Western Cape Government

Sustainable Public Procurement Training and Implementation Manual

Implementing Total Cost of Ownership in the procurement of Infrastructure and Asset Management

31 March 2021

Contents

Joint Foreword from Department of Environmental Affairs & Development Planning, Provincial Treasury and Department of Local Government: in transversal support of Sustainable Public Procurement

Infrastructure is the cornerstone of social upliftment, public health and safety. Through infrastructure and its stimulation of job creation and economic growth, the estalishment of well-serviced areas are conducive for economic investment. The Municipalities of the Western Cape are custodians of community infrastructure such as roads, waste disposal sites, water and sanitation systems, and other public facilities. These are however complex by nature and require robust management practices. Sound knowledge of the location and characteristics, estimated lives, capacity and utilisation, cost characteristics, risk exposure and safety requirements of assets can support this robust management, including best management for sustainable improvements in service delivery.

Sustainable Public Procurement (SPP) is proving to be a successful strategic tool for supporting Municipalities in sustainable infrastructure development and service delivery within a financially sustainable manner, thereby contributing to an inclusive economy for the Western Cape.

"As methodology, SPP responds to the risk profiles of municipal infrastructure and asset management, including operational risk and risk to infrastructure or asset failures. This is particularly useful in light of climate change expectations for the Western Cape Province, combined with requirements for financial sustainability and infrastructure resilience" – Department of Environmental Affairs & Development Planning

Whether we face environmental, climate, economic or health crises – one aspect that is becoming increasingly apparent is the need to 'build back better'. This is supported by legislation and underwritten in the *Disaster Management Act 57 of 2002*. This Act drives all spheres of government to build back and continue development in ways that are reducing provincial vulnerability to disasters and crises, and by so doing, increasing provincial resilience.

In supporting the need to 'build back better' and through the implementation of the *Western Cape Green Economy Strategy Framework* (2013), the Department of Environmental Affairs & Development Planning (DEA&DP) places a strong focus on developing capacity and intelligence in order to drive the greening of the provincial economy which includes the exploration of new sustainable best practice opportunities.

SmartProcurement - the DEA&DP's Sustainable Public Procurement (SPP) programme – was initiated in 2018 to complement foregoing departmental research which indicated that it is both advantageous and feasible to mainstream SPP within the Western Cape Government (WCG) procurement system. A central objective of the *SmartProcurement* programme was to review the current approaches to services, infrastructure and asset procurement in the WCG and to identify key opportunities for the development and implementation of SPP.

Towards these objectives, the principle of Total Cost of Ownership (TcO), which is supported by various legislation and implementation instruments, was identified as an appropriate proxy for SPP – and sustainability. TcO is a powerful tool that can be implemented effectively by municipalities as methodology to compare the direct and indirect costs which the municipality will incur for infrastructure and asset management solutions that may vary in technological approach.

This SPP Training and Implementation Manual is a product of the *SmartProcurement* programme and has the following objectives:

- To increase knowledge of and support for implementing SPP, especially as a tool to achieve sustainable infrastructure development and improve municipal financial sustainability;
- To guide the identification of opportunities for enhancing sustainability, whether as part of existing projects or the development of new programmes and projects;
- To address the question of how to implement SPP in existing procurement processes;
- To guide the incorporation of Total Cost of Ownership methodology in the development and procurement of municipal infrastructure;
- To offers references and practical support for officials to implement SPP in a highly legislated environment, being both a motivator for those new to SPP implementation and an enabler for SPP champions; and
- To serve in feeding into the development of a pipeline of sustainable infrastructure projects.

"SPP transversally responds to municipal infrastructure and asset management shortcomings by supporting several of the Municipal infrastructure and asset management challenges experienced. Through SPP, change management can be introduced including how investments are evaluated for appropriateness and urgency. This can be achieved through principles of Total Cost of Ownership, Lifecycle Modeling and Investment Decision-Making" – Provincial Treasury

Past Auditor General Reports for the *Municipal Finance Management Act 56 of 2003*, indicated several inadequacies in Asset Management at Municipalities and specifically, multiple shortcomings in the development and maintenance of infrastructure in the Western Cape, including: - widespread underspending in infrastructure development projects, delays in project

completion, poor planning that result in deviations and the risk of "scope creep", non-compliance with supply chain management legislation as well as irregular expenditure.

SPP can transversally support several of these shortcomings. The Provincial Treasury Local Government Supply Chain unit assist Municipalities with capacity building through training and development including the review, improvement and formulation of the Asset Management system of Governance for municipalities in the Western Cape. More specifically, Provincial Treasury's support of SPP is targeting:

- The need for Municipalities to mitigate against operational cost inefficiencies due to non-alignment of objectives and resources;
- The need for Municipalities to mitigate against the lack of inconsistency in long-term investment planning and prioritisation through appropriate analysis;
- Aging Municipal Asset Portfolios, which are subjected to obsolete technologies, requiring re-investment within the context of fiscal constraints;
- Assistance with clear strategies to address gaps between what Municipalities require from its assets in the medium and long-term, and the current capability.

"As the Department of Local Government oversees the roll-out of the Municipal Infrastructure Programme, it is strategically positioned to influence planning and the introduction of the Total Cost of Ownership (TcO) principles. The Manual draws on internationally accepted best practice, but has a strong South African flavour, given our unique context" – Department of Local Government, Municipal Infrastructure

The *Constitution of the Republic of South Africa* charges Provincial Local Government to support Municipalities and to promote the development of local government capacity to enable Municipalities to perform their functions and manage their own affairs. The Department of Local Governemnt (DLG) positioned itself to meet infrastructure challenges while realising the excellence in Municipal Infrastructure creation and Technical Services delivery management through embedding the aspects of Sustainability, Integration and Governance as part of its involvement in the *Vision Inspired Priority 2 – Building and Maintaining Infrastructure*. DLG drives a number of interventions that aim to strengthen project planning pipelines in the Province which effectively provides opportunities for enhancing and gaining of further developmental and management momentum. To ensure municipal portfolios of implementation-ready infrastructure projects, Municipalities are supported:

- To reduce infrastructure underspending and carry out medium- to long-term infrastructure planning. This planning will also look at the coordination, phasing, and sequencing of infrastructure investment by all three spheres of government, guided by the *Provincial Spatial Development Framework* and *Municipal Spatial Development Frameworks*.

- The Sustainable Infrastructure Development and Finance Facility (SIDAFF) will continue to be used to provide spatial development planning and associated project development for catalytic revenue-enhancing municipal infrastructure projects that deliver optimal returns to society, the environment and capital in the Western Cape.
- DLG supports local government in achieving programmes that promote sustainable quality of life to all citizens.

How to apply this SPP Training and Implementation Manual

As part of a broader and ongoing support framework, this Training and Implementation Manual has been developed with inputs from local government practitioners. It has been compiled to assist municipal immovable asset managers. In particular, its application will assist in strengthening IDP processes and outcomes, the implementation of generally accepted municipal accounting practices related to immovable assets, improve infrastructure investment planning efforts and other municipal systems related to municipal infrastructure.

The Office of the Accountant General has also been involved in ensuring compliance with local government specific accounting standards, and that sound financial asset management practices are embodied in this Manual. International best practice is presented in a manner that meets local legislative requirements and addresses local challenges. Case studies of how South African and Western Cape municipalities have successfully implemented asset management practices are provided (p. 27).

To make the implementation TCO practical, this Manual includes exploratory notes and actual calculation exercises and project simulations (p. 29) to ground the principles of the SPP and TcO.

This SPP Training and Implementation Manual can be applied by municipal officials, across administrative leadership, engineering and supply chain management as framework and methodology for the process of implementing Sustainable Public Procurement. Although the focus has been narrowed to address municipal infrastructure and asset management, it is however emphasised to the reader, that implementation requires institutionalisation and change management, and within the context of each sector, municipality and provincial department.

The DEA&DP, PT and DLG will continue its collaborative efforts to implement Sustainable Public Procurement as strategic tool and with assistance to the Municipalities of the Western Cape towards better service delivery and and inclusive economy for the Western Cape.

