The need for improved decision-support tools for the minibus taxi industry

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INTRODUCTION

The minibus taxi industry is fast becoming the backbone of public transport in South Africa. This is despite government's wishes to have higher-capacity public transport modes fulfilling this role. The increased number of taxis in the public transport network, however, poses a number of questions, such as:

- For rational network planning purposes, is there a relationship between the supply of minibus taxis and travel demand in the network?
- Are there any other pertinent quantifiable relationships of strategic interest among operational variables in the operated minibus taxi network?

The main objective of this article is to review some of the embedded relationships between supply and demand in minibus taxi networks, and their implications on strategic transport planning. Modelling taxi network behaviour could also allow for the estimation of missing network data where there are gaps in the planning datasets. The data used in the analysis, however, is limited to the Gauteng Province in South Africa.

BACKGROUND

The 'love-hate' relationship between the minibus taxi drivers and the general public is well known. The popularity of this mode of travel in South Africa is, however, undisputed. This popularity is largely due to the relatively high levels of accessibility of minibus taxis, which

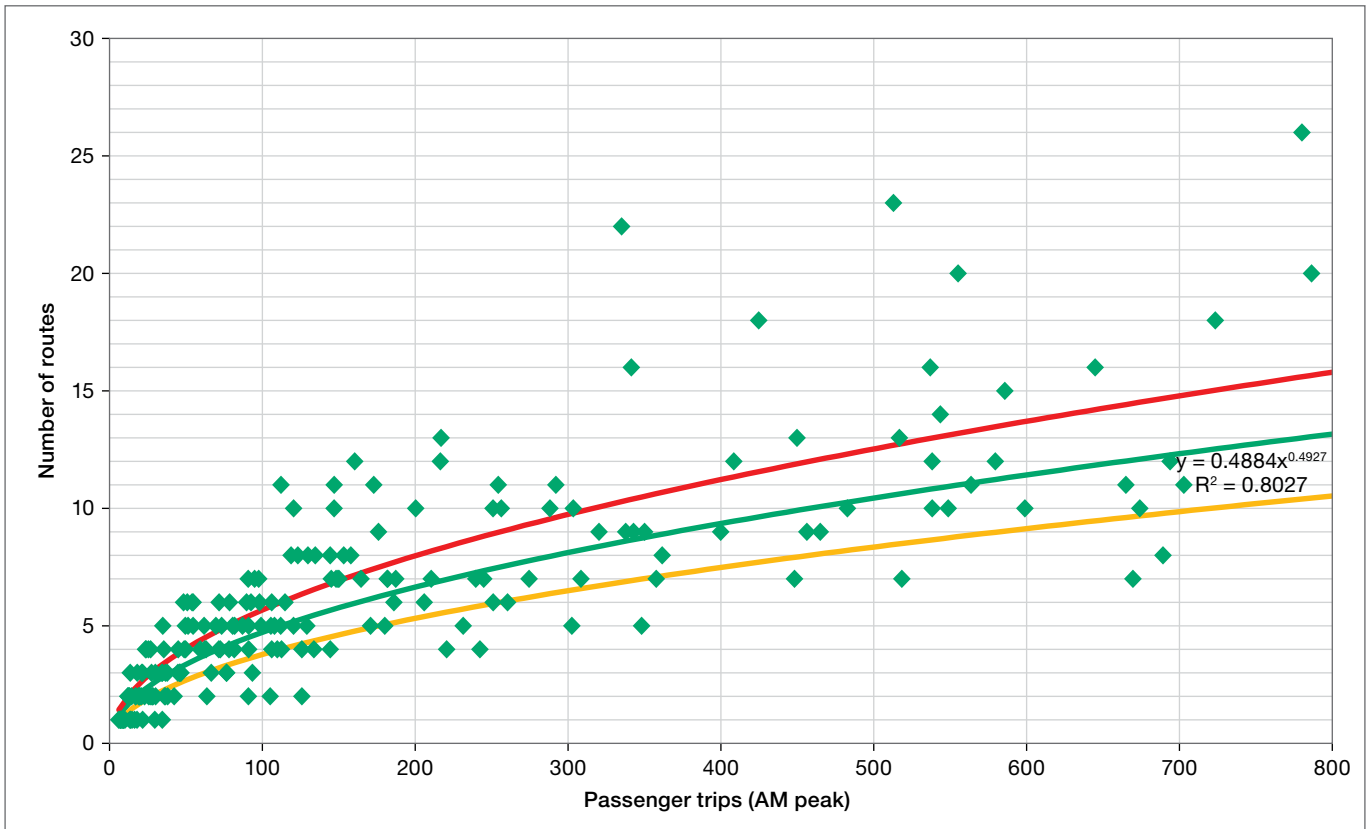

Figure 1: Relationship between the number of minibus taxi passenger trips and the number of routes supplied

