

# Case Study and Direction of Bicycle-Sharing Systems in Japanese Cities

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## Abstract

Bicycle-sharing systems allow people to share bicycles with others, borrow and return them using multiple cycle ports, and register and pay for them with an IC card or smartphone. Because these systems are still new in Japan, few papers can be found on them, even in the National Institute of Informatics. The purpose of this article is to clarify the business purpose, issues, effects, features, numerical values, and direction of bicycle-sharing systems. Therefore, we selected 16 advanced cases nationwide and conducted a survey in 2019. As a result, it was clarified that the main issues facing bicycle-sharing systems are improving the ease of migration and supplementing public transportation, improving profitability, and so on.

*Keywords:* Bicycle-Sharing System, Case Study, Direction

## 1. Introduction (Background and purpose of research, method)

In Japan, the Bicycle Utilization Promotion Law was passed in 2017, and town development and bicycle-sharing businesses have been progressing since. Bicycle-sharing is a system that allows users to share bicycles and freely get on and off at multiple ports.

In addition, bicycle-sharing systems alleviate traffic congestion in cities, save energy, prevent air pollution, reduce travel costs, and improve public health. Therefore, they have recently become widespread in urban municipalities nationwide. However, previous research is not sufficient, and no paper has considered the management trends, issues, and directions of bicycle-sharing systems by conducting a survey of advanced local governments all over Japan.

To fill this gap, 16 advanced cases nationwide were selected and a survey was conducted in 2019. The

purpose of this article is to clarify the business purpose, issues, effects, features, numerical values (number of ports, number of bicycles, etc.), and direction of the 16 cases and to secure useful materials for the introduction of bicycle-sharing systems in the future. For the selection of the precedent cases in April 2019, local governments with a proven track record were selected from online searches, literature, and interviews with the Ministry of Land, Infrastructure, Transport and Tourism.

A survey of local governments was conducted from May to October 2019. In addition, we visited with the majority of the selected local governments to conduct interviews and collect materials.

## 2. Research results

① The most common purpose of the bicycle-sharing businesses is to improve the mobility of the town (10 cases). In particular, the effects of revitalizing the

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central city area and enhancing the convenience of transportation for tourists have increased.

Next, bicycle-sharing systems aim to help society break away from its dependence on automobiles (4 cases) and reduce the environmental burden (4 cases) by switching to using bicycles. The third most common purpose is to supplement public transportation (3 cases) and focus on bike-sharing as a means of promoting the use of public transportation.

Interregional exchange or the promotion of recreation (1 case) is also the goal of a wide-area bicycle-sharing system that spans multiple prefectures.

② In terms of actual effects or advantages, bicycle-sharing systems contribute most to tourism (7 cases). In particular, they are highly effective as a means of transportation that could increase the number of users for sightseeing purposes and help tourists plan sightseeing excursions at their own pace.

Next, we have achieved about 50% of the purpose of improving the ease of migration (5 cases). In addition, the supplementation of public transportation (4 cases) has also been effective, including the development of regional transportation and the establishment of regional transportation networks. The introduction of electric bicycles (4 cases) has been well received by users, and people are able to travel smoothly. PR (6 cases) concerning these efforts has also been effective.

There were three PR projects that improved the recognition of this project throughout the region. According to survey participants, the development of guided bicycle tours, the suppression of the inflow of automobiles into the city (2 cases), and the conversion from automobiles to bicycle use (1 case) have been achieved.

③ The most common problems/issues are the improvement of expenses such as balance of income and expenditures and costs (8 cases). Regarding this, survey participants expressed the opinion that a review of the fee structure should be considered in consideration of the profitability of the business.

The next most common issue is securing more users and creating PR for that purpose (5 cases). The third issue is the relocation of bicycles (4 cases), which is based at each port. Since it is possible to return a bicycle to a port different from the one from which you rented, the number of bicycles at the ports will be uneven. The high labor costs necessary for the relocation of bicycles is still an

issue. In addition, there is a problem of selecting candidate locations for port installation (3 cases). It is necessary to take into consideration the assumption of possible harmful effects such as new construction, location conditions that are more effective in improving the utilization rate, and an increase in the number of illegally parked bicycles. The problem of manners when users use bicycles and the risk of accidents (3 cases) were also issues. Problems with maintenance of management systems and equipment (2 cases), simplification of membership registration (1 case), improvement of the environment for inbound tourists (1 case), and low use by citizens (1 case) were also mentioned.

