Methods of bicycle users' survey

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Abstract – The paper provides a review of data collection methods that can be used for bicycling modeling and planning. The review includes fifteen international studies that use different methods of data collection. The main advantages and disadvantages of each method are listed and the recommendations on when to use particular method are provided.

Key words – bicycle, planning, analysis, stated preference, revealed preference, survey, methods, gps, scenario.

I. Introduction

When planning bicycle infrastructure it is important to use correct and meaningful data about bicycle users and their travel patterns. Methods on how to collect these data significantly relays on purpose and objectives of study. However, to make the right decision on what method of data collection to use the researcher should be aware of different techniques.

This paper reviews recent bicycle studies that used stated preference or revealed preference surveys to collect and analyze bicyclists' behavior. The author discusses advantages and disadvantages of each method and gives recommendations on how to use each of them.

II. Stated Preference Surveys

Stated preference survey is a method of assessing traveler's behavior based on the reported preference of an individual, where researcher simulates the circumstances and examines reaction of a respondent.

The first and the most widely used method is *Stated Preference Questionary* [1, 2, 3, 4, 5]. This type of survey can assess behavior of a person (individual survey) or entire household or family members of surveyed person (household survey). Stated Preference questionaries' allow to get a wide variety of data (e.g. personal data, trip purpose, frequency, etc.) including the reasons of choosing or avoiding particular behavior. The strength of the method is a possibility to evaluate the demand for not existing facilities; however, there is a high level of bias because respondents may report their preferences that differ from actual behavior. To simulate the situation as close as possible, and thus reduce the bias, visual and scenario surveys are used.

Visual Preference Survey is a method that is usually used by architects and urban planners to get public opinion about the physical design of the alternatives. To survey the public, the researcher presents a set of pictures or computer-simulated images of design alternatives and respondents evaluate them based on defined scale according to their preferences. The most significant study that used this method for bicycling planning was "Development of compatibility Index: A Level of Service Concept" conducted by Federal Highway Administration of the United States of America. The researchers selected various bicycle facilities sites and then video taped them as if the person were riding a bike along the way. These video tapes were then shown to the respondents who evaluated their comfort level at each of the facilities. The level of service measurement was developed based on this data [6]. The disadvantage of this method, is that respondents were not physically involved into the process; however, the data were treated like they were .

Scenario Preference Survey is another method that provides a detailed description of simulated situation and behavior options, and collects the prefered reaction of the respondents. Such method was used in Dublin, Ireland, to examine travelers' attitude towards infrastructure features that affect the route choice. The users were given the case that they started a new job that allows them to cycle to work place without regard whether they do so in fact or not. The respondents had to choose the most prefereable route between proposed scenarios. Route scenarios were generated based on combination of five types of infrastructure existing in Dublin and alteration of the route attributes. The total number of scenarious were divided into surveys of six and four alternatives that were distributed to respondents [7].

Although, the method strives to minimize personal bias due to different understanding of the question, there is a chance of misleading results caused by hypothetical nature of scenario. For example, in Dublin study the respondents were asked to evaluate the scenario without regard whether they cycle or not. However, other studies show that persons show a different behavior based on the frequency of ridership.

III.Revealed Preference Survey

Revealed preference survey is a method to observe behavior of an individuals when they perform their actual activities.

The simpliest way to collect information about current bicyclists is a *Bicycle Counts.* The data collected at the designated point of road network and can be executed both manually (record-keeper) or with a help of automated control systems (triggered counting strip or video recording) [8, 9]. When executed manually bicycle counts do not require expensive equipment and it is possibile to recruite volunteers who need basic instructions and do not require special education or preparation. Presence of video recording allows to overcome low quality of record-keepers and collect additional visual information (e.g. riding on sidewalks, motorized traffic intensity, intersections). However, the method will not be effective if the level of cycling is not high enough, road network allows too many route alternatives, or the counts simply misplaced. The method also excludes possibility to collect personal data about cyclists as well as trip data (e.g. origin, destination, and purpose).

The method that allows to collect necessary data trip and user data and also trace the route is *Mental Map*. In this case respondents are asked to answer the questions about their regular trips (usually trips to work or to

school) and draw their route on a copy of the street map [10, 11]. The method does not require expensive equipment and allows to visualize travel patterns. However, the survey itself is massive and hard to fill in, which worsen retention rate of the useful surveys.

The most recent and the most advanced method of revealed preferences collection is *Geographic Positioning System (GPS)-based observations* or *GPS study* [12, 13, 14, 15]. The complete information about the trip route is being recorded by GPS device, which is located on the bicycle. The data then transferred to computer and integrated into geographic information systems network, and after some modifications and clearance may be used for analysis and mdeling. This method allows for detailed and unbiased analysis but requires high technologies to collect and proceed the data. The expensive GPS recorders may be substituted by smart-phone applications that collect and transfer data to the online cloud [15]. Additional trip and user information may be collected by user's quetionary.

Conclusion

This paper presents the review of current methods to collect data about bicycle users and their travel patterns. Study has shown that stated preference surveys are handful because they don't require expensive equipment, allow to predict change in demand, and allow to survey exactly the behavior that we want to evaluate. However, there is a high possibility of bias or misreported behavior due to subjective nature of the survey. To receive more reliable data of current bicycling patterns the revealed preference surveys should be used. These surveys allow to track actual routes of the users and provide precise information about speed, distances and travel time of trips. However, these methods might be expensive and complex to execute. They are also not useful for the cities with low level of bicycling.

Author expects that this paper gave a quick overview of the methods that can be used by city planners, engineers and bicycling activists. It also gives an extensive list of references that can be used as examples and guidleness.

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