

TOOLKIT EDITION 2 2023

CITIES' INFRASTRUCTURE  
DELIVERY AND  
MANAGEMENT SYSTEM

# CIDMS



**national treasury**  
Department:  
National Treasury  
REPUBLIC OF SOUTH AFRICA

**ctiEs** SUPPORT PROGRAMME



**IUDF**  
INTEGRATED URBAN DEVELOPMENT FRAMEWORK



---

This is the second edition of the Cities Infrastructure Delivery and Management System (CIDMS) Toolkit.

The CIDMS provides a holistic system for the management of infrastructure based on the requirements of SANS 55001: Asset management - Management systems – Requirements, tailored for application in South African metropolitan cities and specifically in support of the country's spatial transformation agenda. The CIDMS system also incorporates an infrastructure delivery system based on the National Treasury's Framework for Infrastructure Delivery and Procurement Management (FIDPM) system.

This toolkit was initially developed by the Cities Support Programme of the National Treasury of South Africa in partnership with the eThekweni Municipality, the City of Johannesburg Metropolitan Municipality and the City of Cape Town circa 2018, following demand from metropolitan cities for a system to accelerate the delivery of infrastructure and to manage infrastructure portfolios more sustainably.

Revision 2 of this toolkit provides updates to the toolkit as a whole and has been informed by discussions in the CIDMS reference group meetings, the CIDMS Community of Practice Sessions and the technical engagements with the metros. This revision incorporates inputs from the Climate Resilience and management of resilient infrastructure work undertaken in collaboration with the World Bank. The changes in this revision of the toolkit are aligned with the FIDPM, and a new module for guidance on the Operations and Maintenance of infrastructure assets has been included.

Copyright © National Treasury South Africa. This work is the copyright of the National Treasury South Africa and must be acknowledged should any part of this be reproduced. The first edition (2018) of the CIDMS toolkit was developed with I @ Consulting (Pty) Ltd, and the second edition (2023) has been developed with SMEC South Africa (Pty) Ltd. Matters concerning rights and reproduction must be addressed to the Cities Support Programme of the National Treasury

Cities Infrastructure Delivery Management System Toolkit Edition 2  
2023

ISBN No: ISBN: 978-0-621-46215-9

# ACKNOWLEDGEMENTS

---

## **FUNDER**

The revised CIDMS toolkit and technical support to the CIDMS project has been funded by SECO, the Swiss State Secretariate for Economic Affairs.

## **PROJECT REFERENCE GROUP**

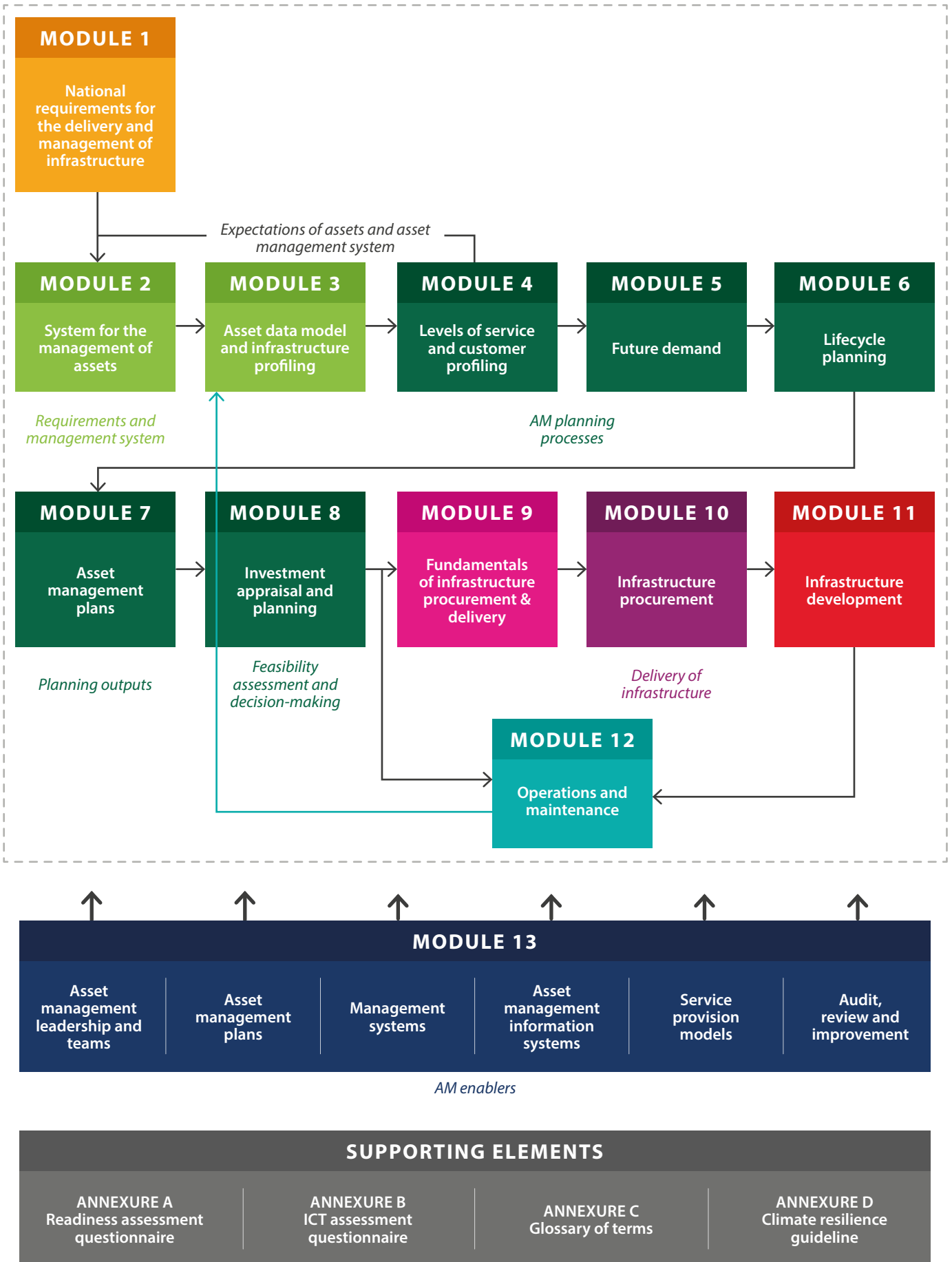
Representatives from the eight metropolitan municipalities, the National Treasury Local Government Infrastructure Unit and the Cities Support Programme.

## **TOOLKIT REVIEW**

This CIDMS Toolkit was Reviewed by the World Bank, Cities Support Programme, National Treasury and SMEC.

## **TOOLKIT LAY-OUT, DESIGN, PRODUCTION AND PRINTING**

Geolix



# CONTENTS



## *Module 1 National requirements for the delivery and management of infrastructure*

<b>1.1</b>	<b>INTRODUCTION</b>	<b>1.1</b>
1.1.1	Purpose and scope of this toolkit	1.1
1.1.2	Best practice	1.5
1.1.3	Unique value of this toolkit	1.7
<b>1.2</b>	<b>HOW TO USE THIS TOOLKIT</b>	<b>1.9</b>
1.2.1	Overall approach and lay-out of this toolkit	1.9
1.2.2	Words	1.12
<b>1.3</b>	<b>URBAN DEVELOPMENT AND INFRASTRUCTURE CHALLENGES</b>	<b>1.13</b>
1.3.1	Fragmented cities	1.13
1.3.2	Carbon-intensive, resource-consumptive cities	1.15
1.3.3	Insufficient investment in infrastructure for growth	1.16
1.3.4	Insufficient asset care and the need for investment in asset renewal	1.19
1.3.5	The Context for Incorporating Climate Adaptation into Asset Management	1.22
1.3.6	Climate Change Adaptation	1.26
<b>1.4</b>	<b>EMERGING SOUTH AFRICAN URBAN POLICY</b>	<b>1.28</b>
1.4.1	Spatial Planning and Land Use Management Act	1.28
1.4.2	National Development Plan (NDP)	1.28
1.4.3	Integrated Urban Development Framework (IUDF)	1.29
1.4.4	The Urban Network Strategy (UNS)	1.30
1.4.5	South African Disaster Risk Management Legislation and Policy	1.31
1.4.6	International Framework	1.34
<b>1.5</b>	<b>EMERGING URBAN POLICY AND IMPLICATIONS FOR INFRASTRUCTURE PLANNING AND DELIVERY</b>	<b>1.35</b>
1.5.1	Spatial form and structure of cities: More compact cities	1.35
1.5.2	Increasing the level and quality of investment in infrastructure and social amenities	1.38
1.5.3	Spatial prioritisation and focusing of infrastructure investment	1.40
1.5.4	Towards greater resource efficiency	1.43
<b>1.6</b>	<b>SUMMARY</b>	<b>1.54</b>



