

# A Study on the Design Strategy for Promotion of Bicycle Use

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**Abstract:** Despite the merits of bicycle riding, the rate of bicycle use in South Korea is far lower than Europe and Japan. In this study, by analyzing structural context of cycling environment and behavior, the factors that impede the popularization of bicycle use in South Korea were evaluated, and a design strategy for encourage the bicycle use was suggested. This study also stressed the importance of the establishment of material infrastructure and the development of new types of bicycle in order to accommodate the user's lifestyle, adverse natural environment, and unexpected traffic accidents.

**Key words:** *rate of bicycle use, environment for bicycle use, transportation allotment rate*

## 1. Introduction

Since a bicycle, an instrument operated only by human physical power, was originally invented as the device for transport and conveyance, it has been continuously developed in the structure and function for a long period of time so much so that nowadays bicycles are used not only as an effective transportation instrument but also as a tool for physical exercise and leisure-time activity[2] Bicycle riding enables the rider to consume 780kcal on 25km/h, which makes it a still more effective aerobic exercise than other types of physical exercise. Besides, considering that the national annual expenses required by traffic congestions amount to 22 billion 800 million won, the increase of bicycles' transportation allotment rate by 1% will generate the economic effect of more than 1 billion won by causing the dissolution of traffic congestion, energy saving, and environmental benefits. Also, the one-kilometer bicycle riding is equivalent to the reduction of CO<sub>2</sub> by 167kg. Therefore, a bicycle is a pro-environmental means of transportation [1] However, the current rate of bicycle use in South Korea is still lower than other advanced countries. The road structures and governmental traffic policies which give first importance to automobiles, have aggravated the already disadvantageous condition for bicycle use, which had in turn led to the decrease in the rate of bicycle use. Bicycles' transportation allotment rate is 1.2% in South Korea, which is far behind in comparison to Japan (14%) and Netherlands (27%). In the mean time, South Korea's industrial foundation of bicycle production has been weakened, turning the market initiative over to the bicycles made in China. As a result, the adverse balance of trade has been so much exacerbated that currently imported products account for 99.8% of the demand for bicycle[4] Such an indifference to bicycle use has brought about the decrease in the rate of bicycle use and the decline of the related industries.

This study examines the function of bicycle design as an important factor for the popularization of bicycle use. It uses as research methodology the investigation of the context surrounding bicycle use and of the problems that obstruct the invigoration of bicycle use. Based on the researches, this study proposes the structural approaches to the matters pertaining to material infrastructure, social infrastructure, and bicycle industry. Lastly, it examines the function that bicycle design may perform in such structural contexts.

**2. Understanding the Context Surrounding Bicycle Use**

**2.1 Analysis of the condition of bicycle uses by the 5W1H method on each page your material**

This section analyzes the condition in which bicycle use is to be actualized with recourse to the 5W1H method. Activating bicycle use first requires the components of 'What,' that is, proper function, structure, and price. The components of 'Who' are comprised of the user's age, gender, occupation, lifestyle, and so on. 'Where' refers to environment that includes road condition, traffic signal, and other facilities. As such, the bicycle, the user, and the environment constitute the three major elements of bicycle use. To these can be added the purpose of bicycle use which corresponds to 'Why,' the hours of bicycle use which is equivalent to 'When,' and the way of bicycle use which falls on the category of 'How.' The purpose of bicycle use includes commuting, physical exercise, leisure-time activity, and daily movement: and the method of bicycle use can be divided into riding whole distance, transferring to another transportation, long-distance riding, short-distance riding, etc. By investigating the time frame of bicycle use, we can define the daily hours, the weekly dates, and the seasons, during which the citizens favor bicycles over other transportations. When the components of 5W1H are in preparation, the event of bicycle use takes place.