④ Relationship between population size, number of bicycles, and number of ports

See the correlation between the population size of each municipality, the number of bicycles installed, and the number of ports in the bike-share example.

It is expected that the bicycle-sharing system of a city with a large population will have a large number of bicycles and ports. Figures 1 and 2 are correlation diagrams of population size, the number of bicycles installed, and the number of ports; they were created from the data in Table 1. Regarding population size and the number of ports, the larger the population, the larger the number of ports and the correlation. On the other hand, regarding the relationship between population size and the number of bicycles, there are some data with large outliers, and there is little correlation in the overall value. The data with particularly large outliers is that of "Shimanami Rental Cycle (Imabari City / Onomichi City)." Unlike other local governments, Shimanami Rental Cycle emphasizes external effects such as wide-area sightseeing tours. As a result of arranging bicycles for tourists, the proportion of the local population is higher than in other cases, i.e., the number of bicycles was large. However, Imabari and Onomichi on the Shimanami route; Takamatsu, a city that frequently uses bicycles; and Koto Ward, which is located in Megalopolis in the metropolitan area, are considered to be special, and there is a correlation in cities other than these.

Table 1. Contents of advanced cases of bicycle-sharing systems in each local government in Japan

| Municipality   | Okayama City  | Miyazaki City   | Koto-ku, Tokyo  | Takamatsu City   | Imabari City   | Onomichi City  | Fujieda City   | Fukuoka City   |
|--|---|---|---|--|--|--|--|--|
| Name   | Momochari   | Miyako PiPPA  | Koto Ward Seaside Community Cycle   | Takamatsu City Bicycle Rental  | Shimanami Rental Cycle   |  | Fujieda Trip (bike share in the city)  | Melchary (currently in the demonstration experiment stage)   |
| Start date   | 7/27/2013   | Jul-17  | Nov-12  | May-01   | Apr-99   | May-99   | Mar-18   | Mar-15   |
| Number of bicycles   | 332 units (as of H27)   | 200 units   | 1,207 units (as of R1.8.30)   | 1,250 units (as of R1)   | 1,800 units  | 1,025 (Onomichi City side as of August 2019)   | 45 units (with electric assist)  | About 1,000  |
| Number of ports  | 35 locations (1 of which is closed as of R1.8)  | 42 places   | 117 locations (as of R1.8.30)   | 7 places   | 13 locations (9 locations in Imabari City)   | 13 locations (5 locations on the Onomichi side)  | 16 places  | More than 180 locations (as of H30)  |
| Registration number  | 91,714 people (as of H30 degrees)   | 2,700 (as of H31.6.30)  | 128,804 people (as of December 31, H30)   | ---  | ---  | ---  | ---  | ---  |
| User registration [A: port, B: smartphone app, C: web, D: window]  | A   | B   | C   | D  | D  |  | B  | B  |
| Payment method [A: cash, B: credit card, C: mobile phone payment, D: IC card, E: electronic money, F: other] | A, B, D, F  | B, C, D, E, F   | A, B, C, D,   | A, D   | A  |  | B, C   | B, F   |
| Operational trends   | [Number of uses] Average 1,453 times a day, total number of uses 530,324 times, turnover rate 3.85 times / day / unit (H29 degrees), H30 degrees cumulative number of uses about 1.63 million times | The breakdown of the occupancy rate of the port utilization rate is 62.1% for public land (17 locations), 37.7% for private land (25 locations), and 0.2% unknown.                                  | Bicycles may be parked excessively, and collection and relocation work to level the number of bicycles is increasing.   | Operated by bicycles with abandoned bicycles<br>Annual usage: Approximately 310,000  | Approximately 150,000 annual users   | [Number of loans (fiscal year)]<br>H25: 81,851<br>H26: 116,303<br>H27: 135,229<br>H28: 141,205<br>H29: 149,740<br>H30: 132,075   | Reiwa first year budget amount: 10,000,000 yen<br>* 2017 budget amount: 2,000,000 yen, 2018 budget amount: 4,500,000 yen   | Mercari dismantled its consolidated subsidiary Sozo in June 2019 and started a new company "neuet" in August. Operated in the form of a joint system between "Co., Ltd." and "Clara Online Co., Ltd."  |
