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EXAMINATION OF THE BICYCLE FACILITIES: NOHÜ CAMPUS AREA OF NIĞDE

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Abstract: Transportation problems make bicycle transportation attractive. The place and the importance of bicycle becoming more and more evident in terms of sustainable transportation. Sustainable transport includes transport modes such as public transport, pedestrian and bicycle transport with low social, economic and environmental damage. Although the level of bicycle use in Turkey is behind many world countries, recently some applications have been taking care of bicycle routes. Niğde is one of the small-scale cities of Turkey and Niğde Ömer Halisdemir University (NOHÜ) campus can be seen as one of the most spacious places in Niğde. With Areas such as faculty buildings, large parking places, university dormitories, basketball courts constructed far from each other, a bicycle route attract attention which is not actively used. In this paper, in general effective parameters of bicycle facilities for ensuring bicycle use will be mentioned. Then, a bicycle route built at the central settlement of NOHÜ was examined and a solution was proposed to actively operate it as a useful transportation system. Taking the examination into account, suggestions are made to improve the cycling situation at NOHÜ. In doing so, a small-scale online survey study was conducted to reflect the cycling preferences of the proposed bicycle route in the campus. Surveys were attended by 100 persons that 68 of them are students. It was determined that 70% of the respondents did not have a bicycle. Surveys revealed that the purpose of cycling was primarily recreational. 87% of the respondents want to ride a bicycle together with bicycle arrangement. Surveys showed that 55% of the respondents preferred to use the intelligent bicycle sharing system that is free of charged and 20% preferred the bicycle rental system that is free of charged. The provision of bicycles and the arrangement of the bicycle facilities are important issue. It is important that the bicycle facility is regulated in the direction of the bicycle use. For the spread of bicycle use, making prospective projects and applications with faculty of engineering students are planned.

Keywords: bicycle use, bicycle facilities, bicycling preference.

1. Introduction

Bicycle is a widespread and efficient mode of transportation. Today, the external effects of transportation and the support of the concept of sustainable transportation have made cycling particularly attractive especially in urban centres. Some countries forefront policies to make cycling safe, convenient and attractive (Pucher and Buehler, 2008).

When looking at the numbers, there are difference in cycling levels among countries. Cycling modes share rates of commuters (Figure1) are high in European cities especially in Copenhagen, Amsterdam and Berlin (DTU, 2018).

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Generally, the use of this bicycle was not common in Turkey. In general, the lack of bicycle culture, lack of infrastructure, and inadequacy of national and local governments' interest in cycling can be cited as the main reasons. However, besides this, in some cities (as in the example of Konya), cycling was used as a means of daily transportation from the past despite the lack of any infrastructure. Today, 275 km bicycle road is available in Konya and the bicycle usage rate is 5% (Özgürlük, 2016).

In recent years, urban transportation planning includes bicycle-related applications (Mert and Öcalır, 2010). Bike roads and bike sharing applications by the municipalities are drawing attention in order to expand the use of bicycles in Turkey.

Niğde a small city with population of 216,695 and part of Cappadocia Region located in the middle of Anatolia was built on the plain of the west of Kızılcasu valley. The western part of this valley consists of low inclined flat areas. There is cold and long winter season in Niğde. Niğde is covering an Area of 7312km^2 and a density 48 of per km^2. Transportation in this area is largely dependent on private cars and public buses. The number of bicycles is very small and Niğde has not a bicycle culture. The expansion of urban areas and rapidly increasing unplanned construction also affect the transportation in the city and causes distress and confusion in urban traffic especially in the evening hours. Recently, a bicycle road has been built in the opposite direction to the city centre. On this road, intersections created confusion as bicycle conflict with the motorized traffic. Also it seems that pedestrians could be violate this route in its tracks. And it is necessary to take measures in this direction.

Niğde became a university city after the foundation of NOHÜ in 1992. NOHÜ also attracts attention with the feature of being a planned and environmentally sensitive settlement in Niğde. A Bicycle route which is built on a certain area in the university are not still actively used and the lack of regulation on the bicycle path is visible. For the active use of these bicycle route in the campus area, the required conditions have been examined and proposals have been developed which can be affect the quality of life starting from the role of the model of the universities. Important parameters for bicycle transportation have been considered and suggestions for bicycle route have been introduced in order to make better use of this bicycle route available on the University campus.