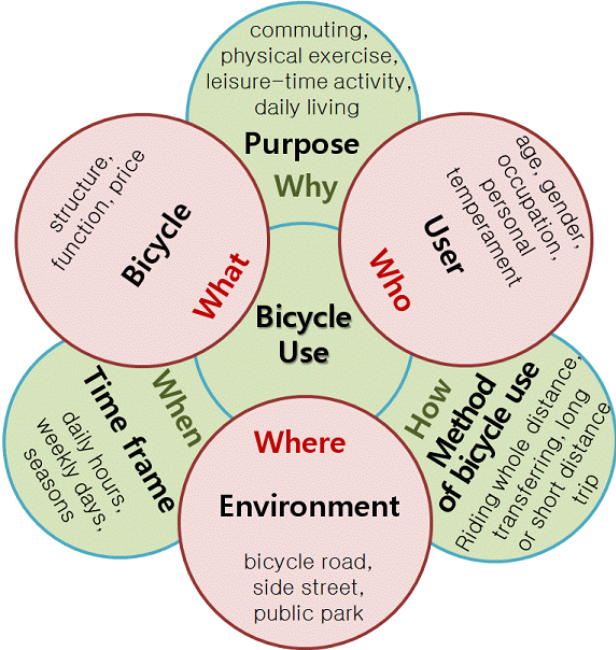


Figure.1 Analysis of Bicycle Use by the 5W1H Method

**2.2 Analysis of temporal progression from preparation to follow-up action for bicycle use**

In order to understand the context of bicycle use in different perspective, this section examines the temporal progression from preparatory phase of bicycle use to follow-up action to be taken after the bicycle use is completed. For the event of bicycle use to take place, a user and a bicycle must be in place. The user is expected to have a purpose and a justifiable reason for bicycle riding, while bicycles are to be produced and supplied to meet the demands in the market. The procedure up to this point can be classified as the 'preparatory phase.' The 'use phase' in which bicycle use is actualized can be subdivided into riding and parking. In the phase, it is required to establish not only the material infrastructure which includes bicycle roads, traffic signals, subsidiary facilities, and bicycle equipments, but also the social infrastructure comprised of bicycle-related traffic laws and systems. Accident, theft, and mechanical trouble may occur during bicycle riding. Such 'negative incidents' put a

stop to bicycle use and require adequate follow-up measures. Medical treatment is to be provided to an injured user, while the malfunctioning or deserted bicycle is to fall into disuse or be recycled.

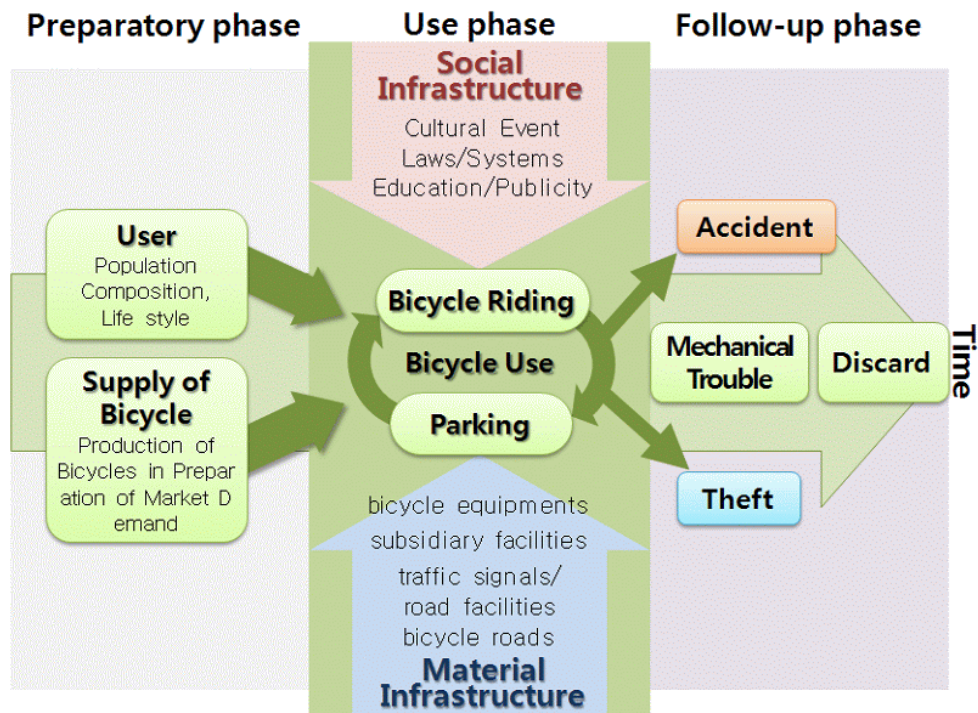


Figure.2 The Context of Temporal Progression of Bicycle Use

### 3. Analysis of the Domestic Environment for Bicycle Use

For an analysis of the domestic environment for bicycle use, this section investigates the six areas that form the context of bicycle use, such as ① user, ② bicycle, ③ material infrastructure, ④ natural environment, ⑤ social infrastructure, ⑥ negative incident. Those areas come from the context of temporal progression of bicycle use.

