TEACHING MATERIAL GUIDANCE

1) Title of the material

Pogodzinska, S.; Kiec, M.; D'Agostino, C. Bicycle Traffic Volume Estimation Based on GPS Data. Transp. Res. Procedia 2020, 45, 874–881, doi:10.1016/j.trpro.2020.02.081.

https://www.sciencedirect.com/science/article/pii/S2352146520301319

2) Which section of the SUMP it is relevant to?

The authors presented in a scientific article the possibility of using data on cycling trips (especially in terms of cycling traffic volume) from various sources. This paper presents an estimation method based on GPS data from a bike-sharing system as a low-cost data collection option. Data from different counting systems can be used to monitor the effects of improvements for pedestrians and cyclists or people using multimodal transport modes. Therefore, the article can be linked especially to the third, fourth, sixth and eleventh parts of the SUMP circle, which deal respectively with: analyse mobility situation (in particular identify information sources and cooperate with data owners – **subsection 3.1.** but also the analysis of problems and opportunities for all modes of transport - subsection 3.2.), scenario building and joint evaluation (developing scenarios of possible futures - **subsection 4.1.**), set targets and indicators (identify indicators for all objectives – **subsection 6.1.** and agree on measurable targets – subsection 6.2.) and monitor, adapt and communicate (in particular monitor progress and adapt – **subsection 11.1.)**.

3) Which Mobility Manager knowledge this material is the most relevant to?

It is related to Transport and mobility planning (section 1 of the Mobility Manager competencies) especially 1c (understanding of travel behaviour) as well as to Data analysis for mobility planning especially 5a (data collection and analysis) and 5c (traffic demand forecasting).

4) Problem approached and content overview

Problem approach - general understanding of what data can be used to estimate cycling speeds and volumes, how data can be used. All analytical methods of assessment of safety or cycling conditions in urban space have as a common factor the number of bicycles entering the system in a certain period or its estimation. Estimating the average cycling traffic volume based on manual and automatic measurements is time-consuming and often requires expensive technology. This paper presents an estimation method based on GPS data from a bike-sharing system as a low-cost data collection option. The analysis was carried out for the city of Krakow (Poland) using daily bicycle traffic from 5 automatic counting loops and GPS data from the Wavelo bike-sharing system. Based on a two-factor analysis of variance (ANOVA) and Tukey's post-hoc test, the influence of the factors "location" and "day of the week" on the share of Wavelo bikes in the total cycling stream was estimated. It was shown that the share studied does not differ significantly between weekdays, but changes significantly between the locations analysed. The results of the

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study indicate that cycling volumes can be estimated using GPS data from the bike-sharing system. However, follow-up measurements are needed to verify the developed models and their applicability to other locations. Cycling trips can be carried out on the roadway, sidewalk or cycling infrastructure, where the implementation of automatic counters is difficult. On the other hand, manual measurements are time-consuming and require adequate data about daily, weekly and seasonal variability of cycling traffic. When such data are not available, the results of short-term measurements cannot be used for estimating e.g. daily volumes. The difficulties described above resulted in the need to look for new, more effective methods of estimating cycling traffic volumes. One such method, very popular in recent years, is GPS technology. This paper presents a method for estimating cycling volumes based on GPS data from a public bicycle system and an assessment of the relationship between observed cycling volumes in the public bicycle system and cycling volumes in general. The influence of two factors, i.e. location and day of the week, on the share of Wavelo users in the total cycling stream was estimated. The study is a prelude to more complex analyses of the variability of cycling volumes and the possibility of estimating it.

The article presents different methods of estimating cycling traffic and examples of the application of each method. It describes the methods of estimating cycling traffic volumes and the purpose of the research, GPS data in cycling traffic analysis - mobile devices and applications and bike-sharing data in cycling traffic analysis.

The simplest and still most popular methods of estimating cycling traffic volumes are manual measurements. Unfortunately, estimating e.g. daily cycling volumes based on these data is difficult because of the lack of reliable coefficients of variation of daily, weekly or seasonal cycling volumes. In previous studies, the coefficients of variation for cycling have been obtained from several automatic counters located in the city and sometimes in the whole region or country.

It should be noted, that depending on the function of the road, land use, presence and standard of cycling infrastructure, the variability of cycling traffic may be different at various locations within one city, let alone the whole region or country. of the whole region or country.

The aim of the study was furthermore to assess the relationship between the number of total cyclists and the number of cyclists using the public bike-sharing system. Such a study may answer as to whether the user of the public bike-sharing system is a random sample of the whole population of cyclists.

5) Who could be interested in this material?

This article is aimed at students and others looking for inspiration for planning sustainable urban mobility measures, taking into account elements that can influence the effectiveness of a measure (in this case cycling measures) in terms of factors to be taken into account when planning measures (the need to ensure data collection for efficiency analysis, monitoring of implementation and the importance of the factor of weather

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conditions to be taken into account when planning solutions). Students specialised in mobility management will find guidance on which measures to include in urban mobility planning. The measures described can be helpful for those developing and monitoring SUMPs measures.

6) What is worth mentioning as an innovative factor for the reader?

The problem with the acquisition of cycling data can be solved by using GPS data from the bike-sharing system. However, it should be assumed that the users of the public bike-sharing system are a random sample of the whole cycling population and the traffic patterns of this group of cyclists are related to the characteristics of the whole cycling stream. This approach is relatively new, as there are no relevant studies in the literature on estimating cycling traffic based on data from a public bike-sharing system. This method, compared to others using GPS data, is characterised by relatively low costs and more accurate reporting of travel parameters of all cyclists. There is no need to buy GPS data. Such data can also come from large and popular applications such as Strava. However, it should be borne in mind that cyclists using such applications are often very experienced, and the result may differ significantly from the journey parameters achieved by other cyclists and may not be a good representation of the cycling population.

7) Limitations

The paper is the first step towards a more comprehensive analysis of the variability of cycling traffic. It is necessary to carry out an extensive validation through control measurements verifying the developed models together with studies on the influence of the street function and the characteristics of the surroundings on the analysed relationships. The share of public bicycle users in cycling streams may change during the day and therefore it is necessary to carry out studies also for hourly cycling volumes. It may also change during the year, e.g. during school holidays or holidays. Such analyses have not yet been included in the study. Estimating the volume of cycling traffic based on the volume of public bicycle users allows one to estimate the volume of cycling traffic anywhere in the street network in a simple way with limited costs. Besides, the article does not present factors that may influence the volume of cycling, but the considerations presented in the article should be taken into account when developing a SUMP for planning and monitoring cycling solutions.

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