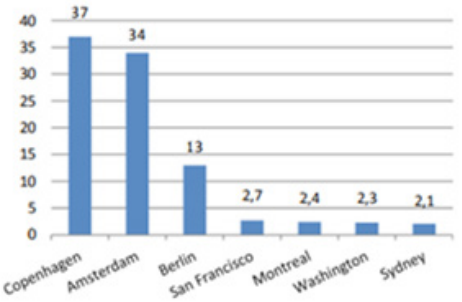

Fig. 1 .
Cycling Mode Share Ratio of Commuters
Source: (Pucher and Buehler, 2008)

2. The Benefits of Cycling

Overall Sustainable transport is an economically consistent, socially just and politically responsible and explainable transport that does not harm the environment beyond its capacity to renew itself. In sustainable transportation, while transport investments are being made, it is considered how to use the existing infrastructure in the most efficient and fair manner (Elbeyli, 2012). Bicycle is a preferred type of transportation in terms of the development of sustainable transportation solutions and the reduction of motor vehicle use.

Cycling has important benefits compared with motor vehicles. Cycling can potentially take place from all origins to all destinations, and is not restricted to a small number of routes (LTSA, 2004). It is well suited to many of the trips currently made in cars, particularly in inner urban areas. Most journeys are short. About two-thirds of all vehicle trips are less than six km (LTSA, 2004), which is an easy cycle ride for most people. Bicycles are especially suited to trips less than 5 km, and trips up to 20 km long are readily achieved by a rider of average fitness (LTSA, 2004).

If the bicycle will be evaluated in the environmental direction, it has significant advantages over the motor vehicles. Shorter auto trips produce far more pollution per mile than longertrips. The transportation sector accounts for one third of CO_2 emission (Nazelle and Rodríguez, 2009). Cycling could help cut carbon emissions from urban transportation 11 percent (Mason et al., 2015) and have desirable aspect related to noise.

Regular physical activity provides wide range of health benefits. The World Health Organization recommends a minimum of 150 minutes of moderate activity per week (Götschi, 2016). Cycling to work or school, or cycling exercises is important activities for improve health. Evidence that cycling as part of normal daily activity can provide the same improvements in physical performance as specific training programme (Pakravan, 2014).

Cycling has economical benefits. Owning and maintaining a bike is easier than a car thanks to fuel cost, maintenance, insurance, parking cost.

Cycling is also important as recreational family activity for people of all ages, fun and children loves it.

With urban cycling traffic congestion (more bike less car on the road) could be reduced its economical, social, enviromental positive impact could be increased. (Litman, 2014) examines the types of measures that most promising in reducing congestion at reasonable costs. The study identifies the improvement of multimodal transport options that include walking and cycling as the most promising measure group due to their relatively lower cost for implementation and potential to influence a mode share shift. A study by OECD and the European Conference of Ministers of Transport also analysed different congestion reduction strategies (OECD, 2007). Both Litman and OECD/ ECMT argue that congestion can be reduced by a modal shift from car to walking and cycling since these modes are more space efficient – as cars need more road space than other modes (Litman, 2014; Koska and Rudolph, 2016). The use of bicycles changes with the reshaping of urban and community habits and journeys by administrations.

Thus, the widespread use of bicycles, which are considered as sustainable modes of transport, will be beneficial. Against the benefits of bicycle use, cyclists are vulnerable in the event of a crash. Strategies to protect cyclists in event of crash are necessary (Ramage-Morin, 2017).

3. Design and Planning of Bicycle Road

The design and planning of bicycle paths differ depending on the purpose of bicycle use (Cycling generally has two main purposes as utility and leisure. Utility cycling involves making a journey for the main purpose of doing an activity at the journey's end, such as work, education or shopping. Time is often an important consideration. Leisure cycling is done for the journey itself. Leisure cyclists include sports training cyclists, recreation riders and cycle tourists. They also include children playing on their bikes near their homes (LTSA, 2004). Although the purpose of bicycle use is changing, in general it should carry the following features: safety • comfort • directness • coherence • attractiveness (LTSA, 2004). Except safety which is the fundamental parameter for cyclist 'route, the weight of the parameters depends on the purpose of use of the bicycle road. Such as directness for road of transport usage is more important than attractiveness while it is just the opposite in a recreational road.

