Seoul Cycle: Making Seoul a Bike-Friendly Destination

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During the fall 2016 semester, students from the University of Delaware's School of Public Policy and Administration had the opportunity to learn from Seoul's Metropolitan Government (SMG) and the University of Seoul as part of the 21ˢᵗ Seoul Case Study Program. During the program, we were given unique opportunities to learn about policy management practices in Seoul. At the end of the experience, we were asked to present analyses and recommendations for SMG to adopt. Drawing upon strategies used to make Newark, Delaware a bicycle-friendly community, this report discusses policy opportunities to enhance the city of Seoul's cycling network.

Introduction

Shifts in urban planning practices have revealed desires by both residents and local governments to embrace the idea of "complete" or "shared" streets. The Institute for Public Administration (IPA) at the University of Delaware defines a "complete street" as being "safe, comfortable, and convenient for travel by automobile, foot, bicycle, and transit, regardless of age and ability" ("Complete streets", 2016, para. 1). This change in dynamics now places an emphasis on reorienting roads towards people, rather than cars. However, as King (2014) explains, people want to choose from multiple transit options within a network. This requires streets to be multi-modal. Multi-modal transportation integrates multiple transportation options and connection points into one connected transit system or network. "In the end … redesigning streets to reduce reliance on cars are big steps for cities, but these efforts will fall short if they don't welcome all travel modes—from walking and cycling to taxis and delivery trucks—as critical functions of our streets" (King, 2014, para. 11).

In 2015, SMG launched a bike sharing system called *Seoul Bikes* after constructing bicycle roads along the Han River. According to Lee (2015), "SMG has offered a total of 1,200 public bikes called "Ddaleungee" at 140 docking stations in five major regions

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including Yeouido, Sinchon, Seongsu and central Seoul near Gwanghwamun" (para. 2). However, bicycle roads throughout Seoul have been designed for recreational purposes, instead of being used to reduce automobile, taxi, and bus trips for basic commuting purposes. In addition, they are not designed to connect residential areas with commercial and business zones. Even though SMG's cycling network clearly aligns with SMG's values and goals, cycling in Seoul predominantly revolves around recreational usage. In this paper, we discuss three major problems with Seoul's current bicycle system and recommend techniques to eliminate the barriers for making Seoul a bike-friendly city.

Complete streets in the United States

The United States has undertaken many efforts to incentivize and encourage local governments to develop complete streets. Federal legislation and regulations from the U.S. Department of Transportation (USDOT) require all transportation plans and projects to include convenient, safe, accessible, and context-sensitive bicycle and pedestrian components, in order to meet the needs of people of all ages and abilities. Recent federal policy initiatives have increasingly emphasized the idea of bikeable environments, or "bikeability," which describes the extent to which individuals feel comfortable navigating their community by bike (DeCoursey, Jones, & Scott, 2015).

According to the League of American Bicyclists, a cycling advocacy group established in 1880, "a Bicycle Friendly Community welcomes bicyclists by providing safe accommodations for bicycling and encouraging people to bike for transportation and recreation" (League of American Wheelmen, Inc., 2015, para. 3). This organization recommends that each Bicycle Friendly Community cover five essential elements:

- Engineering: Creating safe and convenient places to ride and park
- Education: Giving people of all ages and abilities the skills and confidence to ride
- Encouragement: Creating a strong bike culture that welcomes and celebrates bicycling
- Enforcement: Ensuring safe roads for all users
- Evaluation & Planning: Planning for bicycling as a safe and viable transportation option (League of American Wheelmen, Inc., 2015)

Cities across the United States have adopted regulations from the federal government, as well as guidance from advocacy groups like the League of American Bicyclists, to create their own complete street standards.

