EXPLORING THE DESIGN AND MANAGEMENT OF LEARNER TRANSPORT SERVICES

G HITGE

PO Box 2072, Durbanville, 7551
Tel: 082 372 2730; Email: gerhardhitge@mweb.co.za

ABSTRACT

In the Western Cape alone, more than 55 000 learners are being transported to and from schools across the province, every day, along more than 500 routes. Despite the substantial subsidy budgets allocated to these services across the country, very little attention has been given to the design of this unique and complex form of public transport.

This paper is used to explore some of the complexities peculiar to Learner Transport Services (LTS) in South Africa. The factors to consider when designing a route or routes for the learners in a district that attend a school, or cluster of schools, include: the impact of terrain, gradients and surface type on the selection and performance of vehicles in designing a fleet for a route; variation in learner numbers over time and the impact on variations in a contract; and the appropriateness of the Department of Transport's Model Contract for Public Transport Services to contract learner transport services.

The paper includes some of the prevailing practices employed by the Western Cape Education Department (WCED) in managing the routes and contracts under its control. Finally, it demonstrates the recently completed process to migrate the historic hand-drawn route maps to an electronic and web-based format, and the potential this holds to significantly improve the design and management of LTS contracts in future.

1. INTRODUCTION

In the Western Cape alone, more than 55 000 learners are being transported to and from schools across the province, every day. Despite the substantial subsidy budgets allocated to these services across the country, very little attention has been given to the design of this unique and complex form of public transport. To address this gap, the Western Cape Education Department (WCED) adopted a policy document to guide decisions relating to this complex area (WCED, 2015).

During 2016, the WCED embarked on a project to digitise the 527 routes in operation in the Province at the time. They also assessed alternative strategies to reduce the cost of providing Learner Transport Services, to enable them to operate more routes within a given budget.

This paper is used to:

i) describe the process of digitisation, which can be replicated in other provinces;
ii) to show an analysis of the data to make high-level observations about the state of learner transport schemes in the province, and
iii) provide a brief overview of and reflect on improvements in the policy environment.

The paper concludes with highlighting possible next steps in the pursuit of more efficient Learner Transport Schemes (LTS).

