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A Study on Improving Comparative Analysis and Providing Information on Bicycle Roads through Big Data Analysis

Tae-Gu Kang[1], Yeong-Real Kim[1], Dong-Woo Kim[2] and Seong-Taek Park[1]*

[1]Department of Management Information Systems, Chungbuk National University, Korea; snookerk@hanmail.net, yrkim@cbnu.ac.kr, solpherd@cbnu.ac.kr
[2]Department of Big Data, The Korea Association of Software Manpower, Korea; dongwoo1108@naver.com

Abstract

Background/Objectives: The present study analyzes an improvement plan for bicycle roads by using the public data of Seoul and proposes its implications. **Methods/Statistical Analysis:** In this study, an analysis was performed by utilizing a big data analysis tool, R. The present study, after defining the deducted problem phenomenon, conducted a process of planning which included the necessary information for finding an alternative for resolution and a data and application analysis technique. The data needed in the analysis was obtained from the Seoul open data square and the public data portal. The study attempted analysis and visualization by using the open source tool of R for analyzing the data, and conducted a process of interpretation. **Findings**: In this study attempts to find an alternative that can prevent bicycle safety exercises. The study presents the problems of current bicycle roads and their improvement plan by big data analysis which includes the relationship between the installation rate of bicycle roads and the bicycle accident rate, the location of bicycle roads, the location of bicycle amenities, and population data. In this study attempts to find an alternative that can prevent bicycle safety exercises. To achieve this, the study presents the problems of current bicycle roads and their improvement plan by big data analysis which includes the relationship between the installation rate of bicycle roads and the bicycle accident rate, the location of bicycle roads, the location of bicycle amenities, bicycle satisfaction, bicycle use statistics, and population data. The generalization of bicycle roads to regular residences implies a construction by considering the connectivity and stability of bicycle roads, but atypical infrastructure construction has played a part in increased damages resulting from the ignorance of bicycle users to traffic safety regulations. The perception of bicycle users must change and the building of bicycle roads must be based on people centered transportation infrastructure. **Application/Improvements:** The results of this study can be used as part of improvement of bicycle road accidents by central government and local governments. The results seem to be applied in policy, such as building bike paths centered around pedestrians.

Keywords: Big Data, Bicycle Road, Comparative Analysis, Data Analysis, R

1. Introduction

Governments and local self-governing bodies all over the world are currently working hard to vitalize the use of bicycles, which are non-powered non-carbon means of transportation, in order to quickly respond to the crisis of climate change and energy exhaustion and to materialize a sustainable traffic system. The people have the right to use transportation facilities, receive transportation

*Author for correspondence

services, and move, and the nation must take the necessary measures so that the people are not discriminated in terms of transportation services[1].

However, thoughtless construction which constructs and designs according to basic design guidelines without the consideration for site conditions and environmental factors has damaged the safety and convenience of cars, bicycles and pedestrians[2,3].

As the contemporary people become more interested in health, the bicycle use has greatly increased, and the increase of people commuting on bicycles has caused a rise in bicycle accidents. According to studies, fatal bicycle accidents in the city center has increased. The number of bicycles deaths approaches 300 every year with 299 in 2010, 277 in 2011, 292 in 2012, 285 in 2013, and 287 in 2014. The number accident cases continues to increase with 11,449 cases in 2010, 12,357 in 2011, 13,852 in 2013, and 17,471 in 2014[4].

The ill-prepared implementation of bicycle infrastructure requires the strengthening of bicycle safety education in order to prevent accidents along with facility supplementations including securing the safety of the roads. Furthermore, many problems occurring, but the most severe problem is bicycle safety. However, the failure to learn all the transportation safety rules for bicycles and bicycle road installations without considering the characteristics of bicycle and area causes the increase in bicycle accident occurrence along with a decrease in user satisfaction. Also, the cause of bicycle accidents results from perceiving bicycles as pedestrians and not as cars, and it is important that bicycles are classified as cars just like sedans according to the Road Traffic Act.

Therefore, when they violate signals or laws, they are subject to law enforcement and are imposed with a penalty. Moreover, by principle, it is illegal to a ride bicycle on the sidewalk, but most bicycle roads are close to the sidewalk, and even when they are close to the road, they cannot be realistically used due to illegal parking and stopping vehicles.

