses as well as the traffic situations such as traffic jams (Table1.).

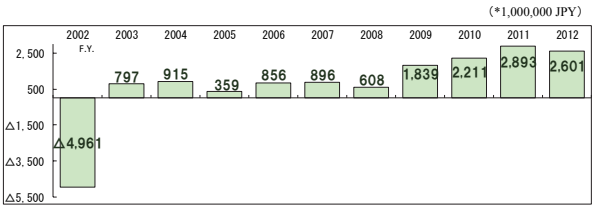



Figure2. Ordinary profit and loss of Kyoto city bus (Kyoto municipal transportation bureau)

Therefore, it is necessary to promote a modal shift from individual cars to public transportation

* Nihonkai Consultant Co., LTD, Planning and Research Division
E-Mail: k-shioji@nihonkai.co.jp

* This is an abstract peer-reviewed by the International Affairs Committee of the City Planning Institute of Japan for ISCP2014.

by improving the convenience of the means of public transportation, particularly the buses.

(2) Management issue of the city bus – breakaway from a slump –

Due to the development of motorization and the opening of the subway systems in Kyoto, the number of the users of the city buses decreased over a long period of time (Figure1.), in which the management situation of the Kyoto City Bus got worse. However, efforts such as streamlining the management contributed to improving the balance of payments in recent years (Figure2.). In this context, it was needed to expand investments to strategically increase the number of the users based on comprehensive research on the trend of use, whereby leading to a large-scale improvement in the management situation.

Table2. Type of Routes in Kyoto city bus

| Type of Routes | | Number |
|---|---|---|
| Major routes | Loop lines | 8 |
| | Sightseeing lines | 3 |
| | Trunk lines | 19 |
| Sub-major routes(between suburbs and central | | 15 |
| Feeder routes(connecting with train) | | 19 |
| Other routes | | 10 |


Figure3. Example of Passenger's Flow: grid-type network at Kyoto city

3. Scientific analyses for the evaluation of the current status

(1) Evaluation of the route networks based on data on the operational results

While Kyoto City has a grid-type road networks, it is pointed out that the large number of bus service routes are confusing. Restructuring bus service routes has long been a subject of research. With regard to the bus routes in Kyoto, this study analyzed the possibility of restructuring the current routes to make them the simpler "few-routes-high-efficiency type," typically found in New York, building upon an investigation on the passenger flow in 2012 and data on five-year operational results. As a result, it was discovered that the current bus route forms in Kyoto City can transport many passengers in an efficient manner, taking advantage of the route system that is designed in such a way that each route reaches their respective destinations without passengers having to change buses (Figure3.).

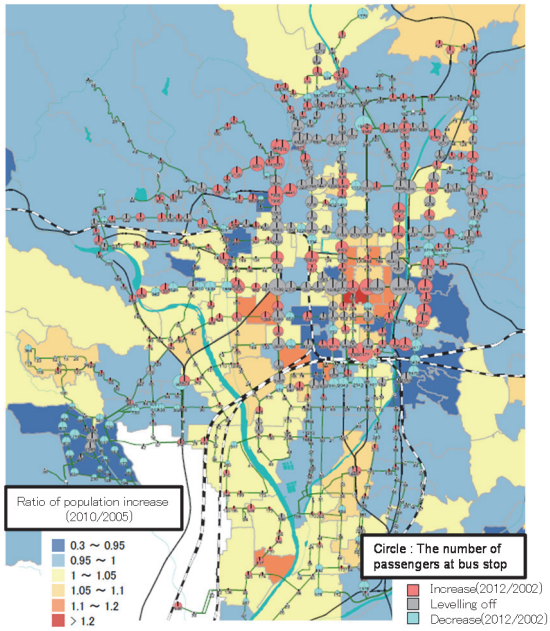



Figure4. Example of analysis on GIS: between population and passengers

Also, this study made a comprehensive analysis of hints for improvements of each route, by analyzing their usage trends and challenges through changes in the numbers of the population and the passengers expressed on GIS (Figure4.).

(2) Punctuality analysis

Since the Kyoto City Bus has introduced a GPS-based operation management system to all the vehicles, log data on what time each vehicle has passed each bus stop every day is available throughout the year. Using this data, the status of delay of the vehicles disaggregated by each day of the week and time periods was displayed graphically. As a result, it was discovered that delays chronically occur in specific directions, of which one of the causes can be attributed to the existence of delay-prone routes (Figure5.).

