ARTICLE IN PRESS

Research in Transportation Business & Management xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Research in Transportation Business & Management

journal homepage: www.elsevier.com/locate/rtbm

The importance of external costs for assessing the potential of trams and trains for urban freight distribution

Katrien De Langhe

Department of Transport and Regional Economics, University of Antwerp, Prinsstraat 13, 2000 Antwerp, Belgium

ARTICLE INFO

Keywords:
Urban freight distribution
Rail
External costs

ABSTRACT

As a solution for increasing urban freight distribution issues, such as rising vehicle movements, more environment-friendly transport modes including rail could be an option. So far, investigation within this domain has been confined primarily to applying (social) cost-benefit analyses to specific cases. These existing (social) cost-benefit analyses show the importance of external costs in the profitability calculations of urban rail freight initiatives. Therefore, accurate and appropriate external cost data are crucial for the robustness of a social cost-benefit framework. This paper identifies firstly the external cost elements related to the use of trams and trains for urban freight distribution. Secondly, a range of common external cost values is provided for Belgian and Flemish urban areas. A minimum and maximum value is determined for each external cost, when available data allowed this. In further research, these values will be used as input for a generic social cost-benefit framework to assess the potential of trains and trams for urban freight distribution.

1. Introduction

Urban freight distribution is influenced by several trends, including increasing freight transport, growing population as well as urbanisation and an increasing sustainability awareness (Behrends, 2012; Meersman et al., 2015). This often leads to increasing urban freight distribution issues, such as more vehicle movements. As a solution, more environment-friendly transport modes such as rail transport could be an option (Arvidsson & Browne, 2013; Behrends, 2012; European Commission, 2011; Ruesch, 2001). So far, investigation within this domain has been confined primarily to applying social cost-benefit analyses (SCBA) to specific cases. These analyses do not measure the same variables and cannot be transferred as such from one case to another (Alessandrini, Delle Site, Filippi, & Valerio Salucci, 2012; De Langhe, 2014; Delaître & De Barbeyrac, 2012; Filippi, 2014; Gonzalez-Feliu, 2014, 2016; Köhler, 2000; Nuzzolo, Crisalli, & Comi, 2007; Regué & Bristow, 2013). Therefore, this research comprises the development of a generic social cost-benefit framework for assessing the feasibility of rail for the transport of goods towards, from and within urban areas. When referring to rail transport in this paper, the use of trams or trains is meant.

An investigation of the external costs plays an important role in the development of an SCB-framework (Lammgård, 2012; Mostert, Caris, & Limbourg, 2017). The rationale is twofold. Firstly, existing SCBAs applied to the use of trams and trains for urban freight distribution show the pivotal role of external costs in the profitability calculations. Alessandrini et al. (2012) developed a multimodal urban distribution centre scheme for Rome in which rail shuttles are used for the transport between the city centre and the hinterland. For the transport in the city centre, either conventional or hybrid vehicles are used. The same authors find that the benefits coming from emissions equal 57% of total benefits in the conventional vehicles scenario and 65% of the benefits in the hybrid vehicles scenario. Regué and Bristow (2013) developed a freight tram scheme for Barcelona. Benefits related to externalities account for 8.4% of the total benefits in the case of using the freight tram for retail deliveries in the first year of operation. More specifically, the main external benefits are related to less congestion, accounting for 6.2% of the total benefits. When making abstraction of the benefits related to value added and stockholding activities and reverse logistics, externalities account for 33% of total benefits, while freight tram operations savings explain 67% of the benefits.

Secondly, in order to obtain a robust social cost-benefit framework for assessing the potential of rail for urban freight distribution, accurate and appropriate external cost data are crucial. The European handbook on external costs of transport (Korzhenevych et al., 2014) offers a general overview of different externalities and related values. However, this handbook has three main shortcomings with respect to urban rail freight transport. First of all, it does not focus on the comparison of road and rail urban freight transport as such. Moreover, it often has to be combined with other sources that offer more appropriate and detailed information for this specific research topic. The handbook contains average externalities values, while in some cases the average externality values might not be appropriate for the specific case.

E-mail address: Katrien.delanghe@uantwerpen.be.

http://dx.doi.org/10.1016/j.rtbm.2017.07.002
Received 21 November 2016; Received in revised form 9 June 2017; Accepted 3 July 2017

Please cite this article as: De Langhe, K., Research in Transportation Business & Management (2017), http://dx.doi.org/10.1016/j.rtbm.2017.07.002

Ultimately, no comparison of externalities and related values for specific small regions is made.

The objective of this paper is twofold. Firstly, the external costs that have to be included in an SCBA of rail transport for urban freight distribution are identified. Secondly, common values of the external costs are determined, which will be used to quantify the external costs in the generic social cost-benefit framework developed in further research. The research strategy of this paper consists of an in-depth analysis of existing external cost literature. The scope of the analysis is Europe for the typology of external costs and Belgium for the determination of external cost values. External costs differ depending on the context in which they appear. Since the cost-benefit framework will be applied to Belgium and an in-depth analysis of rail-based urban freight distribution external costs in Belgium has not yet been done, external cost figures for Belgium are the focus of this paper. The remainder of this paper is structured as follows. Section 2 gives an overview of the literature review. Section 3 explains the research strategy. Section 4 offers the results and discussion, while Section 5 provides the conclusions and research implications.

