ANALYSIS OF BICYCLE SHARING ECONOMY: POLICY AND MANAGERIAL IMPLICATIONS

By

KIM, Hwajin

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF DEVELOPMENT POLICY

2017

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Approval as of December, 2017

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Abstract

ANALYSIS OF BICYCLE SHARING ECONOMY:
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By
Hwajin Kim

Countries are in transition to a low-carbon and climate-resilient economy to achieve sustainable development. One of the important ways into the sustainable growth path is carbon reduction, which is especially true in Korea with high proportion of road vehicle. Therefore, this paper investigates bicycle sharing economy as an emerging and alternative mode of transportation service and provides potential managerial and policy implications. Since bicycle sharing economy is still at an early stage of introduction as a transportation mode, the government is promoting public bicycle sharing to encourage bike riding as a substitute for private car. This study analyzed the current status of bicycle sharing programs through survey which was distributed randomly to users and non-users across the country. Using factor analysis, the overall attitudes such as satisfaction and loyalty for the existing users, and intention to use and expected satisfaction for the potential users were examined in relation with utility factors. The findings of the study could be applicable to the future direction of sharing economy as a means to follow sustainable development of society.

Key words: Sharing Economy, Bicycle Sharing, Utility, Satisfaction, Transportation Policy

I. Introduction

Consumption was long believed to be a necessary prerequisite to fulfill basic human needs and even improve quality of life. The industrialization and automation that were brought about by Industrial Revolutions stimulated competition for a greater productivity and enabled mass production. As it resulted in reduced prices for a product, thus, more consumption was followed. Taking into account the swelling global population, the level of production and consumption may continue to rise going forward. However, over time, traditional consumption and production patterns were revealed to carry huge environmental burden, whose future impact can be considered as disastrous. Some calls for a transformation into a "less-material intensive" way of living, such as "collective use of resources" (Mont, 2004). This way, individuals are sharing materials to satisfy their needs, but without compromising the same function, value or service delivered. Lamberton and Rose (2012) also noted that consumer responses to sharing were found to be positive when costs of sharing are reduced and benefits from sharing are increasing.

As a matter of fact, sharing economy has witnessed its scale and size growing over the past years, with its value estimated at over US$100 billion (Harald, 2013; Sacks, 2011). It is a trend observed that more are shared than owned. In the sharing economy, product becomes a mere mode with which its function is provided, so consumers are purchasing mobility instead of automobiles. (Mont, 2002). Such behavior of sharing rather than owning things is seen across the industry. For example, Zipcar and Uber in the automobile industry, Airbnb in the hotel industry, to name just a few. A study conducted by Lamberton and Rose (2012) also found that bicycle-sharing has spread worldwide, which accounts for around 2.2 million bike-sharing trips per month. According to some authors, the sharing economy can

also be considered as one of the pathways to sustainable development with its perceived positive benefits in the society and the environment (Böcker & Meelen, 2017). Consequently, a growing body of literature pays attention to the nature and impacts of sharing economy (Martin, 2015).

In particular, Böcker and Meelen (2017) observed that those who participate in the sharing economy have environmental concerns and are conscious of the scarcity of natural resources. Out of concerns about climate change, energy, and fuel prices, governments around the world have examined the need for cleaner and sustainable transportation strategies (Shaheen, Guzman & Zhang, 2010). The same awareness has been rising recently centering local governments in Korea. As a matter of fact, the OECD ranks South Korea in the 1st place on the list of cities with worst air quality (Harris & Kang, 2017). One of the culprits attributable to the toxic air in South Korea is the nanoparticle known as PM 2.5, mostly emitted from old diesel vehicles. With a view to contribute to addressing vehicle emissions and air pollutants, a few local municipalities such as the Seoul Metropolitan City, Sejong Special Self-Governing City and Jeju Special Self-governing Province are introducing more environmentally-friendly modes of transportation including electric vehicle and public bicycle. In addition, the emergence of the theme of bike sharing can be noted in line with sustainability and sustainable transportation, which would mean CO2 reduction, air quality improvement, the use of alternative fuels, and so on (Banister, Pucher, Lee-Gosselin, & Lee, 2007; Fishman, 2016).

Therefore, this paper aims to look at public bike-sharing program in South Korea through the lens of sharing economy. A number of public bike-sharing programs are operating in South Korea: Ttareungyi in Seoul-si, Fifteen in Goyang-si, Pedalro in Ahnsan-si, Euling

in Sejong-si, Tashu in Daejeon-si, Nubija in Changwon-si, and U-bike in Yeosu-si (Jeong, 2017). Bikesharing itself can serve as an alternative transportation mode, and if integrated into the daily transportation system, it can offer a mobility strategy to tackle the current environmental concerns.

With this in mind, and given that both the sharing economy and bike-sharing are relatively young agenda to be studied in connection with each other, this paper aims to provide answers to four research questions by applying utility and satisfaction theories. Based on the assumption that the attitude of users such as satisfaction and loyalty is related to the actual use of bikesharing program, the paper attempts to address, first of all, how mobility, storage, technology, economic, trust and sustainable utility affects the satisfaction of users on bike-sharing with the following question:

RQ1. How do the utility factors including mobility, storage, technology, economic, trust, and sustainable affect satisfaction of users on bike-sharing?

Since there are individuals who have never tried to use bicycle sharing program, the paper also examines how the same utility factors affect the intention of potential users to use the program with the following research question:

RQ2. How do the utility factors including mobility, storage, technology, economic, trust, and sustainable affect the intention of potential users to use bike-sharing?

The paper will try to answer the third and fourth questions, with an assumption that the satisfaction level of the users is related to the loyalty of using the program, together with an assumption that the intention of potential users to use bicycle sharing program is related to the level of expected satisfaction, by answering the following question:

RQ3. How does satisfaction of users on bike-sharing affect loyalty?

RQ4. How does the intention of potential users to use bike-sharing affect the level of expected satisfaction?

In the following sections, literatures on sharing economy and its definition, evolution, and bike-sharing models of different countries including South Korea are examined in the section II. Section III provides theoretical background to support the hypotheses which is further developed in the following section IV. Section V introduces how this paper analyzes the data with which methodology, and Section VI presents data analysis. The paper end with the conclusion in Section VII.

II. Literature Review

2.1 Definition of Sharing Economy

Researchers still debate on the definition of sharing economy. Some take an economic approach to define sharing economy, pointing the economic benefits such as reduced costs. In addition, financial crisis of 2008 triggered people to give a second thought on their consumption behavior and the concept of ownership (Böcker & Meelen, 2017). In their study, the authors also find other researches in sharing economy that users of car and accommodation sharing are motivated to participate in sharing because the cost-saving utility increased their satisfaction.

Different perspectives exist towards sharing in terms of social or environmental concept. An example of social aspects of sharing is interactions between users and service providers (Böcker & Meelen, 2017). Interactions such as getting to know new people and socializing are claimed to serve as a key driver to people who participate in sharing economy

(Botsman & Rogers, 2011). For those who take an environmental approach, sharing can be a way to address problems arisen from energy- and resource-intensive consumption. Examples are material sharing, and renting or leasing rooms with a view to increase the intensity of product use (Mont, 2004).

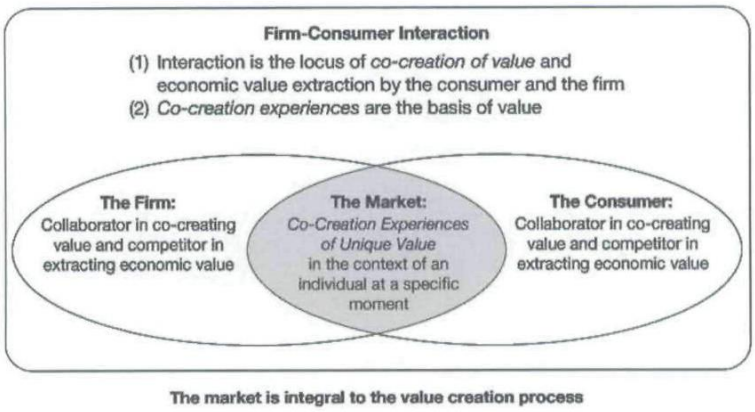
Over time, the definition of sharing economy evolved from indicating a blurred relationship between consumer and producer to implying a lack of consumer ownership of a product. With the technical and technological innovation, sharing became more available and accessible to a wider population. As the term 'sharing economy' can refer to a number of different ways in which it has been used in practice (Martin, 2015), it is worth listing in a chronical order the various usage of the sharing economy in this paper (Table 1).

