Proposal for the 2nd International Workshop

Automated Data Collection Systems: A New Foundation for Urban Public Transport Planning and Operations

COMPARING BEFORE AND AFTER SITUATIONS WITH SMART CARD DATA AND GTFS DATA

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Foreground

Nowadays, the use of smart card automated fare collection systems has become a current practice for transit authorities. Numerous researches have shown the potentialities of using the data from these systems for public transit planning: ridership studies, travel behaviour modelling, network performance measures, etc. (Pelletier and *al*., 2011). However, several issues remain in the processing of such data, one of them being the transferability of such innovative methods to the day-to-day operations of transit authorities (Wilson, 2014). One successful example is the implementation, at the *Société de transport de l'Outaouais* (Gatineau, Canada), of an algorithm to estimate the destination of smart card trips, based on work done in the mid-2000s (Tranchant and *al*., 2007). One of the greatest challenges remains the combination of demand and supply data on a continuous basis. As a start, Nassir and *al*. (2011) proposed a method to estimate stop level origin-destination trips using both schedule and smart card data systems. Previous works were mainly proof of concepts and it is now time to use this data at a larger extent to perform transit network evolution analyses.

Objectives

This paper presents a series of methods and indicators developed to compare before and after situations in the case of large service changes occurring in public transit networks, using smart card and GTFS data. Comparing two networks is not a straightforward task, because the following elements have to be considered:

- in addition of the schedule, the network geometry may have changed (stops, routes), so there is not a constant set of objects to be compared ;
- in addition to the variations of current demand, there is a need to control for any change in accessibility and level of service for the whole population, not only for transit users themselves ;
- the demand may have changed also because of exogenous factors, like annual variations, weather, fares, workplace changes, etc. ;
- there are tens of thousands of users to be analyzed, making it difficult to apply straightforward statistical methods.

The aim is to obtain objective and reproducible indicators that can be used on any pair of situations.

Methodology

The case study is the implementation of a bus rapid transit (BRT) line in the heart of the *Société de transport de l'Outaouais* (STO) network. This BRT line have asked for a complete change of the network routes in the area, because routes were diverted as feeder services and the BRT became the backbone of the network towards the central business district (CBD). For the analysis, we examined two years of data, being the year before and the year after the implementation of the new service. A total of 24,788,550 smart card transactions have been integrated to the analysis. In these years, there are several schedule periods, as it is in most transit authorities. A total of 8 General Transit Feed Specifications (GTFS) data files has been used for the analysis.

The following indicators are proposed:

- typical transit indicators can give a general idea of the global changes (system length, number of stops, vehicle-kilometres, average distance between stops, etc.);
- active pairs of stops that cumulate the opportunities of accessing transit stops during the day, given the number of transfers;
- extent of service at each stop, giving the intensity of service according to destinations;
- demand-based indicators that describe the number of passenger-kilometres, passenger-hours, number of transfers for each card that can be compared;
- grid-based approach, to assess the indicators on a comparable territory independent from the network geometry.

Experiments

Here are some examples taken from the application of the method to the case study.

Figure 1 shows the connectivity among the different pairs of stops given the number of transfers needed to reach a destination. In order to improve a network, the percentage of connected pairs of stops should get higher for smaller amount of transfers or direct trips.