results from their extensive network coverage. It also appears that minibus taxi users are prepared to pay the relatively high fares for this level of service.

Although the minibus taxi operations originally started as informal businesses, they have over time become an industry. Also, because the minibus taxi operators are running businesses, they need to develop and adopt strategies informed by credible information. In fact, the sustainability of this industry will hinge on the quality of decisions made in the next few years, and therefore on the careful analysis of the operations. This article demonstrates the use of some of the analyses that can be derived from such operational datasets.

METHODOLOGY

Existing demand and supply-side datasets from municipalities in the Gauteng Province were collated. The datasets included household travel surveys, historical current public transport records (CPTRs), minibus taxi rank passenger surveys, and existing sets of geo-coded minibus taxi routes. The unit of spatial analysis was

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transport analysis zones (TAZes) that are also used in the Gauteng strategic transport model. Therefore, population and trip demand computations were made at a TAZ level. The variables that were investigated included the number of minibus taxi routes, the number of passengers on the routes, and population size per TAZ.

RESULTS

The relationship between the number of minibus taxi routes and the number of passengers using minibus taxis on a typical weekday, per TAZ, is shown in Figure 1. In this context, the number of routes is defined as the unique minibus taxi origin-destination pairs reported in the household travel surveys (HHTS) for a specific TAZ. As expected, the number of routes is positively correlated with the number of passengers using minibus taxis. A regression analysis was undertaken to determine the relationship between these two variables. At an aggregate level, a power relationship of the form $y = aX^n$ produced the best fit between modelled and observed data, with a correlation coefficient (R^2 value) of 0.80. Of interest is the wide variation of the observed data, showing that, for any given number of routes, there is a wide range of passenger demand. This observation implies that, while supply is responsive to demand, there are areas where there may be an over- and under-supply of routes. Nonetheless, it can be concluded that the minibus taxi routes indeed tend to be demand-responsive.

A ± 20% band (not confidence interval) is drawn around the regression curve to merely show data points above or below the regression curve. Three groups of TAZes emerge from this, namely:

- TAZes within 20% of the regression line (green)

