Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 8 (2015) 72 – 79

Transportation Research Procedia

www.elsevier.com/locate/procedia

European Transport Conference 2014 – from Sept-29 to Oct-1, 2014

New insights in resistance to interchange

Bart de Keizer[a,]*, Marco Kouwenhoven[b], Freek Hofker[c]

[a] *Nederlandse Spoorwegen (NS), P.O. Box 2025, 3500 HA Utrecht, The Netherlands*
[b] *Significance, Koninginnegracht 23 2514 AB The Hague, The Netherlands*
[c] *ProRail, Moreelsepark 3 3511 EP Utrecht, The Netherlands*

Abstract

Train passengers experience an interchange between trains in their trip as a nuisance. To model this resistance, a penalty is usually added in the calculation of the perceived journey time. For many years, NS and ProRail used a fixed penalty of 10 minutes per interchange for rail trips in the Netherlands. This penalty was based on expert-judgement.
A stated preference survey in 2011 [De Keizer et al, 2012, customer resistance to interchanges, ETC Glasgow] demonstrates that customers experience a much higher penalty than 10 minutes. The penalty also strongly differs with characteristics of their transfer, like transfer time, frequency of the connecting service and whether the transfer is cross platform or not. Recently, the SP data have been re-analyzed, based on the recommendations of an audit on the 2011 work. This new analysis shows that a reference penalty is 23 minutes (including 2 minutes transfer time), which is more than twice as high as the current value. However, under certain optimal circumstances, the penalty can be lower than 14 minutes. Comparing the findings with earlier results and findings from international literature shows a similar dependence between punctuality, the connection time and the frequency of the connecting train in all studies. The added value of the new survey is a more detailed analysis of the importance of the various aspects of interchanges between trains. The outcomes of the new analysis have been compared with real-world data. This comparison showed that using the new values led to a much better fit with reality. For example, growth rates of various direct connections to Schiphol Airport were 30-100% higher in reality than had been predicted with the fixed 10 minutes penalty . Applying the new differentiated penalty led to a forecast with a maximum deviation of only 15% compared with the real-world figures.

Selection and peer-review under responsibility of Association for European Transport

Keywords: interchange, resistance, stated preference, railways, customers experience.

* Corresponding author:
E-mail address: Bart.deKeizer@ns.nl

Selection and peer-review under responsibility of Association for European Transport
doi:10.1016/j.trpro.2015.06.043

1. Introduction

Train passengers experience an interchange between trains as a nuisance. To model this resistance, a penalty is usually added in the calculation of the perceived journey time. For many years a fixed penalty of 10 minutes per interchange was used for rail trips in the Netherlands. This penalty was based on expert-judgment.

A stated preference survey conducted by NS in 2011 [De Keizer et al, 2012] demonstrated that customers experience a penalty which is much higher than 10 minutes. The penalty also strongly varies with characteristics of the transfer, such as transfer time, frequency of the connecting service and whether the transfer is cross platform or not. In the Netherlands NS, the operator of the core rail service (whose market share in Passenger-Rail-Kilometres is app. 90%), and ProRail, the infrastructure provider, work closely together in improving the quality of the timetable. Because of this common interest, NS and ProRail decided to use these new insights for future timetable development. Before that, Steer Davies Gleave (SDG) was commissioned to conduct an audit on the study and Significance was asked to improve the model estimations following the recommendations of SDG.

This paper discusses the re-analysis and compares the findings with earlier results and findings from international literature. It also shows the comparison between the model outcomes with the real-world observations and discusses its application in demand forecasting models.

2. Discussion of re-analysis

The 2011 SP survey contained two experiments. In the first, respondents were asked to choose between two travel alternatives. Both with one interchange but different characteristics of the interchange. Each alternative was described by its travel time, the transfer time and the type of interchange (cross-platform, cross-station with escalators, cross-station without escalators). In the second experiment, the number of interchanges between the alternatives varied from 0 to 2 interchanges. The alternatives were described by travel time, transfer time, number of interchanges, possible additional waiting time when missing a connection and cost of the trip. The type of interchange was not presented in the second experiment.

We estimated utility functions to model the choices of the respondents (Ben-Akiva and Lerman, 1985). Data from both experiments were pooled using appropriate scale factors.

We assumed a linear disutility for travel time, travel cost and possible additional waiting time. For the number of interchanges and the type of interchange, we estimated constant disutility factors. For the transfer time, a linear utility term did not fit the data. A transfer time of 5 minutes was clearly preferred above a shorter transfer time (2 minutes) or a longer transfer time (8 minutes or higher), so a 5-minute interchange is viewed as optimal by the respondents (Figure 1). Therefore, we assumed a linear declining disutility function for interchanges between 2 and 5 minutes, and an increasing disutility for transfer times above 5 minutes.

We estimated separate utility functions for three travel purposes: commuting & business, education and other. A general-purpose model was estimated on data from all respondents, using weight factors to correct for an unbalance in the distribution over the purposes in the sample. Error margins were corrected for the panel structure of the data (using a Jackknife procedure, see Miller 1974). Final results are presented in Table 1. All estimated coefficients are divided by the travel time coefficient, so that they can be presented in equivalent travel time minutes.

From these modelling results, we draw the following conclusions:

- The value of travel time is 6.77 minutes per euro, or 8.86 euro per hour. This is consistent with 9.25 euro per hour, which is the official value from a nation-wide value-of-travel-time survey in the Netherlands (Significance et al. 2012; Kouwenhoven et al. 2014).
- The value of one minute transfer time (above 5 minutes) is equivalent to 1.67 minutes of travel time. This is nicely within the range of 1.2 – 2.5 minutes for interchange multiplier factors used in other countries (Wardman 2014). The optimal transfer time is 5 minutes, as can be seen from Figure 1.
- Travelers have a strong preference for a trip without interchanges. A direct connection is valued at 22.63 minutes less compared to a connection with one interchange but otherwise similar characteristics. It should be noted that we assume this interchange to be cross-platform with a transfer time of 2 minutes and a possible extra waiting time of 15 minutes (when the connecting train is missed due to delays).