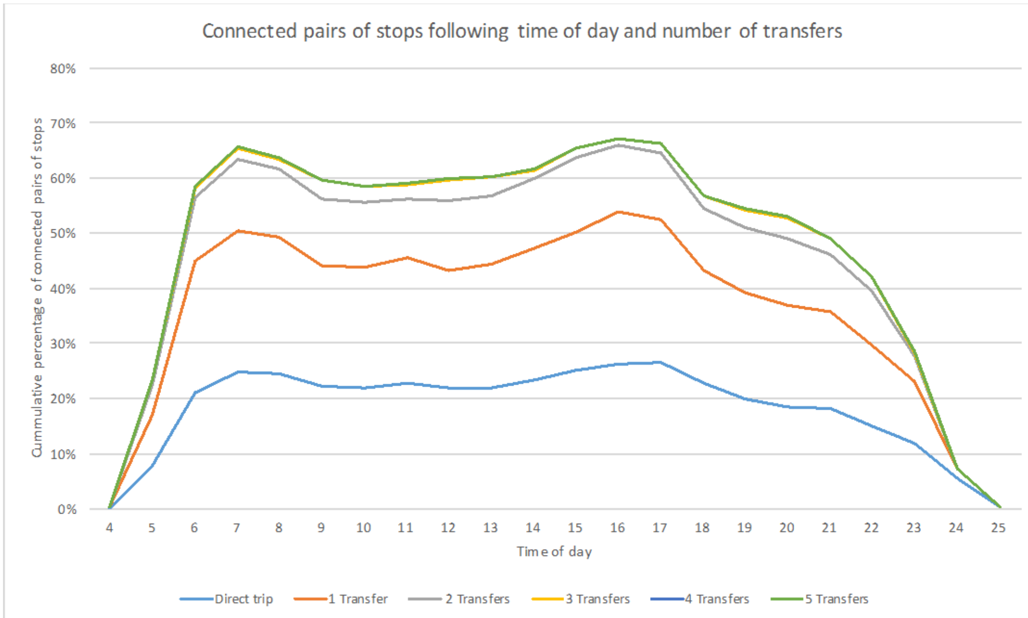

Figure 1 : Connected pairs of stops

Figure 2 shows the intensity of service at the stop level. For each departure at a stop, all possible journey to every other point of the network. It takes into account the frequency of service and reachable destination. A larger point represents a better service provided at this stop for a weekday.

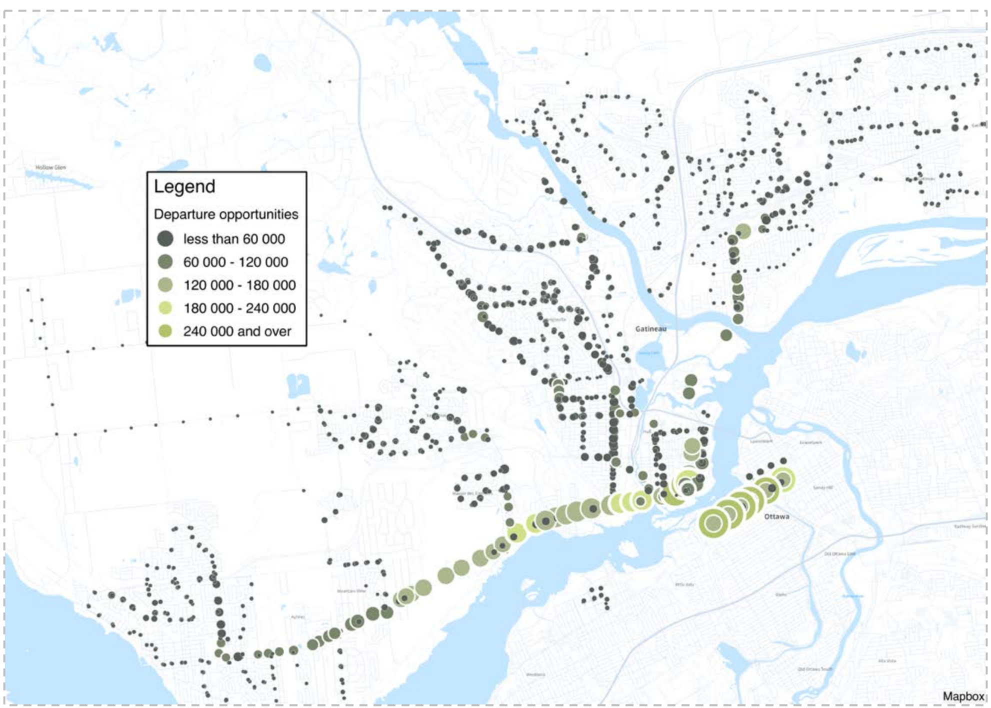

Figure 2 : Departure opportunities for a full week day

Figure 3 illustrates the departure opportunities into a more sizable way. This figure could be used to compare two different states of a same network and see which one provides a better service