4. The Design of Bicycle Route

In relation with motorized traffic cycling facility type can be categorized as: (1) On Street Bicycle Lane (As Mixed traffic that cyclist share the road way with other traffic and adjacent Cycle lanes where Cyclist use the road with other traffic but have separate lanes that is marked and signed) (2) Off Street Bicycle Paths (narrower than a roadway that cyclist only use) (3) Shared Off Street Bicycle Paths (cyclists share with pedestrians).

Five types of on-street facilities can be considered throughout a city or region (US, 2015). These facilities are cycle tracks, street Bikeways, Bicycle Lanes, Shared Use Lanes, Shoulder Bikeways that can be seen in Figure 2, from more comfortable than less comfortable features.

Fig. 2.
Bike Facilities
Source: (US, 2015)

The decision to provide either on road or off road facility depend on main parameter as (1) vehicle speed; (2) volume; (3) type of user and (4) available space and funding (QG, 2015). The preferred bicycle route according to the speed and volume can be seen in Table 1.

Table 1

Preferred Bicycle Route According to the Speed and Volume

Cycle Facility Type	Vehicle Speed (u)(km/h)	Average Daily Traffic (q)(veh./day)
Mixed lane use	u<50	q<2000
Designed bicycle lanes on street	50<u<58	2000<q<8000
Roads with protected lanes	58<u<75	8000<q<14000
Separate Cyle paths	u>75	q>14000

Source: (Grava, 2003; Erçetin, 2014)

For routes designed as transport corridors only for bicycle traffic, designers need to ensure that they apply appropriate principles of highway and traffic engineering in a similar way as they would apply those principles for motor traffic. Geometric features of the route alignment need to be designed according to the selected design speed, and these include curve radii in the vertical and horizontal planes, sight distances required for stopping and overtaking, and lengths of tapers for lateral movements within the route (Parkin, 2012)

There are various guidelines that can be help on planning and design for cycling facilities (US, 2015):

- CROW a Dutch bicycle facility planning guide in the Netherland,
- The National Association of City Transportation Officials' (NACTO) Urban Bikeway Design Guide within United States,
- The American Association of State Highway and Transportation Highway Officials (AASHTO) Guide for the Development of Bicycle Facilities,
- North American City Specific Manuals,
- Collection of Cycle Concepts 2012 Guidelines from Cycling Embassy of Denmark,
- Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads, Ontario Traffic Manual Book 18 (OTM), VeloQuebec Technical Handbook of Bikeway Design from Canada,
- VicRoads Supplement to the Austroads Guide to Road Design, NSW Bicycle Guidelines in Australian Resources.

There are standards as T.S. 10839, T.S. 9826, T.S. 7249 and T.S. 11782 in place on the bike path and bike park in Turkey. The first legislation on the use of bicycles as means of transport vehicles is "Regulation on the Design and Construction of Bicycle Roads, Bicycle Stations and Bicycle Parking Places on the City Roads". This regulation was enacted by the Ministry of Environment and Urbanization with the Official Newspaper dated 03.11.2015.

General design of shared-use paths, a bicycle design speed of 30 km/h (20 mph) is desirable. The maximum grade recommended for shared-use paths is 5 percent and sustained grades should be limited to 3 percent, as much as practical (MN/dot, 2007).

The standard measures of the bicycle route vary from country to country. According to

MnDOT (MN/dot, 2007) the bicycle path measures for shared use path is 1.5 m for one direction and 2.4 m for two directions. These distances are 1.30m and 2.40m in the bicycle guide published by the Ministry of Environment and Urbanization in Turkey in 2017 (RTMEC, 2017).

Equally important is the combination of a bike friendly topography and climate (Midgley, 2009). It is difficult to use bicycles during cold and hard weather. The important condition for bicycle roads is safe infrastructure to be well maintained during cold and snowy months (CITYLAB, 2018).

5. Design of Bicycle Parking

In order to provide and spread bicycle transportation, the bicycle base must be supported with the parking spaces. Generally, the facilities required for bicycle parking are safe, easy to use, well illuminated, well marked and preferably sheltered (DOENI, 2018).

Standards and guidelines for the design of parking spaces are available (such as TSE 11782, Caltrans highway design manual). Information on the location and capacity of bicycle parking spaces can be obtained.

