Challenges facing municipal infrastructural management in South Africa

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Abstract

The quality of life and economic development of our country is underpinned by a vast infrastructure managed by local (municipal) governments and also provincial and national governments.

There is strong evidence that insufficient attention has been paid by the great majority of municipalities to the operation and especially the maintenance of the infrastructure they own. In particular, there is too-frequent gross under-provision of budgets for infrastructure management. But if maintenance is inadequate, infrastructure will fail to deliver the service it is intended to deliver, and social and economic growth will be impeded — something that just cannot be afforded.

Municipalities must plan and provide for the long term management of all their infrastructure assets. There is a need for a structured approach to and methodology of infrastructure management ('management' in this sense includes operations and repair, routine maintenance, refurbishment and replacement).

The Council of Scientific and Industrial Research (CSIR) has reviewed published research into the state of South Africa's municipal infrastructure, has undertaken its own extensive research, and has investigated current management practice. The CSIR has also investigated concepts of sustainable management of that infrastructure, and what is needed in order for that infrastructure to be sustainably managed.

This article describes selected findings, sketches implications, and makes recommendations.

UITDAGINGS WAARMEE MUNISIPALE INFRASTRUKTUURSBESTUURDERS IN SUID-AFRIKA TE KAMPE HET

Die lewenskwaliteit en ekonomiese ontwikkeling van Suid Afrika word onderskraag deur 'n uitgebreide infrastruktuur wat deur sowel plaaslike (munisipale) bestuurders as provinsiale en nasionale regerings bestuur word.

Daar is sterk bewysgronde dat die meerderheid munisipaliteite onvoldoende aandag geskenk het aan die bedryf, maar bowen-al aan die instandhouding van infrastruktuur wat aan hulle behoort. Dit blyk veral uit die onder-begroting vir infrastruktuur wat dikwels plaasvind. Dit is vanselfsprekend dat indien instandhouding ontoereikend is, kan infrastruktuur nie daarin slaag om die dienste te lewer wat dit veronderstel is om te doen nie, met die gevolg dat sosiale en ekonomiese groei belemmer word — iets wat ten alle koste vermy moet word.

Munisipaliteite moet beplan en voorsiening maak vir die langtermyn bestuur van alle infrastruktuurbates. Daar bestaan 'n behoefte aan 'n gestruktureerde benadering tot, en metodologie van, infrastruktuurbestuur in dié sin dat dit die bedryf en bestuur, roetine instandhouding, opknapping en vervanging insluit.

Die CSIR het 'n oorsig van gepubliseerde navorsing oor die stand van Suid-Afrika se munisipalie infrastruktuur gedoen en het verder self uitgebreide navorsing hieromtrent, sowel as na huidige bestuurspraktyke, onderneem. Die CSIR het ook ondersoek ingestel na geskikte konsepte vir die volhoubare bestuur van die bestaande infrastruktuur en na dit wat nodig is om die sodanige infrastruktuur volhoubaar te bestuur.

Hierdie artikel beskryf geselekteerde bevindings, skets implikasies en maak aanbevelings.

DIPHEPHETSO TSE TOBILENG TSAMAISO YA MERALO YA DITSHEBELETSO TSA BOMASEPALA MONA AFRIKA BORWA

Boleng ba bophelo le ntshetsopele ya moruo naheng ya rona di tshehetswa ke meralo e mengata ya ditshebeletso, e laolwang ke mebuso ya metse (bomasepala) le mebuso ya provense le ya naha.

Ho na le bopaki bo matla bo bontshang hore bongata ba bomasepala ha bo shebane ka botebo le meralo ya ditshebeletso tseo ba fanang ka tsona, haholo tlhokomelo ya meralo ya ditshebeletso. Ka ho qolleha, hangata ho ba le nehelano ya ditekanyetso tse haellang bakeng sa tsamaiso ya meralo ya ditshebeletso. Empa, ebang tlhokomelo e haella, meralo ya ditshebeletso e tla hloleha ho nehelana ka ditshebetso tse hlokehang, mme kgolo ya moruo le setjhaba di tla salla morao, e leng ntho e ke keng ya kgoneha.

Bomasepala ba lokela ho rala le ho fana ka tsamaiso ya nako e telele ya thepa yohle ya bona. Ho na le tlhokeho ya mokgwa o lekodisitsweng le mokgwa wa tsamaiso ya meralo ya ditshebeletso (ka "tsamaiso" mona ho kenyelleditswe ditshebetso le ditokiso, tlhomelo ya ka dinako tsohle, tlhabollo le ho rekwa ha thepa e ntjha).

Lekgotla la Mahlale le Indasteri ya Dipatlisiso le entse tekolobotjha ya phuputso e phatlaladitsweng mabapi le boemo ba meralo ya ditshebeletso tsa bomasepala Afrika Borwa. Lekgola leo le tswetsepele ka ho iketsetsa diphuputso tsa lona, mme le fupuditse ditlwaelo tsa jwale tsa tsamaiso. Lekgotla lena le botse le fupuditse mehopolo e amanang le tsamaiso ya moshwelella ya meralo ya ditshebeletso, le hore na ke eng e hlokehang hore meralo eo ya ditshebeletso e kgone ho tsamaiswa ka mokgwa o tshwarellang.

Kgatiso ena e hlakisa dintlha tse ikgethileng tse hlahelletseng diphuputsong le seabo sa ditshwantsho tse sebedisitsweng, mme e phethela ka ho etsa dikgothaletso.

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1. INTRODUCTION

The quality of life and economic development of our country is underpinned by a vast infrastructure of roads, water supply, sanitation, drainage, power supply, flood protection, recreational and other assets. These assets are predominantly managed by local, provincial and national governments. They constitute a major investment over many generations, made in the expectation that benefits will accrue in terms of increased productivity, improved living conditions and greater prosperity.