Complete streets in Seoul

SMG has also recognized the many advantages of offering a multi-modal transportation network. They note the core values of 'people, sharing, and the environment' in their long-term comprehensive plan for traffic and transportation, entitled *Seoul Traffic Vision 2030*. SMG aims to achieve 'People-Oriented Traffic' through the "promotion of walking and cycling, reduction of fatal accidents, and protection of general rights of the 'people with mobility handicaps'" (SMG, 2013, People-Oriented Traffic). They hope to achieve 'All Sharing Traffic' through "construction of a train-centered public transport system, realization of faster public transportation, and creation of a joint-ownership traffic environment" (SMG, 2013, All Sharing Traffic). Finally, SMG aims to achieve 'Environmentally-Friendly Traffic' through the "creation of a low mobility society, construction of an efficient and environment-friendly traffic network, and advancing the traffic culture together with the citizens" (SMG, 2013, Environmentally-Friendly Traffic). While advancing their cycling network clearly aligns with SMG's values and goals, cycling in Seoul today predominantly revolves around recreational usage.

One of the eleven promises of SMG's comprehensive plan is to create a "bicycle-centered environment" (SMG, 2013). In *Seoul Traffic Vision 2030* this plan, SMG also states that they will

provide free public bicycle service throughout the city. There are four main components to their plan:

- Expansion of the public bicycle rental service in Seoul, similar to the VELIB (public bicycle sharing system) in Paris, France, which will enable people to bike everywhere in the city.
- Reinforcement of the connection with public transportation by extending bicycle paths to public residential areas.
- Extension of the public bicycle service to the main parts of the city.
- Connection of the public bicycle service with existing rental services operating under each district office and along the Han River.

Creating a bicycle friendly city

While Seoul has made great strides towards creating an inclusive cycling network, such as developing the cycling-only path next to the Han River, there are still many obstacles to overcome in order to designate Seoul as a bicycle-friendly city. Seoul's current bicycle system has three major problems: (1) current cycling tracks do not lead to work places (2) bike lanes are not protected, and (3) language barriers on current bike share systems prevent visitors and foreigners from using the system.

Barriers to encouraging use

Seoul's cycling network, as it stands today, is limited by both its infrastructure and route destinations. In February 2015, a publication from SMG conveyed their enthusiasm for making additions to their public bicycle network. However, the report also explained that "now Seoul offers only two small bike-sharing services with around 340 bicycles" (Medimorec, 2015, para. 1). A report from the Korea Transport Institute reported 400 bicycles and 43 bike-share stations in service (Kim, Shin, Im, & Park, 2011). While more stations and bicycles will be unveiled over the next five years, the current network of cycling paths leads users to many desirable recreation destinations, but not to the most in-demand work destinations.

Figure 1 was created by SMG to show the quality of bicycle paths throughout Seoul. The ranking system of the map is based on whether or not bike lines and paths are separate from cars and pedestrians.
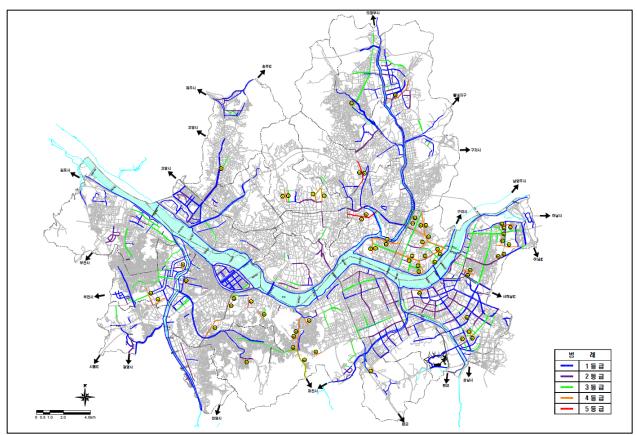
Figure 1. Seoul Bicycle Master Plan

The highest quality trails are indicated in blue, and tend to be clustered around the Han River. The bike paths in Songpa-gu and Yeouido score highly as well. The worst quality road segments are displayed in orange or red.