Names	Author(s) & Year	Definition
"Prosumption"	Toffler, 1980 Ritzer & Jurgenson, 2010	The reintegration of production and consumption that rejects the binary distinction between the two, with the emergence of Web 2.0, turning consumers into prosumers
"Consumer participation"	Fitzsimmons, 1985	Consumer involvement in the service process can enhance productivity (e.g. fast food restaurant, manufacturing sector with technological innovation)
"Product-service systems"	Mont, 2002	Providing utility to consumers through the use of services rather than products by "dematerializing" in production and consumption in an environmentally-friendly way, which are often connected with ownership structure change
"Online volunteering"	Postigo, 2003	Post-industrial concept of collaborative efforts by consumers to reduce costs and maximize benefits
"Value co-creation"	Prahalad & Ramaswamy, 2004	Consumer interaction with companies, co-creating value and personalized experience that suit their needs (Figure 1)
"Co-creation"	Lanier & Schau, 2007	Value shift from being embedded in products to one co-created by both producer and consumer
"Co-production"	Humphreys & Grayson, 2008	Consumer collaboration with producers or other consumers in the value chain to create "exchange value" for companies as opposed to "use value"

"The mesh"	Gansky, 2010	An information-based and network-enabled sharing service that allows people to be connected to others, businesses and things
"Collaborative consumption"	Bostman & Rogers, 2010	"Sharing, swapping, trading or renting products and services" that give users access over ownership, so collaborating for consumption and production at the same time
"Commercial sharing systems"	Lamberton & Rose, 2012	Consumers enjoying the benefits of a product without owning it, where consumers compete each other for a limited supply of the shared-product
Sharing "Idle capacity"	Meelen & Frenken, 2015	"Consumers granting each other temporary access to their under-utilized physical assets, possibly for money"

Table 1. Summary of Terms and Definitions of Sharing Economy

(Belk, 2013; Bocker & Meelen, 2016; Ritzer & Jurgenson, 2010)



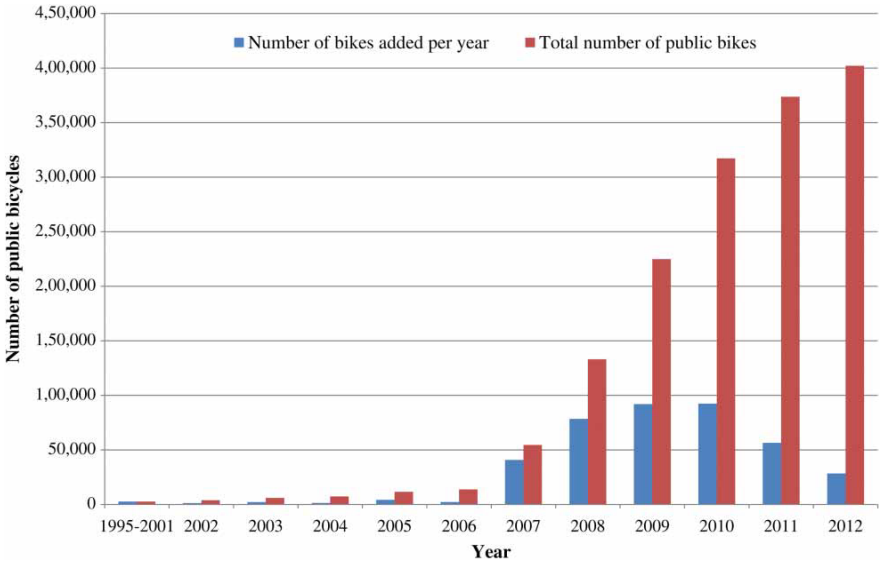
Source: Prahalad & Ramaswamy, 2004

Figure 1. Sharing Economy from the Perspective of Co-Creating Value

2.2 Generational Evolutions of Bike Sharing

It is a relatively new idea to share bicycle which made a sharp increase just from a decade ago (Bachand-Marleau, Lee, & El-Geneidy, 2012; Fishman, Washington & Haworth, 2013) (Figure 2). It was only less than 50 years ago in 1965 when the Netherlands became the pioneer to launch the first generation of bike sharing, so-called "White Bicycle Program (or "Free Bikes")" (Karki & Tao, 2016). The bicycles were located at random stations around

the city, where people can use them free of charge. However, it did not survive long due to problems associated with theft and vandalism (Fishman et al., 2014).



Source: R. Meddin (2012); Fishman, Washington & Haworth (2013)

Figure 2. Global growth in bike share programs

The second-generation bike-sharing program (or "Coin-Deposit Systems") was designed to address the shortcomings of the previous program. Thus it came with an enhanced security and a paid-docking station, with Copenhagen's Bycyklen being a famous example (Jang, Gim & Lee, 2016). Still, the deposit to use the bicycle was too low, some of the bicycles were never returned (Parkes, Marsden, Shaheen & Cohen, 2013). Then, in 1998, France first introduced the third-generation bikeshare program (or "IT-Based Systmes"), which was made possible by the use of technology. Although it still has existing features like docking stations, but it enabled greater control over the bicycles. What sets the third generation apart from the previous two generations is a more sophisticated security, varied bicycle design, and the associated use of websites and apps for making real-time information available to the users (Shaheen, 2012). Since the users have to subscribe to a membership to use bicycles, they were

subject to identification checks by credit card number, and this was effective in reducing vandalism (Bachand-Marleau, Lee, & El-Geneidy, 2012). The latest fourth-generation of bicycle sharing program, called "demand-responsive multimodal system", builds upon the third, with innovative features like mobile and solar-powered docking stations, and so on (De Maio, P, 2009; Shaheen, Guzman & Zhang, 2010). However, the basic principle underpinning the bikesharing system that stood tall throughout the generational evolutions remains undifferentiated: people use bicycles as they needed, free of charge and without responsibilities of ownership, and the basic premise of the system is sustainable transportation (Shaheen, Guzman and Zhang, 2010; Parkes et al., 2013; Midgley, 2009; Murphy and Usher, 2015).

2.3 Bike Sharing Programs in Different Countries

Since its inception, bike-sharing systems have sprung across countries the world over (Figure 3). It is estimated that there are approximately 100 programs in about 125 cities around the globe with more than 139,300 bicycles on four continents, and 45 more to be introduced in 22 countries in 2010 (Shaheen, Guzman & Zhang, 2010). As a short-distance transportation mode, bicycle has increasingly assuming its position as an alternative public transportation to automobile, backed by the widely accepted understanding in the developed countries that it can be a means to tackle many aspects of environment-associated urban problems (Kwon, 2014). Table 2 summarizes key characteristics of major bicycle sharing models of five countries: France, Spain, Denmark, Canada and China.

European countries are the early adopters of the public bicycle sharing systems, with the Netherlands, Germany and Denmark witnessing bike-riding to increase between 20 to 43%

from 1975 and 1995 (Pucher & Buehler 2008). According to Fishman, Washington and Haworth (2013), Paris initiated Europe's largest bicycle sharing system in 2007 with over 20,000 bicycles, whereas in North America, New York launched its bike-sharing scheme with 10,000 bicycles in 2013. However, China is fast catching up with its European counterparts to claim world's largest public bicycle share programs in terms of the number of available bikes with 70,000 and 65,000 bicycles in Wuhan and Hangzhou respectively (Kwon, 2014).

In addition, previous researches on public bike-sharing programs found that the motives behind the launching of the program differed from country to country. China introduced bike-sharing in an attempt to mitigate traffic congestion, while the U.S. and Canada did so to improve public health (Fishman, Washington & Haworth, 2013).

Country	Name of Program	Characteristics
France	Vélib	· The 3rd largest bike-sharing scheme (2013), based on the successful Vélo'v by Lyon · Start operation in 2007 in Paris by JCDecaux (an advertising company) · 1,230 docking stations and14,000 bicycles are available, with daily users of 90,000 · Each docking station is located 300 meters in distance · Having 20 million users in its first year, accumulated to the current 170 million users at present
Spain	Bicing	· Start operation in 2007 in Barcelona by Clear Channel (a private company commissioned by city council) · Subscription to an annual membership is required · 400 docking stations and 6,000 bicycles are available · Each docking station is located 300 meters in distance in plain land · Bicycle and other public transportation are linked (Bicing stations can be identified in the subway or bus) · RFID is used for identity check · Time used for one-time use is 30 minutes on average, and fees are

		charged for the use over 2 hours
Denmark	Bycyklen	· Introducing electric bicycle with electric booking system · World's smart bike system, having GPS and navigation program installed in all bicycles · High-quality maintenance by MIFA (German manufacturer) and new docking system (invented by AXA) providing more flexibility to users
Canada	BIXI	· Started in 2009 in Montreal with 300 docking stations and 3,000 bicycles, and grew into 400 docking stations and 5,000 bicycles · Using solar panel at docking stations to generate electricity which is used for running the docking stations and payment system · Stations are constructed in the existing road network · Payment is made upon distance travelled from a single dock station (ANAT's technology)
China	Pinyin	· Started in 2008 in Hangzhou with 30 docking stations, 30 moving stations and 2,800 bicycles to reduce traffic · World's largest bike-sharing program with 2,700 docking stations and 66,500 bicycles (as of 2013) · Aiming to operate 175,000 bicycles by 2020 · Using smartcard for the bicycle rental, and an initial first-time only deposit of 200 RMB · Other 19 public bike-sharing programs in China include Mobike, Ofo, Bluegogo, Hangzhou Public Bicycle, and so on

Table 2. Summary of Major Public Bike-sharing Models of Different Countries **(**Kwon, 2014)

Source: Kwon (2014)

Figure 3. Public Bicycle Sharing in Different Countries

Although the forms are varying country to country, the bikesharing programs ultimately pursue the integration of cycling into mainstream transportation systems, making it readily available for a daily transportation mode (Shaheen, Guzman & Zhang, 2010). However, studies have found that, so far, public bicycle sharing has limited effects in substituting other transportation modes (Kwon, 2014). Figure 2 and 3 shows different public bicycle sharing systems in countries across the world.

Source: the bike-sharing world map (http://maps.google.com)

Figure 4. Public Bike Sharing World Map

2.4 Public Bike Sharing Program in Korea

While Korea was categorized as non-Annex I country under Kyoto Protocol, the newly established Paris Agreement adopted in the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) bound all member parties including South Korea to submit their Intended Nationally Determined Contributions (INDCs) to collectively limit the global temperature rise to 1.5 degrees Celsius (Jung & Sohn, 2016). Korea's INDC covers its plan to reduce emissions by 37% compared with Business-As-Usual (BAU) level by 2030. In a response to the Paris Agreement, given that CO_2 emissions are

particularly high in transportation, the Korean government has implemented multiple policy measures including tax benefits and subsidies for environmentally-friendly and low-carbon vehicles (Jang, Kim & Lee, 2016).

In fact, air pollution has emerged as a key environmental concern in South Korea. It is world 8th largest CO2 emitter as of 2015, behind China, the United States, India, Russia, Japan, Germany and Iran, and number four in terms of the volume of coal imports in 2015 (Enerdata, 2016). The World Energy Outlook 2015 by the International Energy Agency also estimated that per capita carbon emissions in South Korea will be the third largest in the world by 2030 in the INDC Scenario (IEA, 2015). The air quality level of South Korea is near the bottom at 173 out of total 180 countries (Jeong, 2017). One of the main reasons behind poor air quality in South Korea is particular matter, or PM 10, which are more serious in populous metropolitan areas with heavy road congestion (Kim, 2017). What is worse is fine particular matter, or PM 2.5, that is classified as a first class carcinogenic substance by the World Health Organization. The average concentration of PM 2.5 in South Korea from January to April, 2017 was about 30 $\mu g/m^3$, three times over the level recommended by the WHO (Kim, 2017).