While there is a significant emphasis by government on enhancing delivery of infrastructure, 'delivery' of services does not end with the commissioning of the infrastructure or the building. Once the infrastructure has been commissioned, the activities necessary to ensure that it continues to perform must be carried out — such as the necessary staff is appointed and the necessary budgets are approved. 'Delivery' needs to be universally understood as embracing not just the commissioning of infrastructure and buildings, but the management and maintenance of that infrastructure or that building for the whole of its designed life.

There is however, strong evidence that insufficient attention is being paid by the majority of municipalities (and by many sectors in national and provincial government) to the ongoing commitments that they have incurred to operate and maintain their infrastructure. In addition, many authorities have, due to years of neglect, built up a backlog of maintenance needs. Competing demands made on limited operational budgets (and on staff and other resources) severely constrain proper management of existing and new infrastructure.

The state of management and maintenance of municipal services is highlighted in this paper — based on an ongoing investigation that is being undertaken by the CSIR into the sustainability of municipal infrastructure. The CSIR's work has revealed gross shortfalls in management policies and practice, and that sustained provision of services is under threat in many municipalities. Specifically, many municipalities are not conforming to the requirements of the Municipal Systems Act and other legislation, and adequate provision is seldom made for the long-term management of infrastructure assets.

As government is committed to increasing levels of infrastructure investment at national, provincial and local (municipal) government level as a foundation for service delivery, economic growth and social development, the challenges facing municipalities are becoming very significant.

There should not be a change of focus from providing new infrastructure in order to address backlogs from the past. The challenge is to do this and at the same time also maintain both old and new infrastructure, and upgrade or replace infrastructure that is overloaded or has become obsolescent.

Infrastructure, well maintained, underpins quality of life and economic development. If maintenance is inadequate, infrastructure will fail to deliver the service that it is intended to deliver. Consequently, social and economic growth in South Africa will be impeded — something that just cannot be afforded.

2. MUNICIPAL INFRASTRUCTURE AND SERVICE DELIVERY

2.1 The importance of infrastructure to quality of life and to the economy

Infrastructure is a means to an end. It only supports quality of life and the economy if it delivers the services that individuals and institutions need, and it does this in such a way that they are able to access the services. Access implies several things, including that the service must be reliable and sustainable — if not, the infrastructure (water pipes, for example) may continue to exist, but the service will cease (the water will no longer flow). Clearly, in order to achieve its purpose, infrastructure must be effectively managed and financed.

Infrastructure services, if the appropriate services are being provided, and if they are effectively managed, promote economic growth, promote equity, alleviate poverty and support sustainable development. Individuals benefit from the provision of water and sanitation, transport, shelter, energy and telecommunications infrastructure. They are less prone to sickness, and enjoy better access to facilities, to work opportunities and to markets. Income-earning opportunities arise also in service delivery and in construction projects and in the maintenance of infrastructure. From an economic development point of view, infrastructure lowers the cost of production and consumption, and makes it easier for participants in the economy to enter into transactions. Increasing the efficiency of infrastructure will thus improve growth performance, service provision and development outcomes.

The blueprint for a new South African economy, the Accelerated and Shared Growth Initiative for South Africa (ASGISA), places maintenance high on the developmental agenda as a key to sustainable development and economic growth (Presidency, 2006). The Deputy President, the champion of the ASGISA initiative, strongly put the case for infrastructure management, as follows:

> *… looking after both old and new infrastructure is a challenge and an opportunity ... we have tended not to put maintenance high on the agenda … Not only are we putting it high on the agenda now … we can launch it as an industry in its own right.*

2. 2 Service delivery does not end with the commissioning of infrastructure

All three spheres of government manage very large portfolios of infrastructure and facilities assets on behalf of their communities. While there is a significant emphasis by government on enhancing delivery of infrastructure, 'delivery' of services does not end with the commissioning of the infrastructure or the building. Once the infrastructure has been commissioned, the activities necessary to ensure that it continues to perform are very often not carried out — such as the necessary staff is not appointed or the necessary budgets are not approved. 'Delivery' needs to be understood as embracing not just the commissioning of infrastructure and buildings, but the management and maintenance of that infrastructure or that building for the whole of its designed life.

Elements of built infrastructure, including engineering infrastructure such as water pipes, treatment works, roads, etc. — and also buildings themselves — are designed to last for a minimum number of years and, during that time,

to deliver the services intended of them. However, that the infrastructure delivers the intended services can only be expected if it is properly operated and maintained — and if it is not overloaded or otherwise abused.

2.3 Transforming basic service delivery since 1994

Since 1994, the government has transformed service delivery through programmes such as the Reconstruction and Development Programme (RDP).

This transformation of service delivery has been accompanied by legislative and other changes. Between 1995 and 2000, local government comprised 843 transitional municipalities. A new demarcation process led to the creation in December 2000 of a system of local government incorporating urban and rural areas. This new system comprised a reduced number of 284 municipalities, being six single-tiered urban metropolitan municipalities (the 'metros'), and 231 primary municipalities falling within 47 district municipalities. Boundaries, staff, income, expenditure, assets, liabilities, plans and budgets all changed with the creation of the new municipalities.

A range of legislation impacting on municipalities has also been reviewed or enacted since 1994, including the *Municipal Structures Act* (1998), the *Municipal Demarcation Act* (1998), the *Municipal Systems Act* (2000), the *Municipal Finance Management Act* (2003) (MFMA) and the *Municipal Property Rating Act* (2004). These acts form the foundation of the new local government system, embodying the critical package of policy reforms in local government. They aim to make municipalities more accountable, financially sustainable and capable of delivering essential services to their community (National Treasury, 2004: 21).