      Figure 2 was created by the Urban Planning Bureau of SMG (2007) and shows the 2005 Land Uses of Seoul. According to the map, red colored areas show Commercial and Business zones, whereas yellow colored areas designate Residential zones.
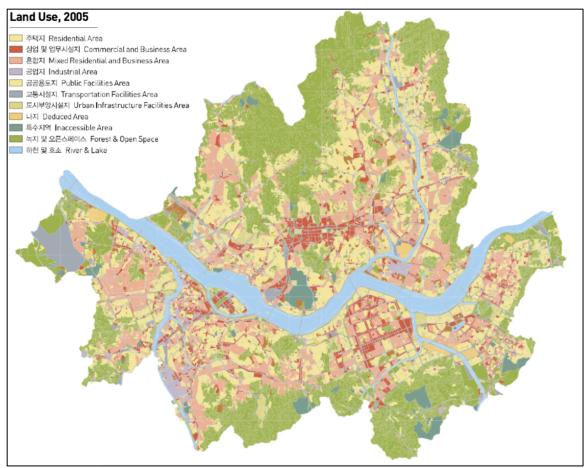
Figure 2. Seoul 2005 Land Use Map

Upon comparing Figures 1 and 2, Seoul's cycling tracks mostly lead to recreation destinations, not commercial and business areas. Bicycle roads throughout Seoul have been designed for recreational purposes, instead of being used to reduce automobile, taxi, and bus trips for basic commuting purposes by connecting residential areas with commercial and business zones. As noted earlier, SMG plans to expand cycling routes to public residential areas, but a report from The Korea Transport Institute notes that "commercial buildings promote public bicycle usage more than residential buildings" (Ki, Shin, Im, & Park, 2011, p. 2). The institute recommends expanding bike-sharing stations near commercial locations to increase network use. Seoul has done this already, but low-stress roads that are inviting to all levels of cyclists must accompany the stations as well.

Barriers to achieving low-stress roads

According to the Seoul Statistical Tables, there are a total of 775.9 kilometers (490 miles) of bike lanes throughout Seoul. Over 151 kilometers (94 miles) of them are bike-only lanes, while 624.6 kilometers (388 miles) are shared paths (SMG, 2015). Current bike roads are not safe because 81 percent of the roads used by cyclists are shared paths with cars and pedestrians. For example, one cyclist from Seoul shared his experience online:

> I ride a bike in Seoul. You have to be really careful here ... even on the sidewalks and bike paths. I've seen two broken legs and 1 broken arm (all bent the wrong way, one was a kid) just on the Han River path. Watch out for everything ... people not signaling, people running

red lights, cars coming from side streets and not yielding, cars cutting into traffic line-ups, cars driving on the sidewalks, and motorcyclists driving everywhere (Waygook, 2011).

Thus, many of Seoul's roadways are too stressful for most users to feel comfortable traversing the streets and using cycling as a method for commuting or running errands. This environment does not attract new cyclists or promote more cycling trips to replace automobile trips.

Barriers to foreigners and visitors

Language barriers prevent foreigners and visitors from using the bike sharing system. SMG introduced their bike sharing system in October 2015, and the system has become more popular over time. However, the signs and directions are not available in languages other than Korean. Moreover, use of a Korean mobile network provider or application is necessary in order to access and pay to rent the bicycles. One visitor shared his anguish:

> The harder part [of cycling in Seoul] is getting hold of a bike in the first place. When we first tracked down one of Seoul's scattered bike-share stations, neither my girlfriend (a native Korean speaker) nor I (a decent reader of the language) could figure out its instructions. It didn't, as far as I could discern, belong to a city-wide system, so even those who were able to extract a bike couldn't stray far from the area immediately along the river … Later, I found out the station requires a Korean mobile phone, meaning only Koreans and registered aliens can use it (The Guardian, 2014, para. 6-7).

And that traveler was not alone. According to the Seoul Statistical Tables (2015), 13.3 million people from other countries visited Seoul in 2015. And according to the South Korea Ministry of Government Administration and Home Affairs, migrant workers account for 3.4 percent of South Korea's total population. Many of those foreigners are concentrated in Seoul, the country's center of commerce and business. Currently, SMG is failing to capture a large population of potential users. If they could adopt practices from the Seoul Metropolitan Rapid Transit Corporation, such as displaying signs in English or Mandarin, many more users could participate in the public bicycling network.