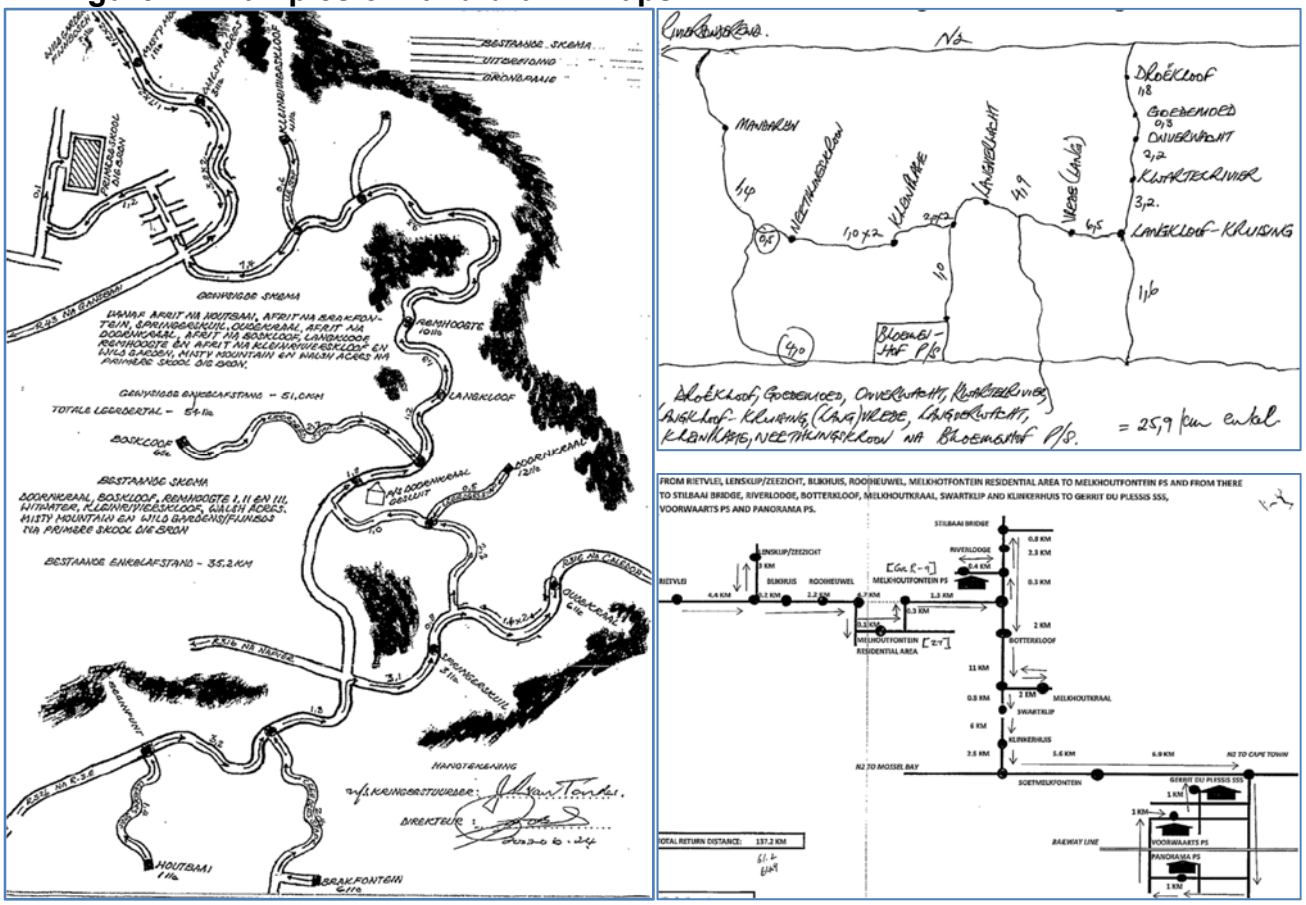
2. THE PROJECT: DIGITISATION AND OPTIMISATION OF ROUTES

2.1. Data recording and digitisation

The key objective of the project was to digitise the 527 route maps of the Learner Transport Schemes operated in the Province at the time. These maps have been developed by officials in the WCED over a period of more than 30 years.

Historically all routes were recorded as hand-drawn maps after measuring the route length by driving along it with a departmental vehicle. Figure 1 shows examples of the various types of conventional hand-drawn maps used until the end of 2016.

Figure 1: Examples of hand-drawn maps



Invariably these maps are not to scale, and distances were often inaccurate due to standard errors on the odometers of different vehicles. However, when asked by the project team to clarify, experienced officials in the WCED district offices could mostly describe exact features of routes in their areas of jurisdiction. This alludes to a vulnerability in the system that is almost solely dependent on knowledge of individuals.

Each route was surveyed by driving along it with a GPS enabled tracking device, while recording the exact coordinates of each stop where learners were picked up or dropped. A survey was planned using tools such as Google Earth (2016), the Provincial Education Department's website listing school names and locations (WCED, 2016), as well as Provincial Agriculture Department's website listing farm names (CapeFarmMapper, 2016). The objective with planning the survey was to eliminate uncertainty created by the hand-drawn maps, as well as to optimise the number of routes that could be surveyed in a week. This was achieved by selecting clusters of routes to be surveyed by a team in a week and minimising the positioning distances between consecutive routes.

A team of surveyors were deployed to survey all routes in a geographic area. Surveyors typically stayed overnight in remote towns where all routes could not be completed within a day. Where internet connectivity was adequate, data was uploaded to a server for the GIS team to clean and process into the required format. Where this was not possible, data was uploaded once survey teams returned to the office.

Innovative software was used that recorded data for routes and stops in a manner that could be transferred directly into the ultimate GIS environment. This greatly reduced the processing time when compared to conventional Global Positioning System (GPS) devices. Typical "errors" that needed to be cleaned, included driving past a correct turn-off or logging a point more than once when several sign boards indicated the same name for a farm. The "clean-up" process was done with assistance of the surveyors between survey trips, as they were familiar with the field conditions.

The final data file of a Learner Transport Service consisted of a separate folder for routes (line files) and stops (point-files).