## List of figures that appear in Module 1

<b>FIGURE 1.1:</b>	Cape Town	<b>1.2</b>
<b>FIGURE 1.2:</b>	Durban	<b>1.2</b>
<b>FIGURE 1.3:</b>	Johannesburg	<b>1.2</b>
<b>FIGURE 1.4:</b>	Lay-out and logic of the CIDMS toolkit	<b>1.10</b>
<b>FIGURE 1.5:</b>	Sterile low-income housing development	<b>1.13</b>
<b>FIGURE 1.6:</b>	Rapid growth in Johannesburg's spatial footprint over the past 20 years	<b>1.14</b>
<b>FIGURE 1.7:</b>	Typical South African city densities	<b>1.15</b>
<b>FIGURE 1.8:</b>	An example of a complete street	<b>1.16</b>
<b>FIGURE 1.9:</b>	Cape Town International Convention Centre	<b>1.16</b>
<b>FIGURE 1.10:</b>	BRT station	<b>1.16</b>
<b>FIGURE 1.11:</b>	Example of an urban renewal project	<b>1.17</b>
<b>FIGURE 1.12:</b>	Example of upgrading of infrastructure works	<b>1.17</b>
<b>FIGURE 1.13:</b>	Typical parabolic condition deterioration curve of civil infrastructure	<b>1.19</b>
<b>FIGURE 1.14:</b>	Indication how frequency of occurrence of weather extremes changes as average climate trends changes, e.g. Heat	<b>1.22</b>
<b>FIGURE 1.15:</b>	Percentage change in maximum daily temperature per year between 1986-2015 and 2036 – 2065	<b>1.23</b>
<b>FIGURE 1.16:</b>	Asset Management System and Climate or Weather Events	<b>1.25</b>
<b>FIGURE 1.17:</b>	Climate adaptations seen as part of a holistic asset management process	<b>1.26</b>
<b>FIGURE 1.18:</b>	Example of an urban hub with concentrated public sector fixed capital investment	<b>1.30</b>
<b>FIGURE 1.19:</b>	Urban network concept	<b>1.41</b>
<b>FIGURE 1.20:</b>	Configurations of monocentric and polycentric cities	<b>1.42</b>

## List of tables that appear in Module 1

<b>TABLE 1.1:</b>	Example Impacts of Different Weather Patterns on Infrastructure Services	<b>1.24</b>
-------------------	--	-------------

## List of case studies that appear in Module 1

<b>CASE STUDY 1:</b>	The need for asset renewal – just how badly can infrastructure failure affect us?	<b>1.21</b>
<b>CASE STUDY 2:</b>	Kaalspruit Climate Resilience Catchment Management Plan	<b>1.27</b>
<b>CASE STUDY 3:</b>	Capital cost of development at various levels of density	<b>1.37</b>
<b>CASE STUDY 4:</b>	eThekweni Municipality - Outlining Institutional Reforms undertaken by the eThekweni Metropolitan Municipality (EMM) in preparing the City for the implementation of a CIDMS and SANS55000 accredited Asset Management System	<b>1.44</b>



## Module 2 System for the management of assets

<b>2.1</b>	<b>PURPOSE OF THIS MODULE</b>	<b>2.1</b>
2.1.1	What is asset management?	2.1
2.1.2	What is an AM system?	2.3
2.1.3	Asset management scope of practice	2.11
2.1.4	Why implement an asset management system in cities?	2.13
2.1.5	Objectives of this module	2.13
<b>2.2</b>	<b>DEFINING THE SCOPE OF THE AM SYSTEM</b>	<b>2.14</b>
2.2.1	Elements and the dimensions of the scope of the AM system	2.14
2.2.2	Asset portfolios managed or controlled	2.14
2.2.3	Functions, policies and processes	2.18
2.2.4	Stakeholder requirements	2.22
2.2.5	Plans within the AM system	2.29
<b>2.3</b>	<b>AM POLICY</b>	<b>2.30</b>
2.3.1	What is an AM policy	2.30
2.3.2	Requirements for an AM policy	2.30
2.3.3	What goes into an AM policy?	2.31
2.3.4	Concluding remarks on the AM policy	2.37
<b>2.4</b>	<b>AM STRATEGY</b>	<b>2.38</b>
2.4.1	AM objectives	2.38
2.4.2	AM strategies	2.38
2.4.3	AM system strategy	2.39
2.4.4	Service delivery strategies	2.42
2.4.5	SAMP planning horizon and template	2.51
2.4.6	Preparation, approval and updating of the SAMP	2.54
<b>2.5</b>	<b>CONCLUSION</b>	<b>2.54</b>



## List of figures that appear in Module 2

<b>FIGURE 2.1:</b>	Asset lifecycle management	<b>2.2</b>
<b>FIGURE 2.2:</b>	The South African city asset management system	<b>2.4</b>
<b>FIGURE 2.3:</b>	Levels of asset optimisation	<b>2.5</b>
<b>FIGURE 2.4:</b>	AM objectives and stakeholder requirements	<b>2.8</b>
<b>FIGURE 2.5:</b>	Some of the key disciplines involved in asset management in a city	<b>2.11</b>
<b>FIGURE 2.6:</b>	39 Subjects comprising the asset management landscape	<b>2.12</b>
<b>FIGURE 2.7:</b>	Process for developing the AM system	<b>2.13</b>
<b>FIGURE 2.8:</b>	Identifying key processes and activities within the supply chain (potable water service)	<b>2.20</b>
<b>FIGURE 2.9:</b>	Stakeholder analysis using the asset lifecycle	<b>2.26</b>
<b>FIGURE 2.10:</b>	City external stakeholder classification system	<b>2.27</b>
<b>FIGURE 2.11:</b>	Plans within the AM system	<b>2.29</b>
<b>FIGURE 2.12:</b>	Structure and components of an AM policy	<b>2.37</b>
<b>FIGURE 2.13:</b>	Key components of city AM strategy	<b>2.38</b>
<b>FIGURE 2.14:</b>	Service provision objectives matched to the city spatial structure (potable water supply)	<b>2.45</b>
<b>FIGURE 2.15(A):</b>	Customer LOS strategy (all customer categories – potable water)	<b>2.49</b>
<b>FIGURE 2.15(B):</b>	Costing LOS strategy (all customer categories – potable water)	<b>2.49</b>
<b>FIGURE 2.A.1</b>	Illustrative condition distribution for various asset portfolio health grades	<b>2.56</b>

## List of tables that appear in Module 2

<b>TABLE 2.1:</b>	Risk types	<b>2.6</b>
<b>TABLE 2.2(A):</b>	Criticality of the service	<b>2.15</b>
<b>TABLE 2.2(B):</b>	Asset intensity	<b>2.16</b>
<b>TABLE 2.2(C):</b>	Revenue capacity of service	<b>2.16</b>
<b>TABLE 2.2(D):</b>	Risk to service delivery if assets fail	<b>2.17</b>
<b>TABLE 2.3:</b>	Scope and importance of assets to be managed: identification and ranking table	<b>2.17</b>
<b>TABLE 2.4:</b>	Identification of AM functions within the “Strategy and Planning” domain	<b>2.18</b>
<b>TABLE 2.5:</b>	Policies and processes relating to AM functions (selected/limited linkages for illustrative purposes)	<b>2.20</b>
<b>TABLE 2.6(A):</b>	Identifying stakeholders within the supply chain (Internal stakeholders: potable water service)	<b>2.23</b>
<b>TABLE 2.6(B):</b>	Identifying stakeholders within the supply chain (External stakeholders: potable water service)	<b>2.24</b>
<b>TABLE 2.7:</b>	Suitability of stakeholder analysis methods	<b>2.25</b>
<b>TABLE 2.8:</b>	AM Policy checklist	<b>2.28</b>
<b>TABLE 2.8(A):</b>	Key issues imbedded in the policy principles	<b>2.35</b>
<b>TABLE 2.9:</b>	Conventions and systems for inclusion in the AM system strategy that are detailed in this CIDMS Toolkit	<b>2.40</b>
<b>TABLE 2.10:</b>	Establishing time-bound customer level of service targets for customers that are currently underserved and for future customers (limited to informal residential customers)	<b>2.48</b>
<b>TABLE 2.11:</b>	SAMP template	<b>2.51</b>
<b>TABLE 2.A.1:</b>	General interpretation of asset consumption ratio	<b>2.55</b>
<b>TABLE 2.B.1:</b>	Process performance requirements: Asset data	<b>2.61</b>
<b>TABLE 2.B.2:</b>	AM objectives relating to asset data confidence	<b>2.63</b>





