Timetable evaluation with focus on quality for travellers

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Abstract

Punctuality and reliability are important for travellers. Railway lines with heterogeneous and dense traffic have proved to be prone to generate delays. Faster services and increased traffic have to be counterbalanced with measures for increased reliability. Efficient timetable planning can improve the use of such lines. Usually, that aim is treated from either a capacity or a socio-economic point of view. Because both are important, this thesis aims to combine the fields. A new method to evaluate timetable alternatives is developed. Commonly used methods are combined in a novel way to reveal values for different variables as input for evaluation of alternatives. That enables the comparison of timetable strategies using relevant input data. The idea is to estimate the benefits of a timetable for a traveller by expressing them as a timetable performance index (TTPI). For this purpose, quality indicators and methods to reveal them are identified. In the next step, traditional valuations for relationships between the indicators are used to test different model configurations for evaluation of alternatives, for example alternative departures on the same line or different timetables.

To treat this multidisciplinary task, several case studies were performed on the Swedish Southern and Western Main lines. As part of a study focussing on methods to measure and evaluate capacity based on travellers' valuations, the importance of delays was analysed in a questionnaire study and relationships between several variables describing the timetable were found. The other case studies aimed to identify relevant variables and use them to evaluate alternatives. Static and dynamic variables are distinguished. The static ones describe the timetable before operation, the dynamic ones the result of operation or estimated outcome revealed by means of, for example, simulation. Empirical delay data is used in one study, simulation with the microscopic tool RailSys in the others. In one of the studies, analysis is combined with the macroscopic timetabling tool TVEM (Lindfeldt, 2010). The case studies showed the characteristics of the analysed lines described by the chosen variables and which methods and variables are relevant to use for a comparison of timetable slots or evaluation of effects of changes in the timetable. An evaluation method was developed where simulation and timetable analysis reveal the variables. The idea is to construct an analytical function using traditional weights for relationships between the variables to convert the values of the variables into a performance index (PI). Based on a PI for each train slot (TSPI), the TTPI for the whole timetable is estimated. It describes the quality of a timetable in terms of timetable time, i.e. the resulting value is a time that is comparable to the scheduled travel time of one train departure, but includes additional information. With this method, complex timetables can be evaluated regarding their robustness to perturbations, which is valuable for socio-economic analysis of effects of measures applied on the railway system.

As shown in a one of the case studies, quality in terms of punctuality and reliability is important for travellers, at the same time as the design of the timetable has significant impact on these aspects. Timetable analysis and simulation are relevant methods to reveal variables that describe these characteristics and evaluation with the presented method is recommended. The configuration of the TTPI is essential for the outcome whereas it is important to choose variables and parameters adequately. If this is taken into account, the approach can be an efficient way to adjust timetables and choose the best alternative, for instance if a train path or timetable change is to be chosen among several.