2.2. Route optimisation

One objective of the project was to determine if any route could be realigned to reduce its length, or whether consolidation of stops was possible, as this exercise could not be done efficiently on the prevailing maps. An assessment of the routes revealed that the potential to reduce the length of individual routes or consolidate stop locations were very limited. This could be expected since WCED district officials would typically use the shortest route to travel between identified pick-up points and the relevant schools. The available data did not reveal

Optimisation of a route depends not only on its length and number of stops, but also on the number of learners picked up along the route, and especially the number of learners at specific stops. This may not influence the total distance of the route, but could result in optimisation of the fleet requirement, and a reduction in the total distance travelled along a route. For instance, consider a route of 40km in one direction, with a total of 30 learners. If more than half of learner live more than 30km from the school, two taxis may be employed to travel along the length of the route. However, if the majority of learners live under 10km from the school, only one vehicle need to travel the entire route length, while the second can be contracted for a limited distance. In theory, routes should be optimised on an annual basis as the number of learners per stop could increase or decrease from one year to the next.

Another area where route lengths could be reduced is by requiring learners to walk along an access road to a main road pick up point. This would reduce the distance a vehicle has to travel along the same road. However, there is no guideline to what an acceptable distance would be in different climatic conditions or at different gradients in expecting learners to walk.

2.3. Outcome of route mapping

The outcome of the digitisation project is shown in Figures 2 and 3, as the combined map of all routes, and the detail of distinct routes within a specific area. The routes shown include the prevailing stops, while alternative alignments were used where optimisation was possible.

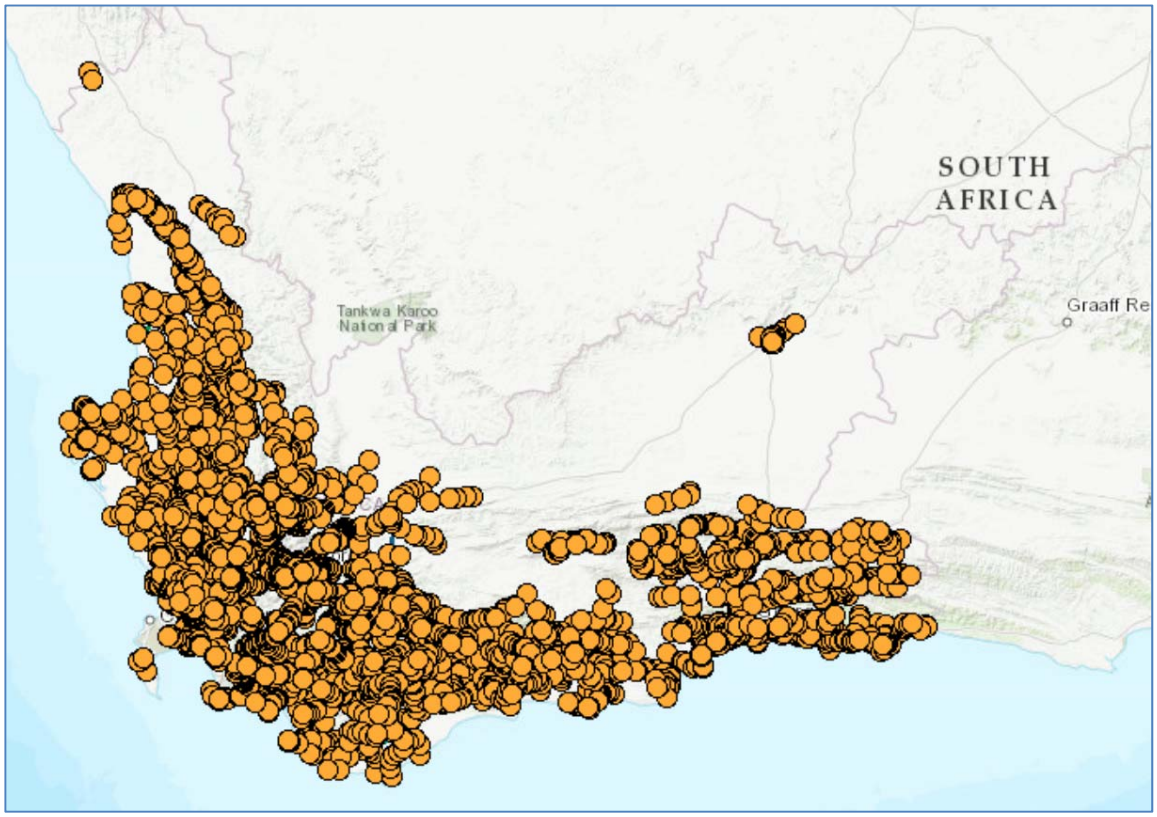


Figure 2: All 2016 WCED digitised routes

Figure 3: Examples of specific digitised routes

3. ANALYSIS OF ROUTE DATA

3.1. Summary of data

A brief analysis of the data for the 527 routes highlights the need for careful planning. Figure 4 shows the distribution of route lengths in ranges of about 12km. The average return route length is 48,8 km, while the median length is 42,4 km. 92,6% of the routes are less than 91,4 km in length. It was surprising to find that 6 routes were less than 10 km in return length. This means that all learners live within 5km on the school, and therefore appear not to qualify for Learner Transport Services according to the National Policy (NDoT, 2015).