| Port with many users   | ---   | High utilization rate of ports on public land under demonstration experiment  | Mostly used for commuting on weekday mornings and evenings. In particular, there are many uses of ports near tower apartments and stations.   | JR Takamatsu station square underground port and Kotoden Kawaramachi station underground port  | ---  | ---  | ---  | ---  |
| Pros   | · Change of traffic behavior, revitalization of town<br>· Reduction of environmental load   | Environmentally friendly and eco-friendly, contributing to health promotion   | Reduction of CO <sub>2</sub> by reducing the movement of automobiles, improvement of attractiveness of the introduction area, improvement of convenience of movement, creation of liveliness by improvement of mobility in the area, etc. | Control the total amount of bicycles through mutual use and effectively utilize illegally parked bicycles  | Promotion of stay-type tourism, promotion of health, promotion of purpose of life and friendship, realization of a society with reduced environmental load, promotion of inbound tourism due to international popularity | You can enjoy the beauty of the islands of Setouchi, interact with the locals, and enjoy gourmet food at your own pace.  | ① Cheaper than a bus and convenient with no waiting time. You can easily climb a slope with an electric bicycle. ② There is a station at Fujieda station. Available 24 hours a day. ③ There is no problem even if you use it frequently. It's cheaper than parking in the parking lot. | · Use unused space as a port (individual application required)<br>· Can travel short distances faster than using public transportation   |
| Problems/issues  | · Simplification of membership registration method<br>· Dissemination of first-time users<br>· PR for increasing users for sightseeing purposes<br>· Elimination of bicycle bias at each port       | There is concern that the risk of accidents due to crossing with automobiles and pedestrians is increasing due to the lack of following traffic rules such as driving on the left side of the road. | · Improved income and expenditure by streamlining the collection and relocation of expensive bicycles<br>· Optimization of the number of bicycles at the cycle port   | · Improvement of balance of income and expenditure<br>· Update of management system due to deterioration over time   | Inbound environment maintenance (Wi-Fi environment, communication means, cashless payment)   | As the number of cyclists increased, we began to hear complaints about driving manners   | · Implementation of effective PR to increase the number of users<br>· Selection of station installation locations that are expected to be used<br>· Reduction of running costs   | · There is a possibility that the correct position of the bicycle will not be displayed on the app due to GPS accuracy<br>· There are users with bad manners such as personalization<br>· Because there is no reservation system, other people will use the bicycle first (possibility of not being able to ride when you want to) |
| Direction  | ---   | ---   | Examining and implementing problems and solutions to problems in demonstration experiments, and shifting to full-scale implementation   | With the entry of private businesses, we will consider the future of the rental cycle business while considering a certain division of living according to each role and in cooperation with private businesses. | Expanding the base of cyclists by attracting non-cyclists such as the elderly and women  | We will continue to disseminate information on the appeal of Shimanami Kaido Cycling both domestically and internationally, and strive to improve the driving environment and manners. | While taking in the opinions of users through effective PR and surveys, we will improve the utilization rate and ease of migration. Since it is an initiative that utilizes IoT, we will consider how to utilize usage data.   | Business succession was passed to "neuet Co., Ltd." and the Mercari business as a new system started in collaboration with "Clara Online". "The purpose of the new system is to focus on Mercari and Mercari. Results of business selection and further business expansion"  |