Therefore, the present study attempts to find an alternative that can prevent bicycle safety exercises. To achieve this, the study presents the problems of current bicycle roads and their improvement plan by big data analysis which includes the relationship between the installation rate of bicycle roads and the bicycle accident rate, the location of bicycle roads, the location of bicycle amenities, bicycle satisfaction, bicycle use statistics, and population data.

2. Research Trends

Domestic research trends include the connectivity and stability of bicycle roads. Ministry of Land, Transport and Maritime Affairs presents the basic design principles of bicycle roads in its bicycle road facilities standard and management guideline[5] as route plans that reflect bicycle transportation characteristics, designs that reflect the area characteristics, designs that consider stability, designs that increase connectivity, and designs that contribute to green growth.

In[6] examines theory on the user environment of bicycle roads, analyzes the form of existing roads in Gwangmyeong, comprehends the current status and problems of bicycle road facilities that are installed and used to present and improvement plan by examining laws and government policy on bicycle roads, and advanced foreign and domestic examples and by considering preceding studies[6].

In[7] comprehended the actual state of us and genera properties of bicycle road users through surveys in order to understand satisfaction in accordance with the user environment of city center bicycle roads in Songpa, Seoul and proposed that bicycle roads created by using road diet method needed to provide convenience and scenery as well as guarantee safety and traversability in order to effectively used[7].

The above studies mainly deal with surveys and case studies on the basic design principles of bicycle roads, current status facilities, analysis of existing road forms, safety, traversability, and convenience, and lack any studies that have attempted analysis using big data. Therefore, the present study proposes a new approach on improvement through a comparative analysis on bicycle roads by using big data.

3. Theoretical Considerations and Foreifn and Domestic Case Reviews

This study conducted a text mining analysis of news

articles with Ireland's 'Transition Year' and Korea's 'Self-Directed Learning Semester,' generated in Naver, Korea's portal site, contained as a title and made a comparative study of similarities and differences between the two systems. In Figure 1 shows research analysis process. The Laweiplein intersection located in the city center of Drachten in the Netherlands is a case where a person centered traffic culture has successfully settled so that cars can slow down without traffic lights or signs even though 22,000 vehicles including buses, thousands of bicycles, and thousands of pedestrians pass through it every day[8].

In this area, bicycle users pass through by sending hand signals when changing direction, but because a culture of prioritizing people has been established, no vehicle passes through by neglecting bicycles or people, and this creates a traffic space centered on people. Since operating a no signal intersection in Drachten, traffic accidents have decreased from 75 to 2, injuries from 17 to 1, and as traffic flow improves due to the absence of waiting for signals, the intersection passing time has been cut down by half.

The representative case of transportation policy centered on people in France is the well known green bicycle policy Velib' in Paris. Velib' is being operated in Paris and thirty surrounding cities since July 15 2007, with 24,100 bicycles, placed between distances of 300m at 2,038 stations, for 24 hours a day[9]. According to city of Paris statistics, the number of Velib' use is 27 million times a Annually, and user satisfaction is extremely high at 94%, with an accompanying effect of reducing CO_2 by 24 million tons each year.

The representative case of transportation policy centered on people in Germany is the pedestrian priority traffic area system in the Vauban residential complex in Freiburg. Vauban is an ecological residential complex that began residence since 2000 and is stated as a successful transportation based facility that has built people-centered infrastructure by establishing and implementing a complex plan centered on pedestrians and bicycles in terms of new town planning. The construction form characteristic of the transportation infrastructure in the Vauban residential complex is that it has built a traffic system that allows a 15 minute access from all subway stations to the city center through walking and a green public transportation system that includes bicycles, trams, and buses[10].

4. Research Methods and Procedure

The present study, after defining the deducted problem phenomenon, conducted a process of planning which included the necessary information for finding an alternative for resolution and a data and application analysis technique.

Next, the study attempted analysis and visualization by using the open source analysis tool R and interpreted the results. After analyzing the defining data including the location information of bicycle roads, bicycle use satisfaction, the population data of Seoul, the status of bicycle accidents, and rate of use statistics, advanced cases were studied to find alternatives.

