March 2015
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Municipal water services

Determining inefficient water services provision

A completed Water Research Commission (WRC) study tested a method to assess the efficiency of South African municipal water service providers.

The quest for better service provision

In order to satisfy demand among water services users for greater efficiency in its provision, it is necessary that inefficient be identified.

But how are the relevant inefficiencies identified? One way is to institute performance benchmarking aimed at efficiency in water service provision. Performance benchmarking is slowly garnering support in the public sector.

Performance benchmarking is a practical method of comparing an organisation's performance against other organisations that are considered to be the best-in-class. Once the best-in-class performer is found, the differences between the current method and the best-in-class method are identified and policy-makers can attempt to engineer strategic interventions aimed at bringing inferior performers more in line with their better-performing counterparts.

This process can assist in identifying areas where productivity can be improved through reorganisation and where breakdowns and losses in service are reduced, inter alia. If not done formally (learning from others), it is invariably done informally and unofficially by those charged with the responsibility for production.

Within the private sector corporate environment, performance benchmarking typically focuses attention on a specific process and endeavours to find the best-in-class performers of that process. Within public sector enterprises it is more common to find targets set as performance benchmarks – as yardsticks generated in strategic planning workshops.

Assessing relative efficiency of performance

The main aim of this WRC study was to select and apply a method for assessing the relative efficiency of performance among South African municipal water service suppliers. In addressing this aim the project investigated the feasibility of applying to South African municipal water service providers one of the parametric or non-parametric statistical performance benchmarking measures.

Two forms of parametric estimation were considered, corrected ordinary least squares (COLS) and stochastic frontier analysis (SFA), and one form of non-parametric estimation, data development analysis (DEA). These methods compare the statistics describing the performance of a particular water service provider against external performance standards or norms (benchmark statistics) as revealed by an analysis of the statistics of other (municipal) providers.

COLS parametric method

The COLS parametric method of generating an efficiency performance measure is a deterministic one. A functional form is decided upon and then this function is estimated using ordinary least squares corrected (adjusted) to a frontier position within the context of the sample data.

A drawback of the deterministic frontier model is that it embeds all measurement error and possible stochastic variation in the dependent variable (output or cost) into the calculated economic (in)efficiency measure, and does not allow for the possibility of statistical noise or measurement error.

The SFA parametric method overcomes this drawback of the COLS model by allowing for the possibility of statistical noise and measurement error in the model, and for this reason it is considered the superior parametric approach.

Instead of imposing a specific functional form to the frontier (as done following a parametric methodology), the (non-parametric) DEA method of generating performance benchmarks uses the data itself to construct a quasi-convex hull (frontier) of linear segments around the data. This hull represents the production frontier against which measures of relative efficiency are determined.

Applying the methods

These methods were applied to information collected about a number of different municipal suppliers of water services. As a result, various efficiency indices could be calculated for 39 selected local municipalities and 12 selected metropolitan and district municipalities.

The non-parametric indices calculated (using the DEA methodology) were preferred to the parametric indices on the grounds that the DEA method is more closely linked to the principles of a frontier than those based on estimating parameters of pre-specified models. It was also found that the validity of the DEA derived indices could be improved by applying a bias correction procedure and that a modified method for calculating the DEA frontier is one where the DEA efficiency index is calculated by excluding the municipality from the DEA evaluation, with reference to a reformed frontier, excluding the particular municipality under consideration.

The excluded municipality is then re-introduced and its efficiency estimate is recalculated against the new frontier (formed in its absence). When the efficiency indices are recalculated in this way, all the maximally efficiency estimates, which were 1, are larger than 1, because the relevant municipality falls beyond the frontier which was constructed in its absence.

This method serves to enable a ranking of otherwise equivalent (maximally) efficient water service providers, while at the same time provides a mechanism for identifying outliers. Efficiencies recalculated in this manner are termed 'super efficiencies' and potential outliers may indicate a need to reconsider the data for consistency and accuracy. A couple of outliers were identified in the dataset used.

Results and discussion

Applying the DEA methodology to a combined set of data, including metropolitan, district and local municipalities it was found that the metropolitan municipalities outperformed the local municipalities. The average efficiency index for metropolitan municipalities was calculated to be 0.986, while the average of the local municipalities was calculated to be 0.717; a difference that is probably due to the different operating environments of the respective groups of municipal water providers.

When efficiencies were calculated on the basis of the DEA estimates for the local municipalities as a separate group, their average efficiency estimate was calculate to be 0.7291, indicating a moderate overall efficiency level. The province with the highest average value of the local municipality efficiency index estimate was the Eastern Cape (0.9033) and the province with the lowest average estimate was the Northern Cape, with an average efficiency index estimate of 0.6364.

The local municipality with the lowest estimated efficiency index level in the whole dataset was the Mogalakwena local municipality in Limpopo, with an estimated efficiency index of 0.2850. the provinces with only a single observed local municipality (Limpopo, North West and KwaZulu-Natal) were excluded in the assessment of average efficiency.

When the efficiencies indices for the metropolitan and district municipalities were estimated for this group alone, the two metropolitan municipalities in the Eastern Cape were calculated to be relatively inefficient, namely Nelson Mandela Bay and Buffalo City. Within the district municipalities, there were a large number of water service authorities who were performing efficiently.

The average efficiency index level of the district and metropolitan municipalities was found to be 0.8397, indicating a reasonably high average level of efficiency, but it should also be borne in mind that the relative small sample size of metropolitan and district municipalities had the effect of inflating the estimates of efficiency.

Conclusion

The study concluded that the municipal water services provider sector is suited to efficiency performance measuring and benchmarking. There are a large number of separate water service providers and their performances differ, but there is sufficient commonality between their inputs and outputs to reject at a general level the uniqueness and welfare counter arguments against the usefulness of efficiency performance measuring and benchmarking.

This conclusion is a qualified one, though, because there are

many challenges that need to be resolved before the efficiency indices generated can be relied upon to guide policy and regulatory effort to improve efficiency performance. The most important of these challenges is data adequacy and authenticity.

The study was able to access relevant (and the best available) data for just over 50 municipalities in order to demonstrate how to rate their efficiency performance. With a bigger sample size and data covering more variables a statistically more reliable and preferred model could be estimated, and also efficiency performance indices.

Given that the parametrically derived estimates incorporated (average) input price information and the non-parametrically derived estimates did not, it would have been expected that differences would emerge between the two sets of efficiency indices.

These differences were found, but they do not alter the conclusion drawn by this study – that either of the frontier estimation methodologies can serve as a platform for estimating relative efficiency performance across South Africa's water service providing municipalities. The case for incorporating or excluding input price information is not overwhelming in practice, but in theory, the input prices are key determinants of the cost function.

The study recommends that there take place discussions with and between the various water service authorities on how the data problem can and should be addressed, and on how the problem of measured inefficiency should be addressed once it is identified.

The ultimate rationale for statistical efficiency performance benchmarking is to trigger a process of improving efficiency in service delivery. Literature on this topic suggests that the ways the signal is sent that efficiency should be improved has to be managed very carefully, and should take into account that there are limits on the scope for engineering change, for example, through threats of withholding budgets. If managed insensitively, efficiency performance measuring and benchkmarking can become associated with negative signalling and undermine employee morale.

Further reading:
To order the report, *An approach to determining inefficient water services provision* (**Report No. 2118/1/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.