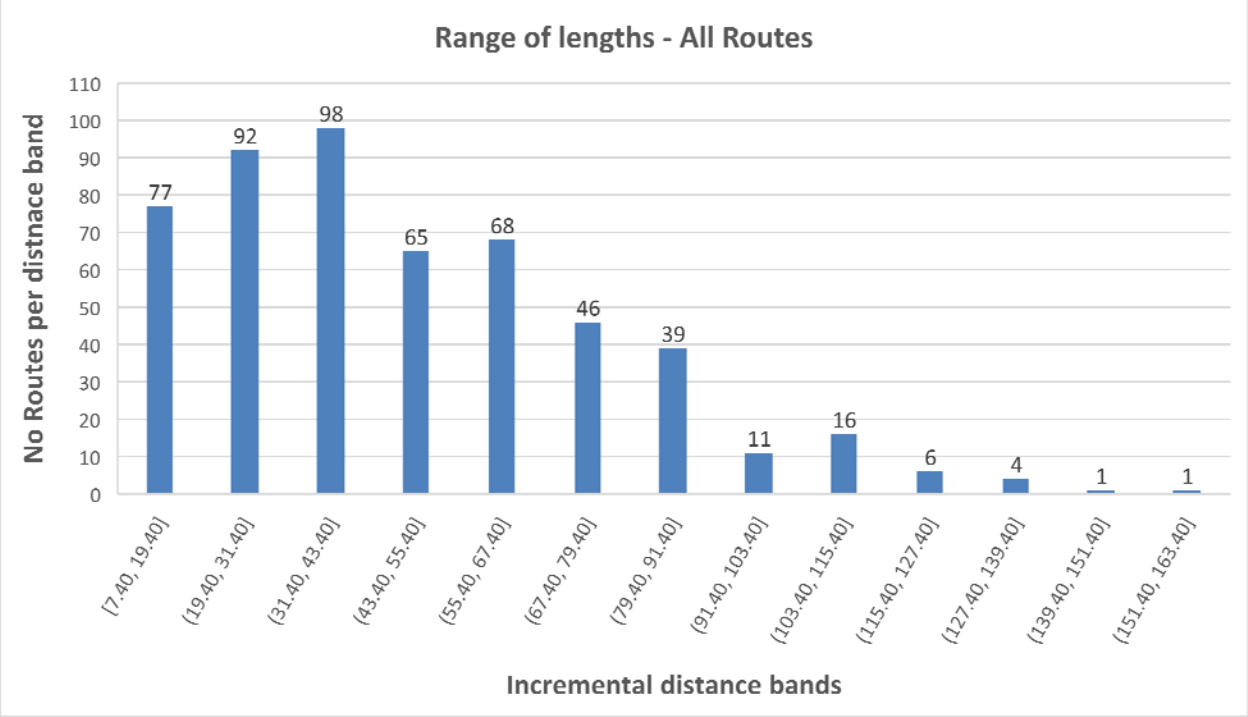


Figure 4: Number of routes in return distance categories

When comparing cost per learner per month to the range of trip lengths, a similar pattern arises. Figure 5 shows that the distribution of costs follows a similar trend as route lengths. This indicates that the cost per km of routes are typically similar as well. However, it is clear from Figure 6 that there are significant deviations from the norm when comparing the cost to individual routes.