The study attempted analysis and visualization by using the open source tool of R for analyzing the data, and conducted a process of interpretation[11].

4.1 Defining Problem

As bicycle roads are generalized even in everyday residences, they are intended for transportation means but because they are also installed for exercise and leisure in parks and beside streams, those that are installed beside sidewalks are accruing damage due to the ignorance of bicycle users to traffic safety rules, which has made their installation nominal. Therefore, the problem presented by the present study is the cause that increases bicycle accidents with the expansion of bicycle roads in accordance with the unplanned implementation of bicycle infrastructure, and the study attempts to define what the resolution will be.

4.2 Information Necessary to the Problem

The study selected, out of the many gu (borough) in Seoul where the population is the most concentrated, Yeongdeungpo-gu where parks have been developed and Gwanak-gu where most of the area is residential, as analysis subjects. Therefore, it is necessary to inquire into the bicycle road distribution map of places that have parks and everyday residential areas.

Finding the cause for the high rate of bicycle safety accidents, with a comparative analysis through R by

comprehending information concerning the bicycle road location information, the number of bicycle traffic accident cases, bicycle user satisfaction, population, and purpose of bicycle use in Yeongdeungpo-gu and Gwanak-gu is necessary to establish a policy alternative.

4.3 Necessary Data for Deducting Information

The relevant data is needed to deduct the information needed to understand the problem. As stated above, to compare Yeongduengpo-gu where parks have been developed in the surroundings, and Gwanak-gu, where most of the area is residential, the status of Seoul bicycle accidents are needed to comprehend the spatial information coordinate system of Seoul bicycle roads and the number bicycle accidents, the rate of Seoul bicycle use is needed to comprehend the purpose of bicycle use, user satisfaction for the Seoul bicycle environment is needed to inquire into the satisfaction of bicycle users, and Seoul demographics data is needed to compare populations.

4.4 Analysis Technique for Deducting Information

To compare the status of bicycle use between Yeongdeungpo-gu and Gwanak-gu, the population of Yeongdeungpo-gu and Gwanak-gu are compared through a bar chart, and they are directly compared through the location visualization of bicycle roads using ggmap. Furthermore, the study conducted linkage analysis to verify the hypothesis that the rate of bicycle accidents in Yeongdeongpo-gu would be lower than Gwanak-gu because it has more bicycle roads installed from the development of parks.

Linkage analysis helps researchers understand the linkage between two or more variables. The analysis also generates statistics of use through a pie chart so as to analyze user patterns which concerns for what purpose bicycle users use bicycles. The analysis collects data and converts the collected data through preprocessing into a form suitable to the analysis tools. By selecting necessary data from the converted data, the study creates new data to calculate the desired information through the analysis tool of R.

5. Data Collection and Analysis

5.1 Data Collecting and Preprocessing

The data needed in the analysis was obtained from the Seoul open data square (http://data.seoul.go.kr) and the public data portal (http://www.data.go.kr).

The study was able to obtain bicycle road location information, status of bicycle accidents, rate of bicycle use statistics, and demographics data for Seoul through the open data square, and obtained the status of national traffic accidents from the public data portal. By preprocessing the collected data, it was converted into a form capable of analysis, and the data used in the analysis was converted into CSV form for use in the analysis.

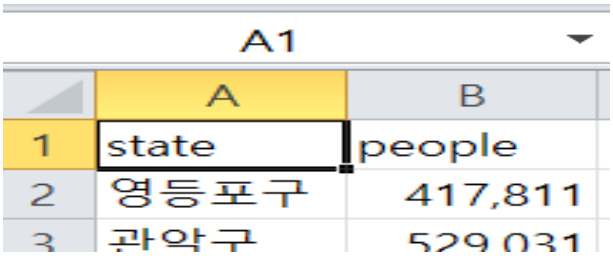
A1

	A	B
1	x	y
2	126.9113	37.55876
3	127.0334	37.54581
4	126.9624	37.5201
5	127.0678	37.55438
6	127.1081	37.54431
7	127.0343	37.54043
8	127.0333	37.54777
9	127.0771	37.56705
10	126.9004	37.56221
11	126.9132	37.55915
12	127.0632	37.56148
13	126.9974	37.52032
14	127.0774	37.56773
15	127.0716	37.5586
16	127.0592	37.54924
17	127.0258	37.54474
18	127.0873	37.56224
19	127.0804	37.55907
20	127.0787	37.55602
21	127.0764	37.55149
22	127.1018	37.54198
23	127.0847	37.53336
24	127.0855	37.53211
25	127.0778	37.53264

bikegps

Figure 1. Location of bicycle road data.

