

Porocle: Bicycle Sharing Service

Creating a Sustainable Human Environment

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Abstract: Porocle is a bicycle sharing service provided in the central district of Sapporo City. The service began in 2010 with the vision of “creating a sustainable human environment.” It solves urban problems by directing efforts toward local revitalization through improved urban mobility, realization of a low carbon society, beautification of the cityscape owing to the decline in the number of abandoned bicycles in the central district, and promotion of urban safety under the rules observed by bicycle users. In this study, we introduce the design concepts of the Porocle service, which we are currently providing in the central district of Sapporo in collaboration with various entities; the devices and system adopted to support the service on the basis of the design concepts; the approach we are adopting to create a new community; and our achievements so far. In addition, we discuss the prospects of Porocle for the creation of a sustainable urban mobility and human environment.

Keywords: *bicycle sharing, designing process, local community, local revitalization, low carbon society*

1. Introduction

Porocle, named after “sapPORO + cyCLE,” is a bicycle sharing service (hereafter, CS) provided in the central district of Sapporo on a full-fledged scale since 2011 as a new one-way drop-off public transport system. The city of Sapporo extends across flat terrain where travelling by bicycle is comfortable during cool summer months but in the winter, the weather is extremely severe with an average annual snowfall of more than six meters, unusual for a city with a population of one million or more. Despite such climate severity, the city has undergone remarkable development as a prefectural capital of Hokkaido and the population has almost doubled to 1.93 million over the 40 years since the 1972 Sapporo Winter Olympics.

Even though Sapporo has remarkably progressed, the city is facing various urban issues. The rapid population growth accelerated the development of suburban residential areas, causing inbound traffic congestion and increasing CO₂ emissions. Urban sprawl and the long-term economic slow-down have reduced prosperity in the downtown area. As people become more health- and environment-oriented, they tend to ride a

bicycle more often. As a result, a growing number of bicycles have come to be parked carelessly on the street and some people ride bicycles without following safety rules, consequently ruining the urban scenery and threatening the safety of pedestrian spaces.

In this study, we introduce the circumstances behind the Porocle project in stages from proposal to implementation, and explain the overall design concepts for Porocle to be accepted by local citizens as a sustainable community-oriented transportation service. Then, we will clarify the devices and mechanisms we have worked on to operate the Porocle service in accordance with the design concepts, and define the system that is expected to promote public interest while creating a new community in collaboration with citizens and various local entities. The results of a two-year survey on the Porocle project are analyzed in terms of the public good and the past achievements it has produced. Finally, we discuss future directions and next steps for Porocle to take to contribute to the goal of creating a sustainable human environment.

2. The objective and history of Porocle

The objective of the Porocle project in the short run is to directly address various urban problems in Sapporo by offering a CS service and improving the city's mobility environment. In the long run, we hope to organize a major social movement to solve urban problems by allowing Porocle users to be aware of such problems and adopt a higher quality lifestyle. Taking these objectives into consideration, we have worked with experts to examine the possibility of CS implementation and started a full operation of the Porocle project since 2008. Currently, Porocle provides about 270 bicycles at 45 cycle ports (bicycle stations) within a range of 3 km north–south and 5 km east–west in the central district of Sapporo City.

Judging from the United States Department of Transportation (USDOT) (2012) and Midgley (2009) reports, the Porocle service is a middle scale operation in comparison to other western counterparts [1, 2]. According to DeMaio (2009), the world's major CS operators can be classified into the following groups: government, transport agencies, universities, non-profits, advertising companies, and for profits [3]. In this context, Porocle is considered a private, for profit business. Shaheen et al. (2010) observe that the advanced CS service is responsive to user demands and that the service is a multi-modal based on its IT [4]. These are also goals for Porocle.

Table 1 shows milestone events for Porocle. In our attempt to solve mobility-related urban issues for the central district of Sapporo, we organized a discussion meeting “Hokkaido Mobility Café” in 2008 with the help of relevant experts and began to develop a Sapporo-style model for a CS service named “Porocle.” Systems for the shared use of bicycles have already been popularized overseas. One example is Vélib' in Paris, which is operated on earnings from the placement of advertisements in public spaces. However, this system was judged inappropriate for Sapporo, where outdoor advertising materials are regulated by city ordinance to promote cityscape improvements. For this reason, rather than following the practice of an existing model, we decided to implement our original CS service, which would fit Sapporo and function as a trigger for creating a sustainable city while solving important local problems.