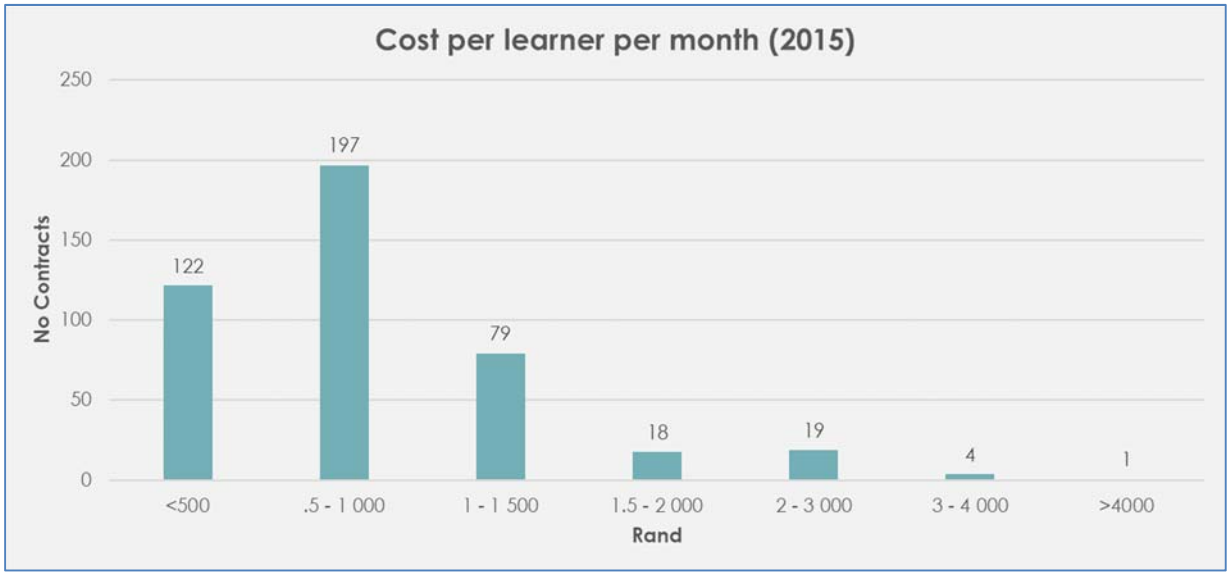


Figure 5: Number of routes in cost categories

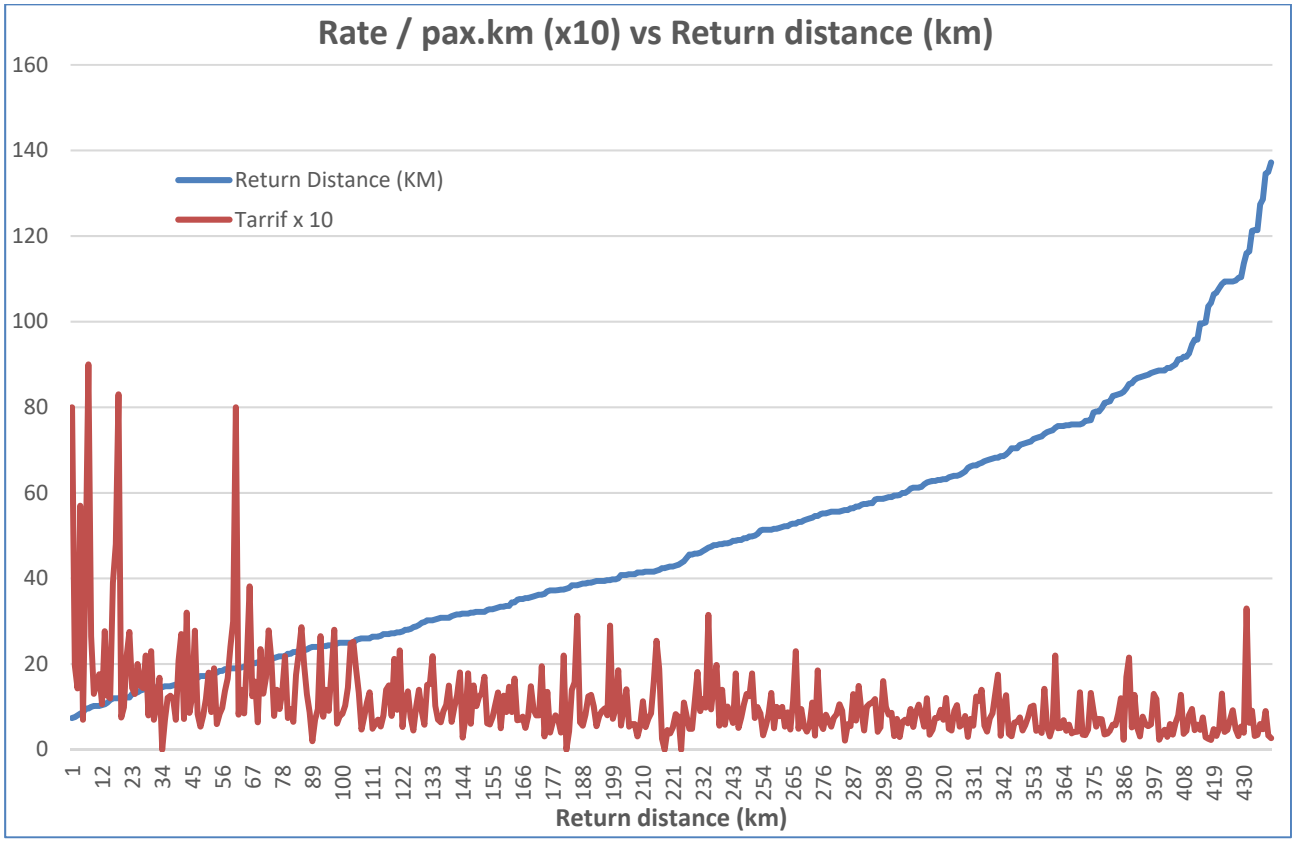


Figure 6: Cost per learner per day in context of route length

It can be expected that it is more difficult to achieve economies of scale on very short routes, which results in a higher cost per passenger (learner). This may be attributed to the capital cost of vehicles as well as overhead costs being disproportionately high, especially where vehicles make no other trips during the day. Even though the deviation around the norm is higher for shorter trips, there appears to be significant outliers on some of the very long routes.

3.2. Interpretation of data analysis

Some of the factors that influence vehicle operating costs include the terrain and condition of roads. Routes could range from only high quality surfaced roads to poor quality gravel roads. Terrains vary from flat urban with high design standards, to mountainous gravel roads with a relatively low design standard. Longer distance routes are often associated with lower design standards and poor surfaces.

These factors not only impact on costs, but has a significant impact on the travel speed, and therefore travel time along routes. Long travel times result in learners having to be picked up very early and arrive home very late. Access to education therefore sometimes come at a price of long periods away from home, and an inability to participate in other important activities. No travel time information was collected during this project.

Tendered rates are typically based of the initial expected number of learners along a route. However, while small variations in the number of learners per stop could be accommodated within a vehicle fleet mix, exceeding thresholds of a vehicle's capacity could trigger the need for additional vehicles at considerable extra cost. Similarly, a decrease in demand below the threshold of a vehicle's capacity may result in redundant vehicles.