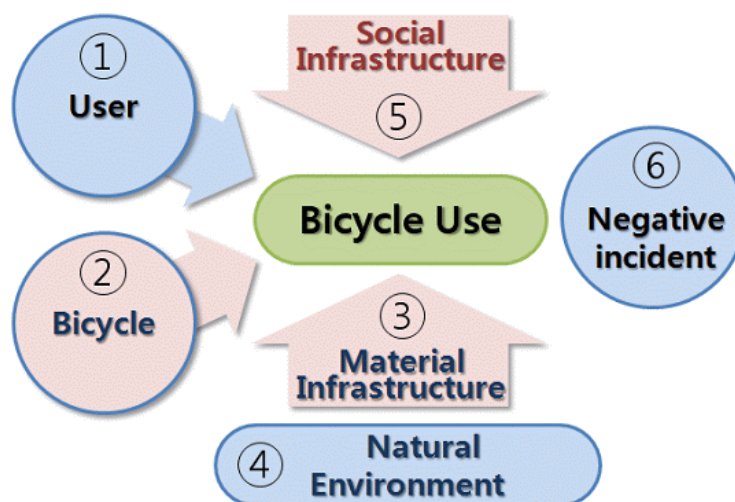


Figure.3 Six Areas for the Analysis of the Current Condition of Bicycle

### **3.1 The lack of the user's motivation for bicycle use**

People are not sufficiently motivated to use bicycles. According to a survey conducted by the Ministry of Public Administration and Security, 66% of the respondents marked 'Lack of Interest' for the reason of not using bicycle. Apart from the purpose of physical exercise, people find no benefit in bicycle riding because cars are faster and more convenient for them to use in commuting to workplace and school and in securing the mobility for daily living. Despite the losses of time and money which result from traffic congestion and parking difficulties in the downtown area, people are still unwilling to turn to bicycle riding. Under these circumstances, it is notable that, in the 1970s, the Dutch government had to rely on the restriction of car use in addition to the building of bicycle lanes to raise the rate of bicycle use.

### **3.2 The weakening of the industrial foundation of bicycle production**

Because little industrial foundation for bicycle production remains in South Korea, cheap bicycle products made in China fill the majority of bicycle supply in the country. This situation has enabled the users to purchase bicycles in low price, but the problems of frequent mechanical troubles and unreliable durability have arisen. Given that the industrial power for the development and production of bicycles has been exhausted, it seems difficult for the domestic industry to meet the potential demands in the bicycle market.

### **3.3 The sack of material infrastructure**

The amount of bicycle lanes is far from sufficient in South Korea. Most bicycle lanes paved on city roads are also for pedestrians, and quite a few existing lanes are hard to use because tree-lines and street vendors often block the way. To be realistic, bicycle lanes must be placed side by side with car roads. Besides, the traffic signals for bicycle lanes are few and far between: the absence of the traffic signals is likely to cause dangerous situations especially at an intersection or a bus stop where road blockages are laid. To make matters worse, public bicycle storages are either insufficient or inoperative. Bicycle racks are built in public spaces such as station and terminal but are extremely vulnerable to theft and adverse weather conditions. Lastly, repair shops and other bicycle-related facilities are not enough for the users to receive a repair or check-up service when a mechanical problem unexpectedly occurs.

### **3.4 Adverse natural environment**

Natural environment is particularly adverse to bicycle use in South Korea. Even the big cities like Seoul and Busan are covered with mountainous areas to a large extent, which have at times violent fluctuations in altitude. It must be difficult to ride a bicycle on the inclined road. Furthermore, since we have distinctive four seasons in South Korea, bicycle riding should be affected by weather condition: cold weather, hot weather, and rainy weather make it practically impossible to ride a bicycle.

### **3.5 The lack of social infrastructure**

Social infrastructure for bicycle riding is not satisfactorily established. According to the traffic law regarding bicycle, a bicycle is equivalent to a car so that if a pedestrian is collided with a running bicycle, the bicycle rider should take the blame. The Road Traffic Act needs to prepare a clause to refine bicycle riders as the underprivileged to be protected on the road. Although the Bicycle-Use Promotion Law has been elaborated since 1995, there is still much to be desired in the law. Preschool education and elementary-school education take little consideration for the promotion of bicycle use among students; there are also few chances for ordinary people to experience bicycle culture through such events as cultural festival, cycling competition, Experience House, or

theme park. In short, there are few opportunities offered to ordinary people to learn about the merits and method of bicycling.

