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GPS data analysis for understanding urban goods movement

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Abstract

This paper aims to investigate the contribution of GPS survey techniques for urban goods movement characterization and diagnosis, more precisely the implementation and application issues related to the introduction of real-time data transmission procedures and phone tools with integrated GPS devices. We propose a GPS-based data collection method for urban freight route characterization using a Smartphone application. After testing and calibrating the data processing tool, we analyze the main results on a baseline of about 900 rounds, with the R software. This analysis allows us to define the characteristics of the overall routes as well as the environmental impacts linked with the categories of roads: urban highways, main roads and residential streets. Moreover, the study shows that the environmental behavior of the driver is connected with the main activity of the carriers. The complementarity between GPS and traditional urban freight surveys is finally discussed.

Keywords: Urban goods movement; survey techniques; deliveries; GPS

1. Introduction

Urban freight is one of the most challenging aspects of urban planning. In the last decades, several data collection methods have been developed, and many models derived from these methods have been proposed in literature [2][14]. Classical surveys are the most popular methods, as the data collected by this means are a good information support and can have many uses, as for example: modeling, quality and performance evaluation, descriptive statistics, decision support, transport operator feedback and marketing issues [1][3]. However, traditional surveys have their limits, and ensuring the quality of data

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implies an increasing cost both in time and money. Another type of method is related to a GPS-based data collection, which is an appropriate way to make automatic data collection for vehicle routes and stops, but does not give a global view of the freight flows and operations [1][2]. Although very popular in person transport, this second category of methods has not been yet much developed for urban goods and only preliminary studies have been recently carried out [7][12].

Concerning GPS data recording, several works deal with this technique in person transport. We have to note that the goals of GPS data collection are not always similar, and three main uses can be identified. The first one allows providing information on probing vehicles to test a technology, or a methodology in order to track the vehicles and collect all wished information. These works usually deal with few vehicles and a small quantity of data. The second one concerns data collection for model calibration and testing. In this case, very popular in city logistics, the number of vehicles can be limited and the data obtained is easily identifiable and analyzable. The third one is less used and related to data collection surveys for UGM characterization. This last category needs an adaptation to the measured object (not necessarily the route but sometimes directly related to pickup/delivery operations) and has to be connected with some individuals (mainly the companies or the nature of freight). Moreover, the quantity of data is important (route surveys can contain thousands of routes).

Traditional surveys are also implemented for route characterization [3]. They involve thousands of routes but the non-response rates and the quantity of incomplete questionnaires can be important (about 15% of questionnaires filled-up correctly [10])

Therefore, the aim of this paper is to study the potential of GPS-based data collection in urban goods transport and discuss the ways of substituting and/or complementing traditional surveys. Firstly, an overview of main survey methods for urban goods understanding is presented. Secondly, a first analysis about benefits and drawbacks of GPS surveys is carried out. Therefore, a methodology of GPS data collection for urban goods in medium urban areas is proposed. After analyzing the surveyed data, we propose a set of indicators, and make a comparison between routes surveyed with and without GPS that completes the preliminary findings. In conclusion, the possible cases for substitution or complementarity of GPS and classical surveys are addressed.

2. Overview and motivation

Many policy makers are reliant on urban goods movement surveys to make a diagnosis and determine policy approaches for urban freight transport [1]. This provides a little insight into relevant factors like goods and service flows, the specific purposes of commercial vehicle trips, the involved establishment and the supply chain decisions related to these trips, among others.

Traditionally policy makers consider traffic counts as the only surveying method for urban freight policy-making support. In the last years, many urban freight transport studies attempted to go beyond vehicle traffic counts [1], and several types of surveys have been proposed. Urban Goods Movement (UGM) data can be collected using different techniques that can be summarized into the following list of data collection techniques: - Establishment survey; - Commodity flow survey; - Freight operator survey; - Driver survey; - Roadside interview survey; - Vehicle observation survey; - Parking survey; - Vehicle trip diaries; - GPS survey; - Suppliers survey; - Service provider survey.

In addition, vehicle traffic counts are commonly used in conjunction with the above techniques to give complementary information. Among them, two main types of surveys can be used for route reconstruction. Driver surveys are used to gather data about the driver's overall trip pattern, as well as information about pick-up and delivery operations where the survey takes place. They are usually conducted face to face at the establishments that receive pickups/deliveries, with driver interviewed after carrying out work before they drive away. They allow collecting information like: time spent, loading and