Oficial sign-off

It is hereby certified that the Sustainable Public Procurement Training and Implementation Manual has been approved.

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Acronyms

DCF	Discounted Cash Flow
NPV	Net Present Value
WACC	Weighted Average Cost of Capital
SPP	Sustainable Public Procurement
TCO	Total Cost of Ownership
BBBEE	Broad-Based Black Economic Empowerment
CIDB	Construction Industry Development Board
WCG	Western Cape Government
SIPDM	Standard for Infrastructure Procurement and Delivery Management
SDGs	Sustainable Development Goals
VfM	Value for Money
BAU	Business As Usual
ESCo	Energy Services Contract
EMPIAs	Empowerment Impact Assessments
DTPW	Department of Transport and Public Works

List of Tables

List of Figures

Purpose and structure of this training manual

This training manual has been developed to be used by provicial and local government officials in the Western Cape to learn about Total Cost of Ownership as a component of Sustainable Public Procurement, its value to long term municipal sustainability, and how it can be applied.

This manual gives a general overview of Sustainable Public Procurement (SPP) and Total Cost of Ownership (TCO). The manual then delves more deeply as to how it can be applied to the public procurement system in South Africa, in particular to the procurement of public infrastructure and asset management.

The financial mechanisms available to implement sustainability in municipalities

Procurement is one of a number of mechanisms available to municipalities to implement more sustainable infrastructure and asset management. Table 1 below provides an overview of these mechanisms[1]:

Table 1: Financial mechanisms available to implement sustainable infrastructure and asset management

Ways to finance	Examples of sources	Examples of using this mechanism for local sustainability action	Benefits	Barriers
Municipal rates, tariffs and taxes	Property rates; Sale of water and electricity; Development contributions; and Sale of sewage and waste collection services.	Reductions or deductions can be offered as a reward for adhering to climate appropriate development and behaviour decisions, such as installing energy efficiency or generation. Increases can be used to penalise development decisions and behaviour choices that are not appropriate in response to climate	Within the municipal council's control. With good revenue collection, the increased revenue collected can be utilised to fund larger climate action and municipal service delivery projects. No significant capital outlay is required.	Consider possible economic impacts of a deduction or increase in rates. Must not impact negatively on lower income families and households. Build broad political support from citizens.

[1] Department of Environment, Forestry and Fisheries (DEFF). 2019. *A Practical Systematic Guide Towards Unlocking Municipal Climate Finance*. Local Government Climate Change Support Programme. Available at: https://drive.google.com/file/d/1Tp9LKHJ7miSKgOv2TOxZBL-aY7mOT8PL/view

Ways to finance	Examples of sources	Examples of using this mechanism for local sustainability action	Benefits	Barriers
		change, such as increasing the cost of a unit of energy or water as more is consumed so that higher users pay more per unit than lower users of resources.		
Policies and by-laws	SDF, land use management, building control, water and electricity policies.	Can help municipalities implement minimum standards for resource use, building and infrastructure design and placement, through compliance, such as delineating 'no development zones' in 100-year flood zones or outlining restrictions for the use of potable water thereby encouraging the use of non-potable water.	Within the municipal council's control. No significant capital outlay is required. Can provide longer-term policy certainty and therefore support investment for climate action. Demonstrates political support to local climate action.	May require awareness raising and training for residents and businesses. Training may be required for municipal officials to undertake compliance checks, designation of peace officers, etc. May need to take a phased approach to implementation.
Sustainable Public Procurement	"A process whereby organisations meet their needs for goods, services, works, and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy,	Climate change considerations, such as resource efficiency and carbon emissions associated with the production and operation of what is procured, can be included in the technical specifications, functionality, eligibility criteria and/or the contract conditions for goods, construction or services.	Within the control of the municipality to implement. There are known solutions for climate mitigation that can already be included in procurement decisions, such as energy efficiency technologies. Co-benefits can be realised such as increased operational cost saving when considering resource efficiency	Need to overcome the perceptions of increased cost and that this is not required by legislation. When doing this for the first time, may take longer than simply following business-as-usual or taking the same approach as previously done. Data on local climate impacts is needed to make informed decisions.

Ways to finance	Examples of sources	Examples of using this mechanism for local sustainability action	Benefits	Barriers
	whilst minimising damage to the environment".		interventions.	
Inter-governmental grants	Equitable share, municipal infrastructure grant.	Municipalities can be proactive in utilising grants for local climate action through policies and by-laws and sustainable public procurement of infrastructure for service delivery using these grants.	More systematic and widespread inclusion of climate change. No restriction on municipalities including climate change considerations in projects designed for these grants.	Grants are mainly directed to capital expenditure, but this is changing to include operational considerations too. Climate change is a cross-cutting issue, but grants are still sector specific. Training may be required.
Public international funding	National governments of countries (taxes) across the world who have designated funds for climate action.	Increasingly, national governments that release international public funding through these agencies are including climate change criteria as a minimum compliance criteria and/or developing specific funds for climate action.	The grant funding and concessional loans available should assist in reducing the cost of implementing climate action. Grants do not need to be paid back and can therefore be used for projects where there is little to no direct return on investment, such as capacity building, strategy and policy development, financial and technical feasibility studies, etc.	Preparing projects can be expensive. Grant funding is associated with reporting requirements to funders that can be burdensome at times. Increasingly, international funds require that grants and concessional loans be used to leverage additional funding, whether from the public or private sector.
Private capital market	Institutional and commercial investors - pension funds, banks, the sale	Private financiers are increasingly including climate change criteria when evaluating investment opportunities and risk.	Private capital markets have significantly larger resources than the public sector, therefore greater	Preparing projects can be expensive. Money received needs to be paid

Ways to finance	Examples of sources	Examples of using this mechanism for local sustainability action	Benefits	Barriers
	and delivery of private goods and services.	Going further, many impact investors are specifically looking to invest in projects that derive direct social, environmental and economic benefits, rather than just profit. As technology has improved, climate change mitigation projects now also have a strong business case for investment and demonstrate stronger returns on investment.	amounts of finance can be leveraged. Private capital markets can provide the necessary upfront capital costs for projects when local governments do not have the resources to do so.	back. The private sector is risk averse and requires guarantees for certainty. Reporting requirements to funders can be burdensome at times.

Understanding Sustainable Public Procurement

Sustainable Public Procurement is defined as "a process whereby organisations meet their needs for goods, services, works, and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimizing damage to the environment"[2].

South Africa is a leader in the implementation of some aspects of Sustainable Public Procurement (SPP), especially regarding preferential points for socio-economic indicators, such as local product procurement, the creation of jobs for local communities, and Broad-Based Black Economic Empowerment (B-BBEE). The legal and legislative framework that permits this procurement also enables the use of other SPP criteria, especially environmental criteria.

In South Africa, each sphere of government procures goods, service and works in line with their mandate and manages this procurement process according to relevant national, provincial and local policy. This means that each municipality and provincial department in the Western Cape has the ability to implement procurement practices that are more sustainable when considering the environmental, social and economic impacts of these goods, serivces and works. Ultimately, with the goal to achieve greater value for money in infrastructure and asset management.

[2] United Nations Environment Program [UNEP] (2011) Marrakech task force on sustainable public procurement led by Switzerland (Activity Report). Available at: http://www.sustainableprocurement.eu.com/documents/MTFonSPPReportCSD19FINAL.pdf. Accessed 13 Jan 2019

Global Goals and Sustainable Procurement

SPP is now framed in the Sustainable Development Goals (SDGs) as Goal 12: Sustainable Production and Consumption, through which all national governments that ratified Agenda 2030 have committed to promoting SPP practices. The inclusion of SPP in the SDGs has raised its status as a tool for the implementation of sustainable development, thereby increasing the focus on SPP on the global stage. The value of SPP is evident when reviewing the interlinkages between the SDGs, and the role that SDG 12 plays in achieving targets under other SDGs. As shown in Figure 1, sustainable production and consumption has important influence on targets of SDG 6: Clean water and sanitation, SDG 7: Affordable and clean energy, SDG 8: Decent work and economic growth, SDG 11: Sustainable cities and communities, SDG 15: Life on land, and SDG 17: Partnerships. Sustainable consumption and production is therefore seen as an enabler of sustainable development.