**3.6 The occurrence of bicycle incidents**

With the recent upsurge in the number of bicycle users, the occurrence rate of bicycle incident has drastically increased. For the last three years, the fatal bicycle incidents have increased by 47.9%, and the 64% of the victims were old people. Most frequent is the incidents that occur when a bicyclist is riding in dead angle at an intersection. Bicycle thefts also occur more often than not. In Netherlands, as the rate of bicycle use and the number of bicycles per household are high, so is the number of bicycle thefts equally high. The frequent occurrence of bicycle theft on the street results in the decline of people's interest in and use of bicycles. The fact that the international market for burglarproof bicycle lock is on the rise testifies to the seriousness of the matter of bicycle theft. Meanwhile, we can almost always see one or two abandoned bicycles in a bicycle rack: such bicycles remain that way for months or years, wasting public spaces.

**4. Structural strategy for the promotion of bicycle use**

In the preceding chapter, we examined the context of bicycle use in terms of user, bicycle, social infrastructure, material infrastructure, natural environment, and the occurrence of negative incidents. Among these, bicycle, social infrastructure, and material infrastructure are the factors that can be improved by the enactment of human creativity and will. On the other hand, it is impossible to control the remainder of the factors such as user characteristics, natural environment in which one should ride a bicycle, and negative effects like bicycle incidents. However, these matters can be controlled to a large extent through the manipulation of bicycle, social infrastructure, and material infrastructure. Therefore, we can establish a structural strategy for the promotion of bicycle use by matching user characteristics, adverse natural environment, and negative incidents with bicycle supply, material infrastructure, and social infrastructure, respectively. In what follows, we will propose the solutions to the problems that arise in the areas of user demand, adverse natural environment, and negative incident.

**4.1 Meeting user demand**

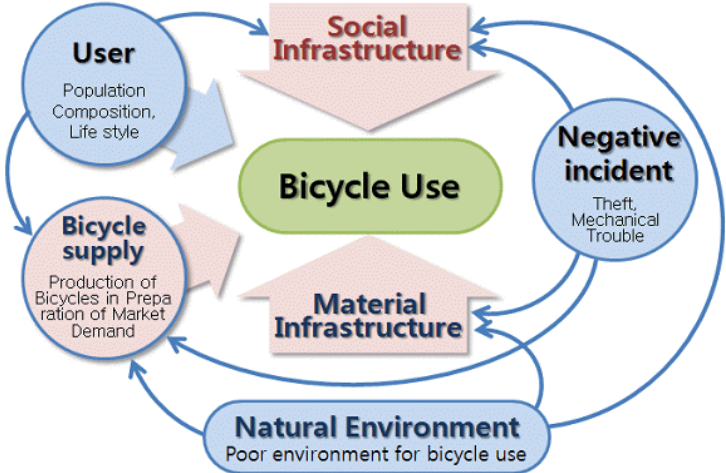


Figure.4 Structural Strategy for the Promotion of Bicycle Use

In order to meet user demand, it is required to take into consideration the purpose and method of bicycle use. The purpose of bicycle use can be divided into commuting to work place or school, long-distance travel, moving

in the downtown area, and physical exercise, while the method of bicycle use is comprise of riding whole distance and transferring to other transportation. If one regards a bicycle as a mere instrument for moving to a destination, the time length required to ride the bicycle bears little significance: what matters is the fast and safe movement. In this case, one may use a bus, a train, or a subway to move fast from one terminal to another, and then ride a bicycle to reach the final destination. For the purposes of physical exercise and travel, the time length of bicycle riding becomes important. In this case, one would only use a bicycle at the expense of other transportations. Thus, the method of bicycle use varies depending on the purpose of bicycle use. To support this mutual relationship, it is required to build reliable public transportation transfer systems.