Table 1. Porocle Milestones

2008	“Hokkaido Mobility Café” was held with the help of experts for the purpose of promoting a CS project. The feasibility of the Porocle service began to be examined.
2009	To provide an unattended CS service, a prototype cycle port with a personal authentication system using an IC card was developed and two types of operational tests (station-based and downtown-based) were carried out in which the service was provided at no charge. In a suburb-based test, a cycle port was installed at one suburban station. The potential for matching demands for transportation from home to station with those from station to neighboring facilities was surveyed. In a downtown-based test, cycle ports were installed in seven locations in the Sapporo downtown area and the potential for matching multiple demands for transportation to and from workplaces, schools, and stores was examined.
2010	In cooperation with NTT Docomo, the use of 100 bicycles was made available for a charge at 18 places in the Sapporo downtown area. The development of bicycles and cycle ports, effective services and management methods, and payment by credit card were examined.
2011	A new company was established to operate Porocle. A full-scale business was started in the central district of Sapporo. By the time of off-season closure in November, a total of 45,000 trips had been made by 3,100 members between 45 ports. The EST (Environmentally Sustainable Transport) Award was received for the contribution of the project to urban sustainability in terms of good connections with public transportation and effective prevention of on-street parking.
2012	The range of service was further extended and a travel planning service for tourists was added. By the time of off-season closure in November, a total of 137,000 trips had been made by 6,500 members between 45 ports. (Figure. 1 illustrates numerical data on Porocle and locations of cycle ports.) Two awards were given recognizing our efforts to reduce CO ₂ emissions and the excellence of total Porocle design to address urban problems: - The Sapporo Mayor’s Award at the Sapporo Environment Awards - An Honorable Mention at the Civil Engineering Design Awards
2013	The service for the 2013 season was restarted in April.