## **Module 3** *Asset data model and infrastructure profiling*

---

<b>3.1</b>	<b>INTRODUCTION</b>	<b>3.1</b>
<b>3.2</b>	<b>ASSET DATA MODELS</b>	<b>3.4</b>
3.2.1	Componentisation and asset hierarchy	<b>3.5</b>
3.2.2	Valuation model	<b>3.21</b>
3.2.3	Attribute data	<b>3.33</b>
3.2.4	Identification referencing	<b>3.36</b>
3.2.5	Asset failure modes and risk analysis	<b>3.37</b>
3.2.6	Data confidence	<b>3.45</b>
3.2.7	Asset register	<b>3.48</b>
<b>3.3</b>	<b>INFRASTRUCTURE PROFILING</b>	<b>3.49</b>
3.3.1	Portfolio overview	<b>3.50</b>
3.3.2	Asset risk profiles	<b>3.55</b>
3.3.3	Asset remaining useful life and renewal profiles	<b>3.60</b>
<b>3.4</b>	<b>DATA QUALITY MANAGEMENT</b>	<b>3.63</b>
3.4.1	Condition assessment and condition data collection programs	<b>3.63</b>
<b>3.5</b>	<b>SUMMARY</b>	<b>3.71</b>

## List of figures that appear in Module 3

<b>FIGURE 3.1:</b>	Consistent organisation-wide application of the asset data model structure	<b>3.3</b>
<b>FIGURE 3.2:</b>	Structure of the asset hierarchy adopted for the CIDMS toolkit	<b>3.7</b>
<b>FIGURE 3.3:</b>	Schematic representation of a water and sewerage network	<b>3.9</b>
<b>FIGURE 3.4:</b>	Example of components in a pump station	<b>3.10</b>
<b>FIGURE 3.5:</b>	Timing of the replacement of the components of the pump station	<b>3.12</b>
<b>FIGURE 3.6(A):</b>	Component renewal profile	<b>3.13</b>
<b>FIGURE 3.6(B):</b>	Component-based depreciation	<b>3.13</b>
<b>FIGURE 3.6(C):</b>	Weighted condition grade of the facility	<b>3.13</b>
<b>FIGURE 3.6(D):</b>	Depreciation of the facility considered as a single asset	<b>3.13</b>
<b>FIGURE 3.7:</b>	Example of spatial referencing and reporting of components	<b>3.17</b>
<b>FIGURE 3.8:</b>	Functional location data linked to the asset hierarchy	<b>3.19</b>
<b>FIGURE 3.9:</b>	Spatial location and distribution of infrastructure benefits	<b>3.20</b>
<b>FIGURE 3.10:</b>	Asset valuation models and techniques	<b>3.22</b>
<b>FIGURE 3.11:</b>	Calculating DRC	<b>3.25</b>
<b>FIGURE 3.12:</b>	Using DRC to determine RUL and carrying value where the age of the asset is unknown	<b>3.29</b>
<b>FIGURE 3.13:</b>	Risk matrix	<b>3.40</b>
<b>FIGURE 3.14:</b>	Asset consumption patterns and depreciation methods	<b>3.41</b>
<b>FIGURE 3.15:</b>	Component deterioration curves	<b>3.42</b>
<b>FIGURE 3.16:</b>	RUL algorithm	<b>3.43</b>
<b>FIGURE 3.17:</b>	Visual presentation of impairment from an accounting point of view	<b>3.44</b>
<b>FIGURE 3.18:</b>	Composition of BCMM asset portfolios (R million, % value of combined asset portfolios)	<b>3.51</b>
<b>FIGURE 3.19:</b>	Risk as a function of Hazard, Vulnerability and Exposure	<b>3.55</b>
<b>FIGURE 3.20:</b>	Risk assessment model	<b>3.55</b>
<b>FIGURE 3.21:</b>	Asset risk profiles: Organisation-level condition-based risk (Ekurhuleni)	<b>3.56</b>
<b>FIGURE 3.22:</b>	Roads condition health status per management region in Buffalo City	<b>3.57</b>
<b>FIGURE 3.23:</b>	Portfolio health grade	<b>3.58</b>
<b>FIGURE 3.24:</b>	Ekurhuleni potable water asset portfolio remaining useful life (replacement value per category)	<b>3.60</b>
<b>FIGURE 3.25:</b>	Ekurhuleni infrastructure renewal needs per annum for a hundred-year period (R' billion)	<b>3.61</b>
<b>FIGURE 3.26:</b>	Slow but certain arrival of the bow-wave of capital renewal needs	<b>3.61</b>
<b>FIGURE 3.27:</b>	Potable water asset portfolio renewal needs by facility type	<b>3.62</b>
<b>FIGURE 3.28:</b>	CAP levels of sophistication	<b>3.65</b>
<b>FIGURE 3.29:</b>	Stepped approach to a condition assessment program	<b>3.72</b>
<b>FIGURE 3.30:</b>	Asset Hierarchy	<b>3.75</b>
<b>FIGURE 3.31:</b>	Water and Sanitation Asset Group Types	<b>3.76</b>
<b>FIGURE 3.32:</b>	Water and Sanitation Asset Types	<b>3.76</b>
<b>FIGURE 3.33:</b>	Example inventory inspection sheet	<b>3.79</b>
<b>FIGURE 3.34:</b>	Example inspection and remedial actions form	<b>3.81</b>



## List of tables that appear in Module 3

<b>TABLE 3.1:</b>	Scope of asset data models	<b>3.4</b>
<b>TABLE 3.2:</b>	Example of components in a pump station	<b>3.11</b>
<b>TABLE 3.3:</b>	High-level asset hierarchy (levels 1 – 3)	<b>3.15</b>
<b>TABLE 3.4:</b>	Middle-level asset hierarchy – asset subcategory to asset group (sample – full table in Annexure 3A) (levels 3 – 4)	<b>3.16</b>
<b>TABLE 3.5:</b>	Lower-level asset hierarchy – asset group to asset type (sample – full table in Annexure 3B) (levels 4 – 5)	<b>3.16</b>
<b>TABLE 3.6:</b>	Examples of components used in the past now replaced with MEAs	<b>3.24</b>
<b>TABLE 3.7:</b>	Location data	<b>3.33</b>
<b>TABLE 3.8:</b>	Example of the approach to provide attribute data	<b>3.34</b>
<b>TABLE 3.9:</b>	Criticality grading	<b>3.35</b>
<b>TABLE 3.10(A):</b>	Failure mode grading scales	<b>3.38</b>
<b>TABLE 3.10(B):</b>	Condition grading scale	<b>3.38</b>
<b>TABLE 3.11:</b>	Example of specific grading scale – utilisation of water distribution pipes	<b>3.39</b>
<b>TABLE 3.12:</b>	Example of specific grading scale – performance of water reticulation	<b>3.39</b>
<b>TABLE 3.13:</b>	Example of specific grading scale – condition of road surface	<b>3.39</b>
<b>TABLE 3.14:</b>	Ratings for Physical Infrastructure Vulnerability	<b>3.40</b>
<b>TABLE 3.15:</b>	Data accuracy grading	<b>3.45</b>
<b>TABLE 3.16:</b>	Derived data confidence grades	<b>3.46</b>
<b>TABLE 3.17:</b>	Overview of data fields in a Valuation Asset Register (VAR)	<b>3.48</b>
<b>TABLE 3.18:</b>	Overview of data fields in a Financial Asset Register (FAR)	<b>3.48</b>
<b>TABLE 3.19:</b>	Example of an asset portfolio overview profile: Buffalo City Metropolitan Municipality	<b>3.52</b>
<b>TABLE 3.20:</b>	Example of an asset portfolio overview profile: Ekurhuleni potable water infrastructure	<b>3.54</b>
<b>TABLE 3.21:</b>	Equating DRC/CRC ratios to portfolio health grade	<b>3.59</b>
<b>TABLE 3.22:</b>	Ekurhuleni potable water asset portfolio remaining useful life (replacement value per category)	<b>3.60</b>
<b>TABLE 3.23:</b>	Attributes and Information for CA	<b>3.76</b>

