Abstract: Service unreliability is generally understood to be something that transit passengers dislike; however, unlike waiting time, riding time, and travel cost, unreliability is not usually quantified as a user cost. Typical measures of service unreliability such as on-time performance and coefficient of variation (cv) of bus headway are indicators from an operator’s viewpoint, not impacts on a passenger. Our inability to express unreliability as a user cost means that it is often ignored or undervalued, and it makes tradeoffs with other user costs difficult to evaluate. For example, if holding control at timepoints is instituted so that riding time increases by 2 minutes while on-time performance improves from 80% to 90%, are passengers better off? We can’t answer that unless we can quantify unreliability as a user cost.

Unreliability affects not only people’s time spent waiting at the platform, but also puts a constraint on the time they must budget for waiting, even if they don’t actually spend the time waiting. This is a hidden form of waiting time called “potential waiting time.” Other hidden forms of waiting time – schedule inconvenience and a synchronization penalty – are also discussed, leading to a comprehensive measure called Equivalent Waiting Time that encompasses the effects of unreliability. This measure is considerably more sensitive to reliability than traditional measures of waiting time; using it will lead to decisions that place a greater importance on reliability.

Next, we show how Equivalent Waiting Time has been used to determine the running time schedule that minimizes a sum of operator and user cost for a route with timepoint holding control. We show that the optimal running time schedule has some slack, slightly increasing riding time but with improved reliability as a consequence. We report on a simulation experiment that finds that adding slack time at timepoints (for better reliability) entails virtually no additional operating cost, as slack allocated to timepoints can be substituted for layover or recovery time.

BIO: Peter Furth is a Professor of Civil Engineering at Northeastern University. He earned his BS, MS, and PhD degrees at MIT, finishing in 1981. His transit research covers routing and scheduling, data collection, ridership estimation and modeling, and transit signal priority. He has been a consultant to more than 25 transit agencies nationwide. Peter also does research in traffic signal control and in bikeway design. In the summers, he teaches a course in the Netherlands on Design for Sustainable Urban Transportation, exposing American students to European practice that includes transit priority, bikeway networks, transit- and bike-oriented design, and traffic calming.