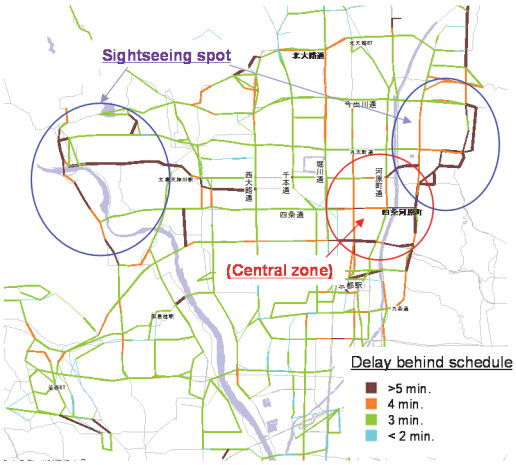



Figure5. Punctuality analysis result (Delay behind schedule)

(3) Needs of the passengers uncovered by a questionnaire survey

A questionnaire survey was conducted with citizens and tourists. As a result, it was found out that there are greater needs of the citizens for "routes that directly go to the destinations without transfer" than "high frequency routes." (Figure6.)

Also, many respondents answered that "buses are often delayed," and that "it is hard to find the locations of transfer."

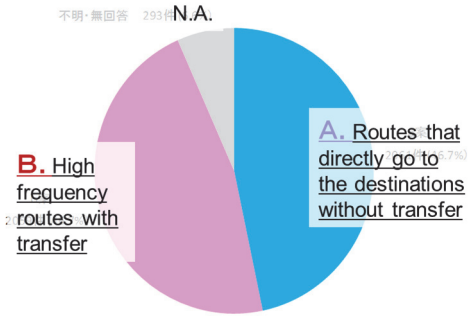
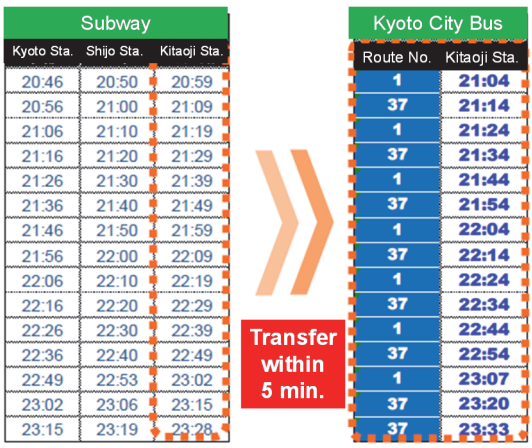



Figure6. Needs of the passengers uncovered by a questionnaire survey

4. Measures implemented based on scientific analyses

(1) Patterning the schedules of several routes

The results of the study and the evaluations by academic experts revealed that the current route network is a very efficient form and that a large-scale restructuring of the routes would be counterproductive. On the other hand, the schedules of several routes with different destinations were adjusted in such a way that the buses arrive at regular intervals so that the schedules become more passenger-friendly (Figure7.). Moreover, as for the routes in which delays occurred frequently, the time required between each bus stop was minutely recalculated and adjusted to avoid delays as much as possible.



| Subway | | |
|---|---|---|
| Kyoto Sta. | Shijo Sta. | Kitaoji Sta. |
| 20:46 | 20:50 | 20:59 |
| 20:56 | 21:00 | 21:09 |
| 21:06 | 21:10 | 21:19 |
| 21:16 | 21:20 | 21:29 |
| 21:26 | 21:30 | 21:39 |
| 21:36 | 21:40 | 21:49 |
| 21:46 | 21:50 | 21:59 |
| 21:56 | 22:00 | 22:09 |
| 22:06 | 22:10 | 22:19 |
| 22:16 | 22:20 | 22:29 |
| 22:26 | 22:30 | 22:39 |
| 22:36 | 22:40 | 22:49 |
| 22:49 | 22:53 | 23:02 |
| 23:02 | 23:06 | 23:15 |
| 23:15 | 23:19 | 23:28 |

Transfer within 5 min.

| Kyoto City Bus | |
|---|---|
| Route No. | Kitaoji Sta. |
| 1 | 21:04 |
| 37 | 21:14 |
| 1 | 21:24 |
| 37 | 21:34 |
| 1 | 21:44 |
| 37 | 21:54 |
| 1 | 22:04 |
| 37 | 22:14 |
| 1 | 22:24 |
| 37 | 22:34 |
| 1 | 22:44 |
| 37 | 22:54 |
| 1 | 23:07 |
| 37 | 23:20 |
| 37 | 23:33 |