Table 1. (Continued)

| Municipality   | Kagoshima City  | Kitakyushu   | Oita City  | Hiroshima City  | Fukui City  | Toyama City  | Himeji City  | Kanazawa  |
|--|---|--|--|---|---|--|--|---|
| Name   | Kagoshima City Community Cycle "Kagorin"  | Kitakyushu City Bike   | Oita Cycle Share   | Hiroshima City Peasakuru  | Fukui City  | Toyama City Avile  | Himeji City Himeji   | Kanazawa City Machinori   |
| Start date   | Mar-15  | Mar-10   | Oct-18   | Feb-15  | 2013  | Mar-10   | Jul-16   | Mar-12  |
| Number of bicycles   | 192 units   | 246 units  | 300 units  | About 500   | 44 units  | 255 units  | 150 units  | 155 units   |
| Number of ports  | 25 locations (as of R1 / 7)   | 21 places  | 35 places  | 62 locations  | [Number of ports] 16 locations (as of R1 / 7)   | [Number of ports] 23 locations (as of R1 / 9)  | [Number of ports] 20 locations (as of R1 / 7)  | [Number of ports] 21 locations  |
| Registration number  | ---   | 535 general members<br>Shear type (corporate) 45 (as of R1 / 5)  | Approximately 1,000 people (as of R1 / 7)  | ---   | ---   | ---  | 180 units (as of R1 / 7)   | 296,616 people (H24 / 3 / 21-H31 / 3 / 31)  |
| User registration [A: port, B: smartphone app, C: web, D: window]  | A, D  | C, D   | B, C   | C, D  | D   | D  | A, C   | A, D  |
| Payment method [A: cash, B: credit card, C: mobile phone payment, D: IC card, E: electronic money, F: other] | A, B, E   | A, B, C  | B, F   | A, B, C, D  | A   | A, B, F  | A, B   | A, B  |
| Operational trends   | The number of uses increases year by year (the total number of uses until the end of July of the first year of Reiwa is about 670,000)                            | Number of users: 147 units / day (2018)  | The monthly membership free campaign was held from February 12, 2019 to June 30, 2019, and the usage increased significantly.  | Consignment contract amount 2014 ... 20,000,000 yen 2015 ... 18,000,000 yen 2016 ... 14,000,000 yen 2017 ... 0 yen 2018 ... 4,300,000 yen   | The number of uses is increasing year by year, and the demand is increasing, especially in. We are able to operate the business on a low budget while coordinating with the private sector. | ---  | The share cycle has become established as a secondary means of transportation, and the number of users and the number of times of use are increasing year by year.   | Number of uses 178,619 times, number of users 63,284 (2018)   |
| Port with many users   | ---   | ---  | ---  | ---   | Port around Fukui Station   | Three stations at the south exit of Toyama Station, Nishicho Station (located in front of Toyama City Hall), and in the city center                                      | Ports around Himeji Station, often used for commuting and sightseeing  | Most often used at Kanazawa Station, the starting point, and ports around major tourist destinations  |
| Pros   | Reducing environmental impact, improving mobility and convenience, responding to a wide range of tourism needs (attractiveness of town tours unique to bicycles)  | By shifting to the use of bicycles, it is possible to reduce the environmental load by means such as reduction of carbon dioxide emissions, electronic assistance, and "drop offs" between stations. | · You can drop off<br>· You don't have to wait like for a bus<br>· You can use it 24 hours a day<br>· Contribute to the establishment of a regional transportation network by combining with the public transportation network | Because it is a city of deltas, you can smoothly tour the city with many undulating bridges by electric bicycle   | All of them are equipped with electric power assist, and rentals are accepted face-to-face, so we can provide tourists information as well as rental services.                              | Cyclocity Co., Ltd., the operator, is operating smoothly and safely by making the best use of the know-how cultivated so far.  | It can be used with cash, and it can be used immediately without the need for pre-registration or other operations.  | · If you have a credit card, you can easily register on the spot<br>· There are many narrow streets in the city of Kanazawa, and the main tourist spots are concentrated in a narrow area, so it is suitable as a means of transportation for tourists  |
| Problems/issues  | Continue to strive for public relations and maintenance of equipment, etc.  | · Ensuring business profitability<br>· A large ratio of labor costs to correct the bias of bicycles between stations   | · It costs a lot of "relocation" to correct the bias of bicycle placement<br>· It takes a certain period of time to increase the number of users   | As a candidate for port installation, it is a highly convenient place, but there are times when it is necessary to abandon the installation due to concerns about problems caused by installing the port, such as the number of illegally parked bicycles increasing  | Business management that is conscious of the difficulty of establishing a new lending port and profitability  | Stable securing of financial resources such as operation and maintenance costs for properly conducting the bicycle-sharing business                                      | · Efforts to increase the number of users<br>· Naming rights and other advertising revenues need to be expanded, fee structure reviewed and costs reduced  | · Low citizen use (about 90% of the total is for tourism)<br>· Increase in repair costs over time   |
| Direction  | By communicating the significance of riding a bicycle in an easy-to-understand and polite manner, we will further increase interest and understanding of bicycles | Aiming to continue business while selecting stations that better meet needs  | We would like to set up a service area so that the relocation work will not be excessive, balance the income and expenditures, and verify that it will be established as a sustainable new transportation system.              | High density of cycle ports so that domestic and foreign tourists and other visitors can comfortably visit tourist facilities in the city area and citizens can conveniently use the ports as a means of daily use that complements public transportation. Promote tourism and regional revitalization using bicycles | We increased the operating rate of bicycles by driving up demand, and based on that situation, we considered establishing new rental ports and increasing the number of turntables.         | The expansion of stations and services has just been implemented by the operator in consideration of profitability, etc., and there are no plans to expand at this time. | While considering the number of bicycles and the arrangement of stations that meet the needs, we will proceed with the introduction of an "in-vehicle share cycle" that can reduce operating costs compared to the current system as a "next generation Hime-chari." | A new system started from March 2 <sup>nd</sup> year of Reiwa. Basic direction: (1) Encourage citizens to use (currently, users are mainly tourists); (2) Respond to new tourism demand based on the central city area; (3) Maintain public-private management and other electric assists in order to comply with the policy of town development<br>Equipped with functions and GPS functions |