Among many other breakthroughs in attempting to address environmental concerns, sharing presents one solution to such a current environmental problem. It is known that transportation has adopted the concept of sharing at an earlier stage (Shin, Kim & Jeong, 2012). According to Shin, Kim and Jeong (2012), examples of sharing in transportation include the use of public transportation such bus and subway, car-pooling, and the use of public goods like roads. Another representative case is car-sharing. It started in Switzerland in the 1950s, and facilitated in the United States and Europe in the 1990s. Car-sharing in Korea was valued at KRW 9 billion in 2013, but jumped to KRW 66.8 billion in 2015 (Jang,

Kim & Lee, 2016). Along with car-sharing, public bicycle sharing is also expanding globally, especially at a time when the need for a more sustainable transportation is high more than ever.

In Korea, however, bicycle as a mode of transportation takes up only about 2%, considerably lower than 15~20% of other developed countries (Do & Noh, 2014). It was also found that the purposes of trip by bicycle are mostly for leisure activities and sports (53.9%), followed by for shopping (18.2%) and commuting (7.4%) rather than for transportation purpose (Do & Noh, 2014).

The public bicycle sharing program was introduced in South Korea against this backdrop firstly in Changwon City in 2008, with a view to reducing carbon emissions and expanding sharing eco-friendly mode of transportation. As of 2012, 14 cities are operating public bicycle sharing program, with Changwon City and Goyang City being the largest operators (Shin, Kim & Jeong, 2012). Seoul City also introduced 'Ttareungyi' in 2015, with 150 docking stations and 2,000 bicycles across five districts (Jang, Kim & Lee, 2016). It applied the features of the 3rd generation of bicycle sharing by introducing technology in service provision. It is also operated in a membership subscription and non-membership temporary use basis. Those who wish to use Ttareungyi first need to sign in on the website for purchasing a yearly-, monthly-, weekly or daily subscription. The bicycles are parked at docking stations which can be found on the Internet or Android-based smartphones. These bicycles are equipped with touch screens so the users can touch the provided number to unlock them. Returning and re-renting bicycles is possible at any docking stations within the subscribed amount of time. The maintenance is supervised by the Seoul Metropolitan Government. The rental rate has been increasing to record one million as of September 2016,

starting from 13,000 in September 2015 (Kim, 2016). Subscription also soared to exceed 100,000 in just 10 months into operation, with 96.6% being short-term users of less than 50 times (Kim, 2017).

Source: Kwon, 2014

Figure 5. Bicycle Sharing in Different Cities in South Korea

III. Theoretical Background

Studies in sharing economy often employ customer satisfaction theories to figure out the influencing factors that change customers purchasing behavior from ownership to sharing. Researches show that customers' intention for a repeated purchase of a good or service is influenced by their satisfaction which is directly associated with customer loyalty (Hung & Wong, 2007). As further noted by Hung and Wong (2007), customer satisfaction can be defined as a concept that a customer makes positive judgement after purchasing goods or services. In addition, Oliver (1997) states that satisfaction can be not only the end state of consumer's purchasing behavior but also an interim judgement of the state of satisfaction. He explains that the prior end- or interim-experience of a consumer develops an *attitude* towards the specific product or service, which is rather strongly associated with the *intention* to repeat the behavior in the future. The intention of repurchasing a good or service can lead to form

commitment and *loyalty* (Oliver, 1997).

Although a wide spectrum of literatures analyzes customer satisfaction theories, this paper intends to limit its frame to the following academic theories that are relevant to customer satisfaction, including "Macro-models" Theory (Hom, 2000), loyalty (Picón, Castro & Roldán, 2014) and self-efficacy theory (Hung & Wong, 2007).

Hom's "macro-models" (2000) are an extension of the concept of customer satisfaction that is defined as "the customer's fulfilment response. It is a judgement that a product or service feature, or the product of service itself, provided (or is providing) a pleasurable level of consumption-related fulfillment, including levels of under- or over-fulfillment…" (Oliver, 1997). It is comprised of related concepts including value, quality and loyalty, as opposed to "micro-model" whose constructs are disconfirmation of expectations, equity and regret (Hom, 2000). Under the macro-models, by placing a focus on the "customer" instead of "consumer", the experience and the actual use of a product and service assume more importance in constructing satisfaction, distinguishing user and non-user (Hom, 2000). Hom (2000) also argues that satisfaction is a short-lived feeling and attitude, and that is has a floor (under-fulfillment) and a ceiling (over-fulfillment). It means that satisfaction is different from behaviors and that it can change depending on given circumstances or available quantity. The macro-model of customer satisfaction builds upon this definition, evolving to embrace the concept of value and connect overall service satisfaction, encounter satisfaction and perceived service quality. This model may help explain why a survey outcome shows different level of customer satisfaction for a service, since it proves a strong correlation between overall service satisfaction and perceived service quality (Hom, 2000).

Picón, Castro and Roldán (2014) analyzed the relationship between satisfaction and

loyalty, with satisfaction being the crucial ingredient to customer loyalty. According to Oliver (1997), customer loyalty is defined as following:

"a deeply held commitment to rebuy or repatronize a preferred product or service consistently in the future, despite situational influences and marketing efforts having the potential to cause switching behavior."

The study by Picón, Castro and Roldán (2014) also mention perceived switching value (PSC) and the perception of a lack of attractiveness of alternative offerings (AA) as other constructs that influence the relationship. In their paper, loyalty is considered as "intention of future behavior", "cognitive loyalty", and "affective loyalty." The authors explain that cognitive loyalty is meant by what a customer considers a certain provider as the only option for future transaction based on the available information. It comes before the affective loyalty which a positive attitudinal commitment toward the provider (Oliver, 1997). Meanwhile, the main two perspectives that are most relevant to loyalty theories are behavioral and attitudinal (Picón, Castro & Roldán, 2014). While behavioral perspective approaches to loyalty based on the view that loyalty may come from the repeated purchasing behavior out of habit, attitudinal perspective views loyalty as a psychological state of a customer. According to the latter perspective, customer loyalty is formed when a customer has a positive attitude toward the provider which would be followed by a repeated purchase in the future.

Hung and Wong (2007) quoted the definition of self-efficacy theory from Wood and Bandura (1989) as "a belief that a person has the capability to execute the course of actions required to manage prospective situations to achieve a particular objective". Self-efficacy theory can be relevant in the research on sharing economy because self-efficacy is affected by prior exposure to a similar situation (experience), cognitive comparison between oneself

and others with regard to a certain behavior (modelling), social encouragement by others (social persuasions), and various signs and responses of an action (physiological factors) (Hung & Wong, 2007). In addition, in analyzing how satisfaction can be followed by loyalty, self-efficacy theory can be employed as it is highly associated with behavioral change and outcomes, and helps "determine how much efforts people will expend on an activity" (Hung & Wong, 2007).

IV. Hypotheses Development

This paper finds consumer satisfaction theory and consumer utility theory as a theoretical framework to build hypotheses. Figure 6 presents that this study explored six utility factors, namely mobility, storage, technology, economic, trust and sustainability, that are assumed to affect satisfaction of users on bicycle sharing, and the intention of potential users to user bicycle sharing, with hypotheses that satisfaction is related to loyalty for the users, and the intention is related to expected satisfaction of potential users. The hypotheses model structure is mostly drawn from literatures on consumer satisfaction (Hom, 2000; Picón, Castro & Roldán, 2014; Hung & Wong, 2007; and Venkatesh, Thong & Xu, 2012).

Previous studies on sharing economy, in particular bicycle sharing serve as a foundation on which utility factors are built, taking into account different focuses of sharing. For example, when sharing is viewed as access-based consumption, it should mean the integrated product or service is provided to customer without ownership transfer (Catulli, et al., 2015). If it is applied to the concept of product service system (PSS), it shall refer to "a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional

business models (Mont, 2002).”

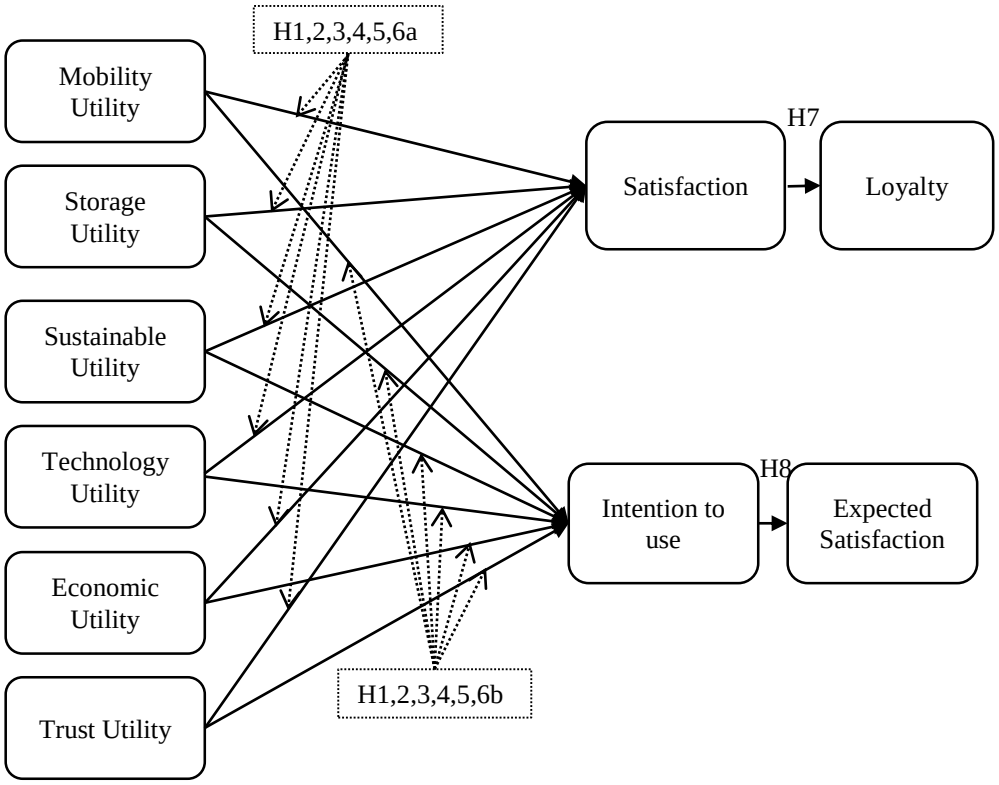


Figure 6. Structural Model of Utility, Intention, Satisfaction & Loyalty in Bicycle Sharing Service

Then, depending on whether a respondent has used bicycle sharing program or not, the effect of overall utility on bicycle sharing on satisfaction and loyalty will be explored for the existing users, while that of on the intention to use and expected satisfaction for the potential users. To test the hypotheses and find whether there are correlations between utility, satisfaction and loyalty, and intention to use will be crucial guideline identifying key determinants to sharing.