In particular, the *Local Government: Municipal Systems Act* (1998) requires municipalities to provide operational strategies that "align the municipality's resources for the realisation of its development objectives..." These must include a medium term financial plan setting out "how the capital and operational expenditure ... is matched by its revenue raising strategy." If due regard is to be paid, in a manner that conforms with the requirements of the *Municipal Systems Act*, to the sustainability of the infrastructure created by development plans, municipalities should simultaneously plan and provide for the long term management of all their infrastructure assets.

However, many municipalities find themselves in financial distress — often exacerbated by poor capacity and rising outstanding debts — debts which have risen to an estimated R37-billion (National Treasury, 2006: iii).

2.4 Local government responsibilities and funding

The fiscal system for municipalities is based on a revenue-sharing model, with all municipalities dependent to some or other extent on transfers from national government for both capital and operational expenses. Local government in the 2005/2006 financial year received R 13.2 billion 'equitable share' and other transfers (14% of all municipal operating budgets) for operating expenses, and R6.4-billion (38% of all municipal capital budgets) for conditional capital grants (National Treasury, 2006: 8). Municipalities have significant revenue-raising powers, and collect (or ought to collect) a major proportion of their income needs from the water, electricity and refuse-removal services that they provide.

However, the range of dependency on national transfers varies widely, from the lower level of dependency of some of the metros through to the very high dependency levels of municipalities that are entirely rural or almost so. The lowest dependency rates for 2003/2004, measured in relation to a combination of capital and operating transfers from national government, are 3,0% for Cape Town and 3,2% for Johannesburg. The highest is the 92% dependency rate of Bohlabela Local Municipality (which includes Bushbuckridge) in Limpopo (National Treasury, 2004: 30).

The dominance of the six metros is shown in that they account for 57% of the combined budget of all municipalities, or 50% of total capital budgets but 59% of total operating budgets (National Treasury, 2006: 10).

The proposed (and much-postponed) restructuring of electricity distribution will further impact on municipal budgets, reducing them significantly. Electricity sales account for an average of 26% of municipal operating income (National Treasury, 2006: 8). The surplus on the sales and distribution of electricity to consumers is an important source of revenue to municipalities, that they can then use to cross-subsidise other services. It is not yet known what financial assistance will, in the event of restructuring, be offered in place of this.

Further financial challenges facing municipalities arise from their need to address the key priority of the free basic services policy that came into effect in 2001. Other priorities include the stabilisation and consolidation of municipalities; modernising delivery, budgeting, and financial management systems; and improving revenue collection.

2.5 A growing asset base: the burden of the future

Since 1994, municipalities have focused strongly on the delivery of basic services, and have made significant progress in investing in new works and upgrading and rehabilitating existing water, sanitation, roads, stormwater and electricity infrastructure. This investment has been funded through the municipalities' own resources, their 'equitable share' and also through loans from Development Bank of Southern Africa (DBSA) and grants through the Consolidated Municipal Infrastructure Programme (CMIP) and Municipal Infrastructure Grant (MIG) Programme.

DBSA, Department of Water Affairs and Forestry (DWAF) and Department of Provincial and Local Government (DPLG) alone funded at least R38-billion of investment in engineering infrastructure new works, upgrading and rehabilitation between 1994 and 2005. A large proportion of the R32-billion spent on public sector housing during this period has been on the township infrastructure that is providing engineering services to that housing. This immense investment in services infrastructure has become the responsibility of municipalities to operate and maintain. In addition to the investment by the public sector, there has been substantial investment by private sector developers, for which the infrastructure component has been taken over by municipalities.

In addition, the replacement cost of services infrastructure constructed prior to 1994 and still in service (or that ought to be in service, but needs repair or rehabilitation) is thought to

be of an even larger order of magnitude than the replacement cost of that constructed since 1994.

DWAF has estimated that the historic value of the capital investment in the water services sector alone (i.e. excluding water resources sector assets such as reservoirs, and excluding also roads and stormwater and other sectors) in 2003 stood at R102-billion, of which R50-billion was in the ownership of municipalities, R12-billion in the ownership of water boards, and R40-billion was in the ownership of DWAF itself (with a portion of that due to be transferred to municipalities). However, DWAF stressed that 'all data are coarse estimates only' and estimates are 'book value; data generally are neither consistent nor reliable' (DWAF, 2003: 3).

Without question, present-day replacement value is much higher. The CSIR has estimated that the current (2006) replacement cost of all municipal engineering infrastructure and buildings (excluding housing) is at least R300 billion. Given the poor state of much of this, and the repair and refurbishment consequently required in addition to planned maintenance, international norms suggest that approximately 4% of the replacement value should on average be spent per annum on maintenance (excluding for disposal and replacement) — amounting to about R12 billion per annum. However, municipalities are on average budgeting for less than half of this.

The competing demands that are made on limited municipal operational budgets (and staff and other resources) severely constrain optimal management of existing and new infrastructure assets. The effect of lack of maintenance will be that this infrastructure will deteriorate well before the end of its designed life, for example water pressures drop, water supplies are interrupted, pipes and fittings leak (at a cost for the purchase and treatment of the water, but with no benefit to the municipality), watercourses are polluted, the riding quality of roads deteriorates and wear and tear on vehicles increases. In due course, communities will be completely deprived of services. If the budgets at that time permit, infrastructure will have to be rebuilt, at much higher cost than if the original infrastructure had only been properly operated and maintained since it had been constructed. And, until the infrastructure is rebuilt and back in service, there will be the cost to the community and the local economy being deprived of the services — the community in some instances in having to make expensive alternative arrangements.