Leveraging information technology to assess active transportation

Seoul has proven itself to be an adaptive city in the information age, and it continues to guide best practices for other municipalities in terms of effectively utilizing digital tools. As SMG writes in *Smart Seoul 2015*, "Information Technology (IT) is not just a tool in pursuit of efficiency. IT, in the Smart age, interacts with people and helps people fully display ingenuity and sensibility. Goods and services applying Smart technologies know what people want and provide what people need" (SMG, 2014, p. 1). The authors of *Smart Seoul 2015* admit that although Seoul has been recognized by many as one of the most technology-friendly cities in the world, there are still strides to be made towards building up smart infrastructure and smart services. Furthermore, SMG has already recognized a need and willingness to create pedestrian-oriented and bicycle-friendly traffic environments ("Seoul Traffic Vision 2030", 2013). As they continue to expand their cycling network and associated infrastructure, SMG should utilize technology to capture data that will influence decision-making.

Because of Seoul's technological expertise, their citizenry's desire to embrace smart technology, and current shifts toward creating smart infrastructure, the city should utilize

information technology to assess active transportation through spatial analysis and public engagement.

Spatial analysis

Seoul also has the opportunity to leverage spatial data to identify cycling hot spots. The city's TOPIS[1] system already collects real-time traffic data from GPS units installed on taxis and cars, to ensure efficient traffic flow. As cycling becomes more popular, GPS units should also be installed on city bikes to develop spatial data on the most popular cycling routes, and to identify cycling 'hot-spots.' Docking station information can also be used to inform riders about how many bikes are available at each nearby station, and whether their destination station has any open spots for docking.

Spatial data can also be used to identify areas where cyclists are experiencing safety hazards or other stressors. A report from the Mineta Transportation Institute explains:

> For a bicycling network to attract the widest possible segment of the population, its most fundamental attribute should be low stress connectivity; that is, providing routes between people's origins and destinations that do not require cyclists to use links that exceed their tolerance for traffic stress, and that do not involve an undue level of detour (Mekuria, Furth, and Nixon, 2012, p. 37).

The authors assign road segments a level of traffic stress (LTS) between one and four, based on perceived dangers and stressors such as traffic speed, designated bicycle lanes, and road width.

> Level of traffic stress 1 (LTS 1) is meant to be a level that most children can tolerate; LTS 2, the level that will be tolerated by the mainstream adult population; LTS 3, the level tolerated by American cyclists who are "enthused and confident" but still prefer having their own dedicated space for riding; and LTS 4, a level tolerated only by those characterized as "strong and fearless (Mekuria et al., 2012, p. 1).

While these classifications were designed to characterize Americans, they were determined based on Dutch bicycle facility planning and design standards cycling enthusiasts. The University of Delaware's Institute for Public Administration built upon this work by developing a Low-Stress Bikeability Assessment Tool. According to this assessment tool, "Low-Stress Cycling (LSC) refers to the idea that a network may be established to ensure that there are ways in which a cyclist can easily access areas throughout a transportation network, without being an extremely confident rider" (DeCoursey, Jones, & Scott, 2015, p. 1). Road segments classified as LTS 1 and LTS 2 are considered low-stress for cycling. The assessment tool can be used in many ways to engage citizens, identify network gaps, and prioritize infrastructure investments.

SMG could utilize the Low-Stress Bikeability Assessment Tool to determine a score for each road segment, and then upload the data to a city map to understand spatial gaps. As Mekuria, Furth, and Nixon (2012) explain:

> Maps including only links with LTS 1 or 2 reveal many gaps created by barriers, [creating] islands of low-stress connectivity, areas within which one can find a low-stress route, but [it requires] the use of high-stress links to get from one island to another (p. 2).

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[1] Seoul TOPIS (Transport Operation & Information Service) is responsible for managing Seoul's traffic network through data collection and demand management.