4.1 Effects of Mobility Utility on Overall Attitude on Bicycle Sharing

The first hypothesized utility is mobility utility which refers to “freedom of flexibility”

(Hennig-Thurau, Henning, & Sattler, 2007). This paper assumes that if one gets more flexibility in mobility in choosing any mode of transport, it would give the person greater utility. Based on such an assumption, "freedom of flexibility" can also be applied in the case of bicycle sharing program which offers transportation-related merits such as a low-carbon and environment-conscious solution to the "last-mile" problem (Shaheen, Guzman & Zhang, 2010). Shaheen, Guzman and Zhang (2010) explains that "last mile" means "the short distance between home and public transit and/or transit stations and the workplace, which may be too far to walk." According to the authors, bike-sharing has the potential to provide for the missing link in existing transportation networks, and give a convenient option to the potential users. Based on the argument, the first hypotheses are developed as following for users and potential users each (for the rest of the hypotheses, a: existing users, b: potential users):

H1a. The perception on mobility utility affects satisfaction of users on bike-sharing service

H1b. The perception on mobility utility affects intention of potential users to use bike-sharing service

4.2 Effects of Storage Utility on Overall Attitude on Bicycle Sharing

The second hypothesized utility in bicycle sharing program is storage utility. According to some studies (Hennig-Thurau, Henning and Sattler, 2007, Lamberton & Rose, 2012), storage utility refers "product storage advantages obtained through sharing products." Bicycle sharing has an advantage over owning one, as it eliminates the attached responsibilities of parking while providing multiple unattended docking stations for pick-up and drop-off (available at different stations) (Shaheen, Guzman & Zhang, 2010). Parkes et al.

(2013) argued that storage aspect and no responsibility of parking space of bicycle sharing could encourage users who may otherwise not ride bicycle. This leads to the following hypotheses.

H2a. The perception on storage utility affects satisfaction of users on bike-sharing service

H2b. The perception on storage utility affects intention of potential users to use bike-sharing service

4.3 Effects of Sustainability Utility on Overall Attitude on Bicycle Sharing

The third hypothesized utility is sustainable utility, given that environmental advantages are often emphasized in the course of sharing economy (Böcker & Meelen, 2017). Shaheen et al. (2010) presents data of notable effect of greenhouse gas (GHG) emissions reduction from bicycle sharing that would otherwise have produced if the same distance was travelled by car. A 2015 study by Majumdar and Mitra indicates that both bike-riders and the users of other transportation modes are aware of the environmental benefits bicycle may provide. So, Böcker and Meelen (2017) state that "sharing economy, as an alternative economic model, make a contribution to environmental sustainability." This leads to the following hypotheses.

H3a. The perception on sustainability utility affects satisfaction of users on bike-sharing service

H3b. The perception on sustainability utility affects intention of potential users to use bike-sharing service

4.4 Effects of Technology Utility on Overall Attitude on Bicycle Sharing

The ubiquitous internet network, wireless technology, smart phone and online payment service help deliver "simple, convenient, reliable and low-cost" access to finding and reserving a bicycle (Chase, 2015). Also as noted by Chase (2015), this technology-enable transportation solutions can be found with bicycles. As a matter of fact, the rapid growth and expansion across Europe and other continents of public bicycle sharing program started to be noticed with better and improved technology (DeMaio, 2009). Now, thanks to more innovative approaches including movable docking stations, solar-powered docking stations, e-bikes and real-time availability application (Midgley, 2011), the bicycle sharing program continues to evolve and become more accessible and available, which possibly satisfies mobility desire of people. This leads to hypothesize the followings:

H4a. The perception on technology utility affects satisfaction of users on bike-sharing service

H4b. The perception on technology utility affects intention of potential users to use bike-sharing service

4.5 Effects of Economic Utility on Overall Attitude on Bicycle Sharing

As discussed above, one of the benefits of bicycle sharing program is cost-saving. Users of bicycle sharing program can save parking cost, maintenance and insurance-related cost. Literatures also identified cost as a key influencing factor on bicycle mode choice (Majumdar & Mitra, 2015). Fishman, et al. (2014) also found that financial saving can be a motivating factor that encourages bike-sharing. Such "perceived merits" of using bicycle sharing program can result in enhanced users' economic utility as it is linked to the user

satisfaction of having financial advantage by purchasing a service (Hennig-Thurau, Henning & Sattler, 2007). This leads to the following hypotheses.

H5a. The perception on economic utility affects satisfaction of users on bike-sharing service

H5b. The perception on economic utility affects intention of potential users to use bike-sharing service

4.6 Effects of Trust Utility on Overall Attitude on Bicycle Sharing

Botsman (2012) refers trust to an important component in sharing economy in that it provides service to other consumers participating in the sharing economy. Trust is especially relevant as it requires more than two parties engaging in a transaction to be formed, which Morgan and Hunt (1994) defined as "confidence in an exchange partner's reliability and integrity." It can also be associated with the notion of willingness to rely on the other party, confidence on the trusting party, and behavioral intention (Morgan & Hunt, 1994). In sharing economy, trust can be built not just between participating consumers but also between users and service providers in the form of service reliability. Bicycle sharing takes additional note of trust utility, because there has to be trust between bike-riders and drivers on the road. Experts often identified safety, security and other physical factors as important criteria in promoting bicycle sharing program (Majumdar & Mitra, 2015). Majumdar and Mitra (2015) explain that the low speed of bicycle contributes to making people feel generally safe, bike-riders are concerned with the "presence of motorized vehicles on the road." According to Karki and Tao (2016) pointed bicycle safety improvements affect the bicycle rider population. Therefore, once safety of bicycling is assured, it can be assumed that bike-riders and drivers

have formed trust. Based on this this academic background, it is hypothesized the followings:

H6a. The perception on trust utility affects satisfaction of users on bike-sharing service

H6b. The perception on trust utility affects intention of potential users to use bike-sharing service

4.7 Effects of Overall Attitude on Bicycle Sharing on the Actual Use, Satisfaction and Loyalty

Following the customer satisfaction theory, this paper hypothesized that the overall attitude on bicycle sharing leads to the actual use and affects the level of satisfaction for the existing users. It goes further to test whether higher level of satisfaction is associated with loyalty. Paul et al. (2016) describe attitudes as a degree to which a person has a positive or negative evaluation of the particular behavior. In addition, attitudes towards the environment is the direct precursors, with which it can be predicted whether or not one would behave pro-environmentally (Paul et al., 2016; Wu, 2015; Steg & Vlek, 2009). It was stated in the study by Li et al. (2013) that the attitude of travelers and their choice of bicycle are related. For example, the attitude towards bicycle is significantly associated with the willingness to use bicycle (Li et al, 2013). According to Dick and Basu (1994), a consumer would respond to a product or a service based on the combination of his/her own prior expectation and perceived performance, and the resulting satisfaction is "considered to act as an antecedent to loyalty." Thus, the paper hypothesized that satisfaction from the actual use of bicycle sharing is related to loyalty.

H7. Satisfaction of users on bike-sharing is associated with loyalty.

4.8 Effects of Overall Attitude on Bicycle Sharing on Intention to Use

This paper applies H8 to those who never experienced bicycle sharing program, based on the hypothesis that the overall attitude on bicycle sharing affects the intention to use. For those without prior experience, the finding that a decision to use the bicycle sharing service to commute is influenced by the attitudes toward cycling can be adapted for this hypothesis (Passafaro et al., 2014). In other words, utility factors combined with the resulting attitudes contribute to determining people's intention to use bicycle sharing. This is because intentions are "a general measurement of commitment", meaning that for people to have intention to use bicycle sharing program, they should be at least aware of the attributes of the program, and the factors influencing the level of utility (Passafaro et al., 2014). Therefore, this study hypothesized H8 to figure out if the intention is related to the level of expected satisfaction, as following.

H8. Intention of potential users to use bike-sharing service is associated with expected satisfaction

V. Methodology

The paper seeks to analyze the utility factors, level of satisfaction and loyalty (for users), and intention to use and expected satisfaction (for potential users). As researches on customer satisfaction and loyalty emphasize, the actual experience of the specific service matters in an attempt to find the links between the above-mentioned factors. For those without prior experience, the overall attitude can be analyzed instead of their actual experience so as to estimate their intention for a future use. One of the most practical ways of collecting primary

data about customer experience or attitude is survey. The survey was conducted in South Korea, with the questions distributed through online channel during one month, from July to August 2017. Online survey was conducted based on the platform called Qualtrics, which creates an online link so that the questionnaire can be easily distributed through such means as MNS, SNS, email, and so on. The survey was comprised of 54 questions that ask random respondents questions not just regarding bicycle sharing program itself but also about their demographic information including gender, age, education level, occupation, income level and the area of residence. However, questions were divided into different parts based on whether or not a respondent had a previous experience of bicycle sharing service. For this reason, respondents were not asked to answer to all 54 questions. As Majumdar and Mitra (2015) use a 5-point Likert scale for user's experience, this paper also adapts the same instruction, so respondents were given with a scale in which *1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree.*

The constructs used to develop survey questions including utility factors were based on previous researches (Lamberton & Rose, 2012; Venkatesh, Thong & Xu, 2012; Fishman, Elliot, Simon Washington, Narelle Haworth and Armando Mazzei, 2014; Majumdar & Mitra, 2015; Möhlmann, 2015; and Kim, 2015), and adjusted to serve the purpose of the study. Specifically, the study developed variable items for measuring attitudes towards bicycle sharing following the items explored by Paul et al. (2016), Majumdar and Mitra (2015), and Möhlmann (2015).

