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Empirical illustration of issues in valuing reliability benefits of transport projects

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Abstract

The improvement of travel time reliability is valuable to travellers, since it helps them to better organise their activities or synchronize their schedules with other peoples'. Reliability benefits can be in the same order of magnitude as the travel time savings. Since 2014, reliability benefits have been included as non-mandatory in French appraisal guidelines. But although several valuation methods for reliability are available, various applicability and consistency issues remain and a comprehensive, consistent among modes and simple feasible method is needed. Thus the aim of this paper is to provide a comparison of methods with a practical perspective for a short term implementation, illustrated by an application on dedicated bus lane projects. This comparison will be derived from existing valuation methods and values from international literature, and will consider both the valuation method and the travel time reliability forecasting method in order to provide a comprehensive method. This paper analyses the empirical robustness and consistency of the reliability benefits resulting from various methods for several modifications of the travel time distributions with a practical perspective. Two categories of methods for the valuation of travel time reliability, mean-dispersion models and mean-lateness models, are tested on simplified case studies of dedicated bus lane projects: mean-dispersion methods and mean-lateness methods. Then the forecast of reliability indicators for such projects is discussed. Statistical models are tested to estimate 90th percentile and finally some tests are run to analyse the sensitivity of reliability benefits to the perimeter over which they are calculated (link or itinerary).

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1. Introduction

The improvement of travel time reliability is valuable to travellers since it helps them to better organise their activities or synchronise their schedules with other peoples'. Recent transport projects tend to focus on managing capacity rather than expanding it and reliability benefits can be a primary goal and a major benefit of such projects, especially for dedicated bus lanes that mainly aim at improving reliability.

An increasing number of countries includes recommendations on travel time reliability forecasts and valuation in their appraisal guidelines (de Jong and Bliemer (2015), DfT. (2009), Eliasson (2009), FHWA (2006), Hamer et al. (2005), HEATCO (2006), NZTA (2008), OECD (2010)). Since 2014, reliability benefits have been included as non-mandatory in French appraisal guidelines. Reliability might be included in the cost benefit analysis as a post-process of the outputs of the traffic model, with no feedback between reliability benefits and traffic models which is the simplest way of measuring reliability benefits in the short term. But although several valuation methods for reliability are available, various applicability and consistency issues remain.

The choice of the method must be based on various considerations: theoretical background, consistent ranking of projects, level of valuation and applicability (understood as the ability to forecast the reliability indicators required for the application of the method). Most national appraisal guidelines recommend using a mean-variance model. This model is well documented, relatively easy to implement and easy to communicate on. However, the forecast of travel time variance can be a challenge, especially for itineraries.

In this paper, we discuss the comparison of reliability valuation methods for dedicated bus lane projects and the applicability of reliability valuation methods in terms of availability of forecasting methods in France.

2. Proposed methodology

In order to analyse the consistency and comparability of reliability valuation methods, the hourly reliability benefits of a dedicated bus lane project are calculated with different methods described below in 2.2 and compared. The overall consistency of the results among the various methods is checked, and a few sensitivity tests are run on reliability indicators. Then the sensitivity of the results to the forecast of reliability indicators is discussed. Finally several tests are run in order to evaluate the sensitivity of the results to the geographic perimeter considered to calculate reliability benefits and more specifically the difference between only taking into account the reliability benefits at the link level (restricting the perimeter of reliability benefits calculations to the road section directly concerned by the project) or on the entire itinerary.

2.1. Description of the project

We consider a 20-kilometre long itinerary in the East of Paris in the direction from the suburbs to Paris. Itinerary travel times are calculated from traffic loop detectors data (average speed on 6 minutes interval). Loop detectors are spaced about 500 meters apart. In order to account for the different speed limit for buses, speed data is capped at 70km/h.

The road travel time distributions on Figure 1 are the various shapes of travel time distributions observed on this itinerary at different times of days, for business days over a year. The shape of the travel time distribution can differ a lot during the day for a given itinerary.

The project consists in creating a dedicated bus lane on this 20-kilometre itinerary, without reducing the road capacity (buses are allowed to drive on the emergency lane) and therefore with no impact on the traffic in the regular lanes. The reliability benefits are only calculated for bus users, considering that in the base case they ride the bus which is within the general traffic, encountering the travel time distributions of Figure 1. With the project, since the bus drives in the dedicated bus lane, the travel time of bus users becomes certain at free flow speed of the bus (70 km/h).

Analyses were also run considering that the project improves reliability but does not make the travel time certain. To do so, we used the distribution of road travel times at 7am (green distribution in Figure 1) as the project case. Conclusions on the comparison of methods are similar to conclusions with the certain travel time distributions and therefore are not detailed in this paper.