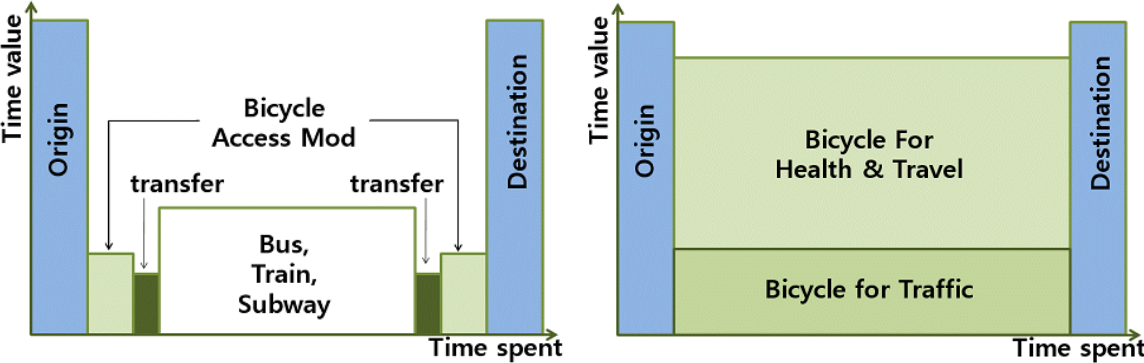


Figure.5 Methods of Bicycle Use Depending on the Purpose of Bicycle Use  
 (Left: Transferring to Other Transportation, Right: Riding Whole Distance)

In the mean time, the introduction of bicycle rental system, which is to promote urbanites' bicycle use in the downtown areas, is being seriously considered by the local governments in South Korea. After Vélib' the bicycle transit system introduced by the city of Paris turned out to be successful, the local governments in South Korea are trying to install similar systems. The prospect of the bicycle transit system looks optimistic in that it will take up a part of the demand for public transportation and make people feel familiar with bicycles, which will eventually promote bicycle use among the public. However, It is desired to examine more closely the needs and deeds of the users to make the system produce practical outcome.

As a way to invigorate bicycle use among the public, the local governments give various benefits to the customers who use bicycle to shop at department stores and downtown commercial districts. For this reason, it is needed to develop a "living-friendly bicycle" which emphasizes practicality and convenience. As popular interest in leisure-time activities grows, there appeared the people who drive cars to arrive at travel spots where they ride bicycles for sightseeing. Riding bicycle to a travel spot or a place for bicycling not only demands enormous physical strength but also involves danger in the process of moving out of the downtown by the bicycle. Therefore, it is needed to reinforce the folding function of a bicycle to be easily loaded into a car. It is also desired to develop new bicycle designs for new types of leisure activities such as long-distance bicycle travel.

What draws our attention in future population trend is the change of population structure and the customization of bicycle design. A rapidly aging society like South Korea requires the development of bicycle that meets the physical and mental demands of aged users, while the customization of bicycle design refers to building of bicycle body and design according to personal specifications or preference.

In addition, the efforts to promote the public interest in bicycle use and motivate people to use bicycles should be made in area of social infrastructure. Not only the financial supports for bicycle users such as tax cut and the bestowment of carbon emission right, but also educational programs and publicities are required to induce ordinary people to consider bicycle use seriously. Especially, the education of bicycle use for preschool children and students will make them think positively about bicycle use throughout their lives.

#### **4.2 Overcoming adverse natural environment**

Adverse natural environment exist such as the road condition characterized by the fluctuations in altitude and the weather condition characterized by drastic changes. To overcome, for instance, the condition of inclined road, a bicycle can be equipped with an electronic motor or an instrument that accelerates power transmission. In terms of facility, a bicycle lift can be installed on a slope. To cope with unfavorable weather conditions such as rain, cold weather, and hot weather, a lid can be attached onto a bicycle. Of course, no all bicycles are to be covered with lids: it is needed to clarify target customers who would need lid-bicycles.

Since car-oriented roads render difficulties to bicycle use, bicycle lanes, traffic signals, and other convenient facilities are to be provided. The tube-shaped bicycle lanes which, according to the government announcement, are to be paved across the downtown area of Seoul can be a good countermeasure to surmount the adverse environment for bicycle use. National roads and provincial roads are covered with mountainous areas, posing another difficulty to bicycle use. To enable long-distance bicycle travel, it is required to build the bicycle-lane network across the country. A legal provision that enforces the environmental consideration for bicycle use needs to be imposed new land-development schemes.

#### **4.3 Countermeasures against the negative effects of bicycle use**

To prevent bicycle incidents, we may conduct the countermeasures such as the incident prevention education, the building of traffic facilities and traffic signals, and the development of the bicycle with alarm function. In terms of social infrastructure, educational programs, in which the danger of bicycle incident is taught to the users based on the statistical information about the examples and types of bicycle incident, are to be prepared. Furthermore, in preparation for an unexpected bicycle incident, the institutional supports such as bicycle insurance and bicycle law must be provided: the institutional supports will serve to prioritize bicycle use in comparison to other types of transportation. In terms of material infrastructure, traffic signals must be augmented at the intersections where incidents frequently occur, and bicycle lanes are to be expanded. Information technology will enable us to develop a danger-prevention sensor to be attached to a bicycle or an urgent communication system in the case of an incident.