This study conducted a pilot study to seek validity of survey questionnaire. It also applied back translation to be distributed to both Koreans and non-Korean residents in Korea. After review and a pilot study, the study also when through reliability test by calculating Cronbach's alpha for each construct. Cronbach's alpha values were 0.77 for mobility, 0.80 for storage,

0.82 for sustainability, 0.89 for technology, 0.81 for economic, and 0.74 for trust utility. For satisfaction and loyalty, the Cronbach's alpha values were 0.96 and 0.77 each, and for intention to use and expected satisfaction, the Cronbach's alpha values were 0.92 and 0.90 each.

VI. Data Analysis

6.1 Demographics

Out of 210 respondents in total, 152 completed the survey with 72.4% response rate. Among them, 40.5% were female and 31.9% were male, while 55.7% were unmarried and 16.7% were married. By age groups, 37.6% were 21-30 years old, 31.4% were 31-40 years old, 2.9% were 41-50 years old, and 0.5% were greater than or equal to 61. With regard to their education level, 25.7% were graduates from 4-year university, 20.5% had master's degree or beyond, 14.8% were attending 4-yar university, 7.6% were attending vocational university, and 1.4% had high school degree. Occupation-wise, students were 25.2%, office workers were 21.4%, civil servants were 9%, housewives were 1.4%, and other occupations took up 14.8%. In terms of income, 24.8% were not applicable, possibly because those respondents were students and still not in the job market, 12.4% had annual incomes between KRW 20 million and KRW 30 million, 9% had annual incomes between KRW 30 million and KRW 40 million, and between KRW 40 million and KRW 50 million each. 5.7% reported their annual incomes between KRW 50 million and KRW 60 million, while 1.4% earned between KRW 60 million and KRW 70 million annually. 2.9% said they had annual incomes greater than KRW 70 million, and 2.9% had annual incomes less than KRW 10 million.

6.2 Hypotheses Testing

To check validity of each construct, this study conducted factor analysis which used principal component analyses as extraction method, and Varimax rotation with Kaiser Normalization. It shows that the factor analyses represented the major constructs in a successful manner, with Eigen values being greater than 1.00. Table 3 and 4 summarizes the results of factor analysis for each construct for existing bicycle-sharing users and for non-user, respectively.

Items		Components					
Factors	**Scale Items**	**1**	**2**	**3**	**4**	**5**	**6**
Mobility Utility 3	I think I would use bicycle sharing because of its travel flexibility.	.910					
Mobility Utility 1	Bicycle sharing service gives me more freedom of mobility.	.887					
Mobility Utility 2	I would like to use bicycle sharing service, if I want to go somewhere close but not connected by public transportation.	.883					
Storage Utility 3	I like bicycle sharing service because I can easily access a transportation without concerns about storage.		.888				
Storage Utility 1	One great thing about bicycle sharing service is not being responsible for finding space to store bicycle.		.887				
Storage Utility 2	I like that I don't have to waste my time for looking for storage place because the docking stations are closer to work and home.		.824				
Sustain-ability Utility 2	I like that if I use bicycle sharing, I can make a contribution to protecting the environment.			.928			
Sustain-ability Utility 1	I would use bicycle sharing because bike-riding is more pro-environmental than automobile because it does not emit toxic chemicals.			.914			
Sustain-ability Utility 3	I would use bicycle sharing because it will help to protect the environment.			.870			
Tech-nology Utility 1	The internet and smartphone is useful for using bicycle-sharing service.				.947		
Tech-nology Utility 2	The internet and smartphone provide me quick and easy access to the docking station and to use the service.				.897		
Tech-nology Utility 3	I like that internet and smartphone enable me access the bicycle without owning it.				.893		

Economic Utility 2	I like the fact that bicycle sharing service because it saves my time: searching for parking lots, driving unnecessary distance, and suitable for getting to the final destination.					.875	
Economic Utility 1	I believe that bicycle sharing service save my money in many different aspects such as owning and parking, oil price, maintenance, insurance, and so on.					.848	
Economic Utility 3	I believe I can save more money when I use bicycle sharing than driving a car.					.844	
Trust Utility 2	I will be happy that users of bicycle sharing service are truthful in dealing with one another.						.929
Trust Utility 1	I will be happy if drivers of motorized vehicles make bike-riders feel safe on the road.						.918
Trust Utility 3	I trust that the service provider will give enough safeguards to protect me from liability for damages so that I am not responsible for.						.337

Table 3. Component Matrix: Utility Factors of the Existing Users of Bicycle Sharing

Items		**Components**					
Factors	**Scale Items**	**1**	**2**	**3**	**4**	**5**	**6**
Mobility Utility 3	I think I would use bicycle sharing because of its travel flexibility.	.924					
Mobility Utility 2	I would like to use bicycle sharing service, if I want to go somewhere close but not connected by public transportation.	.884					
Mobility Utility 1	Bicycle sharing service gives me more freedom of mobility.	.585					
Storage Utility 3	I like bicycle sharing service because I can easily access a transportation without concerns about storage.		.859				
Storage Utility 1	One great thing about bicycle sharing service is not being responsible for finding space to store bicycle.		.843				
Storage Utility 2	I like that I don't have to waste my time for looking for storage place because the docking stations are closer to work and home.		.799				
Sustain-ability Utility 1	I would use bicycle sharing because bike-riding is more pro-environmental than automobile because it does not emit toxic chemicals.			.903			
Sustain-ability	I like that if I use bicycle sharing, I can make			.831			

Utility 2	a contribution to protecting the environment.					
Sustain-ability Utility 3	I would use bicycle sharing because it will help to protect the environment.	.820				
Tech-nology Utility 1	The internet and smartphone is useful for using bicycle-sharing service.		.948			
Tech-nology Utility 2	The internet and smartphone provide me quick and easy access to the docking station and to use the service.		.916			
Tech-nology Utility 3	I like that internet and smartphone enable me access the bicycle without owning it.		.843			
Economic Utility 2	I like the fact that bicycle sharing service because it saves my time: searching for parking lots, driving unnecessary distance, and suitable for getting to the final destination.			.870		
Economic Utility 1	I believe that bicycle sharing service save my money in many different aspects such as owning and parking, oil price, maintenance, insurance, and so on.			.859		
Economic Utility 3	I believe I can save more money when I use bicycle sharing than driving a car.			.800		
Trust Utility 1	I will be happy if drivers of motorized vehicles make bike-riders feel safe on the road.					.895
Trust Utility 2	I will be happy that users of bicycle sharing service are truthful in dealing with one another.					.873
Trust Utility 3	I trust that the service provider will give enough safeguards to protect me from liability for damages so that I am not responsible for.					.684

Table 4. Component Matrix: Utility Factors of the Non-Users of Bicycle Sharing

The utility dimensions are then associated with the overall attitudes such as satisfaction and loyalty for the users, and intention to use and expected satisfaction for the potential users. These scale items were also subject to factor analysis which are shown in Table 5 and 6.

Items		**Components**	
Factors	**Scale Items**	**1**	**2**
Satisfaction 2	I am satisfied with my previous experience with bicycle sharing.	.981	
Satisfaction 3	In general, my experience with bicycle sharing service is positive.	.965	
Satisfaction 1	Bicycle sharing service meets my expectation.	.950	
Loyalty 3	I intend to continue to use bicycle sharing service in the future.		.907
Loyalty 2	I think I will recommend bicycle sharing service to friends and family.		.890

Loyalty 1	I will try to use bicycle sharing service again.	.707

Table 5. Component Matrix: Satisfaction and Loyalty of the Existing Users of Bicycle Sharing

Items		Components	
Factors	**Scale Items**	**1**	**2**
Intention to Use 2	I am considering the use of bicycle sharing service.	.942	
Intention to Use 3	I would like to use bicycle sharing service.	.931	
Intention to Use 1	I expect to use bicycle sharing service in the near future.	.918	
Intention to Use 4	When I need to go somewhere next time, I will try bicycle sharing service.	.891	
Expected Satisfaction 1	I think bicycle sharing service would satisfy my expectations.		.884
Expected Satisfaction 2	In general, I think I will be satisfied with bicycle sharing.		.884

Table 6. Component Matrix: Intention to Use and Expected Satisfaction of the Potential Users of Bicycle Sharing

Regression analysis was applied to test the hypotheses using factor scores. Table 7 represents the results of multiple regression analyses for utility factors on satisfaction of the existing users of bicycle sharing service. Overall, the ANOVA analysis showed that the models were significant at 0.01 level with F=7.066 (*r-square* = .669). The findings indicate that hypothesis H5a is accepted, but not rest of the hypotheses. In other words, economic utility of bicycle sharing service was the only independent variable that is related to satisfaction for the existing users of the service.

Variable (Independent -> dependent)	**Standardized Coefficient (*t*-value-Sig)**
Mobility Utility -> Satisfaction (H1a)	0.380 (1.505)
Storage Utility -> Satisfaction (H2a)	0.208 (1.113)
Sustainable Utility -> Satisfaction (H3a)	-0.170 (-1.043)
Technology Utility -> Satisfaction (H4a)	-0.081 (-0.425)
Economic Utility -> Satisfaction (H5a)	0.550 (2.951**)
Trust Utility -> Satisfaction (H6a)	0.058 (0.329)

** Significant at 0.05 level (2-tailed)

Table 7. Effects of Utility Dimensions on Satisfaction of Users

Then, the Study applied factor and regression analysis for the effects of satisfaction on loyalty. Table 8 shows the results of the analysis: the ANOVA finds the models significant at 0.01 level with *F*=31.568 (*r-square*=.530). Based on the findings, hypothesis H7 is accepted.