## List of case studies that appear in Module 3

<b>CASE STUDY 1:</b>	The superiority of the DRC Method over historic cost	<b>3.31</b>
<b>CASE STUDY 2:</b>	Improvement of asset data confidence at Johannesburg water	<b>3.47</b>

## **Module 4** *Levels of service and customer profiling*

---

<b>4.1</b>	<b>INTRODUCTION</b>	<b>4.1</b>
4.1.1	Purpose and scope of this module	4.1
4.1.2	Scope of municipal infrastructure systems, social amenities and connected green-space systems	4.1
4.1.3	Municipal customers vary: they have different needs, preferences and abilities to pay for municipal services	4.4
4.1.4	Where are our customers and our infrastructure?	4.5
4.1.5	Spatial planning requirements	4.7
<b>4.2</b>	<b>CUSTOMER PROFILING</b>	<b>4.11</b>
4.2.1	Basics of customer profiling	4.12
4.2.2	Criteria for a customer-profiling system	4.22
4.2.3	Customer classification	4.22
4.2.4	Methodology for the spatial profiling of customers	4.25
4.2.5	Examples of outputs of the customer profile	4.31
<b>4.3</b>	<b>SERVICE PROFILING AND DETERMINING CUSTOMER NEEDS</b>	<b>4.37</b>
4.3.1	What are levels and standards of service?	4.37
4.3.2	Proposed levels of service for infrastructure	4.42
4.3.3	Levels of service for social amenities	4.49
4.3.4	Properties of a Climate-Resilient Urban System	4.57
4.3.5	Generating customer service profiles	4.58
<b>4.4</b>	<b>SPATIALLY NUANCED SERVICE PROVISION</b>	<b>4.69</b>
<b>4.5</b>	<b>SUMMARY</b>	<b>4.71</b>



## List of figures that appear in Module 4

<b>FIGURE 4.1:</b>	Levels and standards of service: example potable water	<b>4.2</b>
<b>FIGURE 4.2:</b>	Spatial structuring elements: examples and descriptions	<b>4.8</b>
<b>FIGURE 4.3:</b>	Layout of subsection on customer profiling	<b>4.11</b>
<b>FIGURE 4.4:</b>	Map of vulnerability ratings for communities within zones of high flood hazard	<b>4.14</b>
<b>FIGURE 4.5:</b>	Example of time series imagery illustrating the pace of urban growth	<b>4.18</b>
<b>FIGURE 4.6:</b>	Use of SPOT building-count data to identify customers: Enkanyiswini Shozi Village, eThekweni	<b>4.19</b>
<b>FIGURE 4.7:</b>	Methodology for spatial profiling of customers	<b>4.25</b>
<b>FIGURE 4.8:</b>	Relational database diagram – customer database inputs	<b>4.26</b>
<b>FIGURE 4.9:</b>	Example – capturing structures in informal settlements (Kanana Driefontein – Ekurhuleni)	<b>4.27</b>
<b>FIGURE 4.10:</b>	Customer distribution across priority zones	<b>4.32</b>
<b>FIGURE 4.11:</b>	Annual household income levels	<b>4.32</b>
<b>FIGURE 4.12:</b>	Spatial revenue profiles: net revenue generated per spatial structuring element, Ekurhuleni	<b>4.33</b>
<b>FIGURE 4.13:</b>	Location of top 500 customers in relation to spatial structuring elements, Ekurhuleni	<b>4.34</b>
<b>FIGURE 4.14:</b>	Municipal revenue coverage and levels of outstanding debt	<b>4.35</b>
<b>FIGURE 4.15:</b>	Built-up areas susceptible to flooding	<b>4.36</b>
<b>FIGURE 4.16:</b>	Performance and Level of Service Frameworks in Asset Management	<b>4.46</b>
<b>FIGURE 4.17:</b>	Disaster Resilience Scorecard for Cities	<b>4.48</b>
<b>FIGURE 4.18:</b>	Spatial scales of planning for social amenities	<b>4.51</b>
<b>FIGURE 4.19:</b>	Social amenity compatibility matrix	<b>4.52</b>
<b>FIGURE 4.20:</b>	Municipal social facilities location preference matrix	<b>4.53</b>
<b>FIGURE 4.21:</b>	Customer service access profile: clinics and care centres, Ekurhuleni	<b>4.63</b>
<b>FIGURE 4.22:</b>	Customer service access profile: clinics and care centres, Ekurhuleni	<b>4.64</b>
<b>FIGURE 4.23:</b>	Consolidated customer profile and costs of addressing service access backlogs – Buffalo City	<b>4.65</b>
<b>FIGURE 4.24:</b>	Relative distribution of water access backlog between priority zones expressed in R' million–Buffalo City	<b>4.67</b>
<b>FIGURE 4.25:</b>	Social amenity accessibility index – Ekurhuleni	<b>4.68</b>
<b>FIGURE 4.26:</b>	GIS Thiessen polygon technique	<b>4.68</b>
<b>FIGURE 4.27:</b>	Urban morphology: process of formation and transformation	<b>4.69</b>
<b>FIGURE 4.28:</b>	Nuanced asset lifecycle approach for nodes of various orders and in different stages of urban maturity	<b>4.70</b>



## List of tables that appear in Module 4

<b>TABLE 4.1:</b>	Levels of service hierarchy for potable water services	<b>4.3</b>
<b>TABLE 4.2:</b>	City size measured in hectares and number of cadastre entities*	<b>4.5</b>
<b>TABLE 4.3:</b>	Key geospatial datasets & custodians	<b>4.14</b>
<b>TABLE 4.4:</b>	Geographic levels of analysis	<b>4.15</b>
<b>TABLE 4.5:</b>	Example of the number of households per dwelling type – City of Johannesburg (2011)	<b>4.17</b>
<b>TABLE 4.6:</b>	Example of a household income profile – Nyanga, City of Cape Town (2011)	<b>4.18</b>
<b>TABLE 4.7:</b>	Example of land-use data (Ekurhuleni)	<b>4.20</b>
<b>TABLE 4.8:</b>	Example of valuation-roll data (Buffalo City)	<b>4.20</b>
<b>TABLE 4.9:</b>	Example – meter reading table June 2014, Buffalo City	<b>4.21</b>
<b>TABLE 4.10:</b>	City-customer classification system	<b>4.22</b>
<b>TABLE 4.11:</b>	Customer classification system: formal residential income categories	<b>4.24</b>
<b>TABLE 4.12:</b>	Gross formal residential density categories	<b>4.24</b>
<b>TABLE 4.13:</b>	Customer database – data field structure	<b>4.27</b>
<b>TABLE 4.14:</b>	Attribute fields: informal/backyard shack or traditional rural residential	<b>4.28</b>
<b>TABLE 4.15:</b>	Municipal customer database – data fields	<b>4.30</b>
<b>TABLE 4.16:</b>	Example of a spatially-based customer profile aligned to priority areas in the SDF	<b>4.31</b>
<b>TABLE 4.17:</b>	LOS for roads (primary, secondary and tertiary roads)	<b>4.37</b>
<b>TABLE 4.18:</b>	Converting customer expectations into technical performance measures	<b>4.39</b>
<b>TABLE 4.19:</b>	Standards of service for potable water services (illustrative only, not an extensive list)	<b>4.40</b>
<b>TABLE 4.20:</b>	Nuanced standards of service: water pipe burst response times	<b>4.41</b>
<b>TABLE 4.21:</b>	Electricity LOS	<b>4.42</b>
<b>TABLE 4.22:</b>	Roads LOS (primary, secondary and tertiary roads)	<b>4.43</b>
<b>TABLE 4.23:</b>	Roads-related infrastructure LOS: bridges, pedestrian facilities and storm water	<b>4.43</b>
<b>TABLE 4.24:</b>	Sanitation LOS	<b>4.44</b>
<b>TABLE 4.25:</b>	Solid waste LOS	<b>4.45</b>
<b>TABLE 4.26:</b>	Water LOS	<b>4.45</b>
<b>TABLE 4.27:</b>	Example of Earthquake Resilience LoS for Bridges	<b>4.47</b>
<b>TABLE 4.28:</b>	Standard Levels of Service Under Extreme Natural Hazard Events	<b>4.49</b>
<b>TABLE 4.29:</b>	Classification of settlement types and catchment sizes	<b>4.50</b>
<b>TABLE 4.30:</b>	Components of Natural Hazard Resilience	<b>4.57</b>
<b>TABLE 4.31:</b>	Method of determining customer access to municipal infrastructure services	<b>4.59</b>
<b>TABLE 4.32:</b>	Method of determining customer access to social amenities	<b>4.61</b>
<b>TABLE 4.33:</b>	Number of customer units at each LOS for water per priority area – Buffalo City	<b>4.66</b>