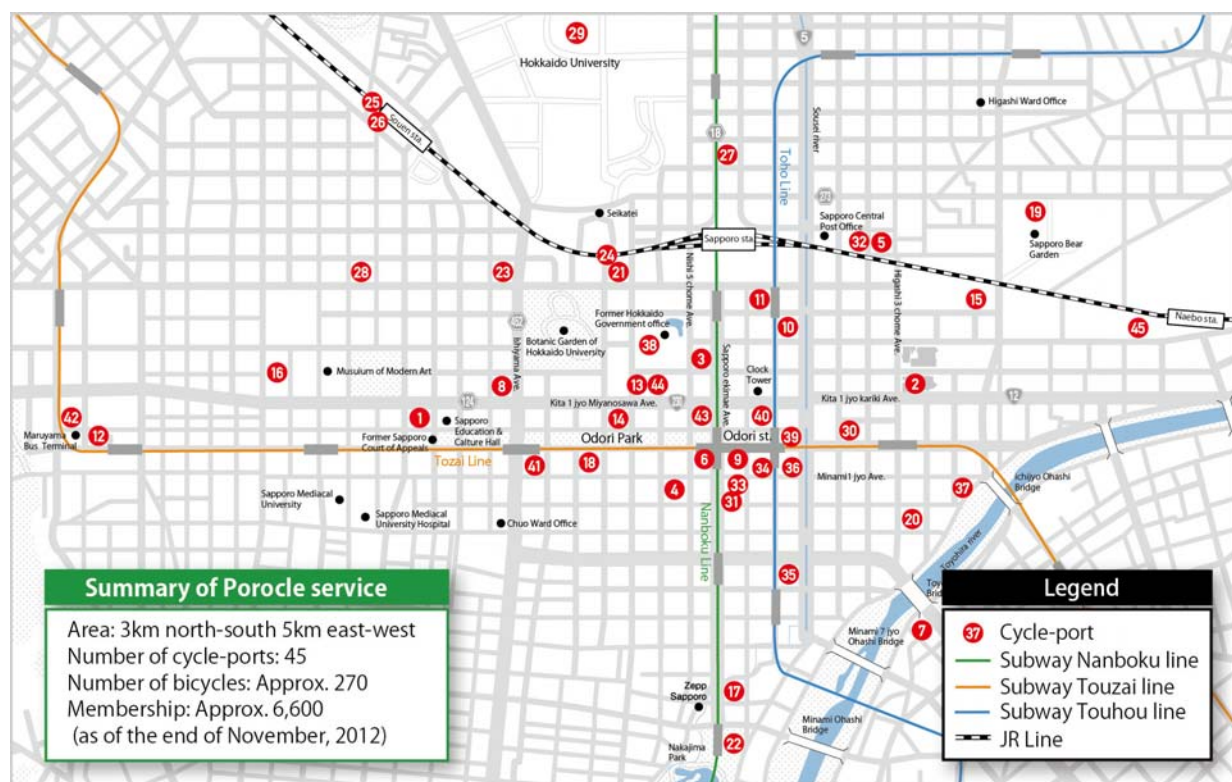


Figure. 1 Numerical data on Porocle and locations of cycle ports

With such objectives and the vision to create a sustainable human environment in mind, we decided to direct our efforts toward coordinating the next-generation of city planning by playing a different role from the typical civil engineering role of simply planning, designing, and building a structure. In this regard, Porocle has been hatched on the basis of knowledge and techniques that most civil engineers have acquired. Further, it was developed in collaboration with various entities who are sympathetically responding to the call for the betterment of society. It has been a privately initiated project since its inception. Shaheen et al. (2010) emphasize the importance of process development in the way users have included CS into their daily lives and restrained themselves from using cars recognizing the social and environmental impacts of CS as desirable measures complementary to public transportation [4]. From the 2008 inception and planning stages of the Porocle project, we have prioritized the facilitation of a smooth transition for people in the urban center by integrating Porocle with public transportation to promote less car-dependent city planning, creation of an invigorated downtown atmosphere, pedestrian safety, and improvement of the cityscape. For these reasons, we have pursued a design for Porocle to function as part of citizens' everyday lives in a sustainable city.

3. Design for Porocle

In this section, we discuss two kinds of designs, first, the physical devices of Porocle and second, the creation of a new community. Both are essential for Porocle to successfully provide its services as a community-oriented transportation system. To materialize our vision of a future sustainable human environment, we began developing Porocle on the basis of the following concepts:

- Improvement of the urban mobility environment
- Creation of a new local community
- Activation of the community as a driving force to solve social issues
- Extensive publicity for the Porocle vision

Here, we discuss the design development for the devices, which consist of cycle ports and bicycles as physical assets of the city and as a convenient means of transportation that can be assimilated into an individual's lifestyle. Additionally, the design for the system collaboratively addresses urban issues with various entities by sharing a common vision to create a sustainable local community among these entities.

3.1 Design of the devices to improve the urban and mobility environment

The devices including cycle ports and bicycles can be physical assets of the city and must be attractive and easy for anyone to use. Thus, their basic design concepts were determined from the following viewpoints and requirements [5, 6]. Porocle bicycles and cycle ports have been developed based on these basic design concepts. Bicycles can be checked in and out at the cycle port with an IC card (Figure. 2 and Figure. 3). The cycle port is activated at any place by photovoltaic power using solar panels and a digital telecommunications network (figure. 4). The port structure is self-supported with no anchor bolts to fix it to the ground for easy in-season installation and off-season removal. The basic color of the bicycles is white, which is associated with freshness and snowy Sapporo. Bicycle features include three-speed gearing, height-adjustable saddle, automatic lighting, and aluminum frames for long-term use (Figure. 5). Bicycles are made available to anyone.