2.6 Maintenance makes good financial sense

The preceding section (2.5) highlights the costs of neglect of infrastructure — such as the capital costs that will eventually be incurred for the rebuilding of crumbling infrastructure, and the direct and indirect costs to consumers who have to contend with deteriorating infrastructure. However, maintenance makes good sense in terms of reducing current non-capital costs and increasing current non-capital revenue.

There are many examples of how routine maintenance reduces life-cycle costs. One such example of how current spending on infrastructure management can save current and future expenditure is 'Operation Gcin' amanzi' of Johannesburg Water. At the commencement of this programme, the 'unaccounted-for water' proportion of the bulk water supplied to Soweto was 66% — in other words, two-thirds of the water supplied to consumers in Soweto leaked away on the plots, either directly from the pipes and into the ground, or out of the overflows of defective flush toilet cisterns, or from defective taps that ran continuously, or by other means.

Operation Gcin'amanzi, which was launched in 2003, is a five-year programme to do the following for the 162 000 residential erven in Soweto:

- give each householder the choice of either a metered full pressure service — or a downsized level of service and no meter; together with; and
- a once-off repair of all pipes and fittings on the property.

The total cost of this programme at present values is R450-million. Estimated savings to Johannesburg Water when this programme is completed, calculated at present values, will be R158-million per annum. Thus, the estimated payback period is three years (Mas, 2004).

As a graphic example of the potential that not infrequently exists for relatively limited spending on repair, refurbishment or replacement to save substantially on operating expenses, the public-private partnership between a firm of consulting engineers and Metsi-a-Lekoa, the ringfenced water utility owned by Emfuleni Local Municipality, may be quoted. The engineers and their private sector funding partners funded the full cost of a R 5 million installation to manage water pressures in the townships of Sebokeng and Evaton. For a period of five years after the commissioning of the installation (2005), a proportion of the savings (in terms of reduced purchases by Metsi from Rand Water) accrues to the engineers and their funding partners, with a larger proportion going to Metsi. If there are no savings, then the private sector partners receive no return on their investment. However the savings (which are independently audited) have been so substantial that the capital outlay has been recovered in under six months (Mckenzie *et al*., 2006).

Of course many of the benefits of improved infrastructure maintenance cannot be quantified financially. Furthermore, the financial benefit (usually in the form of cost saving rather than increased income) is received by parties other than the institution which has had to fund the improved operation and maintenance (the funder generally being the owner of the infrastructure). In other words, the expense appears on the owner's financial balance sheet, but the income does not.

However that benefit will undoubtedly be there, manifesting itself in various ways and it should form part of what would be a strong motivation for national government support of selected measures to improve infrastructure operation and maintenance. While the benefits wouldn't necessarily be financial, they would be manifest in environmental, social, health, and other improvements.

For example, improved drinking water quality would reduce sickness and individuals' absenteeism (with financial benefits to households and to employers).

For another example, improved wastewater effluent would improve the quality of watercourses that eventually wind up in dams, and pass through water treatment works, some of which are suffering so much from the effects of polluted wastewater treatment works effluent, that they

have had to be modified at considerable expense, or were even closed, unable to cope. An example of the latter is the Bospoort water treatment works in Rustenburg, which was mothballed between 2000 and 2006 because it was unable to cope with the increasingly foul effluent from the two wastewater treatment works upstream of it. Water supply to Rustenburg had to be maintained from a pipeline specially built by Rand Water (Marx, 2006: 4).

3. THE STATE OF MUNICIPAL INFRASTRUCTURE: AN OVERVIEW

3.1 The condition of municipal infrastructure and quality of service delivery

South Africa has not had formal broad-based audits or studies of the state of infrastructure (not many countries have). Rather, studies and audits have been undertaken on an ad-hoc basis, or on a routine basis in certain geographic localities and/or sectors (such as provincial road condition surveys).
Furthermore, there are also certain legislative requirements in terms of which, for example, water quality sampling from wastewater treatment works have to be routinely submitted to certain authorities. Unfortunately, in many cases, these legislative requirements are not being complied with.

Some countries do however, undertake routine and formal qualitative grading studies (such as the USA, UK and Australia 'infrastructure report cards') — and South Africa would do well to implement an indicator system for municipal infrastructure.

The CSIR has reviewed published research into the state of South Africa's municipal infrastructure, and has undertaken its own extensive research. CSIR has also investigated current management practice. The CSIR's own research has generally supported the research by others, and has interpreted it and broadened and deepened it. Since the CSIR has begun investigating this topic, it has sought to incorporate into its own work new research findings from others that have appeared from time to time.

The CSIR has also investigated concepts of sustainable management of that infrastructure, and what is needed in order for that infrastructure to be sustainably managed.

An assessment of the physical condition of South Africa's municipal infrastructure and of the quality of services delivered is given in this section. This information is based on limited available formal studies together with studies undertaken by the CSIR. These studies build a picture of some world-class municipal infrastructure and service delivery within South Africa, but also of deteriorating infrastructure and even infrastructure that has collapsed, together with poor and sometimes unacceptable quality services.

Specifically, the studies show that insufficient attention is being paid by the majority of municipalities to the on-going commitments that they have incurred to operate and maintain their infrastructure. The effect will be that much of this infrastructure will deteriorate well before the end of its designed life.

Although it is not by any means a hard-and-fast rule, the more rural municipalities are very often less able to manage their infrastructure, especially the more sophisticated infrastructure such as water and wastewater treatment works, than are the more urban and especially the metropolitan municipalities.

3.1.1 Water treatment

The most important indicator of performance of water treatment works is the quality of water entering the water reticulation system. The most common immediate cause of water quality not meeting required standards is a breakdown of plant and/or the length of time that it takes to have that plant repaired satisfactorily and for it to resume working correctly. The most common causes of plant breakdown typically include inappropriate design and/or construction, faulty operating procedures, lack of routine maintenance, and overload. Very often, the underlying cause of these breakdowns can be attributed to inadequate budgets or operator error or both.

