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Institute for Transport Planning and Systems
Project Summary

Quantifying Public Transport Reliability and its Parameters

Institute for Transport
Planning and Systems

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Quantifying Public Transport Reliability and its Parameters

Objectives

Reliability is one of the most important characteristics of a public transport system. It has a direct impact on mode choice, ridership, and the cost of providing the service. However, service reliability is not easy to quantify.

The goal of this thesis is to quantify the impacts of service reliability influencing route parameters based on Automatic-Vehicle-Location-Data (AVL-Data).

Reliability Metrics

Three different aspects of reliability are considered: Travel time, punctuality and regularity. In each category, 3 reliability metrics are calculated for the sample bus line 31 and the sample tram line 15 in Zurich.

Travel time	Punctuality	Regularity
Run time ratio	Difference in on time performance	Mean headway deviation
Run time coefficient of variation	Standard deviation of schedule adherence	Share of acceptable headways
Travel time reliability	Mean schedule adherence	Headway coefficient of variation

Regression Models

Regression models are developed based on the run time ratio, which is the relation between the actual and the planned travel time for each segment between two stops. Different models for the sample tram and bus line are created.

Model tram line 15:

$$t_{actual} = \beta_1 * t_{pl} + \beta_2 * f_{ob} + \beta_3 * distance + \beta_4 * I_{PT} + C$$

The actual travel time can be calculated from the planned travel time (t_{pl}), a factor of self-obstruction of public transport and pedestrians (f_{ob}), the distance and the number of intersections with other public transport lines (I_{PT}).

Model bus line 31:

$$t_{actual} = \beta_1 * t_{pl} + \beta_2 * VOC_{MT} + \beta_3 * distance + C$$

For bus line 31, the actual travel time can be calculated from the planned travel time (t_{pl}), the distance and the volume over capacity ratio of the segments where the bus does not drive on a separate bus lane but in mixed traffic (VOC_{MT}).

Coefficients of determination for both models are considerably well and lie between 0.62 and 0.88.

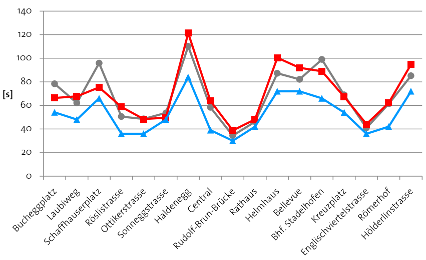

Figure 1: Planned travel time by the VBZ (blue), mean actual travel time (red) and travel time predicted by the model (grey)for line 15 in the morning peak-period (07:00-08:30). Predicted values are quite close to actual values.

Intersections with other public transport lines, the potential of self-obstruction of public transport and the availability of a separate tram or bus lane significantly influence the actual travel time.

Case Study

In order to see if the models are transferable to other lines in Zurich, the regression models are tested on four case study lines: tram lines 5 and 14 and bus lines 32 and 34. One similar and one dissimilar tram respectively bus line is chosen. Both models (tram and bus models) will be applied to the dissimilar lines.

	Similar line	Dissimilar line
Model bus line 31	32 (Holzerhurd – Strassenverkehrsamt)	34 (Klusplatz – Kienastenwies)
Model tram line 15	5 (Kirche Fluntern – Laubegg)	14 (Triemli – Seebach)

To evaluate the model application performance, three categories are defined:

ΔR^2 to model lines (15 or 31):

$\Delta R^2 > -20\,\%$ → good performance

$-20\,\% > \Delta R^2 > -40\,\%$ → moderate performance

$\Delta R^2 < -40\,\%$ → poor performance

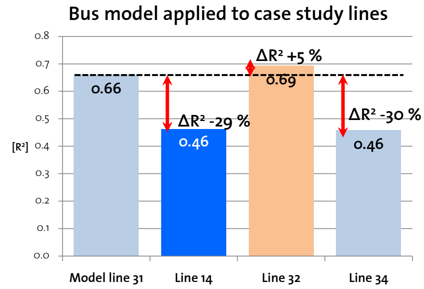

Figure 2: Bus Model application to case study lines

It is found that the model developed on tram line 15 can be applied well to similar lines (5) and dissimilar lines (14 and 34). The model developed on line 31 performs very well on line 32, yet not on line 14 and 34. They are too different in their characteristics. Line 14 is solely operated on a separate tram lane and the model under estimates the travel time because of the missing influence of the mixed traffic (variable VOC_{MT}). Line 34 is more like a quarter bus line and travel times are over estimated by the model. All in all, the models perform well.

Reliability Improvement Strategies

A cost/benefit evaluation procedure is developed and applied to several local strategies. Further, a more general strategy is developed: Travel times and dwell times are adjusted towards the values measured by the AVL-System and a new schedule is created.

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