

# The Investigation of bicycle parking and traveling behavior of university students using GIS and GPS: Case study in Central area, University of Tsukuba

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## 1. Motivation

The purpose of this study is to detect the spatial pattern of parking and traveling behavior of bicycle riders through spatiotemporal context in the central area of the University of Tsukuba.

## 2. Introduction

The bicycling is a vital transportation system at University of Tsukuba. The university has established many bicycle parking places to cover whole area including north, central, south, west and Kasuga areas. Two types of bicycle parking can be identified as regular (legal) parking and irregular (illegal) parking. This study considers both of these parking behaviors of bicycle riders and their traveling distance. The legal parking place is defined using available information of the university and illegal parking is defined as the places except legal parking where there are two or more bicycles are parked.

## 3. Study Area

The highest number of bicycle parking are located in the central area of the university (Figure 1) where the high daily mobility of students can be identified. In this context, the central area can be considered as a one of most congested areas of the university.

## 4. Methodology

The data that drives this analysis was obtained through four methods. First, the legal parking places were plotted with the number of bicycle capacity in each parking place using available data in the Campus GIS website. Second, the number of bicycles were counted using the field survey. Third, the illegal parking were pointed out using GPS (Garmin etrex 20) and counted the number of bicycles in each illegal parking. Fourth, interview was administered to collect the traveling distance of bicycle riders to reach the central area of the university and the distance information was corrected by using google earth map. The field survey was conducted in three days to represent week day and weekend (8th, 9<sup>th</sup> and 10<sup>th</sup> of February 2015). In the week days, the number of bicycles were counted in each bicycle park by considering peak hours (8.00 a.m.-12.00 a.m.) and off-peak hours (2.00 p.m. - 5.00 p.m.). In the weekend day, the number of bicycles were counted without considering time separations as peak or off-peak hours.

In order to analyze the spatial pattern of legal bicycle parking, the Concentric Ring Buffers (CRB) were created from the weighted mean center of building distribution. The weighting factor was the area of building.

The traveling distances of bicycle riders were analyzed to find out the average distance of students who used the bicycles as their mode of transportation to reach the university.

## 5. Results and Discussion

All the parking places, established by the university are located within 500m distance from the center (Figure 1).

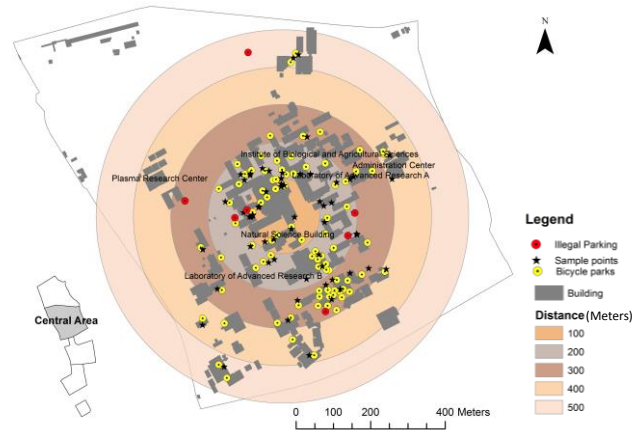


Figure 1. Distribution of bicycle parking places and sample points

The spatial changes of number of bicycle within the study area is represented Figure 2.

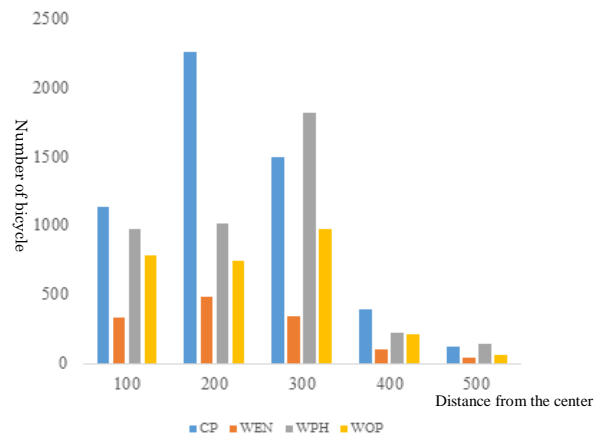


Figure 2. The distribution of number of bicycles from the center  
Note: CP-capacity, WEN-weekend, WPH-weekday peak hours and WOP-weekday off-peak hours

The results show that in the weekday peak hours, the number of bicycles are higher than the capacity of bicycle parks within 300m distance from the center. In the off-peak hours of week days and the weekend, the number of bicycles are less than the capacity of parking place. The conducted filed survey found sparsely distributed seven illegal parking in the study area. Moreover, 97% of responses of interviewee shows that traveling distance to reach the university is less than 3 kilometers.

The obtained spatial pattern of bicycle parking places emphasizes that the university has spatially established an optimum bicycle parking system, while reducing the number of illegal parking and increasing the capacity of legal bicycle parking places in the central area of University of Tsukuba.