Contracts should therefore provide the education department with the flexibility to accommodate variation in demand, given the difficulty of estimating how demand would fluctuate over time. However, projecting this uncertainty onto a transport contractor result in two typical outcomes. The first is where a contractor design redundancy into his fleet, which result in a high rate per learner when the additional capacity is not required. Secondly, a contractor provides for the initial demand only, but is unable to grow his fleet when required, which have led to bankruptcy of some contractors. This scenario not only result in disruption of services, but also in contracting of temporary services while new permanent contractors can be secured.

4. POLICY CONSIDERATIONS

4.1. Policy environment

Section 29(1) of the South African Constitution describes the right to a basic education and further education as follows:

> *Section 29(1) provides: 'Everyone has the right – (a) to a basic education, including adult basic education; and (b) to further education, which the state, through reasonable measures, must make progressively available and accessible.' (RSA, 1996)*

The Constitutional Court strengthen the importance of physical access to schools, with the following statement (*Juma Mushid* in SECTION27, 2017):

> *[The right to a] basic education is an important socioeconomic right directed, among other things, at promoting and developing a child's personality, talents and mental and physical abilities to his or her fullest potential. Basic education also provides a foundation for a child's lifetime learning and work opportunities. To this end, access to school – an important component of the right to a basic education guaranteed to everyone by Section 29(1) (a) of the Constitution – is a necessary condition for the achievement of this right.*

While many provinces have been funding learner transport operations since before the current Constitution was adopted in 1996, a National Learner Transport Policy (South Africa, 2015) was only adopted in late 2015. The vision of this policy document is to achieve: *"A safe, reliable and integrated transport service that caters for the needs of learners"*.