Regarding the matter of bicycle theft, we can think of two approaches: prevention and retrieval. For the prevention of bicycle theft, the improvement of burglarproof lock and the augmentation of bicycle racks are to be considered. For instance, in Toronto, Canada, the public bicycles are designed in the way that they are not to be destroyed by ordinary tools: in that way, theft and damage are effectively blocked. Bicycle racks can be built within a tower building instead of being exposed to burglary outside buildings: the bicycle storage building will also contribute to the effective use of public space. As a component of social infrastructure, bicycle registration system, once implemented, will serve to prevent bicycle theft. If the police manage the information on registered bicycles, it will be much easier to confirm and retrieve stolen bicycles. In fact, bicycle registration system is at work but not much effective in Japan. Therefore, we need to prepare countermeasures against the situation in which the registration system does not work satisfactorily. Bicycling makes the user sweat; therefore, work

places are desired to build shower facilities in their buildings. Also, repair shops are to be in place by the streets in case that mechanical trouble occurs.

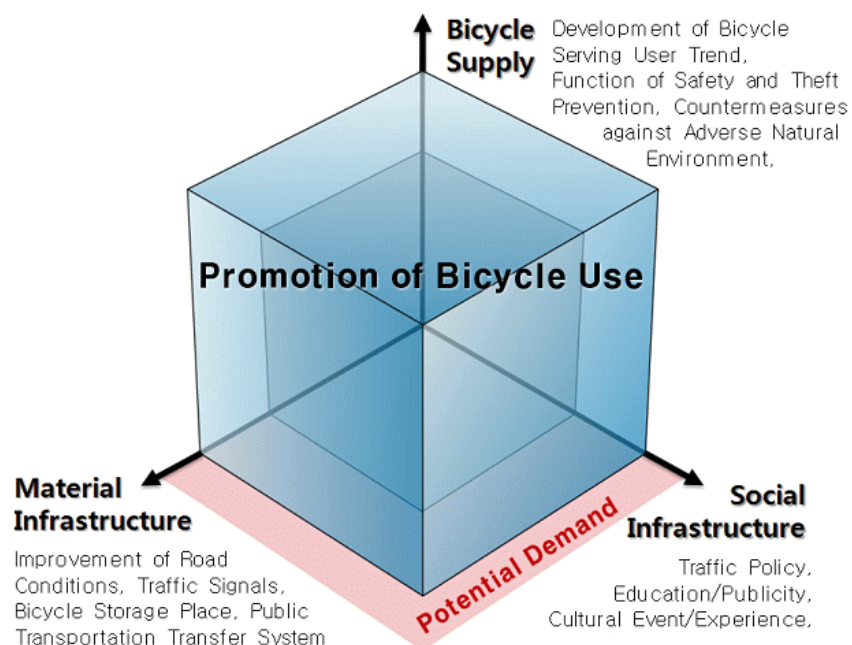


Figure.6 Strategy for the Promotion of Bicycle Use Base on the Reciprocal Relationship between Bicycle Supply, Material Infrastructure and Social Infrastructure.

Table 1. Structural Strategy for the Promotion of Bicycle Use

|   | Bicycle   | Material Infrastructure  | Social Infrastructure  |
|---|---|--|--|
| User Demand, (Changes in Population Composition & Lifestyle)      | *Living-friendly Bicycle<br>*Folding Bicycle<br>*Bicycle for the Old<br>*Bicycle for Travel and Leisure Activities/Bicycle with Customized Design & Structure | *Bicycle Transit System<br>*public transportation transfer system                    | *Financial Support Policy<br>*Early Education & Publicity about Bicycle Use  |
| Natural Environment (Adverse to Bicycle Use existing environment) | *Power assisted bicycle<br>*Bicycle with a Lid  | *Bicycle Lift<br>*Tunnels for Bicycle Lanes<br>*Countrywide Network of Bicycle Lanes | *Bicycle-friendly Policies Including the Enforcement of Bicycle-related Facilities in New Building Construction and Land Development |
| Countermeasures against Negative Effects                          | *Danger-Prevention Sensor Combined with Information Technology<br>*Theft-Prevention Technology<br>*Bicycle with Durable Body & Solid Structure                | *Bicycle Lane<br>*Traffic Signals at an Intersection<br>*Bicycle Storage Tower       | *Incident Prevention Education<br>*Bicycle-oriented Traffic Law<br>*Bicycle Insurance<br>*Bicycle Registration System                |