## Module 5 Future demand

<b>5.1</b>	<b>ENGAGING WITH THE FUTURE</b>	<b>5.1</b>
5.1.1	The future is pliable	5.1
5.1.2	Planning horizon	5.3
5.1.3	Focus and content of this module	5.6
<b>5.2</b>	<b>FROM CUSTOMER GROWTH TO ESTIMATED NET ADDITIONAL DEMAND</b>	<b>5.7</b>
5.2.1	General	5.7
5.2.2	Projecting growth in residential customers	5.8
5.2.3	Projecting growth in non-residential customers	5.12
5.2.4	Apportion growth in customers spatially	5.13
5.2.5	Quantify current demand	5.17
5.2.6	Identify factors and trends driving or influencing future demand	5.18
5.2.7	Calculate net additional demand	5.28
<b>5.3</b>	<b>RESPONDING TO DEMAND</b>	<b>5.32</b>
5.3.1	Strategic objectives and hierarchy of responses to demand	5.32
5.3.2	Supply-side management	5.34
5.3.3	Demand management	5.35
<b>5.4</b>	<b>PREPARE DEMAND RESPONSE PLAN</b>	<b>5.49</b>
<b>5.5</b>	<b>APPROVAL, COMMUNICATION, REVIEW AND UPDATING REQUIREMENTS</b>	<b>5.50</b>
<b>5.6</b>	<b>SUMMARY</b>	<b>5.51</b>



## List of figures that appear in Module 5

<b>FIGURE 5.1:</b>	Process to spatially apportion growth in customers – basic approach	<b>5.13</b>
<b>FIGURE 5.2:</b>	National, provincial and city economies all go through cycles of growth and contraction	<b>5.19</b>
<b>FIGURE 5.3:</b>	Over time there are structural shifts in the economy (Buffalo City)	<b>5.20</b>
<b>FIGURE 5.4:</b>	Possible future urban infrastructure trends	<b>5.21</b>
<b>FIGURE 5.4(A):</b>	Compare annual maximum demand to capacity per customer type (electricity)	<b>5.30</b>
<b>FIGURE 5.4(B):</b>	Determine annual demand per service and compare to current capacity per supply area (electricity)	<b>5.30</b>
<b>FIGURE 5.4(C):</b>	Current ability to meet demand (electricity)	<b>5.31</b>
<b>FIGURE 5.4(D):</b>	Ability to meet future demand per customer type (electricity)	<b>5.31</b>
<b>FIGURE 5.5:</b>	Optimising asset portfolios	<b>5.34</b>
<b>FIGURE 5.6:</b>	Daily electricity demand patterns in South Africa	<b>5.35</b>
<b>FIGURE 5.7:</b>	Hierarchy of responses to scarce resource utilisation	<b>5.37</b>
<b>FIGURE 5.8(A):</b>	Capital development cost premiums – Buffalo City: Soil constraints	<b>5.42</b>
<b>FIGURE 5.8(B):</b>	Capital development cost premiums – Buffalo City: Major land forms	<b>5.43</b>
<b>FIGURE 5.8(C):</b>	Weighted capital development cost premium surface – Buffalo City	<b>5.44</b>
<b>FIGURE 5.9:</b>	Range of demand management tactics	<b>5.45</b>
<b>FIGURE 5.10:</b>	Demand process summarised	<b>5.51</b>

## List of tables that appear in Module 5

<b>TABLE 5.1:</b>	Examples of norms to determine growth in non-residential customers	<b>5.12</b>
<b>TABLE 5.2:</b>	Quantifying current demand: available municipal data sources	<b>5.17</b>
<b>TABLE 5.3:</b>	Factors driving demand for municipal services	<b>5.18</b>
<b>TABLE 5.4:</b>	General trends affecting demand	<b>5.19</b>
<b>TABLE 5.5:</b>	Development cost premium index	<b>5.40</b>
<b>TABLE 5.6A:</b>	Demand management methods: Electricity	<b>5.46</b>
<b>TABLE 5.6B:</b>	Demand management methods: Roads and transportation	<b>5.47</b>
<b>TABLE 5.6C:</b>	Demand management methods: Potable water	<b>5.48</b>





## **Module 6** *Life-cycle strategies and plans*

---

<b>6.1</b>	<b>INTRODUCTION TO LIFECYCLE STRATEGIES AND PLANS</b>	<b>6.1</b>
<b>6.2</b>	<b>CITY INFRASTRUCTURE LIFECYCLE STRATEGY</b>	<b>6.6</b>
6.2.1	Why develop a city infrastructure lifecycle strategy?	<b>6.6</b>
6.2.2	Identifying the nature and scale of the macro needs	<b>6.8</b>
6.2.3	Identifying challenges, strategic risks, opportunities and constraints	<b>6.25</b>
6.2.4	Identifying and assessing strategic response options	<b>6.29</b>
6.2.5	Determining the city lifecycle strategy	<b>6.29</b>
<b>6.3</b>	<b>SECTOR INFRASTRUCTURE LIFECYCLE PLANS</b>	<b>6.31</b>
6.3.1	Why develop infrastructure lifecycle plans per sector?	<b>6.31</b>
6.3.2	Confirming sector context, needs and challenges	<b>6.31</b>
6.3.3	Preparing appropriate responses	<b>6.34</b>
6.3.4	Sector prioritisation	<b>6.41</b>
<b>6.4</b>	<b>TIMELINES AND APPROVALS</b>	<b>6.41</b>
<b>6.5</b>	<b>SUMMARY</b>	<b>6.46</b>



## List of figures that appear in Module 6

<b>FIGURE 6.1:</b>	City and sector asset management objectives informing sector lifecycle strategy and plans	<b>6.2</b>
<b>FIGURE 6.2:</b>	Linkage of city infrastructure lifecycle strategy and sector lifecycle plans	<b>6.3</b>
<b>FIGURE 6.3:</b>	Planning horizons and level of detail	<b>6.3</b>
<b>FIGURE 6.4:</b>	Asset (and component) lifecycle stages	<b>6.4</b>
<b>FIGURE 6.5:</b>	Overview of the process to establish the lifecycle strategies and plans	<b>6.5</b>
<b>FIGURE 6.6:</b>	Cycles of increasing reliability of asset management planning instruments	<b>6.7</b>
<b>FIGURE 6.7:</b>	Financial modelling rolled up from lifecycle strategies per component type	<b>6.9</b>
<b>FIGURE 6.8:</b>	Illustration of key lifecycle activities influencing the portfolio health grade	<b>6.17</b>
<b>FIGURE 6.9:</b>	Example of a report on portfolio renewal investment scenarios	<b>6.18</b>
<b>FIGURE 6.10:</b>	Maintenance hierarchy	<b>6.19</b>
<b>FIGURE 6.11:</b>	Maintenance effort per year (as a percentage of CRC)	<b>6.21</b>
<b>FIGURE 6.12:</b>	Example output from the maintenance and renewals models (% CRC)	<b>6.22</b>
<b>FIGURE 6.13:</b>	Example of prioritised allocation of available maintenance budget	<b>6.23</b>
<b>FIGURE 6.14:</b>	Example illustrating the infrastructure lifecycle needs of various sectors overlaid on the available budget	<b>6.24</b>
<b>FIGURE 6.15:</b>	Example illustrating the infrastructure lifecycle needs of existing and new infrastructure overlaid on the available budget	<b>6.24</b>
<b>FIGURE 6.16:</b>	Catalyst initiatives in support of main-stream service delivery programmes	<b>6.26</b>
<b>FIGURE 6.17:</b>	Refinement of programmes and organisational preparedness ahead of implementation	<b>6.27</b>
<b>FIGURE 6.18:</b>	Component data and portfolio status informing capital renewal programmes	<b>6.36</b>
<b>FIGURE 6.19:</b>	Example multiterm capital renewal needs	<b>6.37</b>
<b>FIGURE 6.20:</b>	Linking maintenance management planning to asset care objectives (standards of service)	<b>6.37</b>
<b>FIGURE 6.21:</b>	Example of link between portfolio maintenance management efficiency and budget needs	<b>6.38</b>
<b>FIGURE 6.22:</b>	One cycle of planning, approval, delivery, and reporting	<b>6.43</b>
<b>FIGURE 6.23:</b>	Concurrent processes in any given year	<b>6.44</b>