A 2004 'self-assessment survey' of municipalities, to estimate their compliance with drinking water quality regulations (i.e. with *SABS 241-2001*) revealed that only 43% of municipalities were compliant. 155 municipalities responded, and, while acknowledging that many municipalities do not have responsibility for water treatment works, some municipalities that do own water treatment works did not respond. A sample of the data was crosschecked against drinking water quality sampling and analyses that were undertaken.

Around the same time, an assessment was made of the drinking water quality in all 24 of the non-metropolitan water services authorities in the Western Cape. It was found that there were 'significant failures' with regards to both total coli forms (average 42% failure, compared to *SABS 241-2001* allowance (less than 4% failure is regarded as compliance with respect to this parameter) and faecal coli forms (19% failure, compared again to 4%). However the results for small towns were worse than those for large towns and the results for villages and rural communities were higher still (Mackintosh *et al*., 2004: 131).

Some clues as to why this might be were found on a visit by the CSIR to the water treatment works of three towns in the Northern Cape. The treatment processes of two of the three were not operating effectively. To all intents and purposes, raw water from the Vaal River was flowing from the works and into the towns' reticulation systems. In the one case, the chemical dosing system had broken down — a readily fixable problem, but beyond the ability of any of the municipal staff responsible. In the other case, poor design and construction, together probably with inappropriate operation, had led to breakdown of the sedimentation and filtration processes, and the municipal staff responsible appeared to have no capacity to fix this. The third treatment works was at the time delivering water to an adequate standard, but the machinery showed signs of neglect.

> *It has been shown that considerable national progress has been made since 1994 in ensuring the provision of adequate basic drinking-water services delivery. However, it has also been shown that most non-Metro Water Services Authorities in South Africa are failing in their compliance with the Compulsory National Standards for the Quality of Potable Water, and that in many instances this failure in regulatory governance is resulting in the provision of drinking-water of unacceptably poor quality. A direct associated impact on primary health can be expected (Mackintosh et al., 2004: 133).*

3.1.2 Water reticulation

The most common problem experienced with water reticulation systems is leakage of water, or even the bursting of pipes.

Rand Water has estimated that about 27% of the water, which is being sold to municipalities, simply leaks away. Of this 27%, 17% constitutes leaks in municipal water systems, and 83% leaks out on private property (Rand Water, 2004: 1,109.)

Water leakage increases with pressure. Water reticulation systems (which invariably include pump-stations and water towers and reservoirs) are normally designed to provide adequate pressure to all parts of the system during the time of peak demand each day. Many municipalities are now realising that, even if leaking mains and fittings are not repaired, water can be saved simply by reducing pressure in the off-peak hours, when pressures increase solely because less water is being drawn off.

There have been numerous investigations into water leakages in municipal areas, including:

- A study by the Cape Metropolitan Council in 1998 found that in some areas the flow in the middle of the night (when households were presumably not using water) was more than half of the flow at peak usage times of day (Cape Metropolitan Council, 2000).
- A study of Sebokeng and Evaton, part of Emfuleni Municipality in Gauteng, found the minimum night flow to be 72% of the average flow, which is very high compared to a well-managed system of between 10 and 30% (Rand Water, 2003).
- Studies in the Khara Hais Municipality (Upington) showed that 78% of the water supplied from the town reservoirs in the middle of the night to the system as a whole was lost to leakage; when the supply was directly pumped from the WTW (and the pressures are higher), 81% was lost to leakage (IMESA, 2004: 49).
- In De Aar, Emthanjeni Municipality, it was calculated that savings of 80% of the water supplied could be made by fixing of those leaks in mains and on properties that it would be economically feasible to fix, metering of all properties and public water supply points, and pressure management (DWAF, 2002: 25).
- A randomly selected 20% sample of 24 completed DWAF rural water supply projects in KwaZulu-Natal found that:
- 45% were found to be sustainable or functioning at RDP standards;
- 35% were working but problematic — with 'problematic' defined as including intermittent operation, implemented at a lower level than RDP standard, project income substantially below the cost of operations and maintenance', and/or 'a high level of social exclusion; and
- 20% were not working at all — due either to problems with their external energy sources (i.e. electricity or diesel), or high levels of internal conflict within the community (Hemson, 2003: 4, 46, Appendix2).

3.1.3 Wastewater treatment

The standards for the performance of wastewater treatment works are laid down by DWAF. The most important indicator of performance is the quality of the effluent from the works, before it is discharged into the watercourse.

A 2005 survey by the CSIR of a substantial number of the wastewater (sewage) treatment works in Gauteng showed that, broadly speaking, wastewater treatment under the auspices of the three metros (Johannesburg, Tshwane, and Ekurhuleni) and by one of the nine local municipalities is meeting DWAF standards. Budgets are adequate, if in some instances barely so. Management levels are staffed by competent, qualified and experienced officials, and the same can be said for the supervisors and works operators, and for other officials such as the laboratory staff. However, not many of the wastewater treatment works run by the other municipalities are producing effluent that is meeting DWAF standards, and some of the works are producing effluent that is little distinguishable from the raw sewage that flows into the works (Wall, 2005).

Similar observations were made on an inspection by the CSIR of the wastewater treatment processes of four Northern Cape towns. Two of these processes involved oxidation ponds only — the one set of ponds was badly neglected, and the other needed substantial attention. Processors in the other two towns were more sophisticated. Of these two, however, the one's treatment works badly needed better operation and maintenance — for example several mixers were out of order, and the grit channel at the entry to the works had obviously not been cleaned out in a long while. The fourth works, less than two years old, and using the activated sludge process, was working satisfactorily.