There are five main type of parking facilities that are (1) cycle stands, (2) cycle racks, (3) cycle lockers or boxes, (4) cycle centres (guarded cycle parking), (5) automatic cycle parking (Bassett et al., 2008).

Cycle stands designed for one or two bicycles whereas cycle racks designed for six or more bicycles. Cycle lockers provide weather protection and added storages of helmets, bags and other accessories requires a management system and organization to manage the system. Cycle centres are collective parking with supervision, offer additional services such, maintains and repair, bike shop, bike rental, and also may have a small coffee shop. Automatic cycle parking are bicycle storage facilities in which the cyclist hands in the bicycle at entrance and system registers and stores the bicycle. The cyclist returns the cycle with an electronic key (Bassett et al., 2008).

6. Bicycle Related Programs: Bike Sharing

Bicycle programs are required to increase the use of bicycles. One of the most remarkable of these is the bike sharing program as explained below.

In general bicycle sharing is an urban mobility concept that presupposes the shared use of a bicycle fleet in order to help to address sustainable strategies for urban development (Shaheen et al., 2010; Bazhko, 2013). It provides a complementary transport offer to buses, trains and tramps and generates multiple benefits (Civitas, 2016).

Bicycle sharing programs can be classified in various ways as Implementation Options: 1-Ad Hoc Bicycle Sharing 2. Managed Fleet (coin-deposit system) 3. Technology-Enabled Bikes Kiosk-Based. Depending on the IT technology, it can be categorized in a historical filter as below:

The 1st generation of bike-sharing programs began on July 28, 1965, in Amsterdam with the Witte Fietsen, or White Bikes by Luud Schimmelpenninck. Ordinary bikes, painted white, were provided for public use. Individuals were to find a bike, ride it to their destination, and leave it for their next user.

Things did not go as planned, as bikes were thrown into the canals or appropriated for private use (DeMaio, 2008). The program collapsed due to theft and vandalism.

To address these issues, a new "second generation" set of systems began in 1991, in Farsø and Grenå, Denmark (DeMaio, 2009). By 1995, the first large scale scheme (called Bycyklen or City Bikes) was introduced in Copenhagen. Special design of bicycle, availability of docking station (where bikes are borrowed, returned and looked) and the first coin deposit model (in order to unlock system) were the main characteristics of the second generation Bike-Sharing. However, the system still suffered from theft due to the lack of user accountability (Datta, 2014).

The third generation of bicycle sharing systems emerged in 1996 at Portsmouth University, United Kingdom, where students could rent a bicycle by using a magnetic stripe card. This tackled the crucial issue of anonymity, as one would have to register to become a cardholder. Also, the bicycles were now locked to the stations. Since then, a range of technological additions have been made to the concept, including electronically-locking racks or bike locks, telecommunication systems, mobile phone access, and on-board computers (DeMaio, 2009). With introduction of smart technology many vandalism and theft problems of earlier bike-sharing programs has been resolved and making bike sharing trendy among young users (Midgley, 2009). The vast majority of currently operating systems use third generation technology (Wiersma, 2010).

"Vélo à la Carte" was one of the bicycle-sharing scheme that use smartcard technology which was introduced in 1998 in Rennes, France. Other systems soon began to develop in Lyon (France) in 2005, culminating in the opening of the famous Vélib' system in Paris in 2007 (Midgley, 2011).

The fourth generation that contains innovations and significant developments such as solar powered and movable docking stations, electric bikes which seems to be the most important one in terms of attractiveness (Midgley, 2011;Erçetin, 2014). Bike-Sharing networks that include advanced IT features such as demand-responsive rebalancing (e.g., real-time information) informs the system where there are imbalances in supply and demand. The most modern development in bike sharing is tech-on-bike. In tech-on-bike systems, the locking and rental technology is located on the bike itself. All this generation sequence reveals the possibility of applying the Bike-Sharing program. In 2016, there was 1,000 bike-sharing schemes around the world with an estimated fleet of more than 1.2 million bicycles (Civitas, 2016).

In recent years, bike-sharing also has expanded to college and work campuses throughout North America. Indeed, there are over 65 college/university bike sharing programs operating throughout North America and another 10 programs planned in 2010. Examples of college/university programs worldwide include "CibiUAM" at the Universidad Autonoma de Madrid (UAM) in Spain and "Velocampus Leeds" at the University of Leeds in the United Kingdom (UK) (Shaheen et al., 2010).