Figure7. Patterning the schedules of several routes

(2) Measures of late-night buses and strengthening the network functions with the trains

Based on the results of the analyses, bus schedules in line with the arrival times of the trains were adopted for stations where transfers between trains and buses often take place. In particular, late-night buses after midnight were newly set up in order to respond to the demands from the metropolitan area late at night. This measure was carried out for bus routes with frequent

transfers to trains and routes that use train stations relatively frequently late at night based on an in-depth analysis of the passengers of each route and bus.

(3) Renewal of signs and information signs

A “design manual” was developed for the first time by the Kyoto City Bus in order to adopt the same designs for the information signs at the stations, the displays indicating the destinations of the buses, and the timetables at the bus stops. Based on this manual, a real-time bus information display system was set up with a large screen in Kyoto Station, which a lot of tourists visit (Figure8.). Also, as a guidance method that takes advantage of the grid-type structure of streets in Kyoto City, different "line colors" depending on the directions were set up for the main streets running in the north-south directions in the city (Figure9.). The line colors are displayed on the signs of the buses indicating the destinations and the information signs at the bus stops to indicate the directions of the vehicles in an easy-to-understand manner.

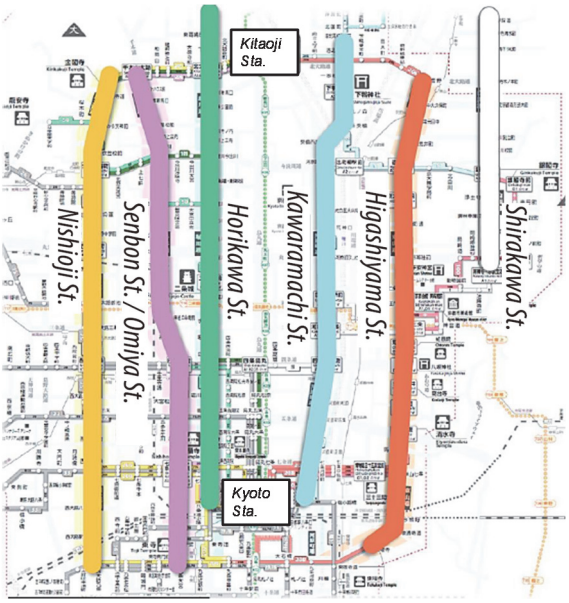



Figure8. Line colors index for main streets

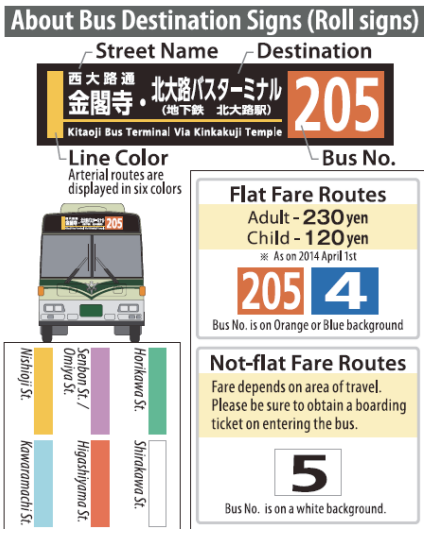



Figure9. Design of information signs and Line colors

(4) Measures related to direct and express routes

Since the Kyoto city buses are widely used by citizens for shopping and tourists, new routes that directly connect the main downtown areas of the city to the Kyoto Station were newly set up so that the buses will be more convenient for these people. Also, as for the routes for the tourists, the design of the buses that connect the main tourist attractions (Ginkaku-ji temple, Kiyomizu-dera temple and Kinkaku-ji temple among others) was renewed and the number of these buses increased in order to make them more convenient for domestic and international tourists.

## 5. Summary

Improvement measures to make the bus transportation system in a metropolitan area more passenger-friendly were introduced above, using Kyoto City as an example. As these measures were simultaneously implemented from March 22, 2014, their effects have not been revealed yet. Continuous monitoring and improvements through PDCA (Plan-Do-Check-Action) measures will be required from now on.

***Keywords***: *route buses, public transport, restructuring bus routes*