

Managing train dwell time is key for high frequency metro operations since dwell time is often a major factor that decides service headways. There have been research and development to inform customers of the passenger loadings of next services, which could be used for controlling passenger loading distribution within the same services. Whilst there has been a good number of studies on the train dwell time and factors that influences it, there has been little research on how the passenger loading of the train and its distribution among its coaches, affect train dwell time. For example, does an already crowded train require a long dwell time? If so, what is the extend to which crowding affects train dwell time? Would it be correct to assume that an even distribution of passenger loading leads to a shorter dwell time? This study investigates these questions.

Using the loadweigh and the service operation records of Hammersmith and City Line of London Underground, this study investigated the effects of passenger distribution on train dwell time. The loadweigh data used for this analysis was that of September 2016. As each boggy of the rolling stock (S Stock) for Hammersmith and City Line is equipped with a weight measurement system, by dividing the measured live load by the average weight of the population, it is possible to estimate the number of passengers on each coach of each service. Note that each train set for Hammersmith and City Line consists of seven coaches. The system setting is that immediately after the train starts moving at each station after dwelling, the on-board system records the weight of each of the seven coaches. In total, the dataset included 2,740 records.

First, we investigated the relationships between loadings of the whole train and dwell times recorded. The analysis was carried out at a disaggregate level for loading categories per 20000 kg. The results suggest that, while the relationship was not clear for the loading in the range of 0 to 20000 kg (roughly up to on average 38 people for each coach given the average weight of 75kg), a clear correlation was observed for the range of 40000-60000 kg (76 to 114 people) or above.

Secondly, the relationships between loadings of the highest loaded coach and dwell times recorded were examined. The results suggest that, while the relationship was not clear when the loadings were within the range of 0 to 4000 kg per coach (roughly up to 105 people per coach), but above this a clear correlation was observed.

Thirdly, in order to measure the unevenness of passenger distribution between train coaches, we created an index, named Train Unevenness Index (TUI). It was built on the Gini coefficient concept. Using TUI, the effects of loading distribution on dwell times were examined. We found that a clear correlation existed only in limited circumstances.

The analysis results of this study offer an improved understanding of train dwell time and the factors that influence it. They can be used in implementing a better users' management strategy to smoothen distribution in order to increase capacity and reduce dwell times as well.