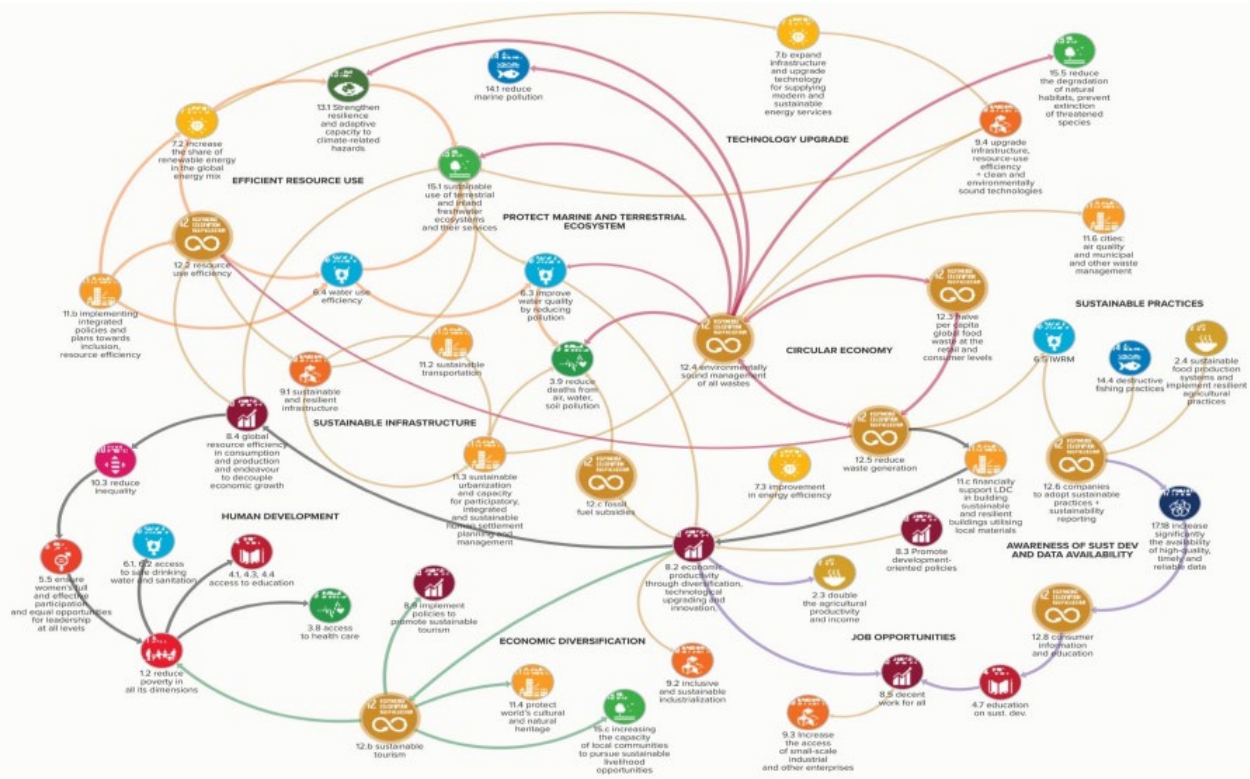

Figure 1: Mapping the interlinkages of the achievement of SDG 12 to other SDGs (Source: [Open Development Mekong])

Sustainable Procurement in Infrastructure and Asset Management

In a municipality, one of the largest categories of procurement is the procurement of goods, services and works related to the delivery of services by infrastructure. This can include the designing and building of new infrastructure, the maintenance and operations of exisiting infrastructure, and the refurbishment, retrofit or decommissioning of infrastructure that has reached its end-of-life, shown in Figure 2.

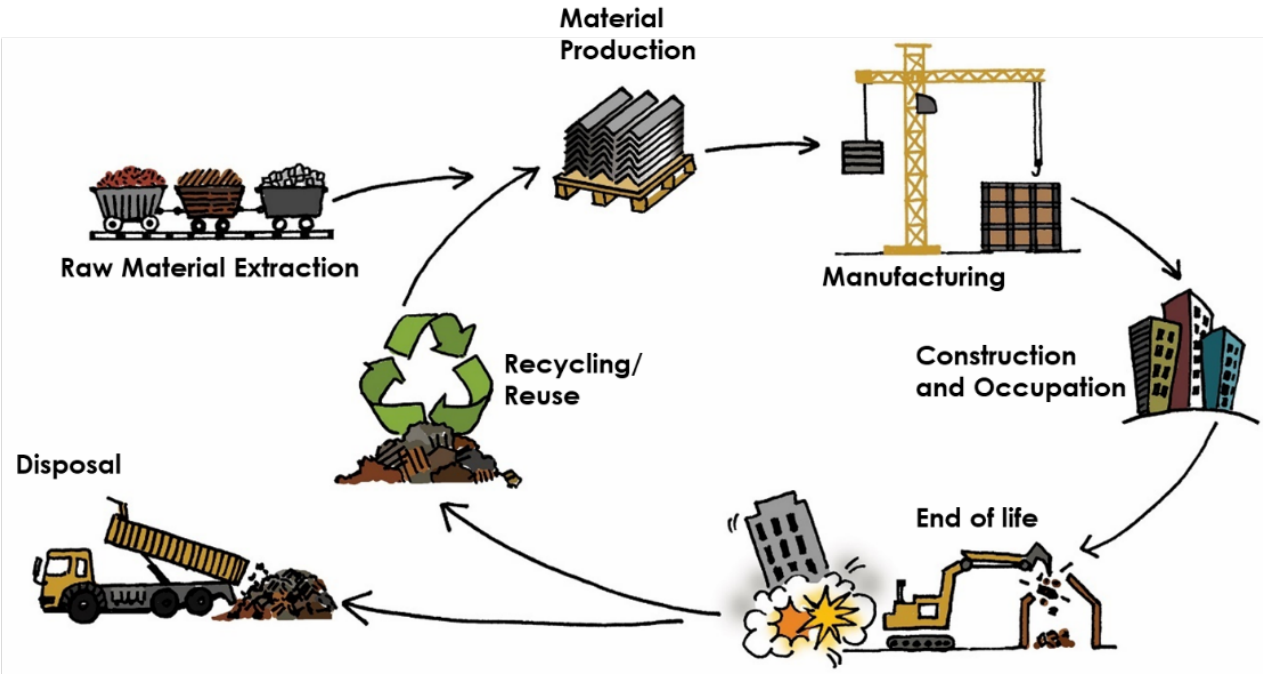

Figure 2: The infrastructure lifecycle (ICLEI Africa, 2015)

Implementing Sustainable Public Prourement (SPP) can be a valuable tool for the development of a pipeline of sustainable infrastructure projects. Early in the project preparation phase, SPP can assist the officials to identify opportunities for improved sustainability, whether enhancing existing projects or develping new projects, through the inclusion of selected Environmental, Social and Governance Indicators (ESG). At a later stage in the project preparation process, implementing SPP can ensure that the sustainability metrics agreed to in the project design are realised.

To implement SPP in infrastructure and asset management successfully, a municipality would need to take a strategic approach to procurement by examining value for money at both the portfolio or progamme level and the project level. Furthermore, it is necessary to ensure that the Municipal Procurement Policy positions environmental, social and economic considerations and impacts as central to municipal sustainability and permits their inclusion in design and procurement processes. Technical staff and bid committees would also then be trained and supported to apply and evaluate relevant sustainability criteria to each specific project and context. Markets and suppliers would be regularly engaged to ensure that the municipality is requesting goods, services and works in line with what the market could deliver and that service providers are aware of the goals and policies of the municipality, to develop the solutions necessary to meet these procurement requests. Municipalities would then also manage contracts in such a way as to use this contract data to monitor and evaluate the effectiveness of the SPP criteria being implemented and documenting the benefits to support more widespread inclusion of SPP, as well as overcoming the barriers identified.