Variable (Independent -> dependent)	Standardized Coefficient (*t*-value-Sig)
Satisfaction -> loyalty (H7)	0.728 (5.619***)

*** Significant at 0.01 level (2-tailed)

Table 8. Effects of Satisfaction on Loyalty of Users

Table 9 represents the results of multiple regression analysis for utility factors on intention of the potential users to use bicycle sharing service. Overall, the ANOVA analysis showed that the models were significant at 0.01 level with *F*=18.966 (*r-square* = .495). The findings indicate that hypotheses H1b, H2b, and H5b are accepted, but not H3b, H4b, and H6b. In other words, for those who never experienced bicycle sharing, mobility, storage and economic utility were related to their intention to use, but not sustainable, technology and trust utility.

Variable (Independent -> dependent)	Standardized Coefficient (*t*-value-Sig)
Mobility Utility -> Intention to Use (H1b)	0.479 (5.119***)
Storage Utility -> Intention to Use (H2b)	-1.99 (-2.152**)
Sustainable Utility -> Intention to Use (H3b)	0.051 (0.508)
Technology Utility -> Intention to Use (H4b)	0.009 (0.088)
Economic Utility -> Intention to Use (H5b)	0.353 (2.956**)
Trust Utility -> Intention to Use (H6b)	0.050 (0.505)

** Significant at 0.05 level (2-tailed), *** Significant at 0.01 level (2-tailed)

Table 9. Effects of Utility Dimensions on Intention to Use of Potential Users

This study also conducted factor and regression analysis for the effects of intention to use on expected satisfaction. Table 10 indicates that the ANOVA results are found to be significant at 0.01 level, and *F*=67.349 (*r-square*=.359). Thus, it was found that the intention to use was associated with expected satisfaction.

Variable (Independent -> dependent)	Standardized Coefficient (*t*-value-Sig)
Intention to Use -> Expected Satisfaction (H8)	0.600 (8.207***)

*** Significant at 0.01 level (2-tailed)

Table 10. Effects of Utility Dimensions on Expected Satisfaction of Potential Users

The testing of the hypotheses that utility factors are related to attitudes including satisfaction, loyalty for the bicycle sharing users, and intention to use and expected satisfaction for the potential users can be summarized as following (Table 11 and Table 12).

Experience of Bicycle Sharing Service	Utility	Hypothesis Testing	Result
Existing Users	Mobility	Mobility Utility → Satisfaction (H1a)	Not Accepted
	Storage	Storage Utility → Satisfaction (H2a)	Not Accepted
	Sustainability	Sustainable Utility → Satisfaction (H3a)	Not Accepted
	Technology	Technology Utility → Satisfaction (H4a)	Not Accepted
	Economic	Economic Utility → Satisfaction (H5a)	Accepted
	Trust	Trust Utility → Satisfaction (H6a)	Not Accepted
Potential User	Mobility	Mobility Utility → Intention to Use (H1b)	Accepted
	Storage	Storage Utility → Intention to Use (H2b)	Accepted
	Sustainability	Sustainable Utility → Intention to Use (H3b)	Not Accepted
	Technology	Technology Utility → Intention to Use (H4b)	Not Accepted
	Economic	Economic Utility → Intention to Use (H5b)	Accepted
	Trust	Trust Utility → Intention to Use (H6b)	Not Accepted

Table 11. Summary of Utility Hypotheses Testing

Group	Hypothesis Testing	Result
Existing Users	Satisfaction → Loyalty (H7)	Accepted
Potential Users	Intention to Use → Expected Satisfaction (H8)	Accepted

Table 12. Summary of Effect of Satisfaction and Intention to Use

6.3 Findings

The findings of this study on bicycle sharing are intriguing in that they are consistent with other previous studies in some ways, but divergent in other ways. People who had not used bicycle sharing service yet were found to appreciate mobility utility that bicycle sharing service would bring about. Considering the increasingly mobile populations (Murphy and Usher, 2015),

the fact that mobility utility affects the intention to use bicycle sharing can deliver an important message with its potential for modal shift. In addition, if bicycle sharing could maximize the freedom of mobility as a possible "last mile (Shaheen, Guzman & Zhang, 2010)" transportation mode, it can attract more bicycle riders to be bicycle-sharing users and present one solution to urban traffic problem. However, for bicycle sharing to be a substitute for driving a car and to succeed in achieving modal shift, the mobility advantage should form a direct relationship with attitude of not just potential users but also the existing users.

Storage utility was another contributing factor that affects the intention to use bicycle sharing service for people with no previous bicycle sharing experience. Reduced responsibility that follows no-ownership of a product was appreciated by potential users of the survey, which is one of the core features of sharing economy. Yet, given that bicycle does not take up as much a huge space for parking as car, nor cost as much as buying a house, the associated storage benefit was not indeed valued by the existing users of the survey.

Böcker and Meelen (2017) studied sharing economy in three different frames of the economy, environment and social aspects. They found that, even though environmental benefits are generally valued the most in promoting sharing economy, there are mixed evidence that the environment serves as a drive that encourages the use of a sharing service (2017). Another study by Mont (2004) noted that environmental value was down on the list of the key issues for many people, compared with the early 1990s. This study hypothesized that sustainability utility affects the overall attitude toward bicycle sharing service, which was not accepted for both the existing users and potential users. In spite of the obvious environmental advantages of bicycle sharing as presented in the studies by Shaheen et al. (2010) and

Möhlmann (2015), this study found that environment has indirect relationship with the overall attitudes such as satisfaction and the intention to use of bicycle sharing service.

Technology development such as smartphone capability, faster access to the Internet, and user-friendly application was hypothesized in the study to influence the attitudes of people. Botsman and Rogers (2010) pointed smartphone as a contributing factor that facilitates the use of a sharing service including car sharing. With smartphone, it becomes convenient to find nearby docking stations, borrow and return a bicycle, and check the remaining availability. Looking at the development history of global bicycle sharing program, technology improvement has always allowed the introduction of an enhanced version of the service. This study, however, produced divergent findings with the previous studies. Both the existing users and potential users of the survey found technology utility insignificant in influencing their attitudes.

Economic drivers for bicycle sharing were found to be valid for both users and non-users. The hypothesis that economic utility affects the overall attitude was accepted, which comes in line with other literatures on sharing economy. These studies found economic reasons behind motivation to use accommodation sharing (Tussyadiah, 2015), increasing satisfaction from cost savings (Möhlmann, 2015), and economic concerns in participating collaborative consumption (Bardhi and Eckhardt, 2012). It might be more interesting to note that the economic utility was the sole determinant that affects attitudes of bicycle sharing service user in this study.

Based on the assumption that trust is a crucial premise in the sharing economy, and especially so when it comes to bicycle sharing as it is related to safety, this study hypothesized trust utility affects the overall attitude. However, the results of the survey questions about trust between bicycle users, between bike riders and service provider, and between bike riders and

car drivers were found to be inconsistent with the assumption. Unlike other study (Karki & Tao, 2016) which examined the linkage between users' safety concerns and trust, this study finds no connection between trust utility and satisfaction level, and the intention to use.

The findings of this study also include that once the respondents surveyed feel satisfied with the bicycle sharing service, they become loyal to the service, whereas if the respondents surveyed have intention to use the service, they are expected to feel satisfied with sharing bicycle.

6.4 Additional Findings

In analyzing the data, this study also noted interesting responses. It was from the attempts to find why the actual users were only about 22% of the total respondents that the linkages were found. Through crosstabulation analyses, this study realized that 67% respondents have heard about bicycle sharing service (117 out of 175), but only 39 of which have actually used the service. The result shown in the table 13 can be interpreted that bicycle sharing service is not new to most of the respondents to the survey, yet the knowledge of the service was not translated into the actual trial.

		Have you ever used bicycle sharing service?		Total
		Yes	No	
Have you ever heard about bicycle sharing service?	**Yes**	39	78	117
	No	0	58	58
Total		39	136	175

Table 13. Summary of Bicycle Sharing Service User Compared with Their Awareness of the Service

As a result, this study took additional steps to try to understand why those who are aware of bicycle sharing service did not in fact use the service, with an assumption that their area of residence or workplace are not equipped with bicycle sharing service infrastructure. However,

it was interesting that the adjacency of the bicycle docking stations was not as influential in encouraging actual use of the service as anticipated. Table 14 indicates that out of the respondents who did live or work near the bicycle sharing infrastructure, more than 50% had no experience of using the service.

		Have you ever used bicycle sharing service?		Total
		Yes	No	
Do you work of live near bicycle sharing docking station?	**Yes**	22	52	74
	No	17	84	101
Total		39	136	175

Table 14. Summary of Bicycle Sharing Service User Compared with Their Adjacency of the Infrastructure

According to Murphy and Usher (2015), among other socio-economic information, age, gender and income show the strongest correlation in transportation mode choice. Thus this study also compared the experience of using bicycle sharing service by sex, age, and income. The result of this study was more female than male respondents answered that they have used bicycle sharing service (Table 15), which was divergent from other studies with a focus on bicycle user gender base that outlined the reasons for the usual gender imbalance as female cyclists being more conscious of safety risks and of their appearance, and their more complex travel patterns (Murphy and Usher, 2015). However, it remains a topic of future research whether such reasons from academic literature are applicable for this study as well.

		Gender		Total
		Male	Female	
Have you ever used bicycle sharing service?	**Yes**	13	20	33
	No	54	63	117
Total		67	83	150

Table 15. Gender comparison with the experience of bicycle sharing service

Turning to the age profile of the survey respondents, it was found that the majority of bicycle sharing users were between 21 and 30, with 18 users out of 33 users. Users aged between 31 to 40 were 12, 41 to 50 were 2, and for those greater than or equal to 61 was just

one. The proportional usage of bicycle sharing scheme declined beyond the age group between 21 and 30, which may be associated with the physical demands required for bicycling.

