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Creating a Remoteness Index for Local Municipalities in SA

Authored by:
Gerbrand Mans
Alize Le Roux
Johan Maritz
Elsona van Huyssteen

Report done by:
CSIR
Built Environment
Spatial Planning and Systems
Pretoria
Tel: 012 888 2552

The purpose

The purpose of the study was to develop a **remoteness index** for all Local Municipalities in SA. What is meant by remoteness in this instance is the **magnitude of the burden** (measured in travel time in minutes by an average vehicle) **to access a range of functions and services** (public and private sector) **as well as livelihood opportunities**. In other words it is the level of access that a person living in that municipality has to a range of services and other functions which are associated with an urban setting.

Methodology

The following procedure was followed to calculate the remoteness index:

a. **Classification of all SA settlements** into three categories based on the level of services and livelihood opportunities available in each settlement. The basis of this classification is the CSIR settlement typology.
b. **Measuring the geographic access** (travel time) of all people in SA to all three levels of settlement types. This was done by using the CSIR mesozones as the analysis units and measuring the average travel time to its nearest settlement in each of the classes via the existing road network. Each mesozone is also **attributed with the total population** residing in it.
c. **Calculating a remoteness index** for each local municipality based on the weighted average of the level of access of the mesozone a local municipality consists of. The weight being the population size per mesozone.

A. Classification of settlements

The CSIR settlement typology was used to develop the three tiered classification used in the study. The settlement typology is a functional classification based on population size, level of economic activity, the extent of the availability of government and private sector services in a town or settlement, as well as the role it plays in terms of providing access to these services to people living within the broader region in which it is situated. For more information about the CSIR settlement typology please see: http://www.stepsa.org/settlement_typology.html. The CSIR settlement typology consists of the following classes:

- City regions (like Gauteng): Large continues and interdependent city regions including other cities or secondary cities.
- Cities (like Mangaung or Buffalo City): Cities which are fairly 'free standing', i.e. no continues development around the city that flows into regional service centres and service – or bigger towns.

- Regional service centres or towns (like Klerksdorp or George): These centres provide services and livelihood opportunities to people in an extended catchment area which includes other bigger towns and usually it is the service centre of a prominent economic region.
- Service towns (like Butterworth or Ceres): Such a town is important as a hub, in a bigger catchment area which includes smaller towns and settlements, where people can access key social services.
- Local and / or niche towns (like Prince Albert or Britstown): Small town providing access to the very basic services, e.g. primary school, bank and grocery store. Some of these towns may have a niche function in for example tourism.

For the purposes of the analysis a three tiered classification based on the typology was developed, which gives a more logical breakdown of access to different levels and choice of services throughout the country:

- Level 1 places: City regions, Cities and Regional service centres
- Level 2 places: Service towns
- Level 3 places: Local and / or niche towns.

Regional service centres have been included with Cities and City Regions as these places do have a significant range of services and livelihood opportunities and if only Cities and City regions were to be considered for Level 1 places it will give a skewed picture in terms of remoteness of municipalities as places like the George / Mossel Bay region would be considered as fairly remote, which is not the case.

B. Measuring geographic access to the three levels of settlements

The measurement was done by using the CSIR mesozones (see: http://www.stepsa.org/socio_econ.html) as the analysis units and measuring the average travel time (in minutes) to its closest settlement in each of the classes via the existing road network. Travel time was used as it inherently takes into consideration factors like road surface and condition as well as traffic congestion which impacts on choice of where people will travel to. Each mesozone is also attributed with the total population residing in it. The distance was measured using a network analysis procedure in GIS. The result was that each mesozone had a travel time measure to three places.