## List of tables that appear in Module 6

<b>TABLE 6.1:</b>	Capital needs – current backlogs	<b>6.12</b>
<b>TABLE 6.2:</b>	Capital needs – first 10 years	<b>6.13</b>
<b>TABLE 6.3:</b>	Capital needs – following Periods	<b>6.14</b>
<b>TABLE 6.4:</b>	Maintenance needs	<b>6.14</b>
<b>TABLE 6.5:</b>	Operational needs	<b>6.15</b>
<b>TABLE 6.6:</b>	Example maintenance model factors	<b>6.21</b>
<b>TABLE 6.7:</b>	Overview of planning cycles	<b>6.42</b>
<b>TABLE 6.8:</b>	Planning approval gates and responsible parties	<b>6.45</b>



## Module 7 Asset management plans

<b>7.1</b>	<b>INTRODUCTION TO ASSET MANAGEMENT PLANS</b>	<b>7.1</b>
<b>7.2</b>	<b>SECTOR ASSET MANAGEMENT PLANS</b>	<b>7.3</b>
7.2.1	Why prepare sector asset management plans?	7.3
7.2.2	Assimilation of the AM plans per sector	7.3
7.2.3	Finalising the sector asset management plans	7.10
<b>7.3</b>	<b>CITY LIFECYCLE PLAN</b>	<b>7.12</b>
7.3.1	Why develop a city infrastructure lifecycle plan?	7.12
7.3.2	Establishing the city infrastructure lifecycle plan	7.12
7.3.3	City infrastructure programme delivery plan	7.13
<b>7.4</b>	<b>STRATEGIC ASSET MANAGEMENT PLAN (SAMP)</b>	<b>7.14</b>
7.4.1	Why document the SAMP?	7.14
7.4.2	Preparation of the SAMP document	7.14
7.4.3	Preparation of the final SAMP	7.15
<b>7.5</b>	<b>SUMMARY</b>	<b>7.19</b>

### List of figures that appear in Module 7

<b>FIGURE 7.1:</b>	Overview of process steps in preparing the asset management plans	<b>7.2</b>
<b>FIGURE 7.2:</b>	Overview of sector AM plan preparation process	<b>7.12</b>
<b>FIGURE 7.3:</b>	Overview of SAMP development process	<b>7.16</b>

### List of tables that appear in Module 7

<b>TABLE 7.1:</b>	Overview of typical data and information sources	<b>7.4</b>
<b>TABLE 7.2:</b>	Illustration of monthly tasks for SAMP and AMP preparation	<b>7.7</b>
<b>TABLE 7.3:</b>	Sector AM Plan chapter structure and overview of content	<b>7.10</b>
<b>TABLE 7.4</b>	Strategic Asset Management Plan Compliance Check List	<b>7.16</b>

## Module 8 *Investment appraisal and planning*

---

<b>8.1</b>	<b>INTRODUCTION TO INFRASTRUCTURE INVESTMENT APPRAISAL AND PLANNING</b>	<b>8.1</b>
8.1.1	What is investment appraisal and planning?	8.1
8.1.2	Lay-out of this module	8.3
<b>8.2</b>	<b>IDENTIFY PROBLEMS OR OPPORTUNITIES AND DEVELOP POTENTIAL SOLUTIONS</b>	<b>8.4</b>
8.2.1	Sustainability and realisation of city strategic objectives	8.4
8.2.2	Identification of a problem or opportunity	8.5
8.2.3	Identify potential solutions	8.7
8.2.4	Sift potential solutions	8.8
8.2.5	Process summary: identification of problem or opportunity through to shortlisting of options	8.9
8.2.6	Determining benefits and costs	8.10
8.2.7	Preparing cash flow forecasts	8.16
<b>8.3</b>	<b>INVESTMENT APPRAISAL</b>	<b>8.22</b>
8.3.1	Net present value (NPV)	8.22
8.3.2	Internal rate of return (IRR)	8.24
8.3.3	Benefit cost ratio (BCR)	8.26
8.3.4	When to use which metric	8.26
8.3.5	Further analysis: sensitivity and scenario analyses, and simulation	8.27
<b>8.4</b>	<b>FINANCIAL PLANNING</b>	<b>8.30</b>
8.4.1	Elements included in the financial analysis	8.30
8.4.2	Funding arrangements	8.31
8.4.3	Prepare or adjust cash flow forecast	8.32
8.4.4	Conduct sensitivity analysis and analyse results	8.32
<b>8.5</b>	<b>ORGANISATIONAL OPTIMISATION</b>	<b>8.34</b>
8.5.1	Corporate-level prioritisation using a multi-criteria analysis framework	8.34
8.5.2	Elements of a MCA system	8.36
8.5.3	Define outcome areas	8.37
8.5.4	Define impacts for each outcome area	8.39
8.5.5	Develop the MCA ranking system	8.43
8.5.6	Develop benefit and cost parameters for each impact	8.45
8.5.7	Formulate amalgamation rules	8.46
<b>8.6</b>	<b>APPROVAL OF MCA SYSTEM</b>	<b>8.48</b>
<b>8.7</b>	<b>CONCLUSION</b>	<b>8.48</b>



## List of figures that appear in Module 8

<b>FIGURE 8.1:</b>	Process from identification of problem or opportunity through to shortlisting of options	<b>8.9</b>
<b>FIGURE 8.2:</b>	Process to develop a MCA system	<b>8.36</b>

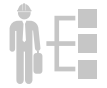
## List of tables that appear in Module 8

<b>TABLE 8.1:</b>	Asset and non-asset solutions	<b>8.7</b>
<b>TABLE 8.2:</b>	Investment proposal screening list: examples of deal-breakers	<b>8.8</b>
<b>TABLE 8.3:</b>	Potential benefits per type of infrastructure portfolio	<b>8.12</b>
<b>TABLE 8.4:</b>	Potential costs per type of infrastructure portfolio	<b>8.13</b>
<b>TABLE 8.5:</b>	Benefits and costs considered in infrastructure investment appraisal	<b>8.14</b>
<b>TABLE 8.6:</b>	Calculation of PV at 8% discount rate	<b>8.20</b>
<b>TABLE 8.7:</b>	Summary of capital budgeting techniques	<b>8.26</b>
<b>TABLE 8.8:</b>	When to use which method, and not to	<b>8.27</b>
<b>TABLE 8.9:</b>	Proposed foundational outcome areas	<b>8.38</b>
<b>TABLE 8.10:</b>	Specific impacts per outcome area	<b>8.41</b>
<b>TABLE 8.11:</b>	Projects delivering different baskets of benefits	<b>8.43</b>
<b>TABLE 8.12:</b>	MCA ranking system	<b>8.44</b>
<b>TABLE 8.13:</b>	Examples of benefit and cost parameters for selective economic development impacts	<b>8.45</b>
<b>TABLE 8.14:</b>	Amalgamation rules	<b>8.46</b>

## Module 9 Fundamentals of infrastructure procurement & delivery

---

<b>9.1</b>	<b>INTRODUCTION</b>	<b>9.1</b>
<b>9.2</b>	<b>THE FRAMEWORK FOR INFRASTRUCTURE DELIVERY AND PROCUREMENT MANAGEMENT (FIDPM)</b>	<b>9.3</b>
9.2.1	What is the FIDPM?	9.3
9.2.2	Key aspects of the supply chain system for Infrastructure Delivery and Procurement Management	9.4
9.2.3	Relationship with asset management and budgeting	9.6
9.2.4	Institutionalising the supply chain system for infrastructure procurement and delivery management	9.6
<b>9.3</b>	<b>CONTROL FRAMEWORK</b>	<b>9.7</b>
9.3.1	Stages, deliverables and controls	9.7
9.3.2	General requirements	9.11
<b>9.4</b>	<b>PROJECTS, PROGRAMMES AND PORTFOLIOS</b>	<b>9.13</b>
9.4.1	Introduction	9.13
9.4.2	Contribution to organisational goals and asset management objectives	9.14
<b>9.5</b>	<b>GETTING STARTED</b>	<b>9.15</b>
9.5.1	Project initiation	9.15
9.5.2	Asset management plans and the strategic asset management plan	9.16
<b>9.6</b>	<b>PROJECT IDENTIFICATION AND PACKAGING</b>	<b>9.16</b>
9.6.1	Introduction	9.16
9.6.2	mSCOA and project identification	9.16
9.6.3	Packaging projects and programmes	9.18
9.6.4	Authorisations	9.24
<b>9.7</b>	<b>PROGRAMME AND PROJECT MANAGEMENT GOVERNANCE</b>	<b>9.29</b>
9.7.1	Programme governance	9.29
9.7.2	Governance framework management plans	9.30
9.7.3	Performance management at the programme level	9.33
9.7.4	Typical programme-level indicators	9.34
9.7.5	Project performance indicators	9.35
<b>9.8</b>	<b>CONCLUSION</b>	<b>9.38</b>