Value for Money and Total Cost of Ownership

Value for Money (VfM) is a key consideration when developing and implementing a procurement process for infrastructure and asset management. Value for Money is not only a function of upfront cost, but also of operational, maintenance and end-of-life costs. In South Africa, infrastructure is an immovable asset and is governed by the Government Immovable Infrastructure Act 19 of 2007, wherein the principles of immovable asset management include:

S5 (1) (c) in relation to an acquisition, it must be considered whether—

> (iii) the cost of the immovable asset, as well as operational and maintenance cost throughout its life cycle justifies its acquisition in relation to the cost of the service.

This means that Government is required to consider all costs associated with the construction and operation of infrastructure when evaluating solutions. Furthermore, additional legislation requires that municipalities implement this broader understanding of value for money. For example, this is captured in the Disaster Management Act 57 of 2002 that requires government to build back better to be less vulnerable, and not build back the same after a disaster event; the National Environmental Management Act 107 of 1998 (NEMA), Section 2: Principles, where lifecycle assessments of environmental impacts and options/scenario assessment are required, and the Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA) that requires municipalities to consider implications of decisions by all spheres of government, to name a few.

Total Cost of Ownership is an effective tool to realise value for money in that it allows for the upfront evaluation of all the costs associated with a purchase over its entire lifecycle. These costs include the cost to procure the infrastructure asset and/or the construction, the costs to operate and maintain the asset, and the costs at the end-of-life such as decommissioning and/disposal costs. This is critical to realising value for money in the procurement of infrastructure and asset management, as purchase price is often a smaller portion of the total cost of an infrastructure solution. Therefore, only considering purchase price does not give an accurate understanding of the full cost implications. This principle of value for money is often depicted as an iceberg as shown below in Figure 3.

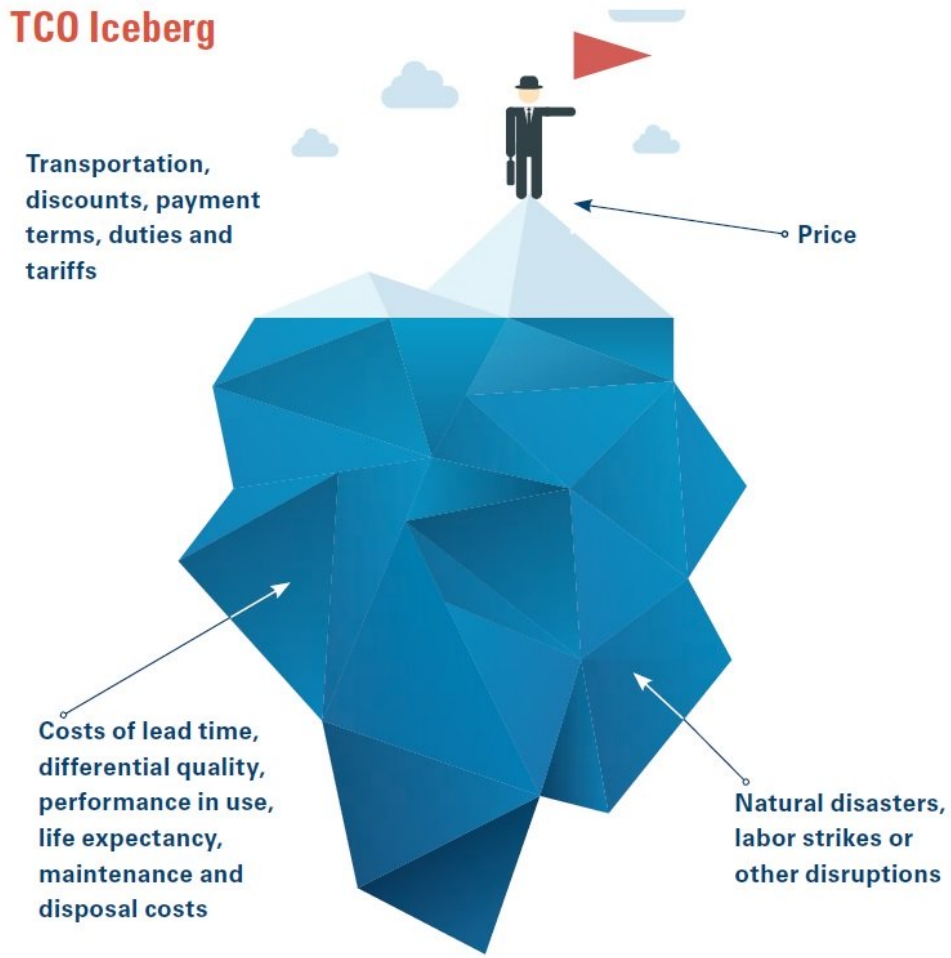

Figure 3: Total Cost of Ownership depicted as an iceberg with obvious, above surface, costs and hidden costs. (Source: Institute for Supply Management)

With regard to infrastructure and asset management, reducing costs across the lifecylce of infrastructure and assets can be used as a proxy for improved project sustainability. For example, the lower the amount of water and energy an infrastructure system requires, the lower the costs of operational resource use, thereby resulting in greater value for money and improved natural resource efficiency.

The benefits of considering total cost of ownership on the viability of infrastructure and municipal service delivery have been modeled by the Western Cape Government as outlined in Table 2 below (DEA&DP, 2015):

Table 2: The benefits of considering TCO as modelled by WCG

Case study on resilient service provision: Feasibility study for alternative and sustainable infrastructure for settlements – focus on Mossel Bay

The aim of the study is to comparatively assess the economic impacts for a project site in Mossel Bay with regard to a Business As Usual (BAU) approach compared to a human settlement project that incorporates renewable technologies and sustainable interventions into settlement design (Integrated Sustainable Settlement).

Findings:

Increased employment opportunities in alternative and sustainable infrastructure provision in both the construction and operational phases.

Skill Level	Highly skilled	Skilled	Unskilled	Total
Business as Usual				
Construction Phase	55	164	328	546
Operational Phase	1	4	5	10
Alternative and sustainable infrastructure				
Construction Phase	78	222	428	727
Operational Phase	14	18	20	52

While there is an increase in the capex and maintenance costs for alternative infrastructure, such as photovoltaics etc., the operational cost is significantly less than conventional services provision. This means that the total cost of ownership for alternative infrastructure is ultimately lower that a business as usual approach. This is important as the maintenance and operational costs have a direct impact on the financial sustainability of municipalities.

Total Costs	CAPEX	OPEX	Maintenance	TOTAL
Business as usual	R 78 M	R 1,6 B	R41 M	R1, 8 B
Alternative Infrastructure	R 531 M	R 96 M	R203 M	R 830 M

When reviewing the accumulated costs over a 40-year period, it is evident that the business as usual approach has a far higher cost with a larger proportion of that cost attributable to residents. This could have negative consequences especially for poorer households.

OPTION	CAPEX		OPEX		Maintenance		TOTAL
BAU: Option 1							
% Payable by Municipality	100%	R108 M	18%	R285 M	100%	R41 M	R434 M
% Payable by Future Residents	0%	R0	82%	R1, 3 B	0%	R0	R1, 3 B
Integrated sustainable development: Option 2							
% Payable by Municipality	100%	R533 M	5%	R5 M	78%	R157 M	R695 M
% Payable by Future Residents	0%	R0	95%	R90 M	22%	R45 M	R135 M

Alternative and sustainable infrastructure systems allow for significant reductions in resource use: Energy (where energy is generated on site) – 59% in winter and 126% in summer; Water – 64%; Landfill space saved – 35%

Implementing Total Cost of Ownership in public infrastructure projects

This section provides a practical guide to implementing Total Cost of Ownership (TCO) in infrastructure procurement in a municipal context. Total Cost of Ownership is defined as,

> "*an estimate of the total costs of goods, services or construction works over the whole of their life. It's the combination of the purchase price plus all other costs you will incur, less any income you receive.*"[3]

Most frequently, TCO is used at the beginning of the design and/or purchase process to evaluate which is the most cost-effective choice. TCO is a powerful tool that can be used to compare the direct costs the municipality will incur for infrastructure and asset management solutions, that vary greatly in technological approach. Detailed project-level TCO calculations will vary based on the context and asset class of the infrastructure and therefore should be undertaken on a project-by-project basis. To expand on this, the technologies and costs may vary based on where the project is located and the risk factors associated with these, such as the cost of labour, the rates and tariffs of water and electricity, etc.