Figure 1 is preprocessed data after downloading Seoul bicycle road location information from the open data square. In this way, the study was able to visualize the location of Seoul bicycle roads and the information relevant to Yeongdeungpo-gu and Gwanak-gu were selected and used for the present study.



	A	B
1	state	people
2	영등포구	417,811
3	관악구	529,031

Figure 2. Number of Population Data

Figure 2 is preprocessed data from an extraction of Gwanak-gu and Yeongdeungpo-gu data after downloading Seoul demographics data. The study was then capable of visualizing a population comparison between Yeongdeungpo-gu and Gwanak-gu in Section 4.3.

5.2 Location Visualization of Bicycle Roads in Yeongdeungpo-gu and Gwanak-gu

First, the distribution of bicycle roads in Yeongdeungpo-gu and Gwanak-gu were confirmed. With the data in Figure 1 collected from Section 5.1, the location of bicycle roads in Yeongdeungpo-gu were expressed in the map. With the data in Figure 1 collected from Section 5.1, the location of bicycle roads in Gwanak-gu were expressed in the map.

The results in Figure 3 and Figure 4 show that the installation distrubution of bicycle roads in Yeongdeungpo-gu, centering on Yeouido Park, are higher than Gwanak-gu, and Figure 4 shows that Gwanak-gu, excluding major roads, lacks bicycle roads compared to Yeongdeungpo-gu.

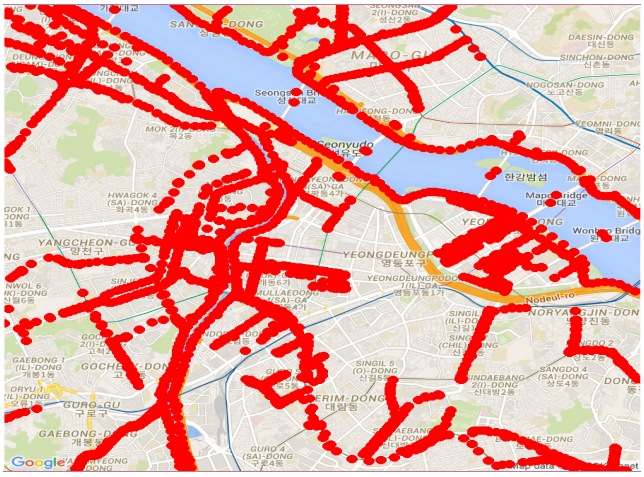


Figure 3. Location of bicycle road in Yeongeungpo-gu.

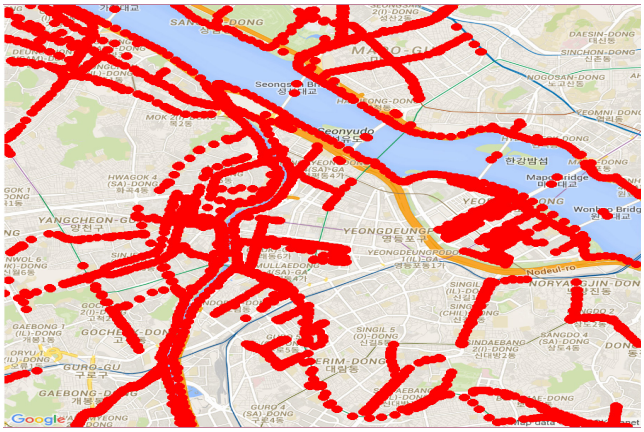


Figure 4. Location of bicycle road in Gwanak-gu.

5.3 Population Comparision between Yeongdeungpo-gu and Gwanak-gu

First, population data was expressed by using barplot in the "ggplot2" package of the R program in order to compare the population of Yeongdeungpo-gu and Gwanak-gu (Figure 5).