The Western Cape Education Department (WCED) also adopted their own policy to manage learner transport services in the Province in 2015 (WCED, 2015). The wording of this policy is more pragmatic than the national policy and deals with the practical operational aspects of planning and contracting learner transport services. The policy vacuum has been filled by these two documents, although earlier discussion papers and policy related documents have been in circulation in various provinces since at least 2000.

However, the policy documents do not give adequate guidance to provincial officials to address many of the complexities in the design and contracting of learner transport services.

4.2. Policy guidance

The cost of providing Learner Transport Schemes is high and competes for funding with other important services. In an environment like this, where demand outstrips supply, the policy guidelines should assist the relevant Contracting Authority to decide who to allow in the scheme, and who will be excluded. A clear and quantified policy framework is therefore required that will provide the parameters and standards with which to design a provincial scheme.

Some of the parameters and standards to guide the design of routes within a LTS include:

- Identify eligible learners
  - Clearly state the criteria for a learner to quality for inclusion in the scheme;
  - Indicate whether parents must apply for inclusion, or whether the school will identify learners for inclusion;
  - Provide guidance to prioritise between different schemes and within a scheme since funding may not allow for all qualifying learners to be transported;

- Determine whether one or more contracts are warranted
  - Specify the minimum number of learners to warrant a service along a particular route, or to a particular school or cluster of schools.
  - This should reflect the maximum time travelled per learner, and relates also to the decision whether to extend a route to include additional learners further away from a school;

- Minimising route lengths
  - Specify preferred and maximum distances a learner is allowed or encouraged to walk to reach a stop point of a service;
  - Specify preferred and maximum distances a learner is allowed or encouraged to cycle to school, and determine when a saving would exceed the cost of providing bicycles to these learners instead;
  - Indicate the extent to which the ambient weather conditions or gradients affect walking distances, i.e. a shorter distance may apply in summer in areas of excessively high temperatures or very heavy rainfall;
  - Specify the earliest time a learner is expected to leave the house in order to walk to a stopping point;
  - Specify the earliest drop-off time at a school, i.e. the longest time learners should wait before school starts;

- Basis for payment
  - Confirm that a contract is per vehicle-km travelled with learners, regardless of the number of eligible learners on the route or route sections;
  - Allow variation in the size of a vehicle where learner numbers change drastically during the contract period;

- Risk assessment
  - The planning and design processes should ensure that only risks within the contractor control are apportioned to them.
  - Large variations in passenger numbers are difficult to predict and could have a significant impact on fleet size and vehicles types.

5. DISCUSSION AND PROPOSALS

The design of a Learner Transport Service appears uncomplicated at first, yet the analysis and interpretation of data reveals several complexities. The recent adoption of policy documents can be seen as a critical step to deal with some of this complexity. However, it is the author's view that these policies should be strengthened, or supplemented with a guideline document, to assist provincial authorities in the design of services and contracts to achieve more cost-effective learner transport services.

While digitisation of routes constitutes a leap forward from hand-drawn maps, it provides the platform for many new and untapped opportunities. GIS based route data could be expanded to include the number of learners boarding (toward school) at each stop. Algorithms can be produced to optimise the number of vehicle and routes around a school or cluster of school at the beginning of each year. Statistical analysis can be applied for more robust prediction of learner numbers over different contract periods.

The technology used in collection of route information has reached the stage where it could be permanently installed in all vehicles providing learner transport services. Such vehicle tracking data could enable real-time monitoring (with adequate signal reception), provide planning data and could also feed directly into an invoicing system.

The National Departments of Transport and Education and all provinces could benefit from the experience of the WCED to digitise their learner transport routes. Technology could improve the monitor and control of learner transport contracts, with the potential of transporting more learners within a given budget.

REFERENCES

CapeFarmMapper, 2016, available at https://gis.elsenburg.com/apps/cfm/

Constitution of the Republic of South Africa, 1996.

Google Earth, 2015, available at https://www.google.com/earth/

SECTION27, 2017, Basic Education Rights Handbook (available at http://section27.org.za/basic-education-handbook/)

South Africa, 2015, National Learner Transport Policy, (Proclamation No. R. 39314) Government Gazette 997, 23 October 2015

WCED, 2015, Western Cape Education Department Policy on Learner Transport Schemes

WCED, 2016, WCED Schools data base, available at http://wcedemis.pgwc.gov.za/wced/findaschool.html