For example, Figure 3 shows apparent gaps within Newark, Delaware's cycling system. Even though Newark has been awarded 'Bicycle Friendly Community' status by the League of American Cyclists, there are still obstacles to overcome. These data are currently being utilized by the city of Newark, the Wilmington Area Planning Council, and the Delaware Department of Transportation, to guide road maintenance and future infrastructure investment.
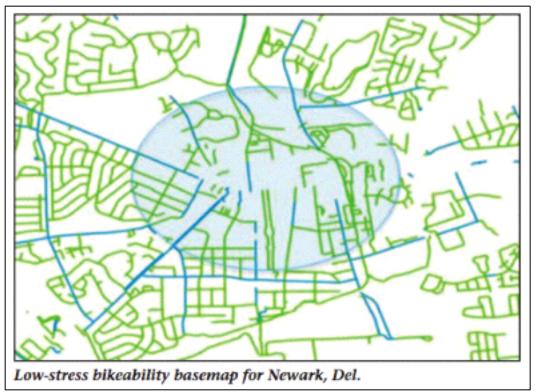

Low-stress bikeability basemap for Newark, Del.

Figure 3. Road segments classified as LTS 1 & LTS 2 in Newark, Delaware

Public engagement

SMG should create a web-based and mobile phone application that engages citizens in two ways. First, it should distribute surveys and public preference polls to engage citizens for ideas about cycling in Seoul. Second, it should enable location-based services to identify infrastructure issues. *Smart Seoul 2015* explains:

> While Seoul has built its reputation as an IT powerhouse, we have not been able to fully utilize IT infrastructure and match the reputation. If we develop user-oriented IT strategies, the status and role of Seoul in ICTs [Information and Communication Technologies] will be further enhanced. (SMG, 2014, p. 3).

When it comes to cycling, SMG must also employ a user-oriented strategy by developing a better understanding of users through technology.

The second goal of *Smart Seoul 2015* is to "realize a Smart government that actively interacts with citizens" (SMG, 2014, p. 4). Seoul already works to encourage two-way communication via smart technology. The city should use pre-established platforms like Mobile Seoul to engage residents about cycling desires, strengths, and barriers. The Michigan Department of Transportation

conducted a comparative analysis of strategies for crowdsourcing data to improve transportation systems. They found that

> a general strategy that has proven successful for collecting bike trip data is to deploy a simple smartphone application that allows cyclists to record bicycle trip routes, average speeds, distances, and simple notes. Cyclists often voluntarily use these apps to help improve local biking facilities. The applications are often coupled with a dedicated web site that allows users to provide additional notes and interact collaboratively with other users and planners. (Dennis, Wallace, & Reed, 2015, p. 27).

Misra, Gooze, Watkins, Asad, & Le Dantec (2014) argue that crowdsourcing data collection can be uniquely effective with a user base that is small but enthusiastic, such as cyclists. SMG can also leverage internet-based social networks to obtain public feedback regarding the condition of the transportation system and performance of the agency. These kinds of social media strategies can be advantageous because "agencies can simultaneously disseminate information, gather additional information from system users, and take advantage of instantaneous unmediated information sharing on the platform." (Dennis, Wallace, & Reed, 2015, p. 38).

Mobile-based geo-spatial information is also readily available when users upload civil complaints through location-based services (LBS). Tagging cycling track barriers should be a main component of any mobile application that is deployed by SMG to engage cyclists. This will allow for targeted infrastructure improvements that will ensure that Seoul's cycling network maintains its quality.

Finally, SMG could integrate cycling for commuting purposes into its eco-mileage program to encourage citizens to use this energy-friendly alternative form of transit. Mobile phone applications such as Plus3 already exist to allow cyclists to tag and record rides. Cyclists can earn dollars towards charitable causes by tracking miles travelled. Similarly, the eco-mileage program can reward points for tracking miles walked or biked. Seoul's desire to become a green, smart city can be accomplished by adapting their environment to encourage more cycling.

Opportunities for positive impact

Adopting a complete bicycle transportation network can localize economic growth, create equitable and inclusive communities, and promote environmental justice.