## List of figures that appear in Module 9

<b>FIGURE 9.1:</b>	Control framework for infrastructure procurement and delivery management	<b>9.8</b>
<b>FIGURE 9.2:</b>	Packages versus programmes and projects	<b>9.20</b>
<b>FIGURE 9.3:</b>	Programmes overview layout	<b>9.22</b>

## List of tables that appear in Module 9

<b>TABLE 9.1:</b>	End-of-stage deliverables	<b>9.9</b>
<b>TABLE 9.2:</b>	Example - breakdown structure of typical project segments within a package	<b>9.18</b>
<b>TABLE 9.3:</b>	Examples of how packages can overlap with programmes and projects	<b>9.19</b>
<b>TABLE 9.4:</b>	Examples of packages	<b>9.22</b>
<b>TABLE 9.5:</b>	Summary – performance management formulae	<b>9.37</b>



## Module 10 Infrastructure procurement

<b>10.1</b>	<b>INTRODUCTION</b>	<b>10.1</b>
10.1.1	Scope of this module	10.1
10.1.2	Composition of procurement system	10.2
10.1.3	Applicable standards	10.3
<b>10.2</b>	<b>CONTROL FRAMEWORK FOR INFRASTRUCTURE PROCUREMENT MANAGEMENT</b>	<b>10.4</b>
<b>10.3</b>	<b>INITIATING THE PROCUREMENT PROCESS</b>	<b>10.8</b>
10.3.1	Establish what is to be procured	10.8
10.3.2	Procurement documentation review	10.8
<b>10.4</b>	<b>SOLICIT AND EVALUATE TENDER OFFERS</b>	<b>10.11</b>
10.4.1	Solicit tender offers	10.11
10.4.2	Evaluate tender offers	10.11
<b>10.5</b>	<b>AWARD AND ADMINISTER CONTRACTS</b>	<b>10.16</b>
10.5.1	Contract award	10.16
10.5.2	Contract management	10.16
<b>10.6</b>	<b>CONCLUSION</b>	<b>10.18</b>

### List of figures that appear in Module 10

<b>FIGURE 10.1:</b>	Components of a procurement system	<b>10.2</b>
<b>FIGURE 10.2:</b>	Control framework for infrastructure procurement	<b>10.5</b>

### List of tables that appear in Module 10

<b>TABLE 10.1:</b>	Procurement activities and gates associated with the formation and conclusion of contracts above the threshold for the quotation procedure	<b>10.6</b>
<b>TABLE 10.2:</b>	Procurement activities and gates associated with the issuing of an order in terms of a framework agreement	<b>10.7</b>
<b>TABLE 10.3:</b>	Content of an evaluation report relating to an expression of interest	<b>10.13</b>
<b>TABLE 10.4:</b>	Content of an evaluation report relating to the solicitation of tender offers	<b>10.14</b>





## Module 11 Infrastructure delivery

<b>11.1</b>	<b>INTRODUCTION</b>	<b>11.1</b>
<b>11.2</b>	<b>STAGE 1: PROJECT INITIATION</b>	<b>11.1</b>
11.2.1	Prefeasibility	<b>11.2</b>
11.2.2	Strategic brief	<b>11.2</b>
11.2.3	Completion of stage 1	<b>11.3</b>
<b>11.3</b>	<b>STAGE 2: CONCEPT</b>	<b>11.4</b>
11.3.1	Completion of stage 2	<b>11.4</b>
<b>11.4</b>	<b>STAGE 3: DESIGN DEVELOPMENT</b>	<b>11.5</b>
11.4.1	From project planning to detailed design	<b>11.5</b>
11.4.2	Design development report	<b>11.5</b>
11.4.3	Completion of stage 3	<b>11.5</b>
<b>11.5</b>	<b>STAGE 4: DESIGN DOCUMENTATION</b>	<b>11.6</b>
11.5.1	Stage 4A: Production information	<b>11.6</b>
11.5.2	Stage 4B: Manufacture, fabrication and construction information	<b>11.6</b>
11.5.3	Completion of stage 4	<b>11.6</b>
<b>11.6</b>	<b>STAGE 5: WORKS</b>	<b>11.7</b>
11.6.1	From detailed design processes to site processes	<b>11.7</b>
11.6.2	Typical works' activities	<b>11.7</b>
11.6.3	Completion of stage 5	<b>11.8</b>
<b>11.7</b>	<b>STAGE 6: HANDOVER</b>	<b>11.8</b>
11.7.1	Commissioning	<b>11.8</b>
11.7.2	Training	<b>11.9</b>
11.7.3	Safeguarding of works	<b>11.9</b>
11.7.4	Record information	<b>11.10</b>
11.7.5	Updating of the asset register	<b>11.10</b>
11.7.6	Completion of stage 6	<b>11.11</b>
<b>11.8</b>	<b>STAGE 7: CLOSE OUT</b>	<b>11.11</b>
11.8.1	Close out report	<b>11.11</b>
11.8.2	Completion of stage 7	<b>11.11</b>
<b>11.9</b>	<b>CONCLUSION</b>	<b>11.12</b>

## Module 12 Operations and maintenance

<b>12.1</b>	<b>INTRODUCTION</b>	<b>12.1</b>
12.1.1	Operations	12.1
12.1.2	Maintenance	12.1
12.1.3	Renewal	12.1
12.1.4	Asset Care	12.2
12.1.5	Maintenance Hierarchy	12.2
12.1.6	Expenditure	12.4
<b>12.2</b>	<b>CURRENT STATE OF OPERATIONS AND MAINTENANCE</b>	<b>12.5</b>
12.2.1	Who is Responsible for Asset Management and Infrastructure Maintenance?	12.5
12.2.2	How Are Assets Managed and Maintained in Reality?	12.6
12.2.3	What are the Results of Poor Asset Maintenance?	12.7
12.2.4	How Does the Government Allocate Funds for the Improvement and Maintenance of Strategic Infrastructure?	12.7
12.2.5	Which Institutions are Supporting or Enforcing Infrastructure Delivery Plans and Maintenance Plans?	12.8
12.2.6	Who Is Responsible for Planning and Execution?	12.8
<b>12.3</b>	<b>MAINTENANCE BUDGET REQUIREMENTS</b>	<b>12.9</b>
12.3.1	Maintenance budget best practice – South Africa	12.10
12.3.2	Maintenance budget best practice – International	12.18
<b>12.4</b>	<b>THE OPERATIONS AND MANAGEMENT PROCESS ACCORDING TO THE IDMS</b>	<b>12.19</b>
12.4.1	Introduction	12.19
12.4.2	Planning Phase	12.20
12.4.3	Mobilisation Phase	12.21
12.4.4	Implementing and Managing Phase	12.21
12.4.4.2	Reporting	12.23
12.4.5	Review Phase	12.24
12.4.6	Improvement Phase	12.25
<b>12.5</b>	<b>OPERATIONS AND MAINTENANCE MANAGEMENT POLICY AND PLANS</b>	<b>12.26</b>
<b>12.6</b>	<b>OPERATIONAL MANAGEMENT PLAN</b>	<b>12.27</b>
12.6.1	Operational Objectives	12.27
12.6.2	Operational KPAs	12.27
12.6.3	Operations Risk Register	12.27
12.6.4	List of Operational Actions	12.28
12.6.5	Operations Schedule	12.28
12.6.7	Operational Cost Estimate/Budget	12.28
12.6.6	Operations Resource Allocation Plan	12.28