In order to understand the extent of challenges faced by the small and medium municipal sector, a study of 51 wastewater treatment works was undertaken in 2005/2006. This found that 'immediate intervention' is required at approximately 30% of the works in order to avoid crisis situations such as an outbreak of waterborne diseases. In the short to medium term, intervention would be required at more than 66% of the works. The majority of micro, small and medium size wastewater treatment works in South Africa were found to be not complying with the regulatory standards. The study stated that the main problem does not seem to be the need for additional or upgraded infrastructure or the need for additional funding. The main challenge is that the available infrastructure and equipment are not well operated and/or sufficiently maintained (Snyman *et al*., 2006).

3.1.4 Sewerage reticulation and sanitation facilities

Municipalities are usually responsible for maintaining the waterborne sanitation piped network, and frequently the pumping facilities. The homeowner is usually responsible for maintaining on-site sanitation systems.

The most common problem experienced with waterborne sanitation reticulation systems is sanitation spillage, due to overloading of the system and to blockages caused by roots of trees, foreign objects, breakages and deterioration of the network.

A sustainability audit of waterborne and on-site sanitation facilities recently undertaken by DWAF concluded that 'currently there is effectively no maintenance programme for on-site dry sanitation systems'. The audit also concluded that smaller municipalities lack the skills to conduct effective operation and maintenance of waterborne systems (DWAF, 2004: Section 5.2.5. Quoted in DWAF 2005b).

3.1.5 Electricity distribution

Municipalities collectively account for 42% of the total volume of electricity sales, while Eskom supplies the balance (National Treasury, 2006: 31). Few municipalities other than those in the larger

urban areas supply electricity themselves.

The most common causes of the failure of electricity reticulation systems are faulty operating procedures, lack of planned maintenance, damage (e.g. to underground cables) during construction nearby, overloading, and equipment ageing.

A survey conducted a few years ago by the National Electricity Regulator (NER) found that 49% of municipalities had no maintenance strategies for their electricity distribution networks and lacked understanding of power quality or performance issues. The survey found that about 45% of electricity distributors are failing to identify areas requiring corrective action and only 2% are able to do so.

The condition of electricity distribution systems and the quality of the services delivered in South Africa is illustrated by the state of electricity distribution within Johannesburg. During the winter of 2004, the central areas of Johannesburg suffered several dozen extended power outages, often affecting the CBD and Braamfontein during working hours. The principal reason for this is that maintenance and refurbishment programmes came to a standstill in 1997 (when Johannesburg was in financial crisis). Direct results included deterioration of equipment, growth in loading without correlating network upgrades, 'band aid' repairs rather than the required refurbishment or replacement, and — but no less important — the exodus of key staff.

An audit of Johannesburg's maintenance and refurbishment gaps in 2003 concluded that:

- the networks in the Central and Southern regions are in the worst condition with almost 80% of the overhead network requiring major replacement;
- approximately 50% of the distribution networks require immediate attention or major refurbishment / replacement; and
- the Northern and Central regions are the most overloaded.

Johannesburg has however turned the corner financially, and the electricity infrastructure backlog, currently in excess of R2-billion, is being tackled energetically. That periodic infrastructure failures are still experienced during the current winter (2006) just goes to demonstrate how far maintenance of the infrastructure had been allowed to slide, and how overloaded some infrastructure had become.

3.1.6 Municipal roads

The most common cause of the failure of paved road surfaces is neglect. Neglect of surface damage or of cracking leads to water penetration of the underlying layers, and consequent erosion followed by loss of a portion of the paved surface (the formation of 'potholes'). Another common cause is overloading.

Because of the two sets of local government boundary changes that took place in 1996 and in 2000, there are major discontinuities in the road condition trend data that municipalities have been keeping over the years. The best proxy available is the trend data that provincial authorities have been keeping of the roads for which they themselves have been responsible. For example, Gautrans has annually abstracted the available road condition survey information for its roads, and the trend is as follows:

- between 1985 and around 1996 the condition slid steadily, with the percentage of 'very good' pavement length dropping drastically, and increase manifested especially in 'poor' and 'very poor'; and
- since 1996 there has been a partial recovery of 'very good' pavement length, but the length of 'very poor' has remained around the 10% level, which is much higher than previous levels.

The pavement management system records of the paved roads of a substantial proportion of the municipalities in the Western Cape were surveyed during 2004. It was found inter alia, that:

- 8% of the network has 'mainly due to the lack of maintenance' deteriorated to the extent that the roads need to be reconstructed — at a cost of R750-million;
- the cost of the resurfacing backlog that has accumulated is R500-million; and
- catching up on these backlogs over five years would require a six-fold increase in current budgets (Western Cape Province, 2004).

3.2 The management and maintenance of municipal infrastructure

3.2.1 Survey findings

In 2002 the Institution of Municipal Engineering of Southern Africa (IMESA) undertook a survey of infrastructure management of seven of the larger authorities (five municipalities and two water utilities) in order to determine their appreciation and application of infrastructure management.

These authorities were benchmarked against best practice internationally, and the pertinent findings of the study were:

- the South African authorities compare well in respect of many aspects of infrastructure management such as knowledge of assets, demand analysis, asset creation and disposal, asset utilisation, and asset operation and maintenance; however
- the South African authorities compare very unfavourably with the benchmark in respect of strategic planning, asset accounting, and planning and making financial provision for improvement of infrastructure.

However, a subsequent IMESA questionnaire survey of a much wider sample of municipalities indicated a far lower level of infrastructure management capability. Also, whereas a high percentage indicated that they prepared the statutory development plans required by national government, such as Integrated Development Plans (IDPs) and Water Services Development Plans (WSDPs), anecdotal evidence and the general level of capability identified by the questionnaire survey suggested that these plans were not supported by sound analysis of infrastructure needs or definition of service levels.