Economic impact

First, creating a cycling friendly environment can attract cycling enthusiasts and families to Seoul through more recreational and tourist opportunities. According to Scott Lane (2016), a senior transportation planner at the League of American Bicyclists, "bicycling generates nearly $50 billion for non-cycling-sector businesses in the form of meals, hotel lodging, clothing, and entertainment" (para. 2). In other words, bike friendly communities have a significant positive impact on both cycling-sector businesses and non-cycling sector businesses by bringing in new visitors and users. Creating bike friendly communities has also been found to elevate property values, which is a clear indication of economic growth. For example, according to Lane (2016):

> A study from Minnesota suggests that property values increase because of trails: 70% of real estate agents surveyed use trails as selling points for homes, and over 80% thought that they would make a home easier to sell. The Indianapolis Cultural Trail has seen property values within a block of this eight-mile urban trail increase by 148% since it opened in 2008 (para. 4).

Thus, it is likely that creating a bike friendly community throughout Seoul will have a positive impact on the city's economy.

Social impact

Second, healthy, organized, and safe communities have positive effects on the social lives of residents. Bicycles are often the cheapest form of transportation for urban residents. Bicycles broaden urban accessibility, because they are significantly cheaper than automobiles. Creating cycling networks that route users to high-demand locations provides more equal access to public transportation across all neighborhoods, especially in poorer neighborhoods that do not always have access to public transportation. In addition, creating cycling networks can help foster a positive sense of community character. For example, the Australia Department of Transport and Main Roads explains that cycling helps foster community pride in Australia. They report "cycling enables people to interact socially and feel more at home in their local community. More people cycling and walking provides additional opportunity for social interaction on the streets and this enhances a sense of community" ("Cycling benefits", 2016, para. 15).

Environmental impact

According to the United Nations Environmental Assembly of UNEP, "The environment plays a pivotal role in lifting people out of poverty, in ending hunger, in growing our economies, in building peaceful, just and inclusive societies, and in promoting the health of our people and this planet" ("United Nations Environmental Assembly", 2016, para. 5). In order to maintain a healthy community, we should respect and protect the environment. Converting commuting modes from cars to bicycles can have huge impacts on establishing Seoul as a green city. Even simply promoting cycling as a means for students to get to school can have positive impacts. According to the Safe Routes to School National Partnership (2008):

> if the number of kids who walk and bike to school [in the United States] returned to 1969 levels, it would save 3.2 billion vehicle miles, 1.5 million tons of carbon dioxide and 89,000 tons of other pollutants annually. This is the equivalent of keeping more than 250,000 cars off the road for a year (Increasing walking and bicycling to school).

Students are also a promising target group for engaging with smart technology to learn about infrastructure updates.

Moreover, according to the Australia Department of Transport and Main Roads, cycling is the most environmentally friendly form of transportation in terms of space consumption, primary energy consumption, carbon dioxide emission, nitrogen oxide emissions, hydrocarbon emissions, and risk of accidents, which can be dangerous for the environment. Figure 4 compares bicycles, cars, cars with a catalytic converter, buses, airplanes, and trains in terms of these environmental risks.

	Car	Car plus Catalytic Converter	Bus	Bicycle	Air	Train
Space Consumption	100	100	10	0	1	6
Primary Energy Consumption	100	100	30	0	405	34
Carbon Dioxide Emission	100	100	29	0	420	30
Nitrogen Oxides Emission	100	15	9	0	290	4
Hydrocarbons Emission	100	15	8	0	140	2
Risk of Accidents	100	100	9	2	12	3

Figure 4. Transportation Mode Environmental Effects Comparison

SMG has already succeeded in expanding cycling opportunities throughout the city of Seoul. But in order to make its cycling network more complete, SMG should work to identify barriers by utilizing smart technology to generate spatial data for analysis, and to better engage citizens in the planning process. In addition to all of the impacts that we mentioned above, if SMG continues to focus on implementing bike friendly policies and maintaining multi-modal infrastructure options, they will also be achieving one of the goals outlined in the *Seoul Traffic Vision 2030,* 'creating a bicycle-centered environment' (2013). Adopting a complete cycle network will surely be another accomplishment towards becoming a smart, green City. This will help Seoul become a smarter, greener city, and an even stronger example of excellence in urban management and design.

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