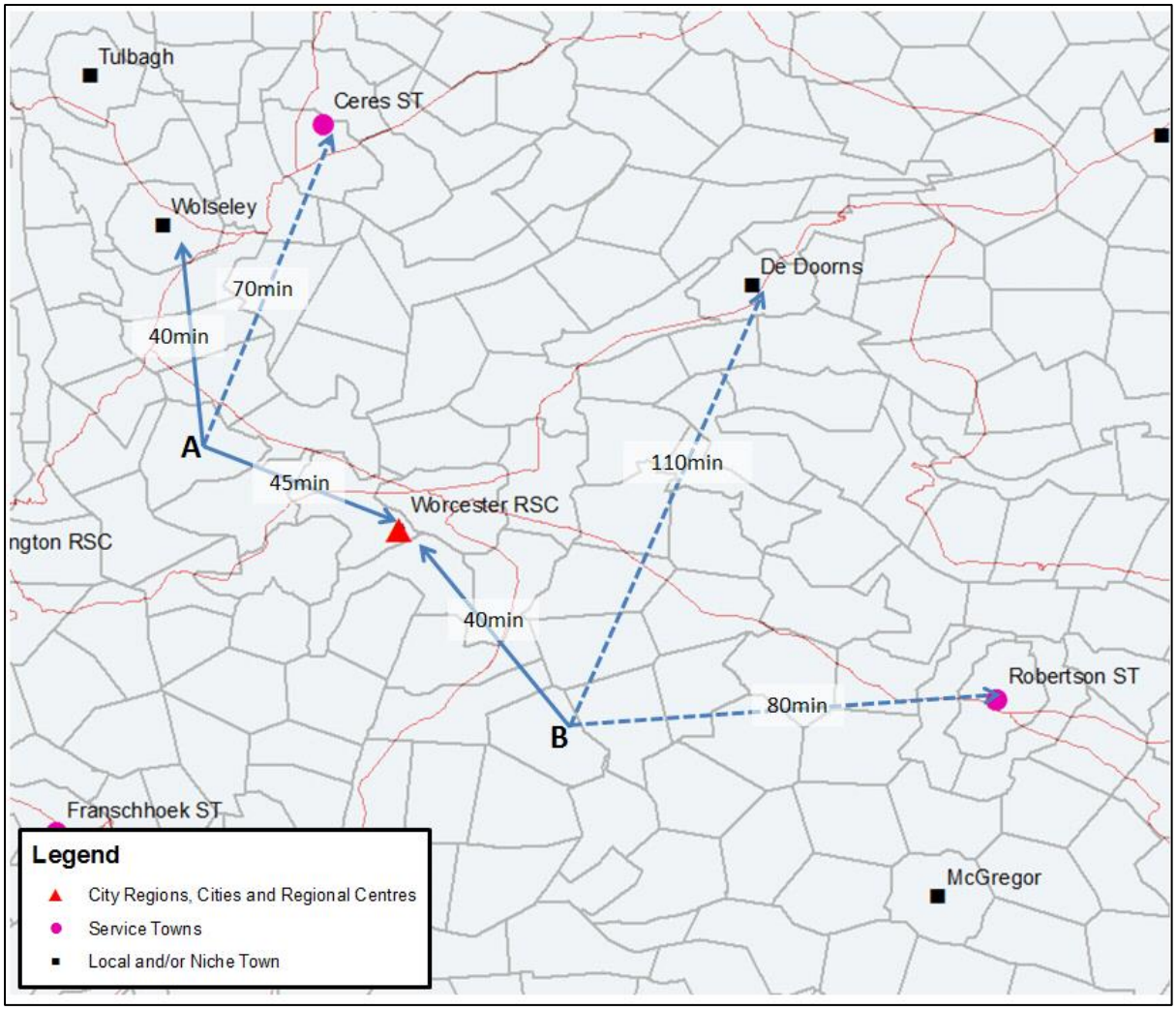

Figure 1: Distance measure from each mesozone to places in the place hierarchy

Figure 1 shows the travel times for mesozones A and B to the respective places in the settlement hierarchy. Refer to the next sections discussion for reference to the dashed lines on the map.

C. Calculating the remoteness index

A set of three travel time scores per mesozone was produced in accessibility analysis exercise just discussed. The next step was to transform these measurements to a: (1) single remoteness measure per mesozone and (2) secondly to generalise the remoteness measure to the level of a local municipality.

Remoteness measure per mesozone

The travel time measures attributed to each mesozone are for a hierarchy of places, i.e. some of these places are more important than others. It was therefore decided that a person or group of persons (represented by a mesozone in the model) who is closest to a major town or city wouldn't go to any lower-order places because they can find all the services/functions at their closest place,

therefore the travel time measure for lower order places which are not the closest service point for a mesozone were ignored. I.e. if you live in a city, or if the city is your closest place to access service and other opportunities, there is no need to travel to a lower order place. However, if you are closest to a service town, you will go to the service town first, but you will also go to the closest city from time-to-time to access services there which are not available in the service town. This line of reasoning is applied down to the mesozones which are closest to a local and/or niche town. In other words, if the mesozone is closest to the local and/or niche town, they will go to the local and/or niche town first before going to next closest place one level up in the hierarchy. What we want to know in the end is how far a person (mesozone) is from the ideal range of services and livelihood opportunities represented by a single score, with the assumption that the *Level 1 places* provides this ideal range of services. The dashed lines in Figure 1 depict the distance measures which will not be considered based on this line of reasoning.

Cartesian distance (also see *Euclidean metric* or *Pythagorean metr*ic) measures exactly this. The formula for Cartesian distance is: $r = \sqrt{A^2 + B^2 + C^2}$, where r is the final composite measure expressed in minutes, A is the distance from the nearest *Level 1 place*, B is the distance from the nearest *Level 2 place* and C is distance from the nearest *Level 3 place*. Based on the logic described in the paragraph above, *inherited distance* is used for lower-order places' values in the formula when e.g. a *Level 1 place* is the closest. I.e. when the nearest place is A in the formula, the values for B and C in the formula will be the same as for A. This is based on the assumption that in general all persons will make the same number of trips to access a variety of services.

Remoteness measure per local municipality

The remoteness measure per mesozone finally needs to be generalised to local municipalities for the purposes of the study. In other words the average remoteness measure of all the mesozones that make up a local municipality needs to be calculated, however the amount of people per mesozone varies throughout a municipality and the remoteness measure of the most populated areas in the local municipality needs to contribute more significantly to the average score. Therefore the *weighted arithmetic mean* of the remoteness measure for each local municipality was calculated. This remoteness measure is expressed as travel time in minutes.

Final index and interpretation

The final index value expressed in minutes (ratio scale) can be seen in CSIR_IndexTable_Jan2016.xlsx as well as CSIR_Index_Jan2016.shp. The fields in both tables are:

Field	Description
CATEGORY	Standard Municipal Classification
MN_CODE	Local Municipality Unique ID
MN_NAME	Local Municipality Name
DC_MN_C	District Municipality Unique ID
DC_NAME	District Municipality Name
PR_CODE	Province Unique Code
PR_NAME	Province Name
POP2011	Population in 2011
CSIR_Index	Remoteness Index

The index shows the level of access to the ideal range of services (public and private) and other livelihood opportunities for each local municipality in SA.

Click here to access metadata files on spatial layers used for this index.