Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 111 (2014) 197 – 202

Procedia
Social and Behavioral Sciences

EWGT2013 – 16th Meeting of the EURO Working Group on Transportation

Freight truck trip generation modelling at regional level

Tomasz Kulpa[a,]*

[a]Politechnika Krakowska, Warszawska 24, 31-155 Kraków, Poland

Abstract

Freight truck trip generation is a crucial part of a 4-stage model, especially in regional freight model development. Data needed to construct trip generation equations are ususally gathered at company level using the trip diary. Although this approach seems to be most suitable it may not cover all trips made by freight vehicles in analysed area. On the other hand, response rate may be unsatisfactory. Thus other methods of trip generation estimation should be explored. Based on results of roadside surveys O-D matrices for freight vehicles were estimated. In the next step, using large set of traffic measurements on national and regional roads, O-D matrices were calibrated. In order to calculate trip generations a step backwards was made. Additionally, the results of comprehensive travel studies and secondary data were used. Developed data sets were used to estimate trip generation equations, applying linear and nonlinear regression as well as artificial neural networks (ANN). The aim of this paper is to develop freight truck trip generation equations at regional level using different data sources, secondary data and indirect approaches.

Keywords: trip generation, road freight transport

1. Introduction

Freight trip generation is the first step in the 4-stage model. Trip generation may refer to different areas (e.g. part of a city, commune, district) or particular objects (e.g. single generators). In road freight transport trip generation may be estimated either by the number of vehicles (vehicle based model) or the amount (tons, value) of commodity (commodity based model).

In commodity based models all modes of transport are considered. In particular, in road freight transport commodities are transferred to trucks using average payload factors. On the other hand, in vehicle based models mode split is conducted with trip generation, where trip generation rates or equations are defined for each type of

* Corresponding author. Tel.: +48 12 628 25 33; fax: +48 12 628 25 35.
E-mail address: tkulpa@pk.edu.pl

1877-0428 © 2013 The Authors. Published by Elsevier Ltd.
Selection and/or peer-review under responsibility of Scientific Committee
doi:10.1016/j.sbspro.2014.01.052

vehicle. However, different vehicle classifications are used in freight models the most typical is division into light and heavy trucks. Light trucks usually have a gross vehicle weight (GVW) less than 3.5 tons while heavy trucks – more than 3.5 tons.

Trip generation may be calculated using different approaches. In majority of vehicle and commodity based models trip generation rates and multiple regression equations are used. This approach was used in many vehicle based models (Vehicle Allen (2000), Chen & Naylor (2009), List, Konieczny, Durnford & Papayanoulis (2002), QRFM (1996), Ruiter (1992)) as well as in commodity based models (Anater, Wall & White (2007), Baker & Bostrom (2008), Hwang (2005), Pendyala (2002), Shar, Anderson, Harris & Schroer (2005)). Different approach is used in I-O Models (e.g. QTFDS (2004), Jones & Sharma (2003)). In fact, in this type of models, OD matrix is directly calculated based on between economy sectors commodity flows. Large set of trip generation rates and equations is provided in NCHRP Synthesis 298 (2001) and QRFM (1996). Finally, in Holguín-Veras (2001) and QRFM II (2007), different approaches to trip generation estimation were presented.

Considering Polish freight studies, only few may be listed – those that were made in parallel with passenger movement analysis (KBR Poznań (2000), KBR Kraków (2007), Zipser et al. (2000)). However, freight transport was identified in mentioned studies no trip generation model was developed. Thus the results of comprehensive travel studies in Kraków and Poznań metropolitan areas will be used to develop trip generation models.

It may be stated that main explanatory variables in trip generation models are: number of inhabitants, number of employed persons (in total and in particular sectors of economy) and number of trucks garaging in particular TAZ (Traffic Analysis Zone). Moreover, main calculation methods used are multiple regression and trip generation rates. Artificial neural networks (ANN) were used only for analysis of single generators (Al-Deek, H. M., et al. (2005)).

Observing different approaches to freight modelling (vehicle/commodity based, I-O models) it may be seen that the choice of approach will depend on data availability and model application. Even the most sophisticated model will not provide good results when input data is uncertain or missing. Considering available data from Polish surveys, vehicle based model was chosen. Trucks were divided into two groups: light (GVW less than 3.5 t) and heavy (GVW more than 3.5 t). When it comes to spatial division it was assumed that the region is equivalent to province (there are 16 provinces in Poland) and TAZ is equivalent to commune.

2. Trip generation modelling

2.1. Estimation of empirical trip generations

As an input data for modelling purposes empirical trip generations has to be obtained. In this paper two sources of data were used: comprehensive travel study in Kraków metropolitan area (KBR Kraków (2007)) and comprehensive travel study in the city and district of Poznań (KBR Poznań (2000)).

Within the comprehensive travel study in Krakow metropolitan area questionnaires in firms using trucks were done. In 33 communes located in area of the survey 100 firms were inquired. In fact, the questionnaire was a trip diary that identifies trips origins, destinations and purposes. Extension of survey results to population gave confusing results. In some communes no truck trips were indentified. Hence, a different approach was introduced. Based on results of questionnaires, average number of daily trips made by light and heavy trucks was calculated. Only trips that have either origin or destination outside particular commune were considered. In average, light trucks carry out 1.91 trips daily, while heavy trucks – 2.34. In the next step the number of trucks registered in each commune was obtained. Then, the number of trucks in each commune was multiplied by average number of daily trips. Those were made for both types of trucks. Described procedure resulted in empirical trip generations. This method might be called the direct method.

A different approach, called indirect method, was used in district of Poznań. The area of the survey covered 17 communes. Based on large set of roadside interviews initial O-D matrix was developed. In the next step elements