There are however three key principles for TCO that should be adhered to in order to ensure its implementation:

- Operational, maintenance, revenue, and end-of-life costs are not easily discerned by looking at the upfront costs alone;
- The lowest upfront cost may not be a good indicator of value for money; and
- TCO requires that costs spent and revenues generated at different times in a project must be evaluated equally. The time value of money means that the costs over time are not comparable unless converted to Net Present Value.

The third principle mentioned above is further elaborated on in the next section.

Benefits of applying TCO to infrastructure projects

Some of the benefits of applying TCO to include:

- Improved decision-making for achieving real value for money for citizens and businesses.
- Improve the quality of the solution and asset delivered.

[3] New Zealand – Government Procurement Branch. 2013. Total Cost of Ownership: An introduction to whole of life costing. Available at: https://www.procurement.govt.nz/assets/procurement-property/documents/guide-total-cost-ownership.pdf

- Improving the competitive procurement process by making visible the factors that truly drive cost of infrastructure and asset management, such as interest rates of loans, labour and resource costs, etc.
- Improving the competitive procurement process by ensuring that all bids are evaluated using a standard approach to measure sustainability.

Different approaches for implementing Total Cost of Ownership at the strategic and project levels

Based on the above, it is important to include TCO in both the strategic level of infrastructure planning and at the project level. To do so, it requires that municipalities apply aligned, but different, approaches, based on the level of public infrastructure planning and asset management.

At the strategic planning or portfolio level, TCO is implemented by adopting a set of principles.

At the project level, TCO is implemented by evaluating estimated costs.

At the strategic level of infrastructure planning, it is necessary to include the following considerations to implement TCO:

- Problem Identification:
  - Does the municipality have a good understanding of the nature of the problem being faced and what is causing it?
- Solutions and alternatives:
  - To address this problem can a non-infrastructure solution be pursued? This could be an institutional change, a behavioural change, a nature-based solution, or a service rather than an asset being procured.
  - Is there an existing asset in the municipality that can be repurposed or improved to address this challenge?
  - Has more than one option/scenario been considered?
  - Have both the operational and capital budget requirements been considered for each solution?
- Consultation:
  - Have other departments in the municipality been consulted to identify and benefit from a shared infrastructure solution or approach?

- Have neighbouring municipalities been engaged to understand whether a regional infrastructure approach is appropriate and viable?

TCO can also be implemented at the strategic planning level by ensuring that indicators of TCO are included in municipal documents, such as the Integrated Development Plan, the Spatial Development Framework and accompanying Capital Expenditure Framework, and the Service Delivery Budget and Implementation Plan. For provincial government, indicators of TCO should be embedded into Integrated Performance and Support System (IPSS) Departmental Annual Performance Plans, the Provincial Spatial Development Framework, the Western Cape Infrastructure Framework, and the Environmental Implementation Plan, to name a few. TCO indicators should be context-specific, with the following as examples of indicators that can be used:

- Reduced operations costs, especially on resource inputs such as water, chemicals, and energy, where applicable.
- Reduction of resource inputs in quantity, such as a specific target for reduced kilolitres of water and kilowatt-hours for energy.
- Reduced maintenance and replacement costs.
- Reduced infrastructure insurance costs by developing projects in lower risks areas, with lower risk technology.
- Increased revenue generated for the project to cover operational costs, therefore requiring lower cross-subsidisation from the municipal budget or other grants.

In infrastructure and asset management at the project level, TCO broadly refers to the following general cost categories that should be taken into account:

- Pre-construction:
  - Professional services for design, relevant studies (EIAs, Technical and financial feasibility) and contract – this can be undertaken by officials or externally by service providers
  - Cost of land, and accompanying fees
- Purchase/Construction Costs:
  - Construction/Installation
  - Materials used in construction
  - Insurance
- Operational (recurring and irregular):
  - Resource and/or raw material inputs, such as water, electricity, chemicals, fuel
  - Personnel to operate asset

    - Training and re-training
    - Insurance
    - Taxes (current and future taxes, such as carbon tax)
    - Loan interest rates or payments made for financing the asset
- Maintenance:
    - Personnel and component costs for:
        - Regular repairs
        - Extraordinary repairs
        - Replacement of parts
- End-of-life:
    - Decommissioning
    - Disassembly/Demolition
    - Reuse of infrastructure asset, in whole or in part
- Revenue generated:
    - From operation of asset/sale of service or resource
    - From sale of asset, in part or whole, at end-of-life

The operational costs are further detailed in the final section of this training manual.

Where a loan or debt is incurred to finance the infrastructure delivery, it is also necessary to take into account the loan repayments and interest on the loan over the period agreed with the creditors. Importantly, these costs are accrued in the construction phase, but only paid during the operational phase once the project is generating revenue. Therefore, the financial feasibility relies significantly on the operational phase of the project. At a high level, this equates to the following equation at the project level:

Total Cost of Ownership =

Purchase Costs + Operational Costs + Maintenance + End-of-life - Revenue

Time Value of Money and Net Present Value

Critical to the calculation of TCO is the need to report all costs in Net Present Value. Net Present Value (NPV) is defined as "the difference between the present value of cash inflows and the present value of cash outflows over a period of time."[4] By calculating NPV, it is possible for project developers to determine whether a project will result in an overall cost benefit to the project owner. Costs and revenues of a project take place at different times and therefore cannot simply be compared, due to the Time Value of Money.

Box: Time value of money

R100 today is worth more than R100 one year from now, due to its potential earning capacity. Effectively, this means that a good investment today will increase in overall value as time goes by, because of its ability to do work and so provide valuable goods and services.

It is, therefore, necessary to discount cash flows back to present value to determine whether a project should be undertaken. The following formula is used to calculate total NPV:

$$NPV = \sum_{t=0}^{n} \frac{Rt}{(1+i)^t}$$

In this equation:

- R_t = net cash inflow-outflows during a single period t
- i = discount rate or return that could be earned in alternative investments
- t = number of time periods

Overall, a positive net present value indicates that the projected earnings generated by a project or investment, in present Rands, exceeds the anticipated costs, also in present Rands. It is assumed that an investment with a positive NPV will be profitable and therefore have a lower total cost of ownership. An investment with a negative NPV will result in a net loss, resulting in a high total cost of ownership as additional funds (beyond the project revenue itself) will be required. In the case of a choice between multiple projects, **the project with the highest NPV can be indicative of greater value for money**.

However, some public infrastructure projects are rarely expected to be profitable. An example of this could be to provide water and electricity to small, rural and remote communities to increase their quality of life, but will not result in any significant direct return on investment. In these situations, the outcome of the NPV calculations is useful to gauge the extent to which there exists a funding

[4] Fernando, J. and Mansa, J. 2021. Net Present Value (NPV). Investopedia. Available at: https://www.investopedia.com/terms/n/npv.asp#:~:text=Net%20present%20value%20(NPV)%20is,a%20projected%20investment%20or%20project.

gap under these circumstances and which of the solutions available will result in the lowest loss of funds due to the project.

Calculating NPV will always be an estimate of the costs. It is therefore crucial for all assumptions made in the calculation to be clearly stated upfront. For example, few municipalities or companies would have been able to foresee the long and devastating impact of the COVID-19 pandemic on the feasibility of different infrastructure projects.