In 2009, the first bike and ride system started operation in Kayseri. Recent years, in many cities such as Bursa (NİLESPIT), Kocaeli (Kobis), Istanbul (ÇABİS) Bike-Sharing application are existing or planned. One of

the Bike-Sharing applications started in 2014 in İzmir (BİSİM). The system is particularly popular on weekends. Some concerns are: not integrating the system into the public transport, only preferring for the weekend activities, not working at night, lack of care for bicycles, insufficient illumination of the lamps and not efficient use of the bicycle route due to the working on Mustafa Kemal Beach Boulevard (IEU, 2018).

The equipment, installation, maintenance and annual operation cost for a single bike station range $50.000-$85.000 (Heda, 2012). The average cost can vary depending on the system's characteristics. For example, on power supply, implementing kiosk system etc. The number of stations and bicycles can be determined according to the demand.

6.1. Some Laws and Traffic Rules for Cycling

Legal Age and Cycle helmet legislation are two common legislation applied in countries. Some national legislations provide that cyclists can only ride on a road after a certain age. In Switzerland, a cyclist must have at least the legal age to go to school before he can ride on a road. In Denmark, children under the age of 6 are not allowed to go by bicycle unless they are escorted by a person who is 15 years old or older. In Germany, children must be at least 8 years old with the same provisions as in Denmark. In Poland, children over 10 years must have passed a test to be allowed on a road (EU, 2018)

In some European countries, cycle helmets have become mandatory in the last few years. In Malta, cycle helmets became mandatory for all cyclists in April 2004. In Sweden, cycle helmets became mandatory for children up to 15 years of age on January 1st 2005. The same group of cyclists has to wear helmets in Slovenia and the Czech Republic. In Spain, cyclists have to wear a helmet outside urban areas except when going uphill (EU, 2018).

The definition of precise standards without which the effectiveness of helmets cannot be guaranteed, is a prerequisite for any regulations on the wearing of helmets. Some countries have already set up such norms. The European Directive No. 89/686/EC on personal protective equipment lays down the standards which could be adopted for cyclist's helmets. The provisions for children's helmets, however, still have to be settled (EU, 2018).

7. The Bicycle Road of Niğde Omer Halisdemir University Campus

University campuses are ideal settings for a bicycling lifestyle with high density, stimulating atmosphere and defined boundaries (League of American Wheelmen, 2018). It is mentioned also that many colleges and universities have built upon these good conditions and embraced the enthusiasm for more bicycle-friendly campuses by incorporating Bike-Share programs, bike co-ops, clubs, bicycling education classes and policies to promote bicycling as a preferred means of transportation. The existing Bicycle Road available in NOHÜ campus can be seen in Figure 4 is approximately 3 km length and the lane is 7-meter-wide as a potential for bicycling transportation. These bicycle roads are not still actively used and the lack of regulation on the bicycle path is visible. An online survey was made to define the current cycling level of cyclists and non-cyclists.

7.1. Survey

The survey was conducted online, created on 12th March 2018. Surveys were attended by 100 persons that 68 of them students and 24 of them University staff and Academician within the engineering faculty. The final response can be seen in Table 2.

The results show that the majority (70%) of the persons do not have their own bicycle. The great majority of respondents use bicycles (63%) which 57% of them for recreational purposes, 27% sport and 14% for transportation. Approximately 37% of the respondent doesn't use bicycle. For non-cyclists and cyclists, the lack of bike lane and bicycle is the biggest shortcomings of bicycle use. The other two concern are security problem and weather conditions for both groups. Along with bicycle path arrangement preferred use of bicycle is 38% for recreation, 37% for sport and 19% for transportation. The other interesting feedback from all of the respondents is that 87% want to ride a bicycle together with bicycle arrangement. According to stated question about bicycle arrangement the first system that the user will prefer is the Intelligent Bike-Sharing System Free of charge and the second system is the Bicycle Rental System free of charge.

a. Bicycle Road *b. Bicycle Road* *c. Bicycle Road* *d. Akkaya Dam Lake* *e. NOHÜ MainEntrance*

Fig. 4.
Bicycle Road Pictures from various side in NOHÜ
Sources: (Personal Archive)