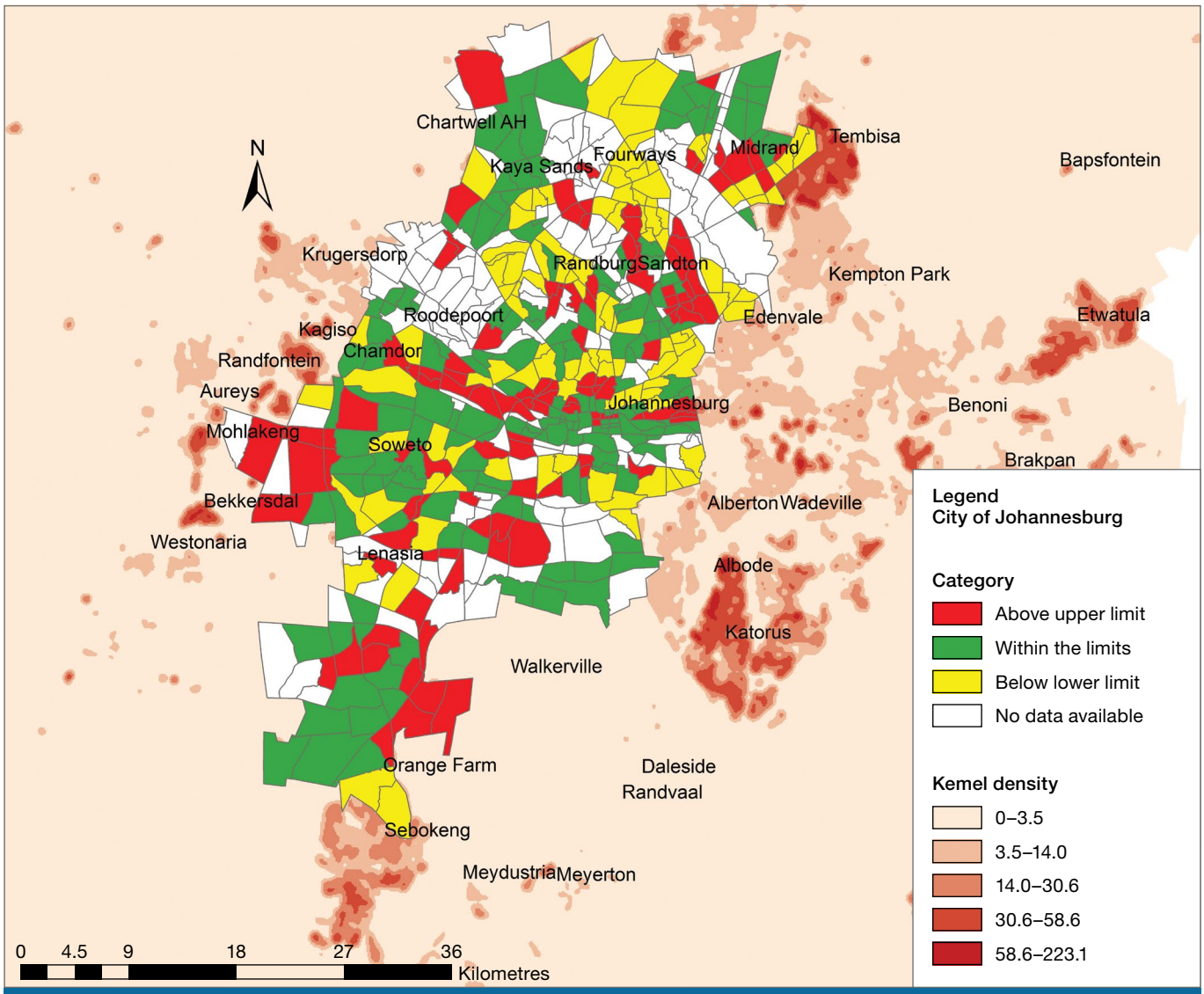

Figure 2: Spatial distribution of minibus route supply in the City of Johannesburg

- Areas more that 20% of the regression lines (red), and
- Areas less than 20% of the curve (yellow).

The TAZes corresponding with the three categories are further depicted spatially in Figure 2 for the City of Johannesburg, where more complete datasets are available.

It is fair to assume that, organically, yellow areas later become green and then red. If the red areas are truly representative of oversupply, then Figure 2 shows that there is a significant number of such areas in the City of Johannesburg, and that these areas seem to be emerging from many parts of the city. Of concern, in particular, would be red areas that are beginning to cluster and expand. More worrying would be the increased issuing of operating licences in such areas without intensive scrutiny.

The yellow areas may be indicative of areas that are generally underserviced by minibus taxis relative to travel demand. Further investigation would be necessary to understand reasons for this, and why red areas exist while the yellow ones are still in existence.

The blank areas, showing unavailable data, are an indication of the need to continue improving the availability and quality of data. This is especially relevant if these datasets are to be of value for dispute resolution.

CONCLUSIONS AND THE WAY FORWARD

The rational and positively correlated relationship between minibus taxi supply and demand is confirmed. However, there is cause for concern about the existence of areas that may be oversupplied or undersupplied with minibus taxi services. It would be of interest to gauge how regulatory authorities currently approach the issuing of operating licences in areas shown through this preliminary assessment to have an oversupply of services.

Analyses such as the ones described in this article, should nonetheless be some of the basic analyses that planning authorities carry out and report on. The minibus taxi industry would also benefit from such basic analyses. Apart from improved transport planning, having such information would help facilitate strategic discussions between the minibus taxi operators and planning or regulatory authorities.

The approach of clustering data at a TAZ level poses some methodological limitations, though. Therefore further research would be required to identify more appropriate methods. It should furthermore be noted that, while the number of routes is used as a proxy indicator for the supply, there could be other more appropriate indicators. This in turn makes a case for continued research work on the appropriate set of indicators to assess the sustainability of minibus taxi industry or public transport networks in general. □