## 5. The Role of Design for the Promotion of Bicycle Use

We have examined the measures to be taken in the areas of bicycle supply, material infrastructure, and social infrastructure for the promotion of bicycle use. Design plays an important part in the areas of bicycle supply and material infrastructure, both of which cover the process of product development.

At first, in the perspective of bicycle supply, living-friendly bicycles are to be diversified. For example, it is required to design a bicycle specifically used for short-distance riding to a shopping center to a park in the neighborhood.

Furthermore, it is needed to make a folding bicycle simple, small, and light to enable the user to bring it easily into a bus or a subway train. Bicycles for aged people are also required. In this case, the bicycle must be designed to compensate for old people's deteriorated muscular power and balancing ability. The development of the long-distance bike and the water-sport bike are needed to meet the increasing demand for the bicycles for leisure-time activities. The customized frame design would cater to the user's desire to have his/her own bicycle. In this case, the user's physical traits such weight and heights are to be considered. To enable the bicyclist to ride upward on a slope, the bicycle with an auxiliary power unit must be developed: the auxiliary power unit should be able to balance the user's muscular power with the motor's operative power. A bicycle with a lid that blocks rain or sunshine is to be invented. A danger-prevention sensor and the interactive design to the same effect can be installed into a bicycle. GPS(global position system) for the prevention of theft and durable body structure can also be applied to bicycle design.

In the perspective of facility and infrastructure, bicycle transit system is to be the major component of design strategy. The comprehensive system that includes user registration, certification, rental, return, settlement must be established to operate the bicycle transit system more safely and conveniently. Moreover, the principle of universal design must be maintained to allow all people to use bicycles, and the usability must be considered to enable the user to operate a bicycle intuitively. For a bicycle user who needs to transfer to other transportations must be assisted to safely move the bicycle in a train, in a bus, or in a subway train. Bicycle lifts are to be installed on the slopes where people ride bicycles frequently, and the bicycle lanes and the countrywide network of bicycle lanes are to be established. In building the nationwide network of bicycle lanes, a comprehensive plan must be drafted to allow bicyclist to enjoy the local cultures and landscapes of the regions around the lanes. Traffic signals at intersections are to be designed in consideration of bicycles: in this case, it is required to make practical measures to prevent the collision between a detouring car and a bicycle. Lastly, bicycle storage towers are to be built. Bicycle storage towers are suitable for narrow spaces around public facilities in the downtown area: since they guarantee the safe custody of bicycles, the storage towers will also contribute to the promotion of bicycle use.

## 6. Conclusions

Despite many merits of bicycle riding, the rate of bicycle use is still low in South Korea. However, comprehensive discussions on the issues of the promotion of bicycle use and the reinvigoration of bicycle industry are taking place. Considering the present conditions involving bicycle use, this study has examined the role of design for the promotion of bicycle use.

The research drew on the 5W1H method by which to understand the context of bicycle use, which consists of the definition of the context in which bicycle use takes place and the analysis of the temporal procedure of bicycle use comprised of the preparatory phase, the use phase, and the follow-up phase. In the process, this study defined the structural context which is filled with user, bicycle, natural environment, material infrastructure, social infrastructure, and negative effect, and analyzed the problems that arise in bicycle use. In order to establish a strategy for the promotion of bicycle use, this study analyzed the problems that occur in the areas of user, natural environment, and negative effect, and attempted to find the solutions by matching the three problematic areas with the areas of bicycle supply, material infrastructure, and social infrastructure, respectively. Consequently, it proposed the interaction between bicycle supply, material infrastructure, and social infrastructure as the strategy for the promotion of bicycle use. Lastly, it highlighted the role of design in the areas of bicycle development and material infrastructure as the major factor that will meet the demand for new types of bicycles, overcome adverse natural environment, and prevent negative incidents.

This study has its merit in that it proposes a comprehensive strategy for the promotion of bicycle use and emphasizes the role of bicycle design for the same purpose. We hope that the issue of bicycle design would take the center stage in the social debates on the promotion of bicycle use.

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