Table 2

The Final Response of Survey

	Female	Male	Student	Academician and Staff	Other	Bicycle Owner	Non-Bicycle Owner
Percentage %	22	78	68	24	8	30	70
	100		100			100	
	Using Bicycle			Non Cyclist			
	NBO	IBL	WC	SR	NBO	IBP	SR	DNL	CNU
	49.18	21.32	18.03	6.56	57	20	7.27	7	5
	63			37			
	Before Bicycle Arrangement			Cycling together with bicycle arrangement			
	Recreation	Sport	Transportation	Recreation	Sport	Transportation	
	57	27.83	14.75	38.38	37.37	19.19	
	63						
	those who want to ride a bicycle if suitable facilities and conditions are provided						
	Yes			No			
	87			10			
	Bicycle Ride Arrangement						
	Bicycle Rental (free of charge)		Bike-Sharing System (free of charge)	Bicycle Rental (charged)		Bike-Sharing (charged)	
	20.83		55.21	10.42		11.46	

NBO: Not a Bicycle Owner, IBP:Insufficient Bicycle Path, WC:Weather Condition, SR:Security Reason, DNL:Don't like, CNU:Can't use

8. Results and Recommendation

The arrangements that can be made on the NOHÜ bicycle path are as shown below:

- The bike route seems suitable for both daily and leisure cycling. The starting point and the destination, that is, the points at which the journey start and ends, should be marked near the main entrance or bus stops and dormitories (Figure 5).
- Cycling is necessary for bicycle access. Survey results show that the majority (70%) of the persons do not have their own bicycle. As a starting point, a certain amount of bicycle can be provided on a small scale with bicycle rental service. Bicycle rental sevice seems suitable for leisure cycling. Intelligent Bike-Sharing system will require a certain cost and installation.
- Bicycle parking spaces (or bike stations, bicycle lending places) are necessary to pick up and return the bike and according to the characteristics of the bicycle facility. For example, on a daily cycling, a person who will go to the city centre must be leave the bike in a safe place close to the main entrance door or near the bus stops, and must be able to continue their trip by public transport. Or at the end of the journey, the bicycle parking area should be close to the destination for the safety and shortening of walking distance. Improving the bicycle route without parking make no sense for bicycle use. While the weather in winter are cold, long and hard, sheltered bicycle parking areas seem appropriate.

In order to prevent pedestrian-bicycle, vehicle-bicycle conflicts, intersections should be arranged for safety and operation. In the past year, two traffic accidents have occurred in the campus area (SBGM, 2018).

The location of the bus parking area next to the student dormitories should be changed. There is a divided road which can be used by public transport in this area. To give cyclist and pedestrians feeling of safety segregated route could be designed. Road conditions need also be improved at most locations in order to encourage people to begin cycling.

Education and encouragement incentives for bicycling should be provided as: taking weekend cycling tours together with family and friends into the campus, teaching basic skills on bike training, bike maintains training, campaign to use bicycle, helmet and clothes wearing with reflector for security reason, establish bicycle centre to provide activities.

The camera system placed on the bicycle path can be used for security and endorsement.

Evaluation the success of system: The success of the system can be analyzed by bicycle counts, and a network could create by expanding the system on campus in the future.

9. Conclusion

In this study, some suggestions have been made regarding the regulation of the existing bicycle route to include bicycle, two-wheeled, nature friendly transportation mode in life of the NOHÜ. These proposals, which will be implemented at university, should be expanded and implemented throughout the entire university environment within a bicycle program framework. If this bike route system is to be considered as a pilot area, it can be expected to be expanded throughout the entire campus and become an integrated transport system with the city centre in the future. The University campus is far from city centre and automobile use seems indispensable as transportation mode for this reason. But it could be a modal shift from automobile to bicycle and public transportation to create sustainable campus in the future. According to the survey results there is strong interest for intelligent Bike-Share system (55.21%) and bicycle rental service (20.83%). The provision of bicycles and the arrangement of the relevant parking spaces are important regulation to be made and it depends on the nature of the system and purposes of the cycling. For leisure cycling a rental service could be enough for beginning. If the scale of the program is to be expanded, an intelligent bike-share system could also be applied. The purpose of cycling, demand, equipment, installation maintenance and operation cost, safety, sustainability of the program, are important issues for applicability of the programs. For the spread of bicycle use, engineering faculty students are planning to make prospective projects and applications.

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