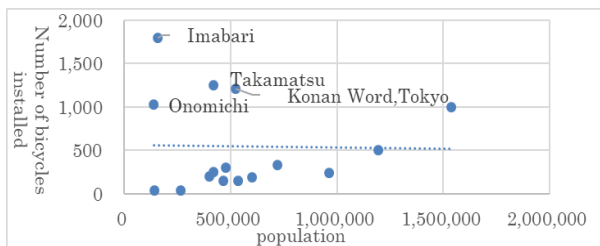


Figure1. Relationship between population size and number of bicycles

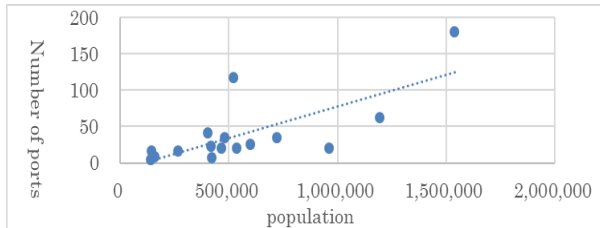


Figure2. Correlation diagram between population size and number of port

### 3. Conclusion

According to a nationwide survey, the number of cycle ports and the number of users are correlated in the bicycle-sharing businesses located in urban areas, and the cycle ports located at railway stations representing the cities have the highest utilization rates. Cycle ports with heavy traffic at transportation hubs have many users, complementing public transportation; shortening travel times for sightseeing, commuting to school, business, etc.; and increasing mobility. However, it is difficult to make a profit in the bicycle-sharing business, so most of these businesses are subsidized by the local government. Large-scale bicycle-sharing businesses with a relatively large number of cycle ports and bicycles have a higher turnover rate and are more likely to improve profitability than small bicycle-sharing businesses.

Therefore, for the sustainable development of bicycle-sharing businesses in the future, it is important to secure the number of bike-share ports and the number of bicycles in a convenient position commensurate with the size of the population and to devise ways to improve profitability, for example, in Toyama City. As you can see, new ideas and implementations are needed, such as attaching electronic public notices to cycle ports to earn sponsorship income.

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