Cash Flow

The NPV should be calculated for total costs and then total revenue generated over the operational life of an asset. Cash flows therefore refer to the total money spent on a project subtracted from the total money earned (both in NPV). The possible types of costs and income attributed to a project are listed earlier in this manual.

Time Period

The time period of an NPV calculation refers to the number of months or years that a project will be active, from the first purchase or disbursement to the end-of-life of an asset.

Time periods can be months or years. Choosing which time period to use will be based on the type of data available, whether the project has monthly or annual cash flow figures.

It is important to make sure that all values used in an NPV calculation have been converted into the time period applicable.

Where there is a once-off upfront payment for the asset or infrastructure, then the time period is simply the number of months/years the asset is operational for. However, this is not the case in most infrastructure projects. For infrastructure, there is generally a number of years where a project is being constructed and payments are being made over a number of time periods. These months need to be accounted for in addition to the number of operational months when calculating NPV.

Discount Rate

The discount rate to be used in NPV calculations should be one of the following:

- A project-specific value that is determined by a specialist consultant (needs to be done for every project).
- Using the Weighted Average Cost of Capital (WACC) rate that incorporates the cost of finance for each project. The various terms in the WACC equation are determined in large part by the type of investment being made:
    - $WACC = (Fraction\ financed\ by\ debt) \times (Cost\ of\ debt) + (Fraction\ financed\ by\ equity) \times (Cost\ of\ equity)$.

  The cost of capital is the interest rate of each type of capital as determined by the shareholder (in the case of equity) or the creditor or bank (in the case of debt).

- The government bond yield rate or the Capital Market Rate for the period of the infrastructure project. The latest rates can be found on the South African Reserve Bank website: https://www.resbank.co.za/Research/Rates/Pages/CurrentMarketRates.aspx. For example, if calculating the NPV for an infrastructure project with a 10-year life span, the discount rate to be used would be 10% according to the rate at the time of writing this manual.
- For infrastructure projects with an operational lifespan of longer than 10-years, discount rates from one of these two sites can be used:
    - Bloomberg Rates & Bonds: https://www.bloomberg.com/markets/rates-bonds
    - World Government Bonds Index:

      https://www.yieldbook.com/m/indices/single.shtml?ticker=WGBI
- A standard and general discount rate of 8% per year.

The discount rate utilised must be justified and critically evaluated as it will have a significant impact on the project's NPV. Discount rates are always reported annually. If the time period used is monthly, then the discount rate needs to be converted to a monthly period. This can be done using the following equation, where the discount rate in this example is 8% or 0.08:

$$\text{Periodic Rate} = ((1 + 0.08)^{\frac{1}{12}}) - 1 = 0.64\%$$

A method for calculating TCO in infrastructure

There is no one method for calculating TCO in infrastructure. TCO can be calculated by the contracting authority or the bidder as part of a response to a Terms of Reference. The calculation method and examples provided below are used to demonstrate some of the factors to be considered as these calculations are developed for each type of infrastructure and/or tender:

1. List all the costs and revenues that must be evaluated. In order to do an accurate comparison (camparing 'apples with apples') all projects must be evaluated on the same criteria. Any value adds must either be costed in to one of these cirteria or listed in addition to this in a narrative format for consideration.
2. Determine the minimum number of years of operation required. If infrastructure solutions differ in their operational life time period, then it may be helpful to consider looking at the average TCO per year of operational life to understand value for money of different options.

3. Determine the required output of the infrastructure, e.g. litres of water treated at a water treatment plant, over the lifecylce of a project. This can be a helpful indicator of value for money if the TCO is divided by total output, to determine a Rand/output unit amount that is comparable across projects.
4. Determine the discount rate, preferably the government bond rate for the relevant operational time period of the infrastructure if a government grant is used to fund the project.
5. Is data available from previous similar projects that can provide insight in to estimated costs? If not, are there recent studies, manufacturers, or skilled professionals (financiers or engineers) that can provide estimates for key cost categories.

Most often, Microsoft Excel is a valuable tool used to calculated TCO, using one of two ways:

1. Use the 'NPV' Function and Formula: '=NPV(discount rate; series of cash flow)', as shown in Figure 4 below. It is important to remember to start the cashflow on the first year of operation, not the first year of construction.

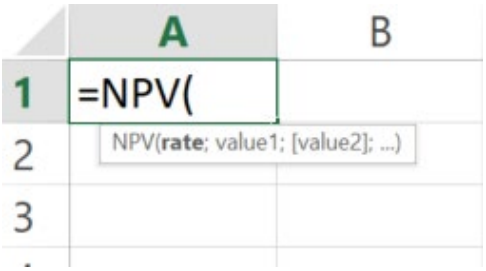

Figure 4: Calculating TCO using NPV in excel

2. Calculate the present value (PV) of each cashflow amount: $PV = F / (1 + I)^t$ typed in excel as PV = F / ((1 + i)^t)

   In this equation:

   - F = Cash Inflow or Outflow value
   - i = discount rate
   - t = number of time periods, e.g. '5' for 5 years of operation

Examples of calculating Net Present Value for three projects are provided in Table 3 below

Table 3: Three project examples for calculating NPV

Discount Rate	10%											
Project 1												
Year	0	1	2	3	4	5	6	7	8	9	10	TOTAL
Purchase Costs	-R1 500 000,00											
Operational (recurring and irregular)	R0,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00	-R50 000,00		
Maintenance	R0,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00		
End-of-life	R0,00										-R200 000,00	
Annual Costs	-R1 500 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R60 000,00	-R200 000,00	
Present Value of Costs												**-R 1,922,650.09**
Annual Revenue	R0,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R200 000,00	
Present Value of Revenue												**R 2,092,766.99**
Total Cost of Ownership												**R 170 116.91**

Project 2												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TOTAL**
Purchase Costs	-R1 000 000,00					-R1 300 000,00						
Operational (recurring and irregular)	R0,00	-R15 000,00	-R15 000,00	-R15 000,00	-R15 000,00		-R15 000,00	-R15 000,00	-R15 000,00	-R15 000,00		
Maintenance	R0,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00		-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00		
End-of-life	R0,00					-R100 000,00					-R100 000,00	
Annual Costs	-R1 000 000,00	-R25 000,00	-R25 000,00	-R25 000,00	-R25 000,00	-R1 400 000,00	-R25 000,00	-R25 000,00	-R25 000,00	-R25 000,00	-R100 000,00	
Present Value of Costs												**R 2,036,296.74**
Annual Revenue	R0,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R0,00	R350 000,00	R350 000,00	R350 000,00	R350 000,00	R0,00	
Present Value of Revenue												**R 1,798,335.87**
Total Cost of Ownership (NPV)												**-R 237,960.87**

Project 3												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TOTAL**
Purchase Costs	-R2 000 000,00											
Operational (recurring and irregular)	R0,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00	-R30 000,00		
Maintenance	R0,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00	-R10 000,00		
End-of-life	R0,00										-R300 000,00	
Annual Costs	-R2 000 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R40 000,00	-R300 000,00	
Present Value of Costs												**R 2,346,023.94**
Annual Revenue	R0,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R400 000,00	R200 000,00	
Present Value of Revenue												**R 2,380,718.18**
Total Cost of Ownership (NPV)												**R 34,694.24**

These three tables indicate the following, to name a few:

- The lowest upfront price bid would have been more expensive over the life cycle of the project due to the higher maintenance and operational costs and lower revenues resulting in a loss of funds due to the project.
- The highest upfront price didn't necessarily equate to greater value for money as the operational costs were higher.
- It is critical to understand the lifespan of a technological solution, as replacement costs may result in result in a lower NPV and higher TCO.
- Overall, a positive NPV indicates that projected revenue generated, exceed the anticipated costs, based on the premise that a positive NPV will be profitable (and therefore lower TCO).
- Overall, a negative NPV indicates a net loss and resulting in a higher TCO – for example, additional funds will be required to maintain an operational state.
- In the case of multiple bids, the project with the highest NPV can be indicative of greater value for money for the municipality.