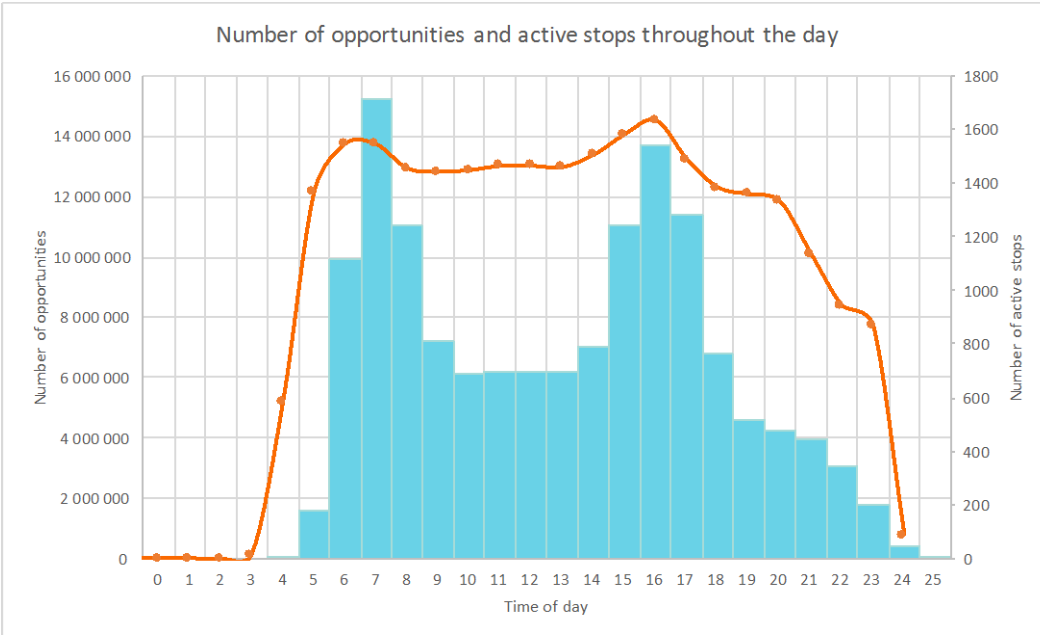

Figure 3 : Distribution of departure opportunities for a full week day

Finally, Figure 4 shows how easy it is for a traveller to access the entire network. It illustrates the areas accessible from a certain bus stop within a trip duration of two hours.

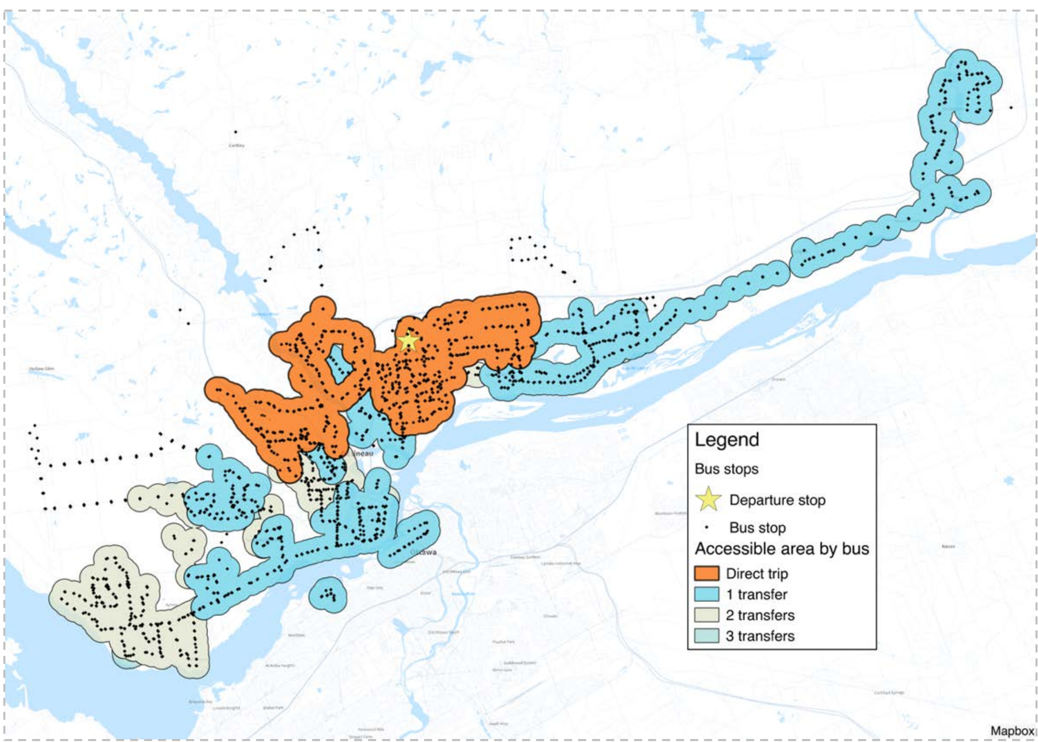

Figure 4 : Accessible area by bus given the number of transfers

FULL PAPER WILL GIVE MORE DETAILS

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