2. Literature review

External costs are a main topic in the European Transport White Paper (European Commission, 2011), which states that these costs should be taken into account for especially road and rail transport. Several definitions of external costs exist in the literature. Blauwens & Van de Voorde (1985, p. 113) define external costs as "*costs that the transport user causes to a third party and for which he does not pay*". Verbruggen (2008, p. 62) defines external costs as "*often unwanted side effects of production and consumption processes, borne by third parties*". These two definitions are in line with the definition provided in the European Handbook on external costs (Korzhenevych et al., 2014, p. 1), which states that external costs equal the difference between the private and the social costs. Social costs are defined in this handbook as "*all costs occurring due to the provision and use of transport infrastructure*", while private costs are defined as "*costs directly borne by the transport user*".

Table 1 gives a non-exhaustive overview of academic papers that use external cost figures in their research and/or discuss the use of rail transport in urban freight distribution. The authors are listed in chronological order and evaluated for the transport mode included, the urban versus interurban scope and the external costs examined.

The first observation of Table 1 concerns the transport mode used. The modes considered in this research are trucks, trams and trains. The incorporation of trucks is important as a benchmark. External costs of the rail transport can be compared in the SCBA to those of the road transport. Only a few papers discuss the external costs related to the use of rail freight transport. Mayeres et al. (1996), den Boer et al. (2008), Regué and Bristow (2013), Gorçun (2014), Kim and Wee (2014) and Zych (2014) discuss the external effects of trams and road transport, although Mayeres et al. (1996) only consider passenger transport and Zych (2014) only makes a qualitative analysis. Beuthe et al. (2002), Nijland and Wee (2005), Andersson and Ögren (2007), Janic (2007), den Boer et al. (2008), De Nocker et al. (2010), Alessandrini et al. (2012) and Korzhenevych et al. (2014) examine the external effects of trains and road transport.

Secondly, it can be observed that not all papers determine their geographical scope. An urban scope means either that the external costs are measured in a city centre, or that the terminology "urban" is used in the original paper. Interurban means that the figures concern transport between cities, or that the terminology "interurban", or "rural" is used in the original paper. It is not in all papers clear whether the external costs are considered for an urban or interurban area. All papers dealing with trams have an urban scope; the scope of the papers dealing with trains is not that clear.

The third observation is related to the external costs examined in the papers. Some papers deal with multiple external cost categories, others focus on one category. Most of the papers do not include up- and downstream processes in their external cost figures. Up- and downstream processes are the activities that occur outside the transport market (Korzhenevych et al., 2014). Some authors incorporate this externality in the calculation of other external costs. Not any of the papers dealing with the external costs of road transport and trams provides an analysis of all external cost categories.

Korzhenevych et al. (2014) mention the location (urban, interurban), the time of the day (peak, off-peak, night) and the vehicle characteristics (euro-standards) as factors influencing the values of the external costs. More specifically, these authors state that the external costs caused by a truck in an urban context during peak hours can be five times the external costs caused in an interurban context during off-peak hours. Therefore, it is important to specify the context before calculating external costs. The level of external costs is not constant for all urban areas. Gorçun (2014) sees a relationship between the population and the income level of the population in an urban area and the logistics and transport activities. This corresponds to the idea of Dablanc (2009), who relates freight activities to the population.

Table 2 shows an application of these relationships between number of loading/unloading operations, number of truck trips and number of freight tons on the one hand and the population on the other hand for the two largest cities of Belgium, being Brussels and Antwerp. Both cities are listed high in the TomTom Traffic Index (TomTom, 2015), meaning that they suffer from congestion. This table shows that urban areas with higher population densities, experience more loading and unloading operations, more truck trips and generate more tons of freight. As a result, external costs due to freight activities differ in these two urban areas.

3. Research strategy

The three-step research strategy applied in this paper is shown in Fig. 1. Firstly, relevant external cost categories are selected from the existing literature. Secondly, urban (rail) freight external costs are identified. Thirdly, external cost values are collected for each of these external cost categories. As such, a database was built, including all relevant monetary values and their characteristics. In the database, all cost values are discounted to the same base year. Based on the external cost values available in the database, the minimum and the maximum value for each external cost category is defined. These three steps are now discussed more in detail in the next sections.

3.1. Step 1: selection of relevant external cost categories

Different categorisations of external costs exist. Schreyer et al. (2004) divide the external costs in the following categories: accidents, additional costs in urban areas, air pollution, climate change, congestion, nature and landscape, noise and up- and downstream processes. Nature and landscape costs and additional costs in the urban area mentioned by these authors are mainly related to transport infrastructure. As a result, they are only of limited relevance for the calculation of the marginal external costs of using rail transport.

Blauwens et al. (2016) make a distinction between four different categories: accidents, congestion, environmental costs and infrastructure costs. The environmental costs consist of air pollution, climate change, noise, soil and water pollution. However, soil and water pollution are the least significant in the case of road and rail transport. Therefore, the focus of this analysis is on the environmental costs of air pollution, climate change and noise. Other categories, such as the loss of nature, the loss of space or odour nuisance are mentioned by for instance Delhaye, De Ceuster, and Maerivoet (2012), but are by the same authors not included in the analysis of external costs for transport projects. When new transport infrastructure is considered, landscape contamination has to be included as an additional factor (den Boer