It was interesting to find out that those with higher annual salary (salary group of greater than or equal to KRW 40M and less than KRW 50M) had actually used the bicycle sharing service than those with lower income level (Figure 7).

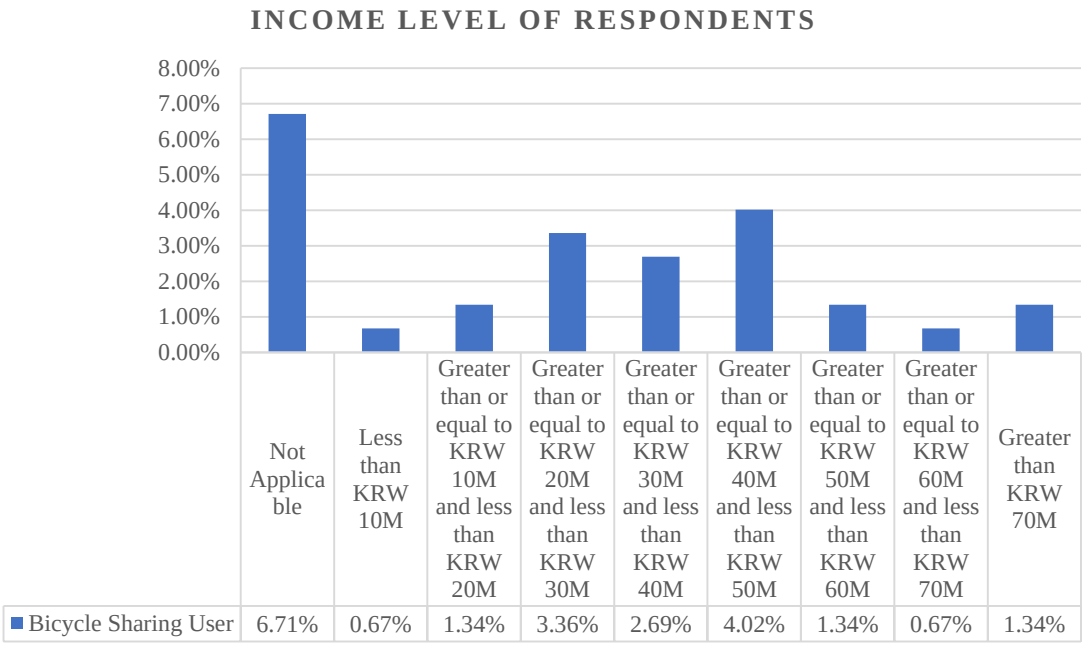


Figure 7. Income level of respondents

Considering that the actual users responded that economic advantage of the scheme gave them satisfaction, this result may be associated with the locations of docking stations. In fact, the docking stations of Seoul City's Ttareungyi are concentrated in the Financial Business District of Yeouido and nearby areas where the average income level is in general high, leading to different user base compared with other locations of docking stations in residential areas (Jang, Gim & Lee 2016). That middle and high income earners, or affluent user base, accounted for the larger user base could also mean that riding sharing bike can become "trendy", and as

social norms are changing, other groups of population could follow the trend (Murphy and Usher, 2015).

VII. Conclusion

7.1 Summary

The study analyzed sharing economy in transportation, in particular bicycle sharing, taking an approach based on user's attitudes such as satisfaction and intention, with a view to facilitate government policy efforts to promote bicycle sharing scheme in South Korea. It was in line with the recent adoption of the Paris Climate Agreement and Sustainable Development Goals that government at central and local levels initiated policy measures for an environmental purpose. Bicycle sharing, for one, has been promoted as a plausible solution to address environmental problems in the modern society where air pollution has increasingly become a threat to governments around the world.

To understand bicycle sharing program, this study first provided overview of the development of the definitions of sharing economy, which was followed by the history of bicycle sharing programs. The initial bicycle sharing program was introduced first in the Netherland around 50 years ago, but then evolved with technological advancement into the second, third, and fourth generation to date. First generation of bicycle sharing program was criticized for being susceptible to theft, which was overcome with the installment of docking stations, integration of advanced technology, and membership subscription scheme. Then, the study introduced the bicycle sharing programs in South Korea, with an example of Seoul

Metropolitan City which claimed to be a ‘sharing city’ (Harald, 2013) and launched public bicycle sharing program called Ttareungyi.

Sharing economy is inevitably followed by behavioral change from ownership to sharing. Previous studies on sharing economy also applied customer satisfaction theories which, in a wider spectrum, include “Macro-model” theory, self-efficacy theory, and loyalty theory to examine customer experience, fulfilment of the need and intention for a future behavior. Therefore, with a focus on the attitudes that can affect customers’ behavior, the study hypothesized mobility, storage, sustainability, technology, economic and trust utility affect the level of satisfaction and loyalty for the existing bicycle sharing users, and the intention to use and expected satisfaction for the potential bicycle sharing users.

The data was collected through the means of survey, which found that economic utility affected the bicycle sharing users to be satisfied with the service. It also revealed that mobility, storage and economic utility affected those with no previous bicycle sharing program to have the intention to use the service in the future. The study analyzed that satisfaction is related to loyalty, and that intention to use is associated with expected satisfaction.

The findings of this study indicate that government policy to promote bicycle sharing scheme would be better to focus on the scheme’s economic advantage to be truly effective. The fact that many people who responded the survey still have not heard about bicycle sharing program and that they have not used bicycle sharing service even though the docking stations were nearby shows the possible need to adjust the policies. Potential improvement in terms of management and policy implementation is suggested in the next two sub-chapters.

7.2 Managerial Implication

Depending on the country, bicycle sharing service providers are either or both public and private. This study was conducted in South Korea where the service is provided only at the local government at the moment, so the implication can be applied at the public level. Based on the findings of the data analyses, this study proposes three managerial implications.

First, the bicycle sharing program currently operated in South Korea should make full use of the technology and target wider population. It was found during post-survey conversation with a respondent that only Android-based smartphone can download the bicycle sharing service application. An iPhone user has no choice but to open the internet app, go to the service website, log in, find the appropriate menu to be finally able to use the service. According to the definition of sharing economy by Gansky (2010), the service should be provided on an information-based and network-enabled platform for the users to enjoy it. Thus, the bicycle sharing program may need to be compatible in different operating system of smartphone device so that wider population can have an access to the service in a convenient manner.

Second, among the respondents surveyed, about 33% answered that they have not heard about bicycle sharing program. Unlike other sharing economy service such as car sharing and accommodation sharing where representative brands are well known to people (Zipcar, Socar for car sharing, and Airbnb for accommodation sharing), bicycle sharing service does not have major brand power yet in South Korea. A strong brand image may be required for the bicycle sharing service provided in Korea to attract more users and achieve what it initially aimed for. Paris' Vélib can be a model to learn and follow to enhance the brand power.

Third, it may be possible to try docking station-free bicycle sharing. Such attempts are already realized in countries like Denmark and China. The increased flexibility would overcome the inconvenience that users have to find nearby docking stations for pick-up and drop-off a bicycle. For instance, Donkey Bikes of Copenhagen are equipped with GPS technology that indicates the location of reserved bicycles on the user's mobile application (www.donkey.bike). Users can unlock the bicycle via Bluetooth, and lock it again if it is not used. Considering that the survey result of the study showed that technology utility was not significant for both the users and potential users, development and application of cutting-edge technology in the bicycle sharing economy seem to be needed. In line with the fourth industrial revolution, the innovation combined with the new payment, operation, and reservation technologies of bicycle sharing service may be able to enable "technology transfer (Parkes et al., 2013)" to other sharing economy services, too. This technology diffusion is likely to accentuate demand-responsive system and integration of data with public transportation, and to allow collaboration between different authorities including finance, information security, transportation and private entities, as an example.

7.3 Policy Implication

A number of studies have already stated the potential benefits that are associated with bicycle sharing (Shin, 2015, Jang et al., 2016, and Kwon, 2014). The benefits include reduced toxic chemical in the atmosphere, health benefits, less congestion, cost savings, among others. In fact, some local governments in South Korea have been operating bicycle sharing program with a view to promote public health and protect the environment (Kwon, 2014). However, this study found that the policy to promote bicycle sharing should focus on its economic advantages

more than other potential benefits. The survey results showed that cost saving by using bicycle sharing service was directly related with the users' satisfaction and non-users' intention. This finding can be relevant to policy design and planning practice which follows a top-down approach in South Korea. Economic utility-focused policy would be able to achieve its intended goal of expanding the user base, and at the same time, indirectly contribute to meeting the environmental goal, as well.

In case that bicycle sharing is promoted as a substitute for car, it should be also noted that the transit effect is actually limited (Gössling, 2013; Kwon, 2014). Previous studies on transportation behavior change found that people ride bicycle substituting for walk, but not for private car (Kwon, 2014). Shaheen et al. (2010) stated the carbon emissions reduction effect that bicycle sharing could bring about, but it could be only realized if bicycle is replacing private car. Gössling (2013) studies the mixed results of substitution effect of bicycle sharing, while this study also found sustainable utility was not directly related to user's satisfaction and potential users' intention from the survey analysis. However, bicycle still has a potential to be a "last mile" modal choice for one-way and multi-modal connectivity, serving as a key link from the origins to destinations. The fact that 67% of the respondents have heard about the service would mean that it has the potential to be widely used in the future. From a policy perspective, providing economic incentive for the modal shift from private car to public bicycle can accelerate the transition to a more sustainable mode of transportation including bicycle sharing. As suggested by Murphy and Usher (2015), it may need to be followed by hard policies with more stations and more bicycle units available with bicycle only lanes that are of close proximity to public transportation stops. This is also supported by Fishman et al. (2014) that

limited docking stations were one of the barriers to bike sharing memberships as convenience emerged as a key driver of using sharing bicycle.