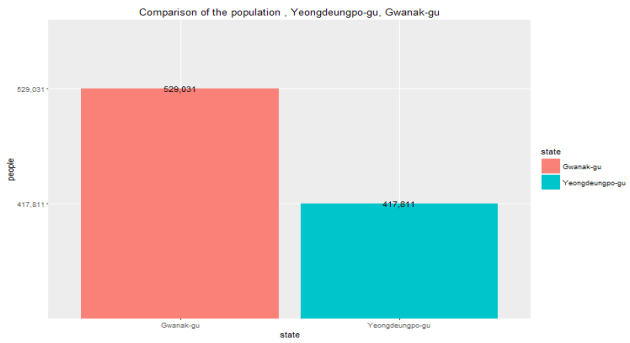


Figure 5. Comparison population Yeongdeungpo vs. Gwanak.

5.4 Number of Bicycle Accidents in Yeongdeungpo-gu and Gwanak-gu

Figure 6 shows that Yeongdeungpo-gu, which has a higher rate of bicycle road installation, having three times as more accidents and injuries than Gwanak-gu. This is because the design failed to provide a safely and conveniently traversable environment by considering bicycle traversability, the basic principle of bicycle road design.

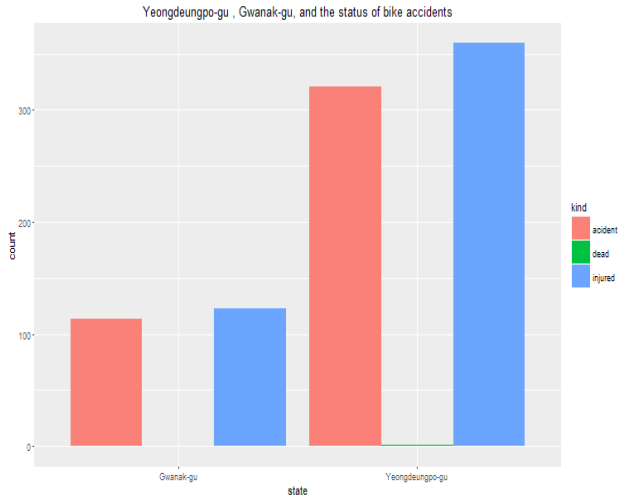


Figure 6. Bicycle road in Yeongeungpo-gu.

5.5 Purpose of Bicycle use in Yeongdeungpo-gu and Gwanak-gu

The study inquired into the purpose of bicycle through a pie chart, in Yeongdeungpo-gu, where the bicycle road installation rate is high, and in Gwanak-gu, where the bicycle road installation rate is low. Figure 7 shows that 81.8% of bicycle users in Gwanak-gu use it for exercise, whereas, Figure 8 shows that bicycle users in Yeongdeungpo-gu, where the bicycle road distribution rate is high, use it for transportation and commuting.

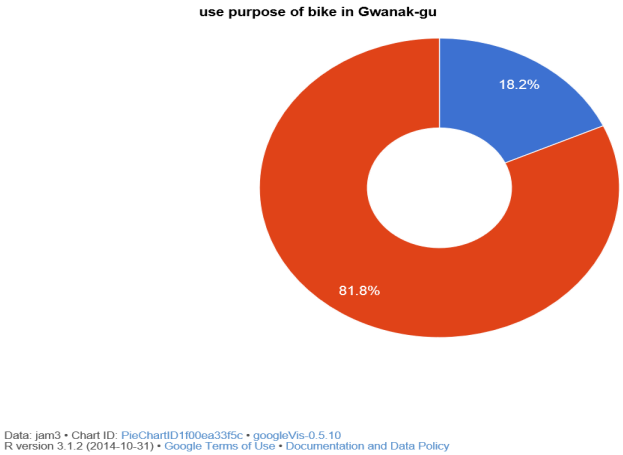


Figure 7. Gwanak-gu cycling application.