Table 2. Viewpoints, requirements, and design concepts for the devices

Viewpoints	Requirements		Basic Design Concepts
Easy to use	Cycle port	-Simple check-out/ check-in procedures	Simplified check-in/check-out procedures with no help from the staff under the automatic personal authentication system using an IC card (Figure. 2 and Figure. 3)
	Bicycle	-Easy to get on and off a bicycle -Easy to change gears	-Development of the Porocle original bicycle which is easy for anyone to use - height-adjustable saddle (flexible saddle) - equipped with auto lighting and reflectors (Figure. 5)
Easy to manage	Cycle port	-Structured for easy installation (in-service) and removal (out of service)	Development of a self-supported cycle port which is not fixed to the ground by anchor bolts (Figure. 2)
		-Efficient bicycle inventory control	The port inventory to be managed under the remote control monitoring system (Figure. 4)
	Cycle port Bicycle	-Durable and weatherproof for outdoor use, with rare breakdown	Employment of rust-proof materials and durable paint
Easy to understand	Cycle port	-Identifiable as a Porocle service -Plain to see new concepts and merits of CS	Visually identifiable logos and concept colors in the design
		-Easy access to necessary information on a map and other materials	A map embedded in the design (Figure. 6)
		-Intuitively operable	Pictographs to be used for operating instructions (Figure. 3)
Harmonious with the surroundings	Cycle port	-Harmonious with the atmosphere of Sapporo, not ruining the surrounding scenery	Adoption of environmentally appropriate color for Sapporo (Figure. 2)
		-Appropriate to Sapporo, to be favorably accepted by the citizens	Adoption of white as a representative color for Sapporo (Figure. 5)
		-Easy to be installed within a limited urban space	Variable capacities for bicycle racks depending on the installation site (Figure. 2)
		-Environmentally-friendly facility, activated mainly by natural resources	Photovoltaic power generation employing solar panels (Figure. 6)
		-Practical as a public sign	Functioning as a signboard to indicate major urban facilities such as subway stations and parks