Total Cost of Ownership in Procurement processes

There is no one-size fits all for embedding TCO in the procurement process, as it can result in different outcomes and a range of approaches. The examples that have been evident from practices in the Western Cape include:

- Type of contract: Procuring a service rather than the goods directly, such as the ESCO model for retrofits in DTPW;
- Specifications: Procuring a new type of technology or design to meet a service delivery challenge at reduced operational cost or one with an opportunity for increased revenue collection to cover the operational costs; and
- Performance specifications: Setting the required efficiency or indicators for the required performance of the infrastructure or service.

Table 4 below provides a few case studies on how officials in the Western Cape have included TCO.

Table 4: Western Cape case studies for applying TCO

	Preekstoel Biofiltration Water Treatment Plant	Energy Services Contract for Provincial Property Portfolio	Worcester Materials Recovery Facility
Location	Overstrand Municipality	Western Cape Province	Breede Valley Municipality
Department Responsible	Overstrand Municipality Infrastructure and Planning: Engineering Planning	Western Cape Department of Transport and Public Works (DTPW)	Breede Valley Municipality, Directorate of Technical Services
Description	The Overstrand Municipality, South Africa, is utilising iron and manganese rich ground water reserves in order to supplement surface water resources. The iron and manganese is removed via biological oxidation and filtration in place of conventional chemical precipitation. The biological oxidation process has been demonstrated internationally, but this is the first installation of its kind in South Africa.	An energy services contract (ESCO) has been established by the DTPW to increase resource efficiency in their buildings. Started with only energy efficiency and demand reduction, now moving to water. An ESCO is a shared savings model where the operational costs saved by installing efficiency measures is shared by the service provider and the DTPW at an agreed percentage.	The project comprised the design and construction of a Material Recovery Facility at the existing Worcester Waste Disposal Facility (Regional Facility). At the proposed recycling centre, the community can recover materials of value from the waste stream before the waste is transported to the licensed Worcester Municipal Waste Disposal Facility. The tailings from the material recovery facility will be transported via road to the regional waste disposal facility at Worcester.

Total Cost of Ownership can be used at various stages in the procurement process[5]:

- Pre-procurement:
  - in a business case to assess the costs, benefits and risks associated with the investment;
  - when assessing different business models, maintenance options or solutions on a comparable cost basis; and
  - to understand the different cost drivers in the life of a procurement.
- Procurement Process (bid evaluation):

[5] https://www.procurement.govt.nz/assets/procurement-property/documents/guide-total-cost-ownership.pdf

- by a supplier when bidding for a contract to demonstrate the total benefits and value being offered – especially where the initial purchase price is higher than competitors, but the total cost of ownership is lower; and
  - in selecting the best supplier by assessing the comparative whole-of-life costs of competing bids.
- Contract Management:
  - in managing the contract to track actual expenses and income against budget; and
  - as part of a benefits realisation exercise.

Engaging with the market/suppliers

Engaging with the market or suppliers outside of the procurement processes can provide valuable insight for Total Cost of Ownership in the following ways:

- To understand the types of cost categories that should be included in TCO calculations for specific types of infrastructure, specifically for the factors that influence operational and maintenance costs;
- To understand estimate values for cost categories; and
- To ensure that the market understands TCO and is able to provide the necessary data or costs needed for TCO calculations.

Suppliers, especially those who are SMMEs, may need to be trained on TCO in order to provide them with the capability to respond to bids appropriately.

Total Cost of Ownership in Bid Documents

TCO relies on evaluating only those considerations that can be costed. Therefore, all broader goals and aims that cannot be costed easily, such as localisation, B-BBEE, sub-contracting of SMMEs and job creation should be included in tender documents as eligibility criteria or functionality criteria.

As mentioned earlier, calculating TCO and NPV relies on a number of assumptions and is an estimate rather than an exact figure. Therefore, when designing tender documents where TCO will be evaluated, it is necessary to consider all assumptions to make the bids submitted as comparable as possible. These assumptions could include:

- The cost categories;
- The revenue categories;
- The rates, where revenue generation is based on set municipal rates;
- The discount rate;
- The rates of any taxes; and
- The rate of financing the cost of capital (if being considered).

As the success of an infrastructure asset is evaluated on performance, it may be beneficial to not consider the final cost alone, but rather the cost per unit of performance. This could give a deeper understanding of value for money, when evaluating competing bids. An example is provided in Table 5 below:

Table 5: Calculating the cost per unit of performance

	WWTW A	WWTW B
Net Present Value of Expenses	1 000 000	1 500 000
Net Present Value of Revenue	250 000	750 000
Total Cost of Ownership	750 000	750 000
Average number of litres of water treated to a regulated standard per year	3 000 000	3 500 000
Total Cost per litre treated	0,25	0,21

Developing this calculation can require special expertise and can be resource intensive, it is therefore recommended that the following approaches are adopted:

- Only projects over a certain cost threshold have TCO included in their procurement processes, say R5 million as is the case for EMPIAs.
- A standardised table that is provided in the bid document is used by service providers.
- Calculations are completed by service providers and then checked by the bid evaluation committee for accuracy.

Performance Specifications for Total Cost of Ownership

Performance-based specifications are a way to place the performance of an asset or service at the centre of its procurement. This can be especially valuable when a municipality knows the outcome required, but not necessarily the best way to achieve this outcome. For example, a reduction in energy consumption is required in all municipal buildings. A municipality may then set out a number of targets or criteria and bidders would need to determine the best way forward, whether this is technological intervention, behaviour change programme, or a combination of the two. Perfromance-based specifications can allow ~~help?~~ to spur innovation in the delivery of municipal services as it allows for improved collaboration between the public and private sector, where the ultimate asset or service delivered has resulted from a combination of expertise from municipalities and the market. The Western Cape Government has previously partnered with WWF to undertake a study and reference guide for performance-based specification that should be consulted.[6]

[6] WWF. 2018. Moving towards performance-based procurement in the Western Cape Province: A guidebook for supply cahin managers, WFF South Africa. Available at: https://wwfafrica.awsassets.panda.org/downloads/WWF_2018_Moving_towards_sustainable_performance_based_procurement_WC.pdf

An exerpt of this study is provided below:

"Moving towards performance-based procurement is a powerful way of implementing sustainable public procurement because it triggers changes throughout the entire procurement process. It does not assume that public agencies are already aware of what these solutions look like, but empowers them with the information and skills necessary to become drivers of change. This is especially useful in the South African context where functionality criteria operate on a pass/fail basis. It results in multiplier effects and has huge potential for driving innovation, job creation and sustainable development in the longer term without requiring supply-chain managers to become a technical expert in every good or service for which they manage procurement."

Contracting to support Total Cost of Ownership

Contracting is a critical component of successful implementation of sustainable public procurement. In particular, contracting will establish the approach to the project design. Additionally, contracting supports how to monitor compliance and delivery of service providers who have won the bid based on achieving certain costs or levels of performance.

In South Africa, municipalities have a number of contracts to use when procuring goods, services and works for infrastructure projects as permitted by the Construction Industry Development Board (CIDB):

- GCC
- JBCC
- NEC
- FIDIC

Of these, it has been found that the NEC 3 & 4 contracts permit for the greatest inclusion of total cost of ownership due to the contracts being more collaborative in nature and less combative in dispute resolution. In particular, the NEC 4 contract has a template for a Design, Build and Operate Contract which builds in the assessment of total cost of ownership from the beginning of the process. While this may not be applicable to all types of projects, it is suggested that wherever possible the Design, Build and Operate Contract typology is considered.

To embed TCO in contracts, it can be valuable to align the procurement and contracting processes, so that they are actually one in the same. This means that commitments made at the tender stage, such as operational considerations, can become a contractual obligation. Figure 5 below provides a diagram that indicates the structure of Contract Procurement Documentation.