In the meantime, the linkage between bicycle sharing and sustainable development could be more strengthened. For this, soft policy as well as hard policy should be employed at the same time. Earlier experience of Denmark's bicycling policy showed that soft policies can be creating positive images of bicycle, relating to fun, convenience and safety (Gössling, 2013). In addition, education is considered important in successfully promoting sustainable transport behavior. Another implication for soft policy is to raise awareness of bicycle riders on the road among car drivers. Murphy and Usher (2015) advocated the impact of bicycle sharing scheme that it contributes to improving drivers' behavior behind the wheel towards cyclists and their level of tolerance of cyclists as co-users of the road. Meanwhile, Gössling (2013) suggested that travel planning using smartphone applications, information on alternative transport modes, and car sharing initiatives as effective soft policy measures. Sustainability arguably contributes to developing sharing economy, and vice versa (Harald, 2013). Therefore, the policy designed for the development of bicycle sharing scheme, either soft or hard, or both, has a broader implication for a mature sharing economy and sustainable development for wider parts of society.

7.4 Future Research and Limitation

This study examined bicycle sharing in South Korea in terms of how the existing users and potential users perceived it. Other studies on bicycle sharing attempted to focus on the demographic characteristics of the users of bicycle sharing service, including gender, income, age, and area of residence that are believed to have substantial influence on the attitudes of

users. The barriers to bicycle sharing scheme was explored by another study. However, given the limited number of survey respondents, and the actual users being only 22% of the total respondents, analyzing the behavioral differences by gender, income and age would not have produced meaningful results. In addition, although the survey for this study was distributed randomly throughout the nation, it could also have made sense if the survey was conducted for a few selected regions where bicycle sharing service was actually provided. That way, the number of actual participants in bicycle sharing program would have been more than it was for the study.

Since there are just too many areas sharing economy is working, including transportation, bicycle sharing alone cannot speak in general for the overall sharing economy. However, it does provide a message that government-led sharing economy is distinctive from market-based sharing economy, and that government can be playing a role of sharing economy participant as service provider. Recognizing the difference between public and private bicycle sharing schemes, future research could also be made by comparing the designs, operation and effectiveness of publicly provided service and privately operated one. In addition, users' perception and attitudes towards bicycle sharing service would differ depending on the service provider. So it would be interesting to look at how the influencing factors differ from each other.

For the purpose of offering insights for policy-makers, this study lacks integration of expert's perspectives. User's perceptions are usually discussed in studies on sharing economy, but not many previous studies analyzed the factors influencing bicycle modal choice from service providers' point of view. In this sense, interviews and surveys with the implementers

of the scheme would be useful for a future research, which can also produce practical policy insights.

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Appendix A.

Exploring Factors of Satisfaction
Applied in Sharing Economy Model (In case of bicycle sharing)

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Background Information

Bicycle sharing is a transportation service offered by the government or a private company, making bicycles available for shared use with a relatively inexpensive subscription fees. It is designed to encourage people to use bicycle to reach the final destination, instead of greenhouse gas (GHG)-emitting vehicles, to contribute to GHG mitigation and sustainable transportation. Advanced technologies and a huge smartphone population enable users find nearby docking stations, and rent and return a bicycle at ease.

Photo 1. 'Ttareungyi' Bicycle Sharing in Seoul

Photo 2. Euling Bicycle Sharing in Sejong

Part 1: Experience in Public Bicycle Sharing Service

Please answer the following questions based on your experiences from public bicycle sharing service

1. Have you ever heard any services from sharing economy? (e.g. sharing car(SoCar), sharing accommodation(Airbnb) ..... ( ) Yes ( ) No
2. Have you ever used sharing economy service? ..... ( ) Yes ( ) No
3. Have you ever heard about bicycle sharing service? ..... ( ) Yes ( ) No
4. Have you ever used bicycle sharing Service? ..... ( ) Yes ( ) No
5. Do you work or live near bicycle sharing docking station? .....( ) Yes ( ) No
6. Are you a bicycle owner? ..... ( ) Yes ( ) No

Part 2: Please rate your opinion on a scale of 5

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

	1. Mobility Utility					
a.	Bicycle sharing service gives me more freedom of mobility.	1	2	3	4	5
b.	I would like to use bicycle sharing service, if I want to go somewhere close but not connected by public transportation.	1	2	3	4	5
c.	I think I would use bicycle sharing because of its travel flexibility.	1	2	3	4	5
	2. Storage (Parking) Utility					
a.	One great thing about bicycle sharing service is not being responsible for finding space to store bicycle.	1	2	3	4	5
b.	I like that I don't have to waste my time for looking for storage place because the docking stations are closer to work and home.	1	2	3	4	5
c.	I like bicycle sharing service because I can easily access a transportation without concerns about storage.	1	2	3	4	5
	3. Sustainability Utility					
a.	I would use bicycle sharing because bike-riding is more pro-environmental than automobile because it does not emit toxic chemicals.	1	2	3	4	5
b.	I like that if I use bicycle sharing, I can make a contribution to protecting the environment.	1	2	3	4	5
c.	I would use bicycle sharing because it will help to protect the environment.	1	2	3	4	5
	4. Technology Utility					

a.	The internet and smartphone is useful for using bicycle-sharing service.	1	2	3	4	5
b.	The internet and smartphone provide me quick and easy access to the docking station and to use the service.	1	2	3	4	5
c.	I like that Internet and smartphone enable me access the bicycle without owning it.	1	2	3	4	5
	5. Economic Utility					
a.	I believe that bicycle sharing service save my money in many different aspects such as owing and parking, oil price, maintenance, insurance, and so on.	1	2	3	4	5
b.	I like the fact that bicycle sharing service because it saves my time: searching time for parking lots, driving unnecessary distance, and suitable for getting to the final destination.	1	2	3	4	5
c.	I believe I can save more money when I use bicycle sharing than driving a car.	1	2	3	4	5
	6. Trust Utility					
a.	I will be happy if drivers of motorized vehicles make bike-riders feel safe on the road.	1	2	3	4	5
b.	I will be happy that users of bicycle sharing service are truthful in dealing with one another.	1	2	3	4	5
c.	I trust that the service provider will give enough safeguards to protect me from liability for damage so that I am not responsible for.	1	2	3	4	5

Have you ever used bicycle sharing service?..... ( ) Yes ( ) No

Part 3. If you have NOT used public bicycle sharing service, please continue answering this section. If you have an experience, please proceed to the next page (4).

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

	Purpose of Use (If you have no experience of public bicycle sharing)					
a.	I expect to use bicycle sharing in the near future.	1	2	3	4	5
b.	I am considering the use of bicycle sharing service.	1	2	3	4	5
c.	I would like to use bicycle sharing service.	1	2	3	4	5
d.	When I need to go somewhere next time I will try bicycle sharing service.	1	2	3	4	5

If you use bicycle-sharing service, what would be the purpose of using the service? (multiple answers allowed)

( ) Commuting ( ) Work(e.g. outside duty) ( ) (grocery) shopping
( ) Picking up/seeing off someone ( ) Social activity/leisure ( ) Traveling
( ) Personal issues ( ) Others (specify: _____)

Expected satisfaction (If you have NO experience of bicycle sharing)

a.	I think bicycle sharing service would satisfy my expectations.	1	2	3	4	5
b.	In general, I think I will be satisfied with bicycle sharing.	1	2	3	4	5

Part 4. If you have used public bicycle sharing service before, please answer this section. If you have not, please proceed to Part 5.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

1. How many times have you used bicycle sharing service?

( ) Once or twice a month ( ) Once or twice a week ( ) Three or four times a week
( ) More than 5 times a week

2. What is your purpose of using bicycle sharing service? (Multiple answers)

( ) Commute ( ) Work-related ( ) (Grocery) shopping
( ) Social purposes/leisure ( ) Travelling ( ) Personal ( ) Others (speficy:_____)

Satisfaction with bicycle sharing service

a.	Bicycle sharing service meets my expectations.	1	2	3	4	5
c.	I am satisfied with my previous experience with bicycle sharing.	1	2	3	4	5
d.	In general, my experience with bicycle sharing service is positive.	1	2	3	4	5

Loyalty to bicycle sharing service

a.	I will try to use bicycle sharing service again.	1	2	3	4	5
b.	I think I will recommend bicycle sharing service to friends and family.	1	2	3	4	5
c.	I intend to continue using bicycle sharing service in the future.	1	2	3	4	5

Part 5. Demographic Question

1. **Sex:** ( ) Female ( ) Male
2. **Marital status:** ( ) Married ( ) Unmarried
3. **Number of family members:** ( ) 1 ( ) 2 or 3 ( ) more than 4
4. **Age:**

( ) Less than or equal to 20

( ) 21 to 30
( ) 31 to 40
( ) 41 to 50
( ) 51 to 60
( ) Greater than or equal to 61

5. Level of education:

( ) High school or less
( ) Attending vocational university
( ) Graduated from vocational university
( ) Attending 4-year university
( ) Graduated from 4-year university
( ) Master's degree or beyond

6. Occupation:

( ) Student ( ) Office worker ( ) Self-employed ( ) Civil servant
( ) Housewife ( ) Others

7. Average annual salary:

( ) Not applicable
( ) Less than KRW 10 M
( ) Greater than equal to KRW 10 M and less than KRW 20 M
( ) Greater than equal to KRW 20 M and less than KRW 30 M
( ) Greater than equal to KRW 30 M and less than KRW 40 M
( ) Greater than equal to KRW 40 M and less than KRW 50 M
( ) Greater than equal to KRW 50 M and less than KRW 60 M
( ) Greater than equal to KRW 60 M and less than KRW 70 M
( ) Greater than KRW 70M

8. Area of residence:

( ) Seoul
( ) Gyeonggi
( ) Chungcheong
( ) Gyeongsang
( ) Jeolla
( ) Jeju
( ) Others (specify: _____)

Thank you for your time to respond to the survey !