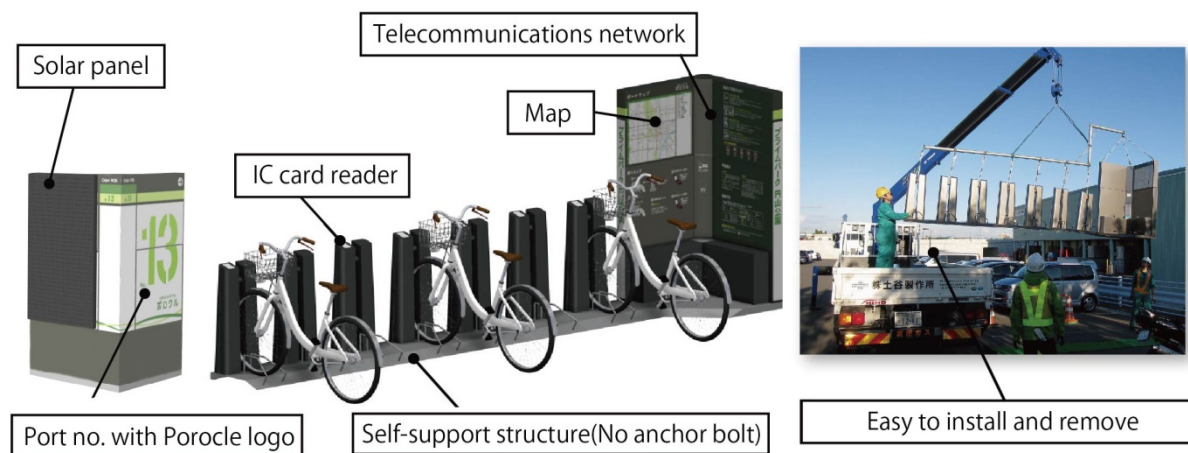


Figure.2 Design for Porocle cycle port



Figure.3 A user applying an IC card to a reader

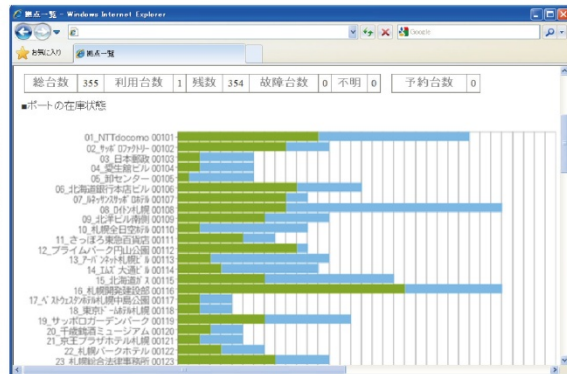


Figure.4 Remote-managed port inventory

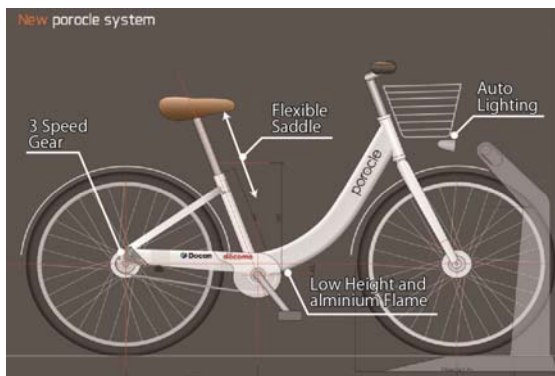


Figure.5 A bicycle in white suggestive of snowy



Figure.6 A cycle port equipped with solar panels, a sign board, and a map

3.2 Design for the system to create a new local community

We consider that various entities engaged in local activities would directly contribute to addressing local issues as more than merely service providers if they collaborate through association with the Porocle project. In order to facilitate their collaborative works, we attempted to organize a new community where various local entities participate and actively perform community-based activities. At the same time, we prepared a design for the system under which community members are able to solve problems that the Porocle project cannot deal with on its own, whereby it is managed with the help of its users and community members.

The Porocle project is efficiently managed so that staff members are able to promote socially meaningful activities and provide proper services. In response to users' needs, cycle ports are rearranged and bicycles are maintained for users to conveniently and safely use the service. The environmental NGO "ezorock," which is constituted mainly of young people around the age of 20, undertakes tasks in the Porocle operation. The young people are involved in various activities on a daily basis, closely and frequently exchanging communications with the Porocle staff and users. Wearing distinctive green shirts, Porocle staff is often observed lining up and inspecting bicycles and greeting users from place to place within the city.

They use a real-time information system embedded in mobile phones to obtain updated reports about the number of bicycles in use. Thus, in response to users' needs, they can redistribute, maintain, and inspect bicycles and cycle ports efficiently. Furthermore, the staff members are required to ride a bicycle when they

need to transfer themselves during business hours. While pedaling along the street, they put the highest priority on pedestrian safety, and simultaneously take the lead to set a good example for the public by observing bicycle rules (Figure. 7). In addition to the management of the Porocle project, the staff regularly organizes workshops for young people with the hope of stimulating a grassroots movement to challenge social problems and make a blueprint for youth-centered social activities to become a driving force for bringing about social change (Figure. 8).



Figure. 7 The Porocle staff riding within bicycle rules



Figure. 8 Workshop for young people

3.3 Designs for the system to provide opportunities for finding solutions

In the Porocle project, the system has been built to provide opportunities for finding solutions to local issues with the cooperation of members from diversified communities who share a sympathetic response to the call for the betterment of society. The Porocle staff, together with community members and experts host an event called the “Hokkaido Mobility Café” to reconsider daily movement and meet to study mobility design. Such a gathering has been held continuously from the planning stage until today. Community members and experts meet and come together to exchange knowledge and information that experts have acquired for the betterment of society in terms of urban landscape and mobility design.

One example is a cooperative activity conducted by a community development company as a project coordinator with local shopkeepers in the downtown district. In addition to road administrators and the police, they promote measures for prevention of abandoned bicycles and observance of bicycle rules. Together, they promote these measures so that they take a firm hold on society.