The CSIR has since investigated selected municipalities in much greater depth, visiting municipalities and interviewing key staff, and viewing infrastructure. The CSIR also drew on reports and studies of the state of municipal infrastructure that had been undertaken by others. The pertinent findings can be summarised as follows:

- a few municipalities have world-class practice in respect of many of the aspects of infrastructure management (such as knowledge

of assets, demand analysis, asset creation and disposal, asset utilisation and asset operation and maintenance), although they might not be at as high a level in respect of other aspects such as asset accounting, and planning and making financial provision for renewal of infrastructure;

- on the other hand, many municipalities do not have even the basics in place, and gross shortfalls in management policies and practice exist in many municipalities; and
- the entire range of capacity and competence can be found in municipalities between these two extremes.

It must however be noted that much encouraging practice was found in the CSIR survey, for example:

- good rapport between councillors and officials in respect of infrastructure management;
- asset registers that held information that is useful to infrastructure asset management;
- asset management that is prioritised — for example those assets which, if identified as a failure, would put services at greater risk, and which therefore receive priority attention in respect of inspection, planned maintenance, the carrying of spare parts, and similar measures to reduce the possibility of failure, the duration of failure, and consequences of failure;
- improved financial provision for renewal of infrastructure — although budgets remained inadequate, instances were found (for example) of understanding that expenditure on infrastructure management can, by reducing water losses, save further expenditure many times over, and can also reduce the risk of system failure;
- attempts being made, before purchasing infrastructure, to project the operations and maintenance requirements into the foreseeable future — and in some instances changing new works infrastructure plans in the light of these projections; and
- understanding that it is necessary to improve infrastructure management across all parts of a system — for example that it is no good just looking after assets in the form of physical infrastructure, if equivalent attention is not paid to personnel (the 'intellectual assets') through for example career path planning and succession planning.

Lack of the last of these (i.e. planning in relation to the 'intellectual assets') is emerging in many municipalities as a major threat to effective infrastructure management. The loss of key technical staff, and their non-replacement, or replacement by others less qualified, is inhibiting infrastructure management and in many cases can be identified as the main reason for breakdown of the service. Specific issues identified are:

- high turnover of staff;
- the loss of skills, of institutional memory, and mentors, the consequence of the departure of experienced staff;
- little or no career path planning and succession planning;
- the loss of mentors consequent upon the departure of experienced staff;
- the loss not just of the highly trained engineers, but also of the technicians — in particular of those who had originally qualified as artisans, and who had worked their way up through the ranks to supervisor positions;
- the appointment of non-technical personnel to management positions requiring technical experience; and
- the shortage of suitable and trained engineering and technician staff in the job market.

As a study by the South African Institution of Civil Engineering showed, the number of and expertise of the municipal staff whose responsibility it is to operate and manage municipal infrastructure has not kept pace with the increase in the stock of infrastructure. Indeed, in many areas it has diminished even in absolute terms, never mind in proportion to the increase in the stock of infrastructure. For example, many municipalities (79 of the 231 local municipalities and four of the 47 district municipalities) have no qualified civil engineering capacity — no civil engineer, technologist or technician, despite each being responsible for millions of Rands worth of civil engineering infrastructure (Lawless, 2005).

In addition to this shortage of technical capacity, there is also a dearth of appropriate technical guides and of norms and standards.

3.2.2 Financial issues

Financial issues often lie behind the threats to infrastructure management. In the first instance, a municipality might not have sufficient financial resources to allocate to infrastructure management, even if all of its councillors were supportive of infrastructure management. In the second instance, however, there is often insufficient understanding by local authority politicians of the importance of maintenance. This insufficient understanding is crucially manifested in the under-provision of maintenance budgets. Under-provision is sometimes exacerbated during the course of a financial year by reallocation of some of the maintenance budget to other purposes.[2]

The under-provision of operating budgets (including maintenance) is highlighted by an analysis of the budgets of all municipalities for expenditure other than of a capital nature, in which it is seen that repairs and maintenance budgets constitute low percentages of the total operating budget. Examples of these low percentages are 6,8% average for municipalities in Gauteng, 4,8% in North West and 9,4% in KwaZulu-Natal (National

[2] **Municipalities not budgeting for repairs; 'Infrastructure is being run down'**
"Municipalities do not budget adequately for infrastructure and its maintenance, something which could spell disaster for the provision of services in the future as billions of rand would be needed to repair and upgrade the systems.

These findings are contained in a report published by the SA Local Government Association (SALGA) yesterday, which analysed budget spending patterns in 13 municipalities for the 2003-04 financial year" (Municipalities not budgeting..., 2003)

Treasury, 2004:Table B1) . Furthermore, repairs and maintenance budgets are invariably the first to be cut in times of financial constraints.

A view from within DWAF is that:

> *Local authorities are reluctant to prioritise sanitation and related issues which have an impact on water quality, with the result that failed sewage pump stations [for example] often remain inoperative for weeks before money and resources are allocated (DWAF, 2005a).*

The budgets of rural-based municipalities are of particular concern, and have been analysed by Gibson (2004) using Treasury sources and information analysed for specific municipalities. Gibson noted that for the more impoverished municipalities, typically:

- the capital charges are low or zero, reflecting the high amount of grant-aided capital investment which is currently undertaken, and the inability of many municipalities to borrow on the open market;
- salaries represent over 50% of non-capital expenditure, compared to less than 30% average for all municipalities nationwide (either because of over-staffing or because the municipality has so few other items of expenditure — which raises the question that if there is 'virtually no other expenditure … how can the municipality effectively use its staff?'); and
- over 75% of the non-capital income comes from national grants and subsidies, compared to 11% average for all municipalities nationwide.