<b>12.7</b>	<b>MAINTENANCE MANAGEMENT PLAN</b>	<b>12.29</b>
12.7.1	Introduction	12.29
12.7.2	Maintenance Objectives	12.30
12.7.3	Maintenance KPAs	12.30
12.7.4	Maintenance Risk Register	12.31
12.7.5	MMP Component Information	12.31
12.7.6	Maintenance Priority	12.32
12.7.7	Maintenance Approach	12.40
12.7.8	List of Maintenance Actions	12.41
12.7.9	Maintenance Schedule	12.42
12.7.10	Maintenance Resource Allocation Plan	12.43
12.7.11	Operations and Maintenance Implementation Strategy	12.44
12.7.12	Procedures for Managing Facility or System Shutdown Events	12.45
12.7.13	Preventative Operations and Maintenance Management System	12.46
12.7.14	Procedures for Managing Corrective Maintenance Incidents or Emergencies	12.46
12.7.15	Responsibility Assignment Matrix	12.47
<b>12.8</b>	<b>RENEWAL MANAGEMENT PLAN</b>	<b>12.48</b>
12.8.1	Renewal Objectives	12.48
12.8.2	Estimated Renewals Intervention Point for each Component	12.48
12.8.3	RMP Component Information	12.51
12.8.4	Estimated Renewals Forecasting	12.51
12.8.5	Estimate of Cost of Renewal for each Component	12.52
<b>12.9</b>	<b>REFERENCES</b>	<b>12.53</b>



## List of figures that appear in Module 12

<b>FIGURE 12.1:</b>	Maintenance hierarchy	<b>12.3</b>
<b>FIGURE 12.2:</b>	Municipal operating expenditure as a percentage of total expenditure for the year ended 30 June 2019	<b>12.6</b>
<b>FIGURE 12.3:</b>	Municipal operating expenditure as a percentage of total expenditure for the year ended 30 June 2020	<b>12.6</b>
<b>FIGURE 12.4:</b>	Municipal operating expenditure as a percentage of total expenditure for the year ended 30 June 2020	<b>12.6</b>
<b>FIGURE 12.5:</b>	Municipal operating expenditure as a percentage of total expenditure for the year ended 30 June 2021	<b>12.6</b>
<b>FIGURE 12.6:</b>	IDM Processes Placemat	<b>12.19</b>
<b>FIGURE 12.7:</b>	Asset-based risk exposure	<b>12.32</b>
<b>FIGURE 12.8:</b>	Calculating risk exposure	<b>12.37</b>
<b>FIGURE 12.9:</b>	Unmoderated risk matrix	<b>12.37</b>
<b>FIGURE 12.10:</b>	Risk exposure classification (unmoderated) and maintenance priority	<b>12.38</b>
<b>FIGURE 12.11:</b>	Restated risk exposure matrix (unmoderated)	<b>12.38</b>
<b>FIGURE 12.12:</b>	Moderated risk exposure matrix	<b>12.38</b>
<b>FIGURE 12.13:</b>	Asset risk profiles: potable water asset portfolio condition-based risk (Ekurhuleni)	<b>12.39</b>
<b>FIGURE 12.14:</b>	Maintenance Types	<b>12.40</b>
<b>FIGURE 12.15:</b>	Ekurhuleni potable water asset portfolio remaining useful life (replacement value per category)	<b>12.49</b>
<b>FIGURE 12.16:</b>	Ekurhuleni infrastructure renewal needs per annum for a hundred-year period (R' billion)	<b>12.49</b>
<b>FIGURE 12.17:</b>	Potable water asset portfolio renewal needs by facility type	<b>12.50</b>

## List of tables that appear in Module 12

<b>TABLE 12.1:</b>	Operational needs	<b>12.9</b>
<b>TABLE 12.2:</b>	Indicative Network Annual O&M Budgets	<b>12.13</b>
<b>TABLE 12.3:</b>	Indicative budgeting guidelines	<b>12.16</b>
<b>TABLE 12.4:</b>	Operational needs	<b>12.29</b>
<b>TABLE 12.5:</b>	Impact of failure rating scale	<b>12.34</b>
<b>TABLE 12.6:</b>	Asset criticality rating scale	<b>12.35</b>
<b>TABLE 12.7:</b>	Asset criticality rating rule set for water pipes	<b>12.36</b>
<b>TABLE 12.8:</b>	Maintenance management	<b>12.41</b>
<b>TABLE 12.9:</b>	Ekurhuleni potable water asset portfolio remaining useful life (replacement value per category)	<b>12.48</b>



## Module 13 Enablers

---

<b>13.1</b>	<b>PURPOSE OF THIS MODULE</b>	<b>13.1</b>
<b>13.2</b>	<b>ASSET MANAGEMENT LEADERSHIP ORGANISATION, AND PEOPLE</b>	<b>13.2</b>
13.2.1	The role of a leader	13.2
13.2.2	Asset management leadership	13.3
13.2.3	Organisational structure	13.4
13.2.4	Asset management capability development	13.13
<b>13.3</b>	<b>SERVICE DELIVERY MODELS</b>	<b>13.21</b>
<b>13.4</b>	<b>ASSET MANAGEMENT INFORMATION SYSTEM</b>	<b>13.22</b>
<b>13.5</b>	<b>ASSET MANAGEMENT PLANS</b>	<b>13.35</b>
<b>13.6</b>	<b>AUDIT, REVIEW AND CONTINUOUS IMPROVEMENT</b>	<b>13.37</b>
<b>13.7</b>	<b>CONCLUSION</b>	<b>13.47</b>



## List of figures that appear in Module 13

<b>FIGURE 13.1:</b>	The asset management system, key planning processes therein, and enablers	<b>13.1</b>
<b>FIGURE 13.2:</b>	High-level structure of a central asset management unit	<b>13.7</b>
<b>FIGURE 13.3:</b>	The asset management system, key planning processes therein, and enablers	<b>13.9</b>
<b>FIGURE 13.4:</b>	High-level view of the AM competency framework	<b>13.14</b>
<b>FIGURE 13.5:</b>	Target AM certification for various levels of practitioners	<b>13.16</b>
<b>FIGURE 13.6:</b>	Service delivery model options and key considerations	<b>13.21</b>
<b>FIGURE 13.7:</b>	Spatial view of assets enriched by database linkages on matters such as condition grade	<b>13.34</b>
<b>FIGURE 13.8:</b>	Options for deciding on the number and clustering of AM plans	<b>13.36</b>
<b>FIGURE 13.9:</b>	ICT Readiness Assessment - Categorisation and Criteria Summary	<b>13.45</b>
<b>FIGURE 13A.1:</b>	Competency framework	<b>13.48</b>
<b>FIGURE 13A.2:</b>	Competency hierarchy and classification system	<b>13.49</b>

## List of tables that appear in Module 13

<b>TABLE 13.1:</b>	Differences between management and leadership	<b>13.2</b>
<b>TABLE 13.2:</b>	Benefits and drawbacks of centralised asset management	<b>13.4</b>
<b>TABLE 13.3:</b>	High-level asset management functions to be centralised or decentralised	<b>13.5</b>
<b>TABLE 13.4:</b>	Asset management certification/professional registration	<b>13.15</b>
<b>TABLE 13.5:</b>	Profile of the Head of the Central Asset Management Unit	<b>13.18</b>
<b>TABLE 13.6:</b>	Requirements for asset management professional services	<b>13.19</b>
<b>TABLE 13.7:</b>	Requirements for asset management professional services	<b>13.20</b>
<b>TABLE 13.8:</b>	Types or stages of asset registers	<b>13.26</b>
<b>TABLE 13.9:</b>	Asset management information system functionality	<b>13.27</b>
<b>TABLE 13.10:</b>	Summarised scope of asset management fundamentals and practices to be assessed	<b>13.34</b>
<b>TABLE 13.11:</b>	Capability levels	<b>13.39</b>
<b>TABLE 13.12.A:</b>	Process attributes required at different capability levels	<b>13.41</b>
<b>TABLE 13.12.B:</b>	CIDMS units of competency summarised	<b>13.41</b>
<b>TABLE 13.13:</b>	ICT readiness assessment categories	<b>13.43</b>
<b>TABLE 13.A.1:</b>	CIDMS units of competency summarised	<b>13.51</b>

# ANNEXURES

---



**Annexure A**  
CIDMS Readiness  
Assessment



**Annexure B**  
CIDMS ICT Readiness  
Assessment



**Annexure C**  
Glossary & Acronyms



**Annexure D**  
Climate Resilience

CITIES' **INFRASTRUCTURE**  
**DELIVERY AND**  
**MANAGEMENT** SYSTEM **CIDMS**