Figure. 9 A Porocle port installed on the street

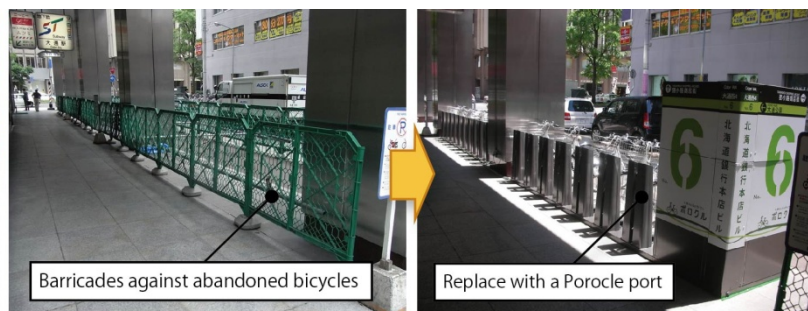


Figure. 10 Barricades replaced with a Porocle port

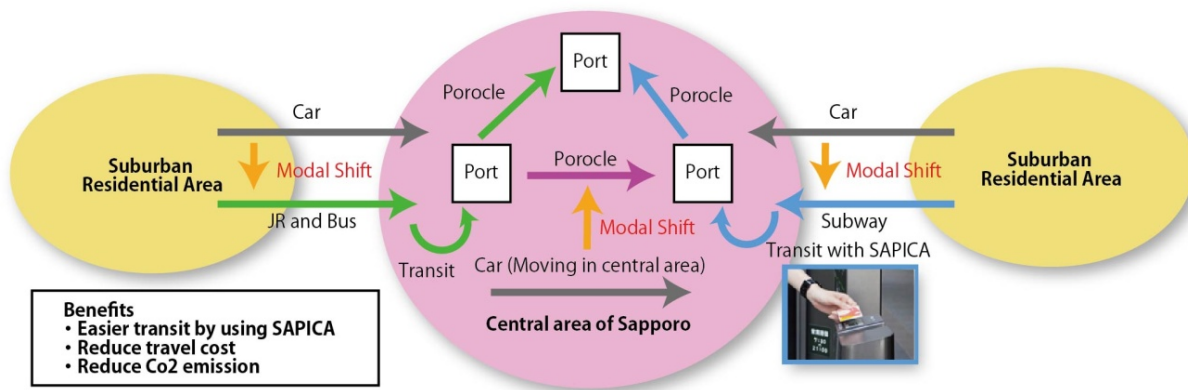


Figure. 11 Mobility management integrating Porocle with public transportation


In areas where a high number of bicycles remain parked carelessly on the street, we install a Porocle cycle port on private land and/or public roads with the approval of the community development company and/or a building management agent who has an interest in the plan for preventing abandoned bicycles (Figure. 9 and Figure. 10). With the help of shopkeepers in the target area, a campaign to recruit new Porocle members is organized to encourage bicycle commuters around the area to convert to being Porocle members and thereby reduce the number of personally-owned bicycles parked on the streets. In addition, communities and administrative organizations continually and frequently join in launching parades and public appeals for observance of bicycle rules to improve pedestrian and bicyclist safety. As for our objective of building a low carbon society while invigorating the downtown area, we have joined forces with the

Sapporo municipality to have a “SAPICA” IC card (a rechargeable contactless smart card for public transport in Sapporo) for the city subway that also works in the Porocle system. At the same time, we have designed a scheme of mobility management to encourage people to convert from driving their cars to becoming Porocle members. Such conversions directly affect issues of traffic congestion and global warming (Figure. 11).

3.4 Design for the system to broadly publicize Porocle’s vision of the future

Because the Porocle project has been introduced to the public quite recently, we are using a range of media to inform as many people as possible about Porocle itself, the objectives of the service, and the convenience of this transportation system. To help establish the Porocle brand, we have planned and developed a visually identifiable design which is expected to become commonly recognized. Also, information about Porocle, how to use the service and how it deals with social issues, is broadly publicized through the media. Thus, Porocle’s vision, namely to create a sustainable human environment, will become easily recognized and shared among citizens. To achieve this purpose, we are currently striving to establish the Porocle brand as useful and accessible. Tools of public relations for Porocle are listed in Table 3.