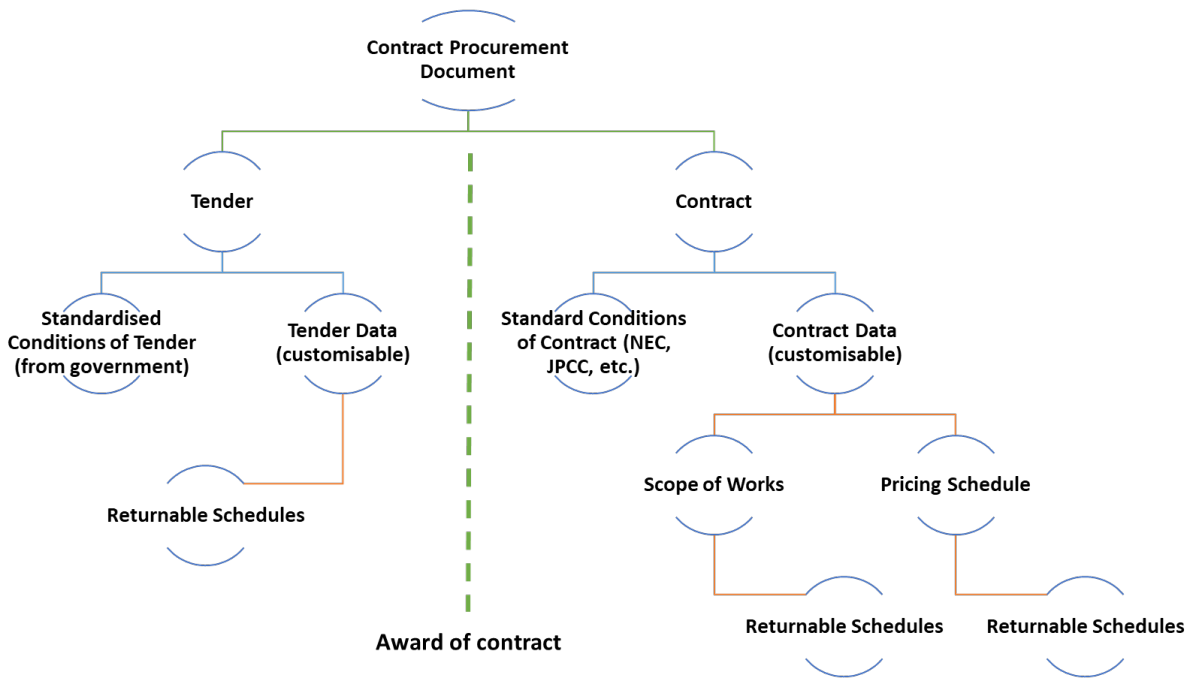

Figure 5: Contents of the Contract Procurement Document

The contract procurement document is made up of the tender documentation and the contract documentation, which must all be made available at the tender stage. This becomes ?

- Conditions of Tender are general clauses that are not hard and fast rules, but rather are to be interpreted. These are related to risk management.
- Tender Data quantifies and specifies the Conditions of Contract that can override clauses in Conditions of Tender Clauses. Include Returnable schedules.
- Conditions of Contract are the standard clauses from one of the CIBD-approved sets of contracts (NEC is preferred for Western Cape Government).
- Contract Data is information provided by the employer and the contractor and is made up of the Scope of Works and the Pricing Schedule – each with their own returnable schedules

Framework agreements can be beneficial when considering a packaging strategy that will promote sustainable public procurement aims and objectives, while increasing the efficiency of the tendering process. For example, the use of Framework Agreements and Term Contracts has allowed the Department of Transport and Public Works to reduce the average time spent on their procurement process for projects from 130 days (4 months) to 1 month.

According to the Standard for Infrastructure Procurement and Delivery Management (SIPDM), a framework agreement is defined as "an agreement between an organ of state and one or more contractors, the purpose of which is to establish the terms governing orders to be awarded during a given period, in particular with regard to price, and where appropriate, the quantity envisaged." Framework agreements allow the employer to execute work on an as-instructed basis over the term of the agreement.

Framework agreements are therefore appropriate for Sustainable Public Procurement as they provide flexibility in the awarding of contracts, have the ability to pool demand from various departments or authorities, and promotes resource efficiency by, for example, reducing the need for advertising, paper consumption and administration costs. Furthermore, framework agreements have the ability to incentivise suppliers to offer more sustainable solutions. This is due to the potential to be awarded multiple contracts over the framework agreement period, thereby recouping any additional expense due to upskilling to implement these solutions.

Although framework agreements are mainly used for construction repair and maintenance contracts for scheduled maintenance, they can also be used for professional service contracts and for construction capital works projects. The Western Cape Government has developed a series of templates for typical term contracts that are available for use by municipalities.

With regard to larger capital works projects, it must be borne in mind that there are a limited number of large construction companies with the required CIDB grading and therefore smaller construction companies may be excluded. However, this may be overcome through targeted strategies, such as mandatory subcontracting and contracting obligations, that can be built into the conditions of contract for the framework agreement.

Data is the foundation of a term contract being developed, as officials must have an illustrative or indicative price for the works and services based on knowledge of previous costs and officials must understand their demand for the works to make sure that it is worthwhile for bidders to be on a term contract, i.e. there is sufficient work to do done per appointed bidder within a specified timeframe.

Material Factors for Total Cost of Ownership of key asset classes

The Western Cape Government has undertaken analysis to identify the critical features or material factors of sustainable infrastructure. Through this process, a number of key asset classes for sustainable infrastructure have been identified:

- Public buildings & social housing;
- Roads & transport;
- Water/Waste water & sewage treatment;
- Energy generation & energy efficiency;
- Waste managemen; and
- Cross-cutting infrastructure.

While all of the material factors are quantitative values, not all can have costs attributed to them. This means that they should be considered in the Scope of Works or Eligibility Criteria. These

material factors can be helpful for developing performance specifications in bids or indicators in strategies and contracts. The material factors listed below are relevant to the above mentioned asset classes, however, their application may differ on a project-by-project basis due to constraints and opportunities of the geographical and institutional context for implementation. Material factors include:

Pre-construction

- Land
- Staff time of officials or fees for professional service providers for design

Energy

- Net energy of the overall system
    - Energy requirements per system element (Design team to provide all energy requirements per system element, to equal the overall net energy value. These could include but is not limited to the following:)
        - MCC energy demand
        - Overall pumping energy demand
        - Process energy demand (inclusive of thermal energy requirements)
        - Ancillary works energy demand
    - Energy generation (if applicable)

Water

- Net water of the overall system
    - Water inputs per system element (Design team to provide all water requirements per system element, to equal the overall net water value. These could include but is not limited to the following)
        - Water influent volume
        - Water required for waste product collection / treatment
        - Water effluent volume
    - Water generation (if applicable)

Waste

- Net waste balance of the overall system
    - Waste streams produced per system element (Design team to provide all waste requirements per system element, to equal the overall net waste value. These could include but is not limited to the following)
        - Processing material waste
        - Final tailings / sludge waste (if applicable)
        - Ancillary works waste generation
    - Waste streams absorbed (if applicable)

Carbon

- Anticipated system carbon emissions
    - Carbon emissions of installation infrastructure
    - Carbon emissions of operation of infrastructure
- Anticipated system carbon absorption (if applicable)
- Net carbon output

Job Creation

- Temporary job opportunities to construct the overall system
- Permanent job opportunities to operate and maintain the overall system

Expected useful life

- Planned for life span of the various elements of the system
    - Civil infrastructure useful life
    - Mechanical infrastructure useful life
    - Electrical infrastructure useful life

Refurbishment and replacement

- Anticipated refurbishment and replacement requirements of the various elements of the system
    - Civil infrastructure refurb requirements
    - Mechanical infrastructure refurb requirements
    - Electrical infrastructure refurb requirements

Maintenance requirements

- Anticipated maintenance requirements of the system
    - Labour requirements (per system element)
    - Material requirements (per system element)

Operational requirements

- Anticipated operational requirements of the system
    - Utility costs (per system element)
    - Waste disposal costs (per system element)

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