Gibson added that, whereas basic levels of water services have been provided, "subsequent lack of maintenance coupled with no control over the high levels of informal connections means that the majority of these schemes are no longer capable of providing a consistent daily basic water supply." Gibson concluded that these municipalities ('at least 90 of them') are not going to be able to provide services to their indigent communities without considerable financial support from national government.

The under-provision of maintenance budgets is in part attributable to inadequate legislation, statutes and regulations impacting on municipalities. Specifically, legislation such as the *Municipal Financial Management Act*, act 56 of 2003 (MFMA) and statutes and regulations relating to development plans set very broad parameters where they relate to infrastructure management. As a result, whereas legislation creates a climate conducive to infrastructure management, it does not compel a municipality to perform adequate infrastructure management — and specifically over the long-term.

For example:

- Generally Accepted Municipal Accounting Practice (GAMAP) requires municipalities to depreciate assets, but does not prescribe that a depreciation model must be used that will adequately determine the funding to be put aside each year to meet future liabilities for infrastructure renewal. Nor does it prescribe that the money actually be put aside. In some countries, municipalities are obliged to put this money aside. South African legislation should require the same of our municipalities.
- GAMAP requires that an asset register must be drawn up, but does not specify that the register should record the capacity, condition, importance and risk, and other factors essential to the register being of use to infrastructure management.

Furthermore, South African legislation is less than satisfactory on defining 'value'. In particular, in terms of GAMAP, valuation is determined on the basis of historical cost adjusted by depreciation and expenditure on refurbishment. This is not of much assistance to infrastructure management.

4. CONCLUSIONS

The research has shown that South Africa has some world-class municipal infrastructure and service delivery, but also has an increasing proportion of deteriorating infrastructure together with poor and often unacceptable quality services. Similarly, a few municipalities have world-class practices in place in respect of many of the aspects of infrastructure management, while on the other hand, many municipalities do not have even the basics in place, and gross shortfalls in management policies and practice exist in many municipalities. Between these two extremes, the entire range of capacity and competence can be found.

The vast majority of municipalities are not making adequate provision for the long-term management and maintenance of municipal infrastructure — and the two principal systemic issues underlying this problem are:

- inadequate budgets; and
- inadequate skills (and especially technical skills) and experience.

The competing demands that are made on limited operational budgets (and staff and other resources) severely constrain the proper management of existing and new infrastructure assets. However, a dangerous assumption (in particular by many municipal councillors) often appears to prevail, namely that once infrastructure has been constructed and commissioned, it doesn't need to be looked after, but will deliver a service for years to come despite lack of maintenance, refurbishment and, where appropriate, replacement. This dangerous assumption manifests itself in many ways, but in particular in gross under-provision of budgets for infrastructure management.

Accordingly, if municipal infrastructure management is to be adequate, a great deal needs to be done. Specifically, an assessment of the state of management and maintenance of municipal infrastructure leads to the following key requirements, which need to be addressed variously across all spheres of government:

- a suitable legislative framework;
- appropriate allocation and protection of appropriate budgets within municipalities;
- a concerted effort to retain trained and experienced staff; review of recruitment policies for key posts; skills training and mentorship programmes;
- the buy-in by national government and other big spenders and/or funders of public infrastructure;
- the development and implementation of alternative delivery models and delivery agents for infrastructure management where appropriate; and

- the determination of norms, standards, levels of service, and key performance indicators.

5. RECOMMENDATIONS

Arising from the understanding of the state of the management and maintenance of municipal infrastructure in South Africa and the underlying systemic causes, the CSIR has recommended, in internal reports (e.g. CSIR, 2004) and submissions to government and its agencies (and also in papers and presentations — e.g. Wall, 2004; Wall, 2005), the following interventions to enhance the maintenance and management of municipal infrastructure:

- Broad-based awareness creation and the promotion of good management and maintenance of municipal infrastructure — including periodic 'State of Public Infrastructure' reports that will include or focus on the management and maintenance of public infrastructure.
- An audit of the available and required public sector capacity to manage and maintain public sector infrastructure — including budgets, financial capacity, programming/ prioritisation of resources, systems, and equipment — to provide a base for structured interventions and for ongoing monitoring.
- An investigation of alternative delivery models and delivery agents for infrastructure management.
- The development and promotion of good practice guidelines for the management and maintenance of public infrastructure, including both management best practice and technical norms and standards. (IMESA 2006 is a good start in this direction.)
- A review of applicable national legislation and codes, such as that in GAMAP and the MFMA, to assess their suitability to regulate and compel adequate infrastructure management.
- Developing mechanisms to make capital development loans and grants conditional on their incorporation of budgets and other measures to ensure adequate future infrastructure asset management will be investigated. Compelling positive incentives are needed for the future owners of the capital works to adequately manage this infrastructure, and to incorporate safeguards that they indeed do so.
- Developing and implementing guidelines for performance management, together with incentives and KRAs for individuals who are responsible for making decisions with respect to the management of the infrastructure in their care (e.g. elected councillors, appointed officials, and contractors' representatives).
- Ongoing monitoring and evaluation of the state of maintenance and management of municipal infrastructure — including the monitoring of headline performance indicators.
- Promotion of 'Centres of Excellence' where proven capability is demonstrated — to promote ongoing performance improvement, including the ongoing development of best practice guidelines and ongoing procurement reform.

It is gratifying to note that the 'National Infrastructure Maintenance Strategy', approved by Cabinet in August 2006, sets out a programme of action that incorporates more or less the same set of interventions, prioritises them, and assigns responsibility for taking each of them forward.

The national strategy was prepared by the national Department of Public Works with the assistance of the CSIR.

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