Table 3. Tools of public relations for Porocle

To establish the Porocle brand	<ul style="list-style-type: none"> - Designing intuitively identifiable signs and promotion items accompanied by friendly mascots and pictographs for cycle port panels, fliers, and websites. 	
	<ul style="list-style-type: none"> - Porocle song recorded on CD and uploaded on the website. - Activities to promote the city and tourism in cooperation with the Sapporo municipality. - Planning of a Porocle tour to visit tourist sites and cultural heritages in cooperation with local communities. 	
To broadly publicize Porocle information	<ul style="list-style-type: none"> - Social significance and interesting elements of Porocle publicized through mass media including TV, newspapers, and magazines - Periodic press releases - Frequent communication with media reporters - Giving advice on the observance of bicycle rules in TV programs - Participation in the Smart Move Campaign and the 3R Forum organized by the Ministry of the Environment - CSR-related advertisements displayed on the bicycle frames 	

4. Porocle achievements to date

In this analysis, we examine the achievements that Porocle has produced since the project started two years ago, the range of services provided, and user demands and local issues solved. We review data on membership and service utilization as well as results of a two-year monitoring survey where the number of users, measures for prevention of abandoned bicycles, observance of bicycle rules, activities to invigorate communities, and realization of a low carbon society are indexed. Also, the impact of CS is evaluated through the examination of changes in public attitudes and awareness.

4.1 The range of services provided, membership, and the number of trips

Equipped with the devices and the system which has been designed to provide good quality services, Porocle currently has its cycle ports installed at 45 locations within the city. The service is used by a membership of 6,600 people. In fiscal 2012, the maximum number of daily trips was 1,100. The total number of trips was 137,000. The service has been gradually received by Sapporo citizens and the number of users is continuously increasing, which suggests the positive development of public interest. Table 4 shows statistics on Porocle.

Table 4. Statistics on Porocle

Number of cycle ports	45
Number of bicycles	270
Number of corporate members (with IC cards)	Approx. 600
Number of individual members (with IC cards)	Approx. 6,000
Total number of trips	Approx. 137,000
Maximum number of daily trips	Approx. 1,100 (4.6 trips/bicycle)

As of the last day of the 2012 business season

4.2 Solutions to urban issues

Table 5 summarizes questionnaire survey results concerning the social impacts of Porocle. Awareness and attitudes of Porocle users toward carelessly parked/abandoned bicycles and also toward observance of bicycle rules have apparently changed owing to a variety of Porocle related activities. Regarding local revitalization and creation of a low-carbon society, both objectives seem to be occurring side by side as people find more chances to go to the downtown area and the utilization rate of public transportation increases. Covered very often by mass media because of its social significance, Porocle has gradually taken root in the everyday life of many Sapporo citizens.

Table 5. Social impacts of Porocle

Changes in awareness and attitude of Porocle users toward on-street parking	Refraining from on-street parking*	56%
	Decline in the number of trips on personal bicycles*	36%
	Giving up ownership of a bicycle*	12%
Percentage of cyclists not riding along a sidewalk	Cyclists other than Porocle users **	11%
	Porocle users*	34%
Local revitalization	Going downtown more frequently (citizens)*	42%
	Touring around downtown (tourists) *	94%
Realization of a low-carbon society	More frequent use of public transportation*	30%
	Less frequent use of vehicles*	37%
	Reduction in CO ₂ emissions*	17tons/year

*Results of the 2012 questionnaire survey to Porocle users

** Results of the 2010 questionnaire survey to bicycle users in general

Table 6. Publicity in the mass media

Types of media	Number of appearances
TV/radio	19
Newspaper	14
Magazines/free magazines etc.	30

As of the last day of the 2012 business season

5. Evaluation of past achievements and future vision

Ever since the Porocle service was introduced to the public, awareness and attitudes among Porocle users toward tackling various urban issues for the central district of Sapporo seem to have changed for the better. For these outcomes to become more socially obvious, the above mentioned approaches need to be continued and expanded.

Future prospects can be expected to materialize as promising young people in Sapporo win the confidence of the general public by transforming society through their own efforts. Because urban activities are always diverse, the designs for various devices and systems of Porocle need to be continuously reviewed and improved in cooperation with various entities, and the operations managed by making use of data and results of user surveys. We believe that Porocle will continue to grow as a business supported by increasing numbers of users while it continues to pursue its vision to create a more sustainable human environment. We will spare no effort to accomplish this objective.

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