MODELLING TRAVEL DECISIONS ON PUBLIC TRANSPORT SYSTEMS

Sebastián Raveau and Juan Carlos Muñoz
Department of Transport Engineering and Logistics
Pontificia Universidad Católica de Chile, Chile

Carlo Giacomo Prato
Department of Transport
Technical University of Denmark, Denmark

ABSTRACT

In this article we present an integrated methodological framework for modelling travel decisions on public transport networks. The modelled decisions correspond to the selection of stops, modes, services and routes in public transport systems. The objective of this study is to enhance and expand the traditional framework of modelling these travel decisions by analyzing in detail the behaviour, perceptions and preferences of the travellers. The final result of the application of the proposed methodology consists in the assignment of a trip matrix to a public transport network and hence in the flows for the different services.

The proposed methodology is composed of two sequential steps. In the first step, we model the choices of public transport stops (i.e., the access from the origin zone to the public transport network). For this purpose, a set of attractive stops is constructed based on different characteristics such as walking time to the stop, type of stop (e.g. bus or metro), number of lines that serve the stop and their frequencies, characteristics of the stop (e.g. available information, safety), topological variables, and an aggregate measure of the level of service from the stop to the destination. This aggregate measure depends on the level-of-service of the travel alternatives that are modelled in the second step.

In the second step, we model the choices of public transport routes from the selected stop to the destination zone. On integrated systems, these routes could be composed of different modes and services. For this purpose, a set of attractive routes is constructed based on their generalized level-of-service, which is composed by attributes such as fare, different time components, reliability, transferring experience, vehicle crowding, and network topology. The set of attractive routes is also constructed taking into account the overlapping of the alternatives, in order to avoid high correlation and similarity between the obtained routes. The algorithm used to construct the route set is based on the link penalty algorithm.

The proposed methodological framework considers also the modelling of different route choice strategies, traditionally used in the literature. These strategies deal with the travellers' consideration of a set of common lines when choosing how to travel: the travellers may not choose a single service, but may board the first service from a set of lines. The traditional assumption is to assume that all travellers behave in the same way

(i.e. all/none of them consider common lines), while in our framework we model users behaviour according to each of both strategies. Accordingly, we segment the population into two classes (whether they consider common lines or not) based on their individual socioeconomic characteristics (such as income level, age, familiarity with the system, and gender).

As some of the relevant attributes such as vehicle crowding and other variables related to comfort depend on the travel decisions of the individuals, the methodological framework results in a fixed-point problem. The application method is iterative until the equilibrium is found. It can be proved that the iterative process converges to a unique equilibrium.

The methodology is applied to the public transport network of Santiago, Chile (6 million inhabitants). In Santiago, over 4 million trips are made daily on the public transport modes. The public transport system (Transantiago) consists of 110 feeder (local) bus lines, 49 trunk bus lines, and 5 metro lines. The resulting flows of the application from the methodology are presented in Figure 1. The results present a high goodness-of-fit with relation to the observed flows in the network (particularly for the most important services, such as the Metro lines), capturing on a macroscopic level the travel patterns in the network.

Figure 1 – Assignment Flows

To illustrate the goodness-of-fit of the assignment, Figure 2 presents the load profiles of Metro Line 1 (the most loaded line in the public transport network). The correlation between observed and modelled loads is 98% in the eastbound and 99% in the west bound. Satisfactory results are also obtained the other Metro lines and the most important bus services.

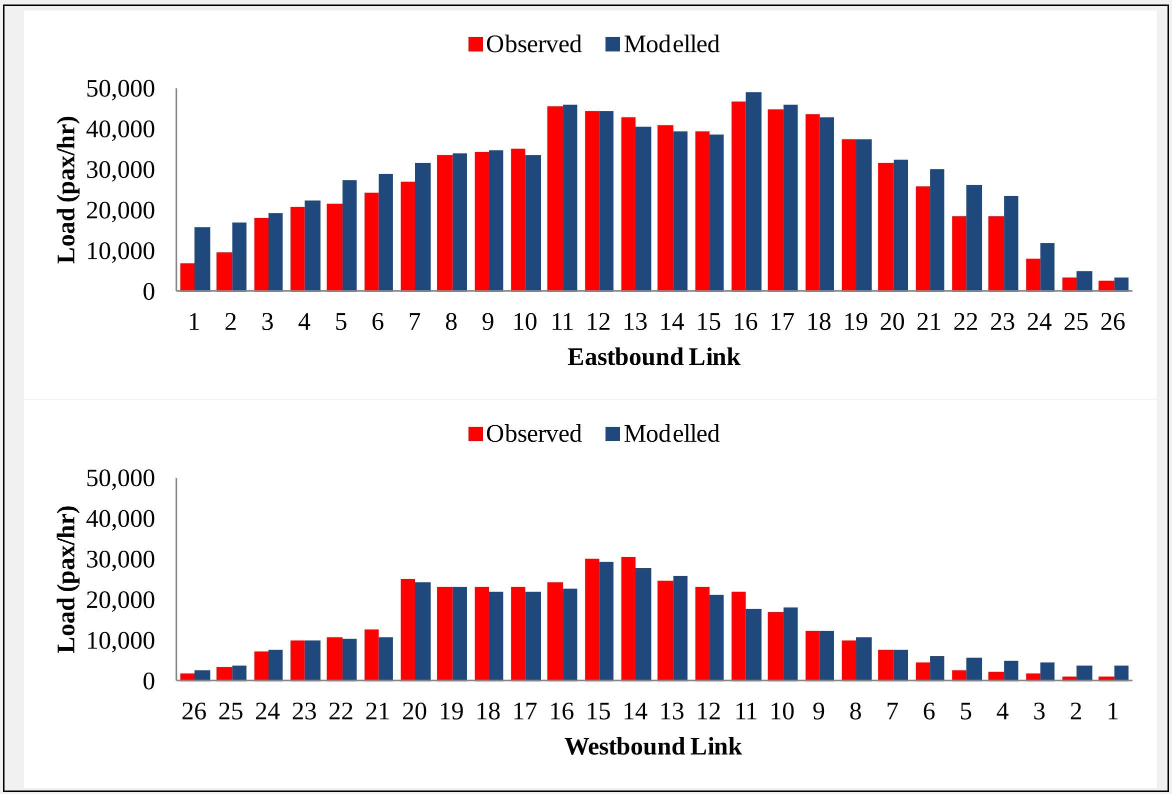

Figure 2 – Load Profile of Metro Line 1

Based on the results of the study, two planning tools are developed: (i) a tactical planning tool for authorities, planners and operators, and (ii) a trip planning tool for travellers.