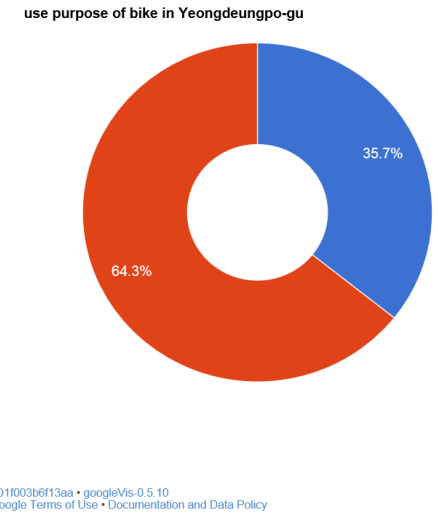


Figure 8. Yeongdeungpo-gu cycling application.

5.6 Improvement Plan for Bicycle Safety Accidents

The convergent analysis of Seoul public data reveals that a high bicycle distribution rate does not lower the rate of safety accidents. Yeondeunpo-gu shows that more bicycle roads are constructed than Gwanak-gu due to its parks. In other words, the construction of roads is related to the surrounding environment. Furthermore, the generalization of bicycle roads to regular residences implies a construction by considering the connectivity and stability of bicycle roads, but atypical infrastructure construction has played a part in increased damages resulting from the ignorance of bicycle users to traffic safety regulations. The perception toward bicycle users as pedestrians has also contributed to the rise in safety accidents. The perception of bicycle users must change and the building of bicycle roads must be based on people centered transportation infrastructure.

6. Conclusions

The present attempt is to propose a plan than can help alleviate bicycle safety accidents through the analysis of Seoul public data. The implications of the research results are as follows:

First, a plan for alleviating bicycle road safety accidents was performed with the big data analysis tool R, based on Seoul public data. Second, the analysis confirmed that a high bicycle road installation rate does not lead to a low bicycle safety accident rate. As explained above, the increase of bicycle roads naturally increases the accident rate.

Third, the atypical infrastructure construction when developing bicycle roads affects the bicycle accident rate. Unlike advanced nations, Korea often conducts bicycle road construction from a policy perspective, and plans and implements it as one axis of transportation infrastructure. In other words, bicycle roads must be build based on a people-centered transportation infrastructure. Fourth, most bicycle users perceive vehicles as pedestrians rather than vehicles, so the safety rate is high. Therefore, a safety education system must be established, that allows bicycles users to receive a systematic safety education. Fifth, it is necessary to build pedestrian-centered bicycle roads based on people-based transportation infrastructure in accordance with the increasing number of bicycle users.

There may be several restrictions in materializing the alternatives suggested in the present study. First, the analysis subjects are limited to a few variables related to bicycle road rates. But his is a policy issue that must complexly consider various variables including bicycle road circumstances. The limitation of the present study is that it failed to collect and analyze other variegated data besides public data. Future studies must secure a variety of data based on wider big data planning and conduct analysis through analysis techniques accordingly.

7. References

1. Kwon YJ, Kim YK, Kang SH. A preliminary study for human-oriented urban transport facility. The Korea Transport Institute Report; 2013.
2. The Korea transport institute. Series of Research; 2013. p. 11.
3. Choi BG, Park HK, Na YW. A study on the design improvement and information service of bicycle road considering environmental factor. Journal of the Korea Society of Surveying, Geodsey. Photogrammetry and Cartography. 2011 Feb; 29(1):11–20.
4. Bicycle roads. Available from: http://www.koroad.or.kr
5. Ministry of Land. Bicycle Road Infrastructure Management Standards and Guidelines. Korea: Transport and Maritime Affairs; 2009.
6. You JS. A study on the bikeway construction of bikeway and activation. Korea: Korea University; 2013.
7. Kim DH. A study of users' satisfaction for bike paths in the city: Focusing on the bike paths of Songpa-gu (Seoul City). Korea: Kyung Hee University; 2010.
8. Inverse Concept. Available from: http://news.joins.com/article/5412593
9. Paris public unattended bicycle hire system (Velib). Available from: http://www.mofa.go.kr
10. Korea research institute for human settlements. International Reporting Major Case Studies for Creating Low-carbon Green city; 2009.
11. Kim GW, Kim DW, Noh KS, Lee JY. An exploratory study on improvement method of the subway congestion based big data convergence. Journal of Digital